Rourke's World of Science

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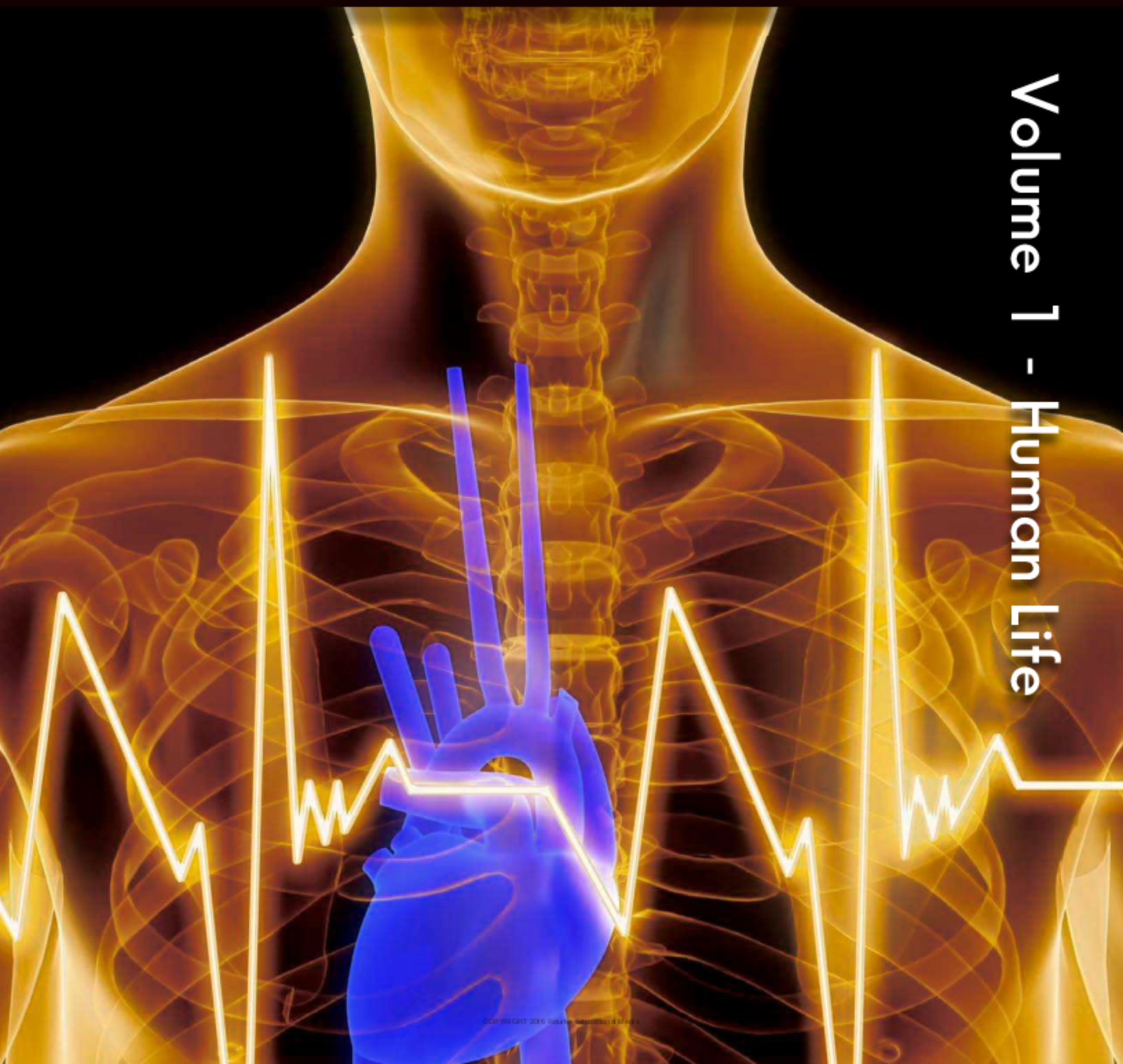

Volume 1 - Human Life

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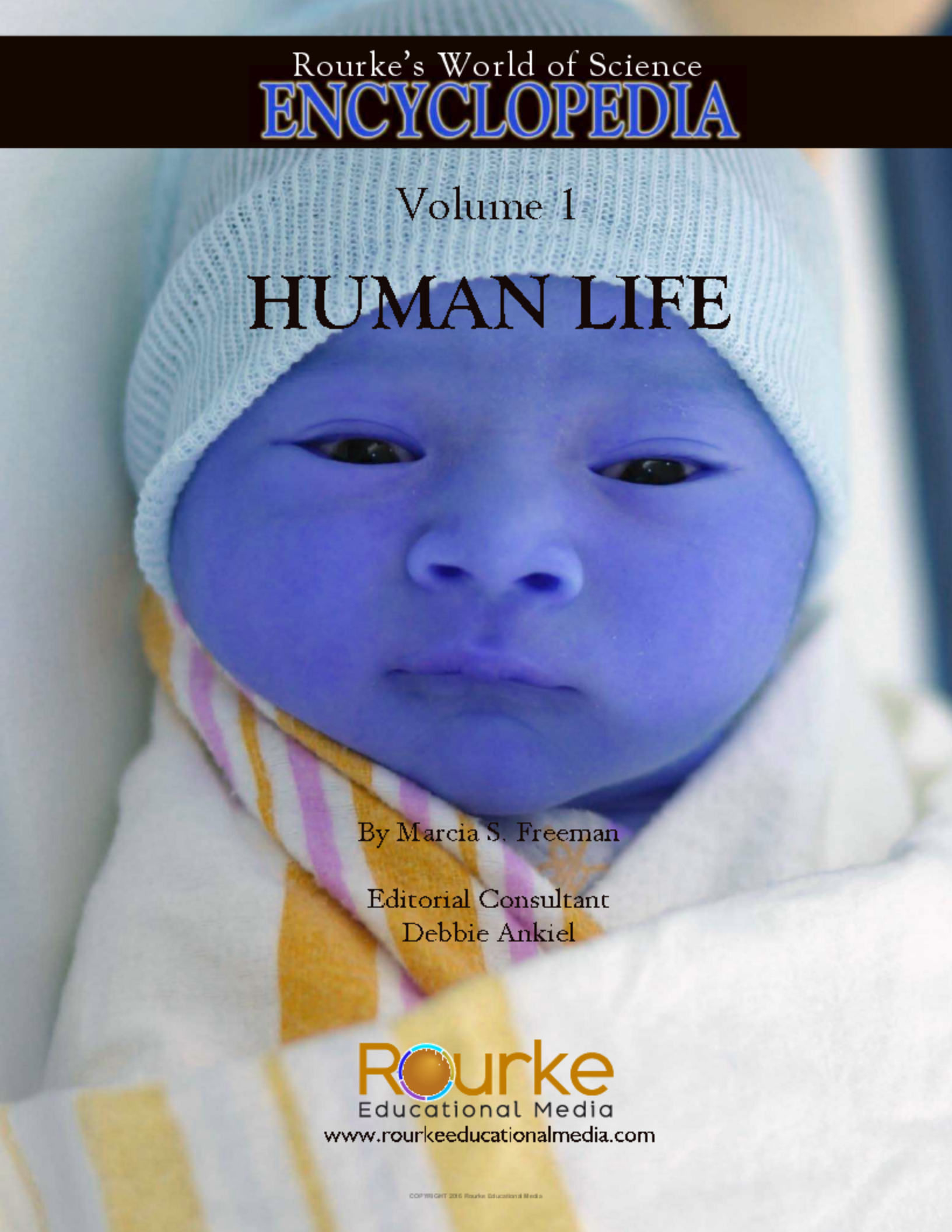
Volume 1

HUMAN LIFE



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What Is Life?

