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Biology Workbook

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Printed: August 23, 2012

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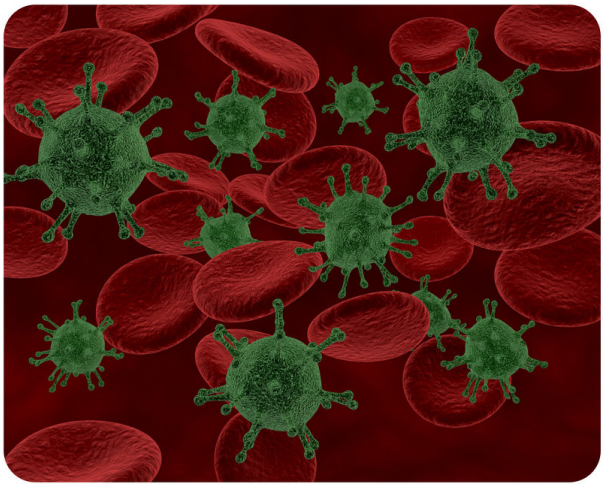

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- **Lesson 1.1: Science and the Natural World**
- **Lesson 1.2: Biology: The Study of Life**

1.1 Science and the Natural World

Lesson 1.1: True or False

Name_____ Class_____ Date_____

Write true if the statement is true or false if the statement is false.

_____ 1. A hypothesis must be based on scientific knowledge.

_____ 2. A scientific theory is a guess about how or why something happens.

_____ 3. Scientists make predictions that tell what will happen under any and all conditions.

_____ 4. The scientific method includes the steps involved in a scientific investigation.

_____ 5. "Did life on Earth evolve over time?" This question can be answered scientifically.

_____ 6. Experiments are performed under controlled conditions.

_____ 7. Scientists can study all aspects of the natural world, including experimenting on an extinct animal.

_____ 8. The dependent variable is always the opposite of the independent variable.

_____ 9. Communicating your results allows others to test your hypothesis.

_____ 10. Experimental evidence that agrees with your prediction supports your hypothesis.

_____ 11. The first step in a scientific investigation is always to develop a hypothesis.

_____ 12. Scientists gradually build an increasingly accurate and detailed understanding of the natural world.

_____ 13. Newton discovered the law of gravity when an apple fell from a tree and hit him on the head.

_____ 14. Scientific evidence is any type of data that may either agree or disagree with a prediction.

_____ 15. Scientific theories are broad explanations that are widely accepted as true.

Lesson 1.1: Critical Reading

Name_____ Class_____ Date_____

Read these passages from the text and answer the questions that follow.

Nature Can Be Understood

Scientists think of nature as a single system controlled by natural laws. By discovering natural laws, scientists strive to increase their understanding of the natural world. Laws of nature are expressed as scientific laws. A scientific law is a statement that describes what always happens under certain conditions in nature.

An example of a scientific law is the law of gravity, which was discovered by Sir Isaac Newton. The law of gravity states that objects always fall towards Earth because of the pull of gravity. Based on this law, Newton could explain many natural events. He could explain not only why objects such as apples always fall to the ground, but he could also explain why the moon orbits Earth. Isaac Newton discovered laws of motion as well as the law of gravity. His laws of motion allowed him to explain why objects move as they do.

Science Cannot Answer All Questions

Science rests on evidence and logic, so it deals only with things that can be observed. An observation is anything that is detected either through human senses or with instruments and measuring devices that extend human senses. Things that cannot be observed or measured by current means — such as supernatural beings or events — are outside the bounds of science. Consider these two questions about life on Earth:

- Did life on Earth evolve over time?
- Was life on Earth created through another method?

The first question can be answered by science on the basis of scientific evidence and logic. The second question could be a matter of belief. Therefore, it is outside the realm of science.

Questions

1. What is an observation?

2. What is a scientific law?

3. What scientific law explains why the moon orbits the Earth? What does the law state? Who developed this law?

4. Complete this sentence: Natural laws allow scientists to _____.

5. Can science answer all questions? Justify your answer.

Lesson 1.1: Multiple Choice

Name_____ Class_____ Date_____

Circle the letter of the correct choice.

a. Assumptions scientists make include:

   a. Nature can be understood through systematic study.
   b. Scientific ideas never need to be revised.
   c. Science can provide answers to all questions.
   d. all of the above

b. A hypothesis

   a. is the first step in a scientific investigation.
   b. is based on what a scientist believes.
   c. is a possible question to a scientific answer.
   d. can be proved incorrect.

c. A scientific theory

   a. is based on lots of evidence.
   b. is a guess about how or why something happens.
   c. can never be altered or changed.
   d. none of the above

d. Which is the correct order in a scientific investigation?

   a. ask a question, test the hypothesis, communicate results, draw conclusions
   b. make observations, ask a question, form a hypothesis, test the hypothesis
   c. draw conclusions, ask a question, form a hypothesis, test the hypothesis
   d. ask a question, make observations, test the hypothesis, draw conclusions

e. To test a hypothesis,

   a. a scientist first collects evidence.
   b. a scientist first draws conclusions.
   c. a scientist first makes a prediction.
   d. a scientist first makes observations.

f. An experiment

   a. is performed under controlled conditions.
   b. generally tests how one variable is affected by another.
   c. contributes important evidence that helps scientists better understand the natural world.
   d. all of the above

g. Food chains are scientific models that

a. represent simple systems in nature.
b. make the scientific systems easier to understand.
c. are based on mathematical equations.
d. are based on a prediction.

h. *Science cannot answer all questions.*

a. The above statement is true because science cannot answer matters of belief.
b. The above statement is true because all science is based on logic.
c. The above statement is false because science can prove that life evolves over time.
d. The above statement is false because science is based on observations and evidence.

Lesson 1.1: Vocabulary I

Name_____ Class_____ Date_____

Match the vocabulary word with the proper definition.

Definitions

_____ 1. a statement that describes what always happens under certain conditions in nature

_____ 2. a possible answer to a scientific question

_____ 3. any type of data that may either agree or disagree with a prediction

_____ 4. a plan for asking questions and testing possible answers

_____ 5. a representation of part of the real world

_____ 6. a broad explanation for events that is widely accepted as true

_____ 7. detected either through human senses or with instruments and measuring devices that extend human senses

_____ 8. a special type of scientific investigation that is performed under controlled conditions

_____ 9. developed the laws of motion

_____ 10. a statement that tells what will happen under certain conditions

_____ 11. developed theory of relativity

_____ 12. a distinctive way of gaining knowledge about the natural world

Terms

a. Albert Einstein

b. evidence

c. experiment

d. hypothesis

e. Isaac Newton

f. model

g. observation

h. prediction

i. science

j. scientific investigation

k. scientific law

l. scientific theory

Lesson 1.1: Vocabulary II

Name_____ **Class**_____ **Date**_____

Fill in the blank with the appropriate term.

1. An _____ is anything that is detected either through human senses or with instruments and measuring devices that extend human senses.

2. An _____ is a special type of scientific investigation that is performed under controlled conditions.

3. A scientific _____ is a statement that describes what always happens under certain conditions in nature.

4. A model is a representation of part of the real _____.

5. _____ is any type of data that may either agree or disagree with a prediction.

6. Scientific investigation are done by following the scientific _____.

7. The goal of _____ is to understand the natural world.

8. A hypothesis is a possible answer to a scientific _____.

9. Matters of _____ are outside the realm of science.

10. A scientific _____ is a broad explanation for events that is widely accepted as true.

11. The last step in a scientific investigation is _____ what you have learned with others.

12. _____ is a distinctive way of gaining knowledge about the natural world that starts with a question and then tries to answer the question with evidence and logic

Lesson 1.1: Critical Writing

Name_____ **Class**_____ **Date**_____

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Discuss why science is not able to answer all questions. Incorporate the steps of the scientific method into your response.

1.2 Biology: The Study of Life

Lesson 1.2: True or False

Name_____ **Class**_____ **Date**_____

Write true if the statement is true or false if the statement is false.

_____ 1. A cell is the basic unit of the structure and function of all living things

_____ 2. An adaptation is a characteristic that helps a living thing survive and reproduce.

_____ 3. Natural selection is a change in the characteristics of living things over time.

_____ 4. A population consists of many different species.

_____ 5. Charles Darwin developed the theory of evolution by natural selection.

_____ 6. All living things must maintain homeostasis.

_____ 7. The characteristics of all living things are controlled by genes.

_____ 8. The four unifying principles of biology are the cell theory, the gene theory, homeostasis, and gravity.

_____ 9. Deer sometimes eat the starlings (birds) that sit on them.

_____ 10. The cells of many different organisms are very similar.

_____ 11. Simple life forms, like bacteria, have simple chemistry.

_____ 12. Simple life forms, like bacteria, do not grow and develop.

_____ 13. Every living thing begins life as a single cell.

_____ 14. The mole's touch organ is an adaptation because it helps the mole survive in its dark.

_____ 15. There are at least 100 million different species live on Earth today.

Lesson 1.2: Critical Reading

Name_____ **Class**_____ **Date**_____

Read this passage from the text and answer the questions that follow.

Evolution of Life

The diversity of life on Earth today is the result of evolution. Life began on Earth at least 4 billion years ago, and it has been evolving ever since. At first, all living things on Earth were simple, single-celled organisms. Much later, the first multicellular organisms evolved, and after that, Earth's biodiversity greatly increased.

Today, scientists accept the evolution of life on Earth as a fact. There is too much evidence supporting evolution to doubt it. However, that wasn't always the case.

Darwin and the Theory of Evolution

The idea of evolution has been around for centuries. In fact, it goes all the way back to the ancient Greek philosopher

Aristotle. However, evolution is most often associated with Charles Darwin. Darwin published a book on evolution in 1869 titled *On the Origin of Species*. In the book, Darwin stated the theory of evolution by natural selection. He also presented a great deal of evidence that evolution occurs. Despite all the evidence Darwin presented, his theory was not well received at first. Many people found it hard to accept the idea that humans had evolved from an ape-like ancestor, and they saw evolution as a challenge to their religious beliefs. Darwin had actually expected this type of reaction to his theory and had waited a long time before publishing his book for this reason. It was only when another scientist, named Alfred Wallace, developed essentially the same theory of evolution that Darwin put his book into print.

Although Darwin presented a great deal of evidence for evolution in his book, he was unable to explain how evolution occurs. That's because he knew nothing about genes. As a result, he didn't know how characteristics are passed from parents to offspring, let alone how they could change over time.

Evolutionary Theory After Darwin

Since Darwin's time, scientists have gathered even more evidence to support the theory of evolution. Some of the evidence comes from fossils, and some comes from studies that show how similar living things are to one another. By the 1930s, scientists had also learned about genes. As a result, they could finally explain how characteristics of organisms could pass from one generation to the next and change over time.

Using modern technology, scientists can now directly compare the genes of living species. The more genes different species share in common, the more closely related the species are presumed to be. Consider humans and chimpanzees. They share about 98% of their genes. This means that they shared a common ancestor in the not-too-distant past. This is just one of many pieces of evidence that show we are part of the evolution of life on Earth.

Questions

1. What were the first living things on Earth?

2. Who is most often associated with developing the theory of evolution?

3. What is the name of the process by which evolution occurs?

4. What discovery allowed scientists to explain how characteristics are passed from parents to offspring?

5. Cite one piece of evidence that demonstrates we are evolutionarily closely related to chimpanzees.

Lesson 1.2: Multiple Choice

Name_____ Class_____ Date_____

Circle the letter of the correct choice.

a. The cell theory states that
    a. all living things are made up of cells.
    b. living cells may come from other living cells.
    c. all living things remain single-celled.
    d. all of the above

b. Levels of organization of an individual organism includes
    a. the tissue.
    b. the population.
    c. the community.
    d. all of the above

c. Which is the best definition of "biology"?

   a. The science of living organisms.
   b. The study of humans and animals.
   c. The study of plants, humans, and animals.
   d. The science of life.

d. Homeostasis is

   a. the ability to give rise to offspring.
   b. maintaining a stable internal environment.
   c. the ability to detect and respond to changes in their environment.
   d. the ability to grow and develop.

e. Evolution

   a. is a change in characteristics of living things over time.
   b. occurs by natural selection.
   c. explains how modern organisms have descended from ancient life forms.
   d. all of the above

f. An example of a symbiotic relationship in which one organism is harmed is

   a. the relationship between a flock of starlings and a red deer stag.
   b. the relationship between a lion and an antelope.
   c. the relationship between hummingbirds and flowers.
   d. the relationship between humans and their pet dogs.

g. Cells

   a. are all unique; no two cells are similar.
   b. come from other cells, except for the very first cell of a new organism.
   c. are the basic unit of structure and function of all living things.
   d. are all circular in shape.

h. To be classified as a living organism, an object must

   a. maintain homeostasis.
   b. have a complex chemistry.
   c. be made of at least one cell.
   d. all of the above

Lesson 1.2: Vocabulary I

Name_____ **Class**_____ **Date**_____

Match the vocabulary word with the proper definition.

Definitions

_____ 1. the basic unit of the structure and function of living things

_____ 2. the process by which evolution occurs

_____ 3. the same species that live in the same area

_____ 4. all of the populations that live in the same area

_____ 5. maintaining a stable internal environment

_____ 6. a change in the characteristics of living things over time

_____ 7. an individual living thing

_____ 8. the diversity of living things

_____ 9. all the living things in a given area, together with the nonliving environment

_____ 10. a characteristic that helps a living thing survive and reproduce

_____ 11. a group of similar ecosystems

_____ 12. the science of life

Terms

a. adaptation

b. biodiversity

c. biology

d. biome

e. cell

f. community

g. ecosystem

h. evolution

i. homeostasis

j. natural selection

k. organism

l. population

Lesson 1.2: Vocabulary II

Name_____ **Class**_____ **Date**_____

Fill in the blank with the appropriate term.

1. _____ developed the theory of evolution by natural selection.
2. All living things grow and _____.
3. A cell is the basic unit of the structure and _____ of living things.
4. An adaptation is a characteristic that helps a living thing survive and _____ in a given environment.
5. The process of maintaining a stable internal environment is _____.
6. A _____ is made of cells of the same kind.
7. An _____ is an individual living thing.
8. _____ is a relationship between living things that depend on the same resources.
9. An ecosystem consists of all the living things in a given area, together with the nonliving _____.
10. _____ is a change in the characteristics of living things over time.
11. The _____ is the part of Earth where all life exists.
12. _____ is the process by which living things give rise to offspring.

Lesson 1.2: Critical Writing

Name_____ Class_____ Date_____

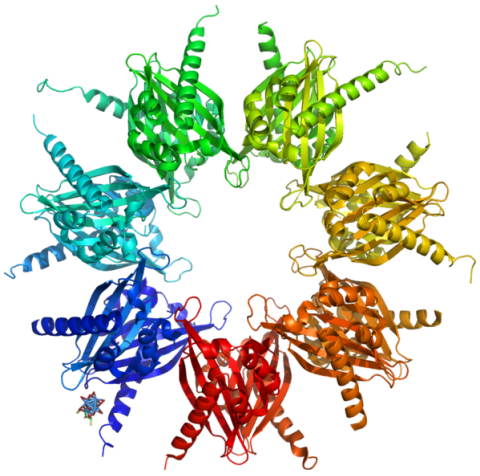
Thoroughly answer the questions below. Use appropriate academic vocabulary and clear and complete sentences.

List and describe three characteristics necessary to define life.

CHAPTER 2

The Chemistry of Life Worksheets

Chapter Outline



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- **Lesson 2.1: Matter and Organic Compounds**
- **Lesson 2.2: Biochemical Reactions**
- **Lesson 2.3: Water, Acids, and Bases**

2.1 Matter and Organic Compounds

Lesson 2.1: True or False

Name_____ **Class**_____ **Date**_____

Write true if the statement is true or false if the statement is false.

_____ 1. An atom is smaller than an element.

_____ 2. Organic compounds are found in living organisms.

_____ 3. Proteins are made out of amino acids.

_____ 4. Proteins speed up chemical reactions.

_____ 5. The DNA code carries instructions for the correct sequence of nucleic acids in a protein

_____ 6. Sugars and phosphate groups form the middle of a nucleic acid chain.

_____ 7. DNA (and RNA) is made out of nucleotides.

_____ 8. A protein consists of one or more polypeptide chains.

_____ 9. Lipids include fats, oils, and sugars.

_____ 10. Carbohydrates are the most common type of organic compound.

_____ 11. Peanut oil is an unsaturated fatty acid.

_____ 12. Cytosine and adenine are complementary bases in DNA.

_____ 13. A double helix is like a spiral staircase.

_____ 14. Phospholipids form cell membranes.

_____ 15. Carbohydrates are made out of monosaccharides.

Lesson 2.1: Critical Reading

Name_____ **Class**_____ **Date**_____

Read these passages from the text and answer the questions that follow.

The Significance of Carbon

A compound found mainly in living things is known as an **organic compound**. Organic compounds make up the cells and other structures of organisms and carry out life processes. Carbon is the main element in organic compounds, so carbon is essential to life on Earth. Without carbon, life as we know it could not exist. Why is carbon so basic to life? The reason is carbon's ability to form stable bonds with many elements, including itself. This property allows carbon to form a huge variety of very large and complex molecules. In fact, there are nearly 10 million carbon-based compounds in living things! However, the millions of organic compounds can be grouped into just four major types: carbohydrates, lipids, proteins, and nucleic acids. You can compare the four types in **Table** 2.1. Each type is also described below.

TABLE 2.1: Types of Organic Compounds

Type of Compound	Examples	Elements	Functions
Carbohydrates	sugars, starches	carbon, hydrogen, oxygen	provides energy to cells, stores energy, forms body structures
Lipids	fats, oils	carbon, hydrogen, oxygen	stores energy, forms cell membranes, carries messages
Proteins	enzymes, antibodies	carbon, hydrogen, oxygen, nitrogen, sulfur	helps cells keep their shape, makes up muscles, speeds up chemical reactions, carries messages and materials
Nucleic Acids	DNA, RNA	carbon, hydrogen, oxygen, nitrogen, phosphorus	contains instructions for proteins, passes instructions from parents to offspring, helps make proteins

Carbohydrates

Carbohydrates are the most common type of organic compound. A **carbohydrate** is an organic compound such as sugar or starch, and is used to store energy. Like most organic compounds, carbohydrates are built of small, repeating units that form bonds with each other to make a larger molecule. In the case of carbohydrates, the small, repeating units are called monosaccharides.

Lipids

A **lipid** is an organic compound such as fat or oil. Organisms use lipids to store energy, but lipids have other important roles as well. Lipids consist of repeating units called fatty acids. There are two types of fatty acids: saturated fatty acids and unsaturated fatty acids.

Proteins

A **protein** is an organic compound made up of small molecules called **amino acids**. There are 20 different amino acids commonly found in the proteins of living things. Small proteins may contain just a few hundred amino acids, whereas large proteins may contain thousands of amino acids.

Nucleic Acids

A **nucleic acid** is an organic compound, such as DNA or RNA, that is built of small units called nucleotides. Many nucleotides bind together to form a chain called a **polynucleotide**. The nucleic acid **DNA** (deoxyribonucleic acid) consists of two polynucleotide chains. The nucleic acid **RNA** (ribonucleic acid) consists of just one polynucleotide chain.

Questions

1. List two functions of organic compounds.

2. Which two categories of organic compounds store energy? Which of these organic compounds is more common?

3. What is a main difference between DNA and RNA?

4. Describe a difference between large and small proteins.

5. Why is carbon considered the essential element of life?

Lesson 2.1: Multiple Choice

Name_____ Class_____ Date_____

Circle the letter of the correct choice.

a. Water (H_2O) is a(n)
   a. element.
   b. atom.
   c. compound.
   d. carbohydrate.

b. A process that changes some chemical substances into others is a
   a. chemical bond.
   b. chemical reaction.
   c. chemical equation.
   d. chemical formula.

c. The main difference between saturated and unsaturated fatty acids is
   a. the amount of energy found in the fatty acid.
   b. saturated fatty acids are liquids.
   c. unsaturated fatty acids can be packed together very tightly.
   d. the number of hydrogen atoms bonded to the carbon atoms.

d. The function of proteins can include
   a. helping cells keep their shape.
   b. helping to destroy foreign substances.
   c. speeding up biochemical reactions.
   d. all of the above

e. The characteristics of DNA includes which of the following?
   a. DNA is made of nucleotides consisting of a sugar, a phosphate group, and a carbon base.
   b. DNA is made of a single polynucleotide chain, which winds into a double helix.
   c. DNA is how inherited characteristics are passed from one generation to the next.
   d. all of the above

f. Which category of organic compound is the major component of cell membranes?
   a. carbohydrate
   b. lipid
   c. protein
   d. nucleic acid

g. The cell wall of plants is made out of
   a. starch.
   b. glycogen.
   c. cellulose.
   d. chitin.

h. The main element of organic compounds is
   a. hydrogen.
   b. oxygen.
   c. nitrogen.
   d. carbon.

Lesson 2.1: Vocabulary I

Name_____ **Class**_____ **Date**_____

Match the vocabulary word with the proper definition.

Definitions

_____ 1. an organic compound that stores energy, forms cell membranes, carries messages

_____ 2. an organic compound that contains instructions for proteins

_____ 3. an organic compound that provides energy to cells, stores energy, forms body structures

_____ 4. an organic compound that helps cells keep their shape

_____ 5. a pure substance, like carbon

_____ 6. may contain just a few simple sugars or thousands

_____ 7. subunit that make up proteins

_____ 8. subunit used to make nucleic acids

_____ 9. lipid in which carbon atoms are bonded to as many hydrogen atoms as possible

_____ 10. lipid in which carbon atoms are bonded to groups of atoms other then hydrogen

_____ 11. the major component of cell membranes

_____ 12. anything that takes up space and has mass

Terms

a. amino acid

b. carbohydrate

c. DNA

d. element

e. lipid

f. matter

g. nucleotide

h. phospholipid

i. polysaccharide

j. protein

k. saturated fatty acid

l. unsaturated fatty acid

Lesson 2.1: Vocabulary II

Name_____ **Class**_____ **Date**_____

Fill in the blank with the appropriate term.

1. A substance that consists of two or more elements is a _____.

2. The information in _____ is passed from parents to offspring when organisms reproduce.

3. _____ are proteins which bind to foreign substances such as bacteria and target them for destruction.

4. _____ compounds make up the cells and other structures of organisms and carry out _____-processes.

5. _____ is the monosaccharide used for energy by the cells of most organisms.

6. _____ are the most common type of organic compound.

7. _____ is a protein that binds with oxygen molecules.

8. The shape of DNA is that of a _____.

9. _____ is used by plants to store energy.

10. _____ is used by plants to form rigid walls around cells.

11. DNA contains _____ instructions for proteins, and _____ helps assemble the proteins.

12. Matter is anything that takes up space and has _____.

Lesson 2.1: Critical Writing

Name_____ Class_____ Date_____

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Describe the main functions of each of the four classes of organic compounds.

2.2 Biochemical Reactions

Lesson 2.2: True or False

Name_____ Class_____ Date_____

Write true if the statement is true or false if the statement is false.

_____ 1. A substance that forms as a result of a chemical reaction is called a reactant.

_____ 2. Only some chemical reactions need energy to get started.

_____ 3. Biochemical reactions take place inside the cells.

_____ 4. A chemical reaction that releases heat is an exothermic reaction.

_____ 5. Most biochemical reactions need help to get started.

_____ 6. Anabolic reactions give off energy.

_____ 7. Metabolism is the sum of all the biochemical reactions in an organism.

_____ 8. In a chemical reaction, the quantity of an element may change.

_____ 9. During a chemical reaction, some bonds break and new bonds form.

_____ 10. Activation energy is the energy needed to start a chemical reaction.

_____ 11. An enzyme speeds up the reaction by lowering the activation energy.

_____ 12. In a chemical reaction, the number of atoms on one side of the arrow may differ from the number of atoms on the other side.

_____ 13. Matter is always conserved.

_____ 14. Understanding chemistry is needed to understand fully the processes within the cell.

_____ 15. In a chemical reaction, the quantity of each element does not change.

Lesson 2.2: Critical Reading

Name_____ Class_____ Date_____

Read these passages from the text and answer the questions that follow.

Biochemical Reactions and Enzymes

Biochemical reactions are chemical reactions that take place inside the cells of living things. Biochemistry is a relatively new field that emerged at the interface of biology and chemistry. Its emergence shows that knowledge of chemistry as well as biology is needed to understand fully the life processes of organisms at the level of the cell. The sum of all the biochemical reactions in an organism is called **metabolism**. It includes both exothermic and endothermic reactions.

Types of Biochemical Reactions

Exothermic reactions in organisms are called **catabolic reactions**. These reactions break down molecules into smaller units and release energy. An example of a catabolic reaction is the breakdown of glucose, which releases energy that cells need to carry out life processes. Endothermic reactions in organisms are called **anabolic reactions**. These reactions build up bigger molecules from smaller ones. An example of an anabolic reaction is the joining of amino acids to form a protein. Which type of reactions — catabolic or anabolic — do you think occur when your body digests food?

Enzymes

Most biochemical reactions in organisms need help in order to take place. Why is this the case? For one thing, temperatures are usually too low inside living things for biochemical reactions to occur quickly enough to maintain life. The concentrations of reactants may also be too low for them to come together and react. Where do the biochemical reactions get the help they need to proceed? The help comes from enzymes.

An **enzyme** is a protein that speeds up a biochemical reaction. An enzyme works by reducing the amount of activation energy needed to start the reaction. Less activation energy is needed when the correct enzyme is present than when it is not present.

Enzymes are involved in most biochemical reactions, and they do their job extremely well. A typical biochemical reaction could take several days to occur without an enzyme. With the proper enzyme, the same reaction can occur in just a split second! Without enzymes to speed up biochemical reactions, most organisms could not survive. The activities of enzymes depend on the temperature, ionic conditions, and the pH of the surroundings. Some enzymes work best at an acidic pH, while others work best in neutral environments.

Questions

1. What is an enzyme?

2. How are biochemistry and metabolism related?

3. Which type of reactions — catabolic or anabolic — do you think occur when your body digests food?

4. How do enzymes work?

5. What is activation energy?

Lesson 2.2: Multiple Choice

Name_____ Class_____ Date_____

Circle the letter of the correct choice.

a. Reactants in the burning of methane include
   a. CH_4 and $2O_2$.
   b. CO_2 and $2H_2O$.
   c. CH_4 and CO_2.
   d. CO_2 and $2O_2$.

b. Activities of enzymes depend on
   a. pH.
   b. temperature.
   c. ionic conditions.
   d. all of the above

c. An enzyme is a _____.

   a. carbohydrate
   b. lipid
   c. protein
   d. nucleic acid

d. Reactions that take place inside cells are

   a. cellular reactions.
   b. enzyme reactions.
   c. metabolic reactions.
   d. biochemical reactions.

e. What is the main difference between an endothermic reaction and an exothermic reaction?

   a. An endothermic reaction gives off energy and an exothermic reaction absorbs energy.
   b. An exothermic reaction gives off energy and an endothermic reaction absorbs energy.
   c. An endothermic reaction does not need activation energy.
   d. Only endothermic reactions involve enzymes.

f. Another name for a "biological catalyst" could be a(n)

   a. enzyme.
   b. reactant.
   c. activator.
   d. metabolism.

g. The joining of amino acids to form a protein is a(n)

   a. anabolic reaction.
   b. catabolic reaction.
   c. amino acid reaction.
   d. polypeptide reaction.

h. The "push" needed to start a chemical reaction is the

   a. enzymatic energy.
   b. endothermic energy.
   c. activation energy.
   d. reactant energy.

Lesson 2.2: Vocabulary I

Name_____ **Class**_____ **Date**_____

Match the vocabulary word with the proper definition.

Definitions

_____ 1. represents a chemical reaction

_____ 2. a protein that speeds up a biochemical reaction

_____ 3. a substance that forms as a result of a chemical reaction

_____ 4. a substance that starts a chemical reaction

_____ 5. sum of all the biochemical reactions in an organism

_____ 6. a process that changes some chemical substances into others

_____ 7. exothermic reactions in organisms

_____ 8. endothermic reactions in organisms

_____ 9. chemical reactions that take place inside the cells of living things

_____ 10. a chemical reaction that releases energy

_____ 11. a chemical reaction that absorbs energy

_____ 12. the energy needed to start a chemical reaction

Terms

a. activation energy

b. anabolic reaction

c. biochemical reaction

d. catabolic reaction

e. chemical equation

f. chemical reaction

g. enzyme

h. endothermic

i. exothermic

j. metabolism

k. product

l. reactant

Lesson 2.2: Vocabulary II

Name_____ **Class**_____ **Date**_____

Fill in the blank with the appropriate term.

1. Biochemical reactions are chemical reactions that take place inside the _____ of living things.

2. During a chemical reaction, the _____ are used up to create the products.

3. All chemical reactions need _____ to get started.

4. _____ reactions in organisms are called catabolic reactions.

5. _____ energy provides the push needed to start a chemical reaction.

6. Your _____ includes both exothermic and endothermic reactions.

7. A chemical reaction involves the breaking and forming of _____.

8. In a chemical reaction, all matter is _____.

9. Energy can be released during a chemical reaction in the form of _____ and light.

10. In a chemical reaction, there is the same amount of each _____ in the products as there was in the reactants.

11. An _____ reaction builds up bigger molecules from smaller ones.

12. An _____ works by reducing the amount of activation energy needed to start the reaction.

Lesson 2.2: Critical Writing

Name_____ Class_____ Date_____

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Describe the roles of enzymes in biochemical reactions. Use specifics in discussing how enzymes work. Provide an example of a biochemical reaction involving an enzyme.

2.3 Water, Acids, and Bases

Lesson 2.3: True or False

Name_____ **Class**_____ **Date**_____

Write true if the statement is true or false if the statement is false.

_____ 1. Water is a chemical.

_____ 2. The hydrogen atoms in a water molecule attract electrons more strongly than the oxygen atom does.

_____ 3. Hydrogen bonds are very strong bonds.

_____ 4. Water is a reactant in photosynthesis.

_____ 5. Enzymes in the small intestine need an acidic environment in order to work.

_____ 6. Pure water has a pH of 7.

_____ 7. Lemon juice is a stronger acid than orange juice.

_____ 8. An ion is an electrically charged atom or molecule.

_____ 9. The stomach is a very acidic environment.

_____ 10. Water is released during cellular respiration.

_____ 11. Soap is very acidic.

_____ 12. Hydrogen bonds cause water to have a relatively high boiling point of 100°F.

_____ 13. Acids have a pH lower than 7.

_____ 14. Bases have a pH lower than 7.

_____ 15. A water molecule has positive and negative parts to it.

Lesson 2.3: Critical Reading

Name_____ **Class**_____ **Date**_____

Read these passages from the text and answer the questions that follow.

Acids and Bases

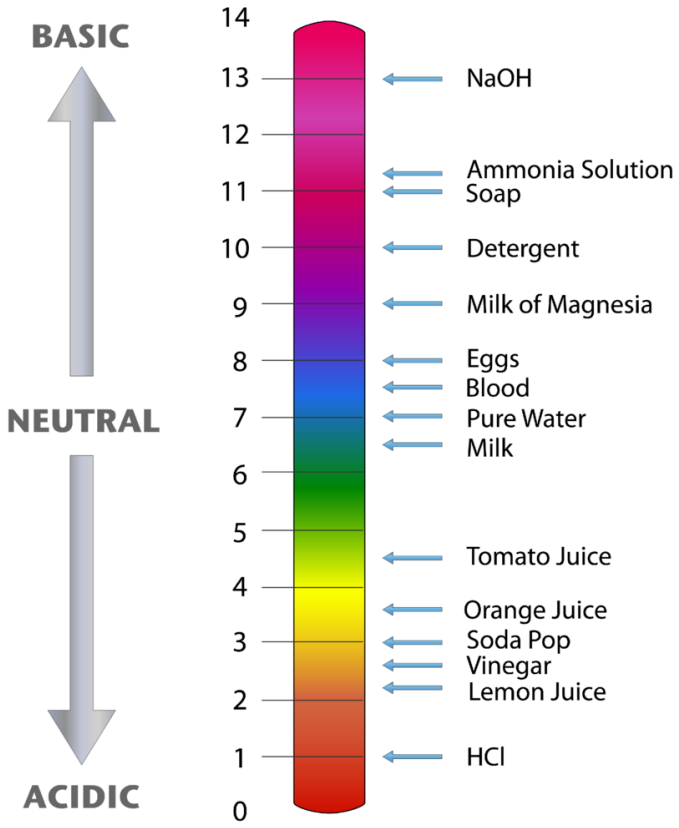
Water is the main ingredient of many solutions. A **solution** is a mixture of two or more substances that has the same composition throughout. Some solutions are acids and some are bases. To understand acids and bases, you need to know more about pure water. In pure water (such as distilled water), a tiny fraction of water molecules naturally break down to form ions. An ion is an electrically charged atom or molecule. The breakdown of water is represented by the chemical equation

$2H_2O \rightarrow H_3O^+ + OH^-$

The products of this reaction are a hydronium ion (H_3O^+) and a hydroxide ion (OH^-). The hydroxide ion, which has

a negative charge, forms when a water molecule gives up a positively charged hydrogen ion (H^+). The hydronium ion, which has positive charge, forms when another water molecule accepts the hydrogen ion.

Acidity and pH The concentration of hydronium ions in a solution is known as acidity. In pure water, the concentration of hydronium ions is very low; only about 1 in 10 million water molecules naturally breaks down to form a hydronium ion. As a result, pure water is essentially neutral. Acidity is measured on a scale called **pH**, as shown in the figure below. Pure water has a pH of 7, so the point of neutrality on the pH scale is 7.



pH Scale. The pH scale ranges from 0 to 14, with 7 being the point of neutrality. What is the pH of lemon juice? Of milk? *(Image courtesy of Edward Stevens, modified by CK-12 Foundation, and under the Creative Commons license CC-BY-SA 3.0.)*

Acids and Bases in Organisms

Acids and bases are important in living things because most enzymes can do their job only at a certain level of acidity. Cells secrete acids and bases to maintain the proper pH for enzymes to work. For example, every time you digest food, acids and bases are at work in your digestive system. Consider the enzyme pepsin, which helps break down proteins in the stomach. Pepsin needs an acidic environment to do its job, and the stomach secretes a strong acid that allows pepsin to work. However, when stomach contents enter the small intestine, the acid must be neutralized. This is because enzymes in the small intestine need a basic environment in order to work. An organ called the pancreas secretes a strong base into the small intestine, and this base neutralizes the acid.

Water and Life

The human body is about 70% water (not counting the water in body fat, which varies from person to person). The body needs all this water to function normally. Just why is so much water required by human beings and other organisms? Water can dissolve many substances that organisms need, and it is necessary for many biochemical reactions. The examples below are among the most important biochemical processes that occur in living things, but they are just two of many ways that water is involved in biochemical reactions.

- Photosynthesis — In this process, cells use the energy in sunlight to change carbon dioxide and water to glucose and oxygen. The reactions of photosynthesis can be represented by the chemical equation

$6CO_2 + 6H_2O + \text{Energy} \rightarrow C_6H_{12}O_6 + 6O_2$

- Cellular respiration — In this process, cells break down glucose in the presence of oxygen and release carbon dioxide, water, and energy. The reactions of cellular respiration can be represented by the chemical equation

$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O + \text{Energy}$

Water is involved in many other biochemical reactions. As a result, just about all life processes depend on water. Clearly, life as we know it could not exist without water.

Questions

1. Describe the best environment for the enzyme pepsin.

2. Why is water so important for life?

3. Which is a stronger acid: lemon juice or soda pop? Why?

4. What is a hydronium ion? How does one form?

5. In terms of water, what is one main difference between photosynthesis and cellular respiration?

Lesson 2.3: Multiple Choice

Name_____ Class_____ Date_____

Circle the letter of the correct choice.

a. Earth is sometimes called the
   a. "water planet," because almost 75% of its surface is covered with water.
   b. "oxygen planet," because oxygen is necessary for life.
   c. "carbon planet," because carbon is the central element in organic compounds.
   d. all of the above.

b. The oxygen in a water molecule
   a. attracts electrons more strongly than the hydrogen atoms.
   b. has a slight negative charge.
   c. binds to a hydrogen of another water molecule through a hydrogen bond.
   d. all of the above

c. Which of the following is an example of a solution?
   a. a pepperoni pizza
   b. a box of Lucky Charms cereal
   c. a glass of orange juice
   d. a hot fudge sundae

d. Which is the strongest acid?
   a. vinegar
   b. soda pop
   c. orange juice
   d. lemon juice

e. A solution with a lower concentration of hydronium ions than pure water

   a. can have a pH of 6.5.
   b. is a base.
   c. can taste sweet.
   d. all of the above

f. How do hydrogen bonds affect water's properties?

   a. Hydrogen bonds explain why water molecules stick together.
   b. Hydrogen bonds cause water to have a relatively high boiling point.
   c. Hydrogen bonds also cause water to expand when it freezes.
   d. all of the above

g. Where is most of the freshwater found?

   a. as ground water
   b. in icecaps, glaciers and inland seas
   c. in the oceans
   d. in other areas

Lesson 2.3: Vocabulary I

Name_____ **Class**_____ **Date**_____

Match the vocabulary word with the proper definition.

Definitions

_____ 1. for water, 212°F or 100°C

_____ 2. a range from 0 to 14

_____ 3. has a pH less than 7

_____ 4. has a pH more than 7

_____ 5. photosynthesis

_____ 6. OH^-

_____ 7. a measure of the acidity of a solution

_____ 8. has the same composition throughout

_____ 9. needs an acidic environment to work

_____ 10. an organ that secretes a strong base into the small intestine

_____ 11. a difference in electrical charge within the same molecule

_____ 12. holds water molecules together

Terms

a. acid

b. base

c. boiling point

d. hydrogen bond

e. hydroxide ion

f. pancreas

g. pepsin

h. pH

i. pH scale

j. polarity

k. solution

l. $6CO_2 + 6H_2O + \text{Energy} \rightarrow C_6H_{12}O_6 + 6O_2$

Lesson 2.3: Vocabulary II

Name_____ **Class**_____ **Date**_____

Fill in the blank with the appropriate term.

1. Water's _____ gives it unique properties that help explain why it is vital to all living organisms.
2. In water, the _____ atom attracts electrons more strongly than the _____ atoms do.
3. Ice floats on water because ice has a _____ density.
4. A mixture of two or more substances with the same composition throughout is a _____.
5. pH is a measure of the _____ of a solution.
6. A(n) _____ has a pH lower than 7.
7. Water molecules are held together by _____ bonds.
8. _____ is a difference in electrical charge between different parts of the same molecule.
9. 100°C is water's _____ point.
10. Water is essentially neutral, with a pH of _____.
11. _____ is slightly basic with a pH just above 7.
12. In a water molecule, the hydrogen atoms have a _____ charge.

Lesson 2.3: Critical Writing

Name_____ **Class**_____ **Date**_____

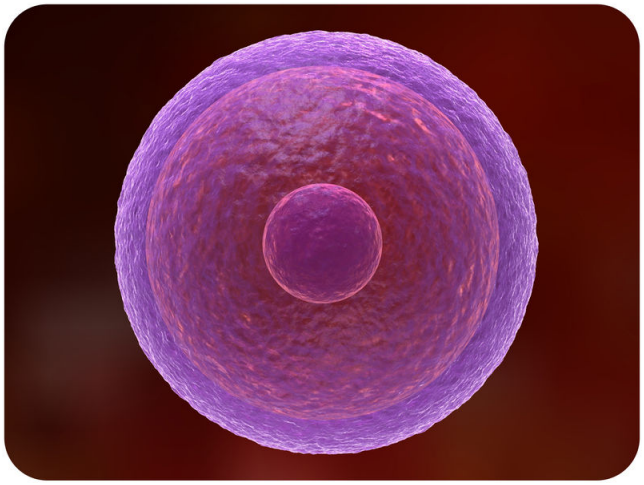
Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Using specifics in describing the structure of the water molecule, and discuss why water is referred to as a "polar molecule."

CHAPTER 3

Cellular Structure and Function Worksheets

Chapter Outline



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- **Lesson 3.1: Introduction to Cells**
- **Lesson 3.2: Cell Structures**
- **Lesson 3.3: Cell Transport and Homeostasis**

3.1 Introduction to Cells

Lesson 3.1: True or False

Name_____ **Class**_____ **Date**_____

Write true if the statement is true or false if the statement is false.

_____ 1. All organisms are made of more than one cell.

_____ 2. Early microscopes created by Leeuwenhoek were almost as strong as modern light microscopes.

_____ 3. Proteins are made on ribosomes.

_____ 4. Prokaryotic cells have a nucleus.

_____ 5. The plasma membrane forms the physical boundary between the cell and its environment.

_____ 6. For cells, a smaller size is more efficient.

_____ 7. Compared to eukaryotic cells, prokaryotic cells are very complex.

_____ 8. Organelles are located within the cytoplasm.

_____ 9. Viruses are similar to prokaryotic cells.

_____ 10. All cells have a plasma membrane, cytoplasm, and ribosomes.

_____ 11. DNA is located in the nucleus of prokaryotic cells.

_____ 12. Organelles allow eukaryotic cells to carry out more functions than prokaryotic cells.

_____ 13. Viruses are considered living organisms.

_____ 14. Most cells are about the size of the period at the end of this sentence.

_____ 15. Observation of cork helped in the discovery of cells.

Lesson 3.1: Critical Reading

Name_____ **Class**_____ **Date**_____

Read these passages from the text and answer the questions that follow.

Two Types of Cells

There is another basic cell structure that is present in many but not all living cells: the nucleus. The **nucleus** of a cell is a structure in the cytoplasm that is surrounded by a membrane (the nuclear membrane) and contains DNA. Based on whether they have a nucleus, there are two basic types of cells: prokaryotic cells and eukaryotic cells.

Prokaryotic Cells

Prokaryotic cells are cells without a nucleus. The DNA in prokaryotic cells is in the cytoplasm rather than enclosed within a nuclear membrane. Prokaryotic cells are found in single-celled organisms, such as bacteria. Organisms with prokaryotic cells are called **prokaryotes**. They were the first type of organisms to evolve and are still the most

common organisms today.

Eukaryotic Cells

Eukaryotic cells are cells that contain a nucleus. Eukaryotic cells are usually larger than prokaryotic cells, and they are found mainly in multicellular organisms. Organisms with eukaryotic cells are called eukaryotes, and they range from fungi to people. Eukaryotic cells also contain other organelles besides the nucleus. An **organelle** is a structure within the cytoplasm that performs a specific job in the cell. Organelles called mitochondria, for example, provide energy to the cell, and organelles called vacuoles store substances in the cell. Organelles allow eukaryotic cells to carry out more functions than prokaryotic cells can.

Viruses: Prokaryotes or Eukaryotes?

Viruses are tiny particles that may cause disease. Human diseases caused by viruses include the common cold and flu. Do you think viruses are prokaryotes or eukaryotes? The answer may surprise you. Viruses are not cells at all, so they are neither prokaryotes nor eukaryotes.

Viruses contain DNA but not much else. They lack the other parts shared by all cells, including a plasma membrane, cytoplasm, and ribosomes. Therefore, viruses are not cells, but are they alive? All living things not only have cells; they are also capable of reproduction. Viruses cannot reproduce by themselves. Instead, they infect living hosts, and use the hosts' cells to make copies of their own DNA. For these reasons, most scientists do not consider viruses to be living things.

Questions

1. What is one main difference between prokaryotic and eukaryotic cells?

2. Give an example of a prokaryotic organism.

3. What is an organelle? Give three examples. (*Hint: See the Eukaryotic Cell figure in the FlexBook.*)

4. Describe the nucleus. What can be found inside the nucleus?

5. Are viruses alive? Discuss why or why not.

Lesson 3.1: Multiple Choice

Name_____ Class_____ Date_____

Circle the letter of the correct choice.

a. Organelles in prokaryotic cells include the
   a. mitochondria.
   b. cytoskeleton.
   c. Golgi complex.
   d. none of the above

b. A major difference between prokaryotic and eukaryotic cells is that
   a. prokaryotic cells have a flagellum.

b. eukaryotic cells have a nucleus.
c. prokaryotic cells have cytoplasm.
d. eukaryotic cells have ribosomes.

c. Robert Hooke was the first person to observe cells. He observed these cells in

a. a piece of cork.
b. a slice of honeycomb.
c. human blood.
d. plaque from his own teeth.

d. Cell size is limited by the

a. amount of cytoplasm.
b. cell's ability to get rid of wastes.
c. the size of the nucleus.
d. the size of the plasma membrane.

e. The spikes on pollen grains probably

a. allow the pollen grain to stick to insects.
b. allow the pollen grain to fly through the air.
c. protect the pollen grain from being eaten.
d. allow insects to stick to the pollen grain.

f. All cells have the following:

a. plasma membrane, cytoplasm, and ribosomes.
b. plasma membrane, nucleus, and DNA.
c. DNA, ribosomes, and cell wall.
d. plasma membrane, cytoplasm, and nucleus.

g. The first microscopes were made around

a. 1965.
b. 1665.
c. 1950.
d. 1776.

h. The cell theory states that

a. all organisms are made of one or more cells.
b. all cells come from already existing cells.
c. all the life functions of organisms occur within cells.
d. all of the above

Lesson 3.1: Vocabulary I

Name_____ **Class**_____ **Date**_____

Match the vocabulary word with the proper definition.

Definitions

_____ 1. organism that has cells containing a nucleus and other organelles

_____ 2. an organelle inside eukaryotic cells where the DNA is located

_____ 3. cell without a nucleus

_____ 4. a structure within the cytoplasm of a cell that is enclosed within a membrane and performs a specific job

_____ 5. phospholipid bilayer that surrounds and encloses a cell

_____ 6. first person to use the word “cell”

_____ 7. tiny, non-living particles that may cause disease

_____ 8. the material inside the plasma membrane of a cell

_____ 9. cell that contains a nucleus and other organelles

_____ 10. organelle where proteins are made

_____ 11. discovered human blood cells

_____ 12. a single-celled organism that lacks a nucleus

Terms

a. Anton van Leeuwenhoek

b. cytoplasm

c. eukaryote

d. eukaryotic cell

e. nucleus

f. organelle

g. plasma membrane

h. prokaryote

i. prokaryotic cell

j. ribosome

k. Robert Hooke

l. virus

Lesson 3.1: Vocabulary II

Name_____ **Class**_____ **Date**_____

Fill in the blanks with the appropriate term.

1. All organisms are made up of one or more _____.
2. All cells have certain parts in common, including a plasma membrane, _____, _____, and DNA.
3. Proteins are made on the _____.
4. A _____ is a typical prokaryotic cell.
5. _____ cells are usually larger than _____ cells.
6. Leeuwenhoek discovered _____ by looking at the plaque from his own teeth.
7. _____ contain DNA, but do not contain cytoplasm or ribosomes.
8. In an eukaryotic cell, DNA is found in the _____.
9. _____ is the genetic instructions that cells need to make proteins.
10. The plasma membrane is a bilayer of _____ that surrounds a cell.

11. A cell's shape is generally related to the cell's _____.

12. _____ are cells without a nucleus.

Lesson 3.1: Critical Writing

Name_____ Class_____ Date_____

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Compare and contrast eukaryotic cells with prokaryotic cells. Include at least 5 specific similarities and/or differences.

3.2 Cell Structures

Lesson 3.2: True or False

Name_____ Class_____ Date_____

Write true if the statement is true or false if the statement is false.

_____ 1. The water-hating hydrophobic tails of the phospholipid bilayer face the outside of the cell membrane.

_____ 2. The cytoplasm essentially acts as a "skeleton" inside the cell.

_____ 3. Roundworms have organ system-level organization, in which groups of organs work together to do a specific job.

_____ 4. Plant cells have special structures that are not found in animal cells, including a cell membrane, a large central vacuole, and plastids.

_____ 5. Centrioles help organize chromosomes before cell division.

_____ 6. Ribosomes can be found attached to the endoplasmic reticulum.

_____ 7. ATP is made in the mitochondria.

_____ 8. Many of the biochemical reactions of the cell occur in the cytoplasm.

_____ 9. Animal cells have chloroplasts, organelles that capture light energy from the sun and use it to make food.

_____ 10. Small hydrophobic molecules can easily pass through the plasma membrane.

_____ 11. In cell-level organization, different cells are specialized for different functions.

_____ 12. The flagella on your lung cells sweep foreign particles and mucus toward the mouth and nose.

_____ 13. Mitochondria contains its own DNA.

_____ 14. The plasma membrane is a single phospholipid layer that supports and protects a cell and controls what enters and leaves it.

_____ 15. The cytoskeleton is made from thread-like filaments and tubules.

Lesson 3.2: Critical Reading

Name_____ Class_____ Date_____

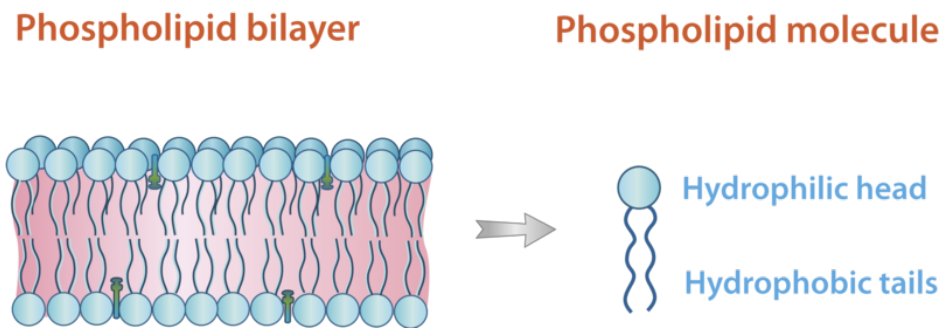
Read these passages from the text and answer the questions that follow.

Plasma Membrane

The plasma membrane forms a barrier between the cytoplasm inside the cell and the environment outside the cell. It protects and supports the cell and also controls everything that enters and leaves the cell. It allows only certain substances to pass through, while keeping others in or out. The ability to allow only certain molecules in or out of the cell is referred to as selective permeability or semipermeability. To understand how the plasma membrane controls what crosses into or out of the cell, you need to know its composition.

Phospholipid Bilayer

The plasma membrane is composed mainly of phospholipids, which consist of fatty acids and alcohol. The phospholipids in the plasma membrane are arranged in two layers, called a phospholipid bilayer. As shown in the figure below, each phospholipid molecule has a head and two tails. The head "loves" water (hydrophilic) and the tails "hate" water (hydrophobic). The water-hating tails are on the interior of the membrane, whereas the water-loving heads point outwards, toward either the cytoplasm or the fluid that surrounds the cell. Molecules that are hydrophobic can easily pass through the plasma membrane, if they are small enough, because they are water-hating like the interior of the membrane. Molecules that are hydrophilic, on the other hand, cannot pass through the plasma membrane — at least not without help — because they are water-loving like the exterior of the membrane.



The phospholipid bilayer consists of two layers of phospholipids (left), with a hydrophobic, or water-hating, interior and a hydrophilic, or water-loving, exterior. A single phospholipid molecule is depicted on the right. *(Image courtesy of CK-12 Foundation and under the Creative Commons license CC-BY-NC-SA 3.0.)*

Other Molecules in the Plasma Membrane

The plasma membrane also contains other molecules, primarily other lipids and proteins. The green molecules in the figure above, for example, are the lipid cholesterol. Molecules of cholesterol help the plasma membrane keep its shape. Many of the proteins in the plasma membrane assist other substances in crossing the membrane.

Extensions of the Plasma Membrane

The plasma membrane may have extensions, such as whip-like flagella or brush-like cilia. In single-celled organisms, the membrane extensions may help the organisms move. In multicellular organisms, the extensions have other functions. For example, the cilia on human lung cells sweep foreign particles and mucus toward the mouth and nose.

Questions

1. What is the plasma membrane?

2. What is the meaning of *semipermeability*?

3. Discuss why the plasma membrane must be a bilayer.

4. What are some of the "other" molecules in the plasma membrane? Describe their function.

5. What are cilia and flagella?

Lesson 3.2: Multiple Choice

Name_____ **Class**_____ **Date**_____

Circle the letter of the correct choice.

a. The "power plant" of the cell is the
    a. nucleus.
    b. ribosome.
    c. chloroplast.
    d. mitochondria.

b. Which organelle ensures that after cell division each daughter cell has the correct number of chromosomes?
    a. the nucleus
    b. the endoplasmic reticulum
    c. the centriole
    d. the cytoskeleton

c. Structures specific in plant cells but not in animal cells include
    a. a large central vacuole.
    b. the mitochondria.
    c. the cell membrane.
    d. the cytoplasts.

d. Having tissues that digest food, such as in the jellyfish, is an example of
    a. cell-level organization.
    b. tissue-level organization.
    c. organ-level organization.
    d. organ system-level organization.

e. The plasma membrane contains which of the following?
    a. phospholipids
    b. cholesterol molecules
    c. many proteins
    d. all of the above

f. Which of the following is true of the nucleus?
    a. The nucleus is considered the control center of the cell.
    b. The nucleus contains all the cell's DNA.
    c. All cells have a nucleus.
    d. all of the above

g. Which structure determines what molecules can enter and leave the cell?
    a. the plasma membrane
    b. the cell wall
    c. the nucleus
    d. all of the above

h. Which organelle may have allowed early eukaryotes to make food and produce oxygen?
    a. the Golgi apparatus
    b. the central vacuole
    c. the plastids
    d. the cell wall

Lesson 3.2: Vocabulary I

Name_____ **Class**_____ **Date**_____

Match the vocabulary word with the proper definition.

Definitions

_____ 1. the arrangement of phospholipids in the plasma membrane

_____ 2. helps make and transport proteins and lipids

_____ 3. stores and transports protein and lipid molecules

_____ 4. helps the cell maintain its shape and holds cell organelles in place within the cytoplasm

_____ 5. layer that surrounds the plasma membrane of a plant cell

_____ 6. help organize the chromosomes before cell division

_____ 7. organelle that processes proteins and prepares them for use both inside and outside the cell

_____ 8. larger of the sac-like organelles that store and transport materials in the cell

_____ 9. describes the formation of eukaryotic cells

_____ 10. energy-carrying molecule

_____ 11. stores substances such as water, enzymes, and salts in plant cells

_____ 12. "power plant" of the cell

Terms

a. ATP

b. cell wall

c. central vacuole

d. centriole

e. cytoskeleton

f. endoplasmic reticulum

g. endosymbiotic theory

h. Golgi apparatus

i. mitochondria

j. phospholipid bilayer

k. vacuole

l. vesicle

Lesson 3.2: Vocabulary II

Name_____ Class_____ Date_____

Fill in the blank with the appropriate term.

1. The _____ is often considered to be the cell's control center.

2. The _____ consists of everything inside the plasma membrane of the cell.

3. The plasma membrane forms a _____ between the inside and outside of the cell.

4. The _____ is essentially a "skeleton" inside the cell.

5. The rough endoplasmic reticulum is covered with _____.

6. Lysosomes use _____ to break down foreign matter and dead cells.

7. _____ cells specifically have a cell wall, a large central vacuole, and chloroplasts.

8. The endoplasmic reticulum is an organelle that helps make and transport _____ and lipids.

9. Mitochondria are sometimes referred to as the _____ of the cell

10. Human beings have _____-level organization, in which groups of organs work together to do a certain job.

11. Centrioles help make sure each daughter cell has the correct number of _____ after the cell divides.

12. Cilia and _____ are extensions of the plasma membrane of many cells.

Lesson 3.2: Critical Writing

Name_____ Class_____ Date_____

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Discuss the properties of the plasma membrane that allow it to act as a barrier around the cell. Include the specifics of the phospholipid bilayer.

3.3 Cell Transport and Homeostasis

Lesson 3.3: True or False

Name_____ **Class**_____ **Date**_____

Write true if the statement is true or false if the statement is false.

_____ 1. Passive transport needs energy.

_____ 2. Active transport needs energy.

_____ 3. Carrier proteins change shape when they transport substances.

_____ 4. Diffusion does not require any help from other molecules.

_____ 5. Facilitated diffusion does not require any help from other molecules.

_____ 6. Endocytosis removes large molecules from the cell.

_____ 7. In diffusion, substances move from an area of lower concentration to an area of higher concentration.

_____ 8. The sodium-potassium pump is a type of channel protein.

_____ 9. Ions can easily flow through a carrier protein.

_____ 10. Diffusion is the osmosis of water.

_____ 11. Endocytosis and exocytosis are types of vesicle transport.

_____ 12. Channel proteins form small "holes" in the plasma membrane.

_____ 13. Transport of substances across the cell membrane helps maintain homeostasis by keeping the cell's conditions within normal ranges.

_____ 14. Channel proteins and carrier proteins are both transport proteins.

_____ 15. The plasma membrane controls what enters and leaves the cell.

Lesson 3.3: Critical Reading

Name_____ **Class**_____ **Date**_____

Read these passages from the text and answer the questions that follow.

Passive Transport

Passive transport occurs when substances cross the plasma membrane without any input of energy from the cell. No energy is needed because the substances are moving from an area where they have a higher concentration to an area where they have a lower concentration. Concentration refers to the number of particles of a substance per unit of volume. The more particles of a substance in a given volume, the higher the concentration. A substance always moves from an area where it is more concentrated to an area where it is less concentrated. It's a little like a ball rolling down a hill. It goes by itself without any input of extra energy.

Simple Diffusion

Diffusion is the movement of a substance across a membrane, due to a difference in concentration, without any help from other molecules. The substance simply moves from the side of the membrane where it is more concentrated to the side where it is less concentrated. Substances that can squeeze between the lipid molecules in the plasma membrane by simple diffusion are generally very small, hydrophobic molecules, such as molecules of oxygen and carbon dioxide.

Osmosis

Osmosis is a special type of diffusion — the diffusion of water molecules across a membrane. Like other molecules, water moves from an area of higher concentration to an area of lower concentration. Water moves in or out of a cell until its concentration is the same on both sides of the plasma membrane.

Facilitated Diffusion

Water and many other substances cannot simply diffuse across a membrane. Hydrophilic molecules, charged ions, and relatively large molecules, such as glucose, all need help with diffusion. The help comes from special proteins in the membrane known as **transport proteins**. Diffusion with the help of transport proteins is called **facilitated diffusion**. There are several types of transport proteins, including channel proteins and carrier proteins.

- Channel proteins form pores, or tiny holes, in the membrane. This allows water molecules and small ions to pass through the membrane without coming into contact with the hydrophobic tails of the lipid molecules in the interior of the membrane.
- Carrier proteins bind with specific ions or molecules, and in doing so, they change shape. As carrier proteins change shape, they carry the ions or molecules across the membrane.

Questions

1. Explain why passive transport does not require energy.

2. What is a main difference between diffusion and facilitated diffusion?

3. Describe how simple diffusion proceeds. What kind of molecules can move across the membrane by simple diffusion?

4. How is water transported across the membrane?

5. What are the two types of transport proteins? Describe how they function.

Lesson 3.3: Multiple Choice

Name_____ Class_____ Date_____

Circle the letter of the correct choice.

a. Controlling what enters and leaves the cell in an important function of the
    a. nucleus.
    b. vesicle.
    c. plasma membrane.
    d. Golgi apparatus.

b. During diffusion, substances move from an area of _____ concentration to an area of _____-_ concentration.
    a. higher, lower
    b. lower, higher
    c. higher, equal

   d. lower, equal

c. A channel protein does which of the following?

   a. Carries ions or molecules across the membrane.
   b. Forms tiny holes in the membrane.
   c. Changes shape as it transports molecules.
   d. all of the above

d. The sodium-potassium pump

   a. uses energy to move sodium ions out of the cell and potassium ions into the cell.
   b. uses energy to move potassium ions out of the cell and sodium ions into the cell.
   c. moves sodium ions out of the cell and potassium ions into the cell without using energy.
   d. moves potassium ions out of the cell and sodium ions into the cell without using energy.

e. Osmosis

   a. is the diffusion of water.
   b. is the diffusion of water and other small molecules.
   c. is the diffusion of water and small ions.
   d. is the diffusion of small molecules and ions.

f. Types of passive transport include which of the following? (1) simple diffusion, (2) osmosis, (3) facilitated diffusion, (4) active transport, and (5) vesicle transport.

   a. 1 and 2
   b. 1, 2, and 3
   c. 4 and 5
   d. 1, 2, 3, 4, and 5

g. Endocytosis and exocytosis

   a. are both a type of vesicle transport.
   b. move very large molecules either in or out of the cell.
   c. are both a form of active transport.
   d. all of the above

h. Which of the following needs energy? (1) passive transport, (2) active transport, (3) exocytosis, and (4) osmosis.

   a. 1 only
   b. 2 only
   c. 2 and 3
   d. 2, 3, and 4

Lesson 3.3: Vocabulary I

Name_____ **Class**_____ **Date**_____

Match the vocabulary word with the proper definition.

Definitions

_____ 1. transport across a membrane without any additional energy requirement

_____ 2. the diffusion of water

_____ 3. type of vesicle transport that moves a substance into the cell

_____ 4. type of vesicle transport that moves a substance out of the cell

_____ 5. special proteins in the membrane that aid diffusion

_____ 6. membrane protein that forms a small hole that allows ions to pass through

_____ 7. an active transport protein

_____ 8. diffusion with the help of transport proteins

_____ 9. the movement of a substance across a membrane without any help from other molecules

_____ 10. the transport of very large molecules, such as proteins

_____ 11. transport across a membrane in which energy is required

Terms

a. active transport

b. channel protein

c. diffusion

d. endocytosis

e. exocytosis

f. facilitated diffusion

g. osmosis

h. passive transport

i. sodium-potassium pump

j. transport protein

k. vesicle transport

Lesson 3.3: Vocabulary II

Name_____ **Class**_____ **Date**_____

Fill in the blank with the appropriate term.

1. By moving substances into and out of cells, _____ , the process of keeping stable conditions inside a cell, is maintained.

2. A _____ protein changes shape as it carries ions or molecules across the membrane.

3. Exocytosis is the type of _____ transport that moves a substance out of the cell.

4. _____ transport is movement across the plasma membrane that does not require an input of energy.

5. The sodium-potassium _____ is involved in the active-transport of ions.

6. Facilitated diffusion needs the help of _____ proteins

7. _____ refers to the number of particles of a substance per unit of volume.

8. _____ is the type of vesicle transport that moves a substance into the cell.

9. Energy for active transport is supplied by molecules of _____.

10. _____ is the diffusion of water.

11. During active transport, a substance is moving from an area of _____ concentration to an area of _____ concentration.

12. Moving molecules in and out of the cell is an important role of the _____.

Lesson 3.3: Critical Writing

Name_____ Class_____ Date_____

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Discuss passive and active transport. Describe the main differences between these two types of transport, and provide examples of each type.

CHAPTER 4 Photosynthesis and Cellular Respiration Worksheets

Chapter Outline

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- **Lesson 4.1: Energy for Life**
- **Lesson 4.2: Photosynthesis: Sugar as Food**
- **Lesson 4.3: Powering the Cell: Cellular Respiration**
- **Lesson 4.4: Anaerobic Respiration**

4.1 Energy for Life

Lesson 4.1: True or False

Name_____ **Class**_____ **Date**_____

Write true if the statement is true or false if the statement is false.

_____ 1. All life needs energy.

_____ 2. $C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$ is the chemical reaction of photosynthesis.

_____ 3. Glucose is a carbohydrate that stores chemical energy in a concentrated and stable form.

_____ 4. Many scientists consider photosynthesis to be the most important life process on Earth.

_____ 5. Only autotrophs can perform photosynthesis.

_____ 6. Only four types of organisms — plants, algae, fungi and some bacteria — can make food through photosynthesis.

_____ 7. ATP is the "energy currency" of the cell, so it makes sense that a molecule of ATP contains much more chemical energy than a molecule of glucose.

_____ 8. Whereas photosynthesis occurs in only some organisms, cellular respiration occurs in the cells of all living things.

_____ 9. Like matter, energy is also recycled by living organisms.

_____ 10. Heterotrophs cannot make their own food.

_____ 11. Because you are able to cook your own food in the microwave oven, you are a producer.

_____ 12. As mushrooms are fungi, they are heterotrophs.

_____ 13. A food chain shows how energy and matter flow from consumers to producers.

_____ 14. Photosynthetic animals are autotrophs.

_____ 15. Autotrophs are producers.

Lesson 4.1: Critical Reading

Name_____ **Class**_____ **Date**_____

Read these passages from the text and answer the questions that follow.

Introduction

All living things need **energy**, which is defined as the ability to do work. You can often see energy at work in living things — a bird flies through the air, a firefly glows in the dark, a dog wags its tail. These are obvious ways that living things use energy, but living things constantly use energy in less obvious ways as well.

Why Living Things Need Energy

Inside every cell of all living things, energy is needed to carry out life processes. Energy is required to break down and build up molecules and to transport molecules across plasma membranes. All life's work needs energy. A lot of energy is also simply lost to the environment as heat. The story of life is a story of energy flow — its capture, its change of form, its use for work, and its loss as heat. Energy, unlike matter, cannot be recycled, so organisms require a constant input of energy. Life runs on chemical energy. Where do living organisms get this chemical energy?

How Organisms Get Energy: Autotrophs and Heterotrophs

The chemical energy that organisms need comes from food. **Food** consists of organic molecules that store energy in their chemical bonds. In terms of obtaining food for energy, there are two types of organisms: autotrophs and heterotrophs.

Autotrophs

Autotrophs are organisms that make their own food. Most autotrophs use the energy in sunlight to make food in a process called **photosynthesis**. Only three types of organisms — plants, algae, and some bacteria — can make food through photosynthesis.

Autotrophs are also called **producers**. They produce food not only for themselves but for all other living things as well (which are known as consumers). This is why autotrophs form the basis of food chains.

Heterotrophs

Heterotrophs are living things that cannot make their own food. Instead, they get their food by consuming other organisms, which is why they are also called **consumers**. They may consume autotrophs or other heterotrophs. Heterotrophs include all animals and fungi and many single-celled organisms. What do you think would happen to consumers if all producers were to vanish from Earth?

Questions

1. What is energy? Give an example of how energy is used in a living organism.

2. Distinguish between autotrophs and heterotrophs.

3. Determine if the following are autotrophs or heterotrophs: (a) a giant redwood tree, (b) a spider, (c) a rose bush, (d) a mushroom, (e) a blue whale.

4. How is energy used in a cell?

5. Why are autotrophs considered the basis of food chains?

Lesson 4.1: Multiple Choice

Name_____ Class_____ Date_____

Circle the letter of the correct choice.

a. Photosynthesis

   a. uses the energy in sunlight to make food.
   b. uses the glucose in sunlight to make food.
   c. uses the energy in sunlight to make ATP.
   d. breaks down glucose to form ATP.

b. Which of the following autotrophs is also a producer?

   a. a maple tree
   b. the blue-green bacteria known as cyanobacteria
   c. *Laurencia*, a marine genus of Red Algae from Hawaii.
   d. All of the above are producers.

c. In the food chain grass → grasshopper → snake → hawk, which organism(s) are the heterotrophs?

   a. the grass
   b. the grass and grasshopper
   c. the hawk
   d. the grasshopper, snake, and hawk

d. Which of the following statements is true about glucose and ATP? (1) Glucose is made during photosynthesis. (2) The energy in sunlight is temporarily stored in glucose before it is transferred to ATP. (3) ATP is the energy-carrying molecule that cells use for energy. (4) The processes that make ATP and glucose also recycle oxygen in Earth's atmosphere.

   a. statement 1 only
   b. statements 2 and 3 only
   c. statements 1, 2, and 3 only
   d. All 4 statements are correct.

e. Photosynthesis can be described as the process that

   a. uses carbon dioxide and water, in the presence of sunlight, to produce food (glucose) and oxygen.
   b. uses glucose and oxygen to produce energy for the cell (ATP), releasing carbon dioxide and water.
   c. uses glucose and oxygen, in the presence of sunlight, to make ATP.
   d. uses carbon dioxide and water, in the presence of sunlight, to produce ATP and oxygen.

f. Which statement best describes the relationship between a consumer and a producer?

   a. A lion eating an antelope.
   b. A caterpillar eating a leaf.
   c. A snake eating a rat.
   d. A flower absorbing sunlight.

g. Which of the following statements is true?

   a. The products of photosynthesis are the reactants of cellular respiration.
   b. The products of cellular respiration are the reactants of photosynthesis.
   c. Both statements are true.
   d. Neither statement is true.

h. The correct chemical formula for photosynthesis (in the presence of sunlight) is

   a. $6CO_2 + 6O_2 \rightarrow C_6H_{12}O_6 + 6H_2O$.
   b. $6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$.
   c. $C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$
   d. $C_6H_{12}O_6 + 6CO_2 \rightarrow 6O_2 + 6H_2O$

Lesson 4.1: Vocabulary I

Name_____ **Class**_____ **Date**_____

Match the vocabulary word with the proper definition.

Definitions

_____ 1. the process in which glucose is broken down and ATP is made

_____ 2. organism at the end of a food chain

_____ 3. shows how energy and matter flow from producers to consumers

_____ 4. also known as autotrophs

_____ 5. the ability to do work

_____ 6. stores chemical energy in a concentrated, stable form

_____ 7. the energy-carrying molecule that cells use for energy

_____ 8. process that stores energy from sunlight in the chemical bonds of glucose

_____ 9. organisms that make their own food

_____ 10. all animals and fungi and many single-celled organisms

_____ 11. organisms that must eat

_____ 12. organic molecules that store energy in their chemical bonds

Terms

a. ATP

b. autotroph

c. cellular respiration

d. consumer

e. decomposer

f. energy

g. food

h. food chain

i. glucose

j. heterotroph

k. photosynthesis

l. producer

Lesson 4.1: Vocabulary II

Name_____ **Class**_____ **Date**_____

Fill in the blank with the appropriate term.

1. Heterotrophs are living things that cannot make their own _____.

2. _____ and _____ are the two types of molecules organisms use for chemical energy.

3. Glucose and _____ are the products of photosynthesis.

4. _____, water, and energy are the products of cellular respiration.

5. Photosynthesis is the process in which energy from _____ is transferred to glucose.

6. _____ is the process in which energy from glucose is transferred to ATP.

7. Without photosynthesis, there would be no _____ in the atmosphere.

8. All organisms burn glucose to form _____ during cellular respiration.

9. The chemical formula of glucose is _____.

10. Photosynthesis occurs in the _____, and cellular respiration occurs in the _____.

11. _____ make their own food, whereas _____ get food by eating other living things.

12. Living organisms get their _____ from food.

Lesson 4.1: Critical Writing

Name_____ Class_____ Date_____

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Draw a five level food chain, identifying autotrophs, heterotrophs, producers, and consumers.

4.2 Photosynthesis: Sugar as Food

Lesson 4.2: True or False

Name_____ Class_____ Date_____

Write true if the statement is true or false if the statement is false.

_____ 1. Photosynthesis provides almost all of the energy used by living things on Earth.

_____ 2. Earth's oxygen comes from photosynthesis.

_____ 3. In photosynthesis, the Calvin cycle comes before the light reactions.

_____ 4. ATP and NADPH are the reactants of the light reactions.

_____ 5. Electron transport occurs in the thylakoid membranes.

_____ 6. All cells have chloroplasts.

_____ 7. During the Calvin cycle, NADPH and ATP are used to make glucose.

_____ 8. Photons of sunlight can excite and energize electrons.

_____ 9. A chemiosmotic gradient causes hydrogen ions to flow across the thylakoid membrane into the stroma.

_____ 10. Like photosynthesis, chemosynthesis also relies on sunlight.

_____ 11. Two turns of the Calvin cycle produce two molecules of glucose.

_____ 12. The Calvin cycle takes place in the stroma surrounding the thylakoid membranes of the chloroplast.

_____ 13. During the light reactions, water molecules are made.

_____ 14. Light is absorbed by photosystems in the thylakoid membranes of chloroplasts.

_____ 15. Both stages of photosynthesis need sunlight to proceed.

Lesson 4.2: Critical Reading

Name_____ Class_____ Date_____

Read these passages from the text and answer the questions that follow.

Photosynthesis Stage I: The Light Reactions

The first stage of photosynthesis is called the light reactions. During this stage, light is absorbed and transformed to chemical energy in the bonds of NADPH and ATP. You can read about this process below.

Steps of the Light Reactions

The light reactions occur in several steps, all of which take place in the thylakoid membrane.

- Step 1: Units of sunlight, called photons, strike a molecule of chlorophyll in photosystem II of the thylakoid membrane. The light energy is absorbed by two electrons (2 e^-) in the chlorophyll molecule, giving them enough energy to leave the molecule.

- Step 2: At the same time, enzymes in the thylakoid membrane use light energy to split apart a water molecule. This produces:
  - two electrons ($2e^-$). These electrons replace the two electrons that were lost from the chlorophyll molecule in Step 1.
  - an atom of oxygen (O). This atom combines with another oxygen atom to produce a molecule of oxygen gas (O_2), which is released as a waste product.
  - two hydrogen ions ($2H^+$). The hydrogen ions, which are positively charged, are released inside the membrane in the thylakoid interior space.
- Step 3: The two excited electrons from Step 1 contain a great deal of energy, so, like hot potatoes, they need something to carry them. They are carried by a series of electron-transport molecules, which make up an **electron transport chain**. The two electrons are passed from molecule to molecule down the chain. As this happens, their energy is captured and used to pump more hydrogen ions into the thylakoid interior space.
- Step 4: When the two electrons reach photosystem I, they are no longer excited. Their energy has been captured and used, and they need more energy. They get energy from light, which is absorbed by chlorophyll in photosystem I. Then, the two re-energized electrons pass down another electron transport chain.
- Step 5: Enzymes in the thylakoid membrane transfer the newly re-energized electrons to a compound called $NADP^+$. Along with a hydrogen ion, this produces the energy-carrying molecule NADPH. This molecule is needed to make glucose in the Calvin cycle.
- Step 6: By now, there is a greater concentration of hydrogen ions — and positive charge — in the thylakoid interior space. This difference in concentration and charge creates what is called a chemiosmotic gradient. It causes hydrogen ions to flow back across the thylakoid membrane to the stroma, where their concentration is lower. Like water flowing through a hole in a dam, the hydrogen ions have energy as they flow down the chemiosmotic gradient. The enzyme ATP synthase acts as a channel protein and helps the ions cross the membrane. ATP synthase also uses their energy to add a phosphate group (Pi) to a molecule of ADP, producing a molecule of ATP. The energy in ATP is needed for the Calvin cycle.

Questions

1. In one sentence, describe what happens during the light reactions.

2. In which step(s) of the light reactions is sunlight absorbed?

3. Why is water "split" during the light reactions?

4. What is an electron transport chain? What is its role during these light reactions?

5. How is ATP made during the light reactions?

Lesson 4.2: Multiple Choice

Name_____ Class_____ Date_____

Circle the letter of the correct choice.

a. Most autotrophs make "food" through the process of
   a. cellular respiration.
   b. chemosynthesis.
   c. homeostasis.
   d. photosynthesis.

b. The correct sequence of events in the light reactions is
   a. absorption of sunlight, electrons flow down the electron transport chain, ATP is made, NADPH is made.
   b. absorption of sunlight, splitting of water, electrons flow down the electron transport chain, ATP is made.
   c. electrons flow down the electron transport chain, NADPH is made, ATP is made, water is split.
   d. absorption of sunlight, electrons flow down the electron transport chain, NADPH is made, water is split.

c. The Calvin cycle occurs

   a. in the granum of the thylakoid membranes of the chloroplast.
   b. in the stroma surrounding the inner membrane of the chloroplast.
   c. in the stroma surrounding the thylakoid membranes of the chloroplast.
   d. in the granum inside the inner membrane of the chloroplast.

d. By the end of the light reactions, energy from sunlight

   a. has been stored in chemical bonds of NADPH and ATP.
   b. has been transferred to glucose.
   c. has entered the Calvin cycle.
   d. is ready for use in the cell.

e. ATP synthase is

   a. both an enzyme that makes ATP and a channel protein, and helps hydrogen ions cross the thylakoid membrane.
   b. both an enzyme that makes ATP and a channel protein, and helps hydrogen ions cross the chloroplast inner membrane.
   c. both an enzyme that makes ATP and a carrier protein, and helps hydrogen ions cross the thylakoid membrane.
   d. both an enzyme that makes ATP and a carrier protein, and helps hydrogen ions cross the chloroplast inner membrane.

f. Essentially, the oxygen we breathe is

   a. necessary for the light reactions to proceed.
   b. a waste product of photosynthesis.
   c. a reactant of the Calvin cycle.
   d. essential for the homeostasis of the plant cell.

g. The Calvin cycle

   a. starts with the molecule RuBP.
   b. uses the energy in ATP and NADPH from the light reactions.
   c. turns twice to produce one molecule of glucose.
   d. all of the above

h. How do bacteria that live deep below the ocean's surface make food?

   a. by photosynthesis
   b. by chemosynthesis
   c. by cellular respiration
   d. They eat other organisms.

Lesson 4.2: Vocabulary I

Name_____ **Class**_____ **Date**_____

Match the vocabulary word with the proper definition.

Definitions

_____ 1. a green pigment

_____ 2. main product of photosynthesis

_____ 3. process in which chemical energy, instead of sunlight, is used to make "food"

_____ 4. process in which sunlight is used to make "food"

_____ 5. sac-like membranes that make up the grana within the chloroplast

_____ 6. organelle of photosynthesis

_____ 7. space outside the thylakoid membranes within the chloroplast

_____ 8. energy carrying molecule

_____ 9. series of electron-transport molecules, which pass electrons from molecule to molecule

_____ 10. groups of molecules where sunlight is absorbed during the light reactions

_____ 11. stage of photosynthesis in which the energy from sunlight is stored in ATP and NADPH

_____ 12. stage of photosynthesis in which glucose is made

Terms

a. Calvin cycle

b. chemosynthesis

c. chlorophyll

d. chloroplast

e. electron transport chain

f. glucose

g. light reactions

h. NADPH

i. photosynthesis

j. photosystem

k. stroma

l. thylakoid membrane

Lesson 4.2: Vocabulary II

Name_____ **Class**_____ **Date**_____

Fill in the blank with the appropriate term.

1. _____ are the organelles where photosynthesis takes place.

2. Stage I of photosynthesis is called the _____.

3. Stage II of photosynthesis is called the _____.

4. During the first stage of photosynthesis, a molecule of _____ gas is released.

5. Making food with chemical energy instead of sunlight is called _____.

6. Chloroplasts contain _____, which are made out of sac-like membranes, known as _____-membranes.

7. Most _____ make food using photosynthesis.

8. The green pigment, _____, absorbs light to start photosynthesis.

9. During the first stage of photosynthesis, two _____ are passed from molecule to molecule down the electron-transport chain.

10. _____ turns of the Calvin cycle produce one molecule of _____.

11. During the light reactions, _____ and _____ are produced.

12. During the Calvin cycle, _____ is produced.

Lesson 4.2: Critical Writing

Name_____ Class_____ Date_____

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

What are the two stages of photosynthesis? Discuss these two stages and how they are related.

4.3 Powering the Cell: Cellular Respiration

Lesson 4.3: True or False

Name_____ **Class**_____ **Date**_____

Write true if the statement is true or false if the statement is false.

_____ 1. Like photosynthesis, cellular respiration begins with an electron transport chain.

_____ 2. Cellular respiration that proceeds in the presence of oxygen is called aerobic respiration.

_____ 3. Oxygen is the final electron acceptor during anaerobic respiration.

_____ 4. Cellular respiration occurs in the mitochondria.

_____ 5. Mitochondria posses their own DNA and ribosomes.

_____ 6. Just like the chloroplast, the stroma separates the inner and outer membranes of the mitochondria.

_____ 7. The Krebs cycle comes after glycolysis, during cellular respiration.

_____ 8. Cellular respiration begins with the absorption of sunlight by the mitochondria photosystems.

_____ 9. ATP synthase pumps, by active transport, hydrogen ions back into the mitochondria matrix.

_____ 10. The first reaction of the Krebs cycle produces citric acid.

_____ 11. One molecule of glucose holds enough energy to produce up to 38 ATP.

_____ 12. The Krebs cycle produces four ATP.

_____ 13. Whereas plants perform photosynthesis, plants and animals perform cellular respiration.

_____ 14. Aerobic respiration evolved prior to anaerobic respiration.

_____ 15. Two NADPH are made during glycolysis.

Lesson 4.3: Critical Reading

Name_____ **Class**_____ **Date**_____

Read these passages from the text and answer the questions that follow.

Cellular Respiration Stage III: Electron Transport

Electron transport is the final stage of aerobic respiration. In this stage, energy from NADH and $FADH_2$, which result from the Krebs cycle, is transferred to ATP. Can you predict how this happens? (*Hint:* How does electron transport occur in photosynthesis?)

Transporting Electrons

High-energy electrons are released from NADH and $FADH_2$, and they move along electron transport chains, like those used in photosynthesis. The electron transport chains are on the inner membrane of the mitochondrion. As the high-energy electrons are transported along the chains, some of their energy is captured. This energy is used to

pump hydrogen ions (from NADH and $FADH_2$) across the inner membrane, from the matrix into the intermembrane space.

Making ATP

The pumping of hydrogen ions across the inner membrane creates a greater concentration of the ions in the intermembrane space than in the matrix. This chemiosmotic gradient causes the ions to flow back across the membrane into the matrix, where their concentration is lower. ATP synthase acts as a channel protein, helping the hydrogen ions cross the membrane. It also acts as an enzyme, forming ATP from ADP and inorganic phosphate. After passing through the electron-transport chain, the "spent" electrons combine with oxygen to form water. This is why oxygen is needed; in the absence of oxygen, this process cannot occur.

How Much ATP?

You have seen how the three stages of aerobic respiration use the energy in glucose to make ATP. How much ATP is produced in all three stages? Glycolysis produces 2 ATP molecules, and the Krebs cycle produces 2 more. Electron transport begins with several molecules of NADH and $FADH_2$ from the Krebs cycle and transfers their energy into as many as 34 more ATP molecules. All told, then, up to 38 molecules of ATP can be produced from just one molecule of glucose in the process of aerobic respiration.