Look around you. All the stuff, or matter, in the world is either living or non-living. Stuff such as rocks, metals, plastic, water, and air are non-living.

Living things include plants and animals, humans and other mammals, insects, birds, and reptiles. Add the living things such as worms and millipedes in the soil, and the fish, crustaceans, and such in the sea. Add all the living organisms that are too small for you to see like the bacteria, molds, and viruses. The world is teeming with life.

Different forms of life are alike in many ways. They all need water and energy to live, grow, and reproduce. Green plants make their own food but animals need to eat. They both convert, or turn, food into energy. Most living things need oxygen and water.

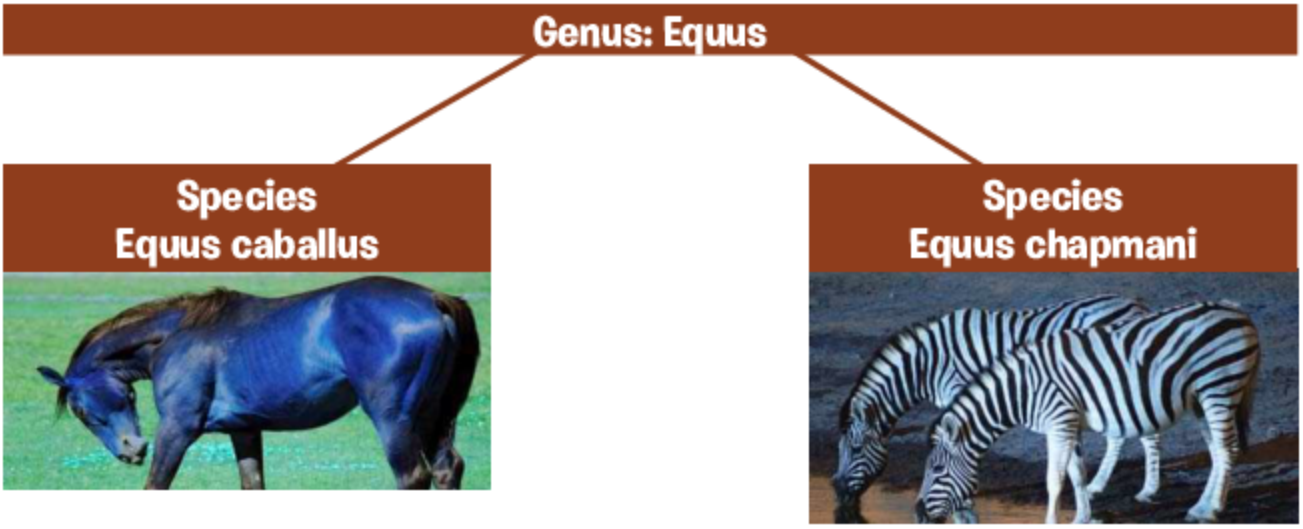
The girl and the plants and animals around her are living things. The paper bag she is holding is non-living.

You should drink about 64 ounces (1.9 liters) of water every day.

Classifying Living Things

Classification is how scientists organize and name plants and animals. When scientists discover a new animal or plant, they compare it to similar living things. Then they place the new specimen in a group with which it shares the most attributes, or characteristics. Scientists divide living things into kingdoms, phyla and subphyla, classes, orders, families,

genus, and species. Each group describes the attributes of the living thing in more detail. All known plants and animals have scientific names. Each Latin scientific name tells us the living thing's genus and species. A horse's scientific name is *Equus caballus* and a zebra's is *Equus chapmani*. They are in the same genus.



Linnaeus (1707-1778)

Getting to know...

Linnaeus was born in Sweden in 1707. We know him by his Latin name, Carolus Linnaeus. Linnaeus was interested in nature and plants. He taught himself about biology and botany, the study of plants.

He devised a system to classify all the plants and animals known at that time. He described living things and grouped them by their shared physical characteristics. For instance, he put animals with backbones, or vertebrae, in one group and those without a backbone in another. He put animals that laid eggs in one group and those that bear live young in another.

Linnaeus gave each group and each kind of living thing a Latin name made up of two descriptive words. Scientists refer to this system as the binomial (two names) system of nomenclature (naming).

In 1735 he published a series of books, *Systema Naturae* which described and named all the animals and plants known at that time. Scientists today still use his binomial classification system to organize and understand all living things.

Humans

What was once the stuff of science fiction is now turning into fact. Thanks to remarkable advances in scientists' understanding of stem cells, genes, bioengineering, and molecular pathways, we may soon be able to keep ourselves in shape and live longer than we ever thought possible.

Scientists classify humans in the animal kingdom. We belong to the subphylum Vertebrata. This means that we have spines or backbones. We are in the class Mammalia (mammals), animals that nurse their young. Humans are in the order Primates. They are omnivores with opposing thumbs and a big brain. The genus and species name for human beings is *Homo sapiens*. These Latin words mean *man* and *knowing*.

Characteristics of Primates

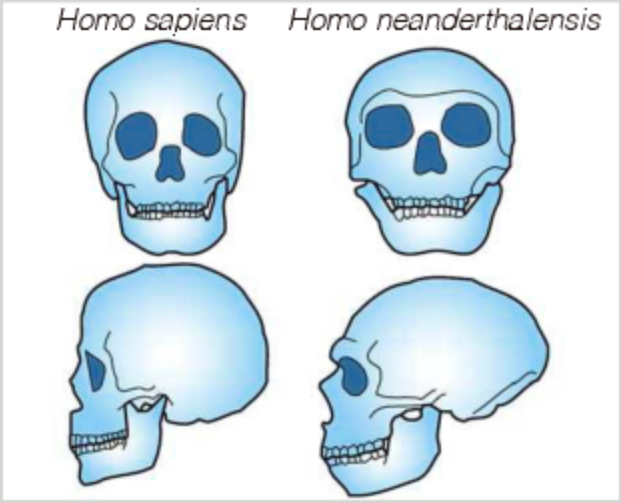
- tendency towards walking upright on two feet
- having five fingers and five toes
- opposing thumbs
- flexible shoulder joints and strong collarbones, or clavicles
- binocular vision - using both eyes to produce three dimensional (3-D) view
- omnivorous - eating both plants and animals
- long gestation (pregnancy) periods for animals of their size
- social behavior - spending time with each other
- large brain size relative to body
- vocalization - producing a variety of sounds from vocal cords

Early Humans

Long before *Homo sapiens*, there were other types of human-like primates, or humanoids, called *Homo neanderthalensis*. They had thick bones and smaller brains than *Homo sapiens*. Scientists found evidence that they used some tools.

Scientists believe that modern *Homo sapiens* evolved from *Homo erectus*. *Homo erectus* comes from the Latin words for man and upright. *Homo erectus* had a larger brain than the Neanderthals. Scientists have found evidence that they used stone tools for hunting and cooking food.

Homo sapiens began to appear 250,000 years ago in Africa, Europe, and Asia. Over time, they spread to America and Australia. They had even larger brains than *Homo erectus* and smaller jaws and teeth. *Homo sapiens* developed language to communicate with one another.



Skull comparisons

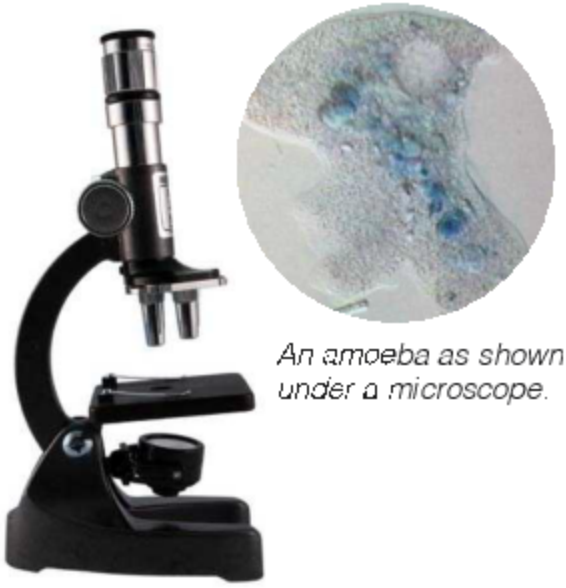
The Human Body: Organs and Systems

Your body is like a complex machine. Many parts make up your body and work to keep you going. Some parts, like your eyes and hands, are easy to see. Some parts, like your vocal cords, are inside your body. When you hum, the vibrations you feel are your vocal cords at work.

Some parts of the body are so small you can't see them without a microscope. Cells are the basic structural units of our body. Tissues form an organ. Organs work together as a system. Your heart, lungs, and brain are examples of organs. A group of organs work together to form a system such as the digestive system.

Cells

Cells make up all living things. Some microscopic organisms, such as amoeba and paramecium, consist of just a single cell. But most animals have millions of cells.



An amoeba as shown under a microscope.

Groups of cells make up tissue. Tissue forms organs. Organs work together as systems.

Words to know

evolve (i-VOLV): to change slowly

humanoid (HYOO-min-oyd): having human-like characteristics

specimen (SPESS-uh-muhn): a sample or an example used to stand for the whole group

successive (suhk-SESS-iv): following in a logical or sequential order

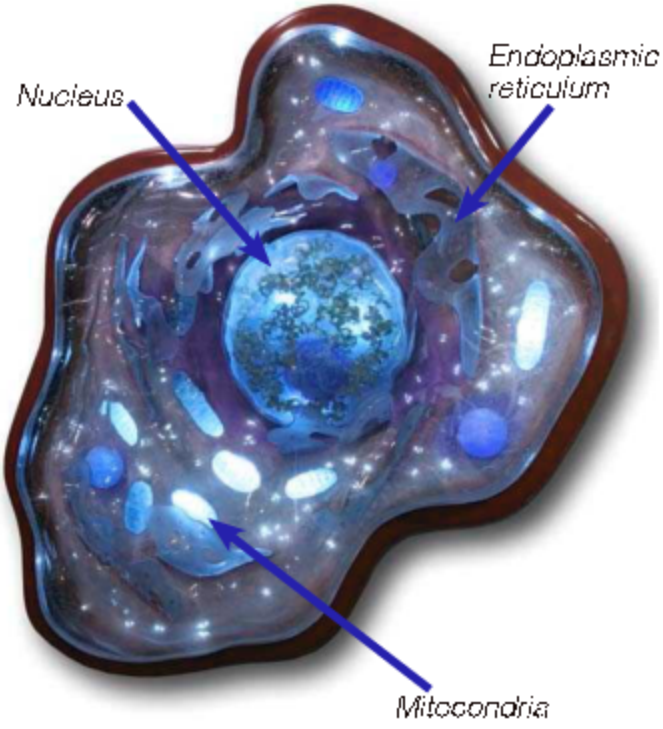
teem (teem): to be very full, to swarm

A jelly-like substance called protoplasm fills every cell. A thin cell membrane surrounds the protoplasm (picture a plastic baggie filled with jelly). Plant cells differ in that they have walls of cellulose outside the membrane. The cell membrane allows water, oxygen, and nutrients to come in and carbon dioxide and other wastes to go out.

Organelles

In addition, most cells contain specialized parts, main organelles, that have specific jobs. The cells contain a nucleus, mitochondria, and an endoplasmic reticulum.

The nucleus contains the genetic material that controls what each part of the cell does. Mitochondria are "cellular power plants" that convert food to energy. The endoplasmic reticulum (*endo* means inside) is a folded membrane that makes proteins and fat.



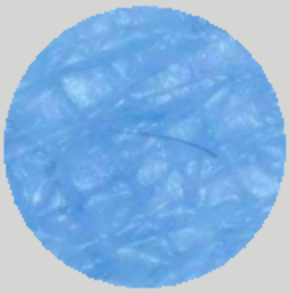
The Nerves and Brain

Your nerves, spinal cord, and brain form the nervous system. Long, thin neurons or nerve cells make this system work.

Many neurons make a strand to form long nerves. Between the ends

Find out more

Your outer skin cells, hair, toenails, and fingernails, are all dead cells.



Magnified view of human skin.

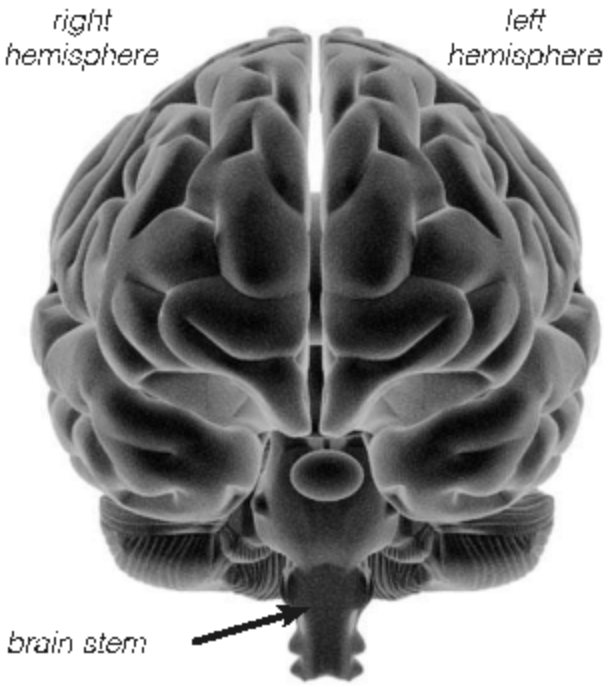
Several layers of cells make up your skin, the largest organ of your body. The living and active cells are in the bottom layers, closest to the blood supply. The living cells at the bottom layer are gradually being pushed up to the surface and eventually die there. Meanwhile, the cells at the bottom layer continue to divide to replace those that have been shed. Every four weeks, you have grown a completely new skin!

of each neuron in a strand is a gap, or synapse. Electrical signals, to and from the brain, travel along a nerve and are converted into chemical signals across the synapse.

Brain Areas

The brain has two sides, or hemispheres. The left hemisphere controls the right side of the body. The right hemisphere controls the left side of the body. The brain is so complex that scientists are always learning new things about what all of its parts do.

The lower part of the brain is the brain stem. It controls involuntary functions, such as breathing and blinking. These functions happen without you having to think about them.



This 3D MRI scan shows a front view of a brain, clearly showing the two hemispheres.

The middle part of the brain is the cerebellum. It controls balance and movement of muscles. Electrical signals start in the brain, travel along nerves in the spinal cord inside your spine, and then out to your muscles. Many muscles work together for the body to walk, eat, or play the drums.

The upper and inner part of the brain is the cerebrum. It responds to the electrical signals from your eyes, ears, and other sense organs. The cerebrum processes the signals, turning them into sights, sounds, smells, tastes, and sensations. The cerebrum also controls thought, memories, and speech.

Injury to some parts of the brain can make people forget things. They may even forget who they are. In some cases of brain damage, the individual must learn how to walk, speak, or read again.