Questions

1. In photosynthesis, electron transport comes at the beginning of the process. Where does electron transport occur during cellular respiration?

2. What is the role of the electron transport chain in cellular respiration?

3. Why is the role of oxygen in cellular respiration?

4. Describe ATP synthase and its role.

5. Summarize how up to 38 molecules of ATP are produced for each glucose molecule.

Lesson 4.3: Multiple Choice

Name_____ Class_____ Date_____

Circle the letter of the correct choice.

a. Glycolysis
   a. uses 2 ATPs and makes 2 ATPs, 2 NADHs, and 2 pyruvates.
   b. uses 2 ATPs and makes 4 ATPs, 2 NADHs, and 2 pyruvates.
   c. uses 4 ATPs and makes 2 ATPs, 2 NADHs, and 2 pyruvates.
   d. uses 2 ATPs and makes 4 ATPs, 4 NADHs, and 2 pyruvates.

b. Cellular respiration in the presence of oxygen is called
   a. anaerobic respiration.
   b. glycolysis.
   c. aerobic respiration.
   d. oxygen respiration.

c. The correct order of stages of cellular respiration is
   a. glycolysis - the Calvin cycle - electron transport.
   b. the light reactions - glycolysis - the Krebs cycle.
   c. glycolysis - the Krebs cycle - electron transport.
   d. electron transport - glycolysis - the Krebs cycle.

d. Where are the electron transport chains of cellular respiration located?
   a. in the inner membrane of the mitochondrion
   b. in the matrix of the mitochondrion
   c. in the intermembrane space of the mitochondrion

d. in the outer membrane of the mitochondrion

e. The final electron acceptor at the end of cellular respiration is

a. hydrogen.
b. oxygen.
c. water.
d. ATP synthase.

f. The chemical formula of cellular respiration is

a. $6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$.
b. $C_6H_{12}O_6 + O_2 \rightarrow CO_2 + H_2O$.
c. $CO_2 + H_2O \rightarrow C_6H_{12}O_6 + O_2$.
d. $C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$.

g. The chemiosmotic gradient of cellular respiration is an

a. ion gradient made by the pumping of hydrogen ions across the inner membrane using the energy of electrons as they are transported down the electron transport chain.
b. ion gradient made by the pumping of hydrogen ions across the outer membrane using the energy of electrons as they are transported down the electron transport chain.
c. ion gradient made by the pumping of oxygen ions across the inner membrane using the energy of electrons as they are transported down the electron transport chain.
d. ion gradient made by the diffusion of hydrogen ions across the inner membrane using the energy of electrons as they are transported down the electron transport chain.

h. In the presence of oxygen, one glucose molecule has the energy to make up to

a. 4 $FADH_2$.
b. 12 NADH.
c. 38 ATP.
d. all of the above

Lesson 4.3: Vocabulary I

Name_____ **Class**_____ **Date**_____

Match the vocabulary word with the proper definition.

Definitions

_____ 1. channel protein and enzyme that makes ATP

_____ 2. also known as the Krebs cycle

_____ 3. energy-carrying compound produced during the Krebs cycle

_____ 4. end product of glycolysis

_____ 5. cellular respiration in the absence of oxygen

_____ 6. energy-carrying compound involved in stage I and stage II of cellular respiration

_____ 7. a greater concentration of hydrogen ions in the intermembrane space than in the mitochondrial matrix

_____ 8. stage II of cellular respiration

_____ 9. “folds” created by the mitochondria inner membrane

_____ 10. glucose splitting

_____ 11. involved in stage III of cellular respiration

_____ 12. cellular respiration in the presence of oxygen

Terms

a. aerobic respiration

b. anaerobic respiration

c. ATP synthase

d. chemiosmotic gradient

e. citric acid cycle

f. cristae

g. electron transport chain

h. $FADH_2$

i. glycolysis

j. Krebs cycle

k. NADH

l. pyruvate

Lesson 4.3: Vocabulary II

Name_____ **Class**_____ **Date**_____

Fill in the blank with the appropriate term.

1. The reactions of cellular respiration can be grouped into three stages: _____, the _____ cycle, and electron transport.

2. Cellular respiration in the absence of oxygen is called _____ respiration.

3. The last two stages of cellular respiration occur in the _____.

4. Most of the ATP is produced in stage _____ of cellular respiration.

5. _____ is the final electron acceptor at the end of the electron transport chain, when water is formed.

6. During glycolysis, enzymes split a molecule of glucose into two molecules of _____.

7. _____ releases the energy in glucose to make ATP.

8. During the Krebs cycle, energy is captured in molecules of _____, _____, and $FADH_2$.

9. _____ is the molecule that enters the Krebs cycle.

10. During glycolysis, _____ molecules of ATP are used, and _____ molecules of ATP are made.

11. _____ is the enzyme that produces ATP during the final stage of cellular respiration.

12. In all three stages of aerobic respiration, up to _____ molecules of ATP may be produced from a single molecule of glucose.

Lesson 4.3: Critical Writing

Name_____ Class_____ Date_____

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Discuss why photosynthesis and cellular respiration can be described as a cycle.

4.4 Anaerobic Respiration

Lesson 4.4: True or False

Name_____ **Class**_____ **Date**_____

Write true if the statement is true or false if the statement is false.

_____ 1. Fermentation is the process of making ATP in the presence of oxygen.

_____ 2. Aerobic respiration evolved after oxygen was added to Earth's atmosphere.

_____ 3. Anaerobic respiration lets organisms live in places where there is little or no oxygen.

_____ 4. Alcoholic fermentation explains why bread dough rises.

_____ 5. Fermentation recycles $NADP^+$.

_____ 6. Anaerobic respiration is a very slow process.

_____ 7. Some plants and fungi and many bacteria do not need oxygen.

_____ 8. Some organisms may not be able to survive in the presence of oxygen.

_____ 9. Alcoholic fermentation explains why your muscles are sore after intense exercise.

_____ 10. There are three types of fermentation: anaerobic, aerobic, and cellular.

_____ 11. Some organisms can use both aerobic and anaerobic respiration.

_____ 12. Most living things use glucose to make ATP from oxygen.

_____ 13. Bread rises because of alcoholic fermentation.

_____ 14. Fermentation allows glycolysis to continue in the absence of oxygen.

_____ 15. Anaerobic respiration produces much more ATP than aerobic respiration.

Lesson 4.4: Critical Reading

Name_____ **Class**_____ **Date**_____

Read these passages from the text and answer the questions that follow.

Fermentation

An important way of making ATP without oxygen is called **fermentation**. It involves glycolysis but not the other two stages of aerobic respiration. Many bacteria and yeasts carry out fermentation. People use these organisms to make yogurt, bread, wine, and biofuels. Human muscle cells also use fermentation. This occurs when muscle cells cannot get oxygen fast enough to meet their energy needs through aerobic respiration. There are two types of fermentation: lactic acid fermentation and alcoholic fermentation. Both types of are described below.

Lactic Acid Fermentation

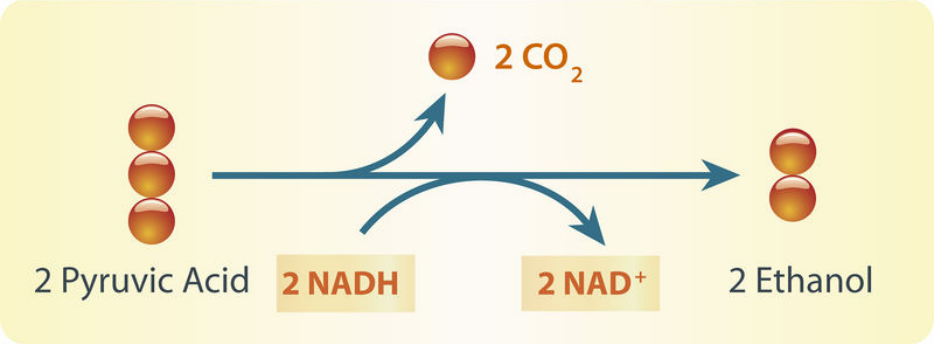
In **lactic acid fermentation**, pyruvic acid from glycolysis changes to lactic acid. In the process, NAD^+ forms

from NADH. NAD^+, in turn, lets glycolysis continue. This results in additional molecules of ATP. This type of fermentation is carried out by the bacteria in yogurt. It is also used by your own muscle cells when you work them hard and fast.

Did you ever run a race and notice that your muscles feel tired and sore afterward? This is because your muscle cells used lactic acid fermentation for energy. This causes lactic acid to build up in the muscles. It is the buildup of lactic acid that makes the muscles feel tired and sore.

Alcoholic Fermentation

In **alcoholic fermentation**, pyruvic acid changes to alcohol and carbon dioxide. NAD^+ also forms from NADH, allowing glycolysis to continue making ATP. This type of fermentation is carried out by yeasts and some bacteria. It is used to make bread, wine, and biofuels.



Alcoholic fermentation produces ethanol and NAD^+. The NAD^+ allows glycolysis to continue making ATP. *(Image courtesy of CK-12 Foundation and under the Creative Commons license CC-BY-NC-SA 3.0.)*

Have your parents ever put corn in the gas tank of their car? They did if they used gas containing ethanol. Ethanol is produced by alcoholic fermentation of the glucose in corn or other plants. This type of fermentation also explains why bread dough rises. Yeasts in bread dough use alcoholic fermentation and produce carbon dioxide gas. The gas forms bubbles in the dough, which cause the dough to expand. The bubbles also leave small holes in the bread after it bakes, making the bread light and fluffy.

Questions

1. What is fermentation?

2. Why is NAD^+ so important in fermentation?

3. Both lactic acid fermentation and alcoholic fermentation begin with the same molecule. What is that molecule and where did it come from?

4. Why is bread light and fluffy?

5. Why do your muscles get sore after intense activity?

Lesson 4.4: Multiple Choice

Name_____ Class_____ Date_____

Circle the letter of the correct choice.

a. Complete this sentence: Most living things use _____ to make _____ from glucose.
   a. oxygen, ATP
   b. ATP, oxygen
   c. NADH, NAD^+
   d. oxygen, NAD^+

b. Which of the following organisms can perform alcoholic fermentation? (1) yeast, (2) humans, (3) bacteria.
   a. 1 only
   b. 1 and 2
   c. 1 and 3
   d. 1, 2, and 3

c. Which of the following is true about anaerobic respiration?
   a. It is a very fast process.
   b. It allows organisms to live in places where there is little or no oxygen.
   c. It evolved before aerobic respiration.
   d. All of the above are true.

d. In alcoholic fermentation
   a. carbon dioxide is released.
   b. NADH is recycled.
   c. lactic acid is produced.
   d. all of the above

e. Fermentation involves which stages of cellular respiration? (1) glycolysis, (2) the Krebs cycle, (3) electron transport.
   a. 1 only
   b. 1 and 2
   c. 2 and 3
   d. all three stages

f. In lactic acid fermentation
   a. carbon dioxide is released.
   b. NADH is recycled.
   c. lactic acid is produced.
   d. all of the above

g. After intense activity, your muscles feel sore because of
   a. the accumulation of NAD^+.
   b. the accumulation of lactic acid.
   c. the accumulation of ATP.
   d. the accumulation of carbon dioxide.

h. Both alcoholic fermentation and lactic acid fermentation
   a. start with pyruvic acid.
   b. recycle NAD^+ from NADH.
   c. allow glycolysis to continue.
   d. all of the above

Lesson 4.4: Vocabulary I

Name_____ **Class**_____ **Date**_____

Match the vocabulary word with the proper definition.

Definitions

_____ 1. an important way of making ATP without oxygen

_____ 2. respiration in the absence of oxygen

_____ 3. makes your muscles feel tired and sore after intense exercise

_____ 4. recycles during fermentation

_____ 5. perform cellular respiration in the presence of oxygen

_____ 6. can use lactic acid fermentation for energy

_____ 7. can use alcoholic fermentation for energy

_____ 8. stage of cellular respiration that occurs with or without oxygen

_____ 9. product of glycolysis

_____ 10. energy in the cell

_____ 11. fermentation in which pyruvic acid from glycolysis changes to lactic acid

_____ 12. fermentation in which pyruvic acid changes to alcohol and carbon dioxide

Terms

a. aerobic organisms

b. alcoholic fermentation

c. anaerobic respiration

d. ATP

e. fermentation

f. glycolysis

g. lactic acid

h. lactic acid fermentation

i. muscle cells

j. NAD^+

k. pyruvic acid

l. yeast

Lesson 4.4: Vocabulary II

Name_____ **Class**_____ **Date**_____

Fill in the blank with the appropriate term.

1. A way of making _____ without oxygen is called fermentation.

2. During lactic acid fermentation, NAD^+ cycles back to allow _____ to continue.

3. Fermentation involves _____, but not the other two stages of cellular respiration.

4. Aerobic respiration evolved after _____ was added to Earth's atmosphere.

5. In _____ fermentation, pyruvic acid changes to alcohol and carbon dioxide.

6. Organisms that can make ATP without oxygen include some plants and _____ and also of many bacteria.

7. In _____ fermentation, pyruvic acid from glycolysis changes to lactic acid.

8. The small holes in bread are formed by bubbles of _____ gas, which is produced by alcoholic fermentation in yeast.

9. Without oxygen, organisms can just split glucose into _____ molecules of pyruvate.

10. _____ in bread dough use alcoholic fermentation and produce carbon dioxide gas.

11. Aerobic respiration produces much more _____ than anaerobic respiration.

12. Most organisms use oxygen to make _____ from glucose.

Lesson 4.4: Critical Writing

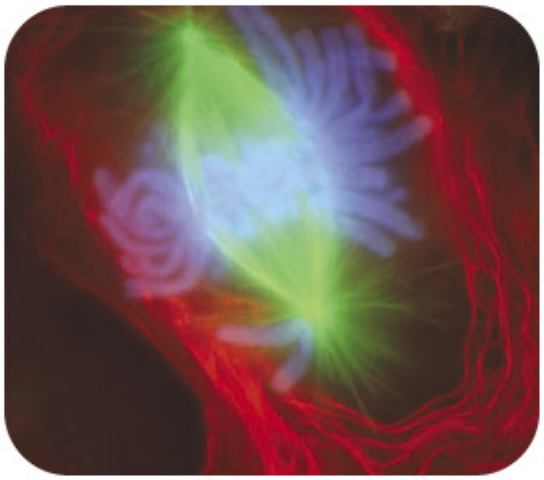
Name_____ **Class**_____ **Date**_____

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Compare aerobic and anaerobic respiration, and discuss the advantages of each.

CHAPTER 5 The Cell Cycle, Mitosis, and Meiosis Worksheets

Chapter Outline



(Opening image courtesy of Conly Rieder and the National Institutes of Health, http://commons.wikimedia.org/wiki/File:Mitosis-fluorescent.jpg, and under the public domain.)

- **Lesson 5.1: Cell Division and the Cell Cycle**
- **Lesson 5.2: Chromosomes and Mitosis**
- **Lesson 5.3: Reproduction and Meiosis**

5.1 Cell Division and the Cell Cycle

Lesson 5.1: True or False

Name_____ **Class**_____ **Date**_____

Write true if the statement is true or false if the statement is false.

_____ 1. Cell division is basically the same in prokaryotic and eukaryotic cells.

_____ 2. Cytokinesis is the division of the cytoplasm.

_____ 3. Mitosis is the process in which the nucleus of the cell divides.

_____ 4. DNA replication results in identical chromosomes.

_____ 5. A cell spends most of its life in growth phase 1 of the cell cycle.

_____ 6. The S checkpoint, just before entry into S phase, makes the key decision of whether the cell should divide.

_____ 7. The correct order of phases of the cell cycle is G1 $\rightarrow$ S $\rightarrow$ G2 $\rightarrow$ M.

_____ 8. Interphase consists of mitosis and cytokinesis.

_____ 9. In prokaryotic cells, all organelles, such as the Golgi apparatus and endoplasmic reticulum, divide prior to cell division.

_____ 10. Bacteria divide cells by binary fusion.

_____ 11. A mass of abnormal cells is called a tumor.

_____ 12. Organelles are made during growth phase 2.

_____ 13. In eukaryotic cells, DNA is replicated during the S phase of the cell cycle.

_____ 14. If the cell cycle is not regulated, cancer may develop.

_____ 15. Mitosis occurs in both prokaryotic and eukaryotic cells.

Lesson 5.1: Critical Reading

Name_____ **Class**_____ **Date**_____

Read these passages from the text and answer the questions that follow.

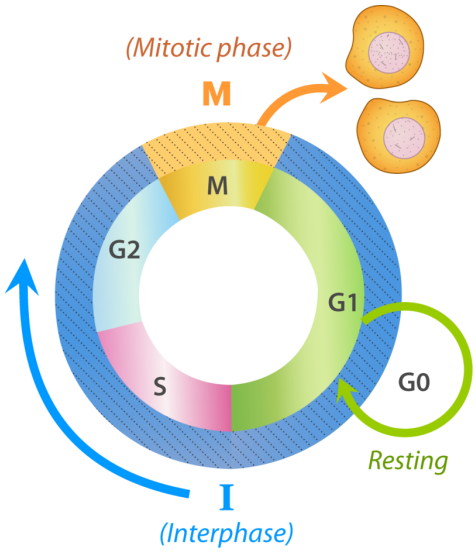
The Cell Cycle

Cell division is just one of several stages that a cell goes through during its lifetime. The **cell cycle** is a repeating series of events, including growth, DNA synthesis, and cell division. The cell cycle in prokaryotes is quite simple: the cell grows, its DNA replicates, and the cell divides. In eukaryotes, the cell cycle is more complicated.

Eukaryotic Cell Cycle

The diagram in the figure below represents the cell cycle of a eukaryotic cell. As you can see, the eukaryotic cell cycle has several phases. The mitosis phase (M) actually includes both mitosis and cytokinesis. This is when the

nucleus and then the cytoplasm divide. The other three phases (G1, S, and G2) are generally grouped together as **interphase**. During interphase, the cell grows, performs routine life processes, and prepares to divide. These phases are discussed below.



Eukaryotic Cell Cycle. This diagram represents the cell cycle in eukaryotes. The G1, S, and G2 phases make up interphase (I). The M phase includes mitosis and cytokinesis. After the M phase, two cells result. *(Image courtesy of CK-12 Foundation and under the Creative Commons license CC-BY-NC-SA 3.0.)*

Interphase

Interphase of the eukaryotic cell cycle can be subdivided into the following three phases, which are represented in the figure above:

- **Growth Phase 1 (G1):** During this phase, the cell grows rapidly, while performing routine metabolic processes. It also makes proteins needed for DNA replication and copies some of its organelles in preparation for cell division. A cell typically spends most of its life in this phase.
- **Synthesis Phase (S):** During this phase, the cell's DNA is copied in the process of DNA replication.
- **Growth Phase 2 (G2):** During this phase, the cell makes final preparations to divide. For example, it makes additional proteins and organelles.

Cancer and the Cell Cycle

Cancer is a disease that occurs when the cell cycle is no longer regulated. This may happen because a cell's DNA becomes damaged. Damage can occur because of exposure to hazards such as radiation or toxic chemicals. Cancerous cells generally divide much faster than normal cells. They may form a mass of abnormal cells called a **tumor**. The rapidly dividing cells take up nutrients and space that normal cells need. This can damage tissues and organs and eventually lead to death.

Questions

1. What is the cell cycle?

2. What are the phases of the eukaryotic cell cycle?

3. In which phase does a cell spend most of its life? What happens during this phase?

4. What is cancer? What may cause cancer to occur?

5. What is the S phase? What happens during this phase?

Lesson 5.1: Multiple Choice

Name_____ Class_____ Date_____

Circle the letter of the correct choice.

a. Which cells undergo cell division?

   a. prokaryotic cells only
   b. eukaryotic cells only
   c. cancer cells only
   d. both prokaryotic and eukaryotic cells

b. Cell division in eukaryotic cells is a complex process because of

   a. the multiple chromosomes.
   b. the nucleus.
   c. the many organelles.
   d. all of the above

c. Most routine metabolic processes occur during which phase of the cell cycle?

   a. growth phase 1
   b. the S phase
   c. growth phase 2
   d. the M phase

d. The correct order of the eukaryotic cell cycle is

   a. G1 → G2 → S → M.
   b. S → G1 → G2 → M.
   c. M → G1 → S → G2.
   d. G1 → S → G2 → M.

e. The correct order of prokaryotic cell division is

   a. cytokinesis → DNA replication → chromosome segregation.
   b. DNA replication → chromosome segregation → cytokinesis.
   c. growth → DNA replication → mitosis.
   d. DNA replication→ mitosis → cytokinesis.

f. Which cell cycle checkpoint determines whether the DNA has been replicated correctly?

   a. the cell growth checkpoint
   b. the DNA synthesis checkpoint
   c. the mitosis checkpoint
   d. the G2 checkpoint

g. What happens during mitosis?

   a. The nucleus of the cell divides.
   b. The cytoplasm of the cell divides.
   c. The cell divides.
   d. The DNA replicates.

h. Cell division in prokaryotic cells is called

   a. binary fission.
   b. binary fusion.
   c. mitosis.
   d. cytokinesis.

Lesson 5.1: Vocabulary I

Name_____ Class_____ Date_____

Match the vocabulary word with the proper definition.

Definitions

_____ 1. the process in which one cell divides to form two daughter cells

_____ 2. the process in which all of the nuclear DNA is copied

_____ 3. a repeating series of events that describes the life of a cell

_____ 4. phase of the cell cycle that includes the G1, S, and G2 phases

_____ 5. the process by which bacterial cells divide

_____ 6. phase of the cell cycle in which the cell's DNA is copied

_____ 7. occurs when the cell cycle is no longer regulated

_____ 8. phase of the cell cycle in which the cell grows rapidly and performs many metabolic processes

_____ 9. phase of the cell cycle in which the cell makes final preparations to divide.

_____ 10. division of the cytoplasm, resulting in two daughter cells

_____ 11. an abnormal mass of cells

_____ 12. the process in which the nucleus of the cell divides

Terms

a. binary fission

b. cancer

c. cell cycle

d. cell division

e. cytokinesis

f. DNA replication

g. growth Phase 1

h. growth phase 2

i. interphase

j. mitosis

k. synthesis phase

l. tumor

Lesson 5.1: Vocabulary II

Name_____ Class_____ Date_____

Fill in the blank with the appropriate term.

1. Cancer is a disease that occurs when the _____ is no longer regulated.

2. During _____, the nucleus of the cell divides.

3. _____ consists of the G1, S, and G2 phases of the cell cycle.

4. During the _____ phase, the cell's DNA is copied in the process of DNA replication.

5. Cell division in _____ occurs by binary fission.

6. During mitosis, the _____ are sorted and separated to ensure that each daughter cell receives a complete set.

7. During cytokinesis, the _____ divides.

8. _____ in the cell cycle ensure that the cell is ready to proceed before it moves on to the next phase of the cycle.

9. After cell division, the new cells are referred to as _____ cells.

10. Chromosome _____ refers to the two chromosomes separating and moving to opposite ends of the cell.

11. In eukaryotes, the first step in cell division is _____, and the second step is cytokinesis.

12. The cell cycle is controlled by regulatory _____ at three key checkpoints.

Lesson 5.1: Critical Writing

Name_____ Class_____ Date_____

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Describe the eukaryotic cell cycle, listing and discussing the main events of each phase.

5.2 Chromosomes and Mitosis

Lesson 5.2: True or False

Name_____ Class_____ Date_____

Write true if the statement is true or false if the statement is false.

_____ 1. A chromatid is made of two identical chromosomes.

_____ 2. There may be thousands of genes on a single chromosome.

_____ 3. Prophase is the first phase of mitosis.

_____ 4. Female human cells have 23 pairs of homologous chromosomes.

_____ 5. Mitosis occurs in the following order: prophase - metaphase - telophase - anaphase.

_____ 6. The process in which the cell divides is called mitosis.

_____ 7. During mitosis, DNA exists as chromatin.

_____ 8. A gene contains the instructions to make a protein.

_____ 9. Chromosomes form during metaphase.

_____ 10. Mitosis is the phase of the eukaryotic cell cycle that occurs between DNA replication and the second growth phase.

_____ 11. Sister chromatids are identical.

_____ 12. Chromatids separate during anaphase.

_____ 13. Chromosomes are coiled structures made of DNA and proteins.

_____ 14. Human cells have 64 chromosomes.

_____ 15. Cytokinesis is the final stage of cell division.

Lesson 5.2: Critical Reading

Name_____ Class_____ Date_____

Read these passages from the text and answer the questions that follow.

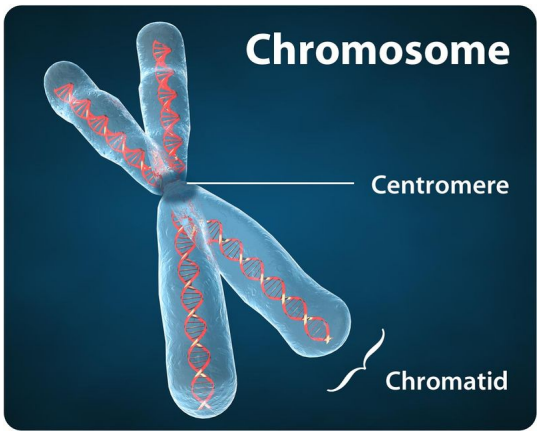
Chromosomes

Chromosomes are coiled structures made of DNA and proteins. Chromosomes are the form of the genetic material of a cell during cell division. During other phases of the cell cycle, DNA is not coiled into chromosomes. Instead, it exists as a grainy material called **chromatin**.

Chromatids and the Centromere

DNA condenses and coils into the familiar X-shaped form of a chromosome only after it has replicated, as seen in the figure below. Because DNA has already replicated, each chromosome actually consists of two identical copies.

The two copies are called sister **chromatids**. They are attached to one another at a region called the **centromere**.



Chromosome. After DNA replicates, it forms chromosomes like the one shown here. *(Image copyright Cre8tive Images, 2010. Used under license from Shutterstock.com. Text added by CK-12 Foundation.)*

Chromosomes and Genes

The DNA of a chromosome is encoded with genetic instructions for making proteins. These instructions are organized into units called **genes**. Most genes contain the instructions for a single protein. There may be hundreds or even thousands of genes on a single chromosome.

Human Chromosomes

Human cells normally have two sets of chromosomes, one set inherited from each parent. There are 23 chromosomes in each set, for a total of 46 chromosomes per cell. Each chromosome in one set is matched by a chromosome of the same type in the other set, so there are actually 23 pairs of chromosomes per cell. Each pair consists of chromosomes of the same size and shape that also contain the same genes. The chromosomes in a pair are known as **homologous chromosomes**.

Questions

1. What is a chromosome? What is it made out of?

2. What are homologous chromosomes? How many homologous pairs are in a human cell?

3. What is the main difference between chromatin and chromosomes?

4. Why do chromosomes look like an "X"?

5. What is a gene?

Lesson 5.2: Multiple Choice

Name_____ Class_____ Date_____

Circle the letter of the correct choice.

a. Why is it necessary for the DNA to replicate prior to cell division?
   a. so that each daughter cell will have 23 chromosomes
   b. so that each daughter cell will have a complete copy of the genetic material
   c. so that each daughter cell will have 46 homologous chromosomes
   d. so that each daughter cell will have 2 sister chromatids

b. Why do chromosomes have an X-shape?
   a. because they are made of two sister chromatins
   b. because they are made of two sister centromeres
   c. because they are made of two sister chromosomes

   d. because they are made of two sister chromatids

c. Chromosomes form during what part of the cell cycle?

   a. prophase of mitosis
   b. the end of the G2 phase
   c. right after S phase and DNA replication
   d. during cytokinesis

d. The correct order of phases during mitosis is

   a. telophase→prophase→metaphase→anaphase
   b. prophase→anaphase→metaphase→telophase
   c. prophase→metaphase→telophase→anaphase
   d. prophase→metaphase→anaphase→telophase

e. How many chromosomes are in a normal human cell?

   a. 23
   b. 32
   c. 46
   d. 64

f. When do the sister chromatids line up at the equator of the cell?

   a. metaphase
   b. anaphase
   c. prophase
   d. telophase

g. Which of the following statements concerning cytokinesis is correct? (1) cytokinesis occurs in both prokaryotes and eukaryotes, (2) cytokinesis is when the cytoplasm splits in two, (3) in plant cells, cytokinesis involves the formation of a cell plate.

   a. 1 only
   b. 2 only
   c. 1 and 2
   d. 1, 2, and 3

h. During which phase of mitosis do the sister chromatids separate?

   a. prophase
   b. telophase
   c. anaphase
   d. metaphase

Lesson 5.2: Vocabulary I

Name_____ **Class**_____ **Date**_____

Match the vocabulary word with the proper definition.

Definitions

_____ 1. division of the nucleus

_____ 2. region of the chromosome where sister chromatids are attached

_____ 3. division of the cytoplasm

_____ 4. phase of mitosis in which spindle fibers attach to the centromere of each pair of sister chromatids

_____ 5. coiled structures made of DNA and proteins

_____ 6. phase of mitosis in which sister chromatids separate and the centromeres divide

_____ 7. a segment of DNA with the genetic instructions to make a protein

_____ 8. two copies of replicated DNA that make a chromosome

_____ 9. the first and longest phase of mitosis

_____ 10. uncoiled DNA

_____ 11. a pair of the same chromosome

_____ 12. phase of mitosis in which the chromosomes begin to uncoil and form chromatin

Terms

a. anaphase

b. centromere

c. chromatid

d. chromatin

e. chromosome

f. cytokinesis

g. gene

h. homologous chromosomes

i. metaphase

j. mitosis

k. prophase

l. telophase

Lesson 5.2: Vocabulary II

Name_____ **Class**_____ **Date**_____

Fill in the blank with the appropriate term.

1. Chromosomes are coiled structures made of _____ and proteins.

2. _____ is the division of the nucleus.

3. During _____, sister chromatids line up at the equator, or center, of the cell.

4. _____ is the division of the cytoplasm.

5. There may be hundreds or even thousands of genes on a single _____.

6. A _____ contains genetic the instructions for making proteins.

7. During anaphase, sister _____ separate and the centromeres divide.

8. The four phases of mitosis, in order, are _____, _____, _____, _____.

9. Human cells normally have _____ chromosomes.

10. A new nuclear membrane forms during _____.

11. The _____ fibers ensure that sister chromatids will separate when the cell divides.

12. When a chromosome first forms, it actually consists of two sister _____.

Lesson 5.2: Critical Writing

Name_____ Class_____ Date_____

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Describe the structure of a chromosome, using proper vocabulary. Discuss when and why a chromosome forms.

5.3 Reproduction and Meiosis

Lesson 5.3: True or False

Name_____ Class_____ Date_____

Write true if the statement is true or false if the statement is false.

_____ 1. The basic types of reproduction are asexual reproduction, binary reproduction and sexual reproduction.

_____ 2. Sexual reproduction always involves two parents.

_____ 3. Asexual reproduction always involves two parents.

_____ 4. Meiosis starts with one cell and ends with four.

_____ 5. "Crossing-over" can occur in meiosis I but not meiosis II.

_____ 6. Prokaryotes go through meiosis I and eukaryotes go through meiosis II.

_____ 7. A zygote is the first cell of a new organism.

_____ 8. Meiosis I and mitosis are very similar.

_____ 9. In humans, a gamete will have 23 chromosomes.

_____ 10. In binary fission, parent and offspring are identical.

_____ 11. In sexual reproduction, parents and offspring are never identical.

_____ 12. Gametes are diploid, a zygote is haploid.

_____ 13. Egg and sperm are diploid gametes.

_____ 14. Meiosis is involved in the production of gametes.

_____ 15. Starfish can reproduce by fragmentation - that is, a whole new fish can grow from just a single arm.

Lesson 5.3: Critical Reading

Name_____ Class_____ Date_____

Read these passages from the text and answer the questions that follow.

Meiosis

The process that produces haploid gametes is meiosis. **Meiosis** is a type of cell division in which the number of chromosomes is reduced by half. It occurs only in certain special cells of the organisms. During meiosis, homologous chromosomes separate, and the haploid cells that form have only one chromosome from each pair. Two cell divisions occur during meiosis, and a total of four haploid cells are produced. The two cell divisions are called meiosis I and meiosis II.

Phases of Meiosis

Meiosis I begins after DNA replicates during interphase. In both meiosis I and meiosis II, cells go through the same

four phases as mitosis. However, there are important differences between meiosis I and mitosis.

Meiosis I

a. Prophase I: The nuclear envelope begins to break down, and the chromosomes condense. Centrioles start moving to opposite poles of the cell, and a spindle begins to form. Importantly, homologous chromosomes pair up, which is unique to prophase I. In prophase of mitosis and meiosis II, homologous chromosomes do not form pairs in this way.
b. Metaphase I: Spindle fibers attach to the paired homologous chromosomes. The paired chromosomes line up along the equator of the cell. This occurs only in metaphase I. In metaphase of mitosis and meiosis II, it is sister chromatids that line up along the equator of the cell.
c. Anaphase I: Spindle fibers shorten, and the chromosomes of each homologous pair start to separate from each other. One chromosome of each pair moves toward one pole of the cell, and the other chromosome moves toward the opposite pole.
d. Telophase I and Cytokinesis: The spindle breaks down, and new nuclear membranes form. The cytoplasm of the cell divides, and two haploid daughter cells result. The daughter cells each have a random assortment of chromosomes, with one from each homologous pair. Both daughter cells go on to meiosis II.

Meiosis II

a. Prophase II: The nuclear envelope breaks down and the spindle begins to form in each haploid daughter cell from meiosis I. The centrioles also start to separate.
b. Metaphase II: Spindle fibers line up the sister chromatids of each chromosome along the equator of the cell.
c. Anaphase II: Sister chromatids separate and move to opposite poles.
d. Telophase II and Cytokinesis: The spindle breaks down, and new nuclear membranes form. The cytoplasm of each cell divides, and four haploid cells result. Each cell has a unique combination of chromosomes.

Questions

1. Define meiosis.

2. Is the DNA replicated after meiosis I? Why or why not?

3. Describe the main difference between metaphase I and metaphase II.

4. State the phase where each of the following processes occurs: (a) sister chromatids separate, (b) homologous chromosomes form pairs, (c) two haploid cells form.

5. What is final product of meiosis?

Lesson 5.3: Multiple Choice

Name_____ Class_____ Date_____

Circle the letter of the correct choice.

a. After meiosis there are
   a. two haploid cells.
   b. two haploid gametes.
   c. four haploid cells.
   d. four haploid gametes.

b. Which of the following is a form of asexual reproduction?
   a. fragmentation
   b. meiosis
   c. binary fusion

   d. bubbling

c. Which of the following is true about a zygote? (1) A zygote is the first cell of a new organism. (2) A human zygote has 23 pairs of chromosomes. (3) A zygote is produced through fertilization.
   a. 1 only
   b. 1 and 3
   c. 2 and 3
   d. 1, 2, and 3

d. Differences between meiosis I and meiosis II include:
   a. how the chromosomes line up at the equator of the cell during meiosis I or meiosis II.
   b. the pairing of chromosomes in meiosis I but not meiosis II.
   c. the amount of DNA in a cell at the end of meiosis I or meiosis II.
   d. all of the above

e. Because of when the chromosomes pair up during meiosis, crossing-over must occur during
   a. prophase II.
   b. metaphase II.
   c. prophase I.
   d. anaphase I.

f. Homologous chromosomes separate during
   a. metaphase I.
   b. anaphase I.
   c. anaphase II.
   d. telophase II.

g. A life cycle in which organisms switch back and forth between diploid and haploid stages
   a. is a haploid life cycle.
   b. is a diploid life cycle.
   c. is an alternation of generations life cycle.
   d. does not exist.

h. The random distribution of homologous chromosomes during cell division is known as
   a. meiosis.
   b. independent assortment.
   c. genetic variation.
   d. crossing-over.

Lesson 5.3: Vocabulary I

Name_____ **Class**_____ **Date**_____

Match the vocabulary word with the proper definition.

Definitions

_____ 1. the process in which two gametes unite

_____ 2. the swapping of genetic material during meiosis

_____ 3. a type of cell division in which the number of chromosomes is reduced by half

_____ 4. series of life stages and events of a sexually reproducing organism

_____ 5. involves a single parent

_____ 6. involves two parents

_____ 7. having half the number of chromosomes

_____ 8. having twice the number of chromosomes

_____ 9. a diploid cell

_____ 10. a haploid cell

_____ 11. the development of haploid cells into gametes

_____ 12. reproductive cells that unite to form an offspring

Terms

a. asexual reproduction

b. crossing-over

c. diploid

d. egg

e. fertilization

f. gametes

g. gametogenesis

h. haploid

i. life cycle

j. meiosis

k. sexual reproduction

l. zygote

Lesson 5.3: Vocabulary II

Name_____ **Class**_____ **Date**_____

Fill in the blank with the appropriate term.

1. When cells divide during meiosis, homologous chromosomes are randomly distributed to daughter cells, and different chromosomes segregate _____ of each other.

2. Crossing-over is the exchange of _____ material between homologous chromosomes.

3. A human egg cell has _____ chromosomes.

4. Binary fission, fragmentation, and _____ are types of asexual reproduction.

5. Meiosis is a type of cell division in which the number of chromosomes is reduced by _____.

6. A human zygote has _____ chromosomes.

7. The _____ life cycle is the simplest life cycle.

8. Meiosis begins with one cell, and ends with _____ cells.

9. Male gametes are called _____, and female gametes are a(n) _____ cell.

10. During _____, spindle fibers attach to the paired homologous chromosomes.

11. Organisms that have a life cycle with _____ generations switch back and forth between diploid and haploid stages.

12. Sexual reproduction involves _____ parents.

Lesson 5.3: Critical Writing

Name_____ Class_____ Date_____

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

List three significant differences between meiosis I and meiosis II.

CHAPTER 6

Gregor Mendel and Genetics Worksheets

Chapter Outline

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- **Lesson 6.1: Mendel's Investigations**
- **Lesson 6.2: Mendelian Inheritance**

6.1 Mendel's Investigations

Lesson 6.1: True or False

Name_____ **Class**_____ **Date**_____

Write true if the statement is true or false if the statement is false.

_____ 1. A homozygous individual could have a *Bb* genotype.

_____ 2. In Mendel's experiments, purple flowers are dominant over white flowers.

_____ 3. Heredity is the science of genetics.

_____ 4. In Mendel's initial experiments, white flowers disappeared after the first parental crosses.

_____ 5. It was his knowledge of genes that allowed Mendel to interpret his data correctly.

_____ 6. Having naturally light or dark skin is part of your phenotype.

_____ 7. Different alleles account for much of the variation in the characteristics of organisms.

_____ 8. Mendel showed that factors controlling different characteristics are inherited independently.

_____ 9. Mendel came up with the idea that two factors control a characteristic, such as pod color.

_____ 10. Mendel developed three laws of inheritance.

_____ 11. The expression of an organism's phenotype produces its genotype.

_____ 12. After he published his work, Mendel achieved great fame among scientists.

_____ 13. Through his experiments, Mendel was able to prove some aspects of the blending theory of inheritance.

_____ 14. A *Dd* genotype has two different alleles.

_____ 15. Flowers are the reproductive organs of plants.

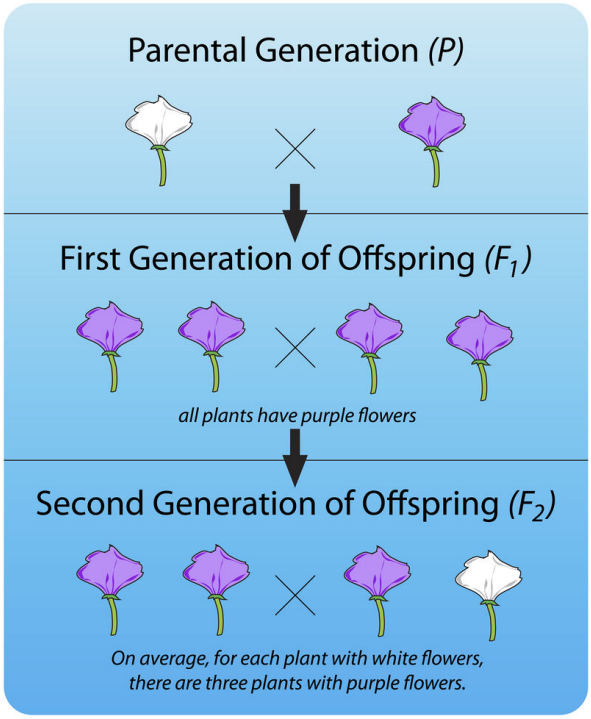
Lesson 6.1: Critical Reading

Name_____ **Class**_____ **Date**_____

Read these passages from the text and answer the questions that follow.

Mendel's First Set of Experiments

At first, Mendel experimented with just one characteristic at a time. He began with flower color. As shown in the figure below, Mendel cross-pollinated purple- and white-flowered parent plants. The parent plants in the experiments are referred to as the P (for parent) generation.



This diagram shows Mendel's first experiment with pea plants. The F1 generation results from cross-pollination of two parent (P) plants. The F2 generation results from self-pollination of F1 plants. *(Image courtesy of CK-12 Foundation and under the Creative Commons license CC-BY-NC-SA 3.0.)*

F1 and F2 Generations

The offspring of the P generation are called the F1 (for filial, or "offspring") generation. As you can see from the figure above, all of the plants in the F1 generation had purple flowers. None of them had white flowers. Mendel wondered what had happened to the white-flower characteristic. He assumed some type of inherited factor produces white flowers and some other inherited factor produces purple flowers. Did the white-flower factor just disappear in the F1 generation? If so, then the offspring of the F1 generation — called the F2 generation — should all have purple flowers like their parents. To test this prediction, Mendel allowed the F1 generation plants to self-pollinate. He was surprised by the results. Some of the F2 generation plants had white flowers. He studied hundreds of F2 generation plants, and for every three purple-flowered plants, there was an average of one white-flowered plant.

Law of Segregation

Mendel did the same experiment for all seven characteristics. In each case, one value of the characteristic disappeared in the F1 plants and then showed up again in the F2 plants. And in each case, 75 percent of F2 plants had one value of the characteristic and 25 percent had the other value. Based on these observations, Mendel formulated his first law of inheritance. This law is called the **law of segregation**. It states that there are two factors controlling a given characteristic, one of which dominates the other, and these factors separate and go to different gametes when a parent reproduces.

Questions

1. What did Mendel do in his first experiment?

2. What was the outcome of the F1 generation in Mendel's first experiment?

3. What was the outcome of the F2 generation in Mendel's first experiment?

4. Did Mendel repeat his initial experiment with other characteristics? What were his results?

5. Explain the law of segregation. Discuss the reasoning Mendel used to develop this law.

Lesson 6.1: Multiple Choice

Name_____ Class_____ Date_____

Circle the letter of the correct choice.

a. Why did Mendel choose to work with the garden pea plant?

   a. Because the pea plant is easy to work with.
   b. Because pea plants are fast growing.
   c. Because the pea plant has a number of characteristics, each with only two forms.
   d. all of the above

b. In Mendel's first experiment

   a. the F1 displayed all purple-flowered plants.
   b. the F1 displayed all white-flowered plants.
   c. the F2 displayed all purple-flowered plants.
   d. the F2 displayed half purple-flowered and half white-flowered plants.

c. The law of independent assortment states that

   a. two factors of the same characteristic separate into different gametes.
   b. there are dominant and recessive factors.
   c. factors controlling different characteristics are inherited independently of each other.
   d. there are two factors that control inheritance.

d. Looking at your dog will give information concerning

   a. the dog's genotype.
   b. the dog's phenotype.
   c. the dog's recessive alleles.
   d. the dog's heterozygous alleles.

e. Which sentence is correct?

   a. Different alleles of the same gene are located at the same locus on different homologous chromosomes.
   b. Different alleles of the same gene are located at different loci on different homologous chromosomes.
   c. Different genes of the same alleles are located at the same locus on different homologous chromosomes.
   d. Different alleles of the same gene are located at different loci on the same chromosome.

f. An *Aa* individual

   a. has a homozygous genotype.
   b. has a heterozygous phenotype.
   c. has a heterozygous genotype.
   d. has a homozygous phenotype.

g. In Mendel's initial experiments, an example of the F2 generation would be

   a. 75 round seed plants to 25 wrinkled seed plants
   b. 75 green seed plants to 25 yellow seed plants
   c. 75 white-flowered plants to 25 purple-flowered plants
   d. all of the above

h. Which of the following is part of the law of segregation? (1) there are two factors controlling a given characteristic, (2) one factor is dominant over the other factor, (3) the two factors separate into different gametes.

   a. 1 and 2
   b. 1 and 3

c. 2 and 3
d. 1, 2, and 3

Lesson 6.1: Vocabulary I

Name_____ Class_____ Date_____

Match the vocabulary word with the proper definition.

Definitions

_____ 1. the science of heredity

_____ 2. an organism with two alleles of the same type

_____ 3. an organism with two different alleles

_____ 4. different version of a gene

_____ 5. states that there are two factors controlling a given characteristic, one of which dominates the other, and these factors separate and go to different gametes

_____ 6. states that factors controlling different characteristics are inherited independently of each other

_____ 7. expressed allele in a heterozygote

_____ 8. allele that is not expressed in a heterozygote

_____ 9. the offspring of cross-pollination

_____ 10. fertilization process in the sexual reproduction of plants

_____ 11. the alleles an individual inherits

_____ 12. the expression of an organism's genotype

Terms

a. allele

b. dominant allele

c. genetics

d. genotype

e. heterozygote

f. homozygote

g. hybrid

h. law of independent assortment

i. law of segregation

j. phenotype

k. pollination

l. recessive allele

Lesson 6.1: Vocabulary II

Name_____ **Class**_____ **Date**_____

Fill in the blank with the appropriate term.

1. Mendel's discoveries formed the basis of _____, the science of heredity.

2. A(n) _____ is an alternative form of a gene.

3. _____ plants are a good choice to use by Mendel because they are fast growing and easy to raise.

4. Characteristics of organisms are controlled by _____ on chromosomes.

5. The law of _____ states that factors controlling different characteristics are inherited independently of each other.

6. In Mendel's first experiment, the F1 generation flowers were all _____ in color.

7. In all of Mendel's first experiments, in the F2 generation, for every _____ purple-flowered plants, there was an average of _____ white-flowered plant.

8. *BB* would be a _____ genotype.

9. The _____ refers to the organism's characteristics, such as purple or white flowers.

10. *Cc* would be a _____ genotype.

11. The position of a gene on a chromosome is called its _____.

12. The law of _____ states that there are two factors controlling a given characteristic and these factors separate and go to different gametes.

Lesson 6.1: Critical Writing

Name_____ **Class**_____ **Date**_____

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Describe dominant and recessive alleles, providing examples from Mendel's work.

6.2 Mendelian Inheritance

Lesson 6.2: True or False

Name_____ **Class**_____ **Date**_____

Write true if the statement is true or false if the statement is false.

_____ 1. The rules of probability apply to genetics.

_____ 2. If an individual has a *Gg* genotype, half of his gametes should have the *G* allele, and the other half should have the *g* allele.

_____ 3. A Punnett square is a chart that allows you to easily determine the expected genotypes in the offspring of two parents.

_____ 4. In a cross between two homozygous dominant individuals, 25% of the offspring may have the recessive phenotype.

_____ 5. A parent cell makes gametes through the process of mitosis.

_____ 6. It is entirely likely for a gene to have more than two alleles.

_____ 7. Incomplete dominance occurs when the recessive allele is not completely dominant.

_____ 8. Your height and skin color are not just due to your genes.

_____ 9. In a cross between an individual homozygous dominant for two characteristics and an individual homozygous recessive for the same characteristics, all of the F1 offspring will have the dominant phenotypes.

_____ 10. All genetics is fairly straightforward and follows the patterns Mendel observed in pea plants.

_____ 11. Codominance occurs when, essentially, there is no recessive allele.

_____ 12. If one parent is *MM* and the other parent is *mm*, the only possible phenotype of their offspring is *Mm*.

_____ 13. The probability of inheriting either an A, B, or O allele for blood type from your parent is 33.33%.

_____ 14. In any cross between two heterozygous parents, half the offspring should have the dominant phenotype and half the offspring should have the recessive phenotype.

_____ 15. When you toss a coin in the air, it should turn up tails 50% of the time.

Lesson 6.2: Critical Reading

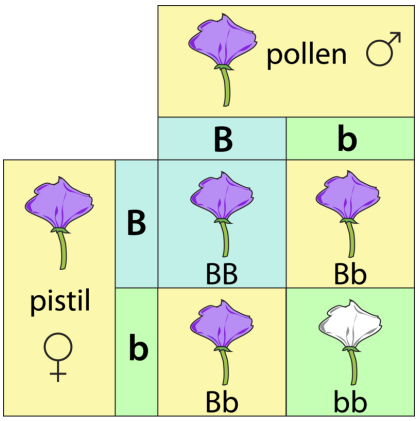
Name_____ **Class**_____ **Date**_____

Read these passages from the text and answer the questions that follow.

Using a Punnett Square

A **Punnett square** is a chart that allows you to easily determine the expected percents of different genotypes in the offspring of two parents. An example of a Punnett square for pea plants is shown below. In this example, both parents are heterozygous for flower color (*Bb*). The gametes produced by the male parent are at the top of the chart,

and the gametes produced by the female parent are along the side. The different possible combinations of alleles in their offspring are determined by filling in the cells of the Punnett square with the correct letters (alleles).



Punnett Square. This Punnett square shows a cross between two heterozygotes. Do you know where each letter (allele) in all four cells comes from? *(Image courtesy of CK-12 Foundation and under the Creative Commons license CC-BY-NC-SA 3.0.)*

Predicting Offspring Genotypes

In the cross shown in the figure above, you can see that one out of four offspring (25 percent) has the genotype *BB*, one out of four (25 percent) has the genotype *bb*, and two out of four (50 percent) have the genotype *Bb*. These percents of genotypes are what you would expect in any cross between two heterozygous parents. Of course, when just four offspring are produced, the actual percents of genotypes may vary by chance from the expected percents. However, if you considered hundreds of such crosses and thousands of offspring, you would get very close to the expected results — just like tossing a coin.

Predicting Offspring Phenotypes

You can predict the percents of phenotypes in the offspring of this cross from their genotypes. *B* is dominant to *b*, so offspring with either the *BB* or *Bb* genotype will have the purple-flower phenotype. Only offspring with the *bb* genotype will have the white-flower phenotype. Therefore, in this cross, you would expect three out of four (75 percent) of the offspring to have purple flowers and one out of four (25 percent) to have white flowers. These are the same percents that Mendel got in his first experiment.

Questions

You may use Punnett squares to answer the following questions.

1. What are the percents of genotypes you would expect in any cross between two heterozygous parents? Use the letters *B* and *b* in your answer.

2. What are the percents of phenotypes you would expect in any cross between two heterozygous parents? Use the genotypes and phenotypes in the reading above.

3. Predict the percents of genotypes you would expect in any cross between a homozygous dominant parent and a homozygous recessive parent.

4. Predict the percents of phenotypes you would expect in any cross between a homozygous dominant parent and a homozygous recessive parent.

5. Predict the percents of genotypes and phenotypes you would expect in any cross between a heterozygous parent and a homozygous recessive parent.

Lesson 6.2: Multiple Choice

Name_____ **Class**_____ **Date**_____

Circle the letter of the correct choice.

a. What is the inheritance pattern when both alleles are expressed equally in the phenotype of a heterozygote?

   a. multiple alleles
   b. incomplete dominance
   c. codominance
   d. polygenic characteristics

b. What is the inheritance pattern when the dominant allele is not completely dominant?

   a. multiple alleles
   b. incomplete dominance
   c. codominance
   d. polygenic characteristics

c. What is the inheritance pattern associated with the ABO blood type in humans?

   a. multiple alleles
   b. incomplete dominance
   c. codominance
   d. polygenic characteristics

d. In a cross between a homozygous dominant parent and a homozygous recessive parent, what is the chance of the offspring having a heterozygous genotype?

   a. 25%
   b. 50%
   c. 75%
   d. 100%

e. In a cross between a homozygous dominant parent and a homozygous recessive parent, what is the chance of the offspring having the dominant phenotype?

   a. 25%
   b. 50%
   c. 75%
   d. 100%

f. In a cross between a homozygous dominant parent and a heterozygous parent, what is the chance of the offspring having a heterozygous genotype?

   a. 25%
   b. 50%
   c. 75%
   d. 100%

g. In a cross between a homozygous dominant parent and a heterozygous parent, what is the chance of the offspring having the dominant phenotype?

   a. 25%
   b. 50%
   c. 75%
   d. 100%

h. In a cross involving two heterozygous parents, which is the chance of the offspring having the dominant phenotype?

   a. 25%
   b. 50%
   c. 75%
   d. 100%

Lesson 6.2: Vocabulary I

Name_____ Class_____ Date_____

Match the vocabulary word with the proper definition.

Definitions

_____ 1. occurs when the dominant allele is not completely dominant

_____ 2. closely associated with appearance

_____ 3. an example of a characteristic due to multiple alleles

_____ 4. controlled by more than one gene

_____ 5. the expressed allele in a heterozygote

_____ 6. cell division involved in gamete formation

_____ 7. used to determine the expected percents of different genotypes in offspring

_____ 8. an alternative form of a gene

_____ 9. chance that a certain event will occur

_____ 10. only expressed when the other allele is absent

_____ 11. occurs when both alleles are expressed equally in the phenotype of the heterozygote

Terms

a. ABO blood type

b. allele

c. codominance

d. dominant allele

e. incomplete dominance

f. meiosis

g. phenotype

h. polygenic characteristic

i. probability

j. Punnett square

k. recessive allele

Lesson 6.2: Vocabulary II

Name_____ Class_____ Date_____

Fill in the blank with the appropriate term.

1. If you toss a coin twice, you might expect to get _____ head and _____ tail.

2. A Punnett square allows you to determine the expected percents of different _____ in the offspring of two parents.

3. _____ is when both alleles are expressed equally in the phenotype of the heterozygote.

4. _____ is the chance that a certain event will occur.

5. Paired alleles always separate and go to different gametes during _____.

6. If one parent is heterozygous and the other parent is homozygous recessive, the probability that their child will be homozygous recessive is _____.

7. If a parent has a *Dd* genotype, the probability of their child inheriting a *d* allele from that parent is _____.

8. _____ dominance occurs when the dominant allele is not completely dominant.

9. Sometimes an individual's phenotype is not just due to his or her genes, but also _____ influences.

10. A cross between a homozygous dominant individual and a homozygous recessive individual will always result in a _____ individual.

11. ABO blood type in humans is a characteristic due to multiple _____.

12. When a *Bb* pea plant forms gametes, the *B* and *b* alleles segregate and go to different _____.

Lesson 6.2: Critical Writing

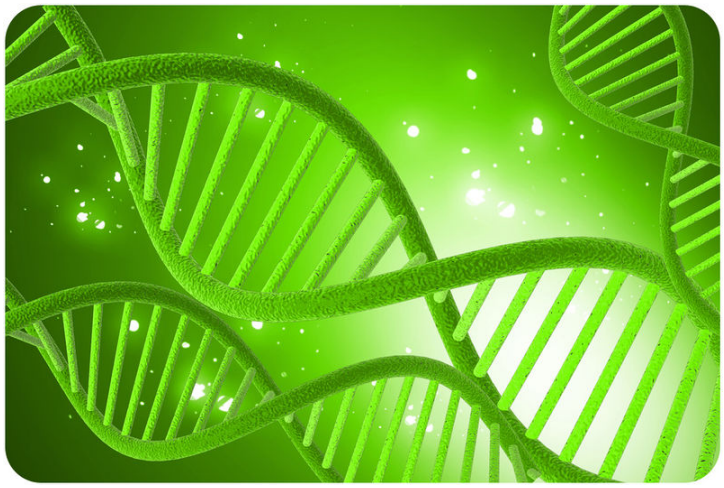
Name_____ Class_____ Date_____

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Draw a Punnett square of a cross between a homozygous dominant individual and a heterozygous individual.

CHAPTER 7 Molecular Genetics: From DNA to Proteins Worksheets

Chapter Outline



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- **Lesson 7.1: DNA and RNA**
- **Lesson 7.2: Protein Synthesis**
- **Lesson 7.3: Mutation**
- **Lesson 7.4: Regulation of Gene Expression**

7.1 DNA and RNA

Lesson 7.1: True or False

Name_____ Class_____ Date_____

Write true if the statement is true or false if the statement is false.

_____ 1. For many decades, scientists thought that proteins were the genetic material.

_____ 2. In eukaryotic cells, proteins always remain in the nucleus, but DNA is made at ribosomes in the cytoplasm.

_____ 3. RNA is much larger than DNA.

_____ 4. Erwin Chargaff demonstrated that in DNA, the amount of adenine is about the same as the amount of guanine.

_____ 5. The shape of DNA is similar to a spiral staircase, and is referred to as a double helix.

_____ 6. Because of Chargaff's rules, if the order of bases on one strand of DNA is known, the order of bases on the other strand can be predicted.

_____ 7. There are 4 types of RNA: mRNA, rRNA, sRNA, and tRNA.

_____ 8. Proteins are made on the ribosomes in the cytoplasm.

_____ 9. In DNA replication, half of the parent DNA molecule is conserved in each of the two daughter DNA molecules.

_____ 10. mRNA is a copy of the genetic instructions from the DNA.

_____ 11. Oswald Avery was the first to conclude that DNA is the genetic material.

_____ 12. James Watson and Francis Crick used X rays to learn about DNA's structure.

_____ 13. RNA uses the instructions in DNA to make a protein.

_____ 14. If one strand of DNA is GAATTC, the opposite strand would be CTTAAG.

_____ 15. DNA contains instructions for all the proteins your body makes.

Lesson 7.1: Critical Reading

Name_____ Class_____ Date_____

Read these passages from the text and answer the questions that follow.

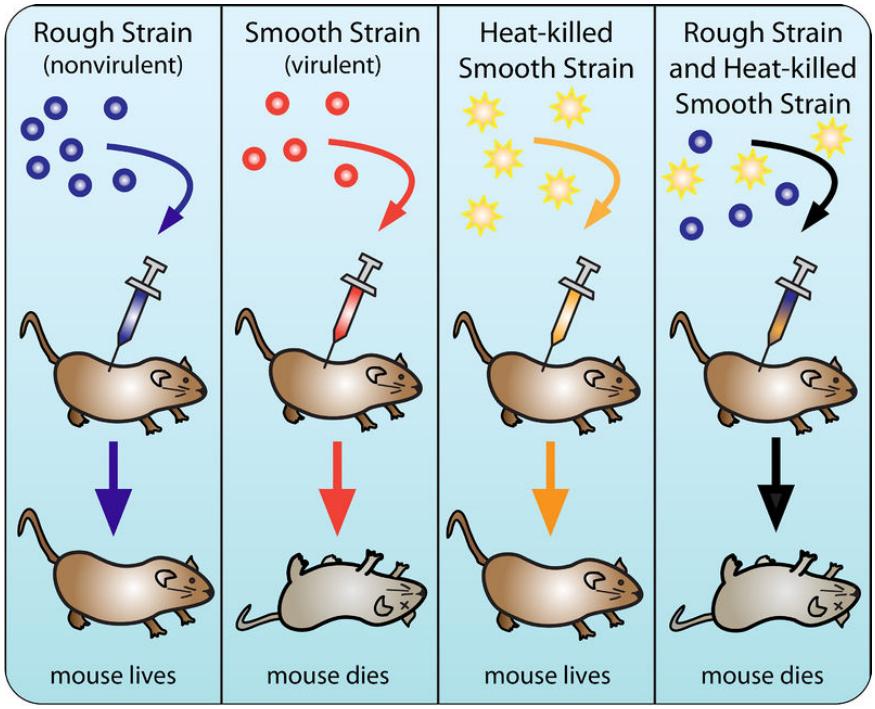
DNA

DNA is the genetic material in your cells. It was passed on to you from your parents and determines your characteristics. The discovery that DNA is the genetic material was another important milestone in molecular biology.

Griffith Searches for the Genetic Material

Many scientists contributed to the identification of DNA as the genetic material. In the 1920s, Frederick Griffith

made an important discovery. He was studying two different strains of a bacterium, called R (rough) strain and S (smooth) strain. He injected the two strains into mice. The S strain (virulent) killed the mice, but the R strain (nonvirulent) did not (see the figure below). Griffith also injected mice with S-strain bacteria that had been killed by heat. As expected, the killed bacteria did not harm the mice. However, when the dead S-strain bacteria were mixed with live R-strain bacteria and injected, the mice died.



Griffith's Experimental Results. Griffith showed that a substance could be transferred to harmless bacteria and make them deadly. *(Image courtesy of CK-12 Foundation and under the Creative Commons license CC-BY-NC-SA 3.0.)*

Based on his observations, Griffith deduced that something in the killed S-strain was transferred to the previously harmless R-strain, making the R-strain deadly. What was that something? What type of substance could change the characteristics of the organism that received it?

Hershey and Chase Seal the Deal

The conclusion that DNA is the genetic material was not widely accepted at first. It had to be confirmed by other research. In the 1950s, Alfred Hershey and Martha Chase did experiments with viruses and bacteria. Viruses are not cells. They are basically DNA inside a protein coat. To reproduce, a virus must insert its own genetic material into a cell (such as a bacterium). Then it uses the cell's machinery to make more viruses. The researchers used different radioactive elements to label the DNA and proteins in viruses. This allowed them to identify which molecule the viruses inserted into bacteria. DNA was the molecule they identified. This confirmed that DNA is the genetic material.

Questions

1. In Griffith's experiments, what killed the mice?

2. Why did the rough strain and heat-killed smooth strain kill the mice?

3. Why are viruses not considered cells?

4. What were the results of Hershey and Chase's experiment?

5. The term given to Griffith's observations is **transformation.** Why do you think that term is appropriate?

Lesson 7.1: Multiple Choice

Name_____ Class_____ Date_____

Circle the letter of the correct choice.

a. The order of experiments proving that DNA is the genetic material is

   a. Avery → Griffith → Hershey and Chase.
   b. Hershey and Chase → Griffith → Avery.
   c. Griffith → Avery → Hershey and Chase.
   d. Griffith → Hershey and Chase → Avery.

b. Chargaff's rules state that

   a. the amount of adenine equals the amount of thymine.
   b. the amount of adenine equals the amount of guanine.
   c. the amount of thymine equals the amount of guanine.
   d. the amount of cytosine equals the amount of thymine.

c. Which of the following statements concerning DNA is correct? (1) DNA contains instructions for all the proteins your body makes. (2) The shape of DNA is a double helix. (3) The central dogma of molecular biology states RNA → DNA → Protein.

   a. 1 only
   b. 1 and 2
   c. 2 and 3
   d. 1, 2, and 3

d. The structure of DNA was identified by

   a. Rosalind Franklin.
   b. Erwin Chargaff.
   c. Alfred Hershey and Martha Chase.
   d. James Watson and Francis Crick.

e. If one strand of DNA is CAGGTTACG, the opposite strand is

   a. GTCCAATGC.
   b. GTCCTTAGC.
   c. CAGGTTACG.
   d. GTCCTTACG.

f. The subunits of DNA are nucleotides consisting of

   a. a sugar, a carbon group, and a nitrogen-containing base.
   b. a sugar, a phosphate group, and a nitrogen-containing base.
   c. a sugar, a phosphate group, and an oxygen-containing base.
   d. a lipid, a phosphate group, and a nitrogen-containing base.

g. Differences between DNA and RNA include which of the following? (1) RNA consists of one nucleotide chain. (2) RNA contains the nitrogen base uracil instead of thymine. (3) RNA contains the sugar ribose instead of deoxyribose.

   a. 1, 2, and 3
   b. 1 and 2
   c. 2 and 3
   d. 2 only

h. The types of RNA include

a. messenger RNA.
b. nuclear RNA.
c. cytoplasmic RNA.
d. all of the above

Lesson 7.1: Vocabulary I

Name_____ Class_____ Date_____

Match the vocabulary word with the proper definition.

Definitions

_____ 1. the shape of DNA

_____ 2. found that there exists a substance that could change the characteristics of another organism

_____ 3. helps form ribosomes

_____ 4. used X rays to learn more about DNA's structure

_____ 5. subunit of DNA

_____ 6. DNA $\rightarrow$ RNA $\rightarrow$ Protein

_____ 7. brings amino acids to ribosomes

_____ 8. confirmed that DNA is the genetic material

_____ 9. the amount of A = T, and the amount of C = G

_____ 10. copies the genetic instructions from DNA in the nucleus, and carries the instructions to the cytoplasm

_____ 11. discovered the shape of DNA

_____ 12. the process in which DNA is copied

Terms

a. central dogma of molecular biology

b. Chargaff's rules

c. DNA replication

d. double helix

e. Franklin

f. Griffith

g. Hershey and Chase

h. messenger RNA (mRNA)

i. nucleotide

j. ribosomal RNA (rRNA)

k. transfer RNA (tRNA)

l. Watson and Crick

Lesson 7.1: Vocabulary II

Name_____ **Class**_____ **Date**_____

Fill in the blank with the appropriate term.

1. In DNA, A always pairs with _____, and G always pairs with _____.
2. The DNA molecule has a double _____ shape.
3. Griffith showed that a substance could be transferred to harmless bacteria and make them _____.
4. DNA → RNA → _____
5. _____ and Chase confirmed that DNA is the genetic material.
6. The amount of A equals the amount of T and the amount of G equals the amount of C is known as _____-_ rules.
7. _____ RNA copies the genetic instructions from DNA in the nucleus, and carries them to the cytoplasm.
8. Proteins are made in the cytoplasm on small organelles called _____.
9. _____ contains the nitrogen base uracil.
10. _____ RNA helps form ribosomes,
11. _____ RNA brings amino acids to ribosomes,
12. DNA stands for _____.

Lesson 7.1: Critical Writing

Name_____ **Class**_____ **Date**_____

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Describe the process of DNA replication. What allows the correct base to be placed in the new DNA strand?

7.2 Protein Synthesis

Lesson 7.2: True or False

Name_____ **Class**_____ **Date**_____

Write true if the statement is true or false if the statement is false.

_____ 1. The process in which cells make proteins is called protein expression.

_____ 2. Transcription takes place in three steps: initiation, elongation, and termination.

_____ 3. Splicing removes introns from mRNA.

_____ 4. A codon can be described as a three-letter genetic "word."

_____ 5. UAG, UGA, AGU, and UAA are the four stop codons

_____ 6. The anticodon is part of each tRNA molecule.

_____ 7. Initiation of transcription occurs when the enzyme, DNA polymerase, binds to the promoter of a gene.

_____ 8. All known living organisms, except some species of primitive bacteria, have the same genetic code.

_____ 9. Elongation is the addition of amino acids to the mRNA strand.

_____ 10. Translation always begins at an AUG codon.

_____ 11. Many proteins are modified in the Golgi apparatus after translation.

_____ 12. During translation, rRNA brings the amino acids into the ribosome.

_____ 13. Termination of transcription occurs at a stop codon.

_____ 14. Transcription uses DNA as a template to make an RNA molecule.

_____ 15. Translation takes place in a ribosome.

Lesson 7.2: Critical Reading

Name_____ **Class**_____ **Date**_____

Read these passages from the text and answer the questions that follow.

The Genetic Code

How is the information in a gene encoded? The answer is the genetic code. The **genetic code** consists of the sequence of nitrogen bases — A, C, G, T (or U) — in a polynucleotide chain. The four bases make up the "letters" of the genetic code. The letters are combined in groups of three to form code "words," called **codons**. Each codon stands for (encodes) one amino acid, unless it codes for a start or stop signal. There are 20 common amino acids in proteins. There are 64 possible codons, more than enough to code for the 20 amino acids. The genetic code is shown in the FlexBook.

Reading the Genetic Code

As shown in the Genetic Code figure (see **Figure 7.8** in the FlexBook), the codon AUG codes for the amino acid methionine. This codon is also the start codon that begins translation. The start codon establishes the reading frame of mRNA. The reading frame is the way the letters are divided into codons. After the AUG start codon, the next three letters are read as the second codon. The next three letters after that are read as the third codon, and so on. The mRNA molecule is read, codon by codon, until a stop codon is reached. UAG, UGA, and UAA are all stop codons. They do not code for any amino acids.

Characteristics of the Genetic Code

The genetic code has a number of important characteristics.

- The genetic code is universal. All known living things have the same genetic code. This shows that all organisms share a common evolutionary history.
- The genetic code is unambiguous. Each codon codes for just one amino acid (or start or stop). What might happen if codons encoded more than one amino acid?
- The genetic code is redundant. Most amino acids are encoded by more than one codon. What might be an advantage of having more than one codon for the same amino acid?

Questions

1. What is the genetic code?

2. Explain the significance of an AUG codon.

3. Why is the genetic code read three bases at a time?

4. "The genetic code is universal." Explain this statement.

5. What might happen if codons encoded more than one amino acid?

Lesson 7.2: Multiple Choice

Name_____ Class_____ Date_____

Circle the letter of the correct choice.

a. How many possible codons exist in the genetic code?
   a. 3
   b. 20
   c. 46
   d. 64

b. The two processes of protein synthesis are
   a. gene expression and protein expression.
   b. transcription and translation.
   c. replication and translation.
   d. transcription and the genetic code.

c. For protein synthesis to initiate,
   a. RNA polymerase must bind to a gene's promoter.
   b. nucleotides must be added to the mRNA strand.
   c. the mRNA must be flow from the nucleus to the cytoplasm.
   d. the tRNA and rRNA molecules must be made.

d. Which of the following terms is most closely associated with a tRNA molecule?
   a. codon
   b. anticodon
   c. transcription

d. ribosome

e. Which of the following statements is correct?

   a. Translation occurs in a ribosome when the codons on the mRNA are "read."
   b. Translation occurs in a ribosome when the anticodons on the mRNA are "read."
   c. Translation occurs in a ribosome when the codons on the rRNA are "read."
   d. Transcription occurs in a ribosome when the codons on the mRNA are "read."

f. "The genetic code is universal." This statement means that

   a. each codon codes for just one amino acid.
   b. all known living things have the same genetic code.
   c. most amino acids are encoded by more than one codon.
   d. all of the above

g. Which of the following statements is correct? (1) Translation always begins with an UAG start codon. (2) The start codon establishes the reading frame of mRNA. (3) The mRNA molecule is read one codon at a time until a stop codon is reached.

   a. 1 only
   b. 2 only
   c. 2 and 3
   d. 1, 2, and 3

h. Which of the following statements is correct?

   a. Editing changes some of the nucleotides in DNA.
   b. Polyadenylation adds a string of Cs to the mRNA.
   c. Splicing removes introns from mRNA.
   d. all of the above

Lesson 7.2: Vocabulary I

Name_____ **Class**_____ **Date**_____

Match the vocabulary word with the proper definition.

Definitions

_____ 1. the process in which cells make proteins

_____ 2. removes introns from mRNA

_____ 3. the sequence of A, C, G, T (or U) bases in a polynucleotide chain

_____ 4. complementary to a strand of DNA

_____ 5. contains an anticodon that is complementary to the codon for an amino acid

_____ 6. RNA → Protein

_____ 7. DNA → RNA

_____ 8. a group of three nitrogen bases

_____ 9. regions of mRNA that code for proteins

_____ 10. regions of mRNA that do not code for proteins

_____ 11. the way the groups of three bases are divided into codons

_____ 12. a region of a gene where RNA polymerase binds

Terms

a. codon

b. exons

c. genetic code

d. introns

e. mRNA

f. promoter

g. protein synthesis

h. reading frame

i. splicing

j. tRNA

k. transcription

l. translation

Lesson 7.2: Vocabulary II

Name_____ **Class**_____ **Date**_____

Fill in the blank with the appropriate term.

1. Transcription takes place in the _____ of the cell.
2. RNA polymerase binds to the _____ of a gene.
3. A group of three bases in the mRNA is a _____.
4. Transcription takes place in three steps: initiation, elongation, and _____.
5. All known living things have the same _____ code.
6. _____ is the second part of the central dogma of molecular biology: RNA $\rightarrow$ Protein.
7. Polyadenylation adds a "tail" of _____ to the mRNA.
8. AUG is the start codon and it codes for the amino acid _____.
9. Splicing removes _____ from mRNA.
10. The mRNA molecule is read, codon by codon, until a _____ codon is reached.
11. An _____ of the tRNA is complementary to the codon.
12. Transcription is the transfer of genetic instructions in DNA to _____.

Lesson 7.2: Critical Writing

Name_____ **Class**_____ **Date**_____

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Describe the genetic code and its important characteristics.

7.3 Mutation

Lesson 7.3: True or False

Name_____ **Class**_____ **Date**_____

Write true if the statement is true or false if the statement is false.

_____ 1. Mutations only occur in DNA.

_____ 2. All mutations are harmful.

_____ 3. Somatic mutations can be transmitted to offspring.

_____ 4. A point mutation is a change in a single nucleotide in DNA.

_____ 5. Neutral mutations can have a significant effect on the organism.

_____ 6. Bacteria can have mutations that allow them to survive in the presence of antibiotic drugs.

_____ 7. A deletion or insertion of one or more nucleotides may result in a frameshift mutation.

_____ 8. Chromosomal alterations are mutations that change chromosome structure.

_____ 9. Mutagens are caused by environmental factors known as mutations.

_____ 10. A genetic disorder is a disease caused by a mutation in one or a few genes.

_____ 11. The cell does not have the capability to repair damaged DNA.

_____ 12. Point mutations can be described as silent, missense, senseless, or nonsense.

_____ 13. A translocation mutation swaps sections from two non-homologous chromosomes.

_____ 14. Natural sunlight can cause mutations.

_____ 15. Mutations are the source of all new genetic material in a species.

Lesson 7.3: Critical Reading

Name_____ **Class**_____ **Date**_____

Read these passages from the text and answer the questions that follow.

Beneficial Mutations

Some mutations have a positive effect on the organism in which they occur. They are called beneficial mutations. They lead to new versions of proteins that help organisms adapt to changes in their environment. Beneficial mutations are essential for evolution to occur. They increase an organism's changes of surviving or reproducing, so they are likely to become more common over time. There are several well-known examples of beneficial mutations. Here are just two:

a. Mutations in many bacteria that allow them to survive in the presence of antibiotic drugs. The mutations lead to antibiotic-resistant strains of bacteria.

b. A unique mutation is found in people in a small town in Italy. The mutation protects them from developing atherosclerosis, which is the dangerous buildup of fatty materials in blood vessels. The individual in which the mutation first appeared has even been identified.

Harmful Mutations

Imagine making a random change in a complicated machine such as a car engine. The chance that the random change would improve the functioning of the car is very small. The change is far more likely to result in a car that does not run well or perhaps does not run at all. By the same token, any random change in a gene's DNA is likely to result in a protein that does not function normally or may not function at all. Such mutations are likely to be harmful. Harmful mutations may cause genetic disorders or cancer.

- A **genetic disorder** is a disease caused by a mutation in one or a few genes. A human example is cystic fibrosis. A mutation in a single gene causes the body to produce thick, sticky mucus that clogs the lungs and blocks ducts in digestive organs.
- Cancer is a disease in which cells grow out of control and form abnormal masses of cells. It is generally caused by mutations in genes that regulate the cell cycle. Because of the mutations, cells with damaged DNA are allowed to divide without limits. Cancer genes can be inherited.

Questions

1. What is a beneficial mutation?

2. What is a harmful mutation?

3. What type of mutation can cause cancer?

4. How can a mutation result in a genetic disorder? Give an example.

5. Why are beneficial mutations essential for evolution to occur?

Lesson 7.3: Multiple Choice

Name_____ Class_____ Date_____

Circle the letter of the correct choice.

a. Which of the following statements concerning mutations is correct?
   a. Mutations can happen spontaneously without any outside influence.
   b. Cigarette smoke is a significant cause of mutations.
   c. Mutations may occur during DNA replication or transcription.
   d. all of the above

b. Germline mutations are potentially dangerous, as they
   a. are confined to just one cell and its daughter cells.
   b. can be passed on to offspring.
   c. can be silent mutations and go undetected.
   d. all of the above

c. Which of the following types of mutations can result in a genetic disorder?
   a. a deletion
   b. an insertion
   c. a duplication
   d. all of the above

d. A frameshift mutation
   a. changes the reading frame of the base sequence.
   b. can be due to a translocation between two chromosomes.
   c. may not have an effect on how the codons in mRNA are read.

d. all of the above.

e. Beneficial mutations

a. may only cause mild genetic disorders.
b. are silent mutations, which code for the same amino acid.
c. help organisms adapt to changes in their environment.
d. are only caused by beneficial mutagens, like barbecuing and tanning.

f. A missense mutation

a. results in a premature stop codon.
b. codes for a different amino acid.
c. codes for the same amino acid.
d. results in a frameshift mutation.

g. Chromosomal alterations include deletions and

a. transfer mutations.
b. doubling mutations.
c. inversion mutations.
d. location mutations.

h. Which of the following statements are correct concerning mutations?

a. Mutations are essential for evolution to occur.
b. A mutation is a change in the sequence of bases only in DNA.
c. Most mutations have a big effect on the organism in which they occur.
d. all of the above

Lesson 7.3: Vocabulary I

Name_____ **Class**_____ **Date**_____

Match the vocabulary word with the proper definition.

Definitions

_____ 1. a deletion or insertion of one or more nucleotides that changes the reading frame

_____ 2. removal of nucleotides or removal of a segment of a chromosome

_____ 3. doubling of a segment of a chromosome

_____ 4. a change in the sequence of bases in DNA or RNA

_____ 5. occur in cells other than gametes

_____ 6. mutations that change chromosome structure

_____ 7. adding additional nucleotides into a chromosome

_____ 8. a change in a single nucleotide in DNA

_____ 9. reversal of a segment of a chromosome

_____ 10. anything in the environment that can cause a mutation

_____ 11. caused by a mutation in one or a few genes

_____ 12. generally caused by mutations in genes that regulate the cell cycle

_____ 13. swapping of material between two non-homologous chromosomes

_____ 14. occur in gametes

Terms

a. cancer

b. chromosomal alteration

c. deletion

d. duplication

e. frameshift mutation

f. genetic disorder

g. germline mutations

h. insertion

i. inversion

j. mutagen

k. mutation

l. point mutation

m. somatic mutations

n. translocation

Lesson 7.3: Vocabulary II

Name_____ Class_____ Date_____

Fill in the blank with the appropriate term.

1. A change in the sequence of bases in _____ is called a mutation.
2. A change in a single nucleotide in DNA is a _____.
3. Chromosomal alterations are mutations that change _____ structure.
4. A silent point mutation codes for the same _____.
5. Mutations are essential for _____ to occur because they increase genetic variation.
6. Neutral mutations have _____ effect on the organism.
7. A _____ mutation is a deletion or insertion of one or more nucleotides that changes the reading frame of the base sequence.
8. _____ mutations can be transmitted to offspring.
9. A _____ disorder is a disease caused by a mutation in one or a few genes.
10. _____ is a disease in which cells grow out of control.
11. _____ mutations have a positive effect on the organism in which they occur.
12. _____ smoke contains dozens of mutagenic chemicals.

Lesson 7.3: Critical Writing

Name_____ Class_____ Date_____

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

What is a frameshift mutation? Explain how such a mutation can occur.

7.4 Regulation of Gene Expression

Lesson 7.4: True or False

Name_____ **Class**_____ **Date**_____

Write true if the statement is true or false if the statement is false.

_____ 1. In your body, different types of cells have different genes.

_____ 2. Using a gene to make a protein is called protein expression.

_____ 3. A regulatory element is located on the DNA.

_____ 4. An operon is a region of prokaryotic DNA.

_____ 5. lacX, lacY, lacZ, and lacA are genes for the four proteins needed to digest lactose.

_____ 6. Essentially, regulatory proteins must turn "on" certain genes in particular cells.

_____ 7. In prokaryotic cells, RNA polymerase binds to the operator.

_____ 8. Repressors promote transcription by enhancing the interaction of RNA polymerase with the promoter.

_____ 9. The ATAT box is a regulatory element that is part of the promoter of most eukaryotic genes.

_____ 10. Because of a mutation, it is possible for a fly to have legs growing out of its head.

_____ 11. Mutations in some regulatory genes can cause cancer.

_____ 12. In eukaryotic gene regulation, regulatory proteins must bind to the regulatory elements before RNA polymerase binds to the promoter.

_____ 13. In the lac operon, when lactose is absent, the repressor protein does not bind to the operator.

_____ 14. Homeobox genes code for regulatory proteins that switch on whole series of major developmental genes.

_____ 15. In your body, different types of cells use different genes.

Lesson 7.4: Critical Reading

Name_____ **Class**_____ **Date**_____

Read these passages from the text and answer the questions that follow.

Eukaryotic Gene Regulation

In eukaryotic cells, the start of transcription is one of the most complicated parts of gene regulation. There may be many regulatory proteins and regulatory elements involved. Regulation may also involve enhancers. Enhancers are distant regions of DNA that can loop back to interact with a gene's promoter.

The TATA Box

Different types of cells have unique patterns of regulatory elements that result in only the necessary genes being transcribed. That's why a skin cell and nerve cell, for example, are so different from each other. However, some

patterns of regulatory elements are common to all genes, regardless of the cells in which they occur. An example is the **TATA box**. This is a regulatory element that is part of the promoter of most eukaryotic genes. A number of regulatory proteins bind to the TATA box, forming a multi-protein complex. It is only when all of the appropriate proteins are bound to the TATA box that RNA polymerase recognizes the complex and binds to the promoter. Once RNA polymerase binds, transcription begins.

Regulation During Development

The regulation of gene expression is extremely important during the development of an organism. Regulatory proteins must turn on certain genes in particular cells at just the right time so the organism develops normal organs and organ systems. **Homeobox genes** are an example of genes that regulate development. They code for regulatory proteins that switch on whole series of major developmental genes. In insects, homeobox genes called hox genes ensure that body parts such as limbs develop in the correct place.