Words to know

axon (AK-sohn): the nerve process that carries signals away from the nerve cell body; also called nerve fiber

involuntary (in-VOL-uhn-ter-ee): done without a person's control

respond (ri-SPOND): to react to something

strand (strand): something that looks like a thread or string

synapse (SIN-apse): the junction across which a nerve impulse passes from one axon to another

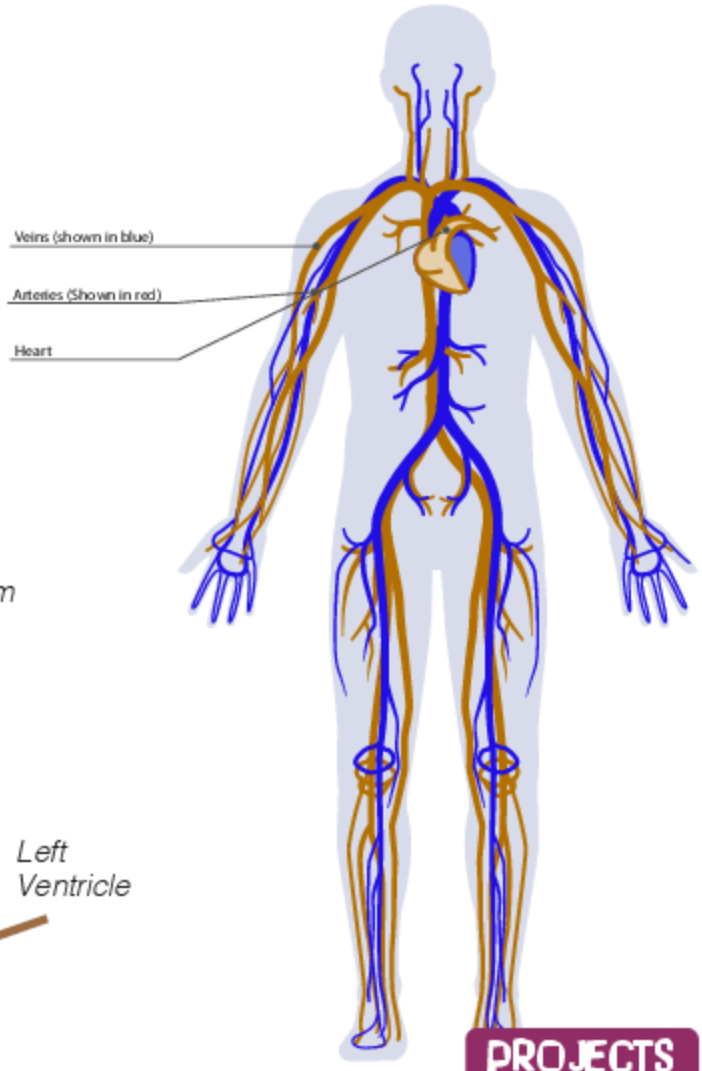
The Heart and Blood

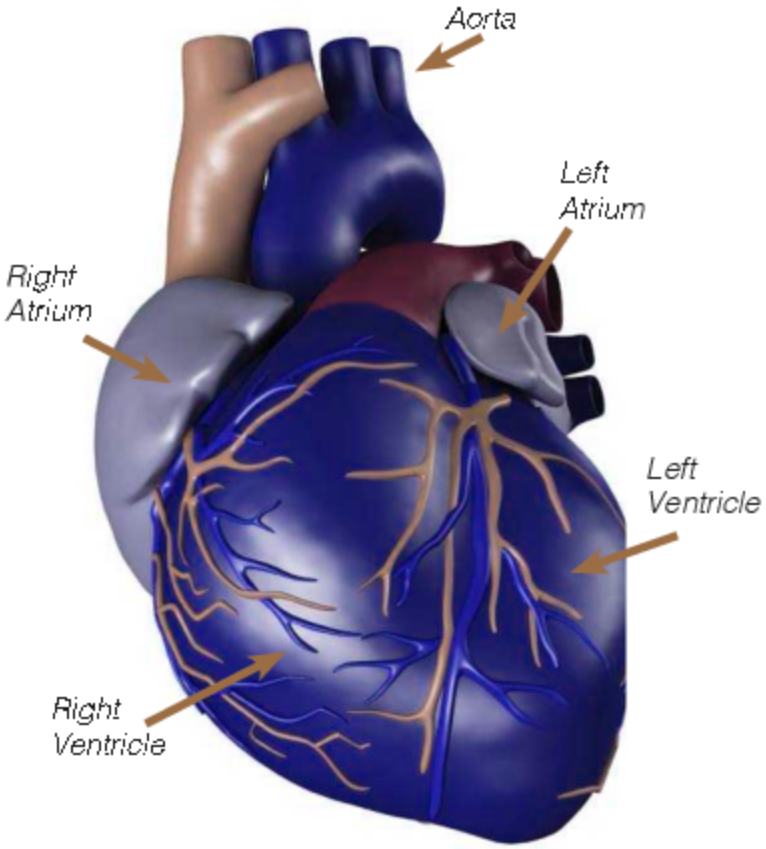
Your heart and blood vessels are in charge of your blood's circulation. The heart, a large and strong muscle, is the pump. It consists of four chambers: right and left atriums and right and left ventricles. The atriums receive blood and the ventricles send blood out.

The heart squeezes, or contracts, many times in a minute to keep blood flowing to all parts of the body. You can feel your heartbeat. Place your fingers gently on the side of your neck below the chin. You should feel a repetitive beat or pulse.

Blood Vessels

Arteries are the blood vessels that carry blood from the heart to the rest of your body. Veins are the blood vessels that bring the blood back to the heart. The blood vessels closest to the heart are larger than the ones that supply your organs and your arms and legs.





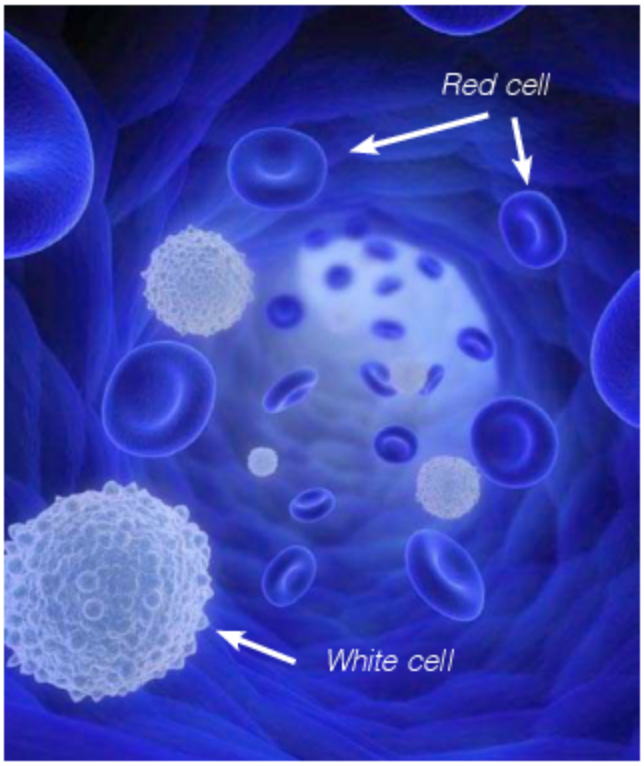
The arteries and veins eventually end in small blood vessels called capillaries. They are the blood vessels at the cellular level, delivering oxygen and nutrients and carrying away carbon dioxide and waste products. The capillaries are so thin that blood cells travel through them in a single file.

Blood Cells and Plasma

Red blood cells and white blood cells in a yellow liquid, or fluid, called plasma is what makes up your blood. You can see plasma if you have a blister. The liquid in the blister is plasma.

A red blood cell (erythrocyte) is doughnut shaped and does not have a nucleus. It contains hemoglobin, a special substance that carries oxygen. White blood cells (leukocytes) come in various sizes and shapes and have a nucleus. White blood cells fight infection and disease. They attack the microscopic organisms we call germs.