Questions

1. List three factors involved in eukaryotic gene regulation.

2. Describe the TATA box and its role.

3. Where does RNA polymerase bind to the DNA? What happens next?

4. What is a homeobox gene?

5. What is an enhancer?

Lesson 7.4: Multiple Choice

Name_____ Class_____ Date_____

Circle the letter of the correct choice.

a. Using a gene to make a protein is called
   a. protein expression.
   b. gene expression.
   c. gene regulation.
   d. protein synthesis.

b. Gene expression is regulated
   a. to ensure that all cells make the same proteins.
   b. to ensure that the correct proteins are made from the right genes.
   c. to ensure that the correct proteins are made in the cells in which they are needed.
   d. to ensure that all cells only use some genes.

c. Which of the following statements concerning the lac operon is correct?
   a. When lactose is present, the repressor protein binds to the operator.
   b. When lactose is absent, a repressor protein binds to the operator.
   c. When lactose is absent, a repressor protein binds to the promoter.
   d. When lactose is present, the repressor protein binds to the promoter.

d. Gene regulation during development involves
   a. homeobox genes.
   b. proto-oncogenes and tumor-suppressor genes.
   c. the lac operon.
   d. all of the above

e. Which three factors are involved in eukaryotic gene regulation?
   a. regulatory proteins, regulatory elements, and activators
   b. regulatory proteins, operator, and promoter
   c. regulatory proteins, regulatory elements, and RNA polymerase
   d. regulatory proteins, regulatory elements, and enhancers

f. Which of the following statements is correct? (1) Activators promote transcription by enhancing the interaction of RNA polymerase with the promoter. (2) Repressors promote transcription by enhancing the progress of RNA polymerase along the DNA strand. (3) Repressors prevent transcription by impeding the progress of RNA polymerase along the DNA strand. (4) Activators prevent transcription by impeding the interaction of RNA polymerase with the promoter.
   a. 1 and 3
   b. 2 and 4
   c. 1 only
   d. All 4 statements are correct.

g. Which statement best describes the TATA box?
   a. The TATA box is a regulatory element that is part of the promoter of most prokaryotic genes.
   b. The TATA box is a regulatory element that is part of the promoter of most eukaryotic genes.
   c. The TATA box is a regulatory protein that binds to the promoter of most eukaryotic genes.
   d. The TATA box is a regulatory protein that binds to the promoter of most prokaryotic genes.

h. Which of the following statements is correct?
   a. Regulatory proteins bind to regulatory elements, which are located near promoters.
   b. Regulatory elements bind to regulatory proteins, which are located near promoters.
   c. Regulatory proteins bind to regulatory elements, which are also known as operons.
   d. Regulatory proteins bind to regulatory elements, which are located near enahncers.

Lesson 7.4: Vocabulary I

Name_____ **Class**_____ **Date**_____

Match the vocabulary word with the proper definition.

Definitions

_____ 1. using a gene to make a protein

_____ 2. regulatory region of DNA located near the promoter

_____ 3. a region of prokaryotic DNA that consists of one or more genes that encode the proteins needed for a specific function and their regulatory regions

_____ 4. when inactivated leads to tumor formation and cancer

_____ 5. enzyme that transcribes DNA to mRNA

_____ 6. code for regulatory proteins that switch on whole series of major developmental genes

_____ 7. protein that binds to regulatory region on DNA

_____ 8. a regulatory element that is part of the promoter of most eukaryotic genes

_____ 9. promotes transcription by enhancing the interaction of RNA polymerase with the promoter.

_____ 10. region of a gene where RNA polymerase binds

_____ 11. gene for a regulatory protein that controls the cell cycle

_____ 12. consists of a promoter, an operator, and three genes that encode the enzymes needed to digest lactose

Terms

a. activator

b. gene expression

c. homeobox genes

d. lac operon

e. operon

f. promoter

g. proto-oncogene

h. regulatory element

i. regulatory protein

j. RNA polymerase

k. TATA box

l. tumor-suppressor gene

Lesson 7.4: Vocabulary II

Name_____ **Class**_____ **Date**_____

Fill in the blank with the appropriate term.

1. The _____ is a region of an operon where regulatory proteins bind.
2. Transcription is partly controlled by _____ proteins.
3. Using a gene to make a protein is called _____ expression.
4. RNA _____ is the enzyme that transcribes DNA to mRNA.
5. The _____ box is a regulatory element that is part of the promoter of most eukaryotic genes.
6. Regulatory proteins bind to regions of DNA, called regulatory _____.
7. Gene expression is regulated to ensure that the correct _____ are made.
8. Mutations in tumor-suppressor genes can cause _____.
9. Homeobox genes regulate _____.
10. Activators _____ transcription.
11. Repressors _____ transcription.
12. An _____ is a region of DNA that consists of one or more genes that encode the proteins needed for a specific function.

Lesson 7.4: Critical Writing

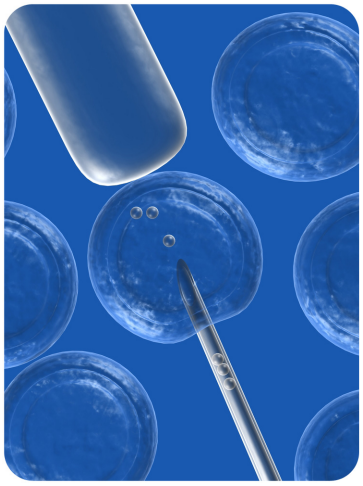
Name_____ **Class**_____ **Date**_____

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Describe gene regulation in the lac operon.

CHAPTER 8 Human Genetics and Biotechnology Worksheets

Chapter Outline



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- **Lesson 8.1: Human Chromosomes and Genes**
- **Lesson 8.2: Human Inheritance**
- **Lesson 8.3: Biotechnology**

8.1 Human Chromosomes and Genes

Lesson 8.1: True or False

Name_____ Class_____ Date_____

Write true if the statement is true or false if the statement is false.

_____ 1. The human genome consists of about 3 million base pairs.

_____ 2. By 2003, scientists had sequenced all of the base pairs of a sample of human DNA.

_____ 3. In humans, chromosome 22 is the largest chromosome, and chromosome 1 is the smallest chromosome.

_____ 4. None of the genes on the Y-chromosome is essential to survival.

_____ 5. The role of the majority of the 3 billion base pairs in the human genome is not known.

_____ 6. Humans have 22 pairs of autosomes.

_____ 7. Genes that are located on the different chromosomes are linked genes.

_____ 8. Linkage is related to crossing-over during meiosis.

_____ 9. Females have two X chromosomes, and males have an X and a Y chromosome.

_____ 10. Genes that assort independently during meiosis will always be in different gametes.

_____ 11. The hemophilia A gene is on the X chromosome.

_____ 12. Only the X chromosome contains genes that determine sex.

_____ 13. The female is the "default" sex of the human species.

_____ 14. Most sex-linked genes are on the Y chromosome.

_____ 15. Most human cells have 23 chromosomes.

Lesson 8.1: Critical Reading

Name_____ Class_____ Date_____

Read these passages from the text and answer the questions that follow.

Chromosomes and Genes

Each species has a characteristic number of chromosomes. The human species is characterized by 23 pairs of chromosomes, as shown in the FlexBook.

Autosomes

Of the 23 pairs of human chromosomes, 22 pairs are autosomes. **Autosomes** are chromosomes that contain genes for characteristics that are unrelated to sex. These chromosomes are the same in males and females. The great majority of human genes are located on autosomes.

Sex Chromosomes

The remaining pair of human chromosomes consists of the **sex chromosomes**, X and Y. Females have two X chromosomes, and males have one X and one Y chromosome. In females, one of the X chromosomes in each cell is inactivated and known as a Barr body. This ensures that females, like males, have only one functioning copy of the X chromosome in each cell.

The X chromosome is much larger than the Y chromosome. The X chromosome has about 2,000 genes, whereas the Y chromosome has fewer than 100, none of which are essential to survival. Virtually all of the X chromosome genes are unrelated to sex. Only the Y chromosome contains genes that determine sex. A single Y chromosome gene, called SRY (which stands for sex-determining region Y gene), triggers an embryo to develop into a male. Without a Y chromosome, an individual develops into a female, so you can think of female as the default sex of the human species. Can you think of a reason why the Y chromosome is so much smaller than the X chromosome?

Human Genes

Humans have an estimated 20,000 to 22,000 genes. This may sound like a lot, but it really isn't. Far simpler species have almost as many genes as humans. However, human cells use splicing and other processes to make multiple proteins from the instructions encoded in a single gene. Of the 3 billion base pairs in the human genome, only about 25 percent make up genes and their regulatory elements. The functions of many of the other base pairs are still unclear.

The majority of human genes have two or more possible alleles. Differences in alleles account for the considerable genetic variation among people. In fact, most human genetic variation is the result of differences in individual DNA bases within alleles.

Questions

1. What are autosomes? How many do humans have?

2. Compare the X and Y chromosome.

3. In terms of sex chromosomes, what is the genotype of a female? a male?

4. How do humans use their genes to produce more than 22,000 proteins?

5. What is the importance of alleles in humans?

Lesson 8.1: Multiple Choice

Name_____ **Class**_____ **Date**_____

Circle the letter of the correct choice.

a. All of the DNA of the human species makes up the human
   a. genes.
   b. genome.
   c. chromosomes.
   d. DNA.

b. Humans have _____ bases divided among _____ chromosomes.
   a. 3 million, 23
   b. 3 million, 23 pairs of
   c. 3 billion, 23
   d. 3 billion, 23 pairs of

c. Differences between the X and Y chromosomes include which of the following? (1) The X chromosome has many more genes than the Y chromosome. (2) Virtually all of the X chromosome genes are unrelated to sex, whereas the Y chromosome contains genes that determine sex. (3) Both males and females have only one functioning copy of the X chromosome in each cell.

   a. 1 only
   b. 2 only
   c. 1 and 2
   d. 1, 2, and 3

d. The goal of the Human Genome Project was to

   a. sequence all 3 billion base pairs of human DNA.
   b. sequence all human DNA and identify all 22,000 proteins.
   c. develop linkage maps of all 22 autosomes of chromosomes.
   d. all of the above

e. Linked genes

   a. are on homologous chromosomes.
   b. are on the same chromosome.
   c. are on sister chromatids.
   d. are on non-homologous chromosomes.

f. Most of the human genome is made of

   a. genes.
   b. regulatory regions.
   c. intergenic regions.
   d. chromosomes.

g. Which of the following statements is correct?

   a. The higher the frequency of crossing-over, the closer together on the same chromosome the genes are presumed to be.
   b. The lower the frequency of crossing-over, the closer together on the same chromosome genes are presumed to be.
   c. The lower the frequency of crossing-over, the farther apart on the same chromosome the genes are presumed to be.
   d. With a high frequency of crossing-over, genes are presumed to be on different chromosomes.

h. A normal human male has

   a. 22 autosomes, and one X chromosome and one Y chromosome.
   b. 22 pairs of autosomes, and one X chromosome and one Y chromosome.
   c. 23 autosomes, and one X chromosome and one Y chromosome.
   d. 23 pairs of autosomes, and one X chromosome and one Y chromosome.

Lesson 8.1: Vocabulary I

Name_____ **Class**_____ **Date**_____

Match the vocabulary word with the proper definition.

Definitions

_____ 1. 20,000 to 22,000 in humans

_____ 2. an international project to sequence the entire human genome

_____ 3. determine the sex of the person

_____ 4. genes that are located on the same chromosome

_____ 5. all of the DNA of the human species

_____ 6. genes on the X-chromosome

_____ 7. chromosomes that contain genes for characteristics that are unrelated to sex

_____ 8. female

_____ 9. male

_____ 10. 23 pairs in humans

_____ 11. shows the locations of genes on a chromosome

_____ 12. genes located on the sex chromosomes

Terms

a. autosome

b. chromosomes

c. gene

d. human genome

e. Human Genome Project

f. linkage map

g. linked genes

h. sex chromosomes

i. sex-linked gene

j. X-linked gene

k. XX

l. XY

Lesson 8.1: Vocabulary II

Name_____ Class_____ Date_____

Fill in the blank with the appropriate term.

1. The human _____ is all of the DNA of a human.

2. The X and Y chromosomes are known as the _____ chromosomes.

3. Genes that are located on the same chromosome are _____ genes.

4. Differences in alleles account for the considerable _____ variation among people.

5. Most sex-linked genes are on the _____ chromosome.

6. Chromosomes 1 to 22 are known as _____.

7. Chromosome _____ is the largest chromosome.

8. A linkage _____ shows the locations of genes on a chromosome.

9. The number of human genes is about _____ to _____ .

10. Genes on non-homologous chromosomes are not linked.

11. Linkage explains why certain characteristics are frequently _____ together.

12. Humans have 23 pairs of _____.

Lesson 8.1: Critical Writing

Name_____ Class_____ Date_____

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Being very specific, what makes you different from everyone else?

8.2 Human Inheritance

Lesson 8.2: True or False

Name_____ **Class**_____ **Date**_____

Write true if the statement is true or false if the statement is false.

_____ 1. Characteristics that are encoded in DNA are called genetic diseases.

_____ 2. Widow's peak and hitchhiker's thumb are multiple allele traits.

_____ 3. Single-gene X-linked traits have a different pattern of inheritance than single-gene autosomal traits.

_____ 4. Most human traits have more complex modes of inheritance than simple Mendelian inheritance.

_____ 5. Because it is a polygenic trait, human height can be represented by a bell-shaped graph.

_____ 6. Pleiotropy is when a more than one gene affects a single trait.

_____ 7. Most genetic disorders are controlled by dominant alleles.

_____ 8. Triple X syndrome results in XYXX males.

_____ 9. A karyotype is a picture of a cell's chromosomes.

_____ 10. A recessive X-linked allele is always expressed in males.

_____ 11. The alleles for ABO blood type are the A, B, AB and O alleles.

_____ 12. Amniocentesis can be used to see if the mother has any genetic abnormalities.

_____ 13. Down syndrome is also known as trisomy 21.

_____ 14. A mutant recessive allele is not expressed in people who inherit just one copy of it.

_____ 15. Epistasis is when one gene affects the expression of another gene.

Lesson 8.2: Critical Reading

Name_____ **Class**_____ **Date**_____

Read these passages from the text and answer the questions that follow.

Genetic Disorders

Many genetic disorders are caused by mutations in one or a few genes. Other genetic disorders are caused by abnormal numbers of chromosomes.

Genetic Disorders Caused by Mutations

Table 8.1 lists several genetic disorders caused by mutations. Some of the disorders are caused by mutations in autosomal genes, others by mutations in X-linked genes. Which disorder would you expect to be more common in males than females?

TABLE 8.1: Genetic Disorders Caused by Mutations

Genetic Disorder	Direct Effect of Mutation	Signs and Symptoms of the Disorder	Mode of Inheritance
Marfan syndrome	defective protein in connective tissue	heart and bone defects and unusually long, slender limbs and fingers	autosomal dominant
Sickle cell anemia	abnormal hemoglobin protein in red blood cells	sickle-shaped red blood cells that clog tiny blood vessels, causing pain and damaging organs and joints	autosomal recessive
Vitamin D-resistant rickets	lack of a substance needed for bones to absorb minerals	soft bones that easily become deformed, leading to bowed legs and other skeletal deformities	X-linked dominant
Hemophilia A	reduced activity of a protein needed for blood clotting	internal and external bleeding that occurs easily and is difficult to control	X-linked recessive

Few genetic disorders are controlled by dominant alleles. A mutant dominant allele is expressed in every individual who inherits even one copy of it. If it causes a serious disorder, affected people may die young and fail to reproduce. Therefore, the mutant dominant allele is likely to die out of the population. A mutant recessive allele, such as the allele that causes sickle cell anemia, is not expressed in people who inherit just one copy of it. These people are called carriers. They do not have the disorder themselves, but they carry the mutant allele and can pass it to their offspring. Thus, the allele is likely to pass on to the next generation rather than die out.

Chromosomal Disorders

Mistakes may occur during meiosis that result in **nondisjunction**. This is the failure of replicated chromosomes to separate during meiosis II. Some of the resulting gametes will be missing a chromosome, while others will have an extra copy of the chromosome. If such gametes are fertilized and form zygotes, they usually do not survive. If they do survive, the individuals are likely to have serious genetic disorders. **Table** 8.2 lists several genetic disorders that are caused by abnormal numbers of chromosomes.

TABLE 8.2: Genetic Disorders Caused by Abnormal Numbers of Chromosomes

Genetic Disorder	Genotype	Phenotypic Effects
Down syndrome	extra copy (complete or partial) of chromosome 21	developmental delays, distinctive facial appearance, and other abnormalities
Turner's syndrome	one X chromosome but no other sex chromosome (XO)	female with short height and infertility (inability to reproduce)
Triple X syndrome	three X chromosomes (XXX)	female with mild developmental delays and menstrual irregularities
Klinefelter's syndrome	one Y chromosome and two or more X chromosomes (XXY, XXXY)	male with problems in sexual development and reduced levels of the male hormone testosterone

Having the wrong number of chromosomes causes the genetic disorders described in **Table** 8.2. Most chromosomal disorders involve the X chromosome. Look back at the X and Y chromosomes and you will see why. The X and Y chromosomes are very different in size, so nondisjunction of the sex chromosomes occurs relatively often.

Questions

1. What two main ways cause genetic disorders?

2. What are the signs and symptoms of sickle cell anemia?

3. Why are few genetic disorders controlled by dominant alleles?

4. Explain what causes chromosomal disorders.

5. Describe the cause and symptoms of Down syndrome.

Lesson 8.2: Multiple Choice

Name_____ Class_____ Date_____

Circle the letter of the correct choice.

a. Which of the following statements concerning genetic disorders is correct? (1) Many genetic disorders are caused by mutations in one or a few genes. (2) Some genetic disorders are caused by abnormal numbers of chromosomes. (3) Most genetic disorders are caused by dominant alleles. (4) Chromosomal disorders result from nondisjunction during mitosis.

   a. 1 only
   b. 1 and 2
   c. 1, 2, and 3
   d. all four statements are correct

b. Single-gene X-linked traits have a different pattern of inheritance than single-gene autosomal traits because

   a. females have just one X chromosome.
   b. females have two X chromosomes.
   c. males have two X chromosomes.
   d. males have just one X chromosome.

c. ABO blood type is a multiple allele trait. Which of the following are possible ABO blood type phenotypes? (1) A, (2) B, (3) AB, (4) O, (5) AO, (6) BO

   a. 1 and 2 only
   b. 3 and 4 only
   c. 5 and 6 only
   d. 1, 2, 3, and 4

d. Hemophilia A is due to

   a. a defective protein in connective tissue.
   b. abnormal hemoglobin protein in red blood cells.
   c. reduced activity of a protein needed for blood clotting.
   d. lack of a substance needed for bones to absorb minerals.

e. Down syndrome is due to

   a. nondisjunction of chromosome 21.
   b. nondisjunction of the X chromosome.
   c. one Y chromosome and two or more X chromosomes.
   d. nondisjunction of the Y chromosome.

f. Which of the following statements is true?

a. A recessive X-linked allele is always expressed in males.
b. Males will have two alleles for any X-linked trait.
c. Males must inherit two copies of a recessive X-linked allele to express the recessive trait.
d. X-linked recessive traits are less common in males than females.

g. In a polygenic trait, such as adult height, most people

a. will have a phenotype close to the average.
b. will have the dominant phenotype.
c. will have a heterozygous genotype.
d. will be 5 feet 8 inches tall.

h. A mother has red-green color blindness. Her husband is not affected.

a. Half of their daughters will have red-green color blindness.
b. All of their daughters will have red-green color blindness.
c. All of their sons will have red-green color blindness.
d. All of their children will have red-green color blindness.

Lesson 8.2: Vocabulary I

Name_____ **Class**_____ **Date**_____

Match the vocabulary word with the proper definition.

Definitions

_____ 1. involves inserting normal genes into cells with mutant genes

_____ 2. when one gene affects the expression of another gene

_____ 3. the inheritance of traits controlled by a single gene with two alleles

_____ 4. trait controlled by genes on the sex chromosomes

_____ 5. when a single gene affects more than one trait

_____ 6. an example of a multiple allele trait

_____ 7. the failure of replicated chromosomes to separate during meiosis

_____ 8. trait controlled by a gene on one of the 22 human autosomes

_____ 9. characteristics (traits) encoded in DNA

_____ 10. shows how a trait is passed from generation to generation within a family

_____ 11. red-green color blindness

_____ 12. traits controlled by a single gene with more than two alleles

Terms

a. ABO blood type

b. autosomal trait

c. epistasis

d. gene therapy

e. genetic trait

f. Mendelian inheritance

g. multiple allele trait

h. nondisjunction

i. pedigree

j. pleiotropy

k. sex-linked trait

l. X-linked trait

Lesson 8.2: Vocabulary II

Name_____ **Class**_____ **Date**_____

Fill in the blank with the appropriate term.

1. Characteristics that are encoded in DNA are called genetic _____.
2. Sex-linked traits are usually associated with genes on the _____ chromosome.
3. Traits controlled by a single gene with more than two alleles are called multiple _____ traits.
4. Mendelian inheritance refers to the inheritance of traits controlled by a single _____ with two _____-_____.
5. ABO blood type is a _____ allele trait.
6. Sickle cell anemia results in an abnormal _____ protein in red blood cells.
7. Hemophilia A results in reduced activity of a protein needed for blood _____.
8. _____ is caused by an extra copy of chromosome 21.
9. An example of a recessive _____ trait would be red-green color blindness.
10. Human height is an example of a _____ trait.
11. Many genetic disorders are caused by _____ in one or a few genes.
12. Nondisjunction occurs during _____.

Lesson 8.2: Critical Writing

Name_____ **Class**_____ **Date**_____

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Explain two complex modes of human inheritance. Give examples.

8.3 Biotechnology

Lesson 8.3: True or False

Name_____ Class_____ Date_____

Write true if the statement is true or false if the statement is false.

_____ 1. Two common biotechnology techniques are gene cloning and genetic engineering.

_____ 2. Gene cloning is the process of isolating and making copies of a chromosome.

_____ 3. Biotechnology has raised ethical questions.

_____ 4. When genes are cloned, DNA polymerase is used to join two pieces of DNA together.

_____ 5. Recombinant DNA is made from joining DNA from different sources.

_____ 6. Insulin was the first human protein to be produced by gene cloning.

_____ 7. The purpose of biotechnology is to create organisms that are useful to humans.

_____ 8. The polymerase chain reaction makes many copies of a gene or other DNA segment.

_____ 9. Gene cloning involves three steps: isolation, transformation, and selection.

_____ 10. The three steps of PCR are denaturing, annealing, and elongation.

_____ 11. The enzyme Taq Polymerase can work at high temperatures.

_____ 12. Transgenic crops have been created that make some food taste better.

_____ 13. Denaturing DNA occurs at room temperature.

_____ 14. Medicine and agriculture are two major fields that use biotechnology.

Lesson 8.3: Critical Reading

Name_____ Class_____ Date_____

Read these passages from the text and answer the questions that follow.

Gene Cloning

Gene cloning is the process of isolating and making copies of a gene. This is useful for many purposes. For example, gene cloning might be used to isolate and make copies of a normal gene for gene therapy. Gene cloning involves four steps: isolation, ligation, transformation, and selection.

a. In isolation, an enzyme is used to break DNA at a specific base sequence. This is done to isolate a gene.
b. During ligation, the enzyme DNA ligase combines the isolated gene with plasmid DNA from bacteria. (Plasmid DNA is circular DNA that is not part of a chromosome and can replicate independently.) The DNA that results is called **recombinant DNA**.
c. In transformation, the recombinant DNA is inserted into a living cell, usually a bacterial cell. Changing an organism in this way is also called **genetic engineering**.

d. Selection involves growing transformed bacteria to make sure they have the recombinant DNA. This is a necessary step because transformation is not always successful. Only bacteria that contain the recombinant DNA are selected for further use.

Polymerase Chain Reaction

The **polymerase chain reaction (PCR)** makes many copies of a gene or other DNA segment. This might be done in order to make large quantities of a gene for genetic testing. PCR involves three steps: denaturing, annealing, and extension. They are repeated many times in a cycle to make large quantities of the gene.

a. Denaturing involves heating DNA to break the bonds holding together the two DNA strands. This yields two single strands of DNA.
b. Annealing involves cooling the single strands of DNA and mixing them with short DNA segments called primers. Primers have base sequences that are complementary to segments of the single DNA strands. As a result, bonds form between the DNA strands and primers.
c. Extension occurs when an enzyme (Taq polymerase or Taq DNA polymerase) adds nucleotides to the primers. This produces new DNA molecules, each incorporating one of the original DNA strands.

Questions

1. What is gene cloning?

2. What is PCR? Why is PCR done?

3. What are the three steps of PCR?

4. What are the four steps of gene cloning?

5. What is recombinant DNA?

6. Why is it important to select for transformed bacteria?

Lesson 8.3: Multiple Choice

Name_____ Class_____ Date_____

Circle the letter of the correct choice.

a. Recombinant DNA
   a. results from the ligation of an isolated gene and plasmid DNA.
   b. is inserted into a living cell in the transformation process.
   c. is screened for in the selection process.
   d. all of the above

b. The steps of gene cloning are, in order,
   a. isolation, transformation, ligation, and selection.
   b. isolation, ligation, transformation, and selection.
   c. ligation, transformation, isolation, and selection.

   d. selection, transformation, ligation, and isolation.

c. The steps of PCR are, in order,

   a. denaturing, annealing, and extension.
   b. denaturing, extension, and annealing.
   c. annealing, extension, and denaturation.
   d. extension, annealing, and denaturation.

d. Transgenic crops have been created that

   a. yield more food.
   b. resist insect pests.
   c. survive drought.
   d. all of the above

e. Ethical, legal, and social issues associated with biotechnology would include questions about

   a. the safety of genetically modified crops.
   b. the use of biotechnology in modifying a baby's genotype.
   c. the ownership of genetically modified organisms.
   d. all of the above

f. PCR allows scientists to

   a. rapidly make many copies of a gene or other DNA segment.
   b. clone a recombinant DNA in bacteria.
   c. ligate together two pieces of DNA from different sources.
   d. all of the above.

g. The first human protein produced using biotechnology was

   a. cytokine.
   b. insulin.
   c. DNA ligase.
   d. Taq polymerase.

h. Biotechnology methods are used in which of the following? (1) medicine, (2) agriculture, (3) law enforcement.

   a. 1 only
   b. 2 only
   c. 1 and 2
   d. 1, 2, and 3

Lesson 8.3: Vocabulary I

Name_____ **Class**_____ **Date**_____

Match the vocabulary word with the proper definition.

Definitions

_____ 1. enzyme that joins two pieces of DNA

_____ 2. first human protein to be produced by genetic engineering

_____ 3. process that makes many copies of a gene or other DNA segment

_____ 4. the process of isolating and making copies of a gene

_____ 5. the process of placing recombinant DNA into a living cell

_____ 6. circular DNA that is not part of a chromosome

_____ 7. genetically modified plants

_____ 8. changing an organism by transforming with recombinant DNA

_____ 9. the use of technology to change the genetic makeup of living things for human purposes

_____ 10. made by joining DNA from two different sources

Terms

a. biotechnology

b. DNA ligase

c. gene cloning

d. genetic engineering

e. insulin

f. plasmid

g. polymerase chain reaction

h. recombinant DNA

i. transformation

j. transgenic crop

Lesson 8.3: Vocabulary II

Name_____ **Class**_____ **Date**_____

Fill in the blank with the appropriate term.

1. Transgenic crops are genetically modified with new _____ that code for traits useful to humans.
2. The _____ makes many copies of a gene or other DNA segment.
3. DNA _____ can join together an isolated gene and plasmid DNA.
4. Gene _____ is the process of isolating and making copies of a gene.
5. Gene cloning involves four steps: isolation, ligation, _____, and selection.
6. Plasmid DNA is circular DNA that is not part of a _____.
7. Changing an organism by transforming with recombinant DNA is known as genetic _____.
8. The use of biotechnology has raised a number of _____, legal, and social issues.
9. The first step of the PCR process is _____.
10. _____ DNA is made by combining DNA from two different sources.
11. Biotechnology can be used to transform bacteria so they are able to make human _____.
12. Biotechnology is the use of _____ to change the genetic makeup of living things for human purposes.

Lesson 8.3: Critical Writing

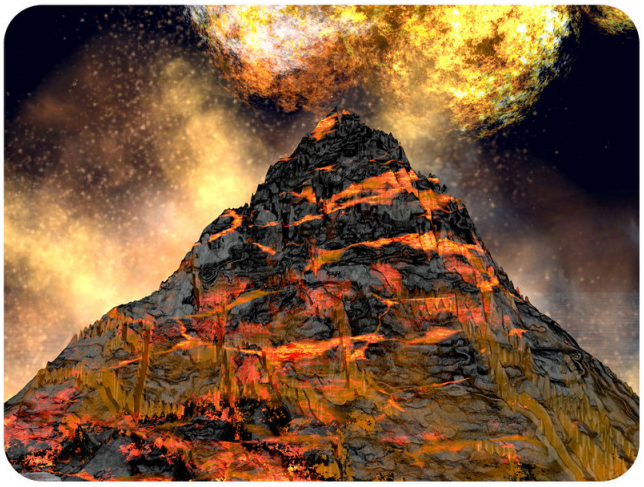
Name_____ Class_____ Date_____

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Describe PCR. Discuss the necessary steps and potential applications in detail.

CHAPTER 9 Life: From the First Organism Onward Worksheets

Chapter Outline



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- **Lesson 9.1: Earth Forms and Life Begins**
- **Lesson 9.2: The Evolution of Multicellular Life**
- **Lesson 9.3: Classification**

9.1 Earth Forms and Life Begins

Lesson 9.1: True or False

Name_____ Class_____ Date_____

Write true if the statement is true or false if the statement is false.

_____ 1. Life first appeared on Earth about 4 million years ago.

_____ 2. Much of what we know about the history of life on Earth is based on the fossil record.

_____ 3. Absolute dating is often based on the amount of radioactive carbon-12.

_____ 4. The geologic time scale is based on major changes in biology, chemistry, and the evolution of life.

_____ 5. In the early Earth, the oceans formed first, followed by the atmosphere.

_____ 6. Did DNA or proteins evolve first? Scientists believe proteins evolved first.

_____ 7. The oxygen catastrophe killed off many early cells.

_____ 8. The earliest cells were probably autotrophs – that is, they made their own food through photosynthesis.

_____ 9. A digital clock uses DNA sequences to estimate how long ago related species diverged from a common ancestor.

_____ 10. As organic molecules evolved before cells, the molecules must have evolved about 4.5 billion years ago.

_____ 11. The earliest cells may have been just nucleic acid inside a lipid membrane.

_____ 12. Did DNA or RNA evolve first? Some scientists believe RNA evolved first.

_____ 13. The solar system evolved from stardust.

_____ 14. Species with few differences in their DNA sequences are closely related.

_____ 15. In order for fossils to provide useful information, they must be dated.

Lesson 9.1: Critical Reading

Name_____ Class_____ Date_____

Read these passages from the text and answer the questions that follow.

The First Cells

How organic molecules such as RNA developed into cells is not known for certain. Scientists speculate that lipid membranes grew around the organic molecules. The membranes prevented the molecules from reacting with other molecules, so they did not form new compounds. In this way, the organic molecules persisted, and the first cells may have formed.

LUCA

No doubt there were many early cells of this type. However, scientists think that only one early cell (or group of

cells) eventually gave rise to all subsequent life on Earth. That one cell is called the **Last Universal Common Ancestor (LUCA).** It probably existed around 3.5 billion years ago. LUCA was one of the earliest prokaryotic cells. It would have lacked a nucleus and other membrane-bound organelles.

Photosynthesis and Cellular Respiration

The earliest cells were probably heterotrophs. Most likely they got their energy from other molecules in the organic "soup." However, by about 3 billion years ago, a new way of obtaining energy evolved. This new way was photosynthesis. Through photosynthesis, organisms could use sunlight to make food from carbon dioxide and water. These organisms were the first autotrophs. They provided food for themselves and for other organisms that began to consume them. After photosynthesis evolved, oxygen started to accumulate in the atmosphere. This has been dubbed the "oxygen catastrophe." Why? Oxygen was toxic to most early cells because they had evolved in its absence. As a result, many of them died out. The few that survived evolved a new way to take advantage of the oxygen. This second major innovation was cellular respiration. It allowed cells to use oxygen to obtain more energy from organic molecules.

Questions

1. Describe the first cells.

2. What was LUCA?

3. Why were the first cells heterotrophs?

4. How long did it take for photosynthesis to evolve?

5. What was the oxygen catastrophe?

Lesson 9.1: Multiple Choice

Name_____ Class_____ Date_____

Circle the letter of the correct choice.

a. Place the following in the order in which they evolved: eukaryotic cell, prokaryotic cell, photosynthesis, organic molecules.

   a. eukaryotic cell - prokaryotic cell - photosynthesis - organic molecules
   b. prokaryotic cell - eukaryotic cell - photosynthesis - organic molecules
   c. organic molecules - prokaryotic cell - photosynthesis - eukaryotic cell
   d. organic molecules - photosynthesis - prokaryotic cell - eukaryotic cell

b. Which of the following statements is true concerning LUCA? (1) LUCA was a cell. (2) All life on Earth evolved from LUCA. (3) LUCA probably existed probably around 4.5 billion years ago.

   a. 1 only
   b. 2 and 2
   c. 1 and 2
   d. 1, 2, and 3

c. The RNA world hypothesis states that

   a. early life was based on RNA as the first organic molecule.
   b. RNA evolved soon after the formation of the world.
   c. the first cells were made of RNA and lipids.
   d. all of the above

d. The "soup" of molecules refers to

   a. an ocean full of a mixture of many different substances.
   b. organic molecules created from inorganic chemicals in Earth's early atmosphere.

c. a Earth full of volcanic eruptions, thunder, and lightning.
d. the classic evolution experiments of Campbell and Chunky.

e. Early Earth

a. had a primitive atmosphere of ammonia, methane, water vapor, and carbon dioxide.
b. lacked much oxygen gas.
c. probably had a very hot environment.
d. all of the above

f. Which of the following can be considered fossils?

a. a 1 billion year-old rock.
b. a 1 billion year-old piece of amber.
c. a 1 billion year-old piece of amber with a primitive insect inside.
d. all of the above

g. "We are made of stardust" refers to

a. the dust of dead skin cells we shed every day.
b. the rotating cloud of stardust that formed the planets.
c. the gases in the stars that formed the gases in the atmosphere.
d. the rotating cloud of stardust that formed LUCA and all the organisms that evolved later.

h. Place the mouse, fruit fly, duck, and gorilla in order of their relatedness to humans, from least related to most related.

a. mouse - fruit fly - duck - gorilla
b. fruit fly - mouse - duck - gorilla
c. gorilla - mouse - duck - fruit fly
d. fruit fly - duck - mouse - gorilla

Lesson 9.1: Vocabulary I

Name_____ Class_____ Date_____

Match the vocabulary word with the proper definition.

Definitions

_____ 1. the preserved remains or traces of organisms that lived in the past

_____ 2. divides Earth's history into divisions that are based on major changes in geology, climate, and the evolution of life

_____ 3. uses DNA sequences to estimate how long it has been since related species diverged

_____ 4. explains how the first eukaryotic cells probably evolved

_____ 5. says that early life was based solely on RNA

_____ 6. occurs when a species completely dies out

_____ 7. process in which organisms could use sunlight to make food from carbon dioxide and water

_____ 8. determines about how long ago a fossil organism lived

_____ 9. when oxygen started to accumulate in the atmosphere

_____ 10. has provided lots of information about the history of life on Earth

_____ 11. determines which of two fossils is older or younger than the other

_____ 12. the one early cell that eventually gave rise to all subsequent life on Earth

Terms

a. absolute dating

b. endosymbiotic theory

c. extinction

d. fossil

e. fossil record

f. geologic time scale

g. Last Universal Common Ancestor

h. molecular clock

i. oxygen catastrophe

j. photosynthesis

k. relative dating

l. RNA world hypothesis

Lesson 9.1: Vocabulary II

Name_____ **Class**_____ **Date**_____

Fill in the blank with the appropriate term.

1. Life first appeared on Earth about _____ billion years ago.

2. A _____ clock uses DNA sequences to estimate how long ago related species diverged from a common ancestor.

3. It is likely that organic molecules evolved before _____.

4. Fossils are the _____ remains or traces of organisms that lived in the past.

5. Scientists think that one early cell gave rise to all subsequent life on Earth. That one cell is called the _____-_____.

6. Absolute dating determines about how long ago a fossil organism _____.

7. Human DNA is most similar to _____ DNA.

8. Some scientists speculate that _____ may have been the first organic molecule to evolve.

9. _____ dating determines which of two fossils is older or younger than the other.

10. The _____ theory explains how eukaryotic cells evolved.

11. _____ and Urey demonstrated that organic molecules could form under simulated conditions on early Earth.

12. If we think of Earth's history as a 24-hour day, humans would have appeared only during the last _____-_ of that day.

Lesson 9.1: Critical Writing

Name_____ Class_____ Date_____

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Describe how the first organic molecules arose.

9.2 The Evolution of Multicellular Life

Lesson 9.2: True or False

Name_____ Class_____ Date_____

Write true if the statement is true or false if the statement is false.

_____ 1. Most of Earth's history passed before multicellular life evolved.

_____ 2. Dinosaurs went extinct just 65 thousand years ago.

_____ 3. Continental drift caused intense volcanic activity.

_____ 4. The disaster called the Cambrian explosion resulted in a tremendous mass extinction.

_____ 5. Birds evolved from reptile ancestors.

_____ 6. The Permian extinction was the biggest mass extinction the world had ever seen.

_____ 7. Sexual reproduction resulted in less variety among offspring.

_____ 8. Sexual reproduction slowed the rate of evolution.

_____ 9. *Homo sapiens* are primates.

_____ 10. The supercontinent called Pangaea formed during the Permian Period, just under 300 million years ago.

_____ 11. By 2 billion years ago, the first multicellular organisms had evolved.

_____ 12. Birds and insects filled the niches left by the dinosaurs.

_____ 13. The Triassic Period was the golden age of dinosaurs.

_____ 14. The Jurassic Period ended with the extinction of the dinosaurs.

_____ 15. During one ice age, snow and ice completely covered the planet.

Lesson 9.2: Critical Reading

Name_____ Class_____ Date_____

Read these passages from the text and answer the questions that follow.

Setting the Stage: The Late Precambrian

The late Precambrian is the time from about 2 billion to half a billion years ago. During this long span of time, Earth experienced many dramatic geologic and climatic changes.

- Continents drifted. They collided to form a gigantic supercontinent and then broke up again and moved apart. Continental drift changed climates worldwide and caused intense volcanic activity.
- Carbon dioxide levels in the atmosphere rose and fell. This was due to volcanic activity and other factors. When the levels were high, they created a greenhouse effect. More heat was trapped on Earth's surface, and the climate became warmer. When the levels were low, less heat was trapped and the planet cooled. Several

times, cooling was severe enough to plunge Earth into an ice age. One ice age was so cold that snow and ice completely covered the planet.

Life During the Late Precambrian

The dramatic changes of the late Precambrian had a major impact on Earth's life forms. Living things that could not adapt died out. They were replaced by organisms that evolved new adaptations. These adaptations included sexual reproduction, specialization of cells, and multicellularity.

- Sexual reproduction created much more variety among offspring. This increased the chances that at least some of them would survive when the environment changed. It also increased the speed at which evolution could occur.
- Some cells started to live together in colonies. In some colonies, cells started to specialize in doing different jobs. This made the cells more efficient as a colony than as individual cells.
- By 1 billion years ago, the first multicellular organisms had evolved. They may have developed from colonies of specialized cells. Their cells were so specialized they could no longer survive independently. However, together they were mighty. They formed an organism that was bigger, more efficient, and able to do much more than any single-celled organism ever could.

The Precambrian Extinction

At the close of the Precambrian 544 million years ago, a mass extinction occurred. In a **mass extinction**, many or even most species abruptly disappear from Earth. There have been five mass extinctions in Earth's history. Many scientists think we are currently going through a sixth mass extinction. What caused the Precambrian mass extinction? A combination of climatic and geologic events was probably responsible. No matter what the cause, the extinction paved the way for a burst of new life during the following Paleozoic Era.

Questions

1. Name two major events of the late Precambrian.

2. Name three major adaptations for life during the late Precambrian.

3. Explain the major benefits of the evolution of sexual reproduction.

4. How did the first multicellular organisms evolve? What were the benefits of being multicellular?

5. What is a mass extinction?

Lesson 9.2: Multiple Choice

Name_____ Class_____ Date_____

Circle the letter of the correct choice.

a. Which division of time during Earth's history came first?

   a. The Paleozoic Era
   b. The Cenozoic Era
   c. The Late Precambrian
   d. The Mesozoic Era

b. Which period was the "golden age of dinosaurs"?

   a. the Triassic Period
   b. the Jurassic Period
   c. the Cretaceous Period
   d. the Tyrannosaurus Period

c. Pangaea

   a. is a supercontinent of all the major landmasses.
   b. formed during the Mesozoic Era.
   c. allowed dinosaurs to roam all over the planet.
   d. all of the above

d. The Permian extinction probably

   a. occurred because photosynthesis stopped and the planet cooled.
   b. occurred at the beginning of the Mesozoic Era, allowing the dinosaurs to evolve.
   c. killed most life on Earth except for small reptiles and mammals.
   d. all of the above

e. The dinosaurs disappeared at the end of the

   a. Triassic Period.
   b. Jurassic Period.
   c. Cretaceous Period.
   d. Mesozoic Period.

f. Which of the following did not occur during the Carboniferous Period?

   a. The first amphibians left the water to live on land, but they had to return to the water to reproduce.
   b. Plants and animals evolved adaptations to dryness.
   c. Widespread forests of huge plants left massive piles of carbon that eventually turned to coal.
   d. The first reptiles evolved.

g. When the dinosaurs went extinct _____ million years ago, the _____ took over.

   a. 65, reptiles
   b. 65, mammals
   c. 145, mammals
   d. 65, birds

h. Which of the following is not true about the Jurassic Period?

   a. The earliest birds evolved from reptile ancestors during this time.
   b. The major groups of mammals evolved during this time.
   c. Flowering plants appeared for the first time.
   d. The period ended with the dramatic extinction of small lizards, an important food for the large dinosaurs.

Lesson 9.2: Vocabulary I

Name_____ Class_____ Date_____

Match the vocabulary word with the proper definition.

Definitions

_____ 1. when many or even most species abruptly disappear from Earth

_____ 2. the era of “old life”

_____ 3. the era of “middle life”

_____ 4. the era of “modern life”

_____ 5. Earth during the ice age of the late Precambrian

_____ 6. the biggest mass extinction the world had ever seen

_____ 7. adaptation that created much more variety among offspring

_____ 8. spectacular burst of new life that began the Palezoic Era

_____ 9. when first dinosaurs branched off from the reptiles

_____ 10. the golden age of dinosaurs

_____ 11. when dinosaurs reached their peak in size and distribution

Terms

a. Cambrian explosion

b. Cenozoic Era

c. Cretaceous Period

d. Jurassic Period

e. mass extinction

f. Mesozoic Era

g. Palezoic Era

h. Permian extinction

i. sexual reproduction

j. snowball Earth

k. Triassic Period

Lesson 9.2: Vocabulary II

Name_____ **Class**_____ **Date**_____

Fill in the blank with the appropriate term.

1. During the late Precambrian, continents drifted. They collided to form a gigantic _____.

2. During the late Precambrian, sexual _____ created much more variety among offspring.

3. During the late Precambrian, the first multicellular organisms had _____.

4. In a _____, many or even most species abruptly disappear from Earth.

5. The Paleozoic Era began with a spectacular burst of new life, called the Cambrian _____.

6. The Paleozoic Era ended with the biggest mass extinction the world had ever seen, known as the Permian _____.

7. The Mesozoic Era is known as the age of _____.

8. During the Triassic Period, the first dinosaurs branched off from _____.

9. Dinosaurs flourished during the _____ period.

10. The Cretaceous Period ended with the dramatic extinction of the _____.

11. The Cenozoic Era is known as the age of _____.

12. The last ice age ended about _____ years ago.

Lesson 9.2: Critical Writing

Name_____ Class_____ Date_____

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Describe three major events of life that occurred during the "age of dinosaurs."

9.3 Classification

Lesson 9.3: True or False

Name_____ **Class**_____ **Date**_____

Write true if the statement is true or false if the statement is false.

_____ 1. Classification helps understand the present diversity and past evolutionary history of life on Earth.

_____ 2. Linnaeus grouped together organisms that shared obvious physical traits, such as number of heads or shape of toes.

_____ 3. Binomial nomenclature gives each species a unique, two-word Latin name.

_____ 4. Eukaryota consists of four kingdoms: Animalia, Plantae, Fungi, and Protista.

_____ 5. Phylogeny is the evolutionary history of a group of related organisms.

_____ 6. Organisms are currently grouped together if they look alike.

_____ 7. The Linnaean system of classification consists of a hierarchy of groupings, called domains.

_____ 8. The domain is a grouping that is larger and more inclusive than the kingdom.

_____ 9. *Homo sapiens* means "ape (primate) with big brain."

_____ 10. Most biologists agree there are four domains of life on Earth: Bacteria, Archaea, Prokaryota, and Eukaryota.

_____ 11. The evolution of life on Earth is ongoing for over 4 billion years.

_____ 12. Closely related species are grouped together in a family.

_____ 13. The kingdom is the largest and most inclusive grouping.

_____ 14. The genus is the smallest and most exclusive grouping.

_____ 15. Carolus Linnaeus developed his classification system in the early 1800s.

Lesson 9.3: Critical Reading

Name_____ **Class**_____ **Date**_____

Read these passages from the text and answer the questions that follow.

Linnaean Classification

All modern classification systems have their roots in the **Linnaean classification system.** It was developed by Swedish botanist Carolus Linnaeus in the 1700s. He tried to classify all living things that were known at his time. He grouped together organisms that shared obvious physical traits, such as number of legs or shape of leaves. For his contribution, Linnaeus is known as the "father of taxonomy." The Linnaean system of classification consists of a hierarchy of groupings, called **taxa** (singular, taxon). Taxa range from the kingdom to the species. The **kingdom** is the largest and most inclusive grouping. It consists of organisms that share just a few basic similarities. Examples

are the plant and animal kingdoms. The **species** is the smallest and most exclusive grouping. It consists of organisms that are similar enough to produce fertile offspring together. Closely related species are grouped together in a **genus.**

Binomial Nomenclature

Perhaps the single greatest contribution Linnaeus made to science was his method of naming species. This method, called **binomial nomenclature**, gives each species a unique, two-word Latin name consisting of the genus name and the species name. An example is *Homo sapiens*, the two-word Latin name for humans. It literally means "wise human." This is a reference to our big brains. Why is having two names so important? It is similar to people having a first and a last name. You may know several people with the first name Michael, but adding Michael's last name usually pins down exactly whom you mean. In the same way, having two names uniquely identifies a species.

Revisions in Linnaean Classification

Linnaeus published his classification system in the 1700s. Since then, many new species have been discovered. The biochemistry of organisms has also become known. Eventually, scientists realized that Linnaeus's system of classification needed revision. A major change to the Linnaean system was the addition of a new taxon called the domain. A **domain** is a taxon that is larger and more inclusive than the kingdom. Most biologists agree there are three domains of life on Earth: Bacteria, Archaea, and Eukaryota. Both Bacteria and Archaea consist of single-celled prokaryotes. Eukaryota consists of all eukaryotes, from single-celled protists to humans. This domain includes the Animalia (animals), Plantae (plants), Fungi (fungi), and Protista (protists) kingdoms.

Questions

1. What is Linnaeus known for?

2. What is binomial nomenclature?

3. What is a major difference between a kingdom and a species?

4. What is a domain? What are the three domains?

5. List the members of the domain Eukaryota.

Lesson 9.3: Multiple Choice

Name_____ Class_____ Date_____

Circle the letter of the correct choice.

a. Who is considered the "father of taxonomy?"
   a. Charles Darwin
   b. Carolus Linnaeus
   c. Gregor Mendel
   d. Francis Crick

b. Which of the following is in the correct order, from most inclusive to most exclusive?
   a. kingdom - family - order - species
   b. kingdom - phylum - family - species
   c. phylum - class - species - genus
   d. order - class - genus - species

c. The three domains of life include

   a. Prokaryota
   b. Eukaryota
   c. Bacteriota
   d. all of the above

d. Phylogeny refers to

   a. the evolutionary history of a group of related organisms.
   b. a group of organisms that includes an ancestor and all of its descendants.
   c. Darwin's method to classify organisms.
   d. all of the above

e. Eukaryotic organisms that are neither fungi, plants, nor animals are members of which kingdom?

   a. Animalia
   b. Plantae
   c. Fungi
   d. Protista

f. An example of binomial nomenclature would be

   a. *Homo sapiens*
   b. *Panthera tigris*
   c. *Tyrannosaurus rex*
   d. all of the above

g. Revisions in Linnaean classification were made, in part, because

   a. many species went extinct.
   b. many organisms were found to be members of the same species.
   c. of an understanding of the biochemistry of many organisms.
   d. all of the above

h. Which two domains consist only of single-celled prokaryotes?

   a. Bacteria and Archaea
   b. Bacteria and Eukaryota
   c. Archaea and Eukaryota
   d. Prokaryota and Bacteria

Lesson 9.3: Vocabulary I

Name_____ **Class**_____ **Date**_____

Match the vocabulary word with the proper definition.

Definitions

_____ 1. the science of classifying organisms

_____ 2. groupings

_____ 3. a taxon that is larger and more inclusive than the kingdom

_____ 4. grouping of closely related species

_____ 5. represents a phylogeny

_____ 6. developed classification system in the 1700s

_____ 7. the largest and most inclusive grouping

_____ 8. the smallest and most exclusive grouping

_____ 9. a group of organisms that includes an ancestor and all of its descendants

_____ 10. the evolutionary history of a group of related organisms

_____ 11. system in which modern classification systems are based

_____ 12. gives each species a unique, two-word Latin name

Terms

a. binomial nomenclature

b. Carolus Linnaeus

c. clade

d. domain

e. genus

f. kingdom

g. Linnaean classification system

h. phylogenetic tree

i. phylogeny

j. species

k. taxa

l. taxonomy

Lesson 9.3: Vocabulary II

Name_____ **Class**_____ **Date**_____

Fill in the blank with the appropriate term.

1. The science of _____ organisms is called taxonomy.
2. A hierarchy of groupings is known as a _____.
3. _____ nomenclature gives each species a unique, two-word Latin name.
4. A _____ is a new taxon that is larger and more inclusive than the kingdom.
5. The _____ is the smallest and most exclusive grouping.
6. The Bacteria and Archaea domains both consist of single-celled _____.
7. Phylogeny is the _____ history of a group of related organisms.
8. Eukaryota consists of the _____, Plantae, Fungi, and Protista kingdoms.
9. The reptile clade shows that _____ evolved from reptiles.
10. A _____ is a group of organisms that includes an ancestor and all of its descendants.
11. Bacteria, Archaea, and Eukaryota are the three _____ of life.
12. All modern classification systems have their roots in the _____ classification system.

Lesson 9.3: Critical Writing

Name_____ Class_____ Date_____

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Describe the Linnaean classification, and define binomial nomenclature.

CHAPTER 10 The Theory of Evolution Worksheets

Chapter Outline

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- **Lesson 10.1: Darwin and the Theory of Evolution**
- **Lesson 10.2: Evidence for Evolution**
- **Lesson 10.3: Microevolution and the Genetics of Populations**
- **Lesson 10.4: Macroevolution and the Origin of Species**

10.1 Darwin and the Theory of Evolution

Lesson 10.1: True or False

Name_____ Class_____ Date_____

Write true if the statement is true or false if the statement is false.

_____ 1. As recently as 200 years ago, many people believed that Earth was only 6,000 years old.

_____ 2. Artificial selection occurs when nature selects for beneficial traits.

_____ 3. The individual Galápagos Islands are all similar to each other.

_____ 4. Malthus argued that human populations grow faster than their resources.

_____ 5. Lamarck was one of the first scientists to propose that species evolve by natural selection.

_____ 6. Lyell was one of the first to say that Earth must be far older than most people believed.

_____ 7. Lamarck's inheritance of acquired characteristics is has become a widely accepted scientific theory.

_____ 8. Fossils proved to Darwin that species can evolve.

_____ 9. The term *fitness* to refer to an organism's ability to outrun its hunters.

_____ 10. Darwin published his findings soon after returning to England from the voyage of the *Beagle.*

_____ 11. According to Darwin, natural selection is what occurs, and evolution is how it happens.

_____ 12. During his journey aboard the *Beagle,* Darwin found fossils from the seas in the mountains.

_____ 13. Galápagos tortoises have differently shaped shells depending on where they live.

_____ 14. Darwin's book changed science forever.

_____ 15. Alfred Russel Wallace developed a theory of evolution at the same time as Darwin.

Lesson 10.1: Critical Reading

Name_____ Class_____ Date_____

Read these passages from the text and answer the questions that follow.

The Voyage of the *Beagle*

In 1831, when Darwin was just 22 years old, he set sail on a scientific expedition on a ship called the *HMS Beagle*. He was the naturalist on the voyage. As a naturalist, it was his job to observe and collect specimens of plants, animals, rocks, and fossils wherever the expedition went ashore.

Darwin was fascinated by nature, so he loved his job on the *Beagle*. He spent more than 3 years of the 5-year trip exploring nature on distant continents and islands. While he was away, a former teacher published Darwin's accounts of his observations. By the time Darwin finally returned to England, he had become famous as a naturalist.

Darwin's Observations

During the long voyage, Darwin made many observations that helped him form his theory of evolution. For example:

- He visited tropical rainforests and other new habitats where he saw many plants and animals he had never seen before. This impressed him with the great diversity of life.
- He experienced an earthquake that lifted the ocean floor 2.7 meters (9 feet) above sea level. He also found rocks containing fossil sea shells in mountains high above sea level. These observations suggested that continents and oceans had changed dramatically over time and continue to change in dramatic ways.
- He visited rock ledges that had clearly once been beaches that had gradually built up over time. This suggested that slow, steady processes also change Earth's surface.
- He dug up fossils of gigantic extinct mammals, such as the ground sloth. This was hard evidence that organisms looked very different in the past. It suggested that living things — like Earth's surface — change over time.

The Galápagos Islands

Darwin's most important observations were made on the **Galápagos Islands**. This is a group of 16 small volcanic islands 966 kilometers (600 miles) off the west coast of South America.

Individual Galápagos Islands differ from one another in important ways. Some are rocky and dry. Others have better soil and more rainfall. Darwin noticed that the plants and animals on the different islands also differed. For example, the giant tortoises on one island had saddle-shaped shells, while those on another island had dome-shaped shells. People who lived on the islands could even tell the island a turtle came from by its shell. This started Darwin thinking about the origin of species. He wondered how each island came to have its own type of tortoise.

Questions

1. What was Darwin's role on the *Beagle?*

2. What was significant about the new habitats Darwin visited?

3. What was significant about the rocks Darwin found in the mountains?

4. What was significant about the fossils Darwin found?

5. What did Darwin notice about life on the Galápagos Islands?

Lesson 10.1: Multiple Choice

Name_____ Class_____ Date_____

Circle the letter of the correct choice.

a. _____ developed the theory of evolution by natural selection.

   a. Alfred Russel Wallace
   b. Charles Darwin
   c. Jean Baptiste Lamarck
   d. Charles Lyell

b. The voyage of the *Beagle* circled the globe. This voyage lasted

   a. 5 months.
   b. 2 years.
   c. 4 years.
   d. 5 years.

c. Aboard the *Beagle*, Darwin served as

   a. a naturalist.
   b. the captain.
   c. the captain's first officer.
   d. the ship's doctor.

d. During the voyage of the *Beagle*, Darwin

   a. experienced an earthquake that lifted the ocean floor 9 feet.
   b. dug up fossils of gigantic extinct mammals.
   c. saw many plants and animals he had never seen before.
   d. all of the above

e. Where did Darwin make some of his most important observations that helped him develop his theory?

   a. England
   b. the Galápagos Islands
   c. South Africa
   d. South America

f. Who argued that human populations grow faster than the resources they depend on?

   a. Thomas Malthus
   b. Charles Lyell
   c. Jean Baptiste Lamarck
   d. Alfred Russel Wallace

g. One of the first scientists to propose that species change over time was

   a. Charles Darwin.
   b. Charles Lyell.
   c. Jean Baptiste Lamarck.
   d. Alfred Russel Wallace.

h. Natural selection states that

   a. a change in a species occurs over time.
   b. nature selects the variations within a species that are most useful for survival.
   c. fitness is an organism's ability to survive and produce fertile offspring.
   d. all of the above

Lesson 10.1: Vocabulary I

Name_____ **Class**_____ **Date**_____

Match the vocabulary word with the proper definition.

Definitions

_____ 1. change in species over time

_____ 2. one of the first scientists to propose that species change over time

_____ 3. ship on which Darwin served as naturalist

_____ 4. his theory of evolution unifies all of biology

_____ 5. the process by which evolution occurs

_____ 6. argued that human populations grow faster than the resources they depend on

_____ 7. small volcanic islands where Darwin made many important observations

_____ 8. selecting for plants and animals with useful traits

_____ 9. argued that gradual geological processes have gradually shaped Earth's surface

_____ 10. states that traits an organism develops during its own life time can be passed on to offspring

_____ 11. developed a theory of evolution at the same time as Darwin

_____ 12. an organism's relative ability to survive and produce fertile offspring

Terms

a. artificial selection

b. Darwin

c. evolution

d. fitness

e. Galápagos Islands

f. HMS Beagle

g. inheritance of acquired characteristics

h. Lamarck

i. Lyell

j. Malthus

k. natural selection

l. Wallace

Lesson 10.1: Vocabulary II

Name_____ **Class**_____ **Date**_____

Fill in the blank with the appropriate term.

1. In 1831, Darwin set sail on a scientific expedition on a ship called the *HMS* _____.
2. Darwin's most important observations were made on the _____ Islands.
3. Lamarck developed the idea known as the inheritance of _____ characteristics.
4. The _____ Darwin found helped convince him that species change over time.
5. The term _____ refers to an organism's ability to survive and produce fertile offspring.
6. _____ paper on evolution confirmed Darwin's ideas.
7. _____ said that Earth must be far older than most people believed.
8. Darwin was influenced by his knowledge of artificial _____.
9. Darwin proposed that _____ selects the variations in organisms that are most useful.
10. The Galápagos Islands are known for having giant _____ with differently shaped shells.
11. From Malthus, Darwin knew that populations could grow faster than their _____.
12. Darwin's theory of evolution unifies all of _____.

Lesson 10.1: Critical Writing

Name_____ Class_____ Date_____

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Explain how a species can evolve through natural selection.

10.2 Evidence for Evolution

Lesson 10.2: True or False

Name_____ Class_____ Date_____

Write true if the statement is true or false if the statement is false.

_____ 1. Fossils provide clear evidence that evolution has occurred.

_____ 2. Embryos of many different vertebrates look much more similar than the adult organisms.

_____ 3. Early horses were about the size of a fox.

_____ 4. Darwin's comparison of DNA sequences provided strong evidence of evolution.

_____ 5. Today's scientists compare the anatomy, embryos, and DNA of modern organisms to understand how they evolved.

_____ 6. Homologous structures are structures that are different in related organisms because they were inherited from a common ancestor.

_____ 7. Comparative anatomy is the study of the similarities and differences in the structures of different species.

_____ 8. Homologous embryology is the study of the similarities and differences in the embryos of different species.

_____ 9. Analogous structures are structures that are similar in related organisms.

_____ 10. Peter and Rosemary Grant were actually able to observe evolution by natural selection taking place.

_____ 11. The wings of bats and birds serve the same function and are homologous structures.

_____ 12. Adaptive radiation is when one species evolves into a new species to fill an available niche.

_____ 13. Biogeography is the study of how and why plants and animals live where they do.

_____ 14. The Galápagos finches have provided a tremendous amount of information about evolution.

_____ 15. DNA sequence similarities are the strongest evidence for evolution from a common ancestor.

Lesson 10.2: Critical Reading

Name_____ Class_____ Date_____

Read these passages from the text and answer the questions that follow.

Evidence from Biogeography

Biogeography is the study of how and why plants and animals live where they do. It provides more evidence for evolution. Let's consider the camel family as an example.

Biogeography of Camels: An Example

Today, the camel family includes different types of camels. All of today's camels are descended from the same camel ancestors. These ancestors lived in North America about a million years ago.

Early North American camels migrated to other places. Some went to East Asia. They crossed a land bridge during the last ice age. A few of them made it all the way to Africa. Others went to South America. They crossed the Isthmus of Panama. Once camels reached these different places, they evolved independently. They evolved adaptations that suited them for the particular environment where they lived. Through natural selection, descendants of the original camel ancestors evolved the diversity they have today.

Island Biogeography

The biogeography of islands yields some of the best evidence for evolution. Consider the birds called finches that Darwin studied on the Galápagos Islands. All of the finches probably descended from one bird that arrived on the islands from South America. Until the first bird arrived, there had never been birds on the islands. The first bird was a seed eater. It evolved into many finch species. Each species was adapted for a different type of food. This is an example of **adaptive radiation**. This is the process by which a single species evolves into many new species to fill available niches.

Eyewitness to Evolution

In the 1970s, biologists Peter and Rosemary Grant went to the Galápagos Islands. They wanted to re-study Darwin's finches. They spent more than 30 years on the project. Their efforts paid off. They were able to observe evolution by natural selection actually taking place. While the Grants were on the Galápagos, a drought occurred. As a result, fewer seeds were available for finches to eat. Birds with smaller beaks could crack open and eat only the smaller seeds. Birds with bigger beaks could crack and eat seeds of all sizes. As a result, many of the small-beaked birds died in the drought. Birds with bigger beaks survived and reproduced. Within 2 years, the average beak size in the finch population increased. Evolution by natural selection had occurred.

Questions

1. What is biogeography and what does it provide?

2. Where do all camels come from?

3. Why did camels evolve?

4. What is adaptative radiation? Give an example.

5. What did the Grants study? What did they observe?

Lesson 10.2: Multiple Choice

Name_____ Class_____ Date_____

Circle the letter of the correct choice.

a. Evidence of evolution includes
   a. DNA sequence analysis.
   b. the fossil record.
   c. anatomical evidence.
   d. all of the above

b. Which of the following is true about horse evolution? (1) Early horses were about the size of a fox. (2) Early horses had toes. (3) During evolution, their molars became covered with cement.
   a. 1 only
   b. 1 and 2
   c. 2 and 3

   d. 1, 2, and 3

c. Examples of analogous structures are

   a. the tails of mice and rats.
   b. the limbs of humans and apes.
   c. the wings of bats and birds.
   d. all of the above

d. An example of a vestigial structure is the

   a. kangaroo pouch.
   b. human tail bone.
   c. cat forelimb.
   d. all of the above

e. The strongest evidence for evolution from a common ancestor is

   a. similar DNA sequences.
   b. similar body structures.
   c. similar embryological structures.
   d. similar fossils.

f. Island biogeography

   a. provides information on the migration and evolution of the camel.
   b. provides information on the migration and evolution of the finch.
   c. provides information on the migration and evolution of the ape.
   d. none of the above

g. Biogeography shows that all camels

   a. came from ancestors that lived in North Africa.
   b. came from ancestors that lived in North America.
   c. came from ancestors that lived in North Egypt.
   d. evolved from the llama.

h. Peter and Rosemary Grant

   a. spent more than 30 years studying Darwin's tortoises.
   b. studied the migration of the camel.
   c. actually observed evolution by natural selection taking place.
   d. all of the above

Lesson 10.2: Vocabulary I

Name_____ **Class**_____ **Date**_____

Match the vocabulary word with the proper definition.

Definitions

_____ 1. the strongest evidence for evolution from a common ancestor

_____ 2. shows how organisms are related by descent from common ancestors

_____ 3. structures that are similar in related organisms because they were inherited from a common ancestor

_____ 4. scientists who find and study fossils

_____ 5. structures that are similar in unrelated organisms

_____ 6. provide clear evidence that evolution has occurred

_____ 7. reduced structures that are no longer used

_____ 8. the process by which a single species evolves into many new species to fill available niches

_____ 9. the study of the similarities and differences in the embryos of different species

_____ 10. the study of how and why plants and animals live where they do

_____ 11. the study of the similarities and differences in the structures of different species

Terms

a. adaptive radiation

b. analogous structure

c. biogeography

d. cladogram

e. comparative anatomy

f. comparative embryology

g. DNA sequences

h. fossils

i. homologous structure

j. paleontologist

k. vestigial structure

Lesson 10.2: Vocabulary II

Name_____ **Class**_____ **Date**_____

Fill in the blank with the appropriate term.

1. Humans and apes are evolutionarily closely related, based on analysis of their _____ sequences.

2. Wings of bats and birds serve the same function and are _____ structures.

3. Comparative _____ is the study of the similarities and differences in the structures of different species.

4. _____ demonstrate that during the evolution of the whale, the whale moved from land into the sea.

5. The human tail bone and appendix are _____ structures.

6. _____ structures are structures that are similar in related organisms because they were inherited from a common ancestor.

7. Comparative _____ is the study of the similarities and differences in the embryos of different species.

8. Early North American camels migrated to other places, some crossing a land bridge during the last _____.

9. The forelimbs of all mammals have the same basic bone _____.

10. _____ who find and study fossils are called paleontologists.

11. Peter and Rosemary Grant studied Darwin's _____ in the Galápagos Islands.

12. The biogeography of _____ yields some of the best evidence for evolution.

Lesson 10.2: Critical Writing

Name_____ Class_____ Date_____

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Describe how fossils help us understand the past. Provide an example.

10.3 Microevolution and the Genetics of Populations

Lesson 10.3: True or False

Name_____ **Class**_____ **Date**_____

Write true if the statement is true or false if the statement is false.

_____ 1. The fossil record reflects macroevolution.

_____ 2. Population genetics is a combination of evolutionary theory and Darwinian genetics.

_____ 3. For a gene with two alleles, if the frequency of one allele is 0.65, the frequency of the other allele is 0.30.

_____ 4. Hardy-Weinberg equilibrium can exist only in populations undergoing normal natural selection.

_____ 5. A forest fire can result in a bottleneck effect.

_____ 6. Individuals with sickle-cell anemia have a high fitness because they are resistant to malaria.

_____ 7. Natural selection causes allele frequencies to change.

_____ 8. Microevolution occurs over a very long period of time within a population or species.

_____ 9. Mutation creates new genetic variation in a gene pool.

_____ 10. Hardy-Weinberg equilibrium can only occur in a very small population.

_____ 11. Inbreeding in certain populations, together with the founder effect, can result in rare phenotypes within the population.

_____ 12. Directional selection occurs when one of two extreme phenotypes is selected for.

_____ 13. Hardy-Weinberg equilibrium conditions rarely occur in real populations.

_____ 14. Emigration results in gene flow.

_____ 15. Disruptive selection occurs when phenotypes at both extremes of the phenotypic distribution are selected against.

Lesson 10.3: Critical Reading

Name_____ **Class**_____ **Date**_____

Read these passages from the text and answer the questions that follow.

Forces of Evolution

The conditions for Hardy-Weinberg equilibrium are unlikely to be met in real populations. The Hardy-Weinberg theorem also describes populations in which allele frequencies are not changing. By definition, such populations are not evolving. How does the theorem help us understand evolution in the real world?

From the theorem, we can infer factors that cause allele frequencies to change. These factors are the forces of evolution. There are four such forces: mutation, gene flow, genetic drift, and natural selection.

Mutation

Mutation creates new genetic variation in a gene pool. It is how all new alleles first arise. In sexually reproducing species, the mutations that matter for evolution are those that occur in gametes. Only these mutations can be passed to offspring. For any given gene, the chance of a mutation occurring in a given gamete is very low. Thus, mutations alone do not have much effect on allele frequencies. However, mutations provide the genetic variation needed for other forces of evolution to act.

Gene Flow

Gene flow occurs when people move into or out of a population. If the rate of migration is high, this can have a significant effect on allele frequencies. Both the population they leave and the population they enter may change.

During the Vietnam War in the 1960s and 1970s, many American servicemen had children with Vietnamese women. Most of the servicemen returned to the United States after the war. However, they left copies of their genes behind in their offspring. In this way, they changed the allele frequencies in the Vietnamese gene pool. Was the gene pool of the American population also affected? Why or why not?

Genetic Drift

Genetic drift is a random change in allele frequencies that occurs in a small population. When a small number of parents produce just a few offspring, allele frequencies in the offspring may differ, by chance, from allele frequencies in the parents. This is like tossing a coin. If you toss a coin just a few times, you may by chance get more or less than the expected 50 percent heads or tails. In a small population, you may also by chance get different allele frequencies than expected in the next generation. In this way, allele frequencies may drift over time. Genetic drift occurs under two special conditions. They are called bottleneck effect and founder effect.

a. Bottleneck effect occurs when a population suddenly gets much smaller. This might happen because of a natural disaster, such as a forest fire. By chance, allele frequencies of the survivors may be different from those of the original population.
b. Founder effect occurs when a few individuals start, or found, a new population. By chance, allele frequencies of the founders may be different from allele frequencies of the population they left.

Questions

1. What are the forces of evolution?

2. Describe the type of mutations that affect evolution. Why?

3. Was the gene pool of the American population also affected by the gene flow described above? Why or why not?

4. What is genetic drift?

5. Describe one special condition under which genetic drift occurs.

Lesson 10.3: Multiple Choice

Name_____ Class_____ Date_____

Circle the letter of the correct choice.

a. The main difference between macroevolution and microevolution is
   a. the time frame of the evolutionary process.
   b. the species that evolve during each.
   c. that microevolution is only for small organisms, and macroevolution is for large organisms.
   d. all of the above

b. Which of the following statements is correct?
   a. Individuals do not evolve, genes do evolve.
   b. Individuals do not evolve, populations do evolve.
   c. Populations do not evolve, individuals do evolve.

d. Populations do not evolve, species do evolve.

c. Which of the following statements is true concerning mutations? (1) Mutations are how all new alleles first arise. (2) Mutations create new genetic variation in a gene pool. (3) Only mutations that occur in gametes influence evolution. (4) Mutations really do not have much influence on allele frequencies.

   a. 1 and 2
   b. 2 and 4
   c. 1, 2, and 3
   d. 1, 2, 3, and 4

d. In a population with 100 members, the total number of copies of each gene in the population is

   a. 50.
   b. 100.
   c. 200.
   d. 400.

e. In a population with 100 members, if there are 120 dominant alleles, how many recessive alleles are there?

   a. 60
   b. 80
   c. 120
   d. 240

f. In a population with 100 members, if 9 individuals have the recessive phenotype, how many individuals are heterozygous?

   a. 9
   b. 21
   c. 42
   d. 70

g. The forces of evolution include

   a. natural selection.
   b. gene drift.
   c. genetic flow.
   d. all of the above

h. Which of the following describes disruptive selection?

   a. Selection that occurs when one of two extreme phenotypes is selected for.
   b. Selection that occurs when phenotypes at both extremes of the phenotypic distribution are selected against.
   c. Selection that occurs when phenotypes in the middle of the range are selected against.
   d. Selection that occurs when one phenotype is disrupted and goes extinct.

Lesson 10.3: Vocabulary I

Name_____ **Class**_____ **Date**_____

Match the vocabulary word with the proper definition.

Definitions

_____ 1. consists of all the genes of all the members of the population

_____ 2. creates new genetic variation in a gene pool

_____ 3. occurs over geologic time above the level of the species

_____ 4. occurs when one of two extreme phenotypes is selected for

_____ 5. refers to differences between the phenotypes of males and females of the same species

_____ 6. occurs when phenotypes in the middle of the range are selected against

_____ 7. occurs when people move into or out of a population

_____ 8. occurs over a relatively short period of time within a population or species

_____ 9. occurs when phenotypes at both extremes of the phenotypic distribution are selected against

_____ 10. how often an allele occurs in a gene pool relative to the other alleles for that gene

_____ 11. the science that focuses on evolution within populations

_____ 12. shows that allele frequencies do not change in a population if certain conditions are met

Terms

a. allele frequency

b. directional selection

c. disruptive selection

d. gene flow

e. gene pool

f. Hardy-Weinberg theorem

g. macroevolution

h. microevolution

i. mutation

j. population genetics

k. sexual dimorphism

l. stabilizing selection

Lesson 10.3: Vocabulary II

Name_____ Class_____ Date_____

Fill in the blank with the appropriate term.

1. _____ occurs over a relatively short period of time within a population or species.

2. _____ occurs over geologic time above the level of the species.

3. The _____ theorem shows that allele frequencies do not change in a population if certain conditions are met.

4. Natural selection occurs when there are differences in _____ among members of a population.

5. Genetic _____ is a random change in allele frequencies that occurs in a small population.

6. The gene _____ consists of all the genes of all the members of the population.

7. Mutation creates new _____ variation in a gene pool.

8. Gene _____ occurs when people move into or out of a population.

9. Allele _____ is how often an allele occurs in a gene pool.

10. _____ selection occurs when one of two extreme phenotypes is selected for.

11. _____ selection occurs when phenotypes in the middle of the range are selected against.

12. Population _____ focuses on evolution within populations.

Lesson 10.3: Critical Writing

Name_____ **Class**_____ **Date**_____

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Distinguish between microevolution and macroevolution.

10.4 Macroevolution and the Origin of Species

Lesson 10.4: True or False

Name_____ Class_____ Date_____

Write true if the statement is true or false if the statement is false.

_____ 1. The process by which a new species evolves is called speciation.

_____ 2. For a new species to arise, members of a species must no longer be able to breed with each other.

_____ 3. Coevolution occurs when members of one species evolve independently of a symbiotic species.

_____ 4. Darwin believed evolution occurred both through gradualism and punctuated equilibrium.

_____ 5. Geographic separation usually leads to sympatric speciation.

_____ 6. A new river separating a population can result in allopatric speciation.

_____ 7. When geologic and climatic conditions are stable, punctuated equilibrium occurs.

_____ 8. The hummingbird and the flower it pollinates have coevolved.

_____ 9. When geologic and climatic conditions are changing, evolution may occur more quickly. This is known as gradualism.

_____ 10. Hawthorn flies are undergoing geographic separation.

_____ 11. During coevolution, as one species changes, the other species goes extinct.

_____ 12. The Kaibab squirrel is in the process of allopatric speciation.

_____ 13. A new mountain range or canyon separating a population can result in sympatric speciation.

_____ 14. A species is a group of organisms that can breed and produce fertile offspring.

_____ 15. Punctuated equilibrium is a relatively slow process.

Lesson 10.4: Critical Reading

Name_____ Class_____ Date_____

Read these passages from the text and answer the questions that follow.

Introduction

Macroevolution is evolution over geologic time above the level of the species. One of the main topics in macroevolution is how new species arise. The process by which a new species evolves is called **speciation**. How does speciation occur? How does one species evolve into two or more new species?

Origin of Species

To understand how a new species forms, it's important to review what a species is. A species is a group of organisms that can breed and produce fertile offspring together in nature. For a new species to arise, some members of a species

must become reproductively isolated from the rest of the species. This means they can no longer interbreed with other members of the species. How does this happen? Usually they become geographically isolated first.

Allopatric Speciation

Assume that some members of a species become geographically separated from the rest of the species. If they remain separated long enough, they may evolve genetic differences. If the differences prevent them from interbreeding with members of the original species, they have evolved into a new species. Speciation that occurs in this way is called **allopatric speciation**.

Sympatric Speciation

Less often, a new species arises without geographic separation. This is called **sympatric speciation**. The following example shows one way this can occur.

a. Hawthorn flies lay eggs in hawthorn trees. The eggs hatch into larvae that feed on hawthorn fruits. Both the flies and trees are native to the U.S.
b. Apple trees were introduced to the U.S. and often grow near hawthorn trees. Some hawthorn flies started to lay eggs in nearby apple trees. When the eggs hatched, the larvae fed on apples.
c. Over time, the two fly populations — those that fed on hawthorn trees and those that preferred apple trees — evolved reproductive isolation. Now they are reproductively isolated because they breed at different times. Their breeding season matches the season when the apple or hawthorn fruits mature.
d. Because they rarely interbreed, the two populations of flies are evolving other genetic differences. They appear to be in the process of becoming separate species.

Questions

1. What is a species?

2. What is speciation?

3. How do new species arise?

4. Describe allopatric speciation.

5. Describe sympatric speciation. Provide an example.

Lesson 10.4: Multiple Choice

Name_____ Class_____ Date_____

Circle the letter of the correct choice.

a. Which statement best describes allopatric speciation?

   a. Speciation that occurs without reproductive separation.
   b. Speciation that occurs without geographic separation.
   c. Speciation that occurs when some members of a species become geographically separated from the rest of the species.
   d. Speciation that occurs when some members of a species become reproductively separated from the rest of the species.

b. Which statement best describes sympatric speciation?

   a. Speciation that occurs without reproductive separation.
   b. Speciation that occurs without geographic separation.

   c. Speciation that occurs when some members of a species become geographically separated from the rest of the species.
   d. Speciation that occurs when some members of a species become reproductively separated from the rest of the species.

c. Which is the best definition of a "species"?

   a. A group of organisms that can breed and produce fertile offspring together.
   b. A group of organisms that can breed and produce infertile offspring together.
   c. A group of organisms that can breed together.
   d. A group of organisms that look and act similar.

d. An example of coevolution would be

   a. the evolution of wings in bats and birds.
   b. the toad and the flies they eat.
   c. the hummingbird and the tubular flower it pollinates.
   d. all of the above

e. Which statement is true concerning gradualism? (1) Gradualism occurs when geologic and climatic conditions are stable. (2) Darwin thought evolution occurred this way. (3) This type of evolution may result in long periods of little change.

   a. 1 only
   b. 1 and 2
   c. 1 and 3
   d. 1, 2, and 3

f. Punctuated equilibrium is

   a. well supported by the fossil record.
   b. a slow form of evolution.
   c. how Darwin proposed evolution occurs.
   d. none of the above

g. The hawthorn fly

   a. is undergoing allopatric speciation.
   b. can live on either hawthorn trees or apple trees.
   c. has been geographically separated by the planting of new tree species.
   d. all of the above

h. The Kaibab squirrel

   a. is undergoing allopatric speciation.
   b. is undergoing sympatric speciation.
   c. were geographically separated from Abert's squirrels by the formation of the Grand Canyon.
   d. both a and c

Lesson 10.4: Vocabulary I

Name_____ **Class**_____ **Date**_____

Match the vocabulary word with the proper definition.

Definitions

_____ 1. a group of organisms that can breed and produce fertile offspring

_____ 2. when a new species arises without geographic separation

_____ 3. the process by which a new species evolves

_____ 4. when some members of a species become geographically separated from the rest of the species

_____ 5. evolution over geologic time above the level of the species

_____ 6. when species in symbiotic relationships evolve together

_____ 7. evolution that occurs gradually

_____ 8. evolution that occurs quickly

Terms

a. allopatric speciation

b. coevolution

c. gradualism

d. macroevolution

e. punctuated equilibrium

f. speciation

g. species

h. sympatric speciation

Lesson 10.4: Vocabulary II

Name_____ Class_____ Date_____

Fill in the blank with the appropriate term.

1. _____ is slow, gradual evolution.

2. _____ equilibrium is illustrated by bursts of rapid change.

3. The very long mouth part of the hummingbird has _____ with the tubular flower it pollinates.

4. _____ speciation is speciation without geographic separation.

5. _____ speciation may occur when some members of a species become geographically separated from the rest of the species.

6. Evolution occurs in response to a change in the _____.

7. A _____ is a group of organisms that can breed and produce fertile offspring.

8. New species arise in the process of _____.

9. In coevolution, as one species changes, the other species must also change in order to _____.

10. Macroevolution is evolution over _____ time.

Lesson 10.4: Critical Writing

Name_____ Class_____ Date_____

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Describe two ways that new species may evolve.

CHAPTER 11 The Principles of Ecology Worksheets

Chapter Outline

(Opening image courtesy of the National Science Foundation, http://www.nsf.gov/news/overviews/earth-environ/assets/interact06.jpg, and under the public domain.)

- **Lesson 11.1: The Science of Ecology**
- **Lesson 11.2: Recycling Matter**
- **Lesson 11.3: Biomes**

11.1 The Science of Ecology

Lesson 11.1: True or False

Name_____ **Class**_____ **Date**_____

Write true if the statement is true or false if the statement is false.

_____ 1. Biotic factors include sunlight, soil, temperature, and water.

_____ 2. Like nutrients and water, energy also recycles through an ecosystem.

_____ 3. An ecosystem consists of all the biotic and abiotic factors in an area and their interactions.

_____ 4. Herbivores are a necessary link between producers and other consumers.

_____ 5. A niche refers to the place an organism lives within its ecosystem.

_____ 6. Dung beetles eat animal feces.

_____ 7. Autotrophs make their own food.

_____ 8. Organisms use 90% of the available energy at each trophic level.

_____ 9. Carnivores include lions, polar bears, hawks, frogs, salmon, and deer.

_____ 10. Biomass increases at the upper levels of a food chain.

_____ 11. Producers occupy the first trophic level.

_____ 12. Scavengers include vultures and raccoons.

_____ 13. In a complex ecosystem, it is likely that two different species will occupy the same niche.

_____ 14. The habitat is the role of a species in its ecosystem.

_____ 15. A food web shows how energy flows through an ecosystem.

Lesson 11.1: Critical Reading

Name_____ **Class**_____ **Date**_____

Read these passages from the text and answer the questions that follow.

Trophic Levels

The feeding positions in a food chain or web are called **trophic levels**. The different trophic levels are defined in **Table** 11.1. All food chains and webs have at least two or three trophic levels. Generally, there are a maximum of four trophic levels. Examples are also given in the table.