Plasma, the liquid part of the blood, contains platelets (thrombocytes) that help blood clot when blood vessels are injured. The blood must clot or the body cannot heal itself.



If you looked at your blood through a microscope, the red and white cells would look like this.

Find out more

Hemophilia, an inherited disease, is a condition in which a person's blood will not clot at all. A person with hemophilia must be very careful. It is hard to stop the bleeding even on a very small cut.

Words to know

circulation (sur-kyuh-LAY-shun): the movement of blood in blood vessels through the body

clot (klot): to become thicker and more solid

inherit (in-HER-it): passed down through genes from parent to child

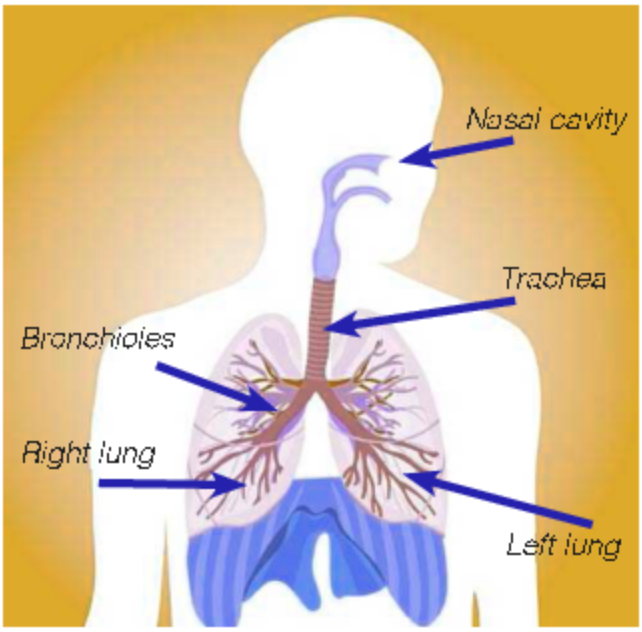
The Lungs

Two lungs and a windpipe, or trachea, primarily make up your respiratory system. The system delivers oxygen to your cells and carries away carbon dioxide.

Breathing

When you breathe in, air moves down your throat through the trachea (windpipe). The trachea branches out into smaller and smaller tubes called bronchioles. They end finally, deep in your lungs, in little round sacs called alveoli. These look like bunches of grapes. Capillaries crisscross the very thin walls of the alveoli. Your capillaries transport the red blood cells that carry oxygen.

When you breathe out, air comes from your lungs and out your nose or mouth. Breathing is the only way your body gets oxygen (O_2) and gets rid of the carbon dioxide (CO_2) produced by your body's cells.




Your body breathes in oxygen and breathes out carbon dioxide

Breathing becomes difficult if the passages become smaller, or constrict. This is what happens in the disease called asthma.

You can still breathe with one damaged lung but not if you damage both lungs. Smoking and breathing fumes or chemicals can damage your lungs irreparably.

Words to know

- **capillary** (KAP-uh-ler-ee): the smallest blood vessels in your body
- **carbon dioxide** (KAR-buhn dye-OK-side): a gaseous chemical compound of oxygen and carbon
- **irreparable** (ihr-REP-er-uh-buhl): not able to be repaired
- **oxygen** (OK-suh-juhn): a colorless gas component of air
- **passage** (PASS-ij): a hall, tube, or tunnel

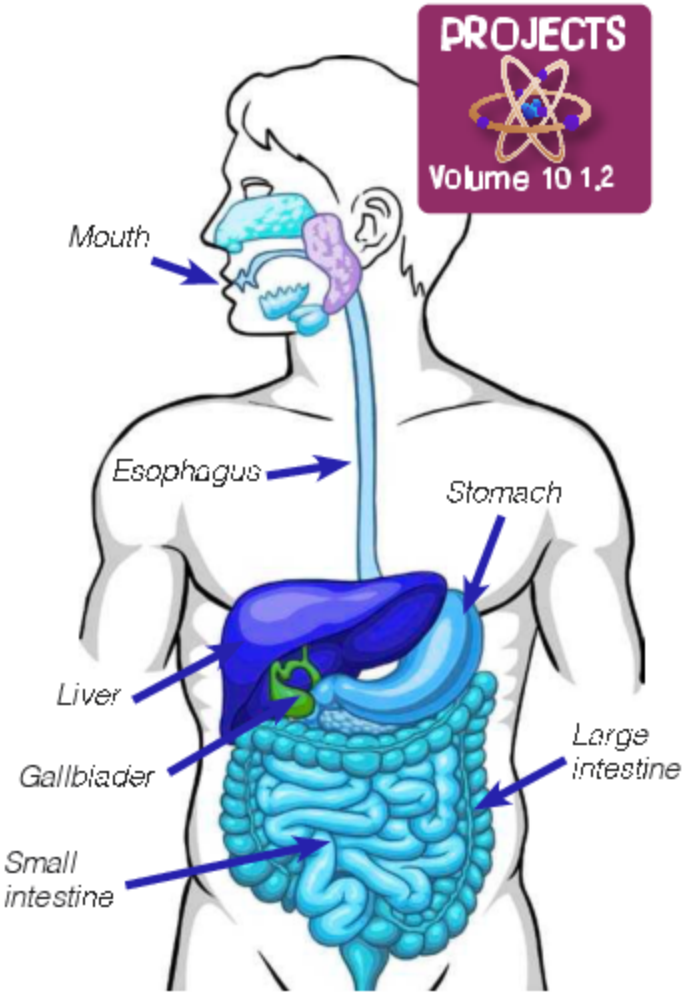
The Stomach and Intestines

The stomach and small and large intestines make up most of the gastro-intestinal system. The prefix *gastro* means stomach. Your mouth, salivary glands, esophagus, liver, gallbladder and pancreas are also important parts of the GI (short for gastro-intestinal) system.

We also call this system the digestive system because it breaks down, or digests, the food you eat. As you begin to chew your food, enzymes go to work by helping break down your food. When you chew and swallow, food travels down your esophagus. The esophagus ends at a large sack-like organ called the stomach.

The food then moves into the small intestine and finally into the large intestine.

After you swallow food, muscles in your esophagus move it down into your stomach.

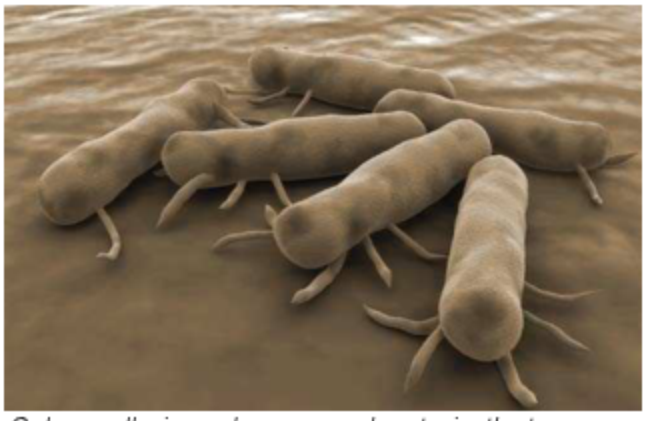


The intestines, known also as guts, are tubes with muscles and capillaries lining their walls. The intestine walls are as thin as plastic wrap. Digested food, broken down into small molecules, passes into the capillaries.

Food that is not fully digested nor absorbed in the small intestine enters the large intestine, or colon. The lowest part of the large intestine is the rectum. The remaining undigested food forms the feces. Feces leave the body through an opening called the anus.

When Digestion Goes Wrong (Bellyaches)

Sometimes, your stomach and intestines may hurt. If you ate food that contained harmful bacteria, food



Salmonella is a dangerous bacteria that causes food poisoning. This is how it looks when viewed through a microscope.

poisoning is causing the pain. When the body tries to get rid of the toxins produced by the bacteria, it moves the food quickly through the intestines. The feces retain a lot of water that would normally be absorbed. We call this diarrhea.

The opposite of diarrhea is constipation. Constipation is when food moves too slowly through the digestive tract, or system, and the undigested food becomes dry and hard.

Words to know

absorb (ab-SORB): the transfer of nutrients from small intestine to the circulatory system for distribution to body cells

bacteria (bak-TIHR-ee-uh): microscopic living things that exist all around you and inside you

toxin (TOK-sin): a poisonous substance

Bones and Muscles

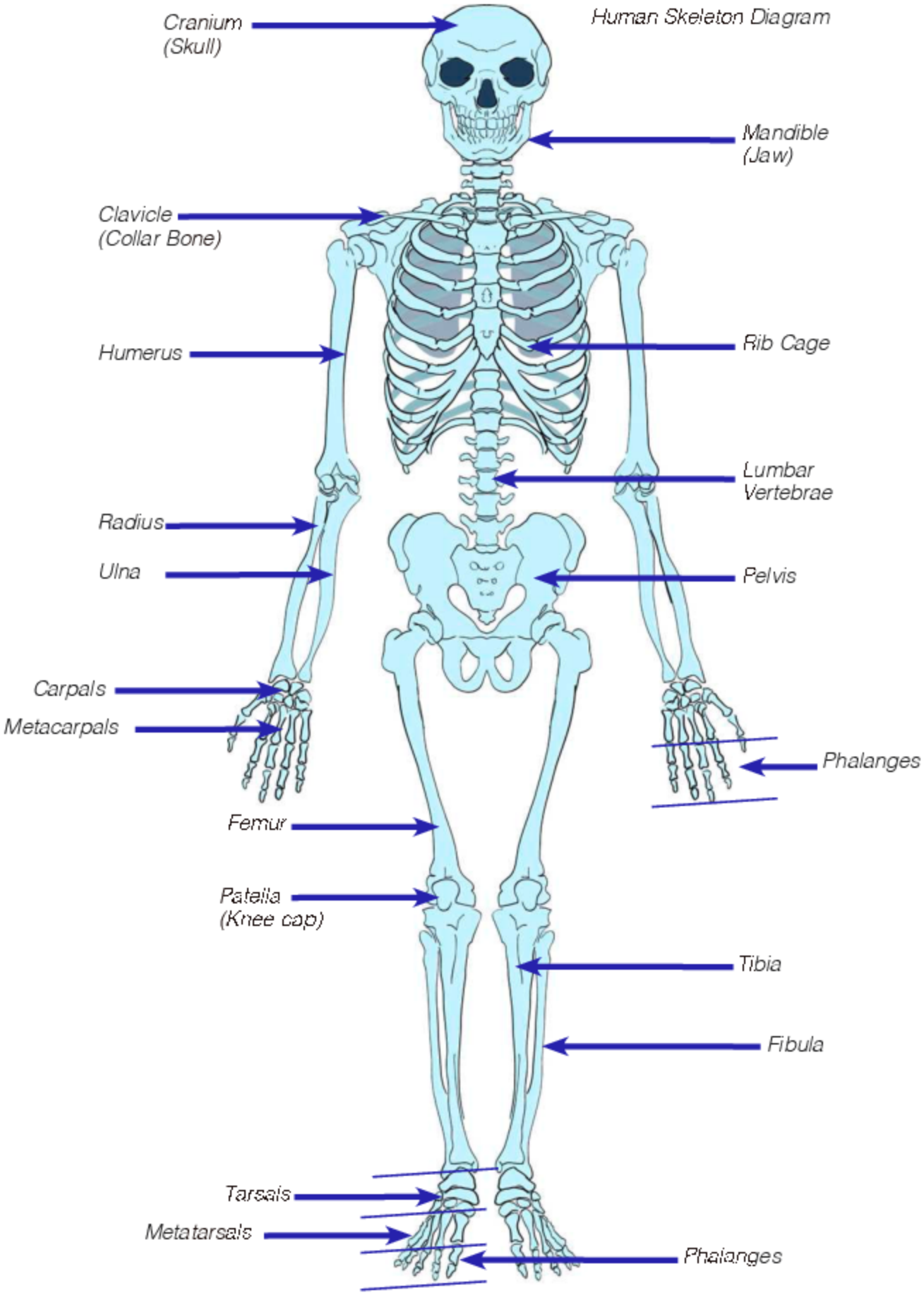
Two hundred and six bones form your skeleton. The skeleton is a framework that supports the rest of your body.

Bones

The outside of a bone is hard. Many bones end in smooth cartilage, a tough but softer tissue. The end of your nose is cartilage. Many bones are hollow and filled with a gooey material called marrow that produces blood cells.

Some bones provide protection for the nervous system. The skull protects your brain. The vertebrae that form your spine protect your spinal cord. Your ribs form a cage to protect your heart and lungs.

Ribs protect the heart and lungs.



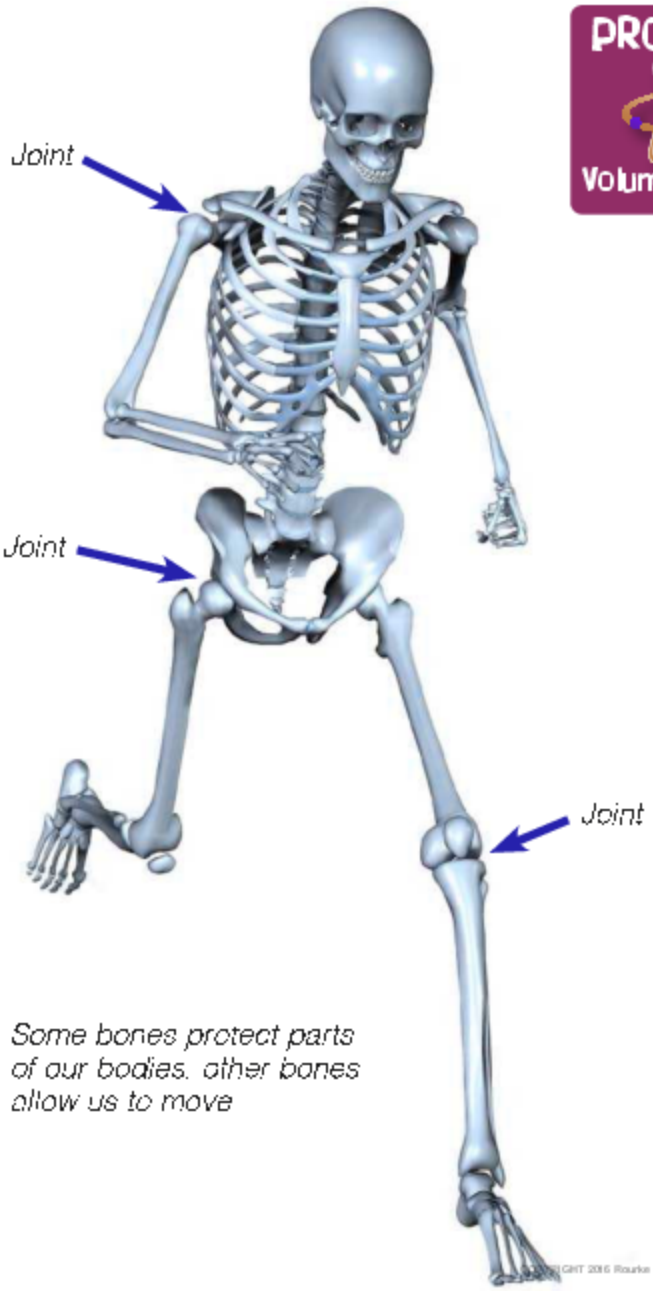
Joints

Other bones allow you to move. Ligaments attach bones together at joints. Ligaments are stiff, slightly elastic tissue. Soft cushion-like discs between each set of vertebrae allow your spine to bend and twist.