TABLE 11.1: Trophic Levels

Trophic Level	Where It Gets Food	Example
1st Trophic Level: Producer	Makes its own food	Plants make food

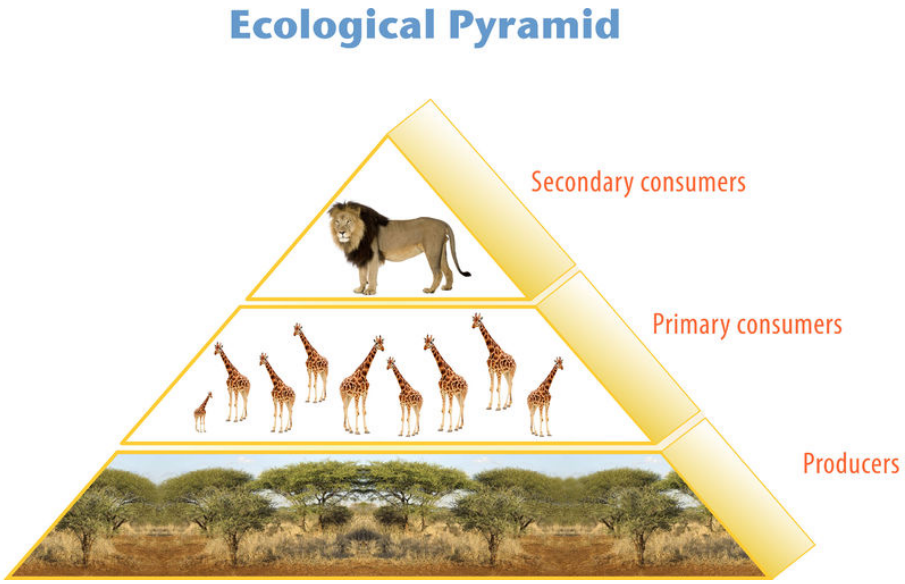
TABLE 11.1: (continued)

Trophic Level	Where It Gets Food	Example
2nd Trophic Level: Primary Consumer	Consumes producers	Mice eat plant seeds
3rd Trophic Level: Secondary Consumer	Consumes primary consumers	Snakes eat mice
4th Trophic Level: Tertiary Consumer	Consumes secondary consumers	Hawks eat snakes

Many consumers feed at more than one trophic level. Humans, for example, are primary consumers when they eat plants such as vegetables. They are secondary consumers when they eat cows. They are tertiary consumers when they eat salmon.

Trophic Levels and Energy

Energy is passed up a food chain or web from lower to higher trophic levels. However, only about 10 percent of the energy at one level is available to the next level. This is represented by the pyramid below. What happens to the other 90 percent of energy? It is used for metabolic processes or given off to the environment as heat. This loss of energy explains why there are rarely more than four trophic levels in a food chain or web. Sometimes there may be a fifth trophic level, but usually there's not enough energy left to support any additional levels.



Ecological Pyramid. This pyramid shows how energy and biomass decrease from lower to higher trophic levels. Assume that producers in this pyramid have 1,000,000 kilocalories of energy. How much energy is available to primary consumers? *(Images of lion and landscape copyright by Eric Isselée, 2010, and image of giraffe copyright Kletr, 2010. Used under licenses from Shutterstock.com. Compilation created by CK-12 Foundation.)*

Trophic Levels and Biomass

With less energy at higher trophic levels, there are usually fewer organisms as well. Organisms tend to be larger in size at higher trophic levels, but their smaller numbers result in less biomass. **Biomass** is the total mass of organisms at a trophic level. The decrease in biomass from lower to higher levels is also represented by the figure above.

Questions

1. What is a trophic level?

2. Which trophic level includes humans?

3. What types of organisms are in the first trophic level? Give an example.

4. Assume that producers in an ecosystem have 1,000,000 kilocalories of energy. How much energy is available to primary consumers?

5. Which trophic level has the greatest biomass?

Lesson 11.1: Multiple Choice

Name_____ Class_____ Date_____

Circle the letter of the correct choice.

a. Examples of biotic factors include

   a. grass, flowers, and sunlight
   b. grass, trees, bees, and ants.
   c. grass, trees, soil, and water.
   d. all of the above

b. Components of an ecosystem include

   a. soil, sunlight, water, and weather.
   b. grass, trees, bees, and ants.
   c. all the biotic and abiotic factors in an area.
   d. all of the above.

c. Which describes the possible flow of energy in an ecosystem?

   a. snakes to frogs to caterpillars to trees
   b. trees to frogs to snakes to caterpillars
   c. trees to caterpillars to frogs to snakes
   d. caterpillars to trees to frogs to snakes

d. The relationship between autotrophs and producers is

   a. that autotrophs make the food the producers eat.
   b. that producers make the food the autotrophs eat.
   c. that autotrophs eat producers.
   d. that they are the same organisms.

e. Which statement best describes a trophic level?

   a. A trophic level is the feeding position of an organism in a food chain or web.
   b. A trophic level is the position of an organism in an ecosystem.
   c. A trophic level is the niche of an organism in an ecosystem.
   d. A trophic level is the feeding role of an organism in an ecosystem.

f. Examples of decomposers include

   a. algae and cyanobacteria.
   b. earthworms, dung beetles, and spiders.
   c. vultures and raccoons.
   d. all of the above.

g. Which organism would usually be in the fourth trophic level?

a. rats
b. humans
c. rabbits
d. hawks

h. Which statement best defines ecology?

a. The study of how living things interact with each other.
b. The study of how living things interact with each other and with their environment.
c. The study of how living things interact with their environment.
d. The study of how living things interact with their habitat.

Lesson 11.1: Vocabulary I

Name_____ **Class**_____ **Date**_____

Match the vocabulary word with the proper definition.

Definitions

_____ 1. represents a single pathway through which energy and matter flow

_____ 2. feeding positions in a food chain or web

_____ 3. the living aspects of the environment

_____ 4. the role of a species in its ecosystem

_____ 5. consumes the soft tissues of dead animals

_____ 6. the physical environment in which a species lives

_____ 7. represents multiple pathways through which energy and matter flow

_____ 8. states that two different species cannot occupy the same niche in the same place for very long

_____ 9. the nonliving aspects of the environment

_____ 10. the study of how living things interact with each other and with their environment

_____ 11. the total mass of organisms at a trophic level

_____ 12. break down remains and other wastes, and release simple inorganic molecules back to the environment

_____ 13. consumes both plants and animals

_____ 14. consumes animals

_____ 15. consumes producers

Terms

a. abiotic factor

b. biomass

c. biotic factor

d. carnivore

e. competitive exclusion principle

f. decomposer

g. ecology

h. food chain

i. food web

j. habitat

k. herbivore

l. niche

m. omnivore

n. scavenger

p. trophic level

Lesson 11.1: Vocabulary II

Name_____ **Class**_____ **Date**_____

Fill in the blank with the appropriate term.

1. Abiotic factors are the _____ aspects of the environment.
2. _____ are organisms that produce food for themselves and other organisms.
3. Scavengers consume the soft tissues of _____ animals.
4. _____ levels are the positions in a food chain or food web
5. Ecosystems require constant inputs of _____ from sunlight or chemicals.
6. Omnivores consume both _____ and animals.
7. The competitive _____ principle states that two different species cannot occupy the same niche.
8. Producers are also called _____.
9. _____ feed on dead leaves and animal feces, among other debris.
10. Examples of _____ are lions, polar bears, and hawks.
11. _____ are organisms that depend on other organisms for food.
12. An _____ consists of all the biotic and abiotic factors in an area and their interactions.

Lesson 11.1: Critical Writing

Name_____ **Class**_____ **Date**_____

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Describe how energy flows through ecosystems.

11.2 Recycling Matter

Lesson 11.2: True or False

Name_____ **Class**_____ **Date**_____

Write true if the statement is true or false if the statement is false.

_____ 1. Just like energy, matter is lost as it passes through an ecosystem.

_____ 2. Sublimation occurs when water changes to water vapor.

_____ 3. Part of a cycle that holds an element or water for a short period of time is a reservoir pool.

_____ 4. The deep ocean store carbon for thousands of years or more.

_____ 5. The ocean is a reservoir for water.

_____ 6. Photosynthesis removes carbon dioxide from the atmosphere.

_____ 7. The water on Earth is billions of years old.

_____ 8. Oxygen makes up most of Earth's atmosphere.

_____ 9. Transpiration occurs when plants release water vapor through their stomata.

_____ 10. Nitrogen fixation is done by by nitrogen-fixing plants.

_____ 11. Cellular respiration releases oxygen into the atmosphere as carbon dioxide.

_____ 12. Water droplets fall from the atmosphere as condensation.

_____ 13. The water cycle takes place on, above, and below Earth's surface.

_____ 14. Carbon cycles quickly between organisms and the atmosphere.

_____ 15. Plants use nitrogen gas from the air to make organic compounds.

Lesson 11.2: Critical Reading

Name_____ **Class**_____ **Date**_____

Read these passages from the text and answer the questions that follow.

Introduction

Where does the water that is needed by your cells come from? Or the carbon and nitrogen that is needed to make your organic molecules? Unlike energy, matter is not lost as it passes through an ecosystem. Instead, matter is recycled. This recycling involves specific interactions between the biotic and abiotic factors in an ecosystem.

Biogeochemical Cycles

The chemical elements and water that are needed by organisms continuously recycle in ecosystems. They pass through biotic and abiotic components of the biosphere. That's why their cycles are called **biogeochemical cycles**. For example, a chemical might move from organisms ("bio") to the atmosphere or ocean ("geo") and back to

organisms again. Elements or water may be held for various periods of time in different parts of a cycle.

- Part of a cycle that holds an element or water for a short period of time is called an **exchange pool**. For example, the atmosphere is an exchange pool for water. It usually holds water (in the form of water vapor) for just a few days.
- Part of a cycle that holds an element or water for a long period of time is called a **reservoir**. The ocean is a reservoir for water. The deep ocean may hold water for thousands of years.

Questions

1. Why is matter not lost as it passes through an ecosystem?

2. What is a biogeochemical cycle?

3. What is an exchange pool? Give an example.

4. What is a reservoir? Give an example.

Lesson 11.2: Multiple Choice

Name_____ Class_____ Date_____

Circle the letter of the correct choice.

a. Which statement best describes a biogeochemical cycle?
   a. A cycle that recycles chemical elements and water.
   b. A cycle that continuously cycles chemical elements and water.
   c. A cycle that continuously cycles chemical elements and water that are needed by organisms.
   d. A cycle that continuously cycles chemical elements and water that are needed by organisms through an ecosystem.

b. An example of an exchange pool is
   a. the atmosphere for water.
   b. the ocean for water.
   c. the Earth for carbon.
   d. all of the above.

c. The relationship between condensation and precipitation is that
   a. precipitation needs to occur prior to condensation.
   b. condensation needs to occur prior to precipitation.
   c. both are parts of the water cycle.
   d. both b and c describe the relationship.

d. The best description of the relationship between runoff and groundwater is that
   a. runoff turns into groundwater.
   b. groundwater turns into runoff.
   c. both result from precipitation and may end up in bodies of water.
   d. none of the above

e. Nitrogen fixation
   a. is the process of changing nitrogen gas to nitrates.
   b. is the process of changing nitrates to nitrogen gas.
   c. is carried out by nitrogen-fixing plants.
   d. naturally occurs in the atmosphere.

f. In terms of carbon and the atmosphere, autotrophs
   a. remove carbon through photosynthesis and release carbon by cellular respiration.
   b. remove carbon through cellular respiration and release carbon by photosynthesis.
   c. remove oxygen through photosynthesis but release carbon by cellular respiration.
   d. only remove carbon through photosynthesis.

g. Which statement is correct?
   a. Nitrogen must cycle through an ecosystem because it is used to make proteins and nucleic acids.
   b. Nitrogen makes up most of Earth's atmosphere.
   c. Nitrogen gas from the atmosphere cannot be used by plants to make organic compounds.
   d. all of the above

h. Which statement is correct?
   a. Fossil fuels can store carbon for millions of years, and release carbon when burned.
   b. Fossil fuels can store carbon for millions of years, and release oxygen when burned.
   c. Fossil fuels can store oxygen for millions of years, and release carbon when burned.

d. Fossil fuels can store nitrogen for millions of years, and release nitrogen when burned.

Lesson 11.2: Vocabulary I

Name_____ Class_____ Date_____

Match the vocabulary word with the proper definition.

Definitions

_____ 1. cycles that recycle chemical elements and water needed by organisms

_____ 2. precipitation that falls on land and soaks into the ground

_____ 3. rain, snow, sleet, hail, or freezing rain

_____ 4. moves nitrogen back and forth between the atmosphere and organisms

_____ 5. includes the atmosphere, living organisms, and fossil fuel deposits

_____ 6. occurs when plants release water vapor through leaf pores

_____ 7. part of a cycle that holds an element or water for a long period of time

_____ 8. an underground layer of rock that stores water

_____ 9. precipitation that falls on land and flows over the surface of the ground

_____ 10. occurs when water on the surface changes to water vapor

_____ 11. occurs when ice and snow change directly to water vapor

_____ 12. the process in which water vapor changes to tiny droplets of liquid water

_____ 13. a global cycle that takes place on, above, and below the Earth's surface

_____ 14. the process of changing nitrogen gas to nitrates

Terms

a. aquifer

b. biogeochemical cycle

c. carbon cycle

d. condensation

e. evaporation

f. groundwater

g. nitrogen cycle

h. nitrogen fixation

i. precipitation

j. reservoir

k. runoff

l. sublimation

m. transpiration

n. water cycle

Lesson 11.2: Vocabulary II

Name_____ **Class**_____ **Date**_____

Fill in the blank with the appropriate term.

1. The _____ of matter involves specific interactions between the biotic and abiotic factors in an ecosystem.
2. Water on _____ is billions of years old.
3. An exchange pool holds an element or water for a _____ period.
4. _____ occurs when plants release water vapor through stomata.
5. A _____ holds an element or water for a long period.
6. Carbon is stored in the atmosphere, in living organisms, and as _____ fuel deposits.
7. _____ occurs when water on the surface changes to water vapor.
8. The nitrogen cycle moves nitrogen through the _____ and _____ parts of ecosystems.
9. Nitrogen makes up _____ percent of Earth's atmosphere.
10. _____ is the process in which water vapor changes to tiny droplets of liquid water.
11. Water released by plants is a product of _____.
12. Sublimation occurs when ice and snow change directly to _____.

Lesson 11.2: Critical Writing

Name_____ **Class**_____ **Date**_____

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Give an overview of the carbon cycle, focusing on the role of photosynthesis and cellular respiration.

11.3 Biomes

Lesson 11.3: True or False

Name_____ **Class**_____ **Date**_____

Write true if the statement is true or false if the statement is false.

_____ 1. Biomes may be terrestrial, aquatic, or atmospheric.

_____ 2. Temperature gets cooler as you move away from the equator.

_____ 3. Terrestrial biomes include all the land and water areas on Earth where organisms live.

_____ 4. Sunlight penetrates roughly 200 meters into the water.

_____ 5. Climate is the average weather in an area over a long period of time.

_____ 6. The growing season may last all year in a hot, wet climate.

_____ 7. Temperature refers to the conditions of the atmosphere from day to day.

_____ 8. Phytoplankton are tiny animals that feed on zooplankton.

_____ 9. Climate determines plant growth.

_____ 10. The terrifying anglerfish lives between 100 and 400 feet below sea level.

_____ 11. Plankton are tiny aquatic organisms that swim around in the photic zone.

_____ 12. The photic zone is water deeper than 200 meters.

_____ 13. The boreal forest in central Alaska has low biodiversity.

_____ 14. Aquatic biomes in the ocean are called marine biomes.

_____ 15. When aquatic organisms die, they sink to the bottom, so water near the bottom may contain more nutrients than water at other depths.

Lesson 11.3: Critical Reading

Name_____ **Class**_____ **Date**_____

Read these passages from the text and answer the questions that follow.

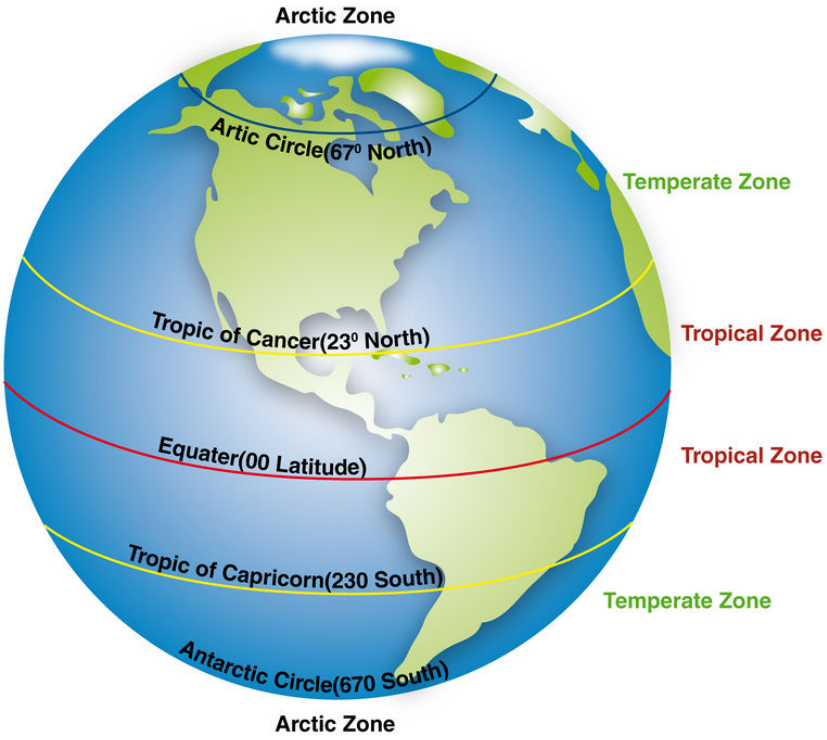
Terrestrial Biomes

Terrestrial biomes include all the land areas on Earth where organisms live. The distinguishing features of terrestrial biomes are determined mainly by climate. Terrestrial biomes include tundras, temperate forests and grasslands, chaparral, temperate and tropical deserts, and tropical forests and grasslands.

Terrestrial Biomes and Climate

Climate is the average weather in an area over a long period of time. Weather refers to the conditions of the atmosphere from day to day. Climate is generally described in terms of temperature and moisture. Temperature

falls from the equator to the poles. Therefore, major temperature zones are based on latitude. They include tropical, temperate, and arctic zones (see figure below). However, other factors besides latitude may also influence temperature. For example, land near the ocean may have cooler summers and warmer winters than land farther inland. This is because water gains and loses heat more slowly than does land, and the water temperature influences the temperature on the coast. Temperature also falls from lower to higher altitudes. That's why tropical zone mountaintops may be capped with snow.



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In terms of moisture, climates can be classified as arid (dry), semi-arid, humid (wet), or semi-humid. The amount of moisture depends on both precipitation and evaporation. Precipitation increases moisture. Evaporation decreases moisture.

Climate and Plant Growth

Plants are the major producers in terrestrial biomes. They have five basic needs: air, warmth, sunlight, water, and nutrients. How well these needs are met in a given location depends on the growing season and soil quality, both of which are determined mainly by climate.

- The **growing season** is the period of time each year when it is warm and wet enough for plants to grow. The growing season may last all year in a hot, wet climate but just a few months in a cooler or drier climate.
- Plants grow best in soil that contains plenty of nutrients and organic matter. Both are added to soil when plant litter and dead organisms decompose. Decomposition occurs too slowly in cold climates and too quickly in hot, wet climates for nutrients and organic matter to accumulate. Temperate climates usually have the best soil for plant growth.

Questions

1. What is a terrestrial biome? Give two examples.

2. What is the difference between climate and weather?

3. How do precipitation and evaporation affect climate?

4. How does climate determine plant growth?

5. What do plants need to grow? How are these needs affected by climate?

Lesson 11.3: Multiple Choice

Name_____ Class_____ Date_____

Circle the letter of the correct choice.

a. A biome is
   a. a group of similar ecosystems with the same general abiotic factors and primary producers and consumers.
   b. a group of similar ecosystems with the same general abiotic factors and primary producers.
   c. a group of similar ecosystems with the same general abiotic factors.
   d. a group of similar ecosystems with the same general biotic factors.

b. Climate is _____, whereas weather is _____.
   a. the conditions of the habitat from day to day, the average weather in an area over a long period of time.
   b. the conditions of the atmosphere from day to day, the average weather in an area over a long period of time.
   c. the average weather in an area over a long period of time, the conditions of the atmosphere from day to day.
   d. the average weather in an area over a long period of time, the conditions of the habitat from day to day.

c. Wetlands are important, as they
   a. remove excess nutrients from runoff before it empties into rivers or lakes.
   b. provide a safe, lush habitat for many species of animals.
   c. store excess water from floods.
   d. all of the above

d. Organisms that live deep in the ocean must be able to
   a. withstand extreme water pressure, very hot water, and complete darkness.
   b. withstand extreme water pressure, very cold water, and complete darkness.
   c. withstand extreme water pressure, cold water, and limited sunlight.
   d. none of the above

e. Nekton are _____, and benthos are _____.
   a. aquatic animals that swim, aquatic organisms that crawl.
   b. aquatic animals that crawl, aquatic organisms that swim.
   c. bacteria and algae, tiny animals that feed on nekton.
   d. decomposers, fish and shrimp.

f. Aquatic biomes are defined in terms of which abiotic factors? (1) sunlight (2) dissolved oxygen and nutrients (3) temperature (4) moisture.
   a. 1 only
   b. 1 and 2
   c. 3 and 4
   d. 1, 2, 3, and 4

g. Which best describes the relationship between climate and biodiversity?
   a. As climate determines the animals in an ecosystem, it directly influences the biodiversity of a biome.
   b. As climate determines the plants in an ecosystem, it also influences the biodiversity of a biome.
   c. As climate determines plant growth, it also directly influences the biodiversity of a biome.
   d. As climate determines plant growth, it also changes the biodiversity of a biome.

h. Examples of adaptations of organisms include

a. the large, hollow leaves of the aloe plant.
b. the stout, barrel-shaped stems of cactus.
c. the fat tail of the Gila monster.
d. all of the above.

Lesson 11.3: Vocabulary I

Name_____ Class_____ Date_____

Match the vocabulary word with the proper definition.

Definitions

_____ 1. includes all the land areas on Earth where organisms live

_____ 2. includes ocean and lakes

_____ 3. the period of time each year when it is warm and wet enough for plants to grow

_____ 4. bacteria and algae that use sunlight to make food

_____ 5. a state in which a plant slows down cellular activities

_____ 6. extends to a maximum depth of 200 meters below the surface of the water

_____ 7. the average weather in an area over a long period of time

_____ 8. aquatic biomes in the ocean

_____ 9. an area that is saturated with water or covered by water for at least one season of the year

_____ 10. have water that contains little or no salt

_____ 11. tiny animals that feed on phytoplankton

_____ 12. a group of similar ecosystems with the same general abiotic factors and primary producers

Terms

a. aquatic biome

b. biome

c. climate

d. dormancy

e. freshwater biome

f. growing season

g. marine biome

h. photic zone

i. phytoplankton

j. terrestrial biome

k. wetland

l. zooplankton

Lesson 11.3: Vocabulary II

Name_____ **Class**_____ **Date**_____

Fill in the blank with the appropriate term.

1. The _____ zone extends to a maximum depth of 200 meters below the surface of the water.
2. _____ biomes have water that contains little or no salt.
3. Water in lakes and the ocean varies in the amount of dissolved oxygen and _____.
4. The Gila monster's fat tail serves as a storage depot for _____.
5. _____ grow best in soil that contains plenty of nutrients and organic matter.
6. A _____ is an area that is saturated with water or covered by water for at least one season each year.
7. Terrestrial biomes include all the _____ areas on Earth where organisms live.
8. Phytoplankton are bacteria and algae that use _____ to make food.
9. _____ is the average weather in an area over a long period of time.
10. In biomes with cold climates, plants may adapt by becoming _____ during the coldest part of the year.
11. Terrestrial biomes are classified by climatic factors and types of primary _____.
12. The _____ is divided into different zones, depending on distance from shore and depth of water.

Lesson 11.3: Critical Writing

Name_____ **Class**_____ **Date**_____

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Identify and describe two terrestrial biomes.

CHAPTER 12 Communities and Populations Worksheets

Chapter Outline

(Opening image courtesy of Metatron, http://en.wikipedia.org/wiki/File:Ocellaris_clownfish.JPG,, and under the Creative Commons license CC-BY-SA 3.0.)

- **Lesson 12.1: Community Interactions**
- **Lesson 12.2: Characteristics of Populations**
- **Lesson 12.3: Human Population Growth**
- **Lesson 12.4: The Biodiversity Crisis**
- **Lesson 12.5: Natural Resources and Climate Change**

12.1 Community Interactions

Lesson 12.1: True or False

Name_____ **Class**_____ **Date**_____

Write true if the statement is true or false if the statement is false.

_____ 1. All biomes, except a desert, have populations of interacting species.

_____ 2. Camouflage is an adaptation that has evolved through natural selection.

_____ 3. Predation is a relationship in which the prey consumes the predator.

_____ 4. Interspecific competition occurs between members of the same species.

_____ 5. Interspecific competition often leads to extinction, or it may lead to greater specialization.

_____ 6. A keystone species is one that plays an especially important role in its population.

_____ 7. Rock that hardens from lava is an example of primary succession.

_____ 8. Mutualism is a symbiotic relationship in which both species benefit.

_____ 9. The first species to colonize a disturbed area such as this are called primary species.

_____ 10. If a parasite kills its host, the parasite may also die.

_____ 11. Intraspecific competition leads to the evolution of better adaptations within a species.

_____ 12. Secondary succession may occur after a forest fire.

_____ 13. A population consists of all the communities of all the species in the same area.

_____ 14. There are three major types of community interactions: predation, competition, and selection.

_____ 15. Lichens that can live on bare rock may be pioneer species after a flood.

Lesson 12.1: Critical Reading

Name_____ **Class**_____ **Date**_____

Read these passages from the text and answer the questions that follow.

Symbiotic Relationships

Symbiosis is a close relationship between two species in which at least one species benefits. For the other species, the relationship may be positive, negative, or neutral. There are three basic types of symbiosis: mutualism, commensalism, and parasitism.

Mutualism

Mutualism is a symbiotic relationship in which both species benefit. An example of mutualism involves goby fish and shrimp (see figure below). The nearly blind shrimp and the fish spend most of their time together. The shrimp maintains a burrow in the sand in which both the fish and shrimp live. When a predator comes near, the fish touches

the shrimp with its tail as a warning. Then, both fish and shrimp retreat to the burrow until the predator is gone. From their relationship, the shrimp gets a warning of approaching danger. The fish gets a safe retreat and a place to lay its eggs.

The multicolored shrimp in the front and the green goby fish behind it have a mutualistic relationship. *(Image courtesy of Haplochromis and under the Creative Commons license CC-BY-SA 3.0.)*

Commensalism

Commensalism is a symbiotic relationship in which one species benefits while the other species is not affected. One species typically uses the other for a purpose other than food. For example, mites attach themselves to larger flying insects to get a "free ride." Hermit crabs use the shells of dead snails for homes.

Parasitism

Parasitism is a symbiotic relationship in which one species (the **parasite**) benefits, while the other species (the **host**) is harmed. Many species of animals are parasites, at least during some stage of their life. Most species are also hosts to one or more parasites. Some parasites live on the surface of their host. Others live inside their host. They may enter the host through a break in the skin or in food or water. For example, roundworms are parasites of mammals, including humans, cats, and dogs. The worms produce huge numbers of eggs, which are passed in the host's feces to the environment. Other individuals may be infected by swallowing the eggs in contaminated food or water.

Some parasites kill their host, but most do not. It's easy to see why. If a parasite kills its host, the parasite is also likely to die. Instead, parasites usually cause relatively minor damage to their host.

Questions

1. What is symbiosis?

2. What is mutualism? Give an example.

3. What is commensalism? Give an example.

4. What is parasitism? Give an example.

5. Why don't most parasites kill their host?

Lesson 12.1: Multiple Choice

Name_____ Class_____ Date_____

Circle the letter of the correct choice.

a. Which of the following would NOT be a community?

   a. All the plants, insects, and soil in your back yard.
   b. All the many varieties of dogs in your neighborhood.
   c. All the fish in an aquarium.
   d. none of the above

b. Community interactions include

   a. predation.
   b. competition.
   c. symbiosis.
   d. all of the above.

c. Which is an example of a predator-prey relationship?

   a. The relationship between a duck and a pond of water.
   b. The relationship between a lion and a zebra.
   c. The relationship between a bee and a flower.
   d. The relationship between a hen and a rooster.

d. The main difference among the types of symbiotic relationships is

   a. how many species either benefit or are harmed.
   b. how many species are eaten.
   c. how many species are protected.
   d. all of the above.

e. An example of interspecific competition is

   a. two male birds competing for the same female.
   b. two male lions competing to lead the same pride.
   c. two species of big cats competing for the same antelope.
   d. all of the above.

f. Which of the following is a parasite?

   a. the goby fish
   b. the hermit crab
   c. the shrimp
   d. the roundworm

g. Which could possibly be a pioneer species during primary succession?

   a. the first grass on new soil
   b. the first lichen on new rock
   c. the first layer of grass in a new park
   d. the first trees to grow in a new forest

h. Camouflage is

   a. an adaptation that evolved through natural selection.
   b. a necessary trait for commensalism.
   c. part of a well-adapted pioneer species traits.
   d. all of the above.

Lesson 12.1: Vocabulary I

Name_____ **Class**_____ **Date**_____

Match the vocabulary word with the proper definition.

Definitions

_____ 1. a species that plays an especially important role in its community

_____ 2. a symbiotic relationship in which both species benefit

_____ 3. a final stable stage

_____ 4. occurs in an area that has never before been colonized

_____ 5. the species that consumes members of another species

_____ 6. a symbiotic relationship in which one species benefits while the other species is not affected

_____ 7. the species that is consumed

_____ 8. the first species to colonize an area that has never before been colonized

_____ 9. the change in the numbers and types of species that live in a community over time

_____ 10. species that benefits in a symbiotic relationship in which another species is harmed

_____ 11. occurs in a formerly inhabited area that was disturbed

_____ 12. occurs between members of the same species

_____ 13. species that is harmed in a symbiotic relationship in which another species benefits

_____ 14. occurs between members of different species

Terms

a. climax community

b. commensalism

c. ecological succession

d. host

e. interspecific competition

f. intraspecific competition

g. keystone species

h. mutualism

i. parasite

j. pioneer species

k. predator

l. prey

m. primary succession

n. secondary succession

Lesson 12.1: Vocabulary II

Name_____ **Class**_____ **Date**_____

Fill in the blank with the appropriate term.

1. A glacier retreating is an example of _____ succession.
2. _____ is a relationship in which one species benefits while the other species is harmed.
3. Lions feed on the South African Cape buffalo: the lions are the _____, and the buffalo are the _____-_____.
4. Symbiosis is a close relationship between two species in which at least one species _____.
5. Specialization occurs when competing species evolve different _____.
6. _____ is a relationship between organisms that strive for the same resources in the same place.
7. Pioneer species includes _____ that can live on bare rock.
8. A keystone species is one that plays an especially important role in its _____.
9. _____ is an adaptation that in prey helps them hide from predators.
10. _____ competition occurs between members of different species.
11. A community consists of all the populations of all the _____ in the same area.
12. All _____ have populations of interacting species.

Lesson 12.1: Critical Writing

Name_____ Class_____ Date_____

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Compare and contrast mutualism, commensalism, and parasitism.

12.2 Characteristics of Population

Lesson 12.2: True or False

Name_____ Class_____ Date_____

Write true if the statement is true or false if the statement is false.

_____ 1. A clumped population distribution always has more individuals than a uniform distribution.

_____ 2. Population growth rate is how fast a population changes in size over time.

_____ 3. A population's age-sex structure influences population growth, as older people are more likely to reproduce.

_____ 4. Dispersal refers to offspring moving away from their parents.

_____ 5. With a type I survivorship curve, most of the offspring survive to adulthood so they can reproduce.

_____ 6. Populations gain individuals through births and emigration.

_____ 7. Logistic growth levels out at the carrying capacity.

_____ 8. *K*-selected population growth is controlled by density-dependent factors.

_____ 9. Most populations live under ideal conditions, so they grow at exponential rates.

_____ 10. Immigration is the regular movement of individuals or populations each year during certain seasons.

_____ 11. The carrying capacity is the largest population size that can be supported in an area without harming the environment.

_____ 12. With a type III survivorship curve, parents produce moderate numbers of offspring and provide some parental care.

_____ 13. With a random population distribution, organisms are clustered together in groups.

_____ 14. A positive population growth rate means a population is increasing.

_____ 15. Species that live in unstable environments are usually *r*-selected, and their population size is usually well below the carrying capacity.

Lesson 12.2: Critical Reading

Name_____ Class_____ Date_____

Read these passages from the text and answer the questions that follow.

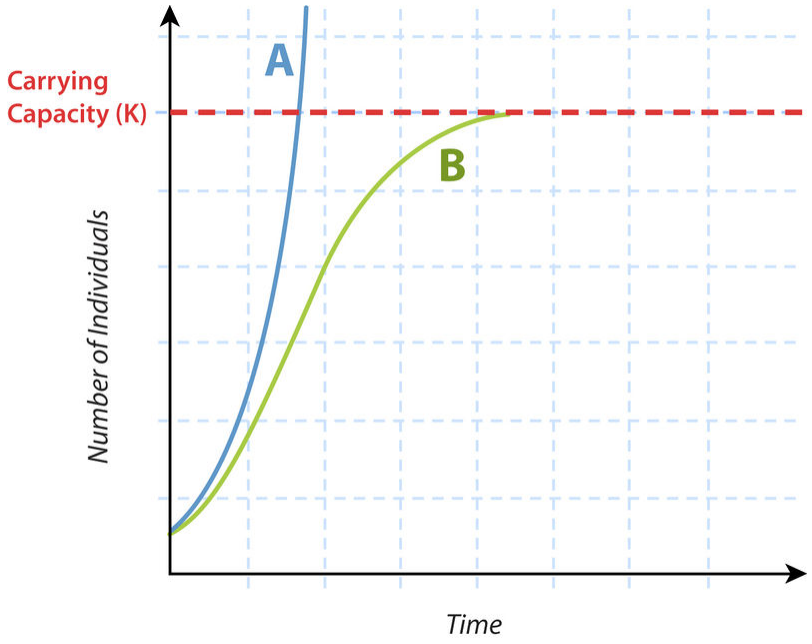
Patterns of Population Growth

Populations may show different patterns of growth. The growth pattern depends partly on the conditions under which a population lives.

Exponential Growth

Under ideal conditions, populations of most species can grow at exponential rates. Curve A in the graph below

represents **exponential growth**. The population starts out growing slowly. As population size increases, the growth rate also increases. The larger the population becomes, the faster it grows.



Exponential and Logistic Growth. Curve A shows exponential growth. Curve B shows logistic growth. *(Image courtesy of CK-12 Foundation and under the Creative Commons license CC-BY-NC-SA 3.0.)*

Logistic Growth

Most populations do not live under ideal conditions. Therefore, most do not grow exponentially. Certainly, no population can keep growing exponentially for very long. Many factors may limit growth. Often, the factors are density-dependent. These are factors that kick in when the population becomes too large and crowded. For example, the population may start to run out of food or be poisoned by its own wastes. As a result, population growth slows and population size levels off. Curve B in graph above represents this pattern of growth, which is called **logistic growth**.

At what population size does growth start to slow in the logistic model of growth? That depends on the population's carrying capacity (see graph above). The **carrying capacity (K)** is the largest population size that can be supported in an area without harming the environment. Population growth hits a ceiling at that size in the logistic growth model.

***K*-Selected and *r*-Selected Species**

Species can be divided into two basic types when it comes to how their populations grow.

- Species that live in stable environments are likely to be ***K*-selected**. Their population growth is controlled by density-dependent factors. Population size is generally at or near the carrying capacity. These species are represented by curve B in the graph above.
- Species that live in unstable environments are likely to ***r*-selected**. Their potential population growth is rapid. For example, they have large numbers of offspring. However, individuals are likely to die young. Thus, population size is usually well below the carrying capacity. These species are represented by the lower part of curve A in the graph above.

Questions

1. What is exponential growth?

2. What is logistic growth?

3. What is the carrying capacity?

4. Define *K*- selected and *r*-selected. What is the main difference between them?

Lesson 12.2: Multiple Choice

Name_____ Class_____ Date_____

Circle the letter of the correct choice.

a. Which would represent a population?
    a. All the fish in an aquarium.
    b. All the dogs in your neighborhood.
    c. All the animals in the local zoo.
    d. all of the above

b. The age-sex structure of a quickly growing population would probably have
    a. a wide base, showing many young individuals.
    b. a wide top, showing many older individuals.
    c. a wide middle area, showing many middle-aged individuals.
    d. all of the above

c. Humans have a type _____ survivorship curve, as _____.
    a. II, parents produce moderate numbers of children.
    b. III, most of the offspring survive to adulthood so they can reproduce.
    c. I, most of the offspring survive to adulthood so they can reproduce.
    d. I, parents produce moderate numbers of children.

d. Population growth can be represented by the equation r =
    a. $(b + e)$ - $(d + i)$
    b. $(b + i)$ - $(d + e)$
    c. $(b + d)$ - $(i + e)$
    d. $(d + i)$ - $(b + e)$

e. During exponential growth,
    a. the larger the population becomes, the slower it grows.
    b. population growth eventually slows and population size levels off.
    c. as population size increases, the growth rate also increases.
    d. all of the above

f. The carrying capacity of a population
    a. is reached as resources become limiting.
    b. is reached at the end of exponential growth.
    c. is reached in r-selected populations.
    d. is reached when the environment begins to be harmed.

g. Which of the following are examples of density-dependent factors? (1) food, (2) disease, (3) rainfall, (4) temperature.
    a. 1 only
    b. 1 and 2
    c. 1, 2, and 3
    d. 1, 2, 3, and 4

h. When organisms must compete for resources, they will usually have a _____ distribution.
    a. uniform
    b. random
    c. clumped
    d. competitive

Lesson 12.2: Vocabulary I

Name_____ **Class**_____ **Date**_____

Match the vocabulary word with the proper definition.

Definitions

_____ 1. represents the age-sex structure of a population

_____ 2. coming into the population from somewhere else

_____ 3. population growth under limiting conditions

_____ 4. the average number of individuals in a population per unit of area or volume

_____ 5. species whose population size is usually well below the carrying capacity

_____ 6. leaving the population for another area

_____ 7. the largest population size that can be supported in an area without harming the environment

_____ 8. graphs that represent the number of individuals still alive at each age

_____ 9. population growth under ideal conditions

_____ 10. how fast a population changes in size over time

_____ 11. species whose population growth is controlled by density-dependent factors

_____ 12. the regular movement of individuals or populations each year during certain seasons

Terms

a. carrying capacity

b. emigration

c. exponential growth

d. immigration

e. *K*-selected

f. logistic growth

g. migration

h. population density

i. population growth rate

j. population pyramid

k. *r*-selected

l. survivorship curve

Lesson 12.2: Vocabulary II

Name_____ **Class**_____ **Date**_____

Fill in the blank with the appropriate term.

1. The population is the unit of natural selection and _____.

2. The purpose of migration usually is to find food, mates, or other _____.

3. Species that live in _____ environments are likely to be *K*-selected.

4. Population _____ may be clumped, random, or uniform.

5. The carrying capacity is the _____ population size that can be supported in an area.

6. A _____ curves represents the number of individuals still alive at each age.

7. The two main factors affecting population _____ are the birth rate and death rate.

8. The age-sex structure influences _____ growth because usually young individuals reproduce and older individuals die.

9. Under ideal conditions, populations of most species can grow at _____ rates.

10. Population _____ is the number of individuals in a population.

11. The formula for population _____ is $r = (b + i) - (d + e)$.

12. Species that live in _____ environments are likely to *r*-selected.

13. Dispersal refers to offspring moving _____ from their parents.

14. A _____ is a group of organisms of the same species that live in the same area.

Lesson 12.2: Critical Writing

Name_____ **Class**_____ **Date**_____

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Compare and contrast exponential and logistic growth.

12.3 Human Population Growth

Lesson 12.3: True or False

Name_____ Class_____ Date_____

Write true if the statement is true or false if the statement is false.

_____ 1. Human populations are fast growing.

_____ 2. Stage 5 may be a new stage of the demographic transition, raising issues for some populations.

_____ 3. The human population has had a pattern of logistic growth.

_____ 4. The development of agriculture let humans settle down in villages and cities.

_____ 5. In the 1700s, advances in science and technology led to lower death rates in humans.

_____ 6. The human population is now growing by about 20,000 people a day.

_____ 7. Today only a few countries remain in Stage 1 of the demographic transition.

_____ 8. Stage 1 of the demographic transition has high birth and death rates, which lead to fast population growth.

_____ 9. In stage 3 of the demographic transition, birth rate starts to fall, so population growth starts to slow.

_____ 10. Some countries are stuck in stage 2 of the demographic transition as their birth rates are still high.

_____ 11. By 2050, the world's population may be close to its carrying capacity.

_____ 12. In some areas, birth rates fell when children were forced to go to school.

Lesson 12.3: Critical Reading

Name_____ Class_____ Date_____

Read these passages from the text and answer the questions that follow.

Demographic Transition

Major changes in the human population first began during the 1700s in Europe and North America. First death rates fell, followed somewhat later by birth rates.

Death Rates Fall

Several advances in science and technology led to lower death rates in 18^{th} century Europe and North America:

- New scientific knowledge of the causes of disease led to improved water supplies, sewers, and personal hygiene.
- Better farming techniques and machines increased the food supply.
- The Industrial Revolution of the 1800s led to new sources of energy, such as coal and electricity. This increased the efficiency of the new agricultural machines. It also led to train transport, which improved the distribution of food.

For all these reasons, death rates fell, especially in children. This allowed many more children to survive to adulthood, so birth rates increased. As the gap between birth and death rates widened, the human population grew faster.

Birth Rates Fall

It wasn't long before birth rates started to fall as well in Europe and North America. People started having fewer children because large families were no longer beneficial for several reasons.

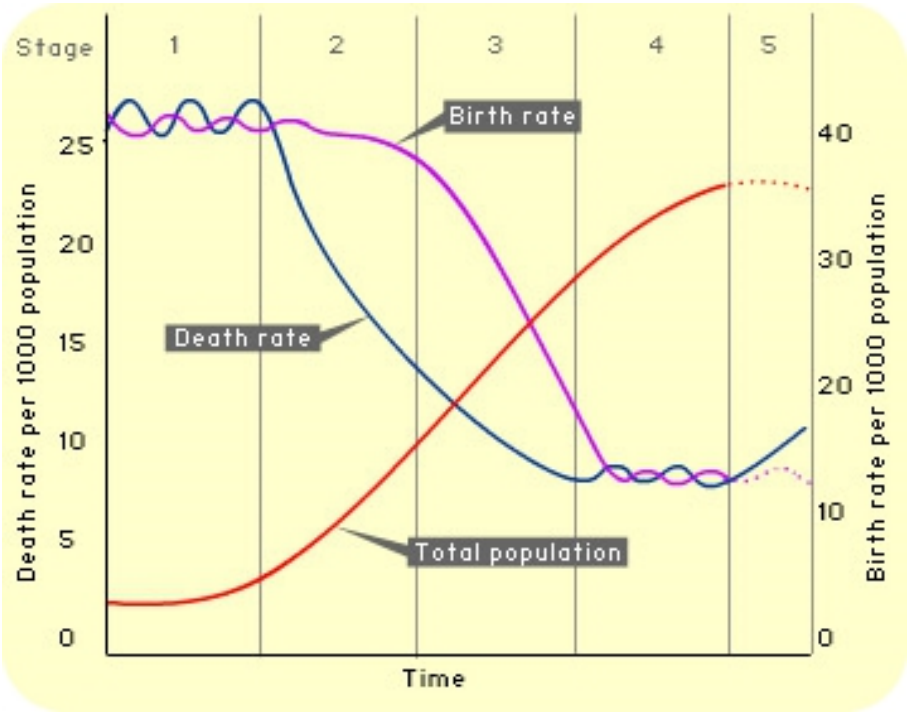
- As child death rates fell and machines did more work, farming families no longer needed to have as many children to work in the fields.
- Laws were passed that required children to go to school. Therefore, they could no longer work and contribute to their own support. They became a drain on the family's income.

Eventually, birth rates fell to match death rates. As a result, population growth slowed to nearly zero.

Stages of the Demographic Transition

These changes in population that occurred in Europe and North America have been called the **demographic transition**. The transition can be summarized in the following four stages, which are illustrated in the graph below:

- Stage 1 — High birth and death rates lead to slow population growth.
- Stage 2 — The death rate falls but the birth rate remains high, leading to faster population growth.
- Stage 3 — The birth rate starts to fall, so population growth starts to slow.
- Stage 4 — The birth rate reaches the same low level as the death rate, so population growth slows to zero.



Stages of the Demographic Transition. In the demographic transition, the death rate falls first. After a lag, the birth rate also falls. How do these changes affect the rate of population growth over time? *(Image courtesy of Charmed88 and under the public domain.)*

Questions

1. Why did death rates fall in the 1700s?

2. Why did birth rates fall in Europe and North America?

3. What is the demographic transition?

4. What are the main differences between the stages of the demographic transition?

Lesson 12.3: Multiple Choice

Name_____ Class_____ Date_____

Circle the letter of the correct choice.

a. During the time when humans moved from Africa throughout the world,
    a. birth and death rates were both fairly low.
    b. population growth was rapid.
    c. population growth was slow.
    d. there was no population growth.

b. The invention of agriculture
    a. led to an increased birth rate and death rate.
    b. provided a more dependable food supply.
    c. allowed people to settle down in villages.
    d. all of the above

c. Lower death rates in the 1700s resulted from
    a. new scientific knowledge of the causes of disease.
    b. better use of coal and electricity.
    c. the Industrial Revolution.
    d. all of the above.

d. Stage 2 of the demographic transition is represented by
    a. slow population growth.
    b. fast population growth.
    c. no population growth.
    d. high birth and death rates.

e. A stage 5 population can be dangerous, as
    a. there is a large aging population.
    b. there is a large young population.
    c. the population has reached its carrying capacity.
    d. all of the above

f. Most developed nations are in which stage of the demographic transition?
    a. stage 1
    b. stage 2
    c. stage 3
    d. stage 4

g. The human population is now growing by more than _____ people a day.
    a. 20,000
    b. 100,000
    c. 200,000
    d. 300,000

h. The carrying capacity for the human population may be about
    a. 8 billion people.
    b. 9 billion people.
    c. 10 billion people.
    d. Humans do not have a carrying capacity.

Lesson 12.3: Vocabulary I

Name_____ **Class**_____ **Date**_____

Match the vocabulary word with the proper definition.

Definitions

_____ 1. the birth rate starts to fall, so population growth starts to slow

_____ 2. the death rate falls but the birth rate remains high, leading to faster population growth

_____ 3. may be 9 billion people for the human population

_____ 4. diagram that shows the age-sex structure of a population

_____ 5. high birth and death rates lead to slow population growth

_____ 6. the birth rate reaches the same low level as the death rate, so population growth slows to zero

_____ 7. a four stage model of population growth

Terms

a. carrying capacity

b. demographic transition

c. population pyramid

d. stage 1

e. stage 2

f. stage 3

g. stage 4

Lesson 12.3: Vocabulary II

Name_____ **Class**_____ **Date**_____

Fill in the blank with the appropriate term.

1. Stage 3: The birth rate starts to fall, so population growth starts to _____.
2. The human population has had a pattern of _____ growth.
3. Most _____ nations have entered Stage 4 of the demographic transition.
4. Today, no country remains in Stage _____ of the demographic transition.
5. *Homo sapiens* arose only about _____ years ago in Africa.
6. Stage _____: High birth and death rates lead to slow population growth.
7. Stage 4: The birth rate reaches the same low level as the death rate, so population growth slows to _____.
8. The human population is now growing by about 200,000 people a _____.
9. Many _____ countries seem to be stuck in Stage 2 of the demographic transition.
10. Stage 2: The death rate falls but the birth rate remains high, leading to _____ population growth.
11. Humans invented _____ about 10,000 years ago.
12. Like weeds, human _____ are fast growing and disperse rapidly.

Lesson 12.3: Critical Writing

Name_____ Class_____ Date_____

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Outline the stages of the demographic transition.

12.4 The Biodiversity Crisis

Lesson 12.4: True or False

Name_____ Class_____ Date_____

Write true if the statement is true or false if the statement is false.

_____ 1. Biodiversity refers to the variety of life and its processes.

_____ 2. Scientists have identified about 1.9 million species alive today.

_____ 3. Many of the most important prescription drugs come from wild species.

_____ 4. Biodiversity helps ensure that at least some species will survive major environmental changes.

_____ 5. Plants and algae maintain the atmosphere; during photosynthesis, they add carbon dioxide and remove oxygen.

_____ 6. Evidence shows that the fifth mass extinction is occurring now.

_____ 7. It is possible that in 1000 years, we could lose more than half of Earth's species.

_____ 8. The single biggest cause of extinction today is habitat loss due to forest fires.

_____ 9. Global climate change, largely due to the burning of fossil fuels, threatens the existence of many species.

_____ 10. Exotic species introduced by humans into new habitats have resulted in extinction of native species.

_____ 11. Plants fixing nitrogen and making it available to animals is an important ecological service due to biodiversity.

_____ 12. Most species alive today have yet to be identified.

Lesson 12.4: Critical Reading

Name_____ Class_____ Date_____

Read these passages from the text and answer the questions that follow.

Why Is Biodiversity Important?

Human beings benefit in many ways from biodiversity. Biodiversity has direct economic benefits. It also provides services to entire ecosystems.

Economic Benefits of Biodiversity

The diversity of species provides humans with a wide range of economic benefits:

- Wild plants and animals maintain a valuable pool of genetic variation. This is important because domestic species are genetically uniform. This puts them at great risk of dying out due to disease.
- Other organisms provide humans with many different products. Timber, fibers, adhesives, dyes, and rubber are just a few examples.

- Certain species may warn us of toxins in the environment. When the peregrine falcon nearly went extinct, for example, it warned us of the dangers of DDT.
- More than half of the most important prescription drugs come from wild species. Only a fraction of species has yet been studied for their medical potential.
- Other living things provide inspiration for engineering and technology.

Ecosystem Services of Biodiversity

Biodiversity generally increases the productivity and stability of ecosystems. It helps ensure that at least some species will survive environmental change. It also provides many other ecosystem services. For example:

- Plants and algae maintain the atmosphere. During photosynthesis, they add oxygen and remove carbon dioxide.
- Plants help prevent soil erosion. They also improve soil quality when they decompose.
- Microorganisms purify water in rivers and lakes. They also return nutrients to the soil.
- Bacteria fix nitrogen and make it available to plants. Other bacteria recycle the nitrogen from organic wastes and remains of dead organisms.
- Insects and birds pollinate flowering plants, including crop plants.
- Natural predators control insect pests. They reduce the need for expensive pesticides, which may harm people and other living things.

Questions

1. List and describe three examples of the economic benefits of biodiversity.

2. List and describe four examples of ecosystem services of biodiversity.

Lesson 12.4: Multiple Choice

Name_____ **Class**_____ **Date**_____

Circle the letter of the correct choice.

a. Biodiversity refers to

   a. the variety of life and its processes.

   b. the variety of life and its processes, including the variety of living organisms.
   c. the variety of life and its processes, including the variety of living organisms, and the genetic differences among them.
   d. the variety of life and its processes, including the variety of living organisms, the genetic differences among them, and the communities and ecosystems in which they occur.

b. Scientists have identified about _____ species alive today.

   a. 1.9 billion
   b. 1.9 million
   c. 5 million
   d. 30 million

c. Economic benefits of biodiversity include

   a. the prevention of soil erosion.
   b. a valuable pool of genetic variation.
   c. the natural pollination of flowering plants.
   d. all of the above.

d. How have exotic species affected biodiversity?

   a. They have resulted in the extinction of native species.
   b. They have resulted in the over-harvesting of fish, trees, and other organisms.
   c. They have resulted in global climate change.
   d. all of the above

e. What is the biggest cause of extinction today?

   a. pollution
   b. exotic species
   c. global warming
   d. habitat loss

f. Biodiversity is beneficial to ecosystems in which of the following ways?

   a. the natural prevention of soil erosion
   b. the natural purification of water in rivers and lakes
   c. the natural control of insect pests
   d. all of the above

g. Scientists estimate that there may be up to _____ species alive today.

   a. 30 billion
   b. 30 million
   c. 1.9 million
   d. 1.9 billion

h. It is likely that Earth could lose half of its species in the next _____ years.

   a. 50
   b. 100
   c. 500
   d. 1000

Lesson 12.4: Vocabulary I

Name_____ **Class**_____ **Date**_____

Match the vocabulary word with the proper definition.

Definitions

_____ 1. the variety of life and its processes

_____ 2. species that may out-compete native species

_____ 3. valuable benefit of biodiversity found in wild plants and animals

_____ 4. mass extinction due to human actions

_____ 5. identified species alive today

_____ 6. beginning of the sixth mass extinction

_____ 7. single biggest cause of extinction today

_____ 8. can result in crowding out other species

Terms

a. 1.9 million

b. biodiversity

c. exotic species

d. genetic variation

e. habitat loss

f. overpopulation

g. Pleistocene

h. sixth mass extinction

Lesson 12.4: Vocabulary II

Name_____ **Class**_____ **Date**_____

Fill in the blank with the appropriate term.

1. The single biggest cause of extinction today is _____ loss.
2. Biodiversity generally increases the productivity and stability of _____.
3. Scientists have identified about _____ million species alive today.
4. _____ mass extinctions are recorded in the fossil record.
5. The sixth mass extinction is due to _____ actions.
6. _____ species may carry disease, prey on native species, and disrupt food webs.
7. Over 99 percent of all species that ever lived on Earth have gone _____.
8. _____ refers to the number of species in an ecosystem or the biosphere as a whole.
9. Global _____ change is raising Earth's air and ocean temperatures.
10. Pollution causes widespread harm to _____.

Lesson 12.4: Critical Writing

Name_____ Class_____ Date_____

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Define biodiversity. Discuss three reasons why biodiversity is important.

12.5 Natural Resources and Climate Change

Lesson 12.5: True or False

Name_____ **Class**_____ **Date**_____

Write true if the statement is true or false if the statement is false.

_____ 1. A natural resource is something supplied by nature that helps support life.

_____ 2. Biodiversity is an important natural resource.

_____ 3. Living things are considered to be nonrenewable — when they die, they cannot be replaced.

_____ 4. Renewable resources can be replenished by natural processes as quickly as humans use them.

_____ 5. Nonrenewable resources include fossil fuels such as petroleum, coal, natural gas, soil and water.

_____ 6. Of all the water on Earth, only a few percent is fresh, liquid water.

_____ 7. The greenhouse effect is a artificial feature of Earth's atmosphere, caused by the burning of fossil fuels.

_____ 8. Soil takes up to hundreds of millions of years to form.

_____ 9. Global warming is caused by too much carbon dioxide in the atmosphere.

_____ 10. About 1 billion people worldwide do not have adequate freshwater.

_____ 11. Global warming has caused the decline in the polar bear population.

_____ 12. Bad ozone is causing the hole in the ozone layer to expand.

Lesson 12.5: Critical Reading

Name_____ **Class**_____ **Date**_____

Read these passages from the text and answer the questions that follow.

The Atmosphere

The atmosphere plays an important part in maintaining Earth's freshwater supply. It is part of the water cycle. It refills lakes and rivers with precipitation. The atmosphere also provides organisms with gases needed for life. It contains oxygen for cellular respiration and carbon dioxide for photosynthesis.

Air Pollution

Earth's atmosphere is vast. However, it has been seriously polluted by human activities. **Air pollution** consists of chemical substances and particles released into the atmosphere, mainly by human actions. The major cause of outdoor air pollution is the burning of fossil fuels. Power plants, motor vehicles, and home furnaces all burn fossil fuels and contribute to the problem (see **Table** 12.1). Ranching and using chemicals, such as fertilizers, also cause air pollution. Erosion of soil in farm fields and construction sites adds dust particles to the air as well. Fumes from building materials, furniture, carpets, and paint add toxic chemicals to indoor air.

TABLE 12.1: Pollutant Problems

Pollutant	Example/Major Source	Problem
Nitrogen oxides (NO_x)	Motor vehicle exhaust	Acid Rain
Carbon monoxide (CO)	Motor vehicle exhaust	Poisoning
Carbon dioxide (CO_2)	All fossil fuel burning	Global Warming
Smog	Coal burning	Respiratory problems; eye irritation
Ground-level ozone	Motor vehicle exhaust	Respiratory problems; eye irritation

In humans, air pollution causes respiratory and cardiovascular problems. In fact, more people die each year from air pollution than from automobile accidents. Air pollution also affects ecosystems worldwide by causing acid rain, ozone depletion, and global warming. Ways to reduce air pollution from fossil fuels include switching to nonpolluting energy sources (such as solar energy) and using less energy. What are some ways you could use less energy?

Ozone Depletion

There are two types of ozone. You can think of them as bad ozone and good ozone. Both are affected by air pollution.

- Bad ozone forms near the ground when sunlight reacts with pollutants in the air. Ground-level ozone is harmful to the respiratory systems of humans and other animals.
- Good ozone forms in a thin layer high up in the atmosphere, between 15 and 35 kilometers above Earth's surface. This ozone layer shields Earth from most of the sun's harmful UV radiation. It plays an important role in preventing mutations in the DNA of organisms.

Unfortunately, the layer of good ozone is being destroyed by air pollution. The chief culprits are chlorine and bromine gases. They are released in aerosol sprays, coolants, and other products. Loss of ozone has created an **ozone hole** over Antarctica. Ozone depletion results in higher levels of UV radiation reaching Earth. In humans, this increases skin cancers and eye cataracts. It also disturbs the nitrogen cycle, kills plankton, and disrupts ocean food webs. The total loss of the ozone layer would be devastating to most life. Its rate of loss has slowed with restrictions on pollutants, but it is still at risk.

Questions

1. Describe two important roles of the atmosphere.
2. What is air pollution? What is the major cause of air pollution?
3. List three pollutants the burning of fossil fuels adds to air. What are the sources of these three pollutants?
4. What is good ozone?
5. What are the major effects of the ozone hole?

Lesson 12.5: Multiple Choice

Name_____ **Class**_____ **Date**_____

Circle the letter of the correct choice.

a. Which of the following is a nonrenewable resource?

   a. aluminum
   b. wind
   c. coal

d. bamboo

b. How much water on Earth is fresh, liquid water?

a. 1%
b. 2%
c. 5%
d. 10%

c. A dead zone can form in areas where

a. low oxygen levels have killed all ocean life.
b. algal blooms have formed.
c. in areas of excessive nutrient-enriched runoff.
d. all of the above

d. What is the major cause of outdoor air pollution?

a. erosion of soil in farm fields
b. excessive cigarette smoke
c. the burning of fossil fuels
d. excess acid rain

e. Acid rain

a. can disrupt homeostasis by altering protein function.
b. can lower the pH of lakes.
c. can cause the death of plants and aquatic organisms.
d. all of the above

f. The ozone hole

a. results in higher levels of UV radiation reaching Earth.
b. is located over the Arctic Circle.
c. is being destroyed by the greenhouse effect.
d. all of the above

g. Global warming

a. refers to a recent decrease in Earth's average surface temperature.
b. has caused a decrease in the greenhouse effect.
c. is caused by more carbon dioxide in the atmosphere.
d. none of the above

h. Effects of global climate change include

a. the melting of glaciers and rising sea levels.
b. more droughts and water shortages.
c. increasing severity of storms.
d. all of the above.

Lesson 12.5: Vocabulary I

Name_____ **Class**_____ **Date**_____

Match the vocabulary word with the proper definition.

Definitions

_____ 1. something supplied by nature that helps support life

_____ 2. hole over Antarctica that results in higher levels of UV radiation reaching Earth

_____ 3. natural resources that exist in fixed amounts

_____ 4. the use of resources in a way that meets the needs of the present and preserves the resources for the future

_____ 5. precipitation that may damage soil and soil organisms

_____ 6. occurs where low oxygen levels have killed all ocean life

_____ 7. can be replenished by natural processes

_____ 8. consists of chemical substances and particles released into the atmosphere

_____ 9. a mixture of eroded rock, minerals, partly decomposed organic matter, and other materials

_____ 10. a recent increase in Earth's average surface temperature

_____ 11. caused by an excessive growth of algae

_____ 12. occurs when gases in the atmosphere radiate the sun's heat back down to Earth's surface

Terms

a. acid rain

b. air pollution

c. algal bloom

d. dead zone

e. global warming

f. greenhouse effect

g. natural resource

h. nonrenewable resource

i. ozone hole

j. renewable resource

k. soil

l. sustainable use

Lesson 12.5: Vocabulary II

Name_____ **Class**_____ **Date**_____

Fill in the blank with the appropriate term.

1. Petroleum, coal, and natural gas are _____ resources.
2. All life relies on a relatively narrow range of _____, or acidity.
3. A natural resource is something supplied by nature that helps support _____.
4. The _____ layer shields Earth from most of the sun's harmful UV radiation.
5. _____ resources are in no danger of being used up.
6. During the past century, the temperature has risen by almost _____.
7. Of all the water on Earth, only _____ percent is fresh, liquid water.

8. Most scientists agree that global warming is caused by an increase of _____ in the atmosphere.
9. If acid _____ falls into lakes, it lowers the pH of the water and kills aquatic organisms.
10. One of the biggest sources of water _____ is runoff.
11. Global _____ has resulted in a decline in cold-adapted species, such as polar bears.
12. Without the _____ effect, Earth's surface temperature would be too cold to support life.

Lesson 12.5: Critical Writing

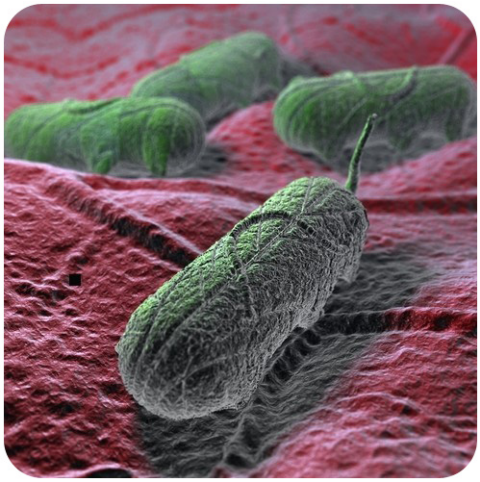
Name_____ **Class**_____ **Date**_____

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Distinguish between renewable and nonrenewable resources.

CHAPTER 13 Microorganisms: Prokaryotes and Viruses Worksheets

Chapter Outline



- **Lesson 13.1: Prokaryotes**
- **Lesson 13.2: Viruses**

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13.1 Prokaryotes

Lesson 13.1: True or False

Name_____ **Class**_____ **Date**_____

Write true if the statement is true or false if the statement is false.

_____ 1. Prokaryotes are single-celled organisms that lack a nucleus.

_____ 2. Since prokaryotes do not have organelles, they do not have ribosomes.

_____ 3. Cyanobacteria were probably the first organisms to photosynthesize.

_____ 4. Cyanobacteria contain the organelle chlorophyll.

_____ 5. The first Archaea discovered were the extremophiles.

_____ 6. The most common prokaryotic shapes are helices, polygons, spheres, and rods.

_____ 7. Prokaryotic DNA is usually one or two circular chromosomes.

_____ 8. Both Bacteria and Archaea have plasma membranes and cell walls.

_____ 9. Flagella help bacteria move.

_____ 10. Because they are simple single cells, prokaryotes do not need energy.

_____ 11. There are billions of bacteria inside the human intestines that help digest food.

_____ 12. Insects are common vectors for spreading bacterial diseases between humans.

_____ 13. Aerobic prokaryotes need oxygen, which they use for cellular respiration.

_____ 14. Bacteria provide vital ecosystem services - they are important producers and are needed for the carbon and nitrogen cycles.

_____ 15. Bacteria in food or water usually cannot be killed.

Lesson 13.1: Critical Reading

Name_____ **Class**_____ **Date**_____

Read these passages from the text and answer the questions that follow.

Evolution and Classification of Prokaryotes

Prokaryotes are currently placed in two domains. A domain is the highest taxon, just above the kingdom. The prokaryote domains are **Bacteria** and **Archaea**. The third domain is Eukarya. It includes all eukaryotes. Unlike prokaryotes, eukaryotes have a nucleus in their cells.

Prokaryote Evolution

It's not clear how the three domains are related. Archaea were once thought to be offshoots of Bacteria that were adapted to extreme environments. For their part, Bacteria were considered to be ancestors of Eukarya. Scientists

now know that Archaea share several traits with Eukarya that Bacteria do not share (see **Table** 13.1). In what ways are Archaea and Bacteria different? In what ways are Archaea and Eukarya alike? How can this be explained? One hypothesis is that Eukarya arose when an Archaean cell fused with a Bacterial cell. The two cells became the nucleus and cytoplasm of a new Eukaryan cell. How well does this hypothesis fit the evidence in **Table** 13.1?

TABLE 13.1: Comparison of Bacteria, Archaea, and Eukarya

Characteristic	Bacteria	Archaea	Eukarya
Flagella	Unique to Bacteria	Unique to Archaea	Unique to Eukarya
Cell Membrane	Unique to Bacteria	Like Bacteria and Eukarya	Unique to Eukarya
Protein Synthesis	Unique to Bacteria	Like Eukarya	Like Archaea
Introns	Absent in most	Present	Present
Peptidoglycan (in cell wall)	Present	Absent in most	Absent

Domain Bacteria

Bacteria are the most diverse and abundant group of organisms on Earth. They live in almost all environments. They are found in the ocean, the soil, and the intestines of animals. They are even found in rocks deep below Earth's surface. Any surface that has not been sterilized is likely to be covered with bacteria. The total number of bacteria in the world is amazing. It's estimated to be 5×10^{30}, or five million trillion trillion. You have more bacteria in and on your body than you have body cells!

Bacteria called **cyanobacteria** are very important. They are bluish green in color because they contain chlorophyll. They make food through photosynthesis and release oxygen into the air. These bacteria were probably responsible for adding oxygen to the air on early Earth. This changed the planet's atmosphere. It also changed the direction of evolution. Ancient cyanobacteria also may have evolved into the chloroplasts of plant cells.

Domain Archaea

Archaea were first discovered in extreme environments. For example, some were found in hot springs. Others were found around deep sea vents. Such Archaea are called **extremophiles**, or "lovers of extremes." The places where some of them live are thought to be similar to the environment on ancient Earth. This suggests that they may have evolved very early in Earth's history.

Questions

1. What is a domain? What are the three domains of life?

2. List three main differences between Bacteria and Archaea.

3. Give three examples of places bacteria live.

4. What are cyanobacteria? What was their most significant contribution?

5. What is an extremophile?

Lesson 13.1: Multiple Choice

Name_____ **Class**_____ **Date**_____

Circle the letter of the correct choice.

a. The prokaryotic domains are

   a. Bacteria and Eukarya.
   b. Bacteria and Archaea.
   c. Archaea and Eukarya.
   d. Prokarya and Bacteria.

b. One significant difference between Bacteria and Archaea is that

   a. genes in Bacteria have introns.
   b. peptidoglycan is found in the cell wall of most Archaea.
   c. genes in Archaea have introns.
   d. two of the above

c. Cyanobacteria

   a. contain chlorophyll.
   b. make food through photosynthesis.
   c. were probably responsible for adding oxygen to the air on early Earth.
   d. all of the above

d. Hyperthermophiles

   a. live in very hot water.
   b. live in very acidic environments.
   c. live in very salty water.
   d. are an early member of the domain Bacteria.

e. The most common prokaryotic shapes include

   a. rod, square, and helix.
   b. helix, sphere, and rod.
   c. sphere, rod, and double helix.
   d. helical, icosahedral, and complex.

f. Prokaryotic DNA

   a. is usually circular and located in the cytoplasm.
   b. is usually circular and located in the nucleus.
   c. consists of numerous chromosomes and is located in the cytoplasm.
   d. consists of numerous chromosomes and is located in the nucleus.

g. Ways humans use bacteria include

   a. killing plant pests.
   b. transferring normal genes to human cells in gene therapy.
   c. cleaning up oil spills and toxic wastes.
   d. all of the above.

h. Genetic transfer refers to

   a. how Archaea dissolve in extreme environments and transfer their DNA to other prokaryotes.
   b. how Bacteria evolve new genes through spontaneous mutations.
   c. how prokaryotes increase genetic variation.
   d. all of the above.

Lesson 13.1: Vocabulary I

Name_____ **Class**_____ **Date**_____

Match the vocabulary word with the proper definition.

Definitions

_____ 1. bacteria that were responsible for adding oxygen to the air on early Earth

_____ 2. prokaryotes that are specialized to live in extreme environments

_____ 3. small, circular pieces of DNA

_____ 4. used by prokaryotes to increase genetic variation

_____ 5. first discovered in extreme environments

_____ 6. the most diverse and abundant group of organisms on Earth

_____ 7. results from misuse and over-use of the drugs

_____ 8. a colony of prokaryotes that is stuck to a surface

_____ 9. help prokaryotes move

_____ 10. enclose the DNA and help it survive under conditions that may kill the cell

_____ 11. bacteria with a thin cell wall

_____ 12. bacteria with a thick cell wall

Terms

a. antibiotic resistance

b. Archaea

c. Bacteria

d. biofilm

e. cyanobacteria

f. endospore

g. extremophile

h. flagella

i. genetic transfer

j. Gram-negative bacteria

k. Gram-positive bacteria

l. plasmid

Lesson 13.1: Vocabulary II

Name_____ **Class**_____ **Date**_____

Fill in the blank with the appropriate term.

1. The prokaryote domains are _____ and _____.

2. The common prokaryotic shapes include helices, _____, and rods.

3. The DNA of a prokaryotic cell is in the cytoplasm because the cell lacks a _____.

4. Under ideal conditions, bacterial populations can double every _____20 minutes.

5. Bacteria called _____ make food through photosynthesis and release oxygen into the air.

6. Genetic _____ increases genetic variation in prokaryotes.

7. A _____ is a colony of prokaryotes that is stuck to a surface such as a host's tissues.

8. Bacterial infections in people can be treated with _____ drugs.

9. Prokaryotes reproduce through binary fission, a type of _____ reproduction.

10. A plasmid is an extra-chromosomal piece of _____.

11. Cellular respiration and photosynthesis take place in the _____ of prokaryotes.

12. Prokaryotes have a _____ outside their plasma membrane, usually to give strength and rigidity to the cell.

13. _____ live everywhere on Earth, including extreme environments such as deep sea vents.

14. There are _____ of bacteria inside the human intestines that help digest food.

Lesson 13.1: Critical Writing

Name_____ Class_____ Date_____

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

What are cyanobacteria? Discuss the importance of this prokaryote.

13.2 Viruses

Lesson 13.2: True or False

Name_____ **Class**_____ **Date**_____

Write true if the statement is true or false if the statement is false.

_____ 1. An individual virus is a virion.

_____ 2. Viruses lack cell membranes, cytoplasm, ribosomes, but they do have genetic material.

_____ 3. Because they evolve, viruses are living organisms.

_____ 4. A virus is essentially DNA or RNA and a protective protein coat.

_____ 5. Populations of viruses still divide like cells even though they are not cells.

_____ 6. Virus can remain latent in within the body for many years.

_____ 7. Antibiotics only kill certain on viruses.

_____ 8. Viruses can be used as vectors in gene therapy treatments.

_____ 9. Viruses are small particles, smaller than eukaryotic cells but larger than prokaryotic cells.

_____ 10. Scientists did not know about viruses until they were first seen with an electron microscope in the 1930s.

_____ 11. A virus can only replicate inside a host cell.

_____ 12. Some viruses can cause cancer.

_____ 13. The protective protein coat around the virus is called a capsid.

_____ 14. Viruses cause AIDS, the flu, chicken pox, the common cold, and food poisoning.

Lesson 13.2: Critical Reading

Name_____ **Class**_____ **Date**_____

Read these passages from the text and answer the questions that follow.

Characteristics of Viruses

An individual virus is called a **virion**. It is a tiny particle much smaller than a prokaryotic cell. Because viruses do not consist of cells, they also lack cell membranes, cytoplasm, ribosomes, and other cell organelles. Without these structures, they are unable to make proteins or even reproduce on their own. Instead, they must depend on a host cell to synthesize their proteins and to make copies of themselves. Viruses infect and live inside the cells of living organisms. When viruses infect the cells of their host, they may cause disease. For example, viruses cause AIDS, influenza (flu), chicken pox, and the common cold.

Although viruses are not classified as living things, they share two important traits with living things. They have genetic material, and they can evolve. This is why the classification of viruses has been controversial. It calls into question just what it means to be alive. What do you think? How would you classify viruses?

Structure and Classification of Viruses

Viruses vary in their structure. The structure of a virus determines how it is classified.

Structure of Viruses

A virus particle consists of DNA or RNA within a protective protein coat called a **capsid**. The shape of the capsid may vary from one type of virus to another.

Some viruses have an envelope of phospholipids and proteins. The envelope is made from portions of the host's cell membrane. It surrounds the capsid and helps protect the virus from the host's immune system. The envelope may also have receptor molecules that can bind with host cells. They make it easier for the virus to infect the cells.

Classification of Viruses

Viruses are classified on the basis of several traits. For example, they may be classified by capsid shape, presence or absence of an envelope, and type of nucleic acid. **Table** 13.2 gives examples of virus families and their traits. Most systems of classifying viruses identify at least 20 virus families, but only 4 are shown in the table. Have any of these viruses made you sick?

TABLE 13.2: Virus Classification: Four Examples

Virus Family	Capsid Shape	Envelope Present?	Type of Nucleic Acid	Disease Caused by a Virus in this Family
Adenovirus	icosahedral	no	DNA	acute respiratory disease
Herpesviruses	icosahedral	yes	DNA	chicken pox
Orthomyxoviruses	helical	yes	RNA	influenza
Coronaviruses	complex	yes	RNA	common cold

Questions

1. Describe a virion.

2. Why are viruses not able to make their own proteins?

3. Describe the structure of a virus.

4. What are the traits used to classify a virus?

5. Do you think viruses should be classified as "living organisms"? Why or why not?

Lesson 13.2: Multiple Choice

Name_____ **Class**_____ **Date**_____

Circle the letter of the correct choice.

a. Viruses are in which domain of life?
   a. Archaea
   b. Bacteria
   c. Eukarya
   d. none of the above

b. Which of the following structures do viruses lack? (1) genetic material, (2) cell membrane, (3) cytoplasm, (4) ribosomes.
   a. 1 only
   b. 1, 2, and 3
   c. 2, 3, and 4

d. 1, 2, 3, and 4

c. Which statement best describes a capsid?

a. A capsid defines the shape of the virus.
b. A capsid is the outside coat of the virus.
c. A capsid is a protein coat that protects the genetic material of the virus.
d. A capsid is either helical, icosahedral, or complex.

d. Which traits describe the virus that causes the common cold?

a. It is an RNA virus with a complex capsid surrounded by an envelope.
b. It is a DNA virus with a complex capsid surrounded by an envelope.
c. It is an RNA virus with a helical capsid surrounded by an envelope.
d. It is a DNA virus with an icosahedral capsid surrounded by an envelope.

e. To replicate, a virus must

a. infect a host cell and use the cell's ribosomes, enzymes, DNA, and other components.
b. infect a host cell and use the cell's ribosomes, enzymes, ATP, and other components.
c. infect a host cell and use the viral enzymes, ATP, and other components.
d. infect a host cell and use the viral DNA and ribosomes, but the cell's enzymes, ATP and other components.

f. Latency refers to

a. the process of viral disease formation inside a host.
b. the process of making a viral envelope from portions of the host's cell membrane.
c. a dormant state of the virus inside a host's body.
d. the process of viral replication inside a host.

g. A vaccine

a. can be harmful because it contains pathogens such as viruses.
b. contains a changed pathogen, so the pathogen is no longer harmful.
c. provokes a response from the viral immune system.
d. all of the above

h. Which of the following statements is true? (1) HPV causes cancer of the cervix in females. (2) Hepatitis B virus causes cancer of the liver. (3) Many viral diseases can be prevented with proper vaccination. (4) Antibiotics have no effect on viruses.

a. 1 and 2
b. 3 and 4
c. 1, 2, and 3
d. 1, 2, 3, and 4

Lesson 13.2: Vocabulary I

Name_____ **Class**_____ **Date**_____

Match the vocabulary word with the proper definition.

Definitions

_____ 1. surrounds the capsid and helps protect the virus

_____ 2. the ability to resist a pathogen

_____ 3. a dormant state inside the body

_____ 4. a protective protein coat

_____ 5. usually considered to be nonliving

_____ 6. a substance that contains harmless pathogens

_____ 7. 20-sided

_____ 8. spiral

_____ 9. an individual virus

Terms

a. capsid

b. envelope

c. helical

d. icosahedral

e. immunity

f. latency

g. vaccine

h. virion

i. virus

Lesson 13.2: Vocabulary II

Name_____ **Class**_____ **Date**_____

Fill in the blank with the appropriate term.

1. Many viral diseases can be prevented by giving people _____.
2. Viruses do not meet most of the criteria of _____.
3. The three shapes of viral capsids are helical, icosahedral, and _____.
4. Viruses are so small that they can be seen only with an _____ microscope.
5. Viruses must use the cell's _____, enzymes, ATP, and other components to replicate.
6. A virus particle consists of DNA or RNA within a _____ coat.
7. Viruses may cause illness by disrupting _____ in host cells.
8. Viruses are used as vectors in gene _____.
9. The virus that causes chicken pox may remain _____ within the body for decades.
10. Though some antiviral drugs are available, the more common _____ have no effect on viruses.
11. One way viruses cause _____ is by causing host cells to burst open and die.
12. Viruses cause diseases such as _____, influenza, chicken pox, and the common cold.

Lesson 13.2: Critical Writing

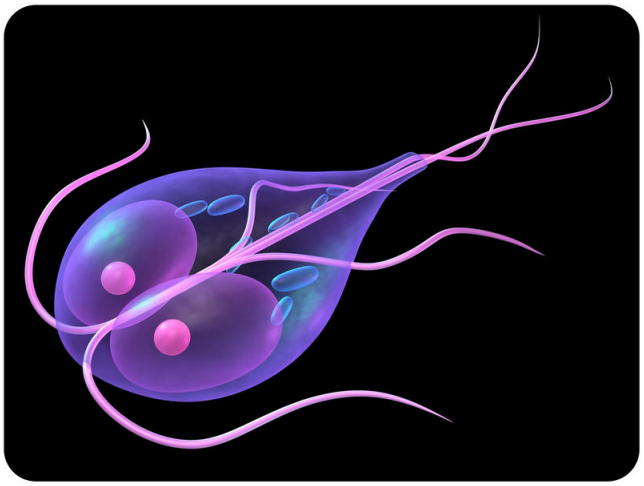
Name_____ Class_____ Date_____

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Are viruses living organisms? Discuss why or why not.

CHAPTER 14 Eukaryotes: Protists and Fungi Worksheets

Chapter Outline



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- **Lesson 14.1: Introduction to Protists**
- **Lesson 14.2: Types of Protists**
- **Lesson 14.3: Introduction to Fungi**
- **Lesson 14.4: Ecology of Fungi**
- **Lesson 14.5: Protists, Fungi, and Human Disease**

14.1 Introduction to Protists

Lesson 14.1: True or False

Name_____ **Class**_____ **Date**_____

Write true if the statement is true or false if the statement is false.

_____ 1. Protists are prokaryotes.

_____ 2. There is currently no scientific evidence supporting the endosymbiotic theory.

_____ 3. According to the endosymbiotic theory, eukaryotic cells evolved from prokaryotic cells.

_____ 4. According to the endosymbiotic theory, mitochondria evolved from small aerobic bacteria that were engulfed by a larger prokaryotic cell.

_____ 5. According to the endosymbiotic theory, chloroplasts evolved from small protists.

_____ 6. Chloroplasts, but not mitochondria, have DNA.

_____ 7. Chloroplasts and mitochondria are surrounded by membranes.

_____ 8. Protists contain organelles.

_____ 9. All protists are multicellular.

_____ 10. Most protists require a watery environment in which to live.

_____ 11. Protists have no way of moving on their own; they must hitch a ride with a motile organism.

_____ 12. Algae are protists.

_____ 13. Spores can be produced by some protists as a response to harsh conditions in their environment.

_____ 14. Some protists can carry out photosynthesis.

_____ 15. Protists cannot reproduce sexually.

Lesson 14.1: Critical Reading

Name_____ **Class**_____ **Date**_____

Read these passages from the text and answer the questions that follow.

Evolution of Protists

Scientists think that protists are the oldest eukaryotes. If so, they must have evolved from prokaryotic cells. How did this happen? The endosymbiotic theory provides the most widely accepted explanation. That's because it is well supported by evidence.

The First Eukaryotic Cells

According to the endosymbiotic theory, the first eukaryotic cells evolved from a symbiotic relationship between two or more prokaryotic cells. Smaller prokaryotic cells were engulfed by (or invaded) larger prokaryotic cells.

The small cells (now called endosymbionts) benefited from the relationship by getting a safe home and nutrients. The large cells (now called hosts) benefited by getting some of the organic molecules or energy released by the endosymbionts. Eventually, the endosymbionts evolved into organelles of the host cells. After that, neither could live without the other.

Some of the endosymbionts were aerobic bacteria. They were specialized to break down chemicals and release energy. They evolved into the mitochondria of eukaryotic cells. Some of the small cells were cyanobacteria. They were specialized for photosynthesis. They evolved into the chloroplasts of eukaryotic cells.

Evidence for Endosymbiotic Theory

Many pieces of evidence support the endosymbiotic theory. For example:

- Mitochondria and chloroplasts contain DNA that is different from the DNA found in the cell nucleus. Instead, it is similar to the circular DNA of bacteria.
- Mitochondria and chloroplasts are surrounded by their own plasma membranes, which are similar to bacterial membranes.
- New mitochondria and chloroplasts are produced through a process similar to binary fission. Bacteria also reproduce through binary fission.
- The internal structure and biochemistry of chloroplasts is very similar to that of cyanobacteria.

Questions

1. What does the endosymbiotic theory attempt to explain?

2. What benefits did the ancient endosymbionts get from their host cells?

3. What benefits did the host cells get from the endosymbionts?

4. Describe two examples of scientific evidence that support the endosymbiotic theory.

5. What does the "endo" part of endosymbiosis refer to? What does the "symbiosis" part refer to?

Lesson 14.1: Multiple Choice

Name_____ **Class**_____ **Date**_____

Circle the letter of the correct choice.

a. Which of the following is **not** a principle of the endosymbiotic theory?
   a. Mitochondria evolved from aerobic bacteria that were engulfed by a larger prokaryotic cell.
   b. Chloroplasts evolved from endosymbiotic photosynthetic bacteria.
   c. Prokaryotic cells evolved from eukaryotic cells.
   d. The first eukaryotic cells evolved from a mutually beneficial relationship between two or more prokaryotic cells.

b. How are mitochondria and chloroplasts similar?
   a. They are both organelles in eukaryotic cells.
   b. They are both surrounded by membranes.
   c. They divide by binary fission.
   d. all of the above

c. Which location is least likely to have a population of protists?
   a. desert
   b. damp soil
   c. ocean
   d. lake

d. Cilia
   a. are false feet.
   b. are short appendages that help some protists move.

c. contain all of the DNA in a protist.
d. all of the above

e. The algae *Spirogyra* produces spores
   a. when conditions in their environment are ideal.
   b. to get rid of extra chloroplasts.
   c. when conditions in their environment become unfavorable.
   d. as a way to make food.

f. The fusion of two *Spirogyra* spores to form a diploid zygote is an example of
   a. asexual reproduction.
   b. sexual reproduction.
   c. binary fission.
   d. triploid fission.

g. Ingestive protists obtain food by
   a. photosynthesis.
   b. diffusion.
   c. osmosis.
   d. engulfing the food.

h. Photosynthesis is
   a. the process of engulfing food particles.
   b. the process of transforming light energy, carbon dioxide, and water into chemical energy (food).
   c. a type of cell movement.
   d. none of the above.

Lesson 14.1: Vocabulary I

Name_____ **Class**_____ **Date**_____

Match the vocabulary word with the proper definition.

Definitions

_____ 1. the simplest eukaryotes

_____ 2. a mutually beneficial relationship between a cell and the cell that engulfed it

_____ 3. longer, whip-like appendages that aid movement

_____ 4. an organelle that carries out photosynthesis

_____ 5. cell without a nucleus

_____ 6. cell with a nucleus

_____ 7. an organelle that carries out cellular respiration

_____ 8. short, whip-like appendages that aid movement

_____ 9. the ability to move

_____ 10. “false feet”

_____ 11. a reproductive cell produced by protists and other organisms

_____ 12. prokaryotes that use oxygen for cellular respiration

Terms

a. aerobic bacteria

b. chloroplast

c. cilia

d. endosymbiosis

e. eukaryote

f. flagella

g. mitochondria

h. motility

i. psuedopods

j. protists

k. prokaryote

l. spore

Lesson 14.1: Vocabulary II

Name_____ **Class**_____ **Date**_____

Fill in the blank with the appropriate term.

1. A term for the ability to move is _____.
2. Whip-like cellular appendages some protists use to help them move are _____.
3. Cells that live inside other cells in a mutually beneficial relationship are called _____.
4. _____ are the simplest eukaryotes.
5. A temporary, foot-like extension of the protist's cytoplasm that it can use for movement is a _____.
6. Mitochondria are cellular _____.
7. Photosynthesis in protists happens in the _____.
8. Protists have a nucleus containing _____.
9. _____ are the haploid *Spirogyra* cells that can survive in harsh environments.
10. Haploid cells are produced from a diploid zygote by _____.
11. Protists can be single celled or _____.
12. Protists have get food by _____, _____, or _____.

Lesson 14.1: Critical Writing

Name_____ **Class**_____ **Date**_____

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Many protists are capable of both asexual and sexual reproduction, including *Spirogyra*. How does *Spirogyra* benefit from being able to reproduce by both asexual and sexual reproduction?

14.2 Types of Protists

Lesson 14.2: True or False

Name_____ **Class**_____ **Date**_____

Write true if the statement is true or false if the statement is false.

_____ 1. Protists are often classified based on how similar they are to animals, fungi, or plants.

_____ 2. Protozoa are fungus-like protists.

_____ 3. Many protists are single-celled organisms.

_____ 4. Some protists are multicellular organisms.

_____ 5. Some protozoa eat bacteria.

_____ 6. Some protists eat algae.

_____ 7. Malaria is caused by algae that live in protozoa.

_____ 8. Sporozoan protozoa are those that move only when they are adults.

_____ 9. Diatoms are a type of protozoa.

_____ 10. Kelp are fungus-like protists.

_____ 11. Kelp are multicellular organisms that live in the ocean.

_____ 12. All algae have roots, stems, and leaves.

_____ 13. All algae reproduce only by sexual reproduction.

_____ 14. On rotting logs, one may find slime molds.

_____ 15. Fish may have parasites called water molds.

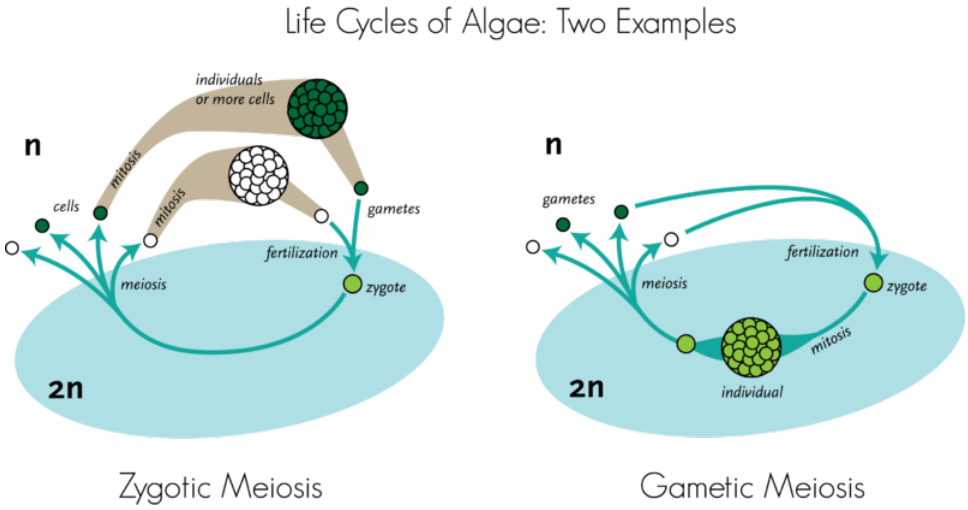
Lesson 14.2: Critical Reading

Name_____ **Class**_____ **Date**_____

Read these passages from the text and answer the questions that follow.

Reproduction of Algae

Algae have varied life cycles. Two examples are shown in the figure below. Both cycles include phases of asexual reproduction (haploid, n) and sexual reproduction (diploid, $2n$). Why go to so much trouble to reproduce? Asexual reproduction is fast, but it doesn't create new genetic variation. Sexual reproduction is more complicated and risky, but it creates new gene combinations. Each strategy may work better under different conditions. Rapid population growth is adaptive when conditions are favorable. Genetic variation helps ensure that some organisms will survive if the environment changes.



Life Cycles of Algae: Two Examples - Zygotic meiosis and Gametic meiosis. In life cycle A, diploid (2n) zygotes undergo meiosis and produce haploid (n) gametes. The gametes undergo mitosis and produce many additional copies of themselves. How is life cycle B different from life cycle A? *(Image courtesy of CK-12 Foundation and under the Creative Commons license CC-BY-NC-SA 3.0.)*

Questions

1. What are the two types of life cycles of algae shown in the figure?

2. What is meiosis?

3. In the zygotic meiosis life cycle, what is the ploidy level (*n* or *2n*) of the individuals? Explain your reasoning.

4. In the gametic meiosis life cycle, what is the ploidy level (*n* or *2n*) of the individuals? Explain your reasoning.

5. What are the advantages of asexual and sexual reproduction? What are the disadvantages of each?

Lesson 14.2: Multiple Choice

Name_____ **Class**_____ **Date**_____

Circle the letter of the correct choice.

a. Protozoa can get their food by
   a. eating algae.
   b. eating dead organic material.
   c. preying on other organisms and engulfing and digesting them.
   d. all of the above.

b. Which of the following is **not** a class of protozoa?
   a. flagellate
   b. sporozoan
   c. bacteria
   d. amoeboid

c. The type of protozoan that uses psuedopods (false feet) to move is

   a. a ciliate protozoan.
   b. an amoeboid protozoan.
   c. a sporozoan.
   d. an algae.

d. Algae are considered plant-like because

   a. they have roots, stems, and leaves.
   b. they are often unicellular.
   c. they eat dead organic matter.
   d. they have chloroplasts and carry out photosynthesis.

e. The common feature shared by dinoflagellates, euglenids, green algae, and red algae is that they

   a. all have chlorophyll.
   b. all are multicelluar organisms.
   c. never carry out photosynthesis.
   d. all of the above

f. Fungus-like protists have

   a. cell walls made of cellulose.
   b. cell walls made of chitin.
   c. chloroplasts for photosynthesis.
   d. none of the above.

g. Slime molds will start to swarm when

   a. the sun is out.
   b. it is a full moon.
   c. food is scarce.
   d. there is a lot of pollen in the air.

h. Water molds are

   a. a type of fungus-like protist.
   b. a type of animal-like protist.
   c. found only in the ocean.
   d. found only in Australia.

Lesson 14.2: Vocabulary I

Name_____ **Class**_____ **Date**_____

Match the vocabulary word with the proper definition.

Definitions

_____ 1. animal-like protists

_____ 2. an organism that hunts living organisms and consumes them as food

_____ 3. multicellular seaweed

_____ 4. fungus-like protist typically found on decaying organic matter such as rotting logs

_____ 5. an organism that uses flagella for motility

_____ 6. an organism that uses psuedopods for motility

_____ 7. an organism that uses cilia for motility

_____ 8. an organism that consumes plants

_____ 9. fungus-like protist typically found on surface water and moist soil

_____ 10. type of protozoa that cannot move in the adult stage

_____ 11. plant-like protists

_____ 12. an organism that gets food from dead organic matter

Terms

a. algae

b. amoeboid

c. ciliate

d. decomposers

e. flagellate

f. herbivore

g. kelp

h. predator

i. protozoa

j. slime mold

k. sporozoa

l. water mold

Lesson 14.2: Vocabulary II

Name_____ Class_____ Date_____

Fill in the blank with the appropriate term.

1. *Plasmodium*, the organism that causes malaria, is the _____ type of protozoan.

2. Some members of the _____ group of protists infect plants and destroy crops such as potatoes, corn, grapes, and lettuce.

3. When food is scarce, cells of the _____ group of protists swarm together and crawl as a mass, ingesting any food they find along the way.

4. The _____ are animal-like protists.

5. The _____ protozoa use flagella to move.

6. The _____ are multicellular seaweeds that can grow as large as some trees.

7. _____ are the unicellular protists that can carry out photosynthesis.

8. _____ capture and engulf prey.

9. The _____ protozoa uses psuedopods to move.

10. _____ eat algae.

11. _____ eat dead organic matter.

12. The _____ protozoa use cilia for motility.

Lesson 14.2: Critical Writing

Name_____ Class_____ Date_____

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

What are some common characteristics of all protists? What are the main distinguishing characteristics of the protozoa, algae, and fungus-like protists?

14.3 Introduction to Fungi

Lesson 14.3: True or False

Name_____ Class_____ Date_____

Write true if the statement is true or false if the statement is false.

_____ 1. Fungi are a kingdom in the domain Prokarya.

_____ 2. Mushrooms are fungi.

_____ 3. Yeasts are fungi.

_____ 4. Amoeba are fungi.

_____ 5. Fungi spend most of their life cycle in the diploid state.

_____ 6. Fungi have cell walls made of cellulose, just like plants do.

_____ 7. Many fungi grow as hyphae.

_____ 8. Most fungi reproduce only by sexual reproduction.

_____ 9. A fungal spore is a diploid cell produced by meiosis of the parent cell.

_____ 10. Fungal spores can be transported by wind, water, and even by traveling on other organisms.

_____ 11. A yeast cell produced by budding off of a parent cell is genetically identical to the parent cell.

_____ 12. Mating of two haploid fungal hyphae produces a diploid zygospore.

_____ 13. Fungi first colonized land at about the same time as plants did.

_____ 14. In general, fungi are able to move themselves around.

_____ 15. Baker's yeast is a fungus.

Lesson 14.3: Critical Reading

Name_____ Class_____ Date_____

Read these passages from the text and answer the questions that follow.

Reproduction of Fungi

The majority of fungi can reproduce both asexually and sexually. This allows them to adjust to conditions in the environment. They can spread quickly through asexual reproduction when conditions are stable. They can increase their genetic variation through sexual reproduction when conditions are changing and variation may help them survive.

Asexual Reproduction

Almost all fungi reproduce asexually by producing spores. A fungi spore is a haploid cell produced by mitosis from a haploid parent cell. It is genetically identical to the parent cell. Fungi spores can develop into new haploid

individuals without being fertilized.

Spores may be dispersed by moving water, wind, or other organisms. Some fungi even have "cannons" that "shoot" the spores far from the parent organism. This helps to ensure that the offspring will not have to compete with the parents for space or other resources. You are probably familiar with puffballs. They release a cloud of spores when knocked or stepped on. Wherever the spores happen to land, they do not germinate until conditions are favorable for growth. Then they develop into new hyphae. Yeasts do not produce spores. Instead, they reproduce asexually by budding. **Budding** is the pinching off of an offspring from the parent cell. The offspring cell is genetically identical to the parent.

Sexual Reproduction

Sexual reproduction also occurs in virtually all fungi. This involves mating between two haploid hyphae. During mating, two haploid parent cells fuse, forming a diploid spore called a **zygospore**. The zygospore is genetically different from the parents. After the zygospore germinates, it can undergo meiosis, forming haploid cells that develop into new hyphae.

Questions

1. How do fungi benefit from being able to reproduce both asexually and sexually?

2. What are fungal spores? How are they made?

3. Why have fungi evolved mechanisms for dispersal of their spores? Name a few of these mechanisms.

4. How do many yeast reproduce asexually? What is this process called?

5. How do fungi mate?

Lesson 14.3: Multiple Choice

Name_____ Class_____ Date_____

Circle the letter of the correct choice.

a. The thread-like filaments of fungi are called
   a. hyphae.
   b. spores.
   c. zygospores.
   d. chitin.

b. The largest known fungus is
   a. in the Sahara desert and is 3 square feet.
   b. in Antarctica and covers the entire surface of the continent.
   c. in Oregon and covers 8.9 square kilometers.
   d. none of the above.

c. When environmental conditions are favorable, _____ is generally more beneficial for a fungal species.
   a. asexual reproduction
   b. sexual reproduction
   c. moving to a new location
   d. stopping reproduction completely

d. Sexual reproduction of fungi involves
   a. production of genetically identical offspring.
   b. fusion of six haploid parent cells to form one giant cell.
   c. fusion of two haploid parent cells to form a zygospore.
   d. fusion of two diploid parent cells to form a tetraploid spore.

e. Germination of a diploid zygospore followed by meiosis produces

   a. four haploid cells.
   b. four diploid cells.
   c. two diploid cells.
   d. a yeast bud.

f. The earliest fungi evolved

   a. independently from thousands of different ancestors.
   b. at least 600 million years ago.
   c. before prokaryotes.
   d. after the first humans appeared on the earth.

g. One way that fungi are similar to plants is

   a. they both have cell walls made of cellulose.
   b. they both carry out photosynthesis.
   c. they both move rapidly from place to place.
   d. none of the above.

h. The phylum of fungi that is found in Antarctica, is often part of a symbiotic relationship, and is found in terrestrial ecosystems throughout the world is

   a. protozoa.
   b. ascomycota.
   c. algae.
   d. water mold.

Lesson 14.3: Vocabulary I

Name_____ Class_____ Date_____

Match the vocabulary word with the proper definition.

Definitions

_____ 1. a kingdom whose members include mushrooms

_____ 2. thread-like filaments consisting of haploid cells connected end-to-end and which can form branches

_____ 3. having two copies of each kind of chromosome (*2n*)

_____ 4. two sequential cell divisions producing four cells, each of which has half the number of chromosomes as the parent cell

_____ 5. the general name for cell division in all organisms that produces cells that have the same number of chromosomes as the parent cell

_____ 6. a diploid spore formed by fusion of two haploid cells

_____ 7. the material that makes up the cell wall of fungi

_____ 8. the material that makes up the cell wall of plants

_____ 9. a mass of fungal hyphae

_____ 10. a form of asexual reproduction in yeast

_____ 11. a reproductive cell specialized for dispersal and survival in harsh environmental conditions

_____ 12. having one copy of each kind of chromosome (*n*)

Terms

a. budding

b. cellulose

c. chitin

d. diploid

e. haploid

f. fungi

g. hyphae

h. meiosis

i. mitosis

j. mycelium

k. spore

l. zygospore

Lesson 14.3: Vocabulary II

Name_____ **Class**_____ **Date**_____

Fill in the blank with the appropriate term.

1. Fusion of two haploid fungal cells produces a _____.

2. _____ is the kingdom whose members include baker's yeast and mushrooms.

3. Many fungi can make thread-like filaments called _____, which consists of haploid cells aligned end-to-end and which may form branches.

4. Haploid cells can be formed via _____ of a diploid zygospore.

5. A haploid offspring cell is produced by _____ of a haploid parent cell.

6. A puffball mushroom releases _____ into the air when it is disturbed.

7. A _____ is a mass of fungal hyphae.

8. A _____ cell is said to have 2n number of chromosomes.

9. A _____ cell is said to have n number of chromosomes.

10. The cell wall of a growing plant cell is of made primarily of _____.

11. The cell wall of a fungus is made of _____.

12. Yeast can reproduce asexually by _____, a process in which a bleb-like extension pinches off from the parent cell.

Lesson 14.3: Critical Writing

Name_____ **Class**_____ **Date**_____

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Why were fungi once classified as plants? What findings led to their reclassification into their own kingdom?

14.4 Ecology of Fungi

Lesson 14.4: True or False

Name_____ Class_____ Date_____

Write true if the statement is true or false if the statement is false.

_____ 1. Fungi make chlorophyll.

_____ 2. Fungi carry out photosynthesis.

_____ 3. Fungi are heterotrophs.

_____ 4. Most fungi use dead organisms as their food.

_____ 5. When fungi break down dead organic matter, nutrients are also released, and these nutrients can be used by other living organisms.

_____ 6. In all parasitic relationships involving fungi, the fungi are attacked by an animal parasite.

_____ 7. Fungi make enzymes that help break down organic compounds.

_____ 8. Bacteria, but not fungi, can break down the cellulose in plant cell walls.

_____ 9. Fungi use their hyphae to access organic matter not reachable to other organisms.

_____ 10. Fungi are the primary producers of carbon-containing compounds in forests.

_____ 11. A mycorrhiza is a parasitic relationship between a plant and a fungus.

_____ 12. A lichen is a mutualistic relationship between a photosynthetic organism (such as a cyanobacterium) and a fungus.

_____ 13. Lichens are often found on rocks.

_____ 14. Some fungi make antibiotics such as penicillin.

_____ 15. Human hormones such as insulin can be produced by genetically engineered fungi.

Lesson 14.4: Critical Reading

Name_____ Class_____ Date_____

Read these passages from the text and answer the questions that follow.

Symbiotic Relationships of Fungi

Not all fungi feed on dead organisms. Many are involved in symbiotic relationships, including parasitism and mutualism.

Fungi as Parasites

In a parasitic relationship, the parasite benefits while the host is harmed. Parasitic fungi live in or on other organisms and get their nutrients from them. Fungi have special structures for penetrating a host. They also produce enzymes

that break down the host's tissues.

Parasitic fungi often cause illness and may eventually kill their host. They are the major cause of disease in agricultural plants. Fungi also parasitize animals. Fungi even parasitize humans. Did you ever have athelete's foot? If so, you were the host of a parasitic fungus. You can read more about fungi and human disease in the last lesson of this chapter.

Mutualism in Fungi

Fungi have several mutualistic relationships with other organisms. In mutualism, both organisms benefit from the relationship. Two common mutualistic relationships involving fungi are mycorrhiza and lichen.

A **mycorrhiza** is a mutualistic relationship between a fungus and a plant. The fungus grows in or on the plant roots. The fungus benefits from the easy access to food made by the plant. The plant benefits because the fungus puts out mycelia that help absorb water and nutrients. Scientists think that a symbiotic relationship such as this may have allowed plants to first colonize the land.

A **lichen** is a mutualistic relationship between a fungus and a photosynthetic organism. The other organism is usually a cyanobacterium or green alga. The fungus grows around the bacterial or algal cells. The fungus benefits from the constant supply of food produced by the photosynthesizer. The photosynthesizer benefits from the water and nutrients absorbed by the fungus.

Questions

1. Define parasitism.

2. Name and describe an example of a parasitic relationship involving a fungus.

3. Define mutualism.

4. Name and describe an example of a mutualistic relationship involving a fungus.

5. Why do you think that parasitism exists, when one of the organisms is harmed by the relationship?

Lesson 14.4: Multiple Choice

Name_____ **Class**_____ **Date**_____

Circle the letter of the correct choice.

a. Fungi are _____ like _____.
   a. autotrophs, plants
   b. autotrophs, animals
   c. heterotrophs, animals
   d. heterotrophs, plants

b. Saprotrophs get their food
   a. by doing photosynthesis.
   b. from absorbing dead organic matter.
   c. by engulfing living organisms .
   d. by eating live plants.

c. Some of the nutrients that plants absorb from the soil
   a. are released into the soil from dead organic matter by fungi.
   b. are cellulose and lignin.
   c. are saprotrophs engulfed by the plant's leaves.
   d. none of the above

d. Fungal hyphae
   a. are long filaments that aid in absorption of water and minerals.
   b. can penetrate deep into organic matter.
   c. release enzymes that can digest organic matter such as cellulose and lignin.

d. all of the above

e. Parasitic fungi

a. help their host.
b. harm their host.
c. carry out photosynthesis.
d. make lignin.

f. Mycorrhiza is

a. a parasitic relationship between a plant and an animal.
b. a mutualistic relationship between a plant and an animal.
c. a mutualistic relationship between a plant and a fungus.
d. a parasitic relationship between a plant and a fungus.

g. A lichen is

a. a parasitic relationship between a plant and an animal.
b. a parasitic relationship between a plant and a fungus.
c. a mutualistic relationship between an animal and a fungus.
d. a mutualistic relationship between a fungus and a photosynthetic organism.

h. Penicillin is

a. an antibiotic produced by plants.
b. an antibiotic produced by a fungus.
c. a parasite of some insects.
d. a mutualism between a fungus and an animal.

Lesson 14.4: Vocabulary I

Name_____ **Class**_____ **Date**_____

Match the vocabulary word with the proper definition.

Definitions

_____ 1. a mutualism between a fungus and a photosynthetic organism (an algae or a cyanobacterium)

_____ 2. a type of fungus that gets its food from dead organisms

_____ 3. a relationship between two organisms that helps both organisms

_____ 4. a relationship between two organisms in which one is helped and the other is harmed

_____ 5. a kingdom whose members include yeasts, mushrooms, and molds

_____ 6. a kind of fungus used by humans in making bread and beer

_____ 7. a mutualism between a fungus and the roots of a plant

_____ 8. an organism that can make its own food

_____ 9. an organism that cannot make its own food and gets food made by other organisms

_____ 10. an organism that gets organic compounds from dead organisms

_____ 11. a carbon-containing molecule that is the main building block of plant cells walls

_____ 12. long, thin, often branching filaments made of fungal cells; helps with absorption of water and nutrients

Terms

a. autotroph

b. cellulose

c. decomposer

d. fungi

e. heterotroph

f. hyphae

g. lichen

h. mycorrhiza

i. mutualism

j. parasitism

k. saprotroph

l. yeast

Lesson 14.4: Vocabulary II

Name_____ **Class**_____ **Date**_____

Fill in the blank with the appropriate term.

1. A _____ is an organism that cannot make its own food and gets food made by other organisms.

2. _____ is a relationship between two organisms that helps both organisms.

3. The kingdom of _____ includes members such as yeasts, mushrooms, and molds.

4. _____ is the main building block of plant cells walls.

5. _____ is a mutualism between a fungus and the roots of a plant.

6. Long, thin, often branching filaments made of fungal cells that help with absorption of water and nutrients are called _____.

7. An organism that can make its own food is an _____.

8. An organism that gets organic compounds from dead organisms is called a _____.

9. _____ is a kind of fungus used by humans in making bread and beer.

10. A _____ is a type of fungus that gets its food from dead organisms.

11. _____ is a a relationship between two organism in which one is helped and the other is harmed.

12. A _____ is a mutualism between a fungus and a photosynthetic organism (an algae or a cyanobacterium).

Lesson 14.4: Critical Writing

Name_____ **Class**_____ **Date**_____

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Can fungi be helpful to humans? Support your answer with specific examples.

14.5 Protists, Fungi, and Human Disease

Lesson 14.5: True or False

Name_____ **Class**_____ **Date**_____

Write true if the statement is true or false if the statement is false.

_____ 1. Of all the protists, algae cause the most disease in humans.

_____ 2. Mutualistic relationships between protists and humans cause harm to human health.

_____ 3. Sleeping sickness is a disease caused by a protozoan, which is an animal-like protist.

_____ 4. Diseases such as sleeping sickness and Chagas disease are spread to humans by insects.

_____ 5. The work of thousands of researchers at the same time was needed to discover what caused Chagas disease.

_____ 6. One definition of vector is a living organism that transfers a disease-causing organism to a host.

_____ 7. Without treatment, Chagas disease always goes away by itself.

_____ 8. Giardia are fungi with many hyphae.

_____ 9. Symptoms of giardiasis include abdominal pain, diarrhea, and fever.

_____ 10. Protozoa in the genus *Plasmodium* cause malaria.

_____ 11. Malaria is spread only when people drink contaminated water.

_____ 12. Symptoms of malaria include abdominal pain, diarrhea, and increased energy.

_____ 13. Malaria is common in the United States in the 21st Century.

_____ 14. It is easy to tell if a mushroom is poisonous just by looking at it.

_____ 15. Ringworm, a skin disease that shows itself as a ring-shaped rash, is caused by a fungus.

Lesson 14.5: Critical Reading

Name_____ **Class**_____ **Date**_____

Read these passages from the text and answer the questions that follow.

Fungi and Human Disease

Fungi cause human illness in three different ways: poisonings, parasitic infections, and allergic reactions. Fungal poisoning and fungal parasites are described below.

Fungal Poisoning

Many fungi protect themselves from parasites and predators by producing toxic chemicals. If people eat toxic fungi, they may experience digestive problems, hallucinations, organ failure, and even death. Most cases of mushroom poisoning are due to mistaken identity. That's because many toxic mushrooms look very similar to safe, edible mushrooms.

Fungal Parasites

Some fungi cause disease when they become human parasites. Two examples are fungi in the genera *Candida* and *Trichophyton*.

- *Candida* are yeast that cause **candidiasis**, commonly called a "yeast infection." The yeast can infect the mouth or the vagina (in females). If yeast enter the blood, they cause a potentially life threatening illness. However, this is rare, except in people with a depressed immune system.
- *Trichophyton* are fungi that cause **ringworm**. This is a skin infection characterized by a ring-shaped rash. The rash may occur on the arms, legs, head, neck, or trunk. The same fungi cause **athlete's foot** when they infect the skin between the toes. Athlete's foot is the second most common skin disease in the U.S.

Questions

1. How do fungi make people sick?

2. Why is it extremely dangerous to eat the "destroying angel" mushroom?

3. What are *Candida*? How do they affect humans?

4. What is ringworm? What causes it?

5. How are ringworm and athlete's foot related?

Lesson 14.5: Multiple Choice

Name_____ **Class**_____ **Date**_____

Circle the letter of the correct choice.

a. Humans can catch giardiasis by _____ the *Giardia* parasite.

   a. drinking water contaminated with
   b. breathing air containing
   c. not having any contact with
   d. all of the above

b. Humans who live in _____ are at risk for getting malaria.

   a. Alaska
   b. Norway
   c. Florida
   d. Mexico

c. Puffball mushrooms

   a. are highly toxic.
   b. are edible.
   c. grow only in areas where there is malaria.
   d. often cause hallucinations when eaten.

d. Infection with *Candida* is life-threatening most often

   a. in all people.
   b. in people with immune systems that don't work well.
   c. when it infects the mouth.
   d. none of the above

e. The second most common skin disease in the United States is
   a. mushroom poisoning.
   b. ringworm.
   c. athlete's foot.
   d. mold allergy.

f. Symptoms of an allergy to mold may include
   a. coughing.
   b. trouble breathing.
   c. sneezing.
   d. all of the above.

g. Allergies to mold
   a. are very rare in humans.
   b. are very common in humans.
   c. occur only in children under two years old.
   d. occur only in adults over 65 years old.

h. Mold can grow
   a. indoors.
   b. outdoors.
   c. only in deserts.
   d. a and b

Lesson 14.5: Vocabulary I

Name_____ **Class**_____ **Date**_____

Match the vocabulary word with the proper definition.

Definitions

_____ 1. a kingdom including yeast, mushrooms, and molds

_____ 2. technical name for a yeast infection caused by *Candida* fungi

_____ 3. a disease spread by mosquitoes infected with a protozoan parasite

_____ 4. the group of protozoa that causes malaria

_____ 5. a fungal skin infection typified by a ring-shaped rash

_____ 6. an infection caused by a *Trypanosoma* parasite and spread by an insect known as the "kissing bug"

_____ 7. a group that includes protozoa with flagella that cause sleeping sickness

_____ 8. an infection, most often in between the toes, by *Trichophyton* fungi

_____ 9. a general name for an organism that can transmit a disease to humans

_____ 10. animal-like protists

_____ 11. a group of eukaryotic organisms including algae, slime molds, and protozoa

_____ 12. a disease caused by a flagellate protozoan and transmitted through water or feces contaminated with this protozoan

Terms

a. athlete's foot

b. candiasis

c. Chagas disease

d. fungi

e. giardiasis

f. malaria

g. *Plasmodium*

h. protist

i. protozoa

j. ringworm

k. *Trypanosoma*

l. vector

Lesson 14.5: Vocabulary II

Name_____ **Class**_____ **Date**_____

Fill in the blank with the appropriate term.

1. Mosquitoes are the _____ that transmits the *Plasmodium* protozoa that cause malaria.
2. A _____ spreads Chagas disease via an insect vector.
3. _____ is a common skin disease typified by a ring-shaped rash.
4. Mushrooms, yeast, and mold are all _____.
5. Algae, slime molds, water molds, and protozoa are all _____.
6. _____ is a common yeast infection.
7. _____ is a disease spread by a mosquito vector.
8. _____ are animal-like protists.
9. The second most common skin disease is _____.
10. People can get _____ by drinking water contaminated by this flagellated protozoan parasite.
11. _____ protozoa cause malaria.
12. A sometimes deadly disease spread by the "kissing bug" is _____.

Lesson 14.5: Critical Writing

Name_____ **Class**_____ **Date**_____

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

What are some possible strategies people could use to reduce the incidence of malaria, Chagas disease, and giardiasis?

CHAPTER 15 Plant Evolution and Classification Worksheets

Chapter Outline

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- **Lesson 15.1: Introduction to the Plant Kingdom**
- **Lesson 15.2: Four Types of Modern Plants**

15.1 Introduction to the Plant Kingdom

Lesson 15.1: True or False

Name_____ **Class**_____ **Date**_____

Write true if the statement is true or false if the statement is false.

_____ 1. Plants are multicelluar prokaryotes with cell walls made of cellulose.

_____ 2. In some plants, the male and female reproductive organs are on different plants.

_____ 3. Some plants have lost the ability to do photosynthesis.

_____ 4. In order to carry out photosynthesis, plants need water, carbon dioxide, and light.

_____ 5. A main purpose of roots is to absorb water and minerals.

_____ 6. During photosynthesis, plants release carbon dioxide into the air and use oxygen and argon.

_____ 7. Because plants photosynthesize, they don't need to carry out cellular respiration.

_____ 8. Plants remove water from the air and into the soil by transpiration.

_____ 9. Weeds are defined as highly desirable plants.

_____ 10. Alternation of generations refers to cycling between haploid to diploid generations.

_____ 11. In plants, gametophytes are haploid.

_____ 12. In plants, sporophytes are haploid.

_____ 13. Plants are believed to have evolved directly from prokaryotic cyanobacteria.

_____ 14. The earliest plants could easily reproduce in a dry environment with almost no water.

_____ 15. Development of a vascular system helped plants colonize dry land.

Lesson 15.1: Critical Reading

Name_____ **Class**_____ **Date**_____

Read these passages from the text and answer the questions that follow.

Magnified Pollen Grain

Bee Peppered with Yellow Pollen Grains

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Seed Plants Emerge

For reproduction, early vascular plants still needed moisture. Sperm had to swim from male to female reproductive organs for fertilization. Spores also needed some water to grow and often to disperse as well. Of course, dryness and other harsh conditions made it very difficult for tiny new offspring plants to survive. With the evolution of seeds in vascular plants, all that changed. Seed plants evolved a number of adaptations that made it possible to reproduce without water. As a result, seed plants were wildly successful. They exploded into virtually all of Earth's habitats.

Why are seeds so adaptive on land? A seed contains an embryo and a food supply enclosed within a tough coating. An embryo is a zygote that has already started to develop and grow. Early growth and development of a plant embryo in a seed is called germination. The seed protects and nourishes the embryo and gives it a huge head start in the "race" of life. Many seeds can wait to germinate until conditions are favorable for growth. This increases the offspring's chance of surviving even more.

Other reproductive adaptations that evolved in seed plants include ovules, pollen, pollen tubes, and pollination by animals.

- An ovule is a female reproductive structure in seed plants that contains a tiny female gametophyte. The gametophyte produces an egg cell. After the egg is fertilized by sperm, the ovule develops into a seed.
- A grain of pollen is a tiny male gametophyte enclosed in a tough capsule (see the figure above). It carries sperm to an ovule while preventing it from drying out. Pollen grains can't swim, but they are very light, so the wind can carry them. Therefore, they can travel through air instead of water.
- Wind-blown pollen might land anywhere and be wasted. Another adaptation solved this problem. Plants evolved traits that attract specific animal pollinators. Like the bee in the figure above, a pollinator picks up pollen on its body and carries it directly to another plant of the same species. This greatly increases the chance that fertilization will occur.
- Pollen also evolved the ability to grow a tube, called a pollen tube, through which sperm could be transferred directly from the pollen grain to the egg. This allowed sperm to reach an egg without swimming through a film of water. It finally freed up plants from depending on moisture to reproduce.

Questions

1. Why did early vascular plants need to live in environment where there was plenty of water?

2. What main advantage do seed plants have over the early spore-producing plants?

3. Define what a plant seed is.

4. What is the function of a plant ovule?

5. How did the evolution of pollen benefit land plants?

Lesson 15.1: Multiple Choice

Name_____ Class_____ Date_____

Circle the letter of the correct choice.

a. The earliest plants had
   a. leaves.
   b. stems.
   c. roots.
   d. none of the above.

b. The flowers of a Venus fly trap
   a. carry out photosynthesis in the dark.
   b. secrete enzymes that can digest trapped insects.
   c. thrive in temperatures below freezing.
   d. all of the above

c. Plants need oxygen because
   a. they carry out cellular respiration just like all other aerobic organisms.
   b. oxygen is consumed during photosynthesis to make carbon-containing organic molecules.
   c. the earth's atmosphere contains too much oxygen and too little carbon dioxide.
   d. none of the above

d. Humans get which of the following kinds of products from plants?
   a. medicines
   b. dyes
   c. rubber
   d. all of the above

e. Red-eyed tree frogs
   a. are green and do photosynthesis, so they do not need to eat or drink.
   b. are not frogs, because frogs never have red eyes.
   c. live in banana trees.
   d. none of the above

f. When plants are transplanted into a new habitat that is not their native one,
   a. they always die immediately.
   b. due to a lack of predators and parasites in their new environment, they sometimes reproduce and spread so well that they outcompete native plants.
   c. they stop producing seeds and start making spores.
   d. they become parasitic plants.

g. Vegetative reproduction is
   a. a type of asexual reproduction.
   b. a type of sexual reproduction.
   c. reproduction using seeds.
   d. reproduction using spores.

h. Lignin
   a. is needed directly for photosynthesis.
   b. is a red pigment.
   c. provides structural support and waterproofing to plants.

d. is the female reproductive cell in seed plants.

Lesson 15.1: Vocabulary I

Name_____ **Class**_____ **Date**_____

Match the vocabulary word with the proper definition.

Definitions

_____ 1. a seed-containing, ripened ovary

_____ 2. the diploid generation produced by sexual reproduction

_____ 3. a reproductive structure in angiosperms; may contain pollen and egg cells

_____ 4. modern seed plants that produce seeds in cones

_____ 5. flower-producing plant

_____ 6. a reproductive structure (present in flowers) that contains the female gametophyte

_____ 7. a water-proofing and strength-providing molecule in plant cell walls

_____ 8. a type of life cycle during which plants alternate between haploid and diploid generations

_____ 9. a structure for water absorption in nonvascular plants

_____ 10. a form of asexual reproduction from stem, roots or leaves

_____ 11. seed container in gymnosperms

_____ 12. haploid individuals produced by asexual reproduction

Terms

a. alternation of generations

b. angiosperm

c. cone

d. flower

e. fruit

f. gametophyte

g. gymnosperm

h. lignin

i. ovary

j. rhizoid

k. sporophyte

l. vegetative reproduction

Lesson 15.1: Vocabulary II

Name_____ **Class**_____ **Date**_____

Fill in the blank with the appropriate term.

1. _____ occurs when the plant embryo grows and bursts through the seed coat.
2. _____, which contains male gametes, can be transported by wind and by insects.
3. _____ transports water from the roots, through the stem, and to the leaves.
4. A _____ is considered to be an unwanted plant.
5. Plants producing flowers are classified as _____.
6. Plants producing seeds in cones are classified as _____.
7. A water-absorbing structure in nonvascular plants is the _____.
8. Production of a new plant from a stem is a form of _____.
9. In a plant such as a fern, the diploid generation is called a _____.
10. In a plant such as a fern, the haploid generation is called a _____.
11. A _____ often contains petals, pollen, and one or more ovaries.
12. A _____ is a ripened ovary that contains seeds.

Lesson 15.1: Critical Writing

Name_____ Class_____ Date_____

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Name and describe several factors limiting the spread of nonvascular plants such as liverworts, hornworts, and mosses.

15.2 Four Types of Modern Plants

Lesson 15.2: True or False

Name_____ **Class**_____ **Date**_____

Write true if the statement is true or false if the statement is false.

_____ 1. Mosses are nonvascular plants.

_____ 2. A gingko tree is a nonvascular plant.

_____ 3. Rhizoids are photosynthetic organs of bryophytes.

_____ 4. The spores of bryophytes are haploid.

_____ 5. The female gametophyte of a bryophyte produces female gametes.

_____ 6. Liverworts are much taller than a typical mature tree in the forest.

_____ 7. Mosses are adapted to grow in extremely dry climates, such as the desert.

_____ 8. Another term for vascular plants is tracheophytes.

_____ 9. Xylem transport sugars from the leaves to the roots.

_____ 10. The main function of phloem is to transport minerals such as nitrogen, from the leaves to the roots.

_____ 11. The transport cells of functional xylem are living.

_____ 12. Phloem tissue consists of living cells.

_____ 13. Water evaporates more rapidly from needle-like leaves than from broad, flat leaves.

_____ 14. The first leaf of a plant, which develops inside the seed, is called a cotyledon.

_____ 15. Seed plants existed at the same time as dinosaurs.

Lesson 15.2: Critical Reading

Name_____ **Class**_____ **Date**_____

Read these passages from the text and answer the questions that follow.

Evolution of Vascular Plants

The first vascular plants evolved about 420 million years ago. They probably evolved from moss-like bryophyte ancestors, but they had a life cycle dominated by the diploid sporophyte generation. As they continued to evolve, early vascular plants became more plant-like in other ways as well.

- Vascular plants evolved true roots made of vascular tissues. Compared with rhizoids, roots can absorb more water and minerals from the soil. They also anchor plants securely in the ground, so plants can grow larger without toppling over.

- Vascular plants evolved stems made of vascular tissues and lignin. Because of lignin, stems are stiff, so plants can grow high above the ground where they can get more light and air. Because of their vascular tissues, stems keep even tall plants supplied with water so they don't dry out in the air.
- Vascular plants evolved leaves to collect sunlight. At first, leaves were tiny and needle-like, which helped reduce water loss. Later, leaves were much larger and broader, so plants could collect more light.

With their vascular tissues and other adaptations, early vascular plants had the edge over nonvascular plants. They could grow tall and take advantage of sunlight high up in the air. Bryophytes were the photosynthetic pioneers onto land, but early vascular plants were the photosynthetic pioneers into air.

Questions

1. How and when did vascular plants evolve?

2. What advantages do roots have compared to rhizoids?

3. What advantages do stems give vascular plants?

4. Why was evolution of leaves successful?

5. If vascular plants have so many advantages, why do you think nonvascular plants still exist on earth today?

Lesson 15.2: Multiple Choice

Name_____ **Class**_____ **Date**_____

Circle the letter of the correct choice.

a. Which seed structure provides the main source of food for the embryo?
   a. endosperm
   b. seed coat
   c. radicle
   d. hypocotyl

b. Which of the following is **not** a plant adaptation to cold?
   a. a waxy cuticle on the leaves
   b. rhizoids
   c. woody trunks
   d. seeds

c. The sugar-filled liquid produced by flowers is
   a. honey.
   b. maple syrup.
   c. nectar.
   d. high-fructose corn syrup.

d. The female plant structure consisting of the stigma, style, and ovary is called
   a. a stamen.
   b. a sepal.
   c. a pistil.
   d. a carpel.

e. The plant structure made of a filament and anther and which makes pollen is called

   a. an ovary.
   b. a stamen.
   c. a pistil.
   d. a sepal.

f. Fruits can be best described as

   a. ripened ovaries.
   b. enlarged stems.
   c. above ground roots.
   d. hardened pollen.

g. One advantage a plant gets from having flowers is that

   a. flowers are smaller than spores and easier to make.
   b. there is no sexual reproduction in plants with flowers.
   c. flowers attract pollinators, which spread pollen to other plants and thus promote cross-fertilization.
   d. all of the above

h. Which of the following is **not** a major class of flowering plants?

   a. magnolids
   b. eudicots
   c. monocots
   d. mosses

Lesson 15.2: Vocabulary I

Name_____ Class_____ Date_____

Match the vocabulary word with the proper definition.

Definitions

_____ 1. part of a flower that is often colorful so pollinators will be attracted

_____ 2. seed plants

_____ 3. female reproductive structure containing the stigma, style and ovary

_____ 4. the area in many seeds where food is stored

_____ 5. vascular plants

_____ 6. structure protecting the immature flower bud

_____ 7. nonvascular plants

_____ 8. pollen-producing structure

_____ 9. a structure protecting the embryo

_____ 10. vascular tissue that transports water and minerals

_____ 11. vascular tissue that transports sugars

_____ 12. a sugary liquid produced by flowers

Terms

a. bryophyte

b. endosperm

c. nectar

d. petal

e. phloem

f. pistil

g. seed coat

h. sepal

i. spermatophyte

j. stamen

k. tracheophyte

l. xylem

Lesson 15.2: Vocabulary II

Name_____ **Class**_____ **Date**_____

Fill in the blank with the appropriate term.

1. Another name for a plant with a vascular system is a _____.
2. Another name for a seed plant is a _____.
3. Liverworts, hornworts, and mosses are all _____.
4. A _____ provides protection for an immature flower bud by covering it.
5. A plant embryo in a seed gets food from the seed's _____.
6. Sugars are transported through a vascular plant through the _____.
7. The _____ of a vascular plant transports water and minerals from the roots up through the stem and into the leaves.
8. A flower's _____ is made of a stigma, style, and ovary.
9. Many flowers produce a sugary liquid called _____ that helps attract pollinators.
10. _____ of flowers are often colorful to attract pollinators.
11. A seed is protected by the _____ that surrounds it.
12. The _____ is composed of an anther and a filament.

Lesson 15.2: Critical Writing

Name_____ **Class**_____ **Date**_____

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

In spermatophytes (seed plants), a fertilized egg develops into an embryo, which is contained within the seed. Describe the structure and function of each part of the embryo. What advantages do these structures give a spermatophyte compared to a bryophyte?

15.3 Plant Evolution and Classification

Chapter 15 Review Worksheet

Name_____ Class_____ Date_____

Multiple Choice

Circle the letter of the correct choice.

a. Skunk cabbage has evolved stinky flowers because
   a. the smell prevents other plants from growing nearby all year long.
   b. all yellow flowers smell bad.
   c. the odor attracts pollinators.
   d. the odor repels pollinators.

b. Which of the following is **not** a characteristic of most plants?
   a. carries out photosynthesis
   b. has cell walls made of cellulose
   c. has yellow flowers
   d. has specialized reproductive organs

c. Much of the oxygen in the earth's atmosphere
   a. is produced as a waste product of cellular respiration in plants.
   b. is released as a byproduct of photosynthesis.
   c. is produced as a waste product of cellular respiration in animals.
   d. is produced by tree frogs.

d. The mature sporophyte of a fern
   a. produces haploid spores by meiosis.
   b. produces diploid spores by meiosis.
   c. produces diploid spores by mitosis.
   d. produces haploid spores by mitosis.

e. Fusion of male and female gametes in plants produces
   a. a eudicot stamen.
   b. a style.
   c. a haploid spore.
   d. a diploid embyro.

f. Marine plants
   a. have always been the dominant organisms of the oceans.
   b. evolved after land plants.
   c. are restricted to the water closer to the air, so they can get sufficient light for photosynthesis.
   d. do not need to photosynthesize.

g. The vascular tissue that transports water and minerals from the soil to the rest of the plant is the
   a. phloem.

b. phlegm.
c. leaf.
d. xylem.

h. The vascular tissue that transports sugars from photosynthetic tissues to the rest of the plant is

a. phloem.
b. phlegm.
c. leaf.
d. xylem.

i. In most land plants, the _____ generation is the dominant one.

a. diploid sporophyte
b. diploid gametophyte
c. haploid sporophyte
d. haploid gametophyte

j. In seed plants, the _____ helps transfer of sperm from the pollen grain to the egg.

a. sepal
b. petal
c. tuberous ovule
d. pollen tube

k. The scales of pine cones are

a. always green.
b. modified roots.
c. modified leaves.
d. modified stems.

l. Plants that make flowers are called

a. gymnosperms.
b. byrophytes.
c. gametophytes.
d. angiosperms.

m. The class of plants that has vascular tissue and reproduces with spores is the

a. clubmosses.
b. liverworts.
c. flowering plants.
d. conifers.

n. The embryonic stem in a seed is called the

a. radicle.
b. hypocotyl.
c. seed coat.
d. endosperm.

o. Pollen contains

a. male gametes.
b. female gametes.
c. fruits.
d. a stigma.

True or False

Write true if the statement is true or false if the statement is false.

_____ 16. Plants are a direct or indirect source of food for most organisms living on earth.

_____ 17. A ripened ovary becomes a pollen grain.

_____ 18. Cross-pollination decreases genetic diversity.

_____ 19. Monocot embryos have one cotyledon.

_____ 20. Currently on earth, there are many more gymnosperm species than angiosperm species.

Fill in the Blanks

Fill in the blank with the term that best completes the sentence.

21. Switching between a haploid gametophyte stage and a diploid sporophyte stage is called _____.

22. _____ gives plant stems stiffness and helps protect plants against predators.

23. Nonvascular plants use _____ for absorbing water.

24. Asexual reproduction from stems, leaves, or roots is called _____.

25. _____ occurs when a growing plant embryo bursts through the seed coat.

26. Liverworts, hornworts, and mosses are all _____ plants.

27. Another name for vascular plants is _____.

28. _____ stores food in seed plants.

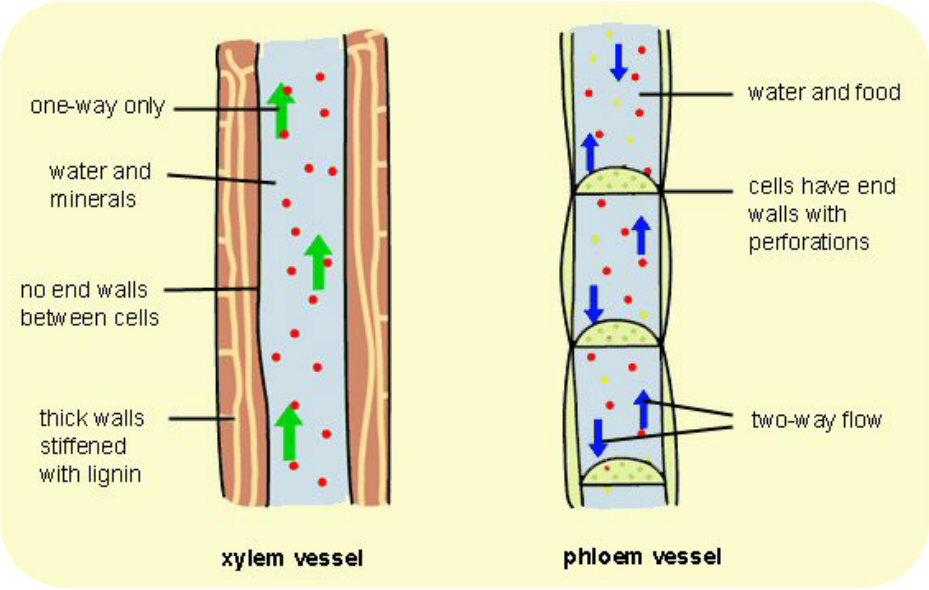
29. In a flower the _____ contains the stigma, style, and ovary.

30. The _____ protects the seed.

Short Answer

Answer each question in the space provided.

Refer to the figure below to answer questions 31 and 32.



(Xylem and phloem image is courtesy of Jesse Landy and under the Creative Commons license CC-BY-SA 3.0.)

31. What is the function of xylem vessels? How does their structure support their function?

32. What is the function of phloem vessels? How does their structure support their function?

33. How did plants and pollinators co-evolve? Describe a specific example.

CHAPTER 16 Plant Biology Worksheets

Chapter Outline

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- **Lesson 16.1: Plant Tissues and Growth**
- **Lesson 16.2: Plant Organs: Roots, Stems, and Leaves**
- **Lesson 16.3: Variation in Plant Life Cycles**
- **Lesson 16.4: Plant Adaptations and Responses**

16.1 Plant Tissues and Growth

Lesson 16.1: True or False

Name_____ Class_____ Date_____

Write true if the statement is true or false if the statement is false.

_____ 1. An organ is a structure made of only one type of tissue.

_____ 2. A tissue is made of a group of cells that have the same job.

_____ 3. Instead of having a plasma membrane, plant cells have a cell wall.

_____ 4. Plant cells are prokaryotic.

_____ 5. The main function of plastids is to maintain pressure against the cell wall.

_____ 6. A plant's central vacuole is typically large.

_____ 7. The plant cell wall is located just inside the plant's plasma membrane.

_____ 8. Plant cells walls can contain both cellulose and lignin.

_____ 9. Some types of parenchymal cells are photosynthetic cells.

_____ 10. Cell walls of sclerenchyma are very thick.

_____ 11. Xylem and phloem are types of dermal tissue.

_____ 12. The plant cuticle protects and waterproofs the above-ground parts of the plant.

_____ 13. Most plants grow only during a very short period during their lifetime.

_____ 14. Cell division decreases the number of cells in a plant.

_____ 15. Meristem is made of differentiated cells.

Lesson 16.1: Critical Reading

Name_____ Class_____ Date_____

Read these passages from the text and answer the questions that follow.

Plant Tissues

All three types of plant cells are found in most plant tissues. Three major types of plant tissues are dermal, ground, and vascular tissues.

Dermal Tissue

Dermal tissue covers the outside of a plant in a single layer of cells called the epidermis. You can think of the epidermis as the plant's skin. It mediates most of the interactions between a plant and its environment. Epidermal cells secrete a waxy substance called cuticle, which coats, waterproofs, and protects the above-ground parts of plant. Cuticle helps prevent water loss, abrasions, infections, and damage from toxins.

Ground Tissue

Ground tissue makes up much of the interior of a plant and carries out basic metabolic functions. Ground tissue in stems provides support and may store food or water. Ground tissues in roots may also store food.

Vascular Tissue

Vascular tissue runs through the ground tissue inside a plant. It consists of xylem and phloem, which transport fluids. Xylem and phloem are packaged together in bundles.

Questions

1. Define the term tissue as used in this passage.

2. What is a plant's epidermis? What is its function?

3. Describe the functions of ground tissue.

4. Why are xylem and phloem bundled together?

5. Do you think that all plants have these three types of tissue? Why or why not?

Lesson 16.1: Multiple Choice

Name_____ **Class**_____ **Date**_____

Circle the letter of the correct choice.

a. Which of the following types of cells would be best at storing food for a plant?
   a. parenchymal
   b. sclerenchymal
   c. cell in a flower petal
   d. prokaryotic

b. The organelle that maintains pressure against the cell wall, so that the plant cell keeps it shape, is the
   a. central vacuole.
   b. rough endoplasmic reticulum.
   c. smooth endoplasmic reticulum.
   d. nucleus.

c. A membrane-bound organelle that contains DNA is a
   a. Golgi body.
   b. smooth endoplasmic reticulum.
   c. chloroplast.
   d. cell wall.

d. The plant cuticle
   a. coats the surface of the root.
   b. is made by ground tissue.
   c. transports sugars throughout the plant.
   d. is made by epidermal cells.

e. Xylem and phloem are
   a. dermal tissue.
   b. ground tissue.
   c. vascular tissue.
   d. epidermal tissue.

f. The meristem consists of
   a. cells with a thick cuticle.
   b. differentiated cells.
   c. undifferentiated cells.

d. all of the above.

g. Plant roots can grow to become wider

a. by cell division of differentiated root cells.
b. from water absorption in the leaves.
c. when the cuticle is made.
d. through cell division in a root meristem.

h. When a single cell divides once by mitosis, the product is

a. a single cell with half the DNA of the original cell.
b. two cells.
c. four cells.
d. eight cells.

Lesson 16.1: Vocabulary I

Name_____ Class_____ Date_____

Match the vocabulary word with the proper definition.

Definitions

_____ 1. a waterproof barrier between the above-ground parts of a plant and its environment

_____ 2. loosely packed, cube-shape cells

_____ 3. functions in the transport of water

_____ 4. celery strings are made of this type of cell

_____ 5. comprises much of the interior of a root, stem, or leaf

_____ 6. contains chlorophyll; conducts photosynthesis

_____ 7. has lignin-containing, thick cell walls

_____ 8. is made of epidermal cells

_____ 9. a large, membrane-bound, water-filled organelle that maintains a positive pressure against the plant cell wall

_____ 10. consists of undifferentiated, dividing cells

_____ 11. a membrane-bound, pigment-containing organelle

_____ 12. a cellulose-containing structure that covers the plant plasma membrane

Terms

a. cell wall

b. central vacuole

c. chloroplast

d. chromoplast

e. collenchyma

f. cuticle

g. dermal tissue

h. ground tissue

i. meristem

j. parenchyma

k. sclerenchyma

l. vascular tissue

Lesson 16.1: Vocabulary II

Name_____ Class_____ Date_____

Fill in the blank with the appropriate term.

1. The _____ contains chlorophyll.
2. A membrane-bound organelle containing pigments other than chlorophyll is the _____.
3. The _____ contains dividing, undifferentiated cells.
4. _____ consists of loosely packed cells with thin cell walls.
5. The tissue type that makes up most of the plant's interior is _____.
6. The epidermis makes up the _____.
7. The _____ provides support for individual plant cells and for the entire plant.
8. The _____ contains xylem and phloem.
9. The _____ contains cells with thick, lignified cell walls.
10. The water-filled, membrane-bound _____ occupies the majority of space inside a mature plant cell.
11. _____ helps support the plant and provides wind-resistance; its cells have irregularly thickened cell walls.
12. The plant's _____ protects the plant against water loss, toxins, abrasions, and infections.

Lesson 16.1: Critical Writing

Name_____ Class_____ Date_____

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Humans grow to a certain height and then do not grow any taller. Do plants grow in the same way? How do plants get taller? Explain.

16.2 Plant Organs: Roots, Stems, and Leaves

Lesson 16.2: True or False

Name_____ **Class**_____ **Date**_____

Write true if the statement is true or false if the statement is false.

_____ 1. Stems absorb water and minerals and transport them to the roots.

_____ 2. Roots contain dermal, ground, and vascular tissues.

_____ 3. Many plants with taproots use the root as a place to store food.

_____ 4. Fibrous roots anchor the plant less securely to the ground than taproots.

_____ 5. Root hairs detect gravity so the root grows downward.

_____ 6. Mycorrhizal relationships allow the plant to absorb more water.

_____ 7. Secondary stems grow from internodes on the primary stem.

_____ 8. Some plants have stems that can store water during dry seasons.

_____ 9. The only function of stems is to bear leaves and flowers.

_____ 10. The width of a tree ring represents a single year's growth in the width of the tree's stem.

_____ 11. The leaf petiole does the majority of photosynthesis for a leaf.

_____ 12. Microphylls are the leaves of flowering plants.

_____ 13. Plants with a basal rosette of leaves are taking advantage of higher temperatures close to the ground.

_____ 14. Compound leaves are made up of a number of leaflets.

_____ 15. Deciduous leaves change color in the fall when their chlorophyll breaks down.

Lesson 16.2: Critical Reading

Name_____ **Class**_____ **Date**_____

Read these passages from the text and answer the questions that follow.

Root Structures and Functions

The tip of a root is called the root cap. It consists of specialized cells that help regulate primary growth of the root at the tip. Above the root cap is primary meristem, where growth in length occurs.

Above the meristem, the rest of the root is covered with a single layer of epidermal cells. These cells may have root hairs that increase the surface area for the absorption of water and minerals from the soil. Beneath the epidermis is ground tissue, which may be filled with stored starch. Bundles of vascular tissues form the center of the root. Waxy layers waterproof the vascular tissues so they don't leak, making them more efficient at carrying fluids. Secondary meristem is located within and around the vascular tissues. This is where growth in thickness occurs.

The structure of roots helps them perform their primary functions. What do roots do? They have three major jobs: absorbing water and minerals, anchoring and supporting the plant, and storing food.

- Absorbing water and minerals: Thin-walled epidermal cells and root hairs are well suited to absorb water and dissolved minerals from the soil. The roots of many plants also have a mycorrhizal relationship with fungi for greater absorption.
- Anchoring and supporting the plant: Root systems help anchor plants to the ground, allowing plants to grow tall without toppling over. A tough covering may replace the epidermis in older roots, making them rope-like and even stronger.
- Storing food: In many plants, ground tissues in roots store food produced by the leaves during photosynthesis.

Questions

1. Picture a plant's root cap. What additional function might it have that is not described in the above passage?

2. How do root hairs increase the surface area for water and mineral absorption?

3. What is a function of the ground tissue of a root?

4. What are the three main functions of roots?

5. What does the secondary root meristem do?

Lesson 16.2: Multiple Choice

Name_____ Class_____ Date_____

Circle the letter of the correct choice.

a. The main difference between a taproot system and a fibrous root system is that

   a. taproots can store a lot of food, while fibrous roots do not.
   b. taproots absorb water, while fibrous roots do not.
   c. fibrous roots can access water sources deep under the ground, while taproots cannot.
   d. fibrous roots have an epidermal cell layer, while taproots do not.

b. Roots grown downward because

   a. they have vascular bundles.
   b. they grow opposite to the force of gravity.
   c. they grow away from water sources.
   d. there are gravity-sensing cells in the root cap.

c. The xylem of the vascular tissue in the root

   a. carries sugars from the leaves to the roots for storage.
   b. carries water and minerals from the root up to the stem.
   c. detects gravity and causes the root to grow downward.
   d. none of the above

d. In stems, the _____ meristem is responsible for growth in length, and the _____ meristem is primarily responsible for growth in width.

   a. secondary, primary
   b. primary, secondary
   c. node, epidermal

d. epidermal, node

e. A main function of the leaf petiole is

   a. to extend the leaf blade away from the stem so the blade can collect sufficient sunlight.
   b. to keep the leaf away from the secondary meristem of the stem.
   c. to produce pollen.
   d. none of the above.

f. Very thick stems are specialized for

   a. clinging and climbing.
   b. strength and support.
   c. storing water or food.
   d. photosynthesis.

g. Leaves arranged in whorls are optimized to

   a. collect sunlight from all directions.
   b. to increase resistance to wind.
   c. to increase water loss.
   d. to increase food storage capacity.

h. The air spaces in the leaf interior

   a. block gas exchange between the mesophyll cells and the environment.
   b. make the leaf weigh more than a leaf packed tightly with cells.
   c. make the leaf weigh less than a leaf packed tightly with cells.
   d. carry out most of the photosynthesis in the leaf.

Lesson 16.2: Vocabulary I

Name_____ **Class**_____ **Date**_____

Match the vocabulary word with the proper definition.

Definitions

_____ 1. photosynthetic leaf cells

_____ 2. increases the surface area for absorbing water in the root

_____ 3. the type of roots a plant has

_____ 4. a plant that keeps its leaves for more than one year

_____ 5. a leaf pore flanked by two guard cells

_____ 6. a plant that loses its leaves yearly and grows new ones

_____ 7. a thick primary root often growing deep into the soil

_____ 8. the outermost woody covering of a stem

_____ 9. the tip of a root

_____ 10. the part of a stem from which secondary branches grow

_____ 11. the leaf part that supports and displays the leaf blade

_____ 12. has multiple, spreading roots without a main primary root

Terms

a. bark

b. deciduous plant

c. evergreen plant

d. fibrous root

e. mesophyll

f. node

g. petiole

h. root cap

i. root hair

j. root system

k. stomata

l. taproot

Lesson 16.2: Vocabulary II

Name_____ Class_____ Date_____

Fill in the blank with the appropriate term.

1. The leaf _____, which is connected to the leaf petiole, is a very important photosynthetic part of a plant.
2. A _____ can grow deep into the ground to access water, and can also store food for the plant.
3. There are two main types of _____ in plants for absorbing water and minerals.
4. In the fall, _____ lose their leaves.
5. The _____ can close to reduce water loss from the leaf.
6. Even though part of it is nonliving, _____ functions to protect the living parts of the stem.
7. _____ consists of photosynthetic cells located in between the upper and lower epidermis of a leaf.
8. Plants with a _____ root system are less securely anchored to the ground.
9. A pine tree is an example of a(n) _____.
10. Leaves and secondary stems grow out of stem _____.
11. _____ are long, thin cells in the epidermal cell layer of roots.
12. The leaf is attached to the stem via a(n) _____.

Lesson 16.2: Critical Writing

Name_____ Class_____ Date_____

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Not all plant stems are the same. Name and describe three different stem types of plants and how they adapt a plant to its environment.

16.3 Variation in Plant Life Cycles

Lesson 16.3: True or False

Name_____ **Class**_____ **Date**_____

Write true if the statement is true or false if the statement is false.

_____ 1. A plant species has either a haploid gametophyte phase, or a diploid sporophyte phase, but not both.

_____ 2. Meiosis in the sporangium produces haploid spores.

_____ 3. A haploid spore develops into a haploid gametophyte.

_____ 4. Fertilization of gametes produces a haploid zygote.

_____ 5. The dominant generation in vascular plants is the gametophyte.

_____ 6. In nonvascular plants, archegonia are the male reproductive organs.

_____ 7. Ferns are seedless vascular plants.

_____ 8. A new sporophyte fern plant develops from a fertilized egg and sperm.

_____ 9. Gymnosperms are flowering vascular plants.

_____ 10. Cones are the reproductive structure in gymnosperms.

_____ 11. The dots on the back of fern fronds are sporangia.

_____ 12. Gymnosperms have male cones and female cones.

_____ 13. Angiosperms are flowering nonvascular plants.

_____ 14. Angiosperms produce pollen.

_____ 15. Fruit develops from a ripened ovary surrounding a seed.

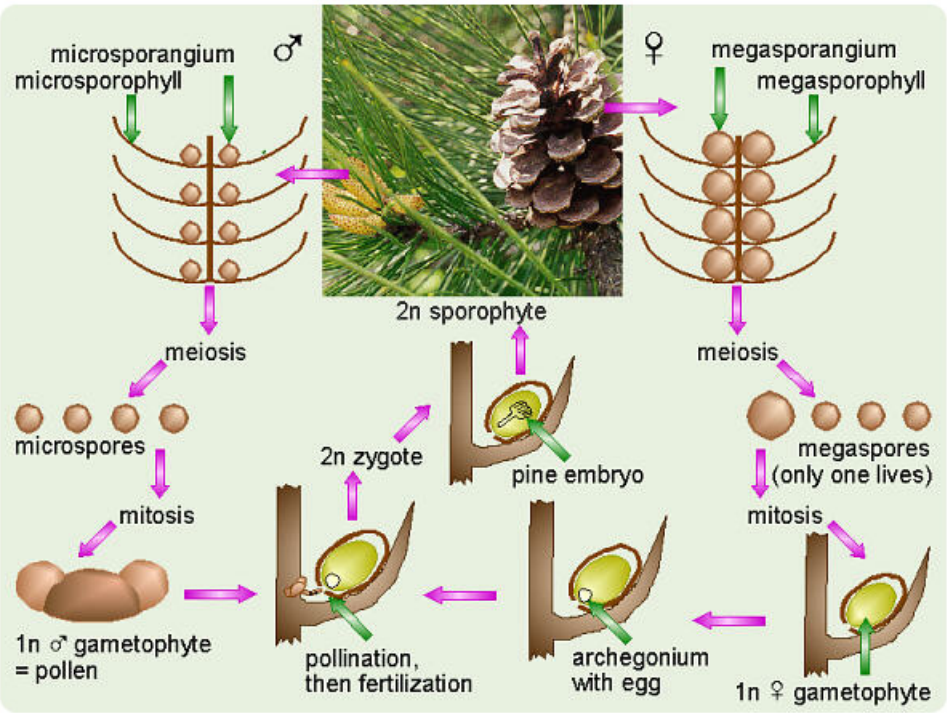
Lesson 16.3: Critical Reading

Name_____ **Class**_____ **Date**_____

Read these passages from the text and answer the questions that follow.

Life Cycle of Gymnosperms

Gymnosperms are vascular plants that produce seeds in cones. Examples include conifers, such as pine and spruce trees. The gymnosperm life cycle has a dominant sporophyte generation. Both gametophytes and the next generation's new sporophytes develop on the sporophyte parent plant. A diagram of a gymnosperm life cycle is shown below.



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Cones form on a mature sporophyte plant. Inside male cones, male spores develop into male gametophytes. Each male gametophyte consists of several cells enclosed within a grain of pollen. Inside female cones, female spores develop into female gametophytes. Each female gametophyte produces an egg inside an ovule.

Pollination occurs when pollen is transferred from a male to female cone. If sperm then travel from the pollen to an egg so fertilization can occur, a diploid zygote results. The zygote develops into an embryo within a seed, which forms from the ovule inside the female cone. If the seed germinates, it may grow into a mature sporophyte tree, which repeats the cycle.

Questions

1. In a complete sentence, define gymnosperm.

2. Name a few examples of gymnosperms.

3. Where do male and female gametophytes develop in gymnosperms?

4. Describe sexual reproduction in gymnosperms.

5. What are the advantages of sexual reproduction?

Lesson 16.3: Multiple Choice

Name_____ Class_____ Date_____

Circle the letter of the correct choice.

a. In plants, sperm and eggs are produced by
    a. mitosis in reproductive organs of the gametophyte.
    b. mitosis in the diploid sporophyte.
    c. meiosis in the zygote.
    d. mitosis of root hairs.

b. The gametophyte generation is dominant in
    a. pine trees, spruce trees, and maple trees.
    b. clubmosses, ginkgo, and cycads.
    c. hornworts, liverworts, and mosses.
    d. all of the above.

c. In nonvascular plants, eggs are produced
    a. by the same structure that produces sperm.
    b. in female reproductive organs called archegonia.
    c. in male reproductive organs called archegonia.
    d. by mitosis in the diploid sporophyte.

d. In seedless vascular plants,
    a. spores fuse to form a zygote.
    b. there are no antheridia.
    c. the haploid gametophyte generation dominates.
    d. the diploid sporophyte generation dominates.

e. Gymnosperms are
    a. seedless nonvascular plants.
    b. flowering nonvascular plants.
    c. vascular plants producing flowers.
    d. vascular plants producing seeds in cones.

f. Gymnosperms reproduce using
    a. xylem and phloem.
    b. pollen and female cones.
    c. flowers and wind.
    d. antheridia and spores.

g. In pollen grains, _____ are formed.
    a. eggs
    b. sperm
    c. female reproductive structures
    d. ovules

h. In angiosperms, the _____ produces eggs via meiosis.
    a. stamen
    b. pollen tube
    c. pistil
    d. seed

Lesson 16.3: Vocabulary I

Name_____ **Class**_____ **Date**_____

Match the vocabulary word with the proper definition.

Definitions

_____ 1. responsible for long distance water transport in many plants

_____ 2. the diploid phase in a plant with alternation of generations

_____ 3. haploid female gamete

_____ 4. male haploid gamete

_____ 5. structure producing haploid spores by meiosis

_____ 6. having two chromosomes of each type

_____ 7. having one chromosome of each type

_____ 8. the haploid phase of a plant's life cycle during which it makes gametes

_____ 9. cell division resulting in cells with half the number of chromosomes as the parent cell

_____ 10. cell division resulting in cells with the same number of chromosomes as the parent cell

_____ 11. female reproductive organ in nonvascular plants; produces egg cells

_____ 12. male reproductive organs in nonvascular plants; produce sperm

Terms

a. antheridia

b. archegonia

c. diploid

d. egg

e. gametophyte

f. haploid

g. meiosis

h. mitosis

i. sperm

j. sporangium

k. sporophyte

l. vascular tissue

Lesson 16.3: Vocabulary II

Name_____ **Class**_____ **Date**_____

Fill in the blank with the appropriate term.

1. Nonvascular plants have male reproductive organs called _____.

2. Nonvascular plants have female reproductive organs called _____.

3. Cells with two chromosomes of each type are _____.

4. Cells with one chromosome of each type are _____.

5. Xylem and phloem make up the _____.

6. The female gamete is the _____.

7. The male gamete is the _____.

8. Cell division that maintains the same number of chromosomes in the offspring cells is _____.

9. Cell division that results in offspring cells with half the number of chromosomes as the parent cell is _____.

10. The diploid phase of the plant life cycle is the _____ generation.

11. The haploid phase of the plant life cycle is the _____ generation.

12. The _____ forms spores.

Lesson 16.3: Critical Writing

Name_____ Class_____ Date_____

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

What are some of the main similarities and differences between gymnosperms and angiosperms, with respect to seed formation?

16.4 Plant Adaptations and Responses

Lesson 16.4: True or False

Name_____ **Class**_____ **Date**_____

Write true if the statement is true or false if the statement is false.

_____ 1. Aquatic plants have thick cuticles on their leaves.

_____ 2. Pollination is most effective when it happens under water.

_____ 3. Xerophytes are adapted to live in wet, rainy climates.

_____ 4. A saguaro cactus stores water in its thick stem.

_____ 5. A cactus is an epiphyte.

_____ 6. An orchid is an epiphyte.

_____ 7. Epiphytes grow on other plants mainly to avoid getting excess sunlight.

_____ 8. Some epiphytes absorb water from the air.

_____ 9. Some kinds of epiphytes can collect water in a tank-like structure.

_____ 10. Phototropism is growth of roots away from the light.

_____ 11. The tip of a plant grows toward a light source.

_____ 12. Some plants produce toxic chemicals that can kill pathogens.

_____ 13. Plants always respond to an infection with increased cell division and growth around the area of infection.

_____ 14. Plant hormones regulate growth in plants.

_____ 15. Because they cannot run away like animals can, plants cannot respond to environmental stimuli.

Lesson 16.4: Critical Reading

Name_____ **Class**_____ **Date**_____

Read these passages from the text and answer the questions that follow.

Adaptations to Extreme Dryness

Plants that live in extremely dry environments have the opposite problem: how to get and keep water. Plants that are adapted to very dry environments are called xerophytes. Their adaptations may help them increase water intake, decrease water loss, or store water when it is available.

The saguaro cactus pictured in **Figure 16.24** in your book has adapted in all three ways. When it was still a very small plant, just a few inches high, its shallow roots already reached out as much as 2 meters (7 feet) from the base of the stem. By now, its root system is much more widespread. It allows the cactus to gather as much moisture as possible from rare rainfalls. The saguaro doesn't have any leaves to lose water by transpiration. It also has a large,

barrel-shaped stem that can store a lot of water. Thorns protect the stem from thirsty animals that might try to get at the water inside.

Questions

1. What is a main challenge faced by plants that live in a desert?

2. Name three strategies used by xerophytes to adapt to their environment.

3. In what type of environment does a saguaro cactus live?

4. How does the saguaro cactus take advantage of rare, brief rainfall?

5. How does the structure of the saguaro cactus stem benefit the plant?

Lesson 16.4: Multiple Choice

Name_____ Class_____ Date_____

Circle the letter of the correct choice.

a. Which of the following is **not** a typical characteristic of aquatic plants?

   a. They live in the water.
   b. They have extensive vascular tissues for transporting water.
   c. Their leaves collect sunlight.
   d. They do not need roots.

b. Desert plants adapt to a limited water supply by

   a. conserving water.
   b. storing water.
   c. efficiently absorbing water when it is available.
   d. all of the above

c. Which of the following plants is an epiphyte?

   a. orchid
   b. saguaro cactus
   c. cattail
   d. water lily

d. Which kind of plant is best adapted for life in the tropical rainforest?

   a. saguaro cactus
   b. epiphyte
   c. oak tree
   d. all of the above

e. The leaves of which plant are shaped to collect and store a lot of water?

   a. water lily
   b. cattail
   c. saguaro cactus
   d. bromeliad

f. Growth toward the force of gravity is called

   a. auxin.
   b. geotropism.
   c. phototropism.
   d. thigmotropism.

g. Growth toward the light is called

a. auxin.
b. geotropism.
c. phototropism.
d. thigmotropism.

h. Plants often enter dormancy

a. when rainfall is abundant.
b. just before they form flowers.
c. during winter.
d. in the spring.

Lesson 16.4: Vocabulary I

Name_____ Class_____ Date_____

Match the vocabulary word with the proper definition.

Definitions

_____ 1. movement toward or away from a stimulus

_____ 2. refers to regions near the equator

_____ 3. living in the water

_____ 4. growth toward a light source

_____ 5. an organism that uses plants as a food source

_____ 6. a growth hormone in plants

_____ 7. not too cold or hot; free from extremes in climate

_____ 8. a plant adapted to a very dry climate

_____ 9. growth in the same direction as the force of gravity

_____ 10. evaporative loss of water from leaves or stems

_____ 11. transformation of light energy, water, and carbon dioxide into chemical energy contained in sugars

_____ 12. a plant that grows on another plant

Terms

a. aquatic

b. auxin

c. epiphyte

d. geotropism

e. herbivore

f. photosynthesis

g. phototropism

h. temperate

i. transpiration

j. tropical

k. tropism

l. xerophyte

Lesson 16.4: Vocabulary II

Name_____ **Class**_____ **Date**_____

Fill in the blank with the appropriate term.

1. Plants that grow near the equator are all _____ plants.
2. _____ do not need roots because they get support and anchoring from another plant.
3. Cells on the dark side of a plant stem elongate in response to the plant growth hormone _____.
4. Plants make their own food by _____.
5. Movement toward or away from a stimulus is a _____.
6. _____ is evaporation of water vapor from the leaves, and sometimes stem of a plant.
7. A _____ climate is not extremely hot or cold.
8. _____ is growth toward a light source.
9. An organism that eats plants is a(n) _____.
10. Roots grow downward due to _____.
11. _____ plants live in water.
12. Plants adapted to environments where there is little water are _____.

Lesson 16.4: Critical Writing

Name_____ **Class**_____ **Date**_____

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

If plants don't have an immune system like that of humans, how do they respond to pathogens?

CHAPTER 17 Introduction to Animals Worksheets

Chapter Outline

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- **Lesson 17.1: Overview of Animals**
- **Lesson 17.2: Overview of Invertebrates**

17.1 Overview of Animals

Lesson 17.1: True or False

Name_____ **Class**_____ **Date**_____

Write true if the statement is true or false if the statement is false.

_____ 1. Animals are multicellular prokaryotes.

_____ 2. Animal cells have cell walls to maintain their shape.

_____ 3. All animals are heterotrophs.

_____ 4. Vertebrates do not have a backbone.

_____ 5. All animal cells are exactly the same shape.

_____ 6. Animals have a nervous system.

_____ 7. Almost all animals digest their food inside their bodies.

_____ 8. Most animals reproduce by sexual reproduction.

_____ 9. Fish are in the phylum Chordata.

_____ 10. Roundworms are in the phylum Arthropoda.

_____ 11. Over 90% of all animals species are vertebrates.

_____ 12. A characteristic of animals is that they have sensory organs.

_____ 13. An exoskeleton is a bony skeleton on the outside of some organisms.

_____ 14. A notochord is a rigid, supportive rod spanning the length of the body of chordates.

_____ 15. The first animals to evolve with true lungs were the reptiles.

Lesson 17.1: Critical Reading

Name_____ **Class**_____ **Date**_____

Read these passages from the text and answer the questions that follow.

Evolution of Amniotes

Amphibians were the first animals to have true lungs and limbs for life on land. However, they still had to return to water to reproduce. That's because their eggs lacked a waterproof covering and would dry out on land. The first fully terrestrial vertebrates were amniotes. Amniotes are animals that produce eggs with internal membranes. The membranes let gases but not water pass through. Therefore, in an amniotic egg, an embryo can breathe without drying out. Amniotic eggs were the first eggs that could be laid on land. The earliest amniotes evolved about 350 million years ago. They may have looked like the animal shown below. Within a few million years, two important amniote groups evolved: synapsids and sauropsids. Synapsids evolved into mammals. The sauropsids gave rise to reptiles, dinosaurs, and birds.

Early Amniote. The earliest amniotes probably looked something like this. They were reptile-like, but not actually reptiles. Reptiles evolved somewhat later. *(Image courtesy of ArthurWeasley and under the Creative Commons license CC-BY-SA 3.0.)*

Questions

1. Why was the evolution of amphibians notable? What did they pioneer?

2. What characteristic of amphibians necessitates that they live near water?

3. Define amniote.

4. What reproductive advantage do amniotes have over pre-amniotes?

5. What are the important animal groups that evolved from amniotes? What in turn, evolved from these groups?

Lesson 17.1: Multiple Choice

Name_____ **Class**_____ **Date**_____

Circle the letter of the correct choice.

a. Animal cells and bacterial cells both may have all of the following cell structures **except**
   a. mitochondria.
   b. DNA.
   c. plasma membrane.
   d. flagella.

b. Which of the following are animals?
   a. snake
   b. sponge
   c. flatworm
   d. all of the above

c. Which of the following is **not** a characteristic shared by almost all animals?
   a. digestion of food internally
   b. the ability to fly
   c. the ability to move, at least at some stage of their life
   d. detection of environmental stimuli

d. Invertebrates evolved adaptations including
   a. a fluid-filled body cavity.
   b. a complete digestive system.
   c. a symmetrical body.
   d. all of the above.

e. A skeleton forming outside the animal's body is a(n)
   a. endoskeleton.
   b. exoskeleton.
   c. notochord.
   d. vertebrate.

f. One of the main challenges animals faced when moving to land was
   a. switching to asexual reproduction.
   b. getting rid of their nervous systems, which would be too sensitive on land.
   c. getting rid of extra water.
   d. not losing too much water from their bodies.

g. An example of an animal that has a notochord but lacks a backbone is a
   a. tunicate.
   b. fish.
   c. bird.
   d. all of the above

h. Animals that have eggs with internal membranes that permit diffusion of gases but prevent water loss are classified as
   a. chordates.
   b. echinoderms.
   c. amniotes.
   d. rotifers.

Lesson 17.1: Vocabulary I

Name_____ **Class**_____ **Date**_____

Match the vocabulary word with the proper definition.

Definitions

_____ 1. living on land

_____ 2. animals with a notochord

_____ 3. an animal with a backbone

_____ 4. a hollow nerve cord running the length of the body

_____ 5. a living organism whose eggs are surrounded by membranes

_____ 6. an animal with no backbone

_____ 7. another name for backbone

_____ 8. heterotrophic organisms that can detect environmental stimuli, can move on their own during at least part of their life, and most often digest their food internally

_____ 9. living in the ocean

_____ 10. the parts of an animal that detect environmental stimuli

_____ 11. a non-bony skeleton on the outside of arthropods

_____ 12. cell with a nucleus

Terms

a. amniote

b. animal

c. chordate

d. eukaryote

e. exoskeleton

f. invertebrate

g. marine

h. notochord

i. sensory organs

j. terrestrial

k. vertebral column

l. vertebrate

Lesson 17.1: Vocabulary II

Name_____ Class_____ Date_____

Fill in the blank with the appropriate term.

1. Another name for backbone is _____.
2. _____ are heterotrophs that have sensory organs, internal digestion, and the ability to move.
3. _____ organisms live in the ocean.
4. _____ organisms live on land.
5. A _____ is a hollow nerve cord running the length of the animal's body.
6. In animals, _____ detect environmental stimuli.
7. _____ animals have backbones.
8. _____ animals lack a backbone.
9. The eggs of _____ have internal membranes.
10. A _____ has its DNA contained within a nucleus.
11. A _____ has a notochord.
12. Arthropods, such as insects and crustaceans, have a(n) _____ to help protect and support them.