Muscles

Skeletal muscles move your bones and give your body its shape. Tendons are a tough, rubbery tissue that attaches your muscles to your bones. A muscle contracts when it receives a signal from your brain. When the muscle contracts, the attached bones move. Together muscles, tendons, and bones work to help your body move.

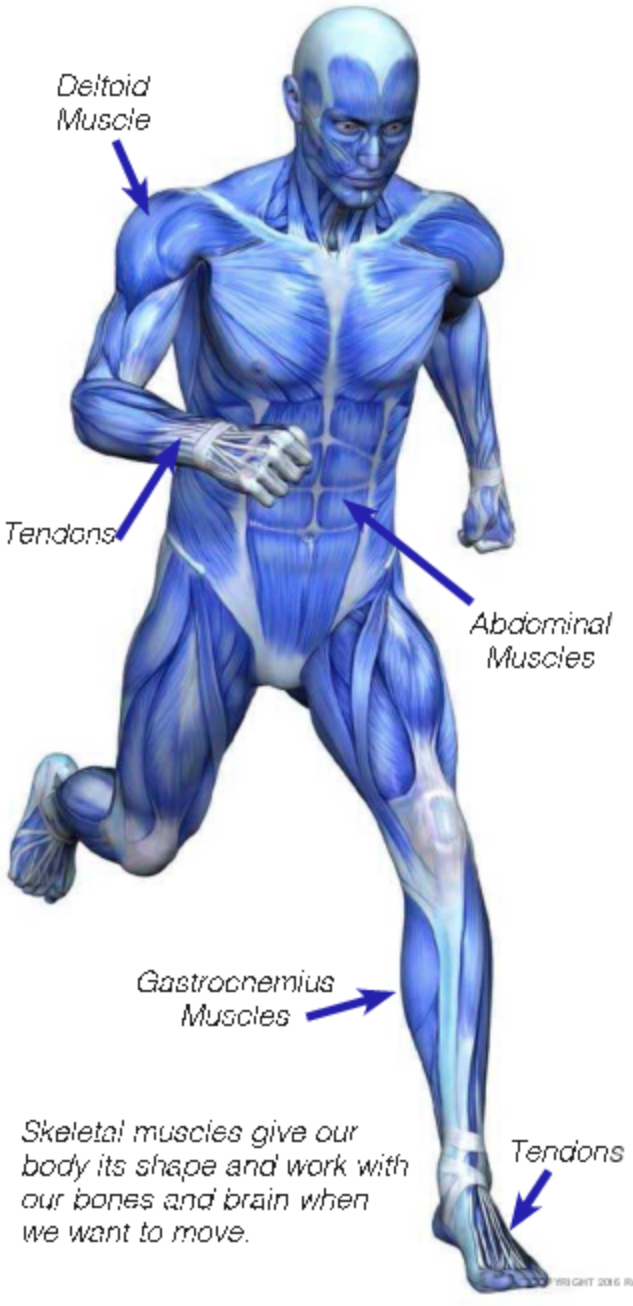
Involuntary Muscles work without you thinking about them. For example, smooth muscles that line your intestines keep food moving through.



Some bones protect parts of our bodies. other bones allow us to move

The smooth muscles in arteries control the flow of blood. The cardiac muscle beats, or contracts, in a regular way called a rhythm.

Muscle at Any Age: As we age, we all lose muscle mass, usually about 1 percent a year after age 40. But scientists have slowed or reversed this process in animals by retuning the network of genes that regulate the activity of myostatin, a protein affecting muscle growth. With less myostatin, lab animals pack on muscle—becoming, in the words of the scientists, "Schwarzenegger mice," and remain buff even into their old age. In people, the idea is to help us hold on to the muscle we already have. Tests on patients with muscle diseases are now being conducted.



Skeletal muscles give our body its shape and work with our bones and brain when we want to move.

Find out more

Exercise keeps you healthy and strong. You can do two kinds of exercise. Aerobic exercise is one kind. Walking fast, running, jumping rope, or dancing, are all aerobic. During aerobic exercise your heart and breathing rates speed up to get oxygen to your muscles. Aerobic exercise burns carbohydrates and fats. Regular aerobic exercise keeps your heart and lungs working well.

The other kind of exercise is anaerobic. Lifting weights is anaerobic. This kind of exercise makes your muscles bigger and your bones stronger. It is best to do both aerobic and anaerobic exercises. This will give you a healthy heart and strong bones and muscles.

Words to know

contract (kuhn-TRAKT): to get smaller

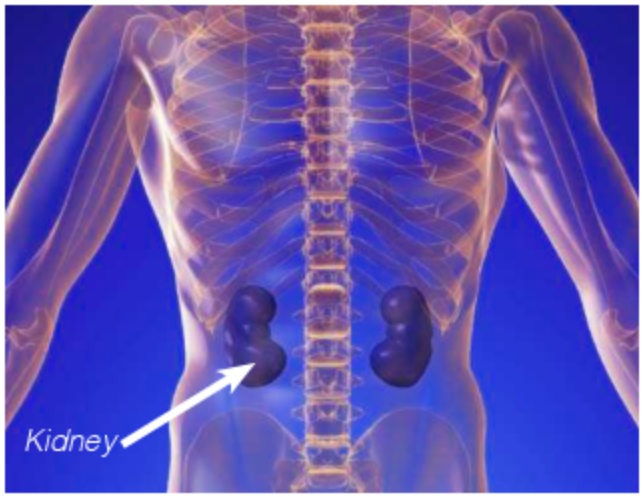
involuntary (in-VOL-uhn-ter-ee): done without a person's control

regular (REG-yuh-lur): happening or reoccurring at the same time

vertebrae (VUR-tuh-bray): the individual bones of the spine

The Kidneys and Bladder

Your kidneys, ureter, urinary bladder, and urethra form your urinary system. This system regulates, or controls, the amount of water in your body. Your two kidneys are on the left and right sides of your spine, and below your rib cage.



The kidneys take out excess salts and cellular waste products as blood circulates, or flows, through them. The remaining liquid, made up of water and the waste products, is urine. The urine travels in a tube called the ureter to the bladder. The bladder keeps the urine until it leaves the body through another tube, the urethra.

Find out more

About 190 quarts (180 liters) of water filters through your kidneys every day, but only about 1.6 quarts (1.5 liters) finally leaves your body as urine.

Infections or Misfunctions

Things can go wrong in our organs. Medical researchers find or invent things to solve organ problems. Doctors use this information to treat their patients.

- **If you develop a kidney or bladder infection:** Doctors may use antibiotics to fight the germs.
- **If your kidneys don't remove waste products correctly:** You may have to use a dialysis machine to do the work of the kidneys.
- **If both kidneys have damage or stop working:** Doctors can transplant a kidney from another person or donor. The donor survives because people can live with just one kidney.

Words to know

donor (DOH-nur): someone who gives something

organ (OR-guhn): a part of the body that does a specific job

salt (sawlt) a chemical compound formed from an acid and a base

transplant (transs-PLANT): to surgically replace a diseased organ with a healthy one

The Reproductive Organs

All animals reproduce. In most animals, adult males and females mate, and the union of a sperm and an egg produces an offspring. Each egg and each sperm carries one half of each parent's genetic material.