Lesson 17.1: Critical Writing

Name_____ Class_____ Date_____

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Land animals evolved from animals that live in the water. What kinds of adaptations did animals evolve that allowed them to move from water to land?

17.2 Overview of Invertebrates

Lesson 17.2: True or False

Name_____ **Class**_____ **Date**_____

Write true if the statement is true or false if the statement is false.

_____ 1. An earthworm is an example of a segmented invertebrate.

_____ 2. Invertebrates with an incomplete digestive system starve, because their food cannot be completely digested.

_____ 3. A psuedocoelom refers to concentration of nervous tissue at one end of the animal.

_____ 4. Some invertebrates move, but cannot regulate which direction they move or how fast they move.

_____ 5. A larva is a juvenile stage of the life cycle.

_____ 6. A bilaterally symmetrical invertebrate has two identical left and right halves.

_____ 7. A radially symmetrical invertebrate can be divided into two similar halves by a line traversing the center of the animal.

_____ 8. Endoderm becomes muscle tissue.

_____ 9. All invertebrates reproduce by asexual budding.

_____ 10. Body segments make an animal less flexible.

_____ 11. Protostome and deuterostome are two main classes of invertebrates.

_____ 12. Some invertebrates have an internal skeleton.

_____ 13. The outside of an animal is formed from the ectoderm.

_____ 14. A partial coelom is called a psuedocoelom.

_____ 15. Complete digestion is less efficient than incomplete digestion because most animals eat too much food.

Lesson 17.2: Critical Reading

Name_____ **Class**_____ **Date**_____

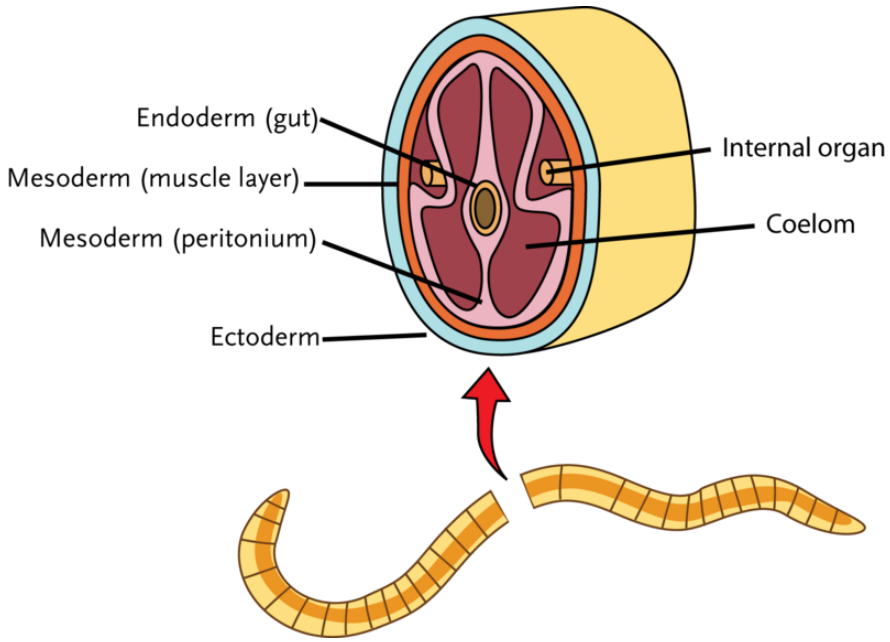
Read these passages from the text and answer the questions that follow.

Complete Digestive System

Early invertebrates had an incomplete digestive system. There was just one opening for the mouth and anus. Ancestors of modern roundworms were the first animals to evolve a complete digestive system. With a separate mouth and anus, food could move through the body in just one direction. This made digestion more efficient. An animal could keep eating while digesting food and getting rid of waste. Different parts of the digestive tract could also become specialized for different digestive functions. This led to the evolution of digestive organs.

Pseudocoelom and Coelom

Ancestors of roundworms also evolved a pseudocoelom. This is a partial body cavity that is filled with fluid. It allows room for internal organs to develop. The fluid also cushions the internal organs. The pressure of the fluid within the cavity provides stiffness. It gives the body internal support, forming a hydrostatic skeleton. It explains why roundworms are round and flatworms are flat. Later, a true coelom evolved. This is a fluid-filled body cavity, completely enclosed by mesoderm. It lies between the digestive cavity and body wall (see the figure below). Invertebrates with a true coelom include mollusks and annelids.



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Questions

1. Define complete digestive system. What are two advantages of having a complete digestive system?

2. Define psuedocoelom.

3. Define coelom.

4. An organism gains what advantages by having a coelom?

5. Do you think humans have a coelom? Why or why not?

Lesson 17.2: Multiple Choice

Name_____ Class_____ Date_____

Circle the letter of the correct choice.

a. An example of an organism that has an incomplete digestive system is
   a. a sea star.
   b. a sponge.
   c. a spider.
   d. a sand dollar.

b. Animals who can control the direction they move in all have
   a. a home in the ocean.
   b. development as a deuterostome.
   c. muscles.

   d. radial symmetry.

c. Corals detect touch with

   a. a nerve net.
   b. a brain.
   c. a complete digestive system.
   d. a gamete.

d. _____ was one of the first animal traits to evolve.

   a. cephalization
   b. a complete digestive system
   c. a notochord
   d. multicellularity

e. Humans have

   a. no symmetry.
   b. radial symmetry.
   c. bilateral symmetry.
   d. none of the above.

f. The mesoderm is located

   a. outside the ectoderm.
   b. inside the endoderm.
   c. in between the ectoderm and endoderm.
   d. inside the gut.

g. The notochord evolved

   a. before a bony backbone.
   b. before multicellurity.
   c. outside the animal's body.
   d. none of the above.

h. Squids belong to the phylum

   a. Porifera.
   b. Nematoda.
   c. Arthropoda.
   d. none of the above

Lesson 17.2: Vocabulary I

Name_____ **Class**_____ **Date**_____

Match the vocabulary word with the proper definition.

Definitions

_____ 1. outer embryonic cell layer in animals

_____ 2. digestive system that consists of a digestive cavity and a single opening that serves as both mouth and anus

_____ 3. concentration of nerve tissue in one end of an animal, forming a head region

_____ 4. partial, fluid-filled cavity inside the body of some invertebrates

_____ 5. fluid-filled body cavity

_____ 6. inner embryonic cell layer in animals

_____ 7. division of an animal body into multiple segments

_____ 8. type of internal support in an animal body that results from the pressure of fluid within the body cavity known as the coelom

_____ 9. digestive system consisting of a digestive tract and two body openings (mouth and anus)

_____ 10. juvenile stage that occurs in the life cycle of many invertebrates, fish, and amphibians and that differs in form and function from the adult stage

_____ 11. embryonic cell layer in many animals that is located between the endoderm (inner cell layer) and ectoderm (outer cell layer)

_____ 12. symmetry of a body plan in which there are distinct head and tail ends, so the body can be divided into two identical right and left halves

Terms

a. bilateral symmetry

b. cephalization

c. coelom

d. complete digestive system

e. ectoderm

f. endoderm

g. hydrostatic skeleton

h. incomplete digestive system

i. larva

j. mesoderm

k. psuedocoelom

l. segmentation

Lesson 17.2: Vocabulary II

Name_____ Class_____ Date_____

Fill in the blank with the appropriate term.

1. Sea stars (starfish) have _____ symmetry.

2. _____ is the concentration of nerve tissue in one end of an animal, forming a head region.

3. A digestive system in which food enters and waste exits the same body opening is _____.

4. A false coelom (incomplete coelom) is called a _____.

5. In animals, the middle embryonic cell layer is the _____.

6. In animals, the inner embryonic cell layer is the _____.

7. In animals, the outer embyronic cell layer is the _____.

8. A _____ is a digestive system consisting of a digestive tract and two body openings.

9. _____ refers to division of an animal into multiple segments.

10. _____ symmetry is the type where the body can be divided into two identical right and left halves.

11. The _____ is a juvenile stage that occurs in the life cycle of many invertebrates, fish, and amphibians and that differs in form and function from the adult stage.

12. The support from a _____ results from the pressure of fluid within the body cavity known as the coelom.

Lesson 17.2: Critical Writing

Name_____ Class_____ Date_____

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Assume you have discovered a new invertebrate. It has multicellularity, specialized cells but no tissues, asymmetry, and an incomplete digestive system. In which phylum would you place it? Why?

CHAPTER 18 From Sponges to Invertebrate Chordates Worksheets

Chapter Outline

(Opening image copyright Mikhail Melnikov, 2010. Used under license from Shutterstock.com.)

- **Lesson 18.1: Sponges, Cnidarians, Flatworms, and Roundworms**
- **Lesson 18.2: Mollusks and Annelids**
- **Lesson 18.3: Arthropods and Insects**
- **Lesson 18.4: Echinoderms and Invertebrate Chordates==**

18.1 Sponges, Cnidarians, Flatworms, and Roundworms

Lesson 18.1: True or False

Name_____ **Class**_____ **Date**_____

Write true if the statement is true or false if the statement is false.

_____ 1. Sponges are terrestrial invertebrates.

_____ 2. Adult sponges cannot move from place to place on their own.

_____ 3. Because sponges evolved before other invertebrates, they do not have a skeleton.

_____ 4. Bacteria are one food source for sponges.

_____ 5. The function of a nematocyst is gamete (egg and sperm) production.

_____ 6. Cnidarians have ectoderm, endoderm, and mesoderm.

_____ 7. Some Cnindarians have a life cycle in which they alternate between medusa and polyp body forms.

_____ 8. The planula is the larval form of Cnidarians.

_____ 9. Corals have a mutualistic relationship with algae.

_____ 10. Some flatworms are less than an inch long, while others are over 60 feet long.

_____ 11. Flatworms have a respiratory system.

_____ 12. Some flatworms are parasitic.

_____ 13. Roundworms are round because they have psuedocoelom.

_____ 14. Most roundworms reproduce asexually.

_____ 15. Pinworms are a type of roundworm.

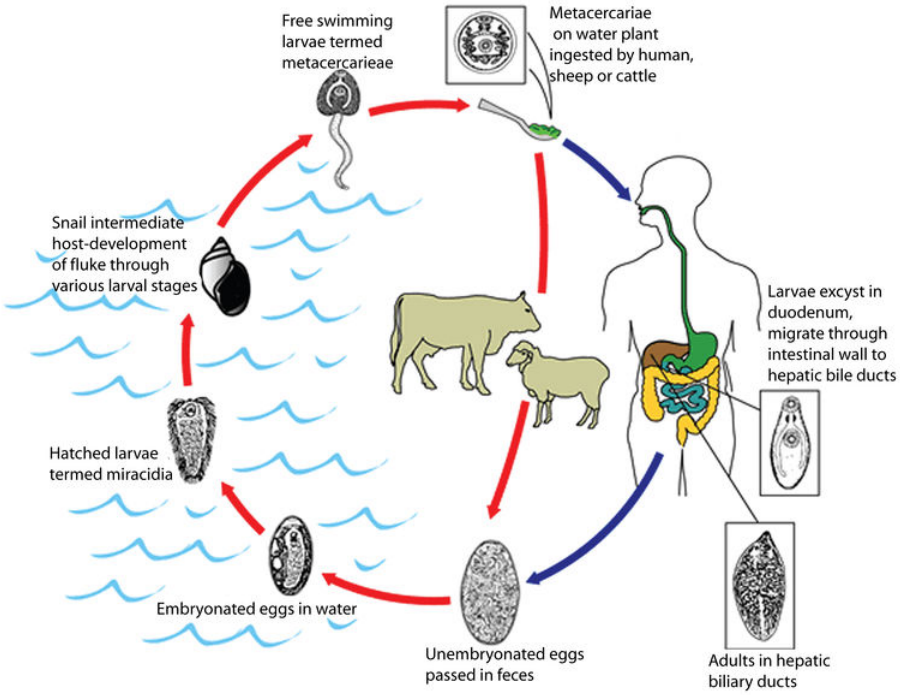
Lesson 18.1: Critical Reading

Name_____ **Class**_____ **Date**_____

Read these passages from the text and answer the questions that follow.

Ecology of Flatworms

Both flukes and tapeworms are parasites with vertebrate hosts, including human hosts. Flukes live in the host's circulatory system or liver. Tapeworms live in the host's digestive system. Usually, more than one type of host is required to complete the parasite's life cycle. Look at the life cycle of the liver fluke in the diagram below. As an adult, the fluke has a vertebrate host. As a larva, it has an invertebrate host. If you follow the life cycle, you can see how each host becomes infected so the fluke can continue its life cycle.



Life Cycle of the Sheep Liver Fluke. The sheep liver fluke has a complicated life cycle with two hosts. How could such a complicated way of life evolve? *(Image courtesy of the Centers for Disease Control and Prevention and under the public domain.)*

Questions

1. What are some major characteristics shared by tapeworms and flukes?

2. Where does the fluke described in the reading above live in humans?

3. What is another host of the liver fluke?

4. When does the fluke live in this host?

5. How does it get from the human host to this host?

Lesson 18.1: Multiple Choice

Name_____ Class_____ Date_____

Circle the letter of the correct choice.

a. Members of the Porifera phylum have
   a. no skeleton.
   b. an exoskeleton.
   c. an endoskeleton.
   d. either an exoskeleton or endoskeleton, depending on the species.

b. Sponges reproduce
   a. sexually in a way favoring cross-fertilization.
   b. sexually in a way favoring self-fertilization.
   c. asexually with sperm only.
   d. none of the above

c. Sponges can protect themselves against predators by

   a. moving away from the predator.
   b. making toxins to poison predators.
   c. using their muscles.
   d. a and b

d. The motile stages of the Cnidarian life cycle include the

   a. polyp stage.
   b. larval stage.
   c. medusa stage.
   d. b and c

e. The phylum with endoderm, mesoderm, and ectoderm is

   a. Cnidaria.
   b. Porifera.
   c. Platyhelminthes.
   d. all of the above.

f. Liver flukes

   a. live in a snail host during part of their life cycle, and in a human during another part of their life cycle.
   b. live in invertebrate hosts only.
   c. live in vertebrates hosts only.
   d. are free-living.

g. Roundworms have

   a. a complete digestive system.
   b. a psuedocoelom.
   c. muscles.
   d. all of the above.

h. Pinworm eggs

   a. are a type of egg made by flatworms.
   b. are made in the soil.
   c. are made in the host's digestive tract.
   d. are never found in the United States.

Lesson 18.1: Vocabulary I

Name_____ Class_____ Date_____

Match the vocabulary word with the proper definition.

Definitions

_____ 1. invertebrate phylum of flatworms that are characterized by a flat body because they lack a coelom or pseudocoelom

_____ 2. animal that obtains organic matter for nutrition by filtering particles out of water

_____ 3. invertebrate phylum of sponges, which have a non-bony endoskeleton and are sessile as adults

_____ 4. basic body plan in cnidarians such as jellyfish that is bell-shaped and typically motile

_____ 5. structure responsible for digesting food in sponges

_____ 6. basic body plan in cnidarians such as jellyfish that is tubular in shape and typically sessile

_____ 7. invertebrate phylum that includes animals such as jellyfish and corals that are characterized by radial symmetry, tissues, and a stinger called a nematocyst

_____ 8. a structure that detects touch in Cnidaridians

_____ 9. phylum of invertebrates called roundworms, which have a pseudocoelom and complete digestive system

_____ 10. a hard endoskeleton that provides support and protection in sponges

_____ 11. internal skeleton that provides support and protection

_____ 12. of or relating to an animal that is unable to move from place to place

Terms

a. Cnidaria

b. collar cell

c. endoskeleton

d. filter feeder

e. medusa

f. Nematoda

g. nerve net

h. Platyhelminthes

i. polyp

j. Porifera

k. sessile

l. spicule

Lesson 18.1: Vocabulary II

Name_____ Class_____ Date_____

Fill in the blank with the appropriate term.

1. With respect to how they get food, sponges are _____.

2. The polyp and medusa forms are typical of _____.

3. _____ are short, sharp rods made of silica, calcium carbonate, or spongin.

4. Flatworms are in the phylum _____.

5. Instead of a brain, Cnidarians detect stimuli with a _____.

6. An internal skeleton is called _____.

7. The flagella-containing, food vacuole-containing cells in the Porifera are _____.

8. A typically motile adult body plan in Cnidarians is the _____.

9. Roundworms are in the phylum _____.

10. An adult animal that stays in one place is said to be _____.

11. Sponges are in the phylum _____.

12. A non-motile adult body plan in Cnidarians is the _____.

Lesson 18.1: Critical Writing

Name_____ Class_____ Date_____

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Corals live in colonies in shallow water in the tropics. They participate in a mutualistic relationship with algae. The algae live inside the coral. Based on this information, how do you think the coral and the algae benefit from this relationship?

18.2 Mollusks and Annelids

Lesson 18.2: True or False

Name_____ Class_____ Date_____

Write true if the statement is true or false if the statement is false.

_____ 1. Mollusks were the first vertebrates to evolve.

_____ 2. Earthworms are mollusks.

_____ 3. The hard outer shell of mollusks is made by the mantle.

_____ 4. Mollusks can be filter feeders.

_____ 5. The radula of mollusks excretes waste from the mollusk's body.

_____ 6. Mollusks have an incomplete digestive system with one opening.

_____ 7. Gills function to digest food.

_____ 8. Mollusks have one or two hearts.

_____ 9. Bivalves are typically very fast moving.

_____ 10. The phylum Annelida consists of unsegmented worms.

_____ 11. Some annelids live in the ocean.

_____ 12. Annelids have a true coelom.

_____ 13. Annelids have an open circulatory system.

_____ 14. Snails are annelids.

_____ 15. In some species of annelids, the same individual can make both female and male gametes.

Lesson 18.2: Critical Reading

Name_____ Class_____ Date_____

Read these passages from the text and answer the questions that follow.

Annelids range in length from less than 1 millimeter to over 3 meters. They never attain the large size of some mollusks. Like mollusks, however, they have a coelom. In fact, the annelid coelom is even larger, allowing greater development of internal organs. Annelids have other similarities with mollusks, including:

- A closed circulatory system (like cephalopods).
- An excretory system consisting of tubular nephridia.
- A complete digestive system.
- A brain.
- Sensory organs for detecting light and other stimuli.
- Gills for gas exchange (but many exchange gas through their skin).

Questions

1. How large are annelids?

2. Do annelids have a coelom?

3. What kind of circulatory system do annelids have?

4. How do annelids exchange gases with their environment?

5. What is the function of gills?

Lesson 18.2: Multiple Choice

Name_____ **Class**_____ **Date**_____

Circle the letter of the correct choice.

a. Which of the following is **not** a mollusk?

   a. hydra
   b. clam
   c. snail
   d. squid

b. The outer shell of mollusks is made of

   a. chitin.
   b. spicules.
   c. calcium carbonate.
   d. muscle.

c. Wastes are excreted from mollusks via the

   a. outer shell.
   b. nerve fibers.
   c. radula.
   d. nephridia.

d. Which of the following classes of mollusks has a closed circulatory system?

   a. bivalves
   b. cephalopods
   c. gastropods
   d. poriferans

e. A trochophore is

   a. an excretory organ of annelids.
   b. an excretory organ of mollusks.
   c. a larval form of mollusks.
   d. a larval form of annelids.

f. The class of mollusks that contains only ocean-living organisms is

   a. bivalves.
   b. cephalopods.
   c. gastropods.
   d. segmented worms.

g. The ability of segmented worms to replace broken off segments by growing new ones is called

a. regeneration.
b. suckers.
c. tentacles.
d. degeneration.

h. An example of a deposit feeder is _____.

a. a squid
b. a clam
c. a polychaete
d. an earthworm

Lesson 18.2: Vocabulary I

Name_____ Class_____ Date_____

Match the vocabulary word with the proper definition.

Definitions

_____ 1. regrowing of tissues, organs, or limbs that have been lost or damaged

_____ 2. type of circulatory system in which blood flows only within a network of blood vessels and not through body cavities

_____ 3. an excretory organ in mollusks and annelids, has functions similar to a kidney

_____ 4. mollusks having two shells hinged together

_____ 5. invertebrate phylum of segmented worms, such as earthworms

_____ 6. layer of tissue that lies between the shell and body of a mollusk and forms a cavity, called the mantle cavity, that pumps water for filter feeding

_____ 7. muscular organ that that pumps blood through blood vessels when it contracts

_____ 8. a class of mollusk with a brain and a closed circulatory system

_____ 9. phylum of invertebrates that are generally characterized by a hard outer shell, a mantle, and a feeding organ called a radula

_____ 10. a class of mollusks with muscular food and typically one shell

_____ 11. type of circulatory system in which blood flows not only through blood vessels but also through a body cavity

_____ 12. organ in aquatic organisms composed of thin filaments that absorb oxygen from water

Terms

a. Annelida

b. bivalve

c. cephalopod

d. closed circulatory system

e. gastropod

f. gill

g. heart

h. mantle

i. Mollusca

j. nephridia

k. open circulatory system

l. regeneration

Lesson 18.2: Vocabulary II

Name_____ **Class**_____ **Date**_____

Fill in the blank with the appropriate term.

1. The ability to replace a damaged or removed body part is called _____.
2. A circulatory system in which the blood enters the body cavity is a(n) _____.
3. A circulatory system in which the blood stays within blood vessels is a(n) _____.
4. A mollusk with a single shell and a muscular foot is a(n) _____.
5. A _____ gets nutrients by eating soil or sediments at the bottom of a body of water.
6. _____ is the phylum containing segmented worms.
7. The phylum _____ is comprised of gastropods, bivalves, and cephalopods.
8. Mollusks and annelids have excretory organs similar in function to kidneys called _____.
9. The _____ pumps blood throughout the body.
10. The organ of gas exchange in mollusks and annelids is the _____.
11. A mollusk with two hinged shells is a _____.
12. The _____ is a layer of tissue between the shell and body of a mollusk and forms a cavity that pumps water for filter feeding.

Lesson 18.2: Critical Writing

Name_____ **Class**_____ **Date**_____

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Describe the structure and function of the mantle and mantle cavity in a mollusk.

18.3 Arthropods and Insects

Lesson 18.3: True or False

Name_____ Class_____ Date_____

Write true if the statement is true or false if the statement is false.

_____ 1. Some estimate that 80% of all species living on earth today are arthropods.

_____ 2. The body segments of an arthropod are the antipode, midpode, and postpode.

_____ 3. Coxal glands get rid of wastes.

_____ 4. Trilobites were terrestrial arthropods.

_____ 5. Arthropods were the first terrestrial animals.

_____ 6. Centipedes and millipedes are characterized by their poison claws.

_____ 7. When crustaceans grow, they shed their exoskeleton by molting and grow a new one.

_____ 8. Hexapoda refers to the six legs of insects.

_____ 9. All insects have only two body regions: thorax and abdomen.

_____ 10. Wings are part of the endoskeleton of an insect.

_____ 11. Some insects use their wings to make sound.

_____ 12. Many insects have a larval stage.

_____ 13. All insects in a colony have the same job.

_____ 14. Termites are solitary insects.

_____ 15. Some crops depend on insects to pollinate them.

Lesson 18.3: Critical Reading

Name_____ Class_____ Date_____

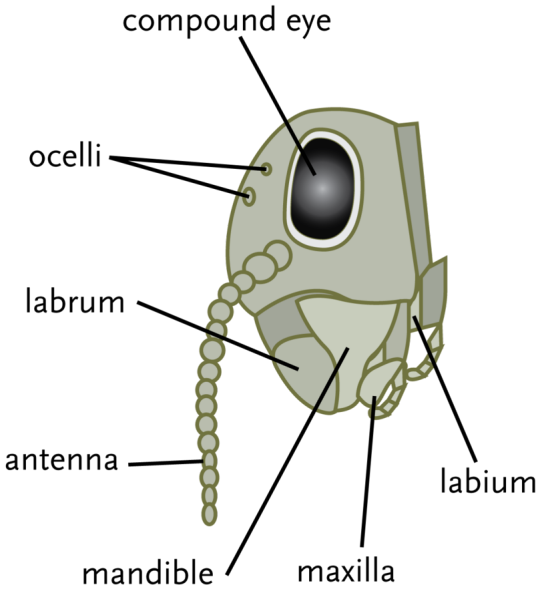
Read these passages from the text and answer the questions that follow.

Structure and Function of Arthropods

Arthropods range in length from about 1 millimeter to 4 meters (about 13 feet). They have a segmented body with a hard exoskeleton. They also have jointed appendages. The body segments are the head, thorax, and abdomen. In some arthropods, the head and thorax are joined together as a cephalothorax.

The arthropod exoskeleton consists of several layers of cuticle. The exoskeleton prevents water loss and gives support and protection. It also acts as a counterforce for the contraction of muscles. The exoskeleton doesn't grow as the animal grows. Therefore, it must be shed and replaced with a new one periodically throughout life. This is called molting. The jointed appendages of arthropods may be used as legs for walking. Being jointed makes them more flexible. Try walking or climbing stairs without bending your knees, and you'll see why joints are helpful. In

most arthropods, the appendages on the head have been modified for other functions. The figure below shows some of head appendages found in arthropods. Sensory organs such as eyes are also found on the head.



Arthropod Head. Arthropods have evolved a variety of specialized appendages and other structures on their head. *(Image courtesy of CK-12 Foundation and under the Creative Commons license CC-BY-NC-SA 3.0.)*

Questions

1. Do arthropods vary in size? If so, by how much?

2. How do arthropods keep from drying out?

3. What do arthropods use for movement?

4. What are the main body segments of arthropods?

5. How do arthropods sense their environment?

Lesson 18.3: Multiple Choice

Name_____ Class_____ Date_____

Circle the letter of the correct choice.

a. A protective, waterproofing structure consisting of several cuticle layers is the _____.
   a. endoskeleton
   b. exoskeleton
   c. labium
   d. ocelli

b. Shedding of the exoskeleton is called
   a. molting.
   b. bolting.
   c. incision.
   d. extrasensation.

c. Structures that collect liquid wastes from the blood of some arthropods and concentrate it are the
   a. Macrolipid tubules.
   b. Malphigian tubules.
   c. coxal glands.
   d. toxal glands.

d. The caterpillar is the _____ stage of a butterfly
   a. larval
   b. pupal
   c. gamete
   d. adult

e. There are fossil records of the earliest arthropods to evolve, the _____.
   a. millipedes
   b. ticks
   c. mites
   d. trilobites

f. Arthropods that are mainly aquatic, scavengers or predators, and have two pairs of antennae and claws are in the subphylum
   a. Myriapoda.
   b. Chelicerata.
   c. Crustacea.
   d. Hexapoda.

g. Arthropods that mainly terrestrial, can be predators or parasites, and have eight walking legs and two body segments are in the subphylum
   a. Myriapoda.
   b. Chelicerata.
   c. Crustacea.
   d. Hexapoda.

h. Ants communicate with chemicals called
   a. silica.
   b. metronomes.
   c. biomes.
   d. pheromones.

Lesson 18.3: Vocabulary I

Name_____ Class_____ Date_____

Match the vocabulary word with the proper definition.

Definitions

_____ 1. process in which a larva undergoes a major transformation to change into the adult form, which occurs in amphibians, arthropods, and other invertebrates

_____ 2. excretory structures that collect waste from the blood and concentrate it

_____ 3. a tube-like structure for gas exchange

_____ 4. sensory structure in invertebrates such as arthropods that detects chemicals and other stimuli

_____ 5. oldest known arthropod, which is now extinct and known only from numerous fossils

_____ 6. jaw-like head appendage in arthropods for holding and swallowing food; or the upper jaw of a mammal or other vertebrate

_____ 7. jaw-like head appendage in arthropods for grasping, biting, and chewing food; or the lower jaw of a mammal or other vertebrate

_____ 8. process in which an animal sheds and replaces the outer covering of the body, such as the exoskeleton in arthropods

_____ 9. excretory structure that transports waste from the digestive tract to the anus

_____ 10. life cycle stage of many insects that occurs between the larval and adult stages and during which the insect is immobile, may be encased within a cocoon, and changes into the adult form

_____ 11. a fused head and thorax

_____ 12. phylum containing insects, spiders, and lobsters

Terms

a. antenna

b. Arthropoda

c. cephalothorax

d. coxal glands

e. Malphigian tubules

f. mandible

g. maxilla

h. metamorphosis

i. molting

j. pupa

k. trachea

l. trilobite

Lesson 18.3: Vocabulary II

Name_____ Class_____ Date_____

Fill in the blank with the appropriate term.

1. A sensory organ on the head of some arthropods that detects chemicals is a(n) _____.

2. Enclosed in a cocoon is the _____.

3. _____ are excretory structures that transfer waste from the digestive tract to the anus.

4. The _____ is the lower jaw.

5. The _____ is the upper jaw.

6. _____ is the shedding of the exoskeleton.

7. _____ are excretory structures that collect waste from the blood and concentrate it.

8. The first arthropods, which are now extinct, are the _____.

9. A fused head and thorax segment is a _____.

10. The _____ is a tube-like structure through whic gases travel.

11. _____ describes the transformation of a larval to adult form.

12. Honeybees communicate to other honeybees about the location of a food source with the _____.

Lesson 18.3: Critical Writing

Name_____ Class_____ Date_____

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

What advantages do flying insects have over arthropods that cannot fly?

18.4 Echinoderms and Invertebrate Chordates

Lesson 18.4: True or False

Name_____ **Class**_____ **Date**_____

Write true if the statement is true or false if the statement is false.

_____ 1. A lancelet belongs to the same phylum as a tunicate.

_____ 2. A sea cucumber belongs to the same phylum as a sea star (starfish).

_____ 3. While larval echinoderms have bilateral symmetry, adult echinoderms have radial symmetry.

_____ 4. Echinoderms live in either freshwater or ocean water.

_____ 5. Tube feet depend upon the echinoderm's water vascular system for their ability to attach to a surface.

_____ 6. Wastes are excreted and oxygen diffuses in through the tube feet of echinoderms.

_____ 7. Unlike annelids, echinoderms cannot regenerate a lost body part.

_____ 8. The fertilized embryo of echinoderms develops directly into an adult.

_____ 9. As a group, Echinoderms can obtain food by filter-feeding, scavenging, or preying on other organisms.

_____ 10. The phylum Chordata contains only animals with a backbone.

_____ 11. Chordates have an unsegmented body.

_____ 12. The hollow nerve cord of chordates is located along the dorsal (top) side of the organism.

_____ 13. Adult tunicates are sessile.

_____ 14. Adult lancelets are sessile.

_____ 15. Tunicates can be very brightly colored.

Lesson 18.4: Critical Reading

Name_____ **Class**_____ **Date**_____

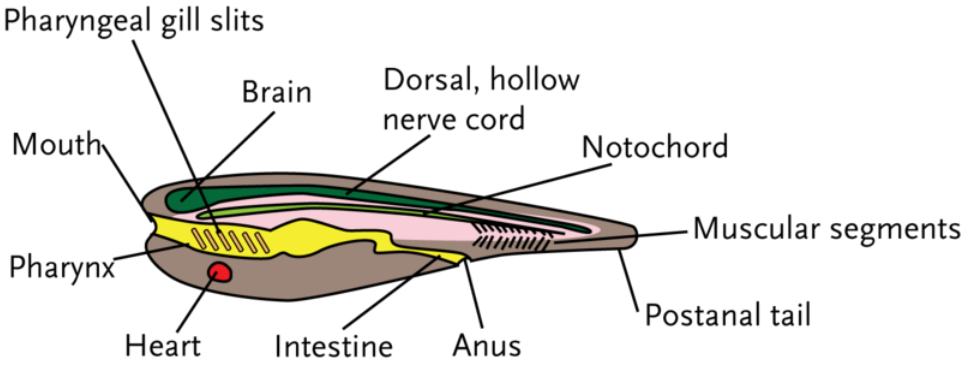
Read these passages from the text and answer the questions that follow.

Characteristics of Chordates

Chordates have three embryonic cell layers. They also have a segmented body with a coelom and bilateral symmetry. Chordates have a complete digestive system and a closed circulatory system. Their nervous system is centralized. There are four additional traits that are unique to chordates. These four traits, shown in the diagram below, define the chordate phylum.

- Post-anal tail: The tail is opposite the head and extends past the anus.
- Dorsal hollow nerve cord: The nerve cord runs along the top, or dorsal, side of the animal. (In nonchordate animals, the nerve cord is solid and runs along the bottom).

- Notochord: The notochord lies between the dorsal nerve cord and the digestive tract. It provides stiffness to counterbalance the pull of muscles.
- Pharyngeal slits: Pharyngeal slits are located in the pharynx. This is the tube that joins the mouth to the digestive and respiratory tracts.



Body Plan of a Typical Chordate. The body plan of a chordate includes a post-anal tail, notochord, dorsal hollow nerve cord, and pharyngeal slits. *(Image courtesy of CK-12 Foundation and under the Creative Commons license CC-BY-NC-SA 3.0.)*

Questions

1. Name the embryonic cell layers of chordates.

2. Briefly describe the digestive system, nervous system, and circulatory system of chordates.

3. What is a post-anal tail?

4. What is the function of the notochord described in the passage?

5. Define pharynx.

Lesson 18.4: Multiple Choice

Name_____ **Class**_____ **Date**_____

Circle the letter of the correct choice.

a. Which of the following organisms is not in the phylum Echinodermata?
   a. brittle star
   b. lancelet
   c. sea star
   d. sand dollar

b. Larval echinoderms have _____ symmetry, and adult echinoderms have _____ symmetry.
   a. no, bilateral
   b. radial, radial
   c. bilateral, radial
   d. trilateral, bilateral

c. The function of muscular contractions that force water into the tube feet is

   a. regeneration.
   b. allowing the echinoderm to float with ocean currents.
   c. digestion.
   d. to enable the echinoderm to attach to surfaces.

d. Echinoderm reproduction typically is

   a. sexual reproduction by budding.
   b. sexual reproduction with internal fertilization.
   c. by regeneraton.
   d. sexual reproduction with external fertilization.

e. The life cycle of an echinoderms typically contains a

   a. free-swimming larval phase.
   b. pupal phase.
   c. long-lasting haploid phase.
   d. all of the above

f. Tunicates live

   a. in the desert.
   b. in shallow freshwater ponds.
   c. in shallow ocean water.
   d. at the bottom of deep freshwater ponds.

g. Which of the following is **not** a defining characteristic of chordates?

   a. pharyngeal slits
   b. a dorsal hollow nerve cord
   c. a complete digestive system
   d. an open circulatory system

h. In humans, pharyngeal slits are present in the embryo and develop into the _____ during maturation.

   a. eyes
   b. nose
   c. middle ear
   d. outer ear

Lesson 18.4: Vocabulary I

Name_____ **Class**_____ **Date**_____

Match the vocabulary word with the proper definition.

Definitions

_____ 1. phylum containing vertebrates

_____ 2. subphylum containing sea stars

_____ 3. subphylum containing feather stars

_____ 4. subphylum containing brittle stars

_____ 5. subphylum containing sea urchins

_____ 6. subphylum containing sea cucumbers

_____ 7. phylum containing sea stars and sand dollars

_____ 8. chemical attractants

_____ 9. simple eyes

_____ 10. the ability to grow back lost body parts

_____ 11. common name is sea squirt; are invertebrate chordates; adults are sessile

_____ 12. group containing only about 25 species; live on the ocean floor; adults can swim

Terms

a. Asteroidea

b. Chordata

c. Crinodea

d. Echinodermata

e. Echinoidea

f. Holothuroidea

g. lancelet

h. ocelli

i. Ophiuroidea

j. pheromones

k. regeneration

l. tunicate

Lesson 18.4: Vocabulary II

Name_____ Class_____ Date_____

Fill in the blank with the appropriate term.

1. The subphylum containing sea cucumbers is _____.

2. The subphylum containing feather stars is _____.

3. The subphylum containing sea stars is _____.

4. The subphylum containing brittle stars is _____.

5. The subphylum containing sea urchins is _____.

6. The phylum containing vertebrates is _____.

7. The phylum containing sea stars and sand dollars is _____.

8. The ability to grow back lost body parts is _____.

9. _____ are chemical attractants.

10. _____ are the simple eyes of some echinoderms.

11. Sea squirt is a common name for _____.

12. _____ are filter feeders with adults that swim, and belong to the phylum Chordata.

Lesson 18.4: Critical Writing

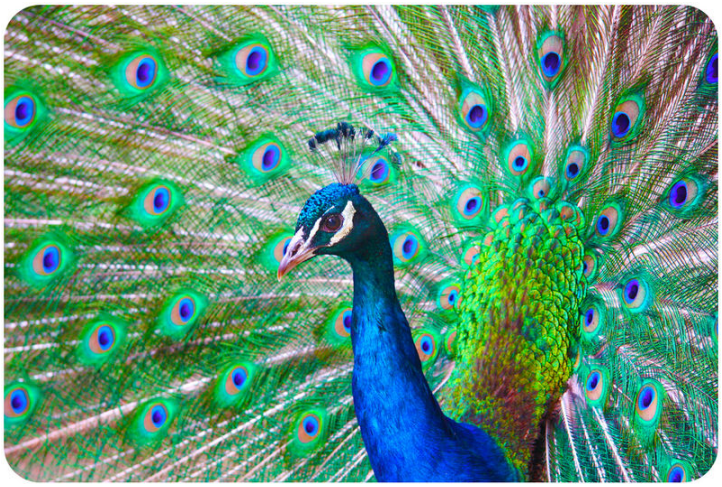
Name_____ Class_____ Date_____

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Name a few examples of echinoderms. What do they all have in common?

CHAPTER 19 From Fish to Birds Worksheets

Chapter Outline



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- **Lesson 19.1: Overview of Vertebrates**
- **Lesson 19.2: Fish**
- **Lesson 19.3: Amphibians**
- **Lesson 19.4: Reptiles**
- **Lesson 19.5: Birds**

19.1 Overview of Vertebrates

Lesson 19.1: True or False

Name_____ Class_____ Date_____

Write true if the statement is true or false if the statement is false.

_____ 1. Like all chordates, vertebrates have a notochord, a dorsal hollow nerve cord, gills, and a post-anal tail.

_____ 2. The main distinguishing feature of vertebrates is their backbone.

_____ 3. Bone is a tough tissue that contains a protein called collagen.

_____ 4. Cartilage is a hard tissue that consists of a collagen matrix, or framework, filled in with minerals such as calcium.

_____ 5. Kidneys are organs that filter blood from waste.

_____ 6. Vivipary occurs in almost all mammals.

_____ 7. The immune system is the organ system that defends the body from pathogens.

_____ 8. There are about 50,000 vertebrate species.

_____ 9. Mammals and birds both evolved from reptile-like ancestors.

_____ 10. Amphibians evolved from reptiles, which evolved from fish.

_____ 11. The earliest vertebrates were jawless fish.

_____ 12. Reptiles were the first vertebrates to live on land.

_____ 13. The earliest vertebrates lived between 500 and 600 million years ago.

_____ 14. The first vertebrates to lay amniotic eggs were amphibians.

_____ 15. Endothermy means regulating body temperature from the outside through behavioral changes.

Lesson 19.1: Critical Reading

Name_____ Class_____ Date_____

Read these passages from the text and answer the questions that follow.

Characteristics of Vertebrates

The main distinguishing feature of vertebrates is their vertebral column, or backbone. The backbone runs from the head to the tail along the dorsal (top) side of the body. The vertebral column is the core of the endoskeleton. It allows a vertebrate to hold its shape. It also houses and protects the spinal (nerve) cord that passes through it. The vertebral column is made up of repeating units called **vertebrae** (singular, vertebra). In many species, there are shock-absorbing discs between the vertebrae to cushion them during movement.

Other Vertebrate Traits

There are several additional traits found in virtually all vertebrates.

- Vertebrates have a system of muscles attached to the endoskeleton to enable movement. Muscles control movement by alternately contracting (shortening) and relaxing (lengthening). Generally, muscles work together in opposing pairs.
- Vertebrates have a closed circulatory system with a heart. Blood is completely contained within blood vessels that carry the blood throughout the body. The heart is divided into chambers that work together to pump blood. There are between two and four chambers in the vertebrate heart. With more chambers, there is more oxygen in the blood and more vigorous pumping action.
- Most vertebrates have skin covered with scales, feathers, fur, or hair. These features serve a variety of functions, such as waterproofing and insulating the body.
- Vertebrates have an excretory system that includes a pair of kidneys. **Kidneys** are organs that filter wastes from blood so they can be excreted from the body.
- Vertebrates have an endocrine system of glands that secrete hormones. Hormones are chemical messengers that control many body functions.
- Vertebrates have an adaptive immune system. The **immune system** is the organ system that defends the body from pathogens and other causes of disease. Being adaptive means that the immune system can *learn* to recognize specific pathogens. Then it can produce tailor-made chemicals called antibodies to *attack* them. This allows the immune system to launch a rapid attack whenever the pathogens invade the body again.
- Vertebrates have a centralized nervous system. The nervous system consists of a brain in the head region. It also includes a long spinal cord that runs from the brain to the tail end of the backbone. Long nerve fibers extend from the spinal cord to muscles and organs throughout the body.

Questions

1. Describe the functions of the vertebral column.

2. List five vertebrate traits other than the backbone.

3. Describe the vertebrate circulatory system.

4. What is the immune system?

5. Describe the vertebrate nervous system.

Lesson 19.1: Multiple Choice

Name_____ Class_____ Date_____

Circle the letter of the correct choice.

a. The main distinguishing feature of vertebrates is their
   a. fur or hair.
   b. backbone.
   c. cranium.
   d. immune system.

b. Which statement about cartilage and bone is correct?
   a. An endoskeleton made of bone rather than cartilage allows animals to grow larger and heavier.
   b. Cartilage is less flexible than bone, but stronger.
   c. Cartilage is a hard tissue that consists of a collagen matrix, or framework, filled in with minerals such as calcium.

d. A distinguishing feature of vertebrates is their exoskeleton made of bone or cartilage.

c. Traits of vertebrates include

a. an endoskeleton made of bone or cartilage.
b. an excretory system that includes a pair of kidneys.
c. a system of muscles that enable movement.
d. all of the above.

d. Most mammals reproduce using which strategy?

a. ovovivipary
b. vivipary
c. ovipary
d. placental development

e. The nine different classes of vertebrates include

a. four fish classes and amphibians, reptiles, birds, whales and mammals.
b. four fish classes and amphibians, reptiles, birds, mammals and primates.
c. five fish classes and amphibians, reptiles, birds, and mammals.
d. five fish classes and amphibians, reptiles, monkeys, and mammals.

f. The first vertebrate class to evolve was the

a. hagfish class.
b. lamprey class.
c. mammalian class.
d. amphibian class.

g. The first vertebrates on land were the

a. reptiles.
b. birds.
c. lobe-finned fish.
d. amphibians.

h. Which of the following statements is correct concerning endothermy? (1) Mammals and birds evolved endothermy. (2) All vertebrates are endothermic. (3) Endothermy is regulating body temperature from the inside using metabolic or other physical changes. (4) Endothermy is regulating body temperature from the outside through behavioral changes.

a. 1 and 3
b. 2 and 4
c. 1 and 4
d. 2 and 3

Lesson 19.1: Vocabulary I

Name_____ Class_____ Date_____

Match the vocabulary word with the proper definition.

Definitions

_____ 1. regulating body temperature from the outside through behavioral changes

_____ 2. main distinguishing feature of vertebrates; the backbone

_____ 3. regulating body temperature from the inside through metabolic or other physical changes

_____ 4. a hard tissue that consists of a collagen matrix filled in with minerals such as calcium

_____ 5. a tough tissue that contains a protein called collagen

_____ 6. the development and nourishment of an embryo within the mother's body

_____ 7. the development of an embryo inside an egg within the mother's body until it hatches

_____ 8. the skull

_____ 9. the development of an embryo within an egg outside the mother's body

_____ 10. repeating units that make up the vertebral column

_____ 11. organs that filter wastes from blood

_____ 12. divided into chambers that work together to pump blood

Terms

a. bone

b. cartilage

c. cranium

d. ectothermy

e. endothermy

f. heart

g. kidney

h. ovipary

i. ovovivipary

j. vertebrae

k. vertebral column

l. vivipary

Lesson 19.1: Vocabulary II

Name_____ Class_____ Date_____

Fill in the blank with the appropriate term.

1. The main distinguishing feature of vertebrates is their _____.

2. There are about _____ vertebrate species.

3. The vertebral column is made up of repeating units called _____.

4. Ectothermy means regulating body _____ from the outside through behavioral changes.

5. Vertebrates have a _____ circulatory system with a heart.

6. _____ are organs that filter wastes from blood so they can be excreted from the body.

7. Most vertebrates have _____ covered with scales, feathers, fur, or hair.

8. _____ refers to the development and nourishment of an embryo within the mother's body.

9. Vertebrates have a centralized nervous system that consists of a _____ in the head region.

10. The first _____ evolved from an amphibian ancestor.
11. _____ and birds both evolved from reptile-like ancestors.
12. _____ means regulating body temperature from the inside through metabolic or other physical changes.

Lesson 19.1: Critical Writing

Name_____ Class_____ Date_____

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Describe the order of vertebrate evolution.

19.2 Fish

Lesson 19.2: True or False

Name_____ Class_____ Date_____

Write true if the statement is true or false if the statement is false.

_____ 1. Fish make up more than half of all vertebrate species.

_____ 2. Fish can be more than 50 feet long.

_____ 3. Fish breathe oxygen found in the water.

_____ 4. Fish have a four-chambered heart that allows them to swim long distances.

_____ 5. Spawning increases the chances that fertilization will take place, and is the first step in parental care of their young.

_____ 6. Fish larvae are attached to a large yolk sac.

_____ 7. Lampreys feed on the blood of other fish species.

_____ 8. Many cartilaginous fish have powerful jaws.

_____ 9. Hagfish are the first fish with a backbone.

_____ 10. The rays are excellent swimmers, despite their strong bony skeletons.

_____ 11. According to the fossil record, bony fish evolved before the cartilaginous fish.

_____ 12. The majority of living fish species is ray-fined fish.

_____ 13. Sharks have a small brain but keen eyesight, making them excellent predators.

_____ 14. Some fish can self-fertilization by producing sperm and eggs.

_____ 15. A swim bladder allows fish to move up or down through the water column.

Lesson 19.2: Critical Reading

Name_____ Class_____ Date_____

Read these passages from the text and answer the questions that follow.

Structure and Function in Fish

Fish show great diversity in body size. They range in length from about 8 millimeters (0.3 inches) to 16 meters (about 53 feet). Most are ectothermic and covered with scales. Scales protect fish from predators and parasites and reduce friction with the water. Multiple, overlapping scales provide a flexible covering that allows fish to move easily while swimming.

Adaptations for Water

Many structures in fish are adaptations for their aquatic lifestyle. Several are described below.

- Fish have gills that allow them to "breathe" oxygen in water. Water enters the mouth, passes over the gills, and exits the body through a special opening. Gills absorb oxygen from the water as it passes over them.
- Fish have a streamlined body. They are typically long and narrow, which reduces water resistance when they swim.
- Most fish have several fins for swimming. They use some of their fins to propel themselves through the water and others to steer the body as they swim.
- Fish have a system of muscles for movement. Muscle contractions ripple through the body in waves from head to tail. The contractions whip the tail fin against the water to propel the fish through the water.
- Most fish have a **swim bladder**. This is a balloon-like internal organ that contains gas. By changing the amount of gas in the bladder, a fish can move up or down through the water column.

Fish Organ Systems

Fish have a circulatory system with a two-chambered heart. Their digestive system is complete and includes several organs and glands. Jawed fish use their jaws and teeth to grind up food before passing it to the rest of the digestive tract. This allows them to consume larger prey.

Fish also have a centralized nervous system with a brain. Fish brains are small compared with the brains of other vertebrates, but they are large and complex compared with the brains of invertebrates. Fish also have highly developed sense organs that allow them to see, hear, feel, smell, and taste. Sharks and some other fish can even sense the very low levels of electricity emitted by other animals. This helps them locate prey.

Questions

1. Why do fish have scales?

2. List three adaptations for water found in fish.

3. List the fish organ systems.

4. What is a swim bladder? What is its purpose?

5. Describe the senses of fish.

Lesson 19.2: Multiple Choice

Name_____ Class_____ Date_____

Circle the letter of the correct choice.

a. Adaptations for water in fish include
    a. several fins for swimming.
    b. a system of muscles for movement.
    c. gills that allow them to "breathe" oxygen in water.
    d. all of the above.

b. A swim bladder allows fish to
    a. move the tail fin against the water to propel the fish through the water.
    b. move up or down through water.
    c. reduce water resistance when they swim.
    d. get rid of waste products while they swim.

c. Most fish species belong to which class?

   a. cartilaginous fish
   b. lobe-finned fish
   c. ray-fined fish
   d. lampreys

d. Characteristics of sharks include

   a. an endoskeleton composed of cartilage.
   b. a swim bladder, like all other fish.
   c. a relatively small brain.
   d. all of the above.

e. Lampreys are known for

   a. secreting large amounts of thick, slimy mucus.
   b. feeding on the blood of other fish species using their large round sucker.
   c. their relatively large brain.
   d. a lung-like organ for breathing air.

f. A fish larvae

   a. is very similar to the adult fish.
   b. is born sexually mature.
   c. is attached to a large yolk sac, which provides the larva with food.
   d. none of the above

g. Spawning is when a

   a. large group of adults release their gametes into the water at the same time.
   b. male and female fish release their gametes together.
   c. male fertilizes the females eggs.
   d. a group of eggs develops into larvae.

h. Fish organ systems include

   a. a centralized nervous system with a brain.
   b. an incomplete digestive system with just one opening.
   c. a circulatory system with a four-chambered heart.
   d. all of the above.

Lesson 19.2: Vocabulary I

Name_____ **Class**_____ **Date**_____

Match the vocabulary word with the proper definition.

Definitions

_____ 1. aquatic vertebrates

_____ 2. newly hatched fish that are different from the adult form

_____ 3. the release of gametes into the water by a group of adult fish

_____ 4. light-emitting organs found on some fish

_____ 5. includes the majority of living fish species

_____ 6. includes coelacanths and lungfish

_____ 7. a balloon-like internal organ that contains gas

_____ 8. allows fish to “breathe” oxygen in water

_____ 9. reduce friction with the water

_____ 10. includes sharks, rays, and ratfish

_____ 11. very primitive fish

_____ 12. have a large round sucker, lined with teeth

Terms

a. cartilaginous fish

b. fish

c. gills

d. hagfish

e. larvae

f. lampreys

g. lobe-fined fish

h. photophores

i. ray-fined fish

j. scales

k. spawning

l. swim bladder

Lesson 19.2: Vocabulary II

Name_____ **Class**_____ **Date**_____

Fill in the blank with the appropriate term.

1. Fish are aquatic _____; they make up more than half of all vertebrate species.

2. Most fish have a swim _____, which allows a fish to move up or down through the water column.

3. Fish have gills that allow them to “breathe” _____ in water.

4. During _____, a large group of adults come together to release their gametes into the water at the same time.

5. Fish have a circulatory system with a two-chambered _____.

6. Cartilaginous fish include _____, rays, and ratfish.

7. A fish _____ swims attached to a large yolk sac, which provides the larva with food.

8. One of the most important traits of cartilaginous fish is their powerful _____.

9. _____ fish include the majority of living fish species.

10. The most striking feature of _____ is a large round sucker, lined with teeth.

11. _____ are very primitive fish; they do not have a backbone.

12. _____ fish were also ancestral to amphibians - their stump-like appendages and lung-like organs evolved into amphibian legs and lungs.

Lesson 19.2: Critical Writing

Name_____ Class_____ Date_____

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Explain how fish reproduce and develop.

19.3 Amphibians

Lesson 19.3: True or False

Name_____ Class_____ Date_____

Write true if the statement is true or false if the statement is false.

_____ 1. Amphibians live on land and in the water.

_____ 2. Amphibians are the first true vertebrates with four limbs.

_____ 3. Amphibians are ectothermic, meaning they can warm their body through metabolic processes.

_____ 4. Amphibians have a cloaca, a shared body cavity with separate openings for wastes and gametes.

_____ 5. Of all amphibians, frogs generally have the best vision and hearing, and a larynx to make sounds.

_____ 6. Most amphibians breathe with lungs as larvae and with gills as adults.

_____ 7. Just like their vertebrate relatives, the reptiles, birds, and mammals, amphibians produce amniotic eggs.

_____ 8. Many amphibians can absorb oxygen through their skin.

_____ 9. During metamorphosis, the amphibian grows legs, grows a tail, and develops lungs.

_____ 10. Frogs croak when searching for mates.

_____ 11. Salamanders cannot jump; instead, they walk and swim.

_____ 12. The amphibian tadpole resembles a fish.

_____ 13. Caecilians are most closely related to salamanders; these amphibians also walk and swim.

_____ 14. Amphibians have important roles in food webs, as predators of birds and snakes, and as prey for worms, snails, and insects.

_____ 15. The frog's back legs are modified for jumping, whereas the toad's back legs are modified for swimming.

Lesson 19.3: Critical Reading

Name_____ Class_____ Date_____

Read these passages from the text and answer the questions that follow.

Amphibian Reproduction and Development

Amphibians reproduce sexually with either external or internal fertilization. They attract mates in a variety of ways. For example, the loud croaking of frogs is their mating call. Each frog species has its own distinctive call that other members of the species recognize as their own. Most salamanders use their sense of smell to find a mate. The males produce a chemical odor that attracts females of the species.

Amphibian Eggs

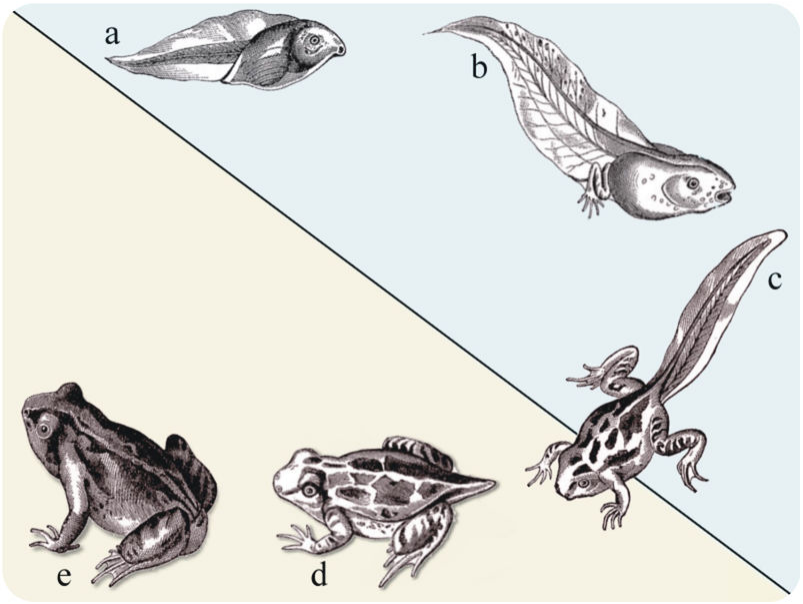
Unlike other tetrapod vertebrates (reptiles, birds, and mammals), amphibians do not produce amniotic eggs. There-

fore, they must lay their eggs in water so they won't dry out. Their eggs are usually covered in a jelly-like substance. The "jelly" helps keep the eggs moist and offers some protection from predators.

Amphibians generally lay large numbers of eggs. Often, many adults lay eggs in the same place at the same time. This helps to ensure that eggs will be fertilized and at least some of the embryos will survive. Once eggs have been laid, most amphibians are done with their parenting.

Amphibian Larvae

The majority of amphibian species go through a larval stage that is very different from the adult form, as you can see from the frog in the diagram below. The early larval, or tadpole, stage resembles a fish. It lacks legs and has a long tail, which it uses to swim. The tadpole also has gills to absorb oxygen from water. As the larva undergoes metamorphosis, it grows legs, loses its tail, and develops lungs. These changes prepare it for life on land as an adult frog.



Frog Development: From Tadpole to Adult. A frog larva (tadpole) goes through many changes by adulthood. How do these changes prepare it for life as an adult frog? *(Frog illustrations illustrated by Meyers Konversations-Lexikon, colored and arranged by TomCatX, and under the public domain.)*

Questions

1. What are two ways amphibians attract mates?

2. Where must amphibians lay their eggs? Why?

3. Why do many amphibians lay their eggs together?

4. Describe the amphibian tadpole.

5. Compare the adult frog to the tadpole.

Lesson 19.3: Multiple Choice

Name_____ Class_____ Date_____

Circle the letter of the correct choice.

a. Amphibian skin
    a. contains keratin, which in amphibians is not very tough, and it allows gases and water to pass through the skin.
    b. is usually moist and has scales.
    c. can be either moist or dry.
    d. contains keratin, a tough, fibrous protein which keeps skin water- and air-tight.

b. Amphibians breathe
    a. with lungs.
    b. with lungs as larvae and with gills as adults.
    c. with gills as larvae and with lungs as adults.
    d. with gills.

c. Which statement is true of amphibian larvae?
    a. The amphibian larval stage is very different from the adult form.
    b. The early amphibian larvae resembles a fish.
    c. The early amphibian larvae has gills to absorb oxygen from water.
    d. all of the above

d. Frogs and tadpoles
    a. are separate orders of amphibian.
    b. have front and back legs that are modified for jumping.
    c. have back legs that are modified for jumping.
    d. none of the above

e. Salamanders
    a. have a long body with short legs.
    b. are adapted for walking and swimming rather than jumping.
    c. can regrow legs that have been lost to predators.
    d. all of the above

f. Caecilians
    a. have a long, worm-like body without legs.
    b. are adapted for walking and swimming.
    c. can regrow legs that have been lost to predators.
    d. have front and back legs that are modified for jumping.

g. Which statement is true of amphibians and their role in the ecosystem?
    a. Amphibians are important predators of animals such as birds, snakes, raccoons, and fish.
    b. Amphibians are important in an ecosystem as both prey and predators.
    c. As adults, amphibians are omnivores, feeding on both plants and animals.
    d. all of the above

h. Amphibians evolved into
    a. reptiles.
    b. birds.
    c. mammals.
    d. fish.

Lesson 19.3: Vocabulary I

Name_____ **Class**_____ **Date**_____

Match the vocabulary word with the proper definition.

Definitions

_____ 1. the only continent without amphibians

_____ 2. shared body cavity

_____ 3. a tough, fibrous protein found in the skin, scales, feathers, hair, and nails

_____ 4. vertebrates with four limbs

_____ 5. have back legs that are modified for jumping; spends more time in water then related species

_____ 6. have a long body with short legs

_____ 7. have a long, worm-like body without legs

_____ 8. have back legs that are modified for jumping; spends more time on land then related species

_____ 9. the early larval stage

_____ 10. the changing of larvae into the adult form

_____ 11. having a body temperature about the same as the environment.

_____ 12. vertebrates that divide their time between freshwater and terrestrial habitats

Terms

a. amphibian

b. Antarctica

c. caecilians

d. cloaca

e. ectothermic

f. frogs

g. keratin

h. metamorphosis

i. salamanders

j. tadpole

k. tetrapod

l. toads

Lesson 19.3: Vocabulary II

Name_____ **Class**_____ **Date**_____

Fill in the blank with the appropriate term.

1. The loud croaking of frogs is their _____ call.

2. Most amphibians breathe with _____ as larvae and with lungs as adults.

3. Amphibians must lay their eggs in _____.

4. _____ spend more time in water, and _____ spend more time on land.

5. The majority of amphibian species go through a _____ stage that is very different from the adult form.
6. _____ have the ability to regenerate legs that have been lost to predators.
7. The amphibian digestive, excretory, and reproductive systems share a body cavity called the _____.
8. Amphibian skin contains _____, a tough, fibrous protein.
9. Amphibians are the first true tetrapods, or vertebrates with _____ limbs.
10. Amphibians divide their time between freshwater and terrestrial _____.
11. Amphibians were the earliest land _____.
12. Amphibians evolved about _____ million years ago.

Lesson 19.3: Critical Writing

Name_____ Class_____ Date_____

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Identify and describe the three living amphibian orders.

19.4 Reptiles

Lesson 19.4: True or False

Name_____ Class_____ Date_____

Write true if the statement is true or false if the statement is false.

_____ 1. Reptiles include crocodiles, alligators, lizards, turtles, and all snakes except water snakes.

_____ 2. Reptiles are tetrapod vertebrates that produce amniotic eggs.

_____ 3. Reptile skin is covered with scales, which keeps the skin moist.

_____ 4. On land, reptiles breathe air through their lungs, and in the water, they breath using their gills.

_____ 5. It is possible for some reptiles to go weeks without eating.

_____ 6. Snakes smell using their tongue.

_____ 7. All reptiles have a three-chambered heart.

_____ 8. Like the amphibian tadpole, the reptilian larval stage also resembles a fish.

_____ 9. The shell, membranes, and other structures of the reptilian amniotic egg protect and nourish the embryo.

_____ 10. Some reptiles are at the top of the food chain - they ate the top predators in their ecosystems.

_____ 11. Alligators replace their teeth throughout their life.

_____ 12. Turtles are the least specialized of all living reptiles.

_____ 13. Snakes can swallow large prey whole.

_____ 14. Small crocodiles were early ancestors of most reptiles.

_____ 15. Crocodiles and alligators use a diaphragm to control their breathing, just like humans.

Lesson 19.4: Critical Reading

Name_____ Class_____ Date_____

Read these passages from the text and answer the questions that follow.

Structure and Function in Reptiles

Reptiles have several adaptations for living on dry land that amphibians lack. For example, the skin of most reptiles is covered with scales. The scales are made of very tough keratin, and they protect reptiles from injury and also prevent them from losing water.

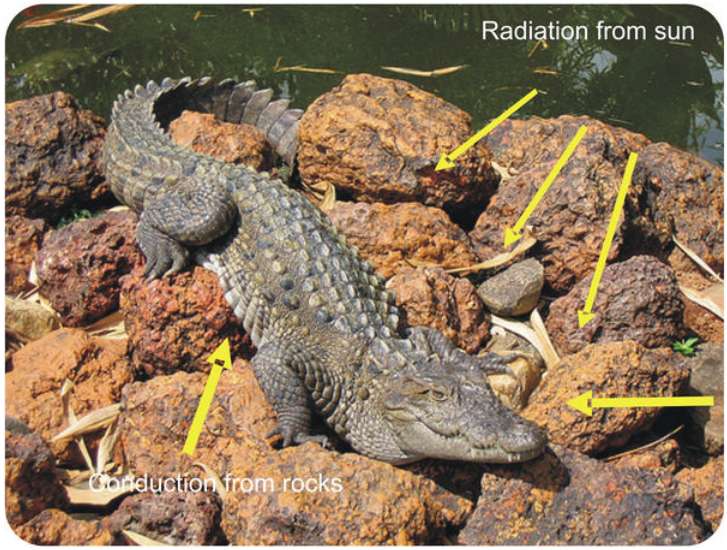
Reptile Respiration

The scales of reptiles prevent them from absorbing oxygen through their skin, as amphibians can. Instead, reptiles breathe air only through their lungs. However, their lungs are more efficient than the lungs of amphibians, with more surface area for gas exchange. This is another important reptile adaptation for life on land.

Reptiles have various ways of moving air into and out of their lungs. Lizards and snakes use muscles of the chest wall for this purpose. These are the same muscles used for running, so lizards have to hold their breath when they run. Crocodiles and alligators have a large sheet of muscle below the lungs, called a **diaphragm,** that controls their breathing. This is a structure found also in mammals.

Ectothermy in Reptiles

Like amphibians, reptiles are ectotherms with a slow metabolic rate. Their metabolism doesn't generate enough energy to keep their body temperature stable. Instead, reptiles regulate their body temperature through their behavior. For example, the crocodile in the figure below is soaking up heat from the environment by basking in the sun. Because of their ectothermy, reptiles can get by with as little as one tenth the food needed by endotherms, such as mammals. Some species of reptiles can go several weeks between meals.



Heat Transfer to an Ectothermic Reptile. This crocodile is being warmed by the environment in three ways. Heat is radiating directly from the sun to the animal's back. Heat is also being conducted to the animal from the rocks it rests on. In addition, convection currents are carrying warm air from surrounding rocks to the animal's body. *(Image courtesy of wildxplorer and under the Creative Commons license CC-BY 2.0. Text added by CK-12 Foundation.)*

Other Reptile Structures

Like amphibians, most reptiles have a heart with three chambers, although crocodiles and alligators have a four-chambered heart like birds and mammals. The reptile brain is also similar in size to the amphibian brain, taking into account overall body size. However, the parts of the reptile brain that control the senses and learned behavior are larger than in amphibians.

Most reptiles have good eyesight and a keen sense of smell. Snakes smell scents in the air using their forked tongue. This helps them locate prey. Some snakes have heat-sensing organs on their head that help them find endothermic prey, such as small mammals and birds.

Questions

1. Describe the skin of reptiles.

2. How do reptiles breathe?

3. “Reptiles are ectotherms.” What does this mean?

4. How can reptiles heat their bodies?

5. Describe reptilian senses.

Lesson 19.4: Multiple Choice

Name_____ Class_____ Date_____

Circle the letter of the correct choice.

a. Reptiles include which of the following? (1) crocodiles, (2) lizards, (3) snakes, (4) turtles.
   a. 1 and 2
   b. 3 and 4
   c. 1, 2, and 3
   d. 1, 2, 3, and 4

b. Adaptations of reptiles for living on land include
   a. sense organs to smell and taste chemicals.
   b. a relatively complex circulatory system with a three-chambered heart.
   c. skin of most reptiles is covered with scales made of very tough keratin.
   d. all of the above.

c. Reptiles breath air
   a. only through their lungs.
   b. through their skin.
   c. through both the skin and lungs, like amphibians.
   d. with gills as larvae.

d. Reptiles are ectotherms. This means
   a. they warm their bodies through their behavior.
   b. they cannot use metabolism to generate heat.
   c. they need less food then mammals to survive.
   d. all of the above.

e. There are four orders of reptiles. They are the
   a. Crocodilia, Sphenodontia, Squamata, and Testudines.
   b. Crocodilia, Alligatoria, Squamata, and Testudines.
   c. Crocodiles, Lizards, Snakes, and Turtles.
   d. Alligatoria, Sphenodontia, Squamata, and Testudines.

f. The reptile amniotic egg
   a. protect and nourish the embryo during development.
   b. keeps the embryo moist and safe while it grows and develops.
   c. provides the embryo with a rich, fatty food source.
   d. all of the above

g. Characteristics of the Crocodilia order include
   a. permanent teeth.
   b. a three-chambered heart.
   c. four sprawling legs that can be used to gallop.
   d. none of the above.

h. Which statement about reptilian evolution is correct? (1) Reptiles, dinosaurs, and birds all developed from sauropsids. (2) Sauropsids evolved into dinosaurs. (3) Dinosaurs evolved from reptiles. (4) Lizards and snakes were the last reptiles to evolve.
   a. 1 and 2
   b. 1, 2, and 3

c. 1, 2, and 4
d. 1, 2, 3, and 4

Lesson 19.4: Vocabulary I

Name_____ Class_____ Date_____

Match the vocabulary word with the proper definition.

Definitions

_____ 1. the amniotes that evolved into reptiles, dinosaurs, and birds

_____ 2. the amniotes that eventually gave rise to mammals

_____ 3. the least specialized of all living reptiles

_____ 4. have four sprawling legs that can be used to gallop

_____ 5. protect and nourish the embryo; keeps the embryo moist and safe while it grows and develops

_____ 6. *Age of the Dinosaurs*

_____ 7. a large sheet of muscle below the lungs that controls their breathing

_____ 8. have a hard shell covering most of their body

_____ 9. lizards and snakes

_____ 10. consists of all amniotes except birds and mammals

Terms

a. amniotic eggs

b. Crocodilia

c. diaphragm

d. Mesozoic Era

e. reptiles

f. sauropsid

g. Sphenodontia

h. Squamata

i. synapsid

j. Testudines

Lesson 19.4: Vocabulary II

Name_____ Class_____ Date_____

Fill in the blank with the appropriate term.

1. Large reptiles, such as crocodilians, have powerful _____ that can crush bones and even turtle shells.

2. By the middle of the Triassic about 225 million years ago, sauropsids had evolved into _____.

3. A snake flicks its _____ in and out to capture scent molecules in the air.
4. Sauropsids were amniotes that evolved into reptiles, dinosaurs, and _____.
5. Reptiles are _____, unable to generate their own heat, so they have a slow metabolic rate.
6. Reptiles produce amniotic _____.
7. Crocodiles and alligators have a _____, a large sheet of muscle below the lungs.
8. Crocodiles and alligators have a four-chambered _____ like birds and mammals.
9. The scales of reptiles prevent them from losing _____.
10. Because of their _____, reptiles can breathe air only through their lungs.
11. Testudines have a hard _____ covering most of their body.
12. The shell, membranes, and other structures of an amniotic egg protect and nourish the _____.

Lesson 19.4: Critical Writing

Name_____ **Class**_____ **Date**_____

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Describe the amniotic egg and reptile reproduction.

19.5 Birds

Lesson 19.5: True or False

Name_____ Class_____ Date_____

Write true if the statement is true or false if the statement is false.

_____ 1. Birds are endothermic tetrapod vertebrates.

_____ 2. Birds lay amniotic eggs with hard, calcium carbonate shells.

_____ 3. Birds are the youngest but most numerous class of vertebrates on Earth.

_____ 4. All modern birds have wings, feathers, and beaks.

_____ 5. Wings are modified front legs.

_____ 6. Down feathers are short and fluffy; they help a bird fly downward.

_____ 7. Birds have an organ called a crop, which contains stones that grind food.

_____ 8. Most birds abandon their young at birth.

_____ 9. Flightless birds are good at running or swimming.

_____ 10. Courtship in birds can involve singing or dancing.

_____ 11. Bird beaks have adapted for the food they eat.

_____ 12. Some birds stay together for life.

_____ 13. Shorebirds, such as ducks, geese, and swans, spend most of their time on the water surface.

_____ 14. Diurnal raptors are active during the night and sleep during the day.

_____ 15. Parrots are found in tropical regions and are very intelligent.

Lesson 19.5: Critical Reading

Name_____ Class_____ Date_____

Read these passages from the text and answer the questions that follow.

Structure and Function in Birds

Birds can vary considerably in size. The tiny bee hummingbird is just 5 centimeters (2 inches) long, whereas the ostrich towers over people at a height of 2.7 meters (9 feet). All modern birds have wings, feathers, and beaks. They have a number of other unique traits as well, most of which are adaptations for flight. Flight is used by birds as a means of locomotion in order to find food and mates and to avoid predators. Although not all modern birds can fly, they all evolved from ancestors that could.

Wings and Feathers

Wings are an obvious adaptation for flight. They are actually modified front legs. Birds move their wings using

muscles in the chest. These muscles are quite large, making up as much as 35 percent of a bird's body weight.

Feathers help birds fly and also provide insulation and serve other purposes. Birds actually have two basic types of feathers: flight feathers and down feathers. Flight feathers are long, stiff, and waterproof. They provide lift and air resistance without adding weight. Down feathers are short and fluffy. They trap air next to a bird's skin for insulation.

Organ Systems Adapted for Flight

Birds need a light-weight body in order to stay aloft. Even so, flying is hard work, and flight muscles need a constant supply of oxygen- and nutrient-rich blood. The organ systems of birds are adapted to meet these needs.

- Birds have light-weight bones that are filled with air. They also lack a jaw, which in many vertebrates is a dense, heavy bone with many teeth. Instead, birds have a light-weight keratin beak without teeth.
- Birds have air sacs that store inhaled air and push it into the lungs like bellows. This keeps the lungs constantly filled with oxygenated air. The lungs also contain millions of tiny passages that create a very large surface area for gas exchange with the blood.
- Birds have a relatively large, four-chambered heart. The heart beats rapidly to keep oxygenated blood flowing to muscles and other tissues. Hummingbirds have the fastest heart rate at up to 1,200 times per minute. That's almost 20 times faster than the human resting heart rate!
- Birds have a sac-like structure called a crop to store and moisten food that is waiting to be digested. They also have an organ called a gizzard that contains swallowed stones. The stones make up for the lack of teeth by grinding food, which can then be digested more quickly. Both structures make it easier for the digestive system to produce a steady supply of nutrients from food.

Questions

1. What is flight used for in birds?

2. Describe the two types of feathers found in birds.

3. List three bird adaptations for flight.

4. Describe the bird heart.

5. What are a crop and gizzard? Describe their functions.

Lesson 19.5: Multiple Choice

Name_____ Class_____ Date_____

Circle the letter of the correct choice.

a. Birds
   a. have eggs with hard, calcium carbonate shells.
   b. lay amniotic eggs.
   c. are bipedal.
   d. all of the above

b. Adaptations for flight in birds include
   a. air sacs that store inhaled air and push it into the lungs.
   b. solid bones that are filled with air.
   c. a relatively large, two-chambered heart.
   d. all of the above.

c. A crop and gizzard

   a. keep the lungs constantly filled with oxygenated air.
   b. are both part of the bird's digestive process.
   c. keep oxygenated blood flowing to muscles and other tissues.
   d. are part of a light-weight keratin beak.

d. Courtship in birds may include

   a. singing and dancing.
   b. a display of bravery.
   c. drinks and dinner.
   d. all of the above.

e. Which of the following statements about incubation is true? In birds, incubation (1) keeps the eggs warm while the embryos inside continue to develop, (2) may be done by males, (3) is only done by females.

   a. 1 only
   b. 1 and 2
   c. 3 only
   d. 1, 2, and 3

f. Flightless birds include

   a. ostriches.
   b. penguins.
   c. kiwis.
   d. all of the above.

g. Birds probably evolved from

   a. frogs and toads.
   b. dinosaurs.
   c. insects.
   d. none of the above.

h. Which of the following statements are true of bird diets? (1) Some birds are generalists. (2) Vultures are scavengers. (3) Bird beaks are generally adapted for the food they eat. (4) Raptors such as hawks and owls are omnivores.

   a. 1 and 2
   b. 2 and 3
   c. 1, 2, and 3
   d. 1, 2, 3, and 4

Lesson 19.5: Vocabulary I

Name_____ Class_____ Date_____

Match the vocabulary word with the proper definition.

Definitions

_____ 1. the most numerous vertebrates on Earth

_____ 2. an organism that can eat many different types of food

_____ 3. the process of keeping eggs warm with body heat

_____ 4. a sac-like structure that stores and moistens food

_____ 5. birds whose flight tends to be brief and close to the ground

_____ 6. they hunt by sight and have excellent vision

_____ 7. can hunt with their sense of hearing alone

_____ 8. contains swallowed stones that grind food

_____ 9. modified front legs adapted for flight

_____ 10. behavior that is intended to attract a mate

_____ 11. are very intelligent

_____ 12. trap air next to a bird's skin for insulation

_____ 13. provide lift and air resistance without adding weight

_____ 14. have webbed feet and are good swimmers

_____ 15. considered to be one of the closest non-bird relatives of modern birds

Terms

a. birds

b. courtship

c. crop

d. *Deinonychus*

e. diurnal raptors

f. down feathers

g. flight feathers

h. generalist

i. gizzard

j. incubation

k. landfowl

l. nocturnal raptors

m. parrots

n. waterfowl

o. wings

Lesson 19.5: Vocabulary II

Name_____ **Class**_____ **Date**_____

Fill in the blank with the appropriate term.

1. _____ are an obvious adaptation for flight.

2. _____ feathers provide lift and air resistance without adding weight.

3. _____ feathers trap air next to a bird's skin for insulation.

4. Birds have a sac-like structure called a _____ to store and moisten food.

5. Birds have light-weight _____ that are filled with air.

6. _____ in birds may involve singing specific courtship song.

7. *Deinonychus* is an extinct _____ that is one of the closest non-bird relatives of modern birds.

8. Flightless birds have long legs and are adapted for _____.

9. During _____, birds keep their eggs warm with their body heat while the embryos inside continue to develop.

10. Eggs are usually laid in a _____.

11. In birds, the part of the brain that controls _____ is the most developed part.

12. Predatory birds, such as hawks, have especially good _____.

Lesson 19.5: Critical Writing

Name_____ Class_____ Date_____

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Describe how birds reproduce and care for their young.

CHAPTER 20 Mammals and Animal Behavior Worksheets

Chapter Outline

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- **Lesson 20.1: Mammalian Traits**
- **Lesson 20.2: Reproduction in Mammals**
- **Lesson 20.3: Evolution and Classification of Mammals**
- **Lesson 20.4: Overview of Animal Behavior**

20.1 Mammalian Traits

Lesson 20.1: True or False

Name_____ Class_____ Date_____

Write true if the statement is true or false if the statement is false.

_____ 1. Examples of mammals include frogs, bats, whales, mice, and humans.

_____ 2. Milk contains disease-fighting molecules and nutrients a baby mammal needs.

_____ 3. The heart of a mammal consists of three chambers, making it very efficient and powerful for delivering oxygenated blood to tissues.

_____ 4. The mammalian middle ear has three tiny bones that carry sound vibrations from the inner to outer ear.

_____ 5. The cheetah is the fastest land mammal.

_____ 6. Herbivores such as zebras and lions live in herds.

_____ 7. Of all animals, mammals are most capable of learning.

_____ 8. The cerebrum controls functions such as memory and learning.

_____ 9. Clusters of alveoli in the lungs resemble tiny bunches of grapes.

_____ 10. Cellular respiration maintains the high metabolic rate in mammals.

_____ 11. Omnivores, such the bear, fox, wolf, and rat, eat both plants and animals.

_____ 12. Maintaining the high metabolic rate needed by mammals takes a lot of energy, which comes from either the sun or food.

_____ 13. Goosebumps result from tiny muscles in the skin.

_____ 14. Mammals, like all vertebrates, have four different types of teeth.

_____ 15. Mammals have hair, scales, or fur, which insulates the body to help conserve body heat.

Lesson 20.1: Critical Reading

Name_____ Class_____ Date_____

Read these passages from the text and answer the questions that follow.

Characteristics of Mammals

Two characteristics are used to define the mammal class. They are mammary glands and body hair (or fur).

a. Female mammals have **mammary glands**. The glands produce milk after the birth of offspring. Milk is a nutritious fluid. It contains disease-fighting molecules as well as all the nutrients a baby mammal needs. Producing milk for an offspring is called **lactation**.

b. Mammals have hair or fur. It insulates the body to help conserve body heat. It can also be used for sensing and communicating. For example, cats use their whiskers to sense their surroundings. They also raise their fur to look larger and more threatening.

Most mammals share several other traits. The traits in the following list are typical of, but not necessarily unique to, mammals.

- The skin of many mammals is covered with sweat glands. The glands produce sweat, the salty fluid that helps cool the body.
- Mammalian lungs have millions of tiny air sacs called **alveoli**. They provide a very large surface area for gas exchange.
- The heart of a mammal consists of four chambers. This makes it more efficient and powerful for delivering oxygenated blood to tissues.
- The brain of a mammal is relatively large and has a covering called the **neocortex**. This structure plays an important role in many complex brain functions.
- The mammalian middle ear has three tiny bones that carry sound vibrations from the outer to inner ear. The bones give mammals exceptionally good hearing. In other vertebrates, the three bones are part of the jaw and not involved in hearing.
- Mammals have four different types of teeth. The teeth of other vertebrates, in contrast, are all alike.

Questions

1. What are the two characteristics used to define the mammal class?

2. What are mammary glands?

3. What is the role of fur or hair?

4. List three other traits of mammals.

5. What is unique about the mammalian ear?

Lesson 20.1: Multiple Choice

Name_____ Class_____ Date_____

Circle the letter of the correct choice.

a. Examples of mammals include
   a. fish.
   b. snakes.
   c. whales.
   d. frogs.

b. Two characteristics used to define mammals include
   a. mammary glands and scales.
   b. mammary glands and hair or fur.
   c. mammary glands and sweat glands.
   d. sweat glands and a four-chamber heart.

c. Mammals generate heat by

   a. keeping a high metabolic rate.
   b. laying in the sun and absorbing heat.
   c. increasing blood flow to the skin.
   d. all of the above

d. Mammals are unique in having

   a. lungs with alveoli, tiny, sac-like structures where gas exchange occurs.
   b. kidneys with alveoli, tiny, sac-like structures where blood filtering occurs.
   c. alveoli, which increase blood flow to the skin allowing excess heat to escape.
   d. alveoli with extra mitochondria, keeping metabolism high and generating heat.

e. Mammals with a carnivorous diet include the

   a. rabbit, mouse, elephant, zebra, and monkey.
   b. bear, badger, fox, human, and rat.
   c. aardvark, whale, hyena, dog, dolphin, and mole.
   d. giraffe, deer, elk, walrus, human, and rat.

f. Which of the following statements are true of the mammalian brain? (1) Of all vertebrates, mammals have the biggest and most complex brain for their body size. (2) The cerebrum controls functions such as memory and learning. (3) The larger the neocortex, the greater the mental abilities of an animal. (4) The area of the neocortex is greatest in humans.

   a. 1 and 2
   b. 3 and 4
   c. 1, 2, and 3
   d. 1, 2, 3, and 4

g. Mammals are social animals. Which of the following statements is correct?

   a. Herbivores such as zebras and dolphins live in herds.
   b. Adults in a herd surround and protect the young, who are most vulnerable to predators.
   c. Adult males in a pride hunt cooperatively, which is more efficient than hunting alone.
   d. all of the above

h. Tree-living mammals have a variety of different specializations for moving in trees, including

   a. very long arms for swinging from tree to tree.
   b. sticky pads on their arms and legs that help them cling to tree trunks and branches.
   c. a prehensile tail used for climbing and hanging from branches.
   d. all of the above.

Lesson 20.1: Vocabulary I

Name_____ **Class**_____ **Date**_____

Match the vocabulary word with the proper definition.

Definitions

_____ 1. producing milk for an offspring

_____ 2. include bats, whales, mice, and humans

_____ 3. part of the brain that controls functions such as memory and learning

_____ 4. eats plants and animals

_____ 5. eats animals

_____ 6. eats plants

_____ 7. swinging from branch to branch

_____ 8. produce milk after the birth of offspring

_____ 9. the large muscle that extends across the bottom of the chest below the lungs

_____ 10. provide a very large surface area for gas exchange

_____ 11. covering of brain

_____ 12. tree-living animals

Terms

a. alveoli

b. arboreal

c. brachiation

d. carnivore

e. cerebrum

f. diaphragm

g. herbivore

h. lactation

i. mammals

j. mammary gland

k. neocortex

l. omnivore

Lesson 20.1: Vocabulary II

Name_____ Class_____ Date_____

Fill in the blank with the appropriate term.

1. Mammals have four limbs and produce _____ eggs.

2. _____ glands produce milk after the birth of offspring.

3. _____ or fur insulates the body to help conserve body heat.

4. _____ in the lungs provide a very large surface area for gas exchange.

5. Three tiny bones in the _____ give mammals exceptionally good hearing.

6. Mammals can generate and conserve heat when it's _____ outside.

7. The cells of mammals have many more _____ than the cells of other animals, allowing mammals to have a high metabolic rate.

8. The larger the surface area of the brain's _____, the greater the mental abilities of an animal.

9. In some mammals, a _____ tail is used for climbing and hanging from branches.

10. Many mammals live in social groups, such as _____ of elephants or prides of lions.
11. The four-chambered mammal _____ is very efficient at delivering oxygenated blood to tissues.
12. Mammals have _____ different types of teeth.

Lesson 20.1: Critical Writing

Name_____ Class_____ Date_____

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Describe three characteristics of mammals.

20.2 Reproduction in Mammals

Lesson 20.2: True or False

Name_____ **Class**_____ **Date**_____

Write true if the statement is true or false if the statement is false.

_____ 1. Most mammals are viviparous.

_____ 2. Mammals that are viviparous are called therian mammals.

_____ 3. There are mammals that lay eggs instead of giving birth to an infant or embryo.

_____ 4. The vagina is a pouch-like, muscular organ where the baby develops.

_____ 5. Therian mammals are divided into three groups: placental mammals, monotreme mammals, and marsupial mammals.

_____ 6. The uterus sustains the fetus while it grows inside the mother's placenta.

_____ 7. The placenta allows the exchange of gases, nutrients, and other substances between the fetus and mother.

_____ 8. Kangaroo and koala are marsupials.

_____ 9. The marsupial embryo is nourished inside the placenta with food from a yolk sac instead of through the uterus.

_____ 10. Because the mother produces a placenta, a fetus can become large and mature before birth.

_____ 11. Marsupials live mainly in Australia.

_____ 12. Therian females have reproductive structures that are not found in other vertebrates.

_____ 13. The only living monotreme specie is the platypus.

_____ 14. Female monotremes are like reptiles and birds, with a cloaca with one opening.

_____ 15. Only five living species of mammals are therian mammals.

Lesson 20.2: Critical Reading

Name_____ **Class**_____ **Date**_____

Read these passages from the text and answer the questions that follow.

Marsupials

Marsupials have a different way of reproducing that reduces the mother's risks. A **marsupial** is a therian mammal in which the embryo is born at an early, immature stage. The embryo completes its development outside the mother's body in a pouch on her belly. Only a minority of therian mammals are marsupials. They live mainly in Australia. Examples of marsupials are pictured below.

Marsupials. Marsupials include the kangaroo, koala, and opossum. *(From left to right, images courtesy of Fir0002/Flagstaffotos and under GNU-FDL 1.2, koala courtesy of David Iliff and under the Creative Commons license CC-BY-SA 3.0, and courtesy of Drcyrus and under the Creative Commons license CC-BY-SA 2.1 Australia. Composite created by CK-12 Foundation.)*

The Marsupial Embryo

The marsupial embryo is nourished inside the uterus with food from a yolk sac instead of through a placenta. The yolk sac stores enough food for the short period of time the embryo remains in the uterus. After the embryo is born, it moves into the mother's pouch, where it clings to a nipple. It remains inside the pouch for several months while it continues to grow and develop. Even after the offspring is big enough to leave the pouch, it may often return to the pouch for warmth and nourishment. Eventually, the offspring is mature enough to remain outside the pouch on its own.

Pros and Cons of Marsupial Reproduction

In marsupials, the short period of development within the mother's uterus reduces the risk of her immune system attacking the embryo. In addition, the marsupial mother doesn't have to eat extra food or carry a large fetus inside her. The risks of giving birth to a large fetus are also avoided. Another pro is that the mother can expel the embryo from her pouch if she is pursued by a predator or if food is scarce. On the other hand, a newborn marsupial is tiny and fragile. Therefore, it may be less likely to survive than a newborn placental mammal.

Questions

1. What is a marsupial? Give an example.

2. What is unique about the marsupial embryo?

3. How is the marsupial embryo nourished?

4. Describe an advantage of marsupial development.

5. Describe a disadvantage of marsupial development.

Lesson 20.2: Multiple Choice

Name_____ Class_____ Date_____

Circle the letter of the correct choice.

a. Therian mammals
    a. are viviparous.
    b. have young that are born live.
    c. have young that are born either as relatively large, well-developed fetuses or as tiny, immature embryos.
    d. all of the above

b. All female mammals have
    a. ovaries, which are the organs that produce eggs.
    b. a uterus, which is a tubular passageway through which the embryo or fetus leaves the mother's body during birth.
    c. a vagina, a pouch-like, muscular organ where the embryo or fetus develops until birth.
    d. all of the above.

c. Which statement is true of a placenta?
    a. The placenta passes oxygen, nutrients, and other useful substances from the fetus to the mother.
    b. The placenta passes oxygen, nutrients, and other useful substances from the mother to the fetus.
    c. The placenta mixes blood from the mother and fetus together.
    d. The placenta protects the mother from being attacked by the fetal immune system.

d. Advantages to placental reproduction include
    a. reduced mobility of the mother as the baby grows.
    b. the ability to abandon the baby to save the mother's life if necessary.
    c. a long period of fetal growth, allowing the fetus to become large and mature before birth.
    d. all of the above.

e. Marsupials include
    a. the kangaroo.
    b. the platypus.
    c. humans.
    d. all whales.

f. Among mammals, female monotremes are unique in that they
    a. have a pouch where the fetus completes development.
    b. have a cloaca with one opening.
    c. "sweat" milk from a patch on their mammary glands.
    d. live mainly in Australia.

g. Female monotremes
    a. lay eggs.
    b. have a placenta.
    c. lack a vagina but have a uterus.
    d. lay eggs and have a placenta.

h. An advantage to marsupial reproduction is that
    a. the marsupial mother has to eat extra food, and marsupials love to eat.
    b. there is a short period of development within the mother's uterus.
    c. a newborn marsupial is small, making delivery and development easy on the mother.
    d. due to their size, newborn marsupials have a very high survival rate.

Lesson 20.2: Vocabulary I

Name_____ **Class**_____ **Date**_____

Match the vocabulary word with the proper definition.

Definitions

_____ 1. viviparous mammals

_____ 2. the organ that produces eggs

_____ 3. opening that is used to excrete wastes as well as lay eggs

_____ 4. a tubular passageway through which the embryo or fetus leaves the mother's body during birth

_____ 5. a pouch-like, muscular organ where the fetus develops

_____ 6. mammals that reproduce by laying eggs

_____ 7. a therian mammal in which the embryo is born at an early, immature stage

_____ 8. therian mammals in which a placenta develops during pregnancy

_____ 9. sustains the fetus while it grows inside the mother's uterus

Terms

a. cloaca

b. marsupial

c. monotreme

d. ovary

e. placenta

f. placental mammal

g. therian mammal

h. uterus

i. vagina

Lesson 20.2: Vocabulary II

Name_____ Class_____ Date_____

Fill in the blank with the appropriate term.

1. Therian mammals are divided into two groups: _____ mammals and marsupial mammals.
2. A placenta sustains the _____ while it grows inside the mother's uterus.
3. The placenta passes _____, nutrients, and other useful substances from the mother to the fetus.
4. A _____ is a therian mammal in which the embryo is born at an early, immature stage.
5. _____ are mammals that reproduce by laying eggs.
6. The only living monotreme species are the _____ and echidnas.
7. Female monotremes have a _____ with only one opening.
8. The _____ embryo is nourished inside the uterus with food from a yolk sac.
9. _____ mammals give birth to relatively large and mature infants.
10. Female therian mammals have an _____ where the embryo or fetus develops.

11. All female mammals have ovaries, the organs that produce _____.

12. _____ are born either as relatively large, well-developed fetuses or as tiny, immature embryos.

Lesson 20.2: Critical Writing

Name_____ Class_____ Date_____

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Explain how marsupials reproduce.

20.3 Evolution and Classification of Mammals

Lesson 20.3: True or False

Name_____ Class_____ Date_____

Write true if the statement is true or false if the statement is false.

_____ 1. Ancestors of mammals evolved close to 30 million years ago.

_____ 2. The positioning of legs under the body instead of along the sides was an early adaptation in mammal evolution.

_____ 3. The ability to regulate body temperature would allow nocturnal animals to remain active at night.

_____ 4. A good sense of vision would be more useful than good hearing when hunting in the dark.

_____ 5. Cynodonts were early ancestors to mammals, and were about the size of a rat.

_____ 6. Of all the mammals, placental mammals were probably the first to evolve.

_____ 7. Unlike modern monotremes, early monotremes did not lay eggs.

_____ 8. The earliest placental mammals were tree climbers and probably ate insects and worms.

_____ 9. Dinosaurs went extinct 65 million years ago.

_____ 10. To this day, marsupials remain the most common and diverse mammals found only in Africa.

_____ 11. The extinction of the dinosaurs allowed mammals to flourish.

_____ 12. The most widely accepted classification of mammals divides living placental mammals into 17 families.

_____ 13. Whales are mammals, but seals are not.

_____ 14. Humans and rats are grouped into the same superorder.

_____ 15. Though not mammals, cynodonts evolved many mammalian traits.

Lesson 20.3: Critical Reading

Name_____ Class_____ Date_____

Read these passages from the text and answer the questions that follow.

Evolution of Early Mammals

The earliest mammals evolved from cynodonts. But the evolution of mammals didn't end there. Mammals continued to evolve. Monotreme mammals probably split off from other mammals first. They were followed by marsupials. Placental mammals probably evolved last.

Evolution of Monotremes

The first monotremes may have evolved about 150 million years ago. Early monotreme fossils have been found in Australia. An example is a genus called *Steropodon*. It may have been the ancestor of the platypus. Early

monotremes retained some of the traits of their therapsid ancestors. For example, they laid eggs and had a cloaca. These traits are still found in modern monotremes.

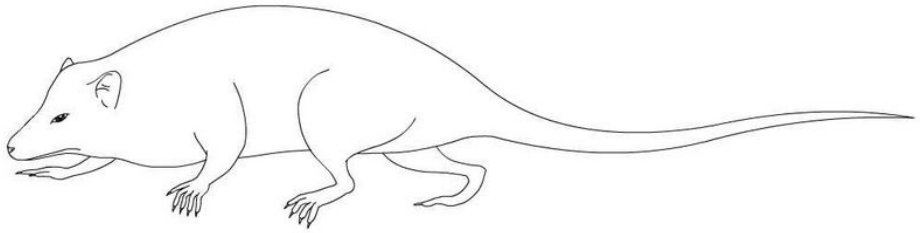
Evolution of Marsupials

The first marsupials may have evolved about 130 million years ago. One of the earliest was the extinct genus *Sinodelphys*. A fossil of this mammal is shown in the FlexBook. It is a remarkable fossil find. It represents a nearly complete animal. Even tufts of hair and imprints of soft tissues were preserved.

Sinodelphys was about 15 centimeters (6 inches) long. Its limb structure suggests that it was a climbing animal. It could escape from predators by climbing into trees. It probably lived on a diet of insects and worms.

Evolution of Placental Mammals

The earliest placental mammals may have evolved about 110 million years ago. The ancestor of placental mammals may be the extinct genus *Eomaia*. Fossils of *Eomaia* have been found in what is now China. It was only about 10 centimeters (4 inches) long. It was a tree climber and probably ate insects and worms. *Eomaia* had several traits of placental mammals. The illustration below shows how *Eomaia* may have looked.



Probable Ancestor of Placental Mammals: Eomaia. Eomaia lived a little over 100 million years ago. *(Image courtesy of Mateus Zica and under the Creative Commons license CC-BY-SA 3.0.)*

The placental mammal descendants of *Eomaia* were generally more successful than marsupials and monotremes. On most continents, placental mammals became the dominant mammals, while marsupials and monotremes died out. Marsupials remained the most common and diverse mammals only in Australia. The debate over the reasons for their success there is not yet resolved.

Questions

1. Describe an early monotreme mammal.

2. Describe an early marsupial mammal.

3. Describe an early placental mammal.

4. What is the order of evolution of the three types of mammals? How long ago did they evolve?

5. Which type of mammals became the most successful?

Lesson 20.3: Multiple Choice

Name_____ Class_____ Date_____

Circle the letter of the correct choice.

a. When did the earliest mammal live?
    a. over 150 million years ago
    b. 150 million years ago
    c. 130 million years ago
    d. 110 million years ago

b. Pelycosaurs
    a. had sprawling legs and walked like a lizard.
    b. had teeth of different types.
    c. was a synapsid.
    d. all of the above

c. Therapsids
    a. had a good sense of hearing.
    b. had the ability to regulate their body temperature.
    c. had legs positioned under the body instead of along the sides.
    d. all of the above

d. By the end of the Triassic Period, cynodonts had
    a. three tiny bones in the middle ear.
    b. ectothermy.
    c. a diaphragm for eating.
    d. all of the above.

e. Place the following in their correct evolutionary order.
    a. marsupials - placental mammals - monotremes
    b. monotremes - marsupials - placental mammals
    c. marsupials - monotremes - placental mammals
    d. placental mammals - marsupials - monotremes

f. The most widely accepted traditional classification of mammals divides living placental mammals into ____-_____ orders.
    a. 7
    b. 12
    c. 17
    d. 22

g. Traits of primates include
    a. five digits on their hands and feet.
    b. rubbery pads on their feet.
    c. long, pointed canine teeth.
    d. all of the above.

h. The most successful mammals are the
    a. marsupials, who practically have a whole continent to themselves.
    b. monotremes, who have a very specific niche without competitors.
    c. placental mammals, who have become dominant on most continents.
    d. none of the above

Lesson 20.3: Vocabulary I

Name_____ **Class**_____ **Date**_____

Match the vocabulary word with the proper definition.

Definitions

_____ 1. active at night

_____ 2. may be the ancestor of the platypus

_____ 3. one of the earliest marsupials

_____ 4. amniotic ancestors of mammals

_____ 5. have long pointed canine teeth, like the coyote

_____ 6. have small sharp teeth, like the mole

_____ 7. have feet with fins, like the seal

_____ 8. have five digits on hands and feet, like the monkey

_____ 9. have incisor teeth grow continuously, like the mouse

_____ 10. have tusks, like the elephant

_____ 11. the most common land vertebrates during the first half of the Permian Period

_____ 12. the ancestor of placental mammals

_____ 13. became the most common and diverse land vertebrates during the second half of the Permian Period

_____ 14. flourished worldwide during the first half of the Triassic Period

Terms

a. Carnivora

b. cynodonts

c. *Eomaia*

d. Insectivora

e. nocturnal

f. pelycosaurs

g. Pinnipedia

h. Primates

i. Proboscidea

j. Rodentia

k. *Sinodelphys*

l. *Steropodon*

m. synapsids

n. therapsid

Lesson 20.3: Vocabulary II

Name_____ **Class**_____ **Date**_____

Fill in the blank with the appropriate term.

1. Ancestors of mammals evolved close to _____ million years ago.
2. Ancestors of mammals were amniotes called _____ .
3. Pelycosaurs evolved some mammalian traits, including _____ of different types.
4. Therapsids evolved _____ positioned under the body instead of along the sides.
5. A nocturnal niche was one of the few niches that _____ did not take over in the Triassic Period.
6. _____ had the ability to regulate their body temperature.
7. Cynodonts probably gave rise to mammals about _____ million years ago.
8. Placental mammals can be divided into _____ orders.
9. Carnivora, like the coyote, have long pointed canine _____.
10. Chiroptera, like the bat, have digits support membranous _____.
11. Perissodactyla, like the horse, have odd-toed _____.
12. Cetacea, like the whale, have paddlelike _____.

Lesson 20.3: Critical Writing

Name_____ Class_____ Date_____

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Summarize the evolution of modern mammals.

20.4 Overview of Animal Behavior

Lesson 20.4: True or False

Name_____ Class_____ Date_____

Write true if the statement is true or false if the statement is false.

_____ 1. The branch of biology that studies animal behavior is called psychology.

_____ 2. Some behaviors are controlled by genes.

_____ 3. Hunting in packs is an adaptive behavior because it increases the chances of killing prey and obtaining food.

_____ 4. A spider spinning a web is a learned behavior.

_____ 5. Innate behaviors must be practiced to be learned.

_____ 6. Innate behaviors involve basic life functions, such as finding food.

_____ 7. A society forms from all the different species that live together.

_____ 8. Animals can communicate with sounds, chemicals, or visual cues.

_____ 9. Social animals live and work together for the good of the group.

_____ 10. Ants communicate with sounds while frogs communicate with chemicals.

_____ 11. Circadian rhythms are regular changes in biology or behavior that occur in a daytime-nighttime cycle.

_____ 12. Aggression is behavior that is intended to cause harm or pain.

_____ 13. Two male deer competing for mates is an example of interspecific competition.

_____ 14. In most species of mammals, parents provide little care to their offspring.

_____ 15. In many mammals, females are more selective than males in choosing mates.

Lesson 20.4: Critical Reading

Name_____ Class_____ Date_____

Read these passages from the text and answer the questions that follow.

Evolution of Animal Behavior

To the extent that behaviors are controlled by genes, they may evolve through natural selection. If behaviors increase fitness, they are likely to become more common over time. If they decrease fitness, they are likely to become less common.

Nature vs. Nurture

Some behaviors seem to be controlled solely by genes. Others appear to be due to experiences in a given environment. Whether behaviors are controlled mainly by genes or by the environment is often a matter of debate. This is

called the **nature-nurture debate**. Nature refers to the genes an animal inherits. Nurture refers to the environment that the animal experiences. In reality, most animal behaviors are not controlled by nature or nurture alone. Instead, they are influenced by both nature and nurture. In dogs, for example, the tendency to behave toward other dogs in a certain way is probably controlled by genes. However, the normal behaviors can't develop in an environment that lacks other dogs. A puppy raised in isolation from other dogs may never develop the normal behaviors. It may always fear other dogs or act aggressively toward them.

How Behaviors Evolve

It's easy to see how many common types of behavior evolve. That's because they obviously increase the fitness of the animal performing them. For example, when wolves hunt together in a pack, they are more likely to catch prey (see the figure below). Therefore, hunting with others increases a wolf's fitness. The wolf is more likely to survive and pass its genes to the next generation by behaving this way.

(Image courtesy of Doug Smith and the U.S. National Park Service and under the public domain.)

The evolution of certain other types of behavior is not as easy to explain. An example is a squirrel chattering loudly to warn other squirrels that a predator is near. This is likely to help the other squirrels avoid the predator. Therefore, it could increase their fitness. But what about the squirrel that raises the alarm? This squirrel is more likely to be noticed by the predator. Therefore, the behavior may actually lower this squirrel's fitness. How could such a behavior evolve through natural selection?

One possible answer is that helping others often means helping close relatives. Close relatives share many of the same genes that they inherited from their common ancestor. As a result, helping a close relative may actually increase the chances that copies of one's own genes will be passed to the next generation. In this way, a behavior that puts oneself at risk could actually increase through natural selection. This form of natural selection is called kin selection.

Questions

1. Is behavior controlled by genes? If a behavior is controlled by a gene, does that behavior evolve?

2. What is the nature-nurture debate?

3. How do many common types of behavior evolve in animals? Give an example.

4. “Helping others often means helping close relatives.” What does this statement refer to?

5. What is “kin selection”?

Lesson 20.4: Multiple Choice

Name_____ Class_____ Date_____

Circle the letter of the correct choice.

a. Examples of animal behaviors include
   a. a spider spinning its web.
   b. children playing.
   c. animals hunting.
   d. all of the above.

b. The branch of biology that studies animal behavior is
   a. veterinary biology.
   b. ethology.
   c. psychology.
   d. behaviology.

c. Behaviors that are closely controlled by genes with little or no environmental influence are
   a. innate behaviors.
   b. instinct behaviors.
   c. learning behaviors.
   d. cooperation behaviors.

d. The nature-nurture debate is a discussion of
   a. the effects of nature on behavior.
   b. the effects of one's parents on their behavior.
   c. whether behaviors are controlled mainly by genes or by the environment.
   d. the effects of the constant struggle between nature and the environment.

e. A reflex is a
   a. response that always occurs when a certain instinct is present.
   b. response that always occurs when a certain stimulus is present.
   c. response that always occurs when a certain behavior is present.
   d. response that always occurs when a certain learning is present.

f. Social animals
   a. must have a way to communicate.
   b. cooperate together for the good of the group.
   c. can do many things that a lone animal could never do.
   d. all of the above

g. Circadian rhythms
   a. are regular changes in biology that occur in a 24-hour cycle.
   b. are seasonal movements of animals.
   c. refers to the union of a male and female of the same species for reproduction.
   d. is a rhythm that develops as a result of learned experience.

h. Aggression
   a. is a learned behavior.
   b. is based on one's circadian rhythms.
   c. is intended to cause harm or pain.
   d. all of the above

Lesson 20.4: Vocabulary I

Name_____ **Class**_____ **Date**_____

Match the vocabulary word with the proper definition.

Definitions

_____ 1. branch of biology that studies animal behavior

_____ 2. whether behaviors are controlled mainly by genes or by the environment

_____ 3. something that triggers behavior

_____ 4. are regular changes in biology or behavior that occur in a 24-hour cycle

_____ 5. a close-knit group with other members of their species

_____ 6. a change in behavior that occurs as a result of experience

_____ 7. the ability of an animal to perform a behavior the first time it is exposed to the proper stimulus

_____ 8. behaviors that are closely controlled by genes

_____ 9. allows animals to do many things that a lone animal could never do

_____ 10. a response that always occurs when a certain stimulus is present

_____ 11. behavior that is intended to cause harm or pain

_____ 12. animals that live in a society

Terms

a. aggression

b. circadian rhythm

c. cooperation

d. ethology

e. innate behavior

f. instinct

g. learning

h. nature-nurture debate

i. reflex

j. social animal

k. society

l. stimulus

Lesson 20.4: Vocabulary II

Name_____ **Class**_____ **Date**_____

Fill in the blank with the appropriate term.

1. Animal _____ includes all the ways that animals interact with each other and the environment.

2. _____ the branch of biology that studies animal behavior,
3. _____ behaviors are closely controlled by genes with little or no environmental influence.
4. A dog drooling when exposed to food is an _____.
5. _____ is a change in behavior that occurs as a result of experience.
6. A reflex is a response that always occurs when a certain _____ is present.
7. _____ animals live together in a society.
8. _____ rhythms are regular changes in biology or behavior that occur in a 24-hour cycle.
9. Animals can _____ with sounds, chemicals, or visual cues.
10. _____ is behavior that is intended to cause harm or pain.
11. Parental care is generally longest and most involved in _____.
12. _____ refers to seasonal movements of animals from one area to another.

Lesson 20.4: Critical Writing

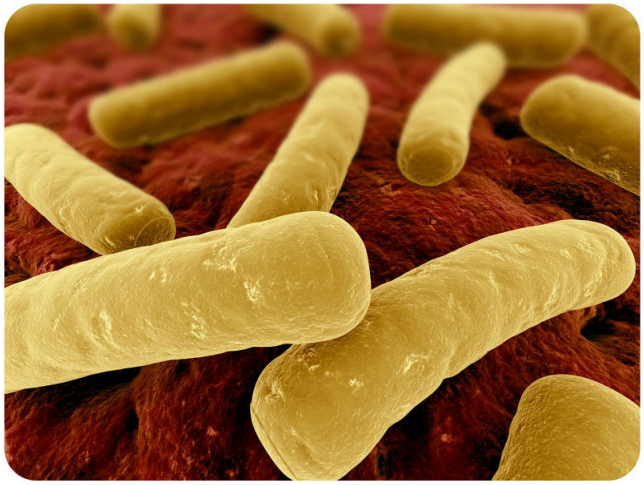
Name_____ **Class**_____ **Date**_____

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Define innate behavior. Give an example.

CHAPTER 21 Introduction to the Human Body: Bones, Muscles, and Skin Worksheets

Chapter Outline



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- **Lesson 21.1: Organization of the Human Body**
- **Lesson 21.2: The Skeletal System**
- **Lesson 21.3: The Muscular System**
- **Lesson 21.4: The Integumentary System**

21.1 Organization of the Human Body

Lesson 21.1: True or False

Name_____ Class_____ Date_____

Write true if the statement is true or false if the statement is false.

_____ 1. Cells are the basic units of structure and function in the human body.

_____ 2. The human body consists of four tissue types.

_____ 3. Bone is an example of epithelial tissue.

_____ 4. Epithelial tissue is made up of cells that only line outer body surfaces.

_____ 5. Muscles attached to bones enable the body to move.

_____6. Neurons carry electrical messages.

_____ 7. After tissues, organs are the next level of organization of the human body.

_____ 8. An organ is a structure that consists of only two types of tissues that work together to do the same job.

_____ 9. The digestive system breaks down food and absorbs its nutrients.

_____ 10. The endocrine system removes excess fluid from tissues and transports substances.

_____ 11. All of the organs and organ systems of the human body work together like a well-oiled machine.

_____ 12. The nervous system controls virtually all body activities.

_____ 13. Keeping a stable internal environment does not require constant adjustments.

_____ 14. A low concentration of carbon dioxide in the blood triggers faster breathing.

_____ 15. A low level of water in the blood triggers retention of water by the kidneys.

Lesson 21.1: Critical Reading

Name_____ Class_____ Date_____

Read these passages from the text and answer the questions that follow.

Maintaining Homeostasis

The process in which organ systems work to maintain a stable internal environment is called homeostasis. Keeping a stable internal environment requires constant adjustments. Here are just three of the many ways that human organ systems help the body maintain homeostasis:

- Respiratory system: A high concentration of carbon dioxide in the blood triggers faster breathing. The lungs exhale more frequently, which removes carbon dioxide from the body more quickly.
- Excretory system: A low level of water in the blood triggers retention of water by the kidneys. The kidneys produce more concentrated urine, so less water is lost from the body.

- Endocrine system: A high concentration of sugar in the blood triggers secretion of insulin by an endocrine gland called the pancreas. Insulin is a hormone that helps cells absorb sugar from the blood.

Failure of Homeostasis

Many homeostatic mechanisms such as these work continuously to maintain stable conditions in the human body. Sometimes, however, the mechanisms fail. When they do, cells may not get everything they need, or toxic wastes may accumulate in the body. If homeostasis is not restored, the imbalance may lead to disease or even death.

Questions

1. What is homeostasis?

2. What is the result of the lungs exhaling more frequently?

3. What is the result of a more concentrated urine?

4. What is the function of insulin?

5. If there is a failure of homeostasis and homeostasis is not restored, what may happen?

Lesson 21.1: Multiple Choice

Name_____ Class_____ Date_____

Circle the letter of the correct choice.

a. Approximately how many cells does the average person reaching adulthood have?
   a. 100 thousand
   b. 100 million
   c. 100 billion
   d. 100 trillion

b. Cartilage is an example of which of the following tissues?
   a. connective tissue
   b. epithelial tissue
   c. muscle tissue
   d. none of the above

c. The lymphatic system removes which of the following from tissues?
   a. excess gases
   b. excess fluids
   c. excess solids
   d. none of the above

d. All of the organs and organ systems of the human body work well together because they are closely regulated by which of the following systems?
   a. lymphatic and nervous
   b. endocrine and muscular
   c. nervous and endocrine
   d. circulatory and lymphatic

e. Which of the following systems secretes hormones?
   a. nervous
   b. endocrine
   c. circulatory
   d. respiratory

f. Which of the following systems produces gametes?
   a. reproductive
   b. endocrine

c. circulatory
d. nervous

g. Insulin is secreted by an endocrine gland called the

a. thyroid.
b. pineal body.
c. pancreas.
d. gall bladder.

h. The correct order of levels of organization is

a. cell → organ → tissue → organism.
b. cell → tissue → organ → organ system.
c. organelle → cell → organ → organ system.
d. atom → cell → organ → tissue.

i. Which of the following statements is true concerning maintaining homeostasis? (1) Homeostasis is maintained through the interactions of a number of organ systems. (2) Not maintaining homeostasis can lead to death. (3) A high concentration of carbon dioxide in the blood triggers faster breathing to remove the oxygen. (4) A high level of water in the blood triggers retention of water by the kidneys.

a. 1 only
b. 1 and 2
c. 3 and 4
d. All four statements are correct.

Lesson 21.1: Vocabulary I

Name_____ **Class**_____ **Date**_____

Match the vocabulary word with the proper definition.

Definitions

_____ 1. a structure that consists of two or more types of tissues that work together to do the same job

_____ 2. made up of neurons, or nerve cells, that carry electrical messages

_____ 3. made up of cells that form the body's structure

_____ 4. a group of connected cells that have a similar function

_____ 5. takes in oxygen and releases waste gases

_____ 6. made up of cells that line body surfaces

_____ 7. secretes hormones that regulate other organs and organ systems

_____ 8. basic units of structure and function in the human body

_____ 9. a hormone that helps cells absorb sugar from the blood

_____ 10. process in which organ systems work to maintain a stable internal environment

_____ 11. made up of cells that have the unique ability to contract, or become shorter

_____ 12. a group of organs that work together to carry out a complex overall function

Terms

a. cells

b. connective tissue

c. endocrine system

d. epithelial tissue

e. homeostasis

f. insulin

g. muscle tissue

h. nervous tissue

i. organ

j. organ system

k. respiratory system

l. tissue

Lesson 21.1: Vocabulary II

Name_____ **Class**_____ **Date**_____

Fill in the blank with the appropriate term.

1. The human machine is organized at different levels, starting with the cell and ending with the entire _____-_____.
2. At each higher level of organization, there is a greater degree of _____.
3. Many human cells are specialized in form and _____.
4. Muscle cells have many _____ that provide the energy they need to move the body.
5. After the cell, the _____ is the next level of organization in the human body.
6. _____ tissue protects the body and its internal organs.
7. Epithelial tissue secretes substances such as _____.
8. Nervous tissue makes up the brain and the _____ that connect the brain to all parts of the body.
9. Human organs are organized into organ _____.
10. The _____ system takes in oxygen and releases waste gases.
11. The skeletal system provides _____ to the body and protects internal organs.
12. Functioning together, the organ systems keep _____, pH, and other conditions at just the right levels to support life processes.

Lesson 21.1: Critical Writing

Name_____ **Class**_____ **Date**_____

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Describe the four types of tissues and give an example of each.

21.2 The Skeletal System

Lesson 21.2: True or False

Name_____ Class_____ Date_____

Write true if the statement is true or false if the statement is false.

_____ 1. Cartilage is a type of dense connective tissue.

_____ 2. One of the functions of the skeleton is to produce blood cells.

_____ 3. When blood levels of minerals are too high, bones release some of the minerals back into the blood.

_____ 4. The basic structure of bones is bone matrix.

_____ 5. There are three types of specialized cells in human bones.

_____ 6. Osteoclasts make new bone cells.

_____ 7. Bones are dynamic, living tissues.

_____ 8. Compact bone makes up the dense outer layer of bone.

_____ 9. Periosteum is soft connective tissue.

_____ 10. Early in the development of a human fetus, the skeleton is made entirely of bone.

_____ 11. A joint is a place where two or more bones of the skeleton meet.

_____ 12. There are four main types of joints.

_____ 13. Immovable joints are also known as synovial joints.

_____ 14. Of all the movable joints, a ball-and-socket joint has the greatest range of motion.

_____ 15. Despite their hardness and strength, bones can suffer from injury and disease.

Lesson 21.2: Critical Reading

Name_____ Class_____ Date_____

Read these passages from the text and answer the questions that follow.

Types of Joints

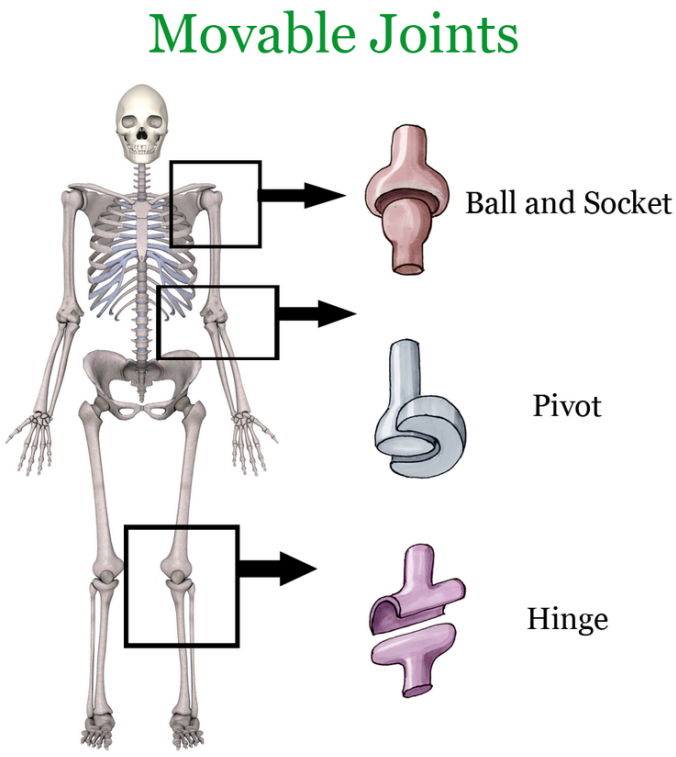
There are three main types of joints: immovable, partly movable, and movable.

- Immovable joints allow no movement because the bones at these joints are held securely together by dense collagen. The bones of the skull are connected by immovable joints.
- Partly movable joints allow only very limited movement. Bones at these joints are held in place by cartilage. The ribs and sternum are connected by partly movable joints.
- Movable joints allow the most movement. Bones at these joints are connected by ligaments. Movable joints are the most common type of joints in the body, so they are described in more detail next.

Movable Joints

Movable joints are also known as synovial joints. This is because the space between the bones is filled with a thick fluid called synovial fluid that cushions the joint.

There are a variety of types of movable joints, which are illustrated below. The joints are classified by how they move. For example, a ball-and-socket joint, such as the shoulder, has the greatest range of motion, allowing movement in several directions. Other movable joints, including hinge joints such as the knee, allow less movement.



Types of Movable Joints in the Human Skeleton. Movable joints can move in a variety of ways. Try moving each of the joints indicated in the diagram. Can you tell how their movements differ? Other joints in the human skeleton that are not depicted here include saddle, elipsoid, and plane joints. *(Skeleton image copyright 3drenderings, 2010, used under license from Shutterstock.com. Joints images courtesy of Produnis and under GNU-FDL 1.2. Composite created by CK-12 Foundation.)*

Questions

1. What are the differences among the three main types of joints?

2. What is the function of synovial fluid?

3. Name three types of movable joints.

4. What are other joints in the human skeleton not depicted in the figure?

5. Try moving each of the joints indicated in the diagram. Can you tell how their movements differ?

Lesson 21.2: Multiple Choice

Name_____ **Class**_____ **Date**_____

Circle the letter of the correct choice.

a. How many bones does the human skeleton consist of?
    a. 203
    b. 206
    c. 216
    d. 235

b. Bone matrix consists of tough fibers made of
    a. carbohydrate.
    b. fat.
    c. protein.
    d. none of the above.

c. Osteoblasts secrete
    a. calcium.
    b. water.
    c. hormones.
    d. collagen.

d. Which of the following makes up the dense outer layer of bone?
    a. compact bone
    b. spongy bone
    c. bone marrow
    d. periosteum

e. Which of the following produces blood cells?
    a. compact bone
    b. spongy bone
    c. bone marrow
    d. periosteum

f. A person reaches skeletal maturity
    a. in the early teens.
    b. in the late teens or early twenties.
    c. in the mid twenties.
    d. in the late twenties or early thirties.

g. The main difference between osteoblasts and osteoclasts is that
    a. osteoblasts make new bone cells and osteoclasts dissolve bone material.
    b. osteoclasts make new bone cells and osteoblasts dissolve bone material.
    c. osteoblasts make new bone from cartilage and osteoclasts make cartilage from bone.
    d. osteoblasts make new bone cells and osteoclasts regulate bone mineral homeostasis.

h. The ribs and sternum are connected by
    a. immovable joints.
    b. partly moveable joints.
    c. movable joints.
    d. none of the above.

Lesson 21.2: Vocabulary I

Name_____ **Class**_____ **Date**_____

Match the vocabulary word with the proper definition.

Definitions

_____ 1. process in which mineral deposits replace cartilage and change it into bone

_____ 2. type of bone cell that regulates mineral homeostasis by directing the uptake of minerals from the blood and the release of minerals back into the blood as needed

_____ 3. band of fibrous connective tissue that holds bones together

_____ 4. soft connective tissue in spongy bone that produces blood cells

_____ 5. dense outer layer of bone that is very hard and strong

_____ 6. type of bone cell that dissolves minerals in bone and releases them back into the blood

_____ 7. place where two or more bones of the skeleton meet

_____ 8. rigid framework of bone that consists of tough protein fibers and mineral crystals

_____ 9. light, porous inner layer of bone that contains bone marrow

_____ 10. human body system that consists of all the bones of the body as well as cartilage and ligaments

_____ 11. type of bone cell that makes new bone cells and secretes collagen

_____ 12. tough, fibrous membrane that covers the outer surface of bone

Terms

a. bone marrow

b. bone matrix

c. compact bone

d. joint

e. ligament

f. ossification

g. osteoblast

h. osteoclast

i. osteocyte

j. periosteum

k. skeletal system

l. spongy bone

Lesson 21.2: Vocabulary II

Name_____ **Class**_____ **Date**_____

Fill in the blank with the appropriate term.

1. Cartilage is a type of dense _____ tissue.

2. The skeleton provides attachment surfaces for _____.

3. The skeleton maintains _____ homeostasis.

4. When mineral levels in the blood are too high, bones absorb some of the minerals and store them as mineral _____.

5. Bone matrix is crisscrossed by blood vessels and _____.

6. Osteoclasts dissolve minerals in bone _____.

7. Bone marrow is found inside the pores of _____ bone.

8. Early in the development of a human fetus, the skeleton is made entirely of _____.

9. By birth, several areas of cartilage remain in the skeleton, including the ends of the _____ bones.

10. With the help of muscles, joints work like mechanical _____.

11. The surfaces of bones at joints are covered with a smooth layer of cartilage that reduces _____-_ at the points of contact between the bones.

12. Immovable joints allow no movement because the bones at these joints are held securely together by dense _____.

Lesson 21.2: Critical Writing

Name_____ Class_____ Date_____

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Describe the three types of bone problems.

21.3 The Muscular System

Lesson 21.3: True or False

Name_____ **Class**_____ **Date**_____

Write true if the statement is true or false if the statement is false.

_____ 1. Muscles are organs composed mainly of muscle cells.

_____ 2. Each muscle fiber is a very short, thin cell.

_____ 3. There are four types of muscle tissues in the human body.

_____ 4. Both skeletal and cardiac muscles appear striated, or striped.

_____ 5. Contractions of smooth muscle are voluntary.

_____ 6. Skeletal muscle is the most common type of muscle in the human body.

_____ 7. Cardiac muscle contains a great many mitochondria.

_____ 8. There are well over 600 skeletal muscles in the human body.

_____ 9. Each skeletal muscle consists of 125 skeletal muscle fibers.

_____ 10. Muscles can contract, actively extend, and lengthen.

_____ 11. In exercises such as weight lifting, skeletal muscle contracts against a resisting force.

_____ 12. Continued exercise is necessary to maintain bigger, stronger muscles.

_____ 13. Each muscle fiber contains hundreds of organelles called myofibrils.

_____ 14. The region between two Z lines is called a sarcomere.

_____ 15. Voluntary contractions of cardiac and smooth muscles are also controlled by nerves.

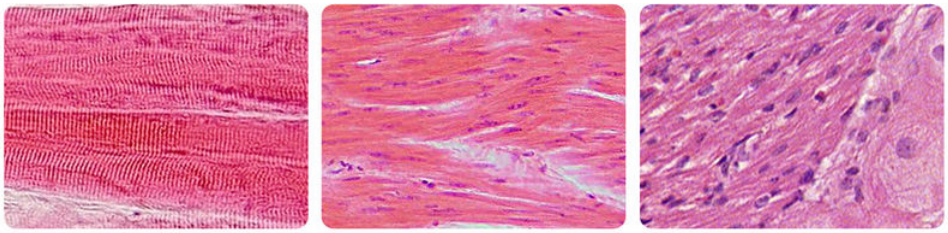
Lesson 21.3: Critical Reading

Name_____ **Class**_____ **Date**_____

Read these passages from the text and answer the questions that follow.

What Are Muscles?

Muscles are organs composed mainly of muscle cells, which are also called **muscle fibers**. Each muscle fiber is a very long, thin cell that can do something no other cell can do. It can contract, or shorten. Muscle contractions are responsible for virtually all the movements of the body, both inside and out. There are three types of muscle tissues in the human body: cardiac, smooth, and skeletal muscle tissues. They are shown and described below.



Types of Muscle Tissue. Both skeletal and cardiac muscles appear striated, or striped, because their cells are arranged in bundles. Smooth muscles are not striated because their cells are arranged in sheets instead of bundles. *(From left to right, images courtesy of the Department of Histology at Jagiellonian University Medical College, Polarlys, and Nathanael Reveal (Nathanael). All images under GNU-FDL 1.2.)*

Smooth Muscle

Muscle tissue in the walls of internal organs such as the stomach and intestines is **smooth muscle**. When smooth muscle contracts, it helps the organs carry out their functions. For example, when smooth muscle in the stomach contracts, it squeezes the food inside the stomach, which helps break the food into smaller pieces. Contractions of smooth muscle are involuntary. This means they are not under conscious control.

Skeletal Muscle

Muscle tissue that is attached to bone is **skeletal muscle**. Whether you are blinking your eyes or running a marathon, you are using skeletal muscle. Contractions of skeletal muscle are voluntary, or under conscious control. Skeletal muscle is the most common type of muscle in the human body, so it is described in more detail below.

Cardiac Muscle

Cardiac muscle is found only in the walls of the heart. When cardiac muscle contracts, the heart beats and pumps blood. Cardiac muscle contains a great many mitochondria, which produce ATP for energy. This helps the heart resist fatigue. Contractions of cardiac muscle are involuntary, like those of smooth muscle.

Questions

1. Describe what a muscle fiber looks like and what it can do.

2. What are the three types of muscle tissues in the human body and where are they located?

3. Explain how cell arrangement causes a muscle to appear either striated or not striated.

4. For each type of muscle tissue, list whether it is voluntary or involuntary.

5. Why is it important for cardiac muscle to have many mitochondria?

Lesson 21.3: Multiple Choice

Name_____ Class_____ Date_____

Circle the letter of the correct choice.

a. Smooth muscle is found in the
   a. heart.
   b. stomach.
   c. upper leg.
   d. middle ear.

b. Skeletal muscle fibers are wrapped in
   a. fat.
   b. bone.
   c. connective tissue.

d. none of the above.

c. Skeletal muscles need a rich blood supply to provide them with

a. oxygen.
b. carbon dioxide.
c. water.
d. none of the above.

d. The biceps and triceps muscles are located in the

a. lower arm.
b. upper arm.
c. knee.
d. stomach.

e. Each myofibril is made up of how many types of protein filaments?

a. one
b. two
c. three
d. four

f. Actin filaments are anchored to structures called

a. W lines.
b. X lines.
c. Y lines.
d. Z lines.

g. Muscles need a stimulus from which of the following to "tell" them to contract?

a. a muscle cell
b. the skeleton
c. a nerve cell
d. none of the above

h. Two main proteins found in muscle are

a. smooth and skeletal.
b. tendons and ligaments.
c. actin and myosin.
d. myofibrils and fibers.

Lesson 21.3: Vocabulary I

Name_____ Class_____ Date_____

Match the vocabulary word with the proper definition.

Definitions

_____ 1. muscle tissue that is attached to bone

_____ 2. long, thin muscle cell that has the ability to contract, or shorten

_____ 3. theory that explains muscle contraction by the sliding of myosin filaments over actin filaments within muscle fibers

_____ 4. tough connective tissue that attaches skeletal muscle to bones of the skeleton

_____ 5. human body system that includes all the muscles of the body

_____ 6. organs composed mainly of muscle cells

_____ 7. the region between two Z lines

_____ 8. involuntary, nonstriated muscle that is found in the walls of internal organs such as the stomach

_____ 9. organelles contained within each muscle fiber

_____ 10. involuntary, striated muscle found only in the walls of the heart

_____ 11. tiny structures within the myosin filaments, that can attach to actin filaments

Terms

a. cardiac muscle

b. cross bridges

c. muscle fiber

d. muscles

e. muscular system

f. myofibril

g. sarcomere

h. skeletal muscle

i. sliding filament theory

j. smooth muscle

k. tendon

Lesson 21.3: Vocabulary II

Name_____ **Class**_____ **Date**_____

Fill in the blank with the appropriate term.

1. Both skeletal and _____ muscles appear striated.

2. Muscle tissue that is attached to _____ is skeletal muscle.

3. Contractions of skeletal muscle are voluntary, or under _____ control

4. Cardiac muscle contains a great many mitochondria, which produce _____ for energy.

5. Skeletal muscles need a rich blood supply to provide them with _____ and oxygen and to carry away their wastes.

6. Many skeletal muscles are attached to the ends of bones that meet at a _____.

7. Muscles can only contract and cannot actively _____.

8. To move bones in opposite directions, pairs of _____ must work in opposition.

9. In exercises such as weight lifting, skeletal muscle contracts against a _____ force.

10. If you don't use a muscle, it will get smaller and weaker—so use it or _____ it.

11. Muscle contraction occurs when muscle fibers get _____.

12. Within a sarcomere, myosin filaments _____ the actin filaments.

Lesson 21.3: Critical Writing

Name_____ Class_____ Date_____

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Describe the Sliding Filament Theory.

21.4 The Integumentary System

Lesson 21.4: True or False

Name_____ Class_____ Date_____

Write true if the statement is true or false if the statement is false.

_____ 1. The skin is the major organ of the integumentary system.

_____ 2. The average square inch of skin has 65 sweat glands.

_____ 3. The average square inch of skin has 60,000 pigment-producing cells.

_____ 4. The skin consists of two distinct layers.

_____ 5. There are no nerve endings or blood vessels in the epidermis.

_____ 6. Melanin is a yellow pigment.

_____ 7. UV light decreases melanin output.

_____ 8. The dermis is made of tough connective tissue.

_____ 9. Sebum increases the growth of microorganisms on the skin.

_____ 10. The skin helps regulate body temperature.

_____ 11. One common problem of the skin is acne.

_____ 12. Acne is caused by a virus.

_____ 13. Skin cancer is caused mainly by excessive exposure to UV light.

_____ 14. People with lighter skin are at greater risk of developing skin cancer.

_____ 15. Skin cancers are generally symmetrical.

Lesson 21.4: Critical Reading

Name_____ Class_____ Date_____

Read these passages from the text and answer the questions that follow.

Functions of the Skin

The skin has multiple roles in the body. Many of these roles are related to homeostasis. The skin's main functions are preventing water loss from the body and serving as a barrier to the entry of microorganisms. In addition, melanin in the skin blocks UV light and protects deeper layers from its damaging effects.

The skin also helps regulate body temperature. When the body is too warm, sweat is released by the sweat glands and spreads over the skin surface. As the sweat evaporates, it cools the body. Blood vessels in the skin also dilate, or widen, when the body is too warm. This allows more blood to flow through the skin, bringing body heat to the surface, where it radiates into the environment. When the body is too cool, sweat glands stop producing sweat, and blood vessels in the skin constrict, or narrow, thus conserving body heat.

Questions

1. What are the skin's two main functions?

2. What is the function of melanin in the skin?

3. How does sweat regulate body temperature when the body is too warm?

4. How do blood vessels in the skin regulate body temperature when the body is too cool?

Lesson 21.4: Multiple Choice

Name_____ **Class**_____ **Date**_____

Circle the letter of the correct choice.

a. The average square inch (6.5 cm^2) of skin has how many blood vessels?
    a. 10
    b. 20
    c. 30
    d. 40

b. Exposure to UV light stimulates the skin to produce which vitamin?
    a. A
    b. B
    c. C
    d. D

c. Melanin in the skin blocks
    a. water.
    b. incadescent light.
    c. UV light.
    d. oxygen.

d. Acne affects approximately what percent of teens?
    a. 30
    b. 55
    c. 75
    d. 85

e. Skin cancers
    a. are generally asymmetrical.
    b. have irregular borders.
    c. may be very dark in color.
    d. all of the above

f. The main component of hair is
    a. keratin.
    b. hemoglobin.
    c. myoglobin.
    d. insulin.

g. Which of the following are functions of hair?
    a. prevents dust particles from reaching the lungs
    b. prevents heat loss from the body
    c. provides sensory input
    d. all of the above

h. Which of the following are located in the dermis?
    a. sebaceous glands
    b. sweat glands
    c. hair follicles
    d. all of the above

Lesson 21.4: Vocabulary I

Name_____ **Class**_____ **Date**_____

Match the vocabulary word with the proper definition.

Definitions

_____ 1. tough, fibrous protein produced by skin cells

_____ 2. lower layer of the skin, located directly beneath the epidermis

_____ 3. structure where hair originates

_____ 4. protective, waterproof layer of skin

_____ 5. brownish pigment that gives skin much of its color

_____ 6. condition in which red bumps called pimples form on the skin

_____ 7. outer layer of skin, consisting of epithelial cells

_____ 8. produces the salty fluid called sweat

_____ 9. produces an oily substance called sebum

_____ 10. a fiber that is found only in mammals

_____ 11. includes the skin, nails and hair

_____ 12. disease in which skin cells grow out of control

Terms

a. acne

b. dermis

c. epidermis

d. hair

e. hair follicle

f. integumentary system

g. keratin

h. melanin

i. sebaceous gland

j. skin cancer

k. stratum corneum

l. sweat gland

Lesson 21.4: Vocabulary II

Name_____ **Class**_____ **Date**_____

Fill in the blank with the appropriate term.

1. The _____ is the major organ of the integumentary system.

2. The innermost cells of the epidermis are continuously dividing through _____ to form new cells.

3. The epidermis also contains _____, which are cells that produce melanin.

4. The amount of melanin produced is determined by heredity and exposure to _____ light.

5. The dermis is attached to the epidermis by _____ fibers.

6. Sweat glands open to the surface through _____ in the skin.

7. Blood vessels in the skin _____ when the body is too warm.

8. The underlying cause of acne is excessive secretion of _____.

9. The best way to prevent skin cancer is to avoid UV exposure by using sunscreen and wearing _____-_____ clothing.

10. A brown spot on the skin is likely to be a harmless _____, but it could be a sign of skin cancer.

11. All the organs of the integumentary system help the body maintain _____.

12. Hair provides _____ input when objects brush against it or it sways in moving air.

Lesson 21.4: Critical Writing

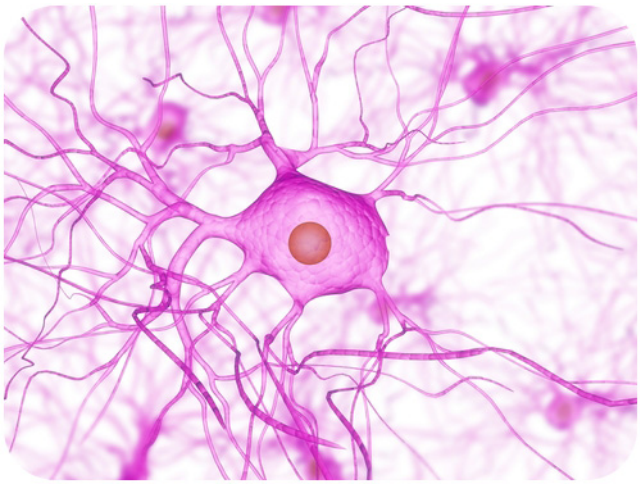
Name_____ **Class**_____ **Date**_____

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Name two common problems of the skin, describing each problem and the underlying cause of each.

CHAPTER 22 The Nervous and Endocrine Systems Worksheets

Chapter Outline



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- **Lesson 22.1: The Nervous System**
- **Lesson 22.2: The Endocrine System**

22.1 The Nervous System

Lesson 22.1: True or False

Name_____ Class_____ Date_____

Write true if the statement is true or false if the statement is false.

_____ 1. An action potential is necessary for a nerve impulse to occur.

_____ 2. Sensory neurons carry nerve impulses from the brain and spinal cord to muscles and glands.

_____ 3. The peripheral nervous system includes the brain and spinal cord.

_____ 4. The myelin sheath is similar to the plastic that encases an electrical cord.

_____ 5. The somatic nervous system controls the reactions necessary to write “true” or “false.”

_____ 6. The sensory division of the CNS includes the eyes, ears, mouth, nose, and skin.

_____ 7. The spinal cord is the most complex organ of the human body and the control center of the nervous system.

_____ 8. Taste buds on the tongue are actually found in taste receptor cells.

_____ 9. All psychoactive drugs are illegal.

_____ 10. Balance is due to an interaction between your hearing and vision receptors.

_____ 11. Neurotransmitters are molecules that cross the synapse.

_____ 12. The peripheral nervous system includes the sensory division and the motor division.

_____ 13. The cerebrum is the largest part of the brain.

_____ 14. The reason you can smell your food is because of the taste buds in your nose.

_____ 15. Dendrites extend from the cell body and send nerve impulses to other neurons.

Lesson 22.1: Critical Reading

Name_____ Class_____ Date_____

Read these passages from the text and answer the questions that follow.

Nerve Cells

Although the nervous system is very complex, nervous tissue consists of just two basic types of nerve cells: neurons and glial cells. **Neurons** are the structural and functional units of the nervous system. They transmit electrical signals, called **nerve impulses**. Glial cells provide support for neurons. For example, they provide neurons with nutrients and other materials.

Neuron Structure

As shown in the FlexBook, a neuron consists of three basic parts: the cell body, dendrites, and axon. You can watch an animation of the parts of a neuron at this link: http://www.garyfisk.com/anim/neuronparts.swf.

- The **cell body** contains the nucleus and other cell organelles.
- **Dendrites** extend from the cell body and receive nerve impulses from other neurons.
- The **axon** is a long extension of the cell body that transmits nerve impulses to other cells. The axon branches at the end, forming axon terminals. These are the points where the neuron communicates with other cells.

Myelin Sheath

The axon of many neurons has an outer layer called a **myelin sheath**. Myelin is a lipid produced by a type of a glial cell known as a Schwann cell. The myelin sheath acts like a layer of insulation, similar to the plastic that encases an electrical cord. Regularly spaced nodes, or gaps, in the myelin sheath allow nerve impulses to skip along the axon very rapidly.

Types of Neurons

Neurons are classified based on the direction in which they carry nerve impulses.

- **Sensory neurons** carry nerve impulses from tissues and organs to the spinal cord and brain.
- **Motor neurons** carry nerve impulses from the brain and spinal cord to muscles and glands.
- **Interneurons** carry nerve impulses back and forth between sensory and motor neurons.

Questions

1. What is a neuron? What are glial cells?

2. What is the role of a dendrite and an axon?

3. What does the myelin sheath do?

4. Describe the three types of neurons.

Lesson 22.1: Multiple Choice

Name_____ Class_____ Date_____

Circle the letter of the correct choice.

a. Neurons transmit electrical signals called
   a. nerve signals.
   b. nerve impulses.
   c. nerve potential.
   d. axon impulses.

b. The parts of a neuron include
   a. the cell body.
   b. one axon.
   c. numerous dendrites.
   d. all of the above.

c. What is an action potential?
   a. An action potential is a sudden reversal of the electrical charge across the membrane of a resting neuron.
   b. An action potential is a sudden reversal of the electrical charge across the membrane of an active neuron.
   c. An action potential is a slow reversal of the electrical charge across the membrane of a resting neuron.
   d. An action potential is a sudden reversal of the chemical charge across the membrane of a resting neuron.

d. At the synapse,
   a. neurotransmitter molecules travel across the axon terminals and bind to receptors on the membrane of the other cell.
   b. neurotransmitter molecules travel across the axon terminals and bind to vesicles on the membrane of the other cell.
   c. neurotransmitter molecules travel across the synaptic cleft and bind to receptors on the membrane of the other cell.
   d. neurotransmitter molecules travel across the synaptic cleft and bind to signal proteins on the membrane of the other cell.

e. The largest part of the human brain is the
   a. cerebellum.
   b. cerebrum.
   c. frontal lobe.
   d. brain stem.

f. Your somatic nervous system is responsible for

   a. involuntary activities not under conscious control.
   b. emergency situations.
   c. the organs of your digestive system.
   d. voluntary activities that are under conscious control.

g. Alzheimer's disease most likely occurs when

   a. nervous tissue degenerates.
   b. nervous tissue may become infected by microorganisms.
   c. there are problems with blood flow.
   d. there are brain or spinal cord injuries.

h. Your sense of balance is the responsibility of

   a. your eyes.
   b. your ears.
   c. both your eyes and ears.
   d. your sense of touch.

i. The peripheral nervous system consists of

   a. all the nervous tissue that lies outside the central nervous system.
   b. your brain and spinal cord.
   c. all your neurons and axons.
   d. all of the above.

j. The central nervous system consists of

   a. all the nervous tissue that lies outside the central nervous system.
   b. just your brain.
   c. just your spinal cord.
   d. your brain and spinal cord.

Lesson 22.1: Vocabulary I

Name_____ **Class**_____ **Date**_____

Match the vocabulary word with the proper definition.

Definitions

_____ 1. electrical signal transmitted by the neurons

_____ 2. carry nerve impulses from the brain and spinal cord to muscles and glands

_____ 3. difference in electrical charge when a neuron is not actively transmitting a nerve impulse

_____ 4. the place where an axon terminal meets another cell

_____ 5. acts like a layer of insulation

_____ 6. carry nerve impulses from tissues and organs to the spinal cord and brain

_____ 7. consists of all the nervous tissue that lies outside the central nervous system

_____ 8. structural and functional unit of the nervous system

_____ 9. molecules that travel across the synaptic cleft and bind to receptors on the membrane of the other cell

_____ 10. carry nerve impulses back and forth between sensory and motor neurons

_____ 11. a sudden reversal of the electrical charge across the membrane of a resting neuron

_____ 12. includes the brain and spinal cord

_____ 13. a cable-like bundle of axons

_____ 14. part of the neuron that contains the nucleus and other cell organelles

_____ 15. extends from the cell body and receives nerve impulses from other neurons

_____ 16. a long extension of the cell body that transmits nerve impulses to other cells

Terms

a. action potential

b. axon

c. cell body

d. central nervous system

e. dendrite

f. interneuron

g. motor neuron

h. myelin sheath

i. nerve

j. nerve impulse

k. neuron

l. neurotransmitter

m. peripheral nervous system

n. resting potential

o. sensory neuron

p. synapse

Lesson 22.1: Vocabulary II

Name_____ Class_____ Date_____

Fill in the blank with the appropriate term.

1. _____ are the structural and functional units of the nervous system.

2. A nerve impulse travels down an axon membrane as an electrical _____ potential.

3. Human senses include sight, hearing, balance, taste, smell, and _____.

4. _____ are chemicals that affect the body's structure or function.

5. The _____ are also responsible for the sense of balance.

6. Sensory nerves carry nerve impulses from _____ to the central nervous system.

7. The_____ nervous system controls mainly voluntary activities that are under conscious control.

8. Neurons consist of a cell body, _____, and axon.

9. A nerve is a cable-like bundle of _____.

10. _____ is use of a drug without the advice of a medical professional and for reasons not originally intended.

11. The _____ is protected by the vertebrae.

12. The place where an axon terminal meets another cell is called a _____.

13. _____ drugs affect the central nervous system.

14. The central nervous includes the brain and _____.

15. The _____ is a long extension of the cell body that transmits nerve impulses to other cells.

Lesson 22.1: Critical Writing

Name_____ Class_____ Date_____

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

An action potential can be referred to as a "wave of depolarization" down the axon. Explain what you think this means.

22.2 The Endocrine System

Lesson 22.2: True or False

Name_____ Class_____ Date_____

Write true if the statement is true or false if the statement is false.

_____ 1. Steroid hormones can enter the nucleus and influence the expression of genes.

_____ 2. Hormones are chemical messengers.

_____ 3. A target cell is the type of cell that has an effect on hormones.

_____ 4. Non-steroid hormones bind to their receptors in the cytoplasm of the cell.

_____ 5. The pancreas is a large endocrine gland in the neck.

_____ 6. Hypersecretion by an endocrine gland is often caused by a tumor.

_____ 7. Most hormone feedback mechanisms involve positive feedback loops.

_____ 8. Milk production by a mother for her baby is positively regulated.

_____ 9. Type 2 diabetes cannot be treated by insulin injections.

_____ 10. The thyroid gland is often called the "master gland" of the endocrine system.

_____ 11. Secondary messengers affect cell processes inside the cell.

_____ 12. Negative feedback controls insulin secretion by the adrenal gland.

_____ 13. Negative feedback regulation occurs when a product feeds back to decrease its own production.

_____ 14. Endocrine hormones travel throughout the body in the blood.

Lesson 22.2: Critical Reading

Name_____ Class_____ Date_____

Read these passages from the text and answer the questions that follow.

Hormone Regulation: Feedback Mechanisms

Hormones control many cell activities, so they are very important for homeostasis. But what controls the hormones themselves? Most hormones are regulated by feedback mechanisms. A feedback mechanism is a loop in which a product feeds back to control its own production. Most hormone feedback mechanisms involve negative feedback loops. Negative feedback keeps the concentration of a hormone within a narrow range.

Negative Feedback

Negative feedback occurs when a product feeds back to decrease its own production. This type of feedback brings things back to normal whenever they start to become too extreme. The thyroid gland is a good example of this type of regulation. It is controlled by the negative feedback loop shown in the FlexBook.

Here's how thyroid regulation works. The hypothalamus secretes thyrotropin-releasing hormone, or TRH. TRH stimulates the pituitary gland to produce thyroid-stimulating hormone, or TSH. TSH, in turn, stimulates the thyroid gland to secrete its hormones. When the level of thyroid hormones is high enough, the hormones feed back to stop the hypothalamus from secreting TRH and the pituitary from secreting TSH. Without the stimulation of TSH, the thyroid gland stops secreting its hormones. Soon, the level of thyroid hormone starts to fall too low. What do you think happens next? Negative feedback also controls insulin secretion by the pancreas.

Positive feedback

Positive feedback occurs when a product feeds back to increase its own production. This causes conditions to become increasingly extreme. An example of positive feedback is milk production by a mother for her baby. As the baby suckles, nerve messages from the nipple cause the pituitary gland to secrete prolactin. Prolactin, in turn, stimulates the mammary glands to produce milk, so the baby suckles more. This causes more prolactin to be secreted and more milk to be produced. This example is one of the few positive feedback mechanisms in the human body. What do you think would happen if milk production by the mammary glands was controlled by negative feedback instead?

Questions

1. What is a feedback mechanism?

2. What is negative feedback regulation? Give an example.

3. What is positive feedback regulation? Give an example.

4. How are most hormones regulated?

5. What do you think would happen if milk production by the mammary glands was controlled by negative feedback loop?

Lesson 22.2: Multiple Choice

Name_____ Class_____ Date_____

Circle the letter of the correct choice.

a. Glands of the endocrine system include

   a. the thyroid gland.
   b. the pituitary gland.
   c. the gonads.
   d. all of the above.

b. Negative feedback regulation of hormones occurs

   a. when a reactant feeds back to decrease its own production.
   b. when a product feeds back to increase its own production.
   c. when a product feeds back to decrease its own production.
   d. when a reactant feeds back to increase its own production.

c. Which statement is true about the thyroid hormones? (1) They increase the rate of metabolism in cells throughout the body. (2)They control how quickly cells use energy. (3) They are not steroid hormones. (4) They are released by the parathyroid glands.

   a. 1 only
   b. 1 and 2
   c. 1, 2, and 3
   d. 1, 2, 3, and 4

d. Steroid hormones

   a. can influence gene expression.

b. can diffuse across the plasma membrane.
c. are made of lipids.
d. all of the above

e. Milk production

a. is negatively regulated by prolactin.
b. is positively regulated by prolactin.
c. is positively regulated by milk-producing factor.
d. is an unregulated process in new mothers.

f. Thyrotropin-releasing hormone, or TRH,

a. is regulated through a negative feedback mechanism.
b. is regulated through a positive feedback mechanism.
c. is not regulated.
d. none of the above

g. The hormones released by the pancreas

a. are located near the thyroid gland.
b. include insulin and glucose.
c. work together to control the level of glucose in the blood.
d. all of the above

h. Which of the following statements is true concerning the hypothalamus? (1) The hypothalamus is actually part of the brain. (2) The hypothalamus can be considered a link between the nervous and endocrine systems. (3) The hypothalamus releases anti-diuretic hormone. (4) The hypothalamus produces hormones that directly regulate other body processes.

a. 1 only
b. 1 and 2
c. 1, 2, and 3
d. 1, 2, 3, and 4

Lesson 22.2: Vocabulary I

Name_____ **Class**_____ **Date**_____

Match the vocabulary word with the proper definition.

Definitions

_____ 1. hormones that are made of lipids such as phospholipids and cholesterol

_____ 2. releases hormones that increase the rate of metabolism in cells throughout the body

_____ 3. releases hormones that helps keep the level of calcium in the blood within a narrow range

_____ 4. releases fight-or-flight hormones

_____ 5. releases hormones that work together to control the level of glucose in the blood

_____ 6. releases hormones that control sleep-wake cycles and several other processes

_____ 7. the type of cell on which a hormone has an effect

_____ 8. releases sex hormones

_____ 9. messenger molecules released by endocrine glands

_____ 10. a system of glands that release chemical messenger molecules

_____ 11. the master gland of the endocrine system

_____ 12. provides a link between the nervous and endocrine systems

Terms

a. adrenal glands

b. endocrine system

c. gonads

d. hormone

e. hypothalamus

f. pancreas

g. parathyroid glands

h. pineal gland

i. pituitary gland

j. steroid hormones

k. target cell

l. thyroid gland

Lesson 22.2: Vocabulary II

Name_____ **Class**_____ **Date**_____

Fill in the blank with the appropriate term.

1. Most hormones are controlled by a _____ feedback regulation mechanism.
2. Steroid hormone and their receptors form a complex that influences the expression of _____.
3. Endocrine hormones travel throughout the body in the _____.
4. Thyroid hormones increase the rate of _____ in cells throughout the body.
5. Hormones of the pancreas include _____ and glucagon.
6. _____-stimulating hormone stimulates the ovaries to develop mature eggs.
7. The hypothalamus is actually part of the _____, but it also secretes hormones.
8. Growth hormone stimulates body cells to synthesize proteins and _____.
9. Most _____ hormones control other endocrine glands.
10. Endocrine system disorders usually involve the secretion of too much or not enough _____.
11. The endocrine system is a system of glands that release chemical _____ molecules into the bloodstream.
12. A _____ cell is the type of cell on which a hormone has an effect.

Lesson 22.2: Critical Writing

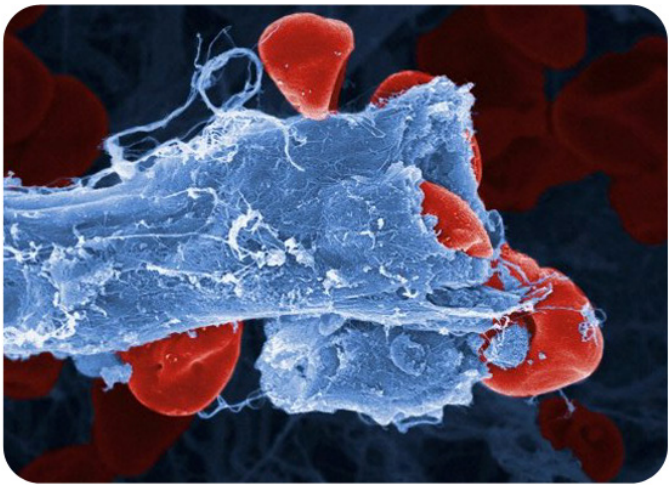
Name_____ **Class**_____ **Date**_____

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Explain how steroid hormones work.

CHAPTER 23 The Circulatory, Respiratory, Digestive, and Excretory Systems Worksheets

Chapter Outline



(Opening image copyright by Anne Weston, http://io9.com/#!373166/when-microscopic-blood-vessels-explode and under the Creative Commons license CC-BY-NC-ND.)

- **Lesson 23.1: The Circulatory System**
- **Lesson 23.2: The Respiratory System**
- **Lesson 23.3: The Digestive System**
- **Lesson 23.4: The Excretory System**

23.1 The Circulatory System

Lesson 23.1: True or False

Name_____ **Class**_____ **Date**_____

Write true if the statement is true or false if the statement is false.

_____ 1. The heart has four chambers: two upper ventricles and two lower atria.

_____ 2. Capillaries are the largest of the blood vessels.

_____ 3. High blood pressure is also known as hypertension.

_____ 4. Blood is a connective tissue.

_____ 5. The systemic circulation carries blood between the heart and body.

_____ 6. The pulmonary circulation carries blood between the heart and body.

_____ 7. White blood cells carry oxygen in the blood.

_____ 8. A heart attack occurs when the blood supply to part of the heart is blocked and cardiac muscle tissue dies.

_____ 9. Cells in blood include red blood cells, white blood cells, green blood cells, and platelets.

_____ 10. ABO blood type is determined by three common antigens, often referred to as antigens A, B, and O.

_____ 11. Smoking contributes to the development of atherosclerosis.

_____ 12. Blood pressure is highest in the veins and lowest in the arteries.

_____ 13. The leading cause of cardiovascular disease is atherosclerosis.

_____ 14. Platelets release chemicals that are needed for blood clotting.

_____ 15. Diseases of the heart and blood vessels are very common.

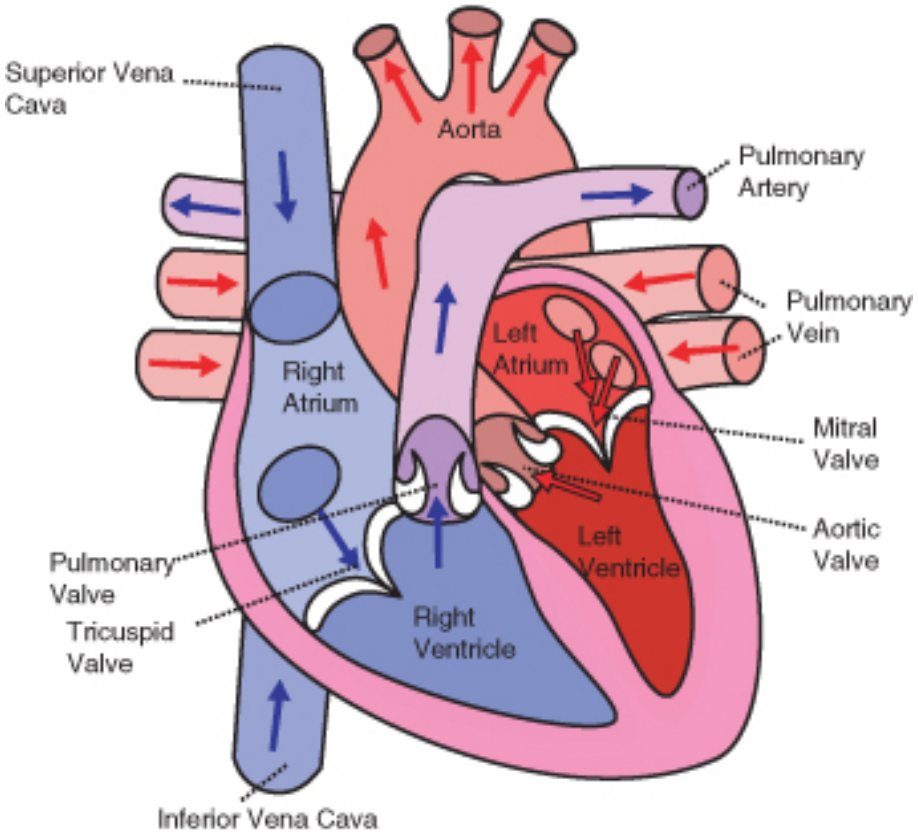
Lesson 23.1: Critical Reading

Name_____ **Class**_____ **Date**_____

Read these passages from the text and answer the questions that follow.

The Heart

The heart is a muscular organ in the chest. It consists mainly of cardiac muscle tissue and pumps blood through blood vessels by repeated, rhythmic contractions. The heart has four chambers, as illustrated below: two upper atria (singular, atrium) and two lower ventricles. Valves between chambers keep blood flowing through the heart in just one direction.



The chambers of the heart and the valves between them are shown here. *(Image courtesy of Wapcaplet and Yaddah and under GNU-FDL 1.2.)*

Blood Flow Through the Heart

Blood flows through the heart in two separate loops, which are indicated by the arrows in the figure above.

a. Blood from the body enters the right atrium of the heart. The right atrium pumps the blood to the right ventricle, which pumps it to the lungs. This loop is represented by the blue arrows in the figure above.
b. Blood from the lungs enters the left atrium of the heart. The left atrium pumps the blood to the left ventricle, which pumps it to the body. This loop is represented by the red arrows in the figure above.

Heartbeat

Unlike skeletal muscle, cardiac muscle contracts without stimulation by the nervous system. Instead, specialized cardiac muscle cells send out electrical impulses that stimulate the contractions. As a result, the atria and ventricles normally contract with just the right timing to keep blood pumping efficiently through the heart.

Questions

1. What is the role of the heart?

2. The _____ chambers of the heart are: _____ , _____ , _____ , _____ .

3. What is the main difference between the right side and left side of the heart?

4. What causes the heart to beat? Describe how this occurs.

Lesson 23.1: Multiple Choice

Name_____ Class_____ Date_____

Circle the letter of the correct choice.

a. The materials carried by the circulatory system include which of the following? (1) blood, (2) hormones, (3) oxygen, (4) cellular wastes.
   a. 1 only
   b. 1 and 2
   c. 1, 2, and 3
   d. 1, 2, 3, and 4

b. The correct order of blood flow is
   a. aorta → right atrium → right ventricle → lungs → left atrium → left ventricle → vena cava.
   b. vena cava → right atrium → right ventricle → lungs → left atrium → left ventricle → aorta.
   c. vena cava → left atrium → left ventricle → lungs → right atrium → right ventricle → aorta.
   d. aorta → left atrium → left ventricle → lungs → right atrium → right ventricle → vena cava.

c. The major blood vessels include
   a. arteries.

b. veins.
c. capillaries.
d. all of the above.

d. Which statement is correct?

a. The pulmonary circulation carries blood between the heart and lungs, while the systemic circulation carries blood between the heart and body.
b. The systemic circulation carries blood between the heart and lungs, while the pulmonary circulation carries blood between the heart and body.
c. The systemic circulation carries blood between the heart and lungs, while the pulmonary circulation carries oxygen between the heart and body.
d. The pulmonary circulation carries oxygen between the heart and lungs, while the systemic circulation carries blood between the heart and body.

e. Atherosclerosis

a. occurs when the blood supply to part of the heart muscle is blocked.
b. is the buildup of plaque inside arteries.
c. consists of cell debris, cholesterol, and other substances.
d. all of the above

f. Blood

a. in veins carries carbon dioxide and nutrients, while blood in arteries carries oxygen and other wastes.
b. in veins carries oxygen and nutrients, while blood in arteries carries carbon dioxide and other wastes.
c. in arteries carries oxygen and nutrients, while blood in veins carries carbon dioxide and other wastes.
d. in arteries carries carbon dioxide and nutrients, while blood in veins carries oxygen and other wastes.

g. Plasma includes

a. white blood cells.
b. red blood cells.
c. platelets.
d. all of the above.

h. Roles of blood include which of the following? (1) defending the body against infection, (2) repairing body tissues, (3) transporting water from the lungs to body cells (4) controlling the body's pH.

a. 1 and 2
b. 1, 2, and 3
c. 1, 2, and 4
d. 1, 2, 3, and 4

Lesson 23.1: Vocabulary I

Name_____ Class_____ Date_____

Match the vocabulary word with the proper definition.

Definitions

_____ 1. the smallest type of blood vessel

_____ 2. the part of the circulatory system that carries blood between the heart and body

_____ 3. diseases of the heart and blood vessels

_____ 4. transports materials from one place to another

_____ 5. blood vessel that carries blood toward the heart

_____ 6. carries oxygen

_____ 7. a fluid connective tissue

_____ 8. muscular blood vessel that carries blood away from the heart

_____ 9. the buildup of plaque inside arteries

_____ 10. the fluid part of blood

_____ 11. the part of the circulatory system that carries blood between the heart and lungs

_____ 12. occurs when the blood supply to part of the heart muscle is blocked and cardiac muscle fibers die

Terms

a. artery

b. atherosclerosis

c. blood

d. capillary

e. cardiovascular disease

f. circulatory system

g. heart attack

h. plasma

i. pulmonary circulation

j. red blood cell

k. systemic circulation

l. vein

Lesson 23.1: Vocabulary II

Name_____ **Class**_____ **Date**_____

Fill in the blank with the appropriate term.

1. Red blood cells contain _____, a protein with iron that binds with oxygen.
2. The most commonly known blood types are the _____ and Rhesus blood types.
3. The exchange of gases between cells and blood takes place across the thin walls of _____.
4. Cardiac muscle contracts without stimulation by the _____ system.
5. Platelets are cell fragments involved in blood _____.
6. The main components of the circulatory system are the heart, blood vessels, and _____.
7. The _____ has four chambers: two upper atria, and two lower ventricles.
8. Arteries are muscular vessels that carry blood _____ from the heart.
9. _____ circulation is the part of the circulatory system that carries blood between the heart and body.
10. Pulmonary circulation is the part of the circulatory system that carries blood between the heart and _____-

___.

11. _____ generally carry deoxygenated blood.

12. _____ is the buildup of plaque inside arteries.

Lesson 23.1: Critical Writing

Name_____ Class_____ Date_____

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Define and outline pathways of the pulmonary and systemic circulations.

23.2 The Respiratory System

Lesson 23.2: True or False

Name_____ Class_____ Date_____

Write true if the statement is true or false if the statement is false.

_____ 1. The exchange of gases between the body and the outside air is called breathing.

_____ 2. Respiration begins with gas exchange.

_____ 3. Respiration and cellular respiration are different.

_____ 4. Pulmonary gas exchange occurs in the alveoli of the lungs.

_____ 5. Asthma is a disease in which the air passages of the lungs periodically become too large.

_____ 6. Oxygenated blood is transported by the respiratory system from lungs to tissues throughout the body.

_____ 7. The mouth is an organ of the respiratory system.

_____ 8. Ventilation is the process of moving air into and out of the lungs.

_____ 9. Pulmonary gas exchange is the exchange of gases between inhaled air and the blood.

_____ 10. The heart pumps the oxygen-rich blood into your veins, which carry it throughout the body.

_____ 11. Body cells have a much higher concentration of oxygen than blood in the peripheral capillaries.

_____ 12. The regular, rhythmic contractions of the diaphragm are controlled by the brain stem.

_____ 13. Carbon dioxide from body cells travels in the blood back to the heart, then to the lungs where it is inhaled again.

_____ 14. Emphysema is a lung disease usually caused by smoking and is irreversible.

_____ 15. Gas exchange is extremely important in maintaining homeostasis.

Lesson 23.2: Critical Reading

Name_____ Class_____ Date_____

Read these passages from the text and answer the questions that follow.

Journey of a Breath of Air

Take in a big breath of air through your nose. As you inhale, you may feel the air pass down your throat and notice your chest expand. Now exhale and observe the opposite events occurring. Inhaling and exhaling may seem like simple actions, but they are just part of the complex process of respiration, which includes these four steps:

a. Ventilation.
b. Pulmonary gas exchange.
c. Gas transport.

d. Peripheral gas exchange.

Ventilation

Respiration begins with **ventilation**. This is the process of moving air in and out of the lungs. The **lungs** are the organs in which gas exchange takes place between blood and air.

- Air enters the respiratory system through the nose. As the air passes through the nasal cavity, mucus and hairs trap any particles in the air. The air is also warmed and moistened so it won't harm delicate tissues of the lungs.
- Next, the air passes through the **pharynx**, a long tube that is shared with the digestive system. A flap of connective tissue called the epiglottis closes when food is swallowed to prevent choking.
- From the pharynx, air next passes through the **larynx**, or voice box. The larynx contains vocal cords, which allow us to produce vocal sounds.
- After the larynx, air moves into the **trachea**, or wind pipe. This is a long tube that leads down to the chest.
- In the chest, the trachea divides as it enters the lungs to form the right and left bronchi. The bronchi contain cartilage, which prevents them from collapsing. Mucus in the bronchi traps any remaining particles in air. Tiny hairs called cilia line the bronchi and sweep the particles and mucus toward the throat so they can be expelled from the body.
- Finally, air passes from the bronchi into smaller passages called bronchioles. The bronchioles end in tiny air sacs called alveoli.

Questions

1. Describe the journey of air during ventilation.

2. What happens to air in the nasal cavity?

3. What is the role of the larynx?

4. What happens in the bronchi?

5. Where are the alveoli located?

Lesson 23.2: Multiple Choice

Name_____ Class_____ Date_____

Circle the letter of the correct choice.

a. The functions of the respiratory system include which of the following? (1) bringing air containing oxygen into the body, (2) releasing carbon dioxide into the atmosphere, (3) exchanging oxygen with carbon dioxide in blood cells, (4) transporting oxygen to cells throughout the body.

   a. 1 only
   b. 1 and 2
   c. 1, 2, and 3
   d. 1, 2, 3, and 4

b. The four steps of respiration are

   a. ventilation, central gas exchange, gas transport, peripheral gas exchange.
   b. ventilation, pulmonary gas transport, gas exchange, peripheral gas transport.

c. ventilation, pulmonary gas exchange, gas transport, peripheral gas exchange.
d. breathing, pulmonary gas exchange, central gas exchange, peripheral gas exchange.

c. Inhaling

a. occurs when the diaphragm contracts.
b. occurs when the diaphragm relaxes.
c. is the exchange of gas between blood cells and the lungs.
d. is when oxygen in the air is drawn into the body and carbon dioxide is released from the body.

d. Respiration begins with

a. gas transport between the mouth and the atmosphere.
b. ventilation, the process of moving air in and out of the lungs.
c. ventilation between the lungs and the blood.
d. gas exchange between the lungs and the blood.

e. Ventilation involves which organs?

a. the larynx, pharynx, and trachea
b. the lungs, larynx, pharynx, and trachea
c. the heart and lungs, larynx, pharynx, and trachea
d. the heart, blood and lungs, larynx, pharynx, and trachea

f. Gas exchange occurs

a. in the lungs, between the blood and the air.
b. in the alveoli of the lungs, between the peripheral capillaries and lung cells.
c. in the alveoli of the lungs, between the peripheral capillaries and body cells.
d. all of the above

g. Emphysema

a. results in less gas can be exchanged in the lungs.
b. is caused by smoking and is irreversible.
c. causes shortness of breath.
d. all of the above

h. Asthma occurs when the

a. some of the alveoli of the lungs fill with fluid so gas exchange cannot occur.
b. air passages of the lungs periodically become too narrow, often with excessive mucus production.
c. walls of the alveoli break down so less gas can be exchanged in the lungs.
d. all of the above

Lesson 23.2: Vocabulary I

Name_____ **Class**_____ **Date**_____

Match the vocabulary word with the proper definition.

Definitions

_____ 1. the voice box

_____ 2. the exchange of gases between the body and the outside air

_____ 3. a long tube that is shared with the digestive system

_____ 4. a disease in which the air passages of the lungs periodically become too narrow

_____ 5. the wind pipe

_____ 6. tiny air sacs in the lungs

_____ 7. the organs in which gas exchange takes place between blood and air

_____ 8. the body system that brings air containing oxygen into the body and releases carbon dioxide into the atmosphere

_____ 9. a disease in which some of the alveoli of the lungs fill with fluid

_____ 10. the metabolic process by which cells obtain energy

_____ 11. the process of moving air in and out of the lungs

_____ 12. a lung disease in which walls of the alveoli break down

Terms

a. alveoli

b. asthma

c. cellular respiration

d. emphysema

e. larynx

f. lungs

g. pharynx

h. pneumonia

i. respiration

j. respiratory system

k. trachea

l. ventilation

Lesson 23.2: Vocabulary II

Name_____ **Class**_____ **Date**_____

Fill in the blank with the appropriate term.

1. Respiration begins with _____.

2. Gas exchange is needed to provide cells with the _____ they need for cellular respiration.

3. Tiny air sacs in the lungs are known as _____.

4. Inhaling is an active movement that results from the contraction of a muscle called the _____.

5. Asthma is a disease in which the air passages of the _____ become narrow, often with excessive mucus production.

6. The _____ is also known as the wind pipe.

7. Emphysema is usually caused by _____ and is irreversible.

8. The _____ is also known as the voice box.

9. The _____ pumps oxygen-rich blood into arteries.

10. _____ gas exchange is the exchange of gases between inhaled air and the blood.

11. _____ is a disease in which some of the alveoli of the lungs fill with fluid so gas exchange cannot occur.

12. Oxygen _____ from the peripheral capillaries into body cells.

Lesson 23.2: Critical Writing

Name_____ Class_____ Date_____

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Define respiration, and explain how it differs from cellular respiration.

23.3 The Digestive System

Lesson 23.3: True or False

Name_____ **Class**_____ **Date**_____

Write true if the statement is true or false if the statement is false.

_____ 1. To get glucose from food, digestion must occur.

_____ 2. Chemical digestion is the physical breakdown of chunks of food into smaller pieces.

_____ 3. The GI tract is one long tube that connects your mouth to your anus.

_____ 4. The small intestine is part of the GI tract and is about 23 feet long in adults.

_____ 5. Mechanical digestion occurs mainly in the small intestine.

_____ 6. Shellfish and chicken cause common food allergies.

_____ 7. Your mouth is an organ of the digestive system.

_____ 8. Absorption is the process in which nutrients pass into the bloodstream, where they can circulate throughout the body.

_____ 9. Nutrients the body needs in relatively small amounts are called macronutrients.

_____ 10. The major salivary enzyme is maltase, which aids in the digestion of carbohydrates.

_____ 11. Minerals are chemical elements that are essential for life.

_____ 12. Most nutrients are absorbed into the blood in the jejunum.

_____ 13. Most chemical digestion takes place in the stomach.

_____ 14. According to MyPyramid, ice cream and chips can be eaten every day.

_____ 15. Most people can survive only a few days without carbohydrates.

Lesson 23.3: Critical Reading

Name_____ **Class**_____ **Date**_____

Read these passages from the text and answer the questions that follow.

Digestion and Absorption: The Small Intestine

The **small intestine** is a narrow tube about 7 meters (23 feet) long in adults. It is the site of most chemical digestion and virtually all absorption. The small intestine consists of three parts: the duodenum, jejunum, and ileum.

Digestion in the Small Intestine

The duodenum is the first and shortest part of the small intestine. Most chemical digestion takes place here, and many digestive enzymes are active in the duodenum (see **Table** 23.1). Some are produced by the duodenum itself. Others are produced by the pancreas and secreted into the duodenum.

TABLE 23.1: Digestive Enzymes Active in the Duodenum"'

Enzyme	What It Digests	Where It Is Made
Amylase	carbohydrates	pancreas
Trypsin	proteins	pancreas
Lipase	lipids	pancreas
Maltase	carbohydrates	duodenum
Peptidase	proteins	duodenum
Lipase	lipids	duodenum

The **liver** is an organ of both digestion and excretion. It produces a fluid called **bile**, which is secreted into the duodenum. Some bile also goes to the **gall bladder**, a sac-like organ that stores and concentrates bile and then secretes it into the small intestine. In the duodenum, bile breaks up large globules of lipids into smaller globules that are easier for enzymes to break down. Bile also reduces the acidity of food entering from the highly acidic stomach. This is important because digestive enzymes that work in the duodenum need a neutral environment. The pancreas contributes to the neutral environment by secreting bicarbonate, a basic substance that neutralizes acid.

Absorption in the Small Intestine

The jejunum is the second part of the small intestine, where most nutrients are absorbed into the blood. The mucous membrane lining the jejunum is covered with millions of microscopic, fingerlike projections called **villi** (singular, villus). Villi contain many capillaries, and nutrients pass from the villi into the bloodstream through the capillaries. Because there are so many villi, they greatly increase the surface area for absorption. In fact, they make the inner surface of the small intestine as large as a tennis court!

The ileum is the third part of the small intestine. A few remaining nutrients are absorbed here. Like the jejunum, the inner surface of the ileum is covered with villi that increase the surface area for absorption.

Questions

1. What happens in the small intestine?

2. List and describe three enzymes of the small intestine.

3. What is bile? What is the function of bile?

4. What are the three parts of the small intestine?

5. What is the role of the villi in the jejunum?

Lesson 23.3: Multiple Choice

Name_____ Class_____ Date_____

Circle the letter of the correct choice.

a. The gastrointestinal tract is a long tube that includes
   a. the mouth, stomach, intestines and anus.
   b. the mouth, stomach, intestines, liver and anus.
   c. the mouth, stomach, intestines, liver, gallbladder and anus.
   d. the mouth, stomach, intestines, liver, gallbladder, pancreas and anus.

b. The organs of the GI tract are lined with
   a. enzymes that break down food.
   b. cilia to sweep food through the GI tract.
   c. mucous membranes that secrete digestive enzymes and absorb nutrients.
   d. all of the above.

c. Which of the following statements is the best description of digestion?

   a. Mechanical digestion is the physical breakdown of food, and chemical digestion is the chemical breakdown of food molecules.
   b. Chemical digestion is the physical breakdown of food, and mechanical digestion is the chemical breakdown of food molecules.
   c. Chemical digestion is the physical breakdown of food, and mechanical digestion is the mechanical breakdown of food molecules.
   d. Mechanical digestion occurs in your mouth, and chemical digestion occurs in your stomach.

d. In your mouth,

   a. pepsin begins the acidic digestion of proteins.
   b. amylase begins the chemical digestion of carbohydrates.
   c. amylase begins the mechanical digestion of carbohydrates.
   d. amylase, pepsin, trypsin, and other enzymes start to break down food.

e. The stomach

   a. digests food both mechanically and chemically.
   b. contains pepsin, which chemically digests protein.
   c. has an acidic environment, which kills bacteria in food and is needed for the stomach enzymes to function.
   d. all of the above

f. In the small intestine,

   a. most nutrients from food are absorbed into the blood.
   b. excess water is absorbed from food.
   c. the mechanical breakdown of food is completed.
   d. partly digested food is stored until ready for the final aspects of digestion.

g. The large intestine includes

   a. the duodenum, jejunum, and ileum.
   b. the GI tract, from the mouth to the anus.
   c. the cecum, colon, and rectum.
   d. the duodenum, jejunum, ileum, cecum, colon, and rectum.

h. Nutrients

   a. include carbohydrates, proteins, lipids, and water.
   b. are needed for energy, building materials, and control of body processes.
   c. include chemical elements like calcium and potassium.
   d. all of the above

Lesson 23.3: Vocabulary I

Name_____ **Class**_____ **Date**_____

Match the vocabulary word with the proper definition.

Definitions

_____ 1. an involuntary muscle contraction that moves rapidly along an organ

_____ 2. a relatively wide tube that connects the small intestine with the anus

_____ 3. a long tube that connects the mouth with the anus

_____ 4. the process in which substances pass into the bloodstream

_____ 5. shows the relative amounts of foods in different food groups you should eat each day

_____ 6. substances the body needs for energy, building materials, and the control of body processes

_____ 7. a long, narrow tube that passes food from the pharynx to the stomach

_____ 8. the breakdown of food

_____ 9. consists of organs that break down food and absorb nutrients

_____ 10. the chemical breakdown of large, complex food molecules

_____ 11. microscopic, finger-like projections of the jejunum

_____ 12. a sac-like organ in which food is further digested

_____ 13. organic compounds that are needed by the body to function properly

_____ 14. the site of most chemical digestion and virtually all absorption

_____ 15. the physical breakdown of chunks of food

Terms

a. absorption

b. chemical digestion

c. digestion

d. digestive system

e. esophagus

f. gastrointestinal tract

g. large intestine

h. mechanical digestion

i. MyPyramid

j. nutrients

k. peristalsis

l. small intestine

m. stomach

n. villi

o. vitamins

Lesson 23.3: Vocabulary II

Name_____ **Class**_____ **Date**_____

Fill in the blank with the appropriate term.

1. Peristalsis is an _____ muscle contraction that moves rapidly along an organ.

2. The _____ is a sac-like organ in which food is further digested both mechanically and chemically.

3. The small intestine consists of three parts: the duodenum, _____, and ileum.

4. Macronutrients include carbohydrates, _____, lipids, and water.

5. _____ shows the relative amounts of foods you should eat each day.

6. _____ is the process in which substances pass into the bloodstream.

7. The large intestine consists of three parts: the cecum, _____, and rectum.

8. _____ is the process in which wastes leave the body.

9. _____ digestion is the chemical breakdown of large, complex food molecules into smaller, simpler nutrient molecules.

10. Mechanical _____ is the physical breakdown of chunks of food into smaller pieces.

11. The _____ is where most nutrients are absorbed into the blood.

12. Body mass _____ is an estimate of the fat content of the body.

Lesson 23.3: Critical Writing

Name_____ Class_____ Date_____

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Identify three classes of nutrients and their functions in the human body.

23.4 The Excretory System

Lesson 23.4: True or False

Name_____ Class_____ Date_____

Write true if the statement is true or false if the statement is false.

_____ 1. If you exercise on a hot day, you are likely to lose a lot of sweat in water.

_____ 2. The kidneys filter all the blood in the body many times each day and produce a total of about 1.5 pints of urine.

_____ 3. The amount of water lost in urine is controlled by the kidneys.

_____ 4. The kidney is the structural and functional unit of the nephron.

_____ 5. Excretion is one of the major ways the body maintains homeostasis.

_____ 6. The bladder stores urine.

_____ 7. The kidneys are a pair of bean-shaped organs just below the waist.

_____ 8. The skin is considered an excretory organ.

_____ 9. A single kidney may have more than a million nephrons.

_____ 10. Kidney stones are common. Many people have kidney stones and do not even know it!

_____ 11. The main function of the urinary system is to filter waste products and excess water from the blood and excrete them from the body.

_____ 12. Urine leaves the body through the urethra.

_____ 13. Urine leaves the body through the process of excretion.

_____ 14. The kidneys play very important roles in homeostasis.

_____ 15. Kidney failure is treatable.

Lesson 23.4: Critical Reading

Name_____ Class_____ Date_____

Read these passages from the text and answer the questions that follow.

Excretion

Excretion is the process of removing wastes and excess water from the body. It is one of the major ways the body maintains homeostasis. Although the kidneys are the main organs of excretion, several other organs also excrete wastes. They include the large intestine, liver, skin, and lungs. All of these organs of excretion, along with the kidneys, make up the **excretory system**. This lesson focuses on the role of the kidneys in excretion. The roles of the other excretory organs are summarized below:

- The large intestine eliminates solid wastes that remain after the digestion of food.
- The liver breaks down excess amino acids and toxins in the blood.
- The skin eliminates excess water and salts in sweat.
- The lungs exhale water vapor and carbon dioxide.

Lesson Summary

- The kidneys filter blood and form urine. They are part of the urinary system, which also includes the ureters, bladder, and urethra.
- Each kidney has more than a million nephrons, which are the structural and functional units of the kidney. Each nephron is like a tiny filtering plant.
- The kidneys maintain homeostasis by controlling the amount of water, ions, and other substances in the blood. They also secrete hormones that have other homeostatic functions.
- Kidney diseases include kidney stones, infections, and kidney failure due to diabetes. Kidney failure may be treated with dialysis.

Questions

1. What is excretion?

2. What are the body's organs of excretion?

3. Describe the role in excretion of two organs other than the kidney.

4. What is a nephron? What role do nephrons play in the kidney?

5. Excretion is one of the major ways the body maintains homeostasis. What role does the kidney play in maintaining homeostasis?

Lesson 23.4: Multiple Choice

Name_____ Class_____ Date_____

Circle the letter of the correct choice.

a. Excretion involves which of the following?

   a. The large intestine eliminates solid wastes that remain after the digestion of food.
   b. The lungs break down excess amino acids and toxins in the blood.
   c. The liver eliminates excess water and salts in sweat.
   d. The skin exhales water vapor and carbon dioxide.

b. The main function of the urinary system is to

   a. form urine.
   b. remove excess water from the body.
   c. filter waste products and excess water from the blood and excrete them from the body.
   d. eliminate solid wastes that remain after the digestion of food.

c. The function of the kidney is to

   a. eliminate excess water and salts.
   b. filter blood and form urine.
   c. excrete water vapor and carbon dioxide.
   d. destroy excess amino acids and toxins in the blood.

d. In the nephron, when blood moves diffuses out of the capillaries, it enters the

   a. renal artery of the nephron.
   b. glomerulus of a nephron.

c. Bowman's capsule.
d. renal tubule of the nephron.

e. Urine follows which of the following pathways?

a. collecting ducts of the kidneys, ureters, bladder, urethra.
b. collecting ducts of the kidneys, bladder, ureters, urethra.
c. bladder, collecting ducts of the kidneys, ureters, urethra.
d. collecting ducts of the kidneys, urethra, bladder, ureters.

f. The role of the kidneys in homeostasis includes which of the following?

a. The kidneys control the amount of water, ions, and other substances in the blood.
b. The kidneys secrete hormones that regulate other body processes.
c. The kidneys filter all the blood in the body many times each day.
d. all of the above

g. Kidney "stones"

a. are infections of the urinary tract, especially the bladder.
b. are mineral crystals that form in urine inside the kidney.
c. can result in damage to the capillaries of nephrons.
d. are used when blood is filtered through a machine.

Lesson 23.4: Vocabulary I

Name_____ Class_____ Date_____

Match the vocabulary word with the proper definition.

Definitions

_____ 1. includes the kidneys, large intestine, liver, skin, and lungs

_____ 2. how urine leaves the body

_____ 3. a muscular tube that carries urine out of the body

_____ 4. filters waste products and excess water from the blood and excretes them from the body

_____ 5. the liquid waste product of the body

_____ 6. when the kidneys lose much of their ability to filter blood

_____ 7. the process of removing wastes and excess water from the body

_____ 8. two muscular tubes that move urine by peristalsis to the bladder

_____ 9. the structural and functional units of the kidneys

_____ 10. a hollow, sac-like organ that stores urine

_____ 11. a medical procedure in which blood is filtered through a machine

Terms

a. bladder

b. dialysis

c. excretion

d. excretory system

e. kidney failure

f. nephron

g. ureters

h. urethra

i. urinary system

j. urination

k. urine

Lesson 23.4: Vocabulary II

Name_____ **Class**_____ **Date**_____

Fill in the blank with the appropriate term.

1. The large intestine eliminates solid wastes that remain after the digestion of _____.
2. The _____ eliminates excess water and salts in sweat.
3. The lungs exhale water vapor and _____.
4. The function of the _____ is to filter blood and form urine.
5. The _____ is a hollow, sac-like organ that stores urine.
6. _____ are the structural and functional units of the kidneys.
7. The kidneys filter all the _____ in the body many times each day.
8. A single _____ may have more than a million nephrons.
9. If you exercise on a hot day, you are likely to lose a lot of _____ in sweat.
10. Blood enters the kidney through the _____ artery.
11. The urethra is a muscular tube that carries _____ out of the body.
12. Kidney _____ are mineral crystals that form in urine inside the kidney.

Lesson 23.4: Critical Writing

Name_____ **Class**_____ **Date**_____

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Explain how the urinary system filters blood and excretes wastes.

CHAPTER 24 The Immune System and Disease Worksheets

Chapter Outline

(Opening image courtesy of Bruce Wetzel/Harry Schaefer/National Cancer Institute, http://visualsonline.cancer.gov/details.cfm?imageid=1762, colorized by Sam McCabe, and under the public domain.)

- **Lesson 24.1: Nonspecific Defenses**
- **Lesson 24.2: The Immune Response**
- **Lesson 24.3: Immune System Diseases**
- **Lesson 24.4: Environmental Problems and Human Health**

24.1 Nonspecific Defenses

Lesson 24.1: True or False

Name_____ **Class**_____ **Date**_____

Write true if the statement is true or false if the statement is false.

_____ 1. The skin is the single most important defense the body has.

_____ 2. Sneezing removes pathogens from your nose.

_____ 3. Sweat, mucus, tears, and saliva are all types of mechanical barriers used to protect you.

_____ 4. The inflammatory response is part of the body's first line of defense.

_____ 5. Leukocytes are white blood cells that fight infections and get rid of debris.

_____ 6. Barriers that keep out pathogens are the body's first line of defense.

_____ 7. The second line of defense attacks pathogens that manage to enter the body.

_____ 8. The second line of defense includes mechanical, chemical, and biological barriers.

_____ 9. The first line of defense includes the inflammatory response and phagocytosis.

_____ 10. A nonspecific defense can be tailored to a particular pathogen.

_____ 11. The inflammatory response is triggered by chemicals called histakines and cytomines.

_____ 12. Biological barriers include millions of harmless bacteria live on the human skin.

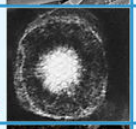
Lesson 24.1: Critical Reading

Name_____ **Class**_____ **Date**_____

Read these passages from the text and answer the questions that follow.

The First Line of Defense

The body's first line of defense consists of different types of barriers that keep most pathogens out of the body. **Pathogens** are disease-causing agents, such as bacteria and viruses. These and other types of pathogens are described in the figure below. Regardless of the type of pathogen, however, the first line of defense is always the same.

Type of pathogen	Description	Human diseases caused by pathogens of that type
Bacteria *Escherichia coli* 	Single-celled organisms without a nucleus	Strep throat, staph infections, tuberculosis, food poisoning, tetanus, pneumona, syphilis
Viruses *Herpes simplex* 	Non living particles that reproduce by taking over living cells	Common cold, flu, genital herpes, col sores, measle, AIDS, genital warts, chicken pox, small pox
Fungi *Death cap mushroom* 	Simple organisms, including mushrooms and yeasts, that grow as single cells or thread like filaments.	Ringworm, athlete's foot, tineas, candidiasis, histoplasmosis, mushroom poisoning
Protozoa *Giardia lamblia* 	Single-celled organism with a nucleus.	Malaria, "traveller's diarrhea" giardiasis, typano somiasis ("sleeping sickness")

Types of pathogens that commonly cause human diseases include bacteria, viruses, fungi, and protozoa. Which type of pathogen causes the common cold? Which type causes athlete's foot? *(From top to bottom, images courtesy of Rocky Mountain Laboratories/NIAID/NIH and under the public domain, courtesy of CDC/Dr. Erskine Palmer and under the public domain, courtesy of Archenzo and under GNU-FDL 1.2, and courtesy of CDC/Janice Carr and under the public domain. Composite created by CK-12 Foundation.)*

Mechanical Barriers

Mechanical barriers physically block pathogens from entering the body. The skin is the most important mechanical barrier. In fact, it is the single most important defense the body has. The outer layer of the skin is tough and very difficult for pathogens to penetrate. **Mucous membranes** provide a mechanical barrier at body openings. They also line the respiratory, GI, urinary, and reproductive tracts. Mucous membranes secrete **mucus**, a slimy substance that traps pathogens. The membranes also have hair-like cilia. The cilia sweep mucus and pathogens toward body openings where they can be removed from the body. When you sneeze or cough, pathogens are removed from the nose and throat. Tears wash pathogens from the eyes, and urine flushes pathogens out of the urinary tract.

Chemical Barriers

Chemical barriers destroy pathogens on the outer body surface, at body openings, and on inner body linings. Sweat, mucus, tears, and saliva all contain enzymes that kill pathogens. Urine is too acidic for many pathogens, and semen contains zinc, which most pathogens cannot tolerate. In addition, stomach acid kills pathogens that enter the GI tract in food or water.

Biological Barriers

Biological barriers are living organisms that help protect the body. Millions of harmless bacteria live on the human skin. Many more live in the GI tract. The harmless bacteria use up food and space so harmful bacteria cannot grow.

Questions

1. What is a pathogen? Which type of pathogen causes the common cold? Which type causes athlete's foot?

2. What is meant by *The First Line of Defense?*

3. What is a mechanical barrier? Give an example.

4. What is a chemical barrier? Give an example.

5. What is a biological barrier? Give an example.

Lesson 24.1: Multiple Choice

Name_____ Class_____ Date_____

Circle the letter of the correct choice.

a. Which statement best describes the immune system?

   a. The immune system produces gametes.
   b. The immune system exchanges gases between the blood and lungs.
   c. The immune system protects the body from pathogens.
   d. The immune system digests food into usable nutrients.

b. The immune system is comprised of _____ lines of defense.

   a. two
   b. three
   c. four
   d. five

c. Which statement best describes the first line of defense?

   a. The first line of defense consists of different types of barriers that keep most pathogens out of the body.
   b. The first line of defense includes the inflammatory response.
   c. Leukocytes are the cells responsible for the first line of defense.
   d. The first line of defense includes the skin, mucous membranes and biological barriers such as white blood cells.

d. Which statements are true about mechanical barriers? (1) Mechanical barriers physically block pathogens from entering the body. (2) The skin is the most important mechanical barrier. (3) Mechanical barriers are living organisms that help protect the body. (4) Mechanical barriers destroy pathogens on the outer body surface.

   a. 1 and 2
   b. 3 and 4
   c. 1, 2, and 3
   d. 1, 2, 3, and 4

e. Which statement describes the second line of defense?

   a. The second line of defense includes biological and chemical barriers.
   b. The skin is the major organ of the second line of defense.
   c. The second line of defense keeps most pathogens out of the body.
   d. The second line of defense is encountered by pathogens that enter the body.

f. What is the inflammatory response?

   a. The inflammatory response begins when cytokines or histamines infect a tissue.
   b. The inflammatory response is the first reaction of the body to tissue damage or infection.
   c. The inflammatory response is a chemical barrier that destroys pathogens on the body surface.
   d. none of the above

g. Leukocytes

   a. are red blood cells that bring extra oxygen to the site of infection.
   b. are biological barriers that help protect the body.
   c. are white blood cells that fight infections and get rid of debris.
   d. are released by mucous membranes at body openings.

h. Phagocytosis

a. is the process in which leukocytes engulf and break down pathogens and debris.
b. are chemical barriers destroy pathogens.
c. are part of the first line of defense.
d. all of the above

Lesson 24.1: Vocabulary I

Name_____ Class_____ Date_____

Match the vocabulary word with the proper definition.

Definitions

_____ 1. provide a mechanical barrier at body openings

_____ 2. disease-causing agents

_____ 3. a type of white blood cell

_____ 4. living organisms that help protect the body

_____ 5. the most important mechanical barrier

_____ 6. a slimy substance that traps pathogens

_____ 7. the process in which leukocytes engulf pathogens

_____ 8. destroy pathogens on the outer body surface, at body openings, and on inner body linings

_____ 9. the first reaction of the body to tissue damage or infection

_____ 10. physically block pathogens from entering the body

_____ 11. protects the body from worms, germs, and other agents of harm

_____ 12. sweep mucus and pathogens toward body openings

Terms

a. biological barriers

b. chemical barriers

c. cilia

d. immune system

e. inflammatory response

f. leukocyte

g. mechanical barriers

h. mucous membrane

i. mucus

j. pathogens

k. phagocytosis

l. skin

Lesson 24.1: Vocabulary II

Name_____ **Class**_____ **Date**_____

Fill in the blank with the appropriate term.

1. _____ are disease-causing agents, such as bacteria and viruses.
2. _____ is the process in which cells engulf and break down pathogens and debris.
3. The skin_____ is the single most important defense the body has.
4. The _____ response is the first reaction of the body to tissue damage or infection.
5. _____ membranes secrete mucus, a slimy substance that traps pathogens.
6. _____ barriers destroy pathogens on the outer body surface.
7. Leukocytes are _____ blood cells that fight infections and get rid of debris.
8. A _____ defense is tailored to a particular pathogen.
9. A _____ defense is the same no matter what type of pathogen is involved.
10. Millions of harmless _____ live on the human skin.
11. Mucous membranes provide a _____ barrier at body openings.
12. Sweat, mucus, tears, and saliva all contain _____ that kill pathogens.
13. The _____ line of defense attacks pathogens that manage to enter the body.
14. Barriers that keep out pathogens are the body's _____ line of defense.

Lesson 24.1: Critical Writing

Name_____ **Class**_____ **Date**_____

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Describe the barriers that keep most pathogens out of the human body.

24.2 The Immune Response

Lesson 24.2: True or False

Name_____ **Class**_____ **Date**_____

Write true if the statement is true or false if the statement is false.

_____ 1. The third line of defense is referred to as the immune response.

_____ 2. The lymphatic system produces leukocytes called lymphocytes.

_____ 3. Lymphocytes can destroy certain cancer cells.

_____ 4. Lymph is a fluid that leaks out of cells into spaces between capillaries.

_____ 5. The human body has as many as two billion lymphocytes.

_____ 6. Antigens trigger the immune system to react against the cells that carry them.

_____ 7. T cells mature in bone marrow, and B cells mature in the thymus.

_____ 8. B cells must be activated by an antigen before they can fight pathogens.

_____ 9. Antibodies are large, Y-shaped proteins that recognize and bind to antigens.

_____ 10. The cell-mediated immune response leads to the destruction of cells that are infected with viruses.

_____ 11. Helper T cells destroy virus-infected cells and some cancer cells.

_____ 12. Cytotoxic T cells suppress other T cells that mistakenly react against self antigens.

_____ 13. Memory B and T cells help protect the body from re-infection by pathogens.

_____ 14. Since antibodies are such important proteins, they can recognize many types of antigens.

_____ 15. Immunization is a form of passive immunity.

Lesson 24.2: Critical Reading

Name_____ **Class**_____ **Date**_____

Read these passages from the text and answer the questions that follow.

Lymphatic System

The immune response mainly involves the lymphatic system. The **lymphatic system** is a major part of the immune system. It produces leukocytes called lymphocytes. **Lymphocytes** are the key cells involved in the immune response. They recognize and help destroy particular pathogens in body fluids and cells. They also destroy certain cancer cells.

Structures of the Lymphatic System

The structures of the lymphatic system include organs, lymph vessels, lymph, and lymph nodes. Organs of the lymphatic system are the bone marrow, thymus, spleen, and tonsils.

- Bone marrow is found inside many bones. It produces lymphocytes.

- The thymus is located in the upper chest behind the breast bone. It stores and matures lymphocytes.
- The spleen is in the upper abdomen. It filters pathogens and worn out red blood cells from the blood, and then lymphocytes in the spleen destroy them.
- The tonsils are located on either side of the pharynx in the throat. They trap pathogens, which are destroyed by lymphocytes in the tonsils.

Lymphocytes

The human body has as many as two trillion lymphocytes, and lymphocytes make up about 25% of all leukocytes. The majority of lymphocytes are found in the lymphatic system, where they are most likely to encounter pathogens. The rest are found in the blood. There are two major types of lymphocytes, called **B cells** and **T cells**. These cells get their names from the organs in which they mature. B cells mature in bone marrow, and T cells mature in the thymus. Both B and T cells recognize and respond to particular pathogens.

Antigen Recognition

B and T cells actually recognize and respond to antigens on pathogens. Antigens are molecules that the immune system recognizes as foreign to the body. Antigens are also found on cancer cells and the cells of transplanted organs. They trigger the immune system to react against the cells that carry them. This is why a transplanted organ may be rejected by the recipient's immune system. How do B and T cells recognize specific antigens? They have receptor molecules on their surface that bind only with particular antigens.

Questions

1. What are lymphocytes? What is their function?

2. List the organs of the lymphatic system. Describe the functions of two of these organs.

3. Define B cells and T cells.

4. What are antigens?

5. How do B and T cells recognize specific antigens?

Lesson 24.2: Multiple Choice

Name_____ Class_____ Date_____

Circle the letter of the correct choice.

a. The immune response
   a. is specific to a particular pathogen.
   b. is the third line of defense.
   c. allows the immune system to "remember" the pathogen after the infection is over.
   d. all of the above

b. The immune response mainly involves the
   a. lymphatic system.
   b. spleen and tonsils.
   c. blood cells.
   d. antibodies and lymphocytes.

c. Organs of the lymphatic system include

   a. the spleen, which filters and destroys lymphocytes.
   b. the thymus, which stores and matures antibodies.
   c. bone marrow, which produces lymphocytes.
   d. all of the above.

d. Which statement concerning lymphocytes is correct?

   a. B cells mature in bone marrow, and T cells mature in the thymus, and both B and T cells recognize and respond to particular pathogens.
   b. B cells mature in bone marrow, and T cells mature in the thymus, and both B and T cells recognize and respond to particular lymphocytes.
   c. B cells mature in bone, and T cells mature in the thymus, and both B and T cells recognize and respond to particular pathogens.
   d. B cells mature in bone, and T cells mature in the thymus, and both B and T cells recognize and respond to particular lymphocytes.

e. The humoral immune response

   a. involves mainly T cells and takes place in blood and lymph.
   b. involves mainly B cells and takes place in blood and lymph.
   c. involves mainly antibodies and takes place in blood and lymph.
   d. involves mainly antigens and takes place in blood and lymph.

f. Antibodies are

   a. large, Y-shaped proteins that recognize and bind to antigens.
   b. large, X-shaped proteins that recognize and bind to antigens.
   c. large, Y-shaped proteins that recognize and bind to lymphocytes.
   d. large, X-shaped proteins that recognize and bind to lymphocytes.

g. The cell-mediated immune response

   a. involves mainly B cells and leads to the destruction of cells that are infected with lymphocytes.
   b. involves mainly T cells and leads to the destruction of cells that are infected with lymphocytes.
   c. involves mainly B cells and leads to the destruction of cells that are infected with viruses.
   d. involves mainly T cells and leads to the destruction of cells that are infected with viruses.

h. Active immunity

   a. can last a lifetime.
   b. can result from an immunization.
   c. results when an immune response to a pathogen produces memory cells.
   d. all of the above

Lesson 24.2: Vocabulary I

Name_____ **Class**_____ **Date**_____

Match the vocabulary word with the proper definition.

Definitions

_____ 1. involves mainly T cells and leads to the destruction of cells that are infected with viruses

_____ 2. involves mainly B cells and takes place in blood and lymph

_____ 3. being able to resist a pathogen that infected the body in the past

_____ 4. the deliberate exposure of a person to a pathogen in order to provoke an immune response

_____ 5. part of the immune system that produces lymphocytes

_____ 6. results when antibodies are transferred to a person who has never been exposed to the pathogen

_____ 7. the third line of defense

_____ 8. lymphocyte that matures in bone marrow

_____ 9. lymphocyte that matures in the thymus

_____ 10. results when an immune response to a pathogen produces memory cells

_____ 11. long-living plasma cells

_____ 12. the fluid that leaks out of capillaries into spaces between cells

_____ 13. the key cells involved in the immune response

_____ 14. Y-shaped proteins that recognize and bind to antigens

Terms

a. active immunity

b. antibody

c. B cell

d. cell-mediated immune response

e. humoral immune response

f. immune response

g. immunity

h. immunization

i. lymph

j. lymphatic system

k. lymphocyte

l. memory cell

m. passive immunity

n. T cell

Lesson 24.2: Vocabulary II

Name_____ Class_____ Date_____

Fill in the blank with the appropriate term.

1. The _____ line of defense is referred to as the immune response.

2. _____ are large, Y-shaped proteins that recognize and bind to antigens.

3. The lymphatic system produces leukocytes called _____.

4. _____ cells and _____ cells are the two major types of lymphocytes.

5. Lymphocytes recognize and help destroy _____ in body fluids and cells.

6. Memory B and T cells help protect the body from re-infection by pathogens that have infected the body in the past, a protection called _____.

7. The human body has as many as _____ trillion lymphocytes.

8. The _____ immune response involves mainly T cells.

9. The cell-mediated immune response leads to the destruction of cells that are infected with _____.

10. B and T cells recognize and respond to _____ on pathogens.

11. Active immunity can result from _____.

12. _____ cells are activated B cells that secrete antibodies.

13. _____ cells help launch a rapid response against the pathogen if it invades the body again in the future.

14. Organs of the lymphatic system are the bone marrow, thymus, spleen, and _____.

Lesson 24.2: Critical Writing

Name_____ **Class**_____ **Date**_____

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Define immunity, and distinguish between active and passive immunity.

24.3 Immune System Diseases

Lesson 24.3: True or False

Name_____ **Class**_____ **Date**_____

Write true if the statement is true or false if the statement is false.

_____ 1. AIDS is not a single disease but a set of diseases.

_____ 2. AIDS occurs with elevated levels of helper T cells.

_____ 3. The HIV frequently mutates and changes its surface antigens.

_____ 4. Autoimmune diseases occur when the immune system attacks itself.

_____ 5. An allergen is a disease in which the immune system makes an inflammatory response to a harmless antigen.

_____ 6. Any allergen that causes an allergy is an antigen.

_____ 7. Ragweed pollen and poison ivy are two common causes of allergies.

_____ 8. Allergies can be very dangerous, even life-threatening.

_____ 9. Histamines can reduce or eliminate the effects of the antihistamines that cause allergy symptoms.

_____ 10. Multiple sclerosis attacks the insulin-producing cells of the pancreas.

_____ 11. Systemic lupus erythematosus can attack the joints, heart, and other organs.

_____ 12. Immunodeficiency can occur naturally in older individuals.

_____ 13. Immunodeficiency can occur in people who have undergone organ transplants.

_____ 14. AIDS is a virus that attacks the immune system.

_____ 15. Because HIV screening is not accurate, donated blood can still be infected with the virus.

Lesson 24.3: Critical Reading

Name_____ **Class**_____ **Date**_____

Read these passages from the text and answer the questions that follow.

Autoimmune Diseases

Autoimmune diseases occur when the immune system fails to recognize the body's own molecules as "self," or belonging to the person. Instead, it attacks body cells as though they were dangerous pathogens. Some relatively common autoimmune diseases are listed in **Table** 24.1. These diseases cannot be cured, although they can be treated to relieve symptoms and prevent some of the long-term damage they cause.

TABLE 24.1: Autoimmune Diseases

Name of Disease	Tissues Attacked by Immune System	Results of Immune System Attack
Rheumatoid arthritis	tissues inside joints	joint damage and pain
Type 1 diabetes	insulin-producing cells of the pancreas	inability to produce insulin, high blood sugar
Multiple sclerosis	myelin sheaths of central nervous system neurons	muscle weakness, pain, fatigue
Systemic lupus erythematosus	joints, heart, other organs	joint and organ damage and pain

Why does the immune system attack body cells? In some cases, it's because of exposure to pathogens that have antigens similar to the body's own molecules. When this happens, the immune system not only attacks the pathogens. It also attacks body cells with the similar molecules.

Immunodeficiency

Immunodeficiency occurs when the immune system is not working properly. As a result, it cannot fight off pathogens that a normal immune system would be able to resist. Rarely, the problem is caused by a defective gene. More often, it is acquired during a person's lifetime. Immunodeficiency may occur for a variety of reasons:

- The immune system naturally becomes less effective as people get older. This is why older people are generally more susceptible to disease.
- The immune system may be damaged by other disorders, such as obesity or drug abuse.
- Certain medications can suppress the immune system. This is an intended effect of drugs given to people with transplanted organs. In many cases, however, it is an unwanted side effect of drugs used to treat other diseases.
- Some pathogens attack and destroy cells of the immune system. An example is the virus known as HIV. It is the most common cause of immunodeficiency in the world today.

Questions

1. What is an autoimmune disease?

2. Describe rheumatoid arthritis.

3. Why does the immune system attack body cells?

4. What is immunodeficiency?

5. Immunodeficiency may occur for a variety of reasons. Describe two of these reasons.

Lesson 24.3: Multiple Choice

Name_____ Class_____ Date_____

Circle the letter of the correct choice.

a. What is an allergy?
   a. An allergy is a disease in which the immune system makes an inflammatory response to a harmless antibody.
   b. An allergy is a disease in which the immune system makes an inflammatory response to a harmless antigen.
   c. An allergy is a disease in which the lymphatic system makes an inflammatory response to a harmless antigen.
   d. An allergy is a disease in which the immune system destroys harmless pathogens.

b. Two common causes of allergies are

a. ragweed and poison ivy.
b. ragweed and poison roses.
c. poison ragweed and ivy.
d. all of the above.

c. An autoimmune disease

a. occurs when the immune system initiates an immune response against foreign pathogens.
b. occurs when the immune system attacks the body's own pathogens.
c. occurs when the immune system fails to recognize the body's own molecules as belonging to the person.
d. occurs when the immune system fails to recognize foreign molecules as belonging to the person.

d. Type 1 diabetes

a. attacks the insulin-producing cells of the pancreas.
b. is an autoimmune disease.
c. results in high blood sugar levels.
d. all of the above

e. Causes of immunodeficiency include

a. damage of the immune system by other disorders.
b. suppression of the immune system by certain medications.
c. destruction of cells of the immune system by pathogens.
d. all of the above.

f. Which statement is true of the relationship between HIV and AIDS?

a. HIV causes AIDS.
b. AIDS causes HIV.
c. HIV and AIDS are the same disease.
d. HIV and AIDS are not related.

g. HIV transmission

a. can occur through saliva.
b. occurs through the direct contact of mucous membranes or some body fluids.
c. can occur through kissing.
d. all of the above

h. AIDS occurs

a. when helper T cells fall to a very low level.
b. about 3-5 years after an HIV infection.
c. when HIV levels match the level of helper T cells.
d. after years of damage to the immune system by helper T cells.

Lesson 24.3: Vocabulary I

Name_____ **Class**_____ **Date**_____

Match the vocabulary word with the proper definition.

Definitions

_____ 1. occur when the immune system fails to recognize the body's own molecules as "self"

_____ 2. can treat mild allergy symptoms

_____ 3. occurs when the immune system is not working properly

_____ 4. autoimmune disease that attacks central nervous system

_____ 5. destroyed by HIV infections

_____ 6. the virus that attacks cells of the immune system and causes AIDS

_____ 7. any antigen that causes an allergy

_____ 8. the most severe allergic reaction

_____ 9. autoimmune disease that attacks tissues at joints

_____ 10. a disease in which the immune system makes an inflammatory response to a harmless antigen

_____ 11. a set of diseases that results from years of damage to the immune system by HIV

Terms

a. anaphylaxis

b. antihistamines

c. AIDS

d. allergen

e. allergy

f. autoimmune disease

g. helper T cells

h. HIV

i. immunodeficiency

j. multiple sclerosis

k. rheumatoid arthritis

Lesson 24.3: Vocabulary II

Name_____ **Class**_____ **Date**_____

Fill in the blank with the appropriate term.

1. An _____ is a disease in which the immune system makes an inflammatory response to a harmless antigen.

2. Any _____ that causes an allergy is called an allergen.

3. In autoimmune diseases, the _____ system attacks body cells as though they were dangerous pathogens.

4. _____ occurs when the immune system is not working properly.

5. AIDS results from years of damage to the _____ system by HIV.

6. Many people infected with _____ eventually develop acquired immune deficiency syndrome (AIDS).

7. HIV is a _____ that attacks cells of the immune system.

8. HIV is transmitted through direct contact of _____ membranes or certain body fluids.

9. HIV is no longer transmitted through _____ transfusions.

10. HIV infects and destroys helper _____ cells.

Lesson 24.3: Critical Writing

Name_____ Class_____ Date_____

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Explain how HIV is transmitted and how it causes AIDS.

24.4 Environmental Problems and Human Health

Lesson 24.4: True or False

Name_____ **Class**_____ **Date**_____

Write true if the statement is true or false if the statement is false.

_____ 1. Most carcinogens cause cancer by producing mutations in DNA.

_____ 2. Most cancers are caused by viruses.

_____ 3. UV radiation is the leading cause of lung cancer.

_____ 4. Tumor-suppressor genes normally help control cell division.

_____ 5. More cancer deaths in adults are due to lung cancer than any other type of cancer.

_____ 6. Almost 5 million people die each year because of air pollution.

_____ 7. Oncogenes promote the division of cells with damaged DNA.

_____ 8. A low AQI value is the most hazardous.

_____ 9. Smog contains tiny particles of solids or liquids that are suspended in the air.

_____ 10. Bioterrorism is usually an accident.

_____ 11. Exposure to tobacco smoke is the leading cause of lung cancer.

_____ 12. Not smoking, or stopping smoking, can reduce your own risk of getting cancer.

Lesson 24.4: Critical Reading

Name_____ **Class**_____ **Date**_____

Read these passages from the text and answer the questions that follow.

Carcinogens and Cancer

A **carcinogen** is anything that can cause cancer. Cancer is a disease in which cells divide out of control. Most carcinogens cause cancer by producing mutations in DNA.

Types of Carcinogens

There are several different types of carcinogens. They include pathogens, radiation, and chemicals. Some carcinogens occur naturally. Others are produced by human actions.

- Viruses cause about 15 percent of all human cancers. For example, the virus called hepatitis B causes liver cancer.
- UV radiation is the leading cause of skin cancer. The radioactive gas known as radon causes lung cancer.
- Tobacco smoke contains dozens of carcinogens, including nicotine and formaldehyde. Exposure to tobacco smoke is the leading cause of lung cancer.

- Some chemicals that were previously added to foods, such as certain dyes, are now known to cause cancer. Cooking foods at very high temperatures also causes carcinogens to form.

How Cancer Occurs

Mutations that lead to cancer usually occur in genes that control the cell cycle. These include tumor-suppressor genes and proto-oncogenes.

- Tumor-suppressor genes normally prevent cells with damaged DNA from dividing. Mutations in these genes prevent them from functioning normally. As a result, cells with damaged DNA are allowed to divide.
- Proto-oncogenes normally help control cell division. Mutations in these genes turn them into oncogenes. Oncogenes promote the division of cells with damaged DNA.

Cells that divide uncontrollably may form a tumor, or abnormal mass of cells. Tumors may be benign or malignant. Benign tumors remain localized and generally do not harm health. Malignant tumors are cancerous. There are no limits to their growth, so they can invade and damage neighboring tissues. Cells from malignant tumors may also break away from the tumor and enter the bloodstream. They are carried to other parts of the body, where new tumors may form.

Questions

1. What is a carcinogen? What is cancer?

2. Describe two carcinogens.

3. What is a tumor-suppressor gene?

4. What is a proto-oncogene?

5. Discuss how a malignant tumor can cause cancer.

Lesson 24.4: Multiple Choice

Name_____ Class_____ Date_____

Circle the letter of the correct choice.

a. Which statement is true concerning cancer?
   a. Most carcinogens cause cancer by producing mutations in DNA.
   b. Cancer is a disease in which cells divide out of control.
   c. A carcinogen is anything that can cause cancer.
   d. all of the above

b. Carcinogens include
   a. viruses, which cause about 50 percent of all human cancers.
   b. UV radiation, which is the leading cause of lung cancer.
   c. exposure to tobacco smoke, which is the leading cause of skin cancer.
   d. none of the above.

c. The most common deadly cancer in the United States is
   a. skin cancer.
   b. lung cancer.
   c. breast cancer.
   d. prostate cancer.

d. Tumor-suppressor genes
   a. help cells with damaged DNA to divide.
   b. normally help control cell division.
   c. prevent cells with damaged DNA from dividing.

   d. normally help stop cell division.

e. Warning signs of cancer include

   a. a lump in the breast or elsewhere.
   b. an obvious changes in a wart or mole.
   c. an unusual bleeding or discharge.
   d. all of the above.

f. The Air Quality Index

   a. measures levels of ground-level ozone and particulates.
   b. is one of the main components of smog.
   c. is harmful to people with certain health problems, such as asthma.
   d. affects almost 5 million people each year.

g. Bioterrorism

   a. contains dozens of carcinogens, and is the leading cause of lung cancer.
   b. is the intentional release of disease causing viruses, bacteria, or other toxins.
   c. includes pollutants in the outdoor air.
   d. includes anything that causes cancer.

h. Air pollution

   a. can make asthma and other diseases more severe.
   b. can cause skin cancer.
   c. is the leading cause of lung cancer.
   d. all of the above

Lesson 24.4: Vocabulary I

Name_____ **Class**_____ **Date**_____

Match the vocabulary word with the proper definition.

Definitions

_____ 1. kills almost 5 million people die each year

_____ 2. when inhaled, replaces oxygen in the blood and quickly leads to death

_____ 3. anything that can cause cancer

_____ 4. normally help control cell division

_____ 5. contains dozens of carcinogens

_____ 6. an assessment of the pollutants in the outdoor air based on their human health effects

_____ 7. the leading cause of skin cancer

_____ 8. the intentional release or spread of agents of disease

_____ 9. normally prevent cells with damaged DNA from dividing

_____ 10. one of the main components of smog

_____ 11. cause about 15 percent of all human cancers

_____ 12. a disease in which cells divide out of control

Terms

a. Air Quality Index (AQI)

b. air pollution

c. bioterrorism

d. cancer

e. carbon monoxide

f. carcinogen

g. ozone

h. proto-oncogenes

i. tobacco smoke

j. tumor-suppressor genes

k. UV radiation

l. viruses

Lesson 24.4: Vocabulary II

Name_____ **Class**_____ **Date**_____

Fill in the blank with the appropriate term.

1. A carcinogen is anything that can cause _____.
2. There are no limits to the _____ of malignant tumors, so they can invade and damage neighboring tissues.
3. Most carcinogens cause cancer by producing _____ in DNA.
4. Exposure to _____ smoke causes lung cancer.
5. UV radiation is the leading cause of _____ cancer.
6. Air pollution harms the _____ and circulatory systems.
7. Tumor-suppressor _____ normally prevent cells with damaged DNA from dividing.
8. Proto-oncogenes normally help control cell _____.
9. _____ is the intentional release or spread of agents of disease.
10. Indoor air may contain harmful substances such as mold, _____, and radon.
11. _____ cause about 15 percent of all human cancers.
12. Cells that divide uncontrollably may form a _____.

Lesson 24.4: Critical Writing

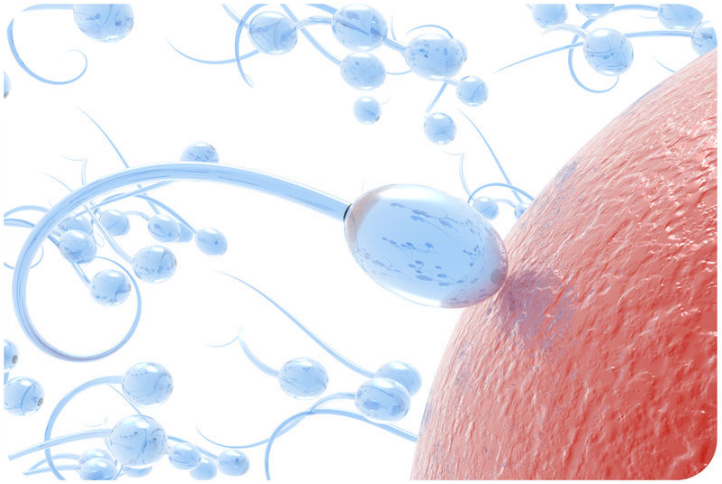
Name_____ **Class**_____ **Date**_____

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Identify two causes of air pollution and its effects on human health.

CHAPTER 25 Reproduction and Human Development Worksheets

Chapter Outline



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- **Lesson 25.1: Male Reproductive System**
- **Lesson 25.2: Female Reproductive System**
- **Lesson 25.3: From Fertilization to Old Age**
- **Lesson 25.4: Sexually Transmitted Infections**

25.1 Male Reproductive System

Lesson 25.1: True or False

Name_____ Class_____ Date_____

Write true if the statement is true or false if the statement is false.

_____ 1. A gamete is a haploid cell that combines with another haploid gamete during fertilization.

_____ 2. Each testis contains more than 90 meters of tiny, tightly packed tubules called seminiferous tubules.

_____ 3. Sperm mature and are stored in the epididymis.

_____ 4. In the first several weeks after fertilization, males and females are essentially the same.

_____ 5. Genes on the X chromosome cause male organ formation.

_____ 6. In the United States, boys generally begin puberty at about age 10 and complete it at about age 18.

_____ 7. Rapid growth occurs during puberty.

_____ 8. A sexually mature male produces hundreds of sperm each day.

_____ 9. Spermatogenesis takes between 9 and 10 weeks.

_____ 10. Sperm are produced in the epididymis and become mature in the seminiferous tubules.

_____ 11. When sperm "swim," the tail rotates like a propeller.

_____ 12. Hundreds of billions of sperm are released with each ejaculation.

_____ 13. Spermatogenesis involves both mitosis and meiosis.

_____ 14. The part of the sperm called the tip produces enzymes that help the sperm penetrate an egg.

_____ 15. Spermatogonia lining the seminiferous tubule undergo meiosis to form primary spermatocytes.

Lesson 25.1: Critical Reading

Name_____ Class_____ Date_____

Read these passages from the text and answer the questions that follow.

Sexual Development in Males

The only obvious difference between boys and girls at birth is their reproductive organs. However, even the reproductive organs start out the same in both sexes.

Development Before Birth

In the first several weeks after fertilization, males and females are essentially the same except for their chromosomes. Females have two X chromosomes (XX), and males have an X and a Y chromosome (XY). Then, during the second month after fertilization, genes on the Y chromosome of males cause the secretion of testosterone. Testosterone stimulates the reproductive organs to develop into male organs. (Without testosterone, the reproductive organs

always develop into female organs.) Although boys have male reproductive organs at birth, the organs are immature and not yet able to produce sperm or secrete testosterone.

Puberty and Its Changes

The reproductive organs grow very slowly during childhood and do not mature until puberty. **Puberty** is the period during which humans become sexually mature. In the U.S., boys generally begin puberty at about age 12 and complete it at about age 18. What causes puberty to begin? The hypothalamus in the brain "tells" the pituitary gland to secrete hormones that target the testes. The main pituitary hormone involved is **luteinizing hormone (LH)**. It stimulates the testes to secrete testosterone. Testosterone, in turn, promotes protein synthesis and growth. It brings about most of the physical changes of puberty.

Questions

1. What is the difference between the male and female chromosomes?

2. Describe the role of testosterone during development.

3. Define "puberty." When does puberty begin in boys?

4. What causes puberty to begin?

5. What is luteinizing hormone? What does it do?

Lesson 25.1: Multiple Choice

Name_____ Class_____ Date_____

Circle the letter of the correct choice.

a. Which statement best describes a gamete?

   a. A gamete is a sex cell.
   b. A gamete is a cell involved in reproduction.
   c. A gamete is a haploid reproductive cell that combines with another haploid gamete during fertilization.
   d. Gametes combine during fertilization.

b. Structures of the male reproductive system include which of the following? (1) the vas deferens, (2) the epididymis, (3) the fallopian tubes, (4) the seminiferous tubules.

   a. 1 and 2
   b. 1, 2, and 3
   c. 1, 2, and 4
   d. 1, 2, 3, and 4

c. In boys, the adolescent growth spurt

   a. is controlled by testosterone.
   b. can be about 10 centimeters per year.
   c. rapidly continues for several years.
   d. all of the above

d. During spermatogenesis,

   a. sperm are produced in the seminiferous tubules of the testes and become mature in the epididymis.
   b. sperm are produced in the epididymis of the testes and become mature in the seminiferous tubules.
   c. sperm are produced in the vas deferens of the testes and become mature in the epididymis.

d. sperm are produced in the vas deferens of the testes and become mature in the seminiferous tubules.

e. Structures of a mature sperm cell include

a. a tail.
b. the mitochondrial segment.
c. an acrosome.
d. all of the above.

f. What causes puberty to begin?

a. The secretion of testosterone from the testes.
b. The initial release of luteinizing hormone from the pituitary gland.
c. New protein synthesis and growth.
d. The development of testes.

g. The epididymis

a. is a very long coiled tube inside the scrotum.
b. is where sperm mature.
c. is where sperm are stored.
d. all of the above

h. How many sperm are released with each ejaculation?

a. hundreds
b. thousands
c. millions
d. hundreds of millions

Lesson 25.1: Vocabulary I

Name_____ **Class**_____ **Date**_____

Match the vocabulary word with the proper definition.

Definitions

_____ 1. chemical messengers that control sexual development and reproduction

_____ 2. produce sperm and secrete testosterone

_____ 3. the period during which humans become sexually mature

_____ 4. the male sex hormone

_____ 5. the process of producing mature sperm

_____ 6. stimulates the testes to secrete testosterone

_____ 7. an external male genital organ

_____ 8. where sperm mature and are stored until they leave the body

_____ 9. rapid growth during puberty

_____ 10. consists of structures that produce gametes and secrete sex hormones

_____ 11. process of releasing sperm

_____ 12. the fluid that carries sperm through the urethra

Terms

a. adolescent growth spurt

b. ejaculation

c. epididymis

d. luteinizing hormone

e. penis

f. puberty

g. reproductive system

h. semen

i. sex hormones

j. spermatogenesis

k. testis

l. testosterone

Lesson 25.1: Vocabulary II

Name_____ **Class**_____ **Date**_____

Fill in the blank with the appropriate term.

1. A _____ is a haploid cell that combines with another haploid gamete during fertilization.
2. _____ is the male sex hormone.
3. Each testis contains more than 30 meters of tiny, tightly packed _____ tubules.
4. The _____ is a coiled tube about 6 meters long lying atop the testis.
5. _____ is the fluid that carries sperm through the urethra and out of the body.
6. The two sex chromosomes in males are _____.
7. _____ is the period during which humans become sexually mature.
8. _____ are diploid, sperm-producing cells.
9. _____ hormone stimulates the testes to secrete testosterone.
10. The process of producing mature sperm is called _____.
11. After spermatids form, they mature in the _____.
12. A sexually mature male produces hundreds of _____ of sperm each day.

Lesson 25.1: Critical Writing

Name_____ **Class**_____ **Date**_____

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

A mature sperm cell has several structures that help it reach and penetrate an egg. These structures include the tail, mitochondria, and acrosome. How does each structure contribute to the sperm's function?

25.2 Female Reproductive System

Lesson 25.2: True or False

Name_____ **Class**_____ **Date**_____

Write true if the statement is true or false if the statement is false.

_____ 1. The female reproductive system breast-feeds a baby before birth.

_____ 2. The uterus is where a fetus grows and develops until birth.

_____ 3. A female produces all the eggs she will ever make before birth.

_____ 4. Just like boys, girls begin puberty around the age of 12.

_____ 5. Two pituitary hormones — follicle hormone and luteinizing-stimulating hormone — start puberty in girls.

_____ 6. Menarche is the beginning of menstruation.

_____ 7. After menstruation begins, two eggs typically matures each month — one from each ovary.

_____ 8. During oogenesis, one primary oocyte produces four mature eggs.

_____ 9. During ovulation, the follicle that protects the developing egg ruptures, and the oocyte is forced out of the ovary.

_____ 10. If fertilization is to occur, it will happen in a fallopian tube.

_____ 11. A mature egg forms only if a secondary oocyte is fertilized by a sperm.

_____ 12. During oogenesis, the cytoplasm divides equally between the resulting cells.

_____ 13. The average menstrual cycle lasts between 4 and 6 weeks.

_____ 14. During menstruation, the endometrium breaks away from the uterus and is discarded from the body.

_____ 15. Ovulation occurs around the middle of a monthly cycle.

Lesson 25.2: Critical Reading

Name_____ **Class**_____ **Date**_____

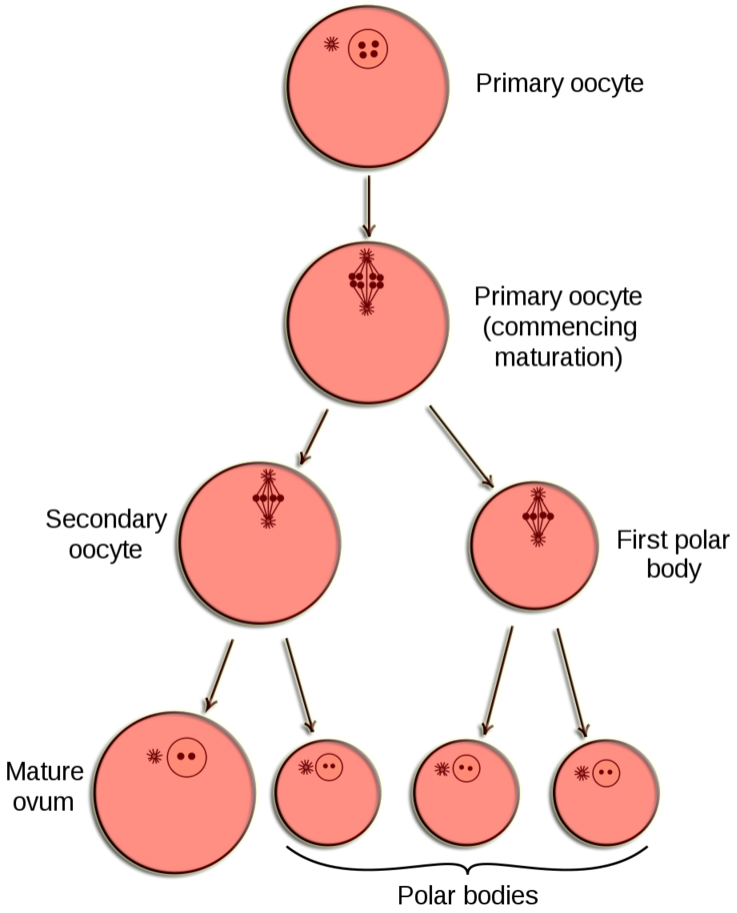
Read these passages from the text and answer the questions that follow.

Egg Production

At birth, a female's ovaries contain all the eggs she will ever produce. However, the eggs do not start to mature until she enters puberty. After menarche, one egg typically matures each month until a woman reaches middle adulthood.

Oogenesis

The process of producing eggs in the ovary is called **oogenesis**. Eggs, like sperm, are haploid cells, and their production occurs in several steps that involve different types of cells, as shown in the figure below. You can follow the process of oogenesis in the figure as you read about it below.



(Image courtesy of Mysid and under the public domain.)

Oogenesis begins long before birth when an oogonium with the diploid number of chromosomes undergoes mitosis. It produces a diploid daughter cell called a primary oocyte. The primary oocyte, in turn, starts to go through the first cell division of meiosis (meiosis I). However, it does not complete meiosis until much later. The primary oocyte remains in a resting state, nestled in a tiny, immature follicle until puberty.

Maturation of a Follicle

Beginning in puberty, each month one of the follicles and its primary oocyte starts to mature. The primary oocyte resumes meiosis and divides to form a secondary oocyte and a smaller cell, called a polar body. Both the secondary oocyte and polar body are haploid cells. The secondary oocyte has most of the cytoplasm from the original cell and is much larger than the polar body.

Ovulation and Fertilization

After 12–14 days, when the follicle is mature, it bursts open, releasing the secondary oocyte from the ovary. This event is called **ovulation**. The follicle, now called a corpus luteum, starts to degenerate, or break down. After the secondary oocyte leaves the ovary, it is swept into the nearby Fallopian tube by the waving, fringe-like end.

If the secondary oocyte is fertilized by a sperm as it is passing through the Fallopian tube, it completes meiosis and forms a mature egg and another polar body. (The polar bodies break down and disappear.) If the secondary oocyte is not fertilized, it passes into the uterus as an immature egg and soon disintegrates.

Questions

1. A man produces sperm daily after puberty. When does a women produce her eggs?

2. What is oogenesis?

3. When does the haploid egg form?

4. What is ovulation? When does ovulation occur?

5. When is meiosis competed?

Lesson 25.2: Multiple Choice

Name_____ Class_____ Date_____

Circle the letter of the correct choice.

a. Functions of the female reproductive system include

   a. receiving eggs during sexual intercourse.
   b. delivering a baby after birth.
   c. breast feeding a baby before birth.
   d. supporting the development of a fetus.

b. Female reproductive structures include which of the following? (1) the Fallopian tubes, (2) the ovaries, (3) the uterus, (4) the pelvis.

   a. 1 and 2
   b. 2 and 3
   c. 1, 2, and 3
   d. 1, 2, 3, and 4

c. Puberty in girls starts when

   a. the pituitary gland secretes estrogen, luteinizing hormone, and follicle-stimulating hormone.
   b. the pituitary gland secretes luteinizing hormone and follicle-stimulating hormone.
   c. the ovaries secrete luteinizing hormone and follicle-stimulating hormone.
   d. the ovaries secrete estrogen and follicle-stimulating hormone.

d. The correct sequence of events in the ovary is

   a. the development of the oocyte - development of the follicle - degeneration of the corpus luteum - ovulation.
   b. the development of the oocyte - development of the follicle - ovulation - degeneration of the corpus luteum.
   c. the development of the follicle - development of the oocyte - ovulation - degeneration of the corpus luteum.
   d. the development of the oocyte - ovulation - development of the follicle - degeneration of the corpus luteum.

e. The corpus luteum

   a. is the remains of the follicle after ovulation.
   b. is the remains of the ovary after ovulation.
   c. is the remains of the oocyte after ovulation.
   d. none of the above

f. During menstruation,

   a. the endometrium of the uterus is shed from the body.
   b. the uterus is shed from the body.
   c. the corpus letuem is shed from the body.
   d. excess sperm is discarded from the uterus.

g. If the egg is fertilized,

   a. the corpus letuem will be maintained and help nourish the egg.
   b. the endometrium of the uterus will be maintained and help nourish the egg.
   c. the ovary will be maintained and help nourish the egg.
   d. the oocyte will be maintained and help nourish the egg.

h. Menopause

a. is when a woman's menstrual cycles slow down and eventually stop.
b. starts in the mid to late 40s.
c. occurs and women can no longer produce eggs.
d. all of the above

Lesson 25.2: Vocabulary I

Name_____ Class_____ Date_____

Match the vocabulary word with the proper definition.

Definitions

_____ 1. a muscular organ where a fetus grows and develops until birth

_____ 2. stimulates the ovary to produce estrogen

_____ 3. external female reproductive structures

_____ 4. the process of producing eggs in the ovary

_____ 5. the female sex hormone

_____ 6. the process in which the endometrium of the uterus is shed from the body

_____ 7. a tube-like structure that receives sperm during sexual intercourse, and it provides a passageway for a baby to leave during birth

_____ 8. the beginning of menstruation

_____ 9. a period during which their menstrual cycles slow down and eventually stop

_____ 10. release of the secondary oocyte from the ovary

_____ 11. has a fringe-like structure that collects eggs from the ovary

_____ 12. typically occurs each month in a sexually mature female unless she is pregnant

Terms

a. estrogen

b. Fallopian tube

c. follicle-stimulating hormone

d. menarche

e. menopause

f. menstrual cycle

g. menstruation

h. oogenesis

i. ovulation

j. uterus

k. vagina

l. vulva

Lesson 25.2: Vocabulary II

Name_____ **Class**_____ **Date**_____

Fill in the blank with the appropriate term.

1. _____ is the female sex hormone.
2. The _____ is where a fetus grows and develops until birth.
3. From an ovary, an egg is swept into a _____ tube.
4. The two sex chromosomes in females are _____.
5. Luteinizing hormone and _____ hormone stimulate the ovary to produce estrogen.
6. Girls typically reach their adult height by about age _____.
7. Menarche is the beginning of _____.
8. After puberty, once a month a follicle matures and its primary oocyte resumes _____.
9. When the follicle is mature, the secondary oocyte is released in a process called _____.
10. Menstruation is the process in which the endometrium of the _____ is shed from the body.
11. The process of producing eggs in the ovary is called _____.
12. At birth, a female's ovaries contain all the _____ she will ever produce.
13. Ovulation occurs around day _____ of the monthly menstrual cycle.
14. After _____, ovaries no longer produce eggs.

Lesson 25.2: Critical Writing

Name_____ **Class**_____ **Date**_____

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Describe the phases of the menstrual cycle.

25.3 From Fertilization to Old Age

Lesson 25.3: True or False

Name_____ Class_____ Date_____

Write true if the statement is true or false if the statement is false.

_____ 1. An egg will only complete meiosis if fertilized.

_____ 2. During fertilization, the nuclei of the egg and sperm fuse, and the resulting diploid cell is the zygote.

_____ 3. Cleavage refers to a series of cell division soon after fertilization resulting in a ball of cells called a morula.

_____ 4. The blastocyst has three cell layers: the ectoderm, the mesoderm, and the endoderm.

_____ 5. Differentiation is the process by which specialized cells become unspecialized.

_____ 6. The mesoderm develops into muscle tissue.

_____ 7. From the end of the eighth week until birth, the developing organism is referred to as an embryo.

_____ 8. Birth typically occurs at about 40 weeks after fertilization.

_____ 9. The placenta delivers oxygen and nutrients from the fetus to the mother.

_____ 10. The fetus is connected to the placenta through the umbilical cord.

_____ 11. The pregnant mother must avoid toxic substances such as alcohol.

_____ 12. Most people over 65 have mood swings because of surging hormones.

_____ 13. By age 4, most children speak fluently and are learning to read and write.

_____ 14. Adolescence is the period of transition between the beginning of puberty and adulthood.

_____ 15. Infants have well-developed senses of touch, hearing, and smell.

Lesson 25.3: Critical Reading

Name_____ Class_____ Date_____

Read these passages from the text and answer the questions that follow.

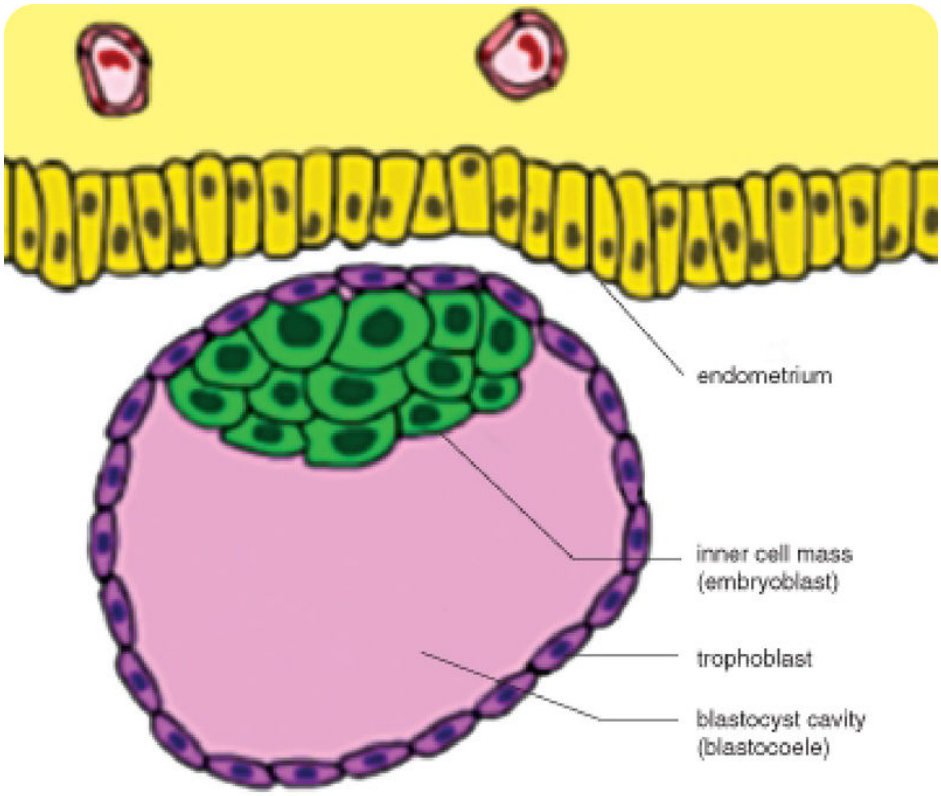
Cleavage and Implantation

When a sperm penetrates the egg, it triggers the egg to complete meiosis. The sperm also undergoes changes. Its tail falls off, and its nucleus fuses with the nucleus of the egg. The resulting cell, called a zygote, contains all the chromosomes needed for a new human organism. Half the chromosomes come from the egg and half from the sperm.

Morula and Blastocyst Stages

The zygote spends the next few days traveling down the Fallopian tube toward the uterus, where it will take up residence. As it travels, it divides by mitosis several times to form a ball of cells called a morula. The cell divisions

are called cleavage. They increase the number of cells but not the overall size of the new organism. As more cell divisions occur, a fluid-filled cavity forms inside the ball of cells. At this stage, the ball of cells is called a **blastocyst**. The cells of the blastocyst form an inner cell mass and an outer cell layer, as shown in the figure below. The inner cell mass is called the embryoblast. These cells will soon develop into an embryo. The outer cell layer is called the trophoblast. These cells will develop into other structures needed to support and nourish the embryo.



Blastocyst. The blastocyst consists of an outer layer of cells called the trophoblast and an inner cell mass called the embryoblast. *(This image is under GNU-FDL 1.2.)*

Implantation

The blastocyst continues down the Fallopian tube and reaches the uterus about 4 or 5 days after fertilization. When the outer cells of the blastocyst contact cells of the endometrium lining the uterus, the blastocyst embeds in the endometrium. The process of embedding is called **implantation**. It generally occurs about a week after fertilization.

Questions

1. Describe a zygote.

2. What is a morula?

3. What is a blastocyst? Describe the blastocyst.

4. What is implantation? When does implantation occur?

Lesson 25.3: Multiple Choice

Name_____ Class_____ Date_____

Circle the letter of the correct choice.

a. Fertilization takes place in

   a. a Fallopian tube.
   b. the uterus.
   c. the egg.
   d. a zygote.

b. Which is the correct order of events?

   a. implantation - formation of the morula - formation of the blastocyst - cleavage
   b. cleavage - formation of the morula - formation of the blastocyst - implantation
   c. cleavage - formation of the blastocyst - formation of the morula - implantation
   d. implantation - formation of the blastocyst - formation of the morula - cleavage

c. The blastocyst is

   a. the ball of cells that forms after implantation.
   b. the initial ball of cells that develops from the zygote.
   c. a ball of cells with a fluid-filled cavity that forms a few days after fertilization.
   d. the inner cell mass of cells that forms the embryo.

d. After implantation occurs, the developing organism is called

   a. an embryoblast.
   b. an embryo.
   c. a fetus.
   d. a baby.

e. The initial three distinct cell layers in the developing organisms include

   a. the endoderm.
   b. the ectoderm.
   c. the mesoderm.
   d. all of the above.

f. During embryonic development, which event occurs first?

   a. The lungs begin to form.
   b. The heart begins to beat.
   c. The face begins to look human.
   d. The eyes start to form.

g. The placenta

   a. is an enclosed membrane that surrounds and protects the fetus.
   b. is made up of a large mass of blood vessels from both the mother and fetus.
   c. mixes the mother's and fetus's blood to exchange substances.
   d. allows the fetus to move freely.

h. Adolescence is the period of transition between the beginning of puberty and adulthood. During adolescence, individuals

   a. may have mood swings because of surging hormones.
   b. usually become more attached to their parents.
   c. generally develop the ability to think.
   d. all of the above

Lesson 25.3: Vocabulary I

Name_____ **Class**_____ **Date**_____

Match the vocabulary word with the proper definition.

Definitions

_____ 1. ball of cells that forms soon after fertilization

_____ 2. developing organism from the end of the eighth week until birth

_____ 3. the first year of life after birth

_____ 4. the period of transition between the beginning of puberty and adulthood

_____ 5. the process by which unspecialized cells become specialized

_____ 6. the carrying of one or more offspring from fertilization until birth

_____ 7. a temporary organ that allows the exchange of substances between the mother and fetus

_____ 8. the process of childbirth

_____ 9. ball of cells with a fluid-filled cavity

_____ 10. an enclosed membrane that surrounds and protects the fetus

_____ 11. the first cell of the new organism

_____ 12. stage of cell divisions that occurs soon after fertilization

_____ 13. the blastocyst after implantation

_____ 14. the process of embedding the blastocyst into the uterus

Terms

a. adolescence

b. amniotic sac

c. blastocyst

d. cleavage

e. differentiation

f. embryo

g. fetus

h. implantation

i. infancy

j. labor

k. morula

l. placenta

m. pregnancy

n. zygote

Lesson 25.3: Vocabulary II

Name_____ **Class**_____ **Date**_____

Fill in the blank with the appropriate term.

1. Fertilization occurs in a _____ tube.

2. When a sperm penetrates the egg, it triggers the egg to complete _____.

3. The cell that results from fertilization is called a _____.

4. A _____ is a ball of cells with a fluid-filled cavity that forms a few days after fertilization.

5. _____ is the process of embedding the blastocyst into the uterus lining.

6. After implantation occurs, the blastocyst is called an _____.

7. The three distinct cell layers of the embryo are the _____, mesoderm, and endoderm.

8. _____ is the process by which unspecialized cells become specialized.

9. From the end of the eighth week until birth, the developing organism is referred to as a _____.

10. Birth typically occurs at about _____ weeks after fertilization.

11. The _____ provides oxygen and nutrients to the developing fetus.

12. The _____ is an enclosed membrane that surrounds and protects the fetus.

13. _____ is the first year of life after birth.

14. _____ is the period of transition between the beginning of puberty and adulthood.

Lesson 25.3: Critical Writing

Name_____ **Class**_____ **Date**_____

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Explain how the embryo forms specialized cells and organs.

25.4 Sexually Transmitted Infections

Lesson 25.4: True or False

Name_____ Class_____ Date_____

Write true if the statement is true or false if the statement is false.

_____ 1. A sexually transmitted infection is an infection that spreads mainly through sexual contact.

_____ 2. The common cold can be considered a STI.

_____ 3. Most STIs are caused by viruses or bacteria.

_____ 4. Viral STIs can be cured with antibiotics.

_____ 5. Many STIs can be transmitted through blood and semen.

_____ 6. STIs become more common the older a person gets.

_____ 7. Some of the most common bacterial STIs are chlamydia, gonorrhea, trichomoniasis, and syphilis.

_____ 8. Using condoms can prevent acquiring a STI.

_____ 9. Chlamydia is the most common STI in the United States.

_____ 10. Many more young women get chlamydia then young men.

_____ 11. The human papilloma virus can cause cancer of the uterus in females.

_____ 12. A PAP test can detect cervical cancer.

Lesson 25.4: Critical Reading

Name_____ Class_____ Date_____

Read these passages from the text and answer the questions that follow.

Understanding Sexually Transmitted Infections

To be considered a sexually transmitted infection (STI), an infection must have only a small chance of spreading naturally in ways other than sexual contact. Some infections that can spread through sexual contact, such as the common cold, spread more commonly by other means. These infections are not considered STIs.

Pathogens that Cause STIs

STIs may be caused by several different types of pathogens, including protozoa, insects, bacteria, and viruses. For example: Protozoa cause an STI called **trichomoniasis**. The pathogen infects the vagina in females and the urethra in males, causing symptoms such as burning and itching. Trichomoniasis is common in young people. Pubic lice are insect parasites that are transmitted sexually. They suck the blood of their host and irritate the skin in the pubic area.

Most STIs are caused by bacteria or viruses. Several of them are described below. Bacterial STIs can be cured with antibiotics. Viral STIs cannot be cured. Once you are infected with a viral STI, you are likely to be infected for life.

How STIs Spread

Most of the pathogens that cause STIs enter the body through mucous membranes of the reproductive organs. All sexual behaviors that involve contact between mucous membranes put a person at risk for infection. This includes vaginal, anal, and oral sexual behaviors. Many STIs can also be transmitted through body fluids such as blood, semen, and breast milk. Therefore, behaviors such as sharing injection or tattoo needles are another way these STIs can spread. Why are STIs common in young people? One reason is that young people often take risks. They may think, "It can't happen to me." They also may not know how STIs are spread, so they don't know how to protect themselves. In addition, young people may have multiple sexual partners.

Preventing STIs

The only completely effective way to prevent infection with STIs is to avoid sexual contact and other risky behaviors. Using condoms can lower the risk of becoming infected with STIs during some types of sexual activity. However, condoms are not foolproof. Pathogens may be present on areas of the body not covered by condoms. Condoms can also break or be used incorrectly.

Questions

1. What is a sexually transmitted infection? What causes most STIs?

2. Describe trichomoniasis.

3. How are pathogens that cause STIs transmitted?

4. What are two ways to prevent STIs? What is the main difference between the two methods discussed in the text?

Lesson 25.4: Multiple Choice

Name_____ Class_____ Date_____

Circle the letter of the correct choice.

a. A 2008 study had found that one in _____ teen girls in the U.S. had a sexually transmitted infection.

   a. two
   b. four
   c. ten
   d. twenty

b. Pubic lice

   a. are insect parasites that are transmitted sexually.
   b. irritate the skin in the pubic area.
   c. suck the blood of their host.
   d. all of the above

c. Most of the pathogens that cause STIs enter the body through

   a. any mucous membrane.
   b. the mouth.
   c. mucous membranes of the reproductive organs.
   d. body fluids such as blood, semen, and breast milk.

d. Bacterial STIs include

   a. genital herpes, gonorrhea, and syphilis.
   b. chlamydia, gonorrhea, and syphilis.
   c. hepatitis B and genital herpes.
   d. chlamydia, hepatitis B, and genital warts.

e. Infection with HPV

   a. can be prevented with a vaccine.
   b. can cause hepatitis B.
   c. is very common in young men.
   d. all of the above

f. Syphilis

   a. can cause serious damage to the heart, brain, and other organs.
   b. causes small sores on or near the genitals.
   c. if untreated, may eventually lead to death.
   d. all of the above

g. The most likely population to get chlamydia is

a. 20 - 24 year old females.
b. 20 - 24 year old males.
c. 15 - 19 year old females.
d. 25 - 29 year old females.

Lesson 25.4: Vocabulary I

Name_____ Class_____ Date_____

Match the vocabulary word with the proper definition.

Definitions

_____ 1. inflammation of the liver

_____ 2. symptoms include painful blisters on the genitals

_____ 3. small, rough growths on the genitals

_____ 4. includes protozoa, insects, bacteria, and viruses

_____ 5. caused by protozoa

_____ 6. the most common STI in the United States

_____ 7. STI whose symptoms include painful urination and discharge from the vagina or penis

_____ 8. STI that can cause serious damage to the heart and brain

_____ 9. may cause genital warts

_____ 10. an infection caused by a pathogen that spreads mainly through sexual contact

Terms

a. chlamydia

b. genital herpes

c. genital warts

d. gonorrhea

e. hepatitis B

f. human papilloma virus

g. pathogens

h. sexually transmitted infection

i. syphilis

j. trichomoniasis

Lesson 25.4: Vocabulary II

Name_____ Class_____ Date_____

Fill in the blank with the appropriate term.

1. A sexually transmitted infection is an infection caused by a pathogen that spreads mainly through _____-_ contact.

2. Worldwide, a _____ people a day become infected with STIs.

3. STIs may be caused by several different types of _____ , including protozoa, insects, bacteria, and viruses.

4. Bacterial STIs can be cured with _____ .

5. Viral STIs _____ be cured.

6. Most of the pathogens that cause STIs enter the body through _____ membranes of the reproductive organs.

7. Many STIs can also be transmitted through _____ such as blood, semen, and breast milk.

8. Some of the most common bacterial STIs are chlamydia, _____ , and syphilis.

9. _____ is the most common STI in the United States.

10. The human papillomavirus may cause _____ of the cervix in females.

Lesson 25.4: Critical Writing

Name_____ Class_____ Date_____

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Explain what causes STIs and how they can be prevented.