Organs

The organs and body parts that produce the sperm and egg make up the reproductive system. They also allow for mating and provide for the development and nurturing of the resulting young.

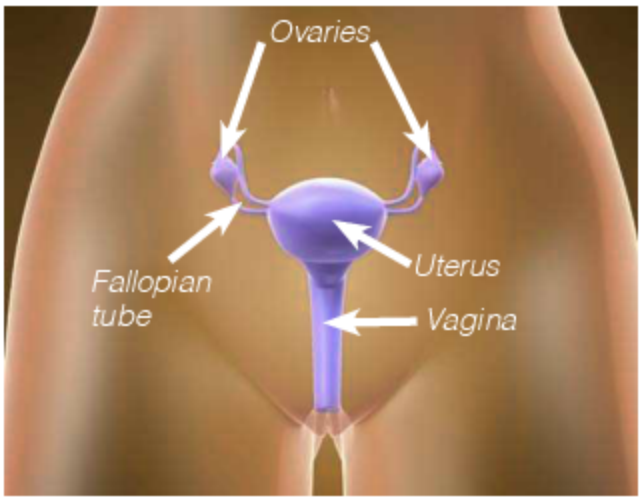
Women produce eggs. Two ovaries produce the eggs. Every month during ovulation, an egg leaves one of the ovaries. (The Latin word for egg is *ova*.) It travels down the fallopian tube and enters the uterus.

Each month, the uterus wall prepares to receive the egg by building up an extra blood supply. An egg fertilized by a sperm will attach to the wall of the uterus and develop into an embryo and subsequently, a fetus.

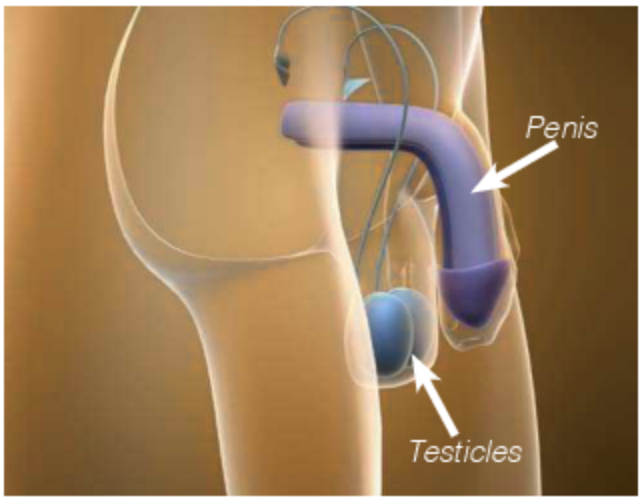
An unfertilized egg will break down. It, and the extra blood, will leave the body through a tube called the vagina. Menses, or menstruation, is the shedding of the unfertilized egg and the extra blood from the uterus.

Men produce sperm. Two organs called testicles, or testes, make the sperm cells. A sac called the scrotum protects the testicles. Sperm leave the body through the urethra in the penis.

3 Dimensional Ovaries? In 2009, researchers created a fully functional ovary in a specialized petri dish. Earlier attempts had foundered on the difficulties of growing the many types of cells that make up an ovary, but, using a petri dish that allows cells to develop in 3-D, scientists at Brown University managed to produce all the necessary elements. And when egg cells were implanted in the ovary, they matured. It's hoped that artificial ovaries could preserve fertility in some women whose ovaries were not working properly or damaged by cysts, not allowing them to have a child.



Female reproductive organs



Male reproductive organs

Hormones

Besides producing eggs and sperm, the ovaries and testes produce the hormones that determine female and male characteristics. These characteristics involve body hair, beards, breasts, and larynx (vocal cords), as well as muscular and skeletal growth.

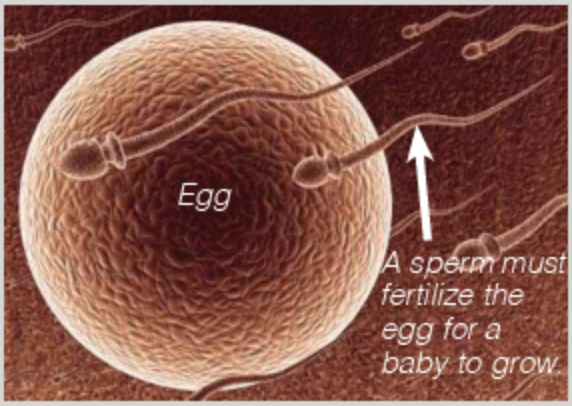
Men grow hair on their face because of a hormone called testosterone.

Words to know

- **genetic material** (juh-NET-ik muh-TIHR-ee-uhl): the cell parts that carry the biological instructions (chromosomes, genes, and DNA)
- **hormone** (HOR-mohn): a chemical substance produced in body glands that controls growth and development
- **mate** (mate): to join together for reproduction
- **nurture** (NUR-chur): to take care of
- **shed** (shed): to fall out, to give off

Find out more

The single fertilized egg cell divides and multiplies into millions of cells, forming all the tissues and organs of a new human in the nine months before birth.



Doctors can take photos of a baby inside its mother with an ultrasound machine.

A model shows a baby inside its mother.

How the Body Works

All the organs and systems of your body work together. When they work correctly you move, you fight off germs and diseases, you heal, you learn, you grow, and you age. In other words, you live.

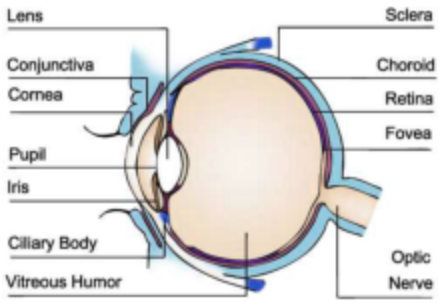
The Senses

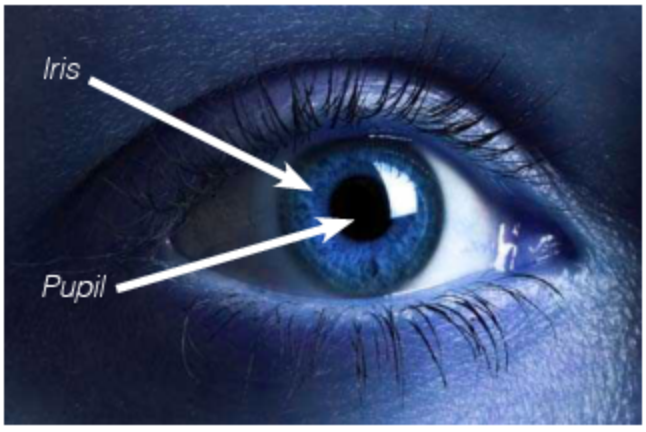
The senses are one way you and your body learn about the world around you. The five senses are sight, hearing, taste, smell, and touch. A different organ controls each sense. Your sensory organs are your eyes, ears, tongue, nose, and your skin and its nerves.

Sight

What you can see of your eyeball is the white covering, some tiny blood vessels, and the iris. The iris is the colored donut-shaped circle with a black hole in the middle. That black hole is your pupil. Light enters the eye through the pupil. Because the ring of the iris is a muscle, it can contract or expand, making the pupil change in size. This regulates how much light comes into the eye.

The parts of the eye you cannot see are the clear lens in the pupil, the retina, and the vitreous fluid.





The clear lens brings light to an area at the back of your eyeball, called the retina. The iris muscles and the cornea, which is a clear layer that covers the eye, hold the lens in place.

The retina is made of two different kinds of cells, called rods and cones. These cells change light into electrical signals to send to the brain via the optic nerve.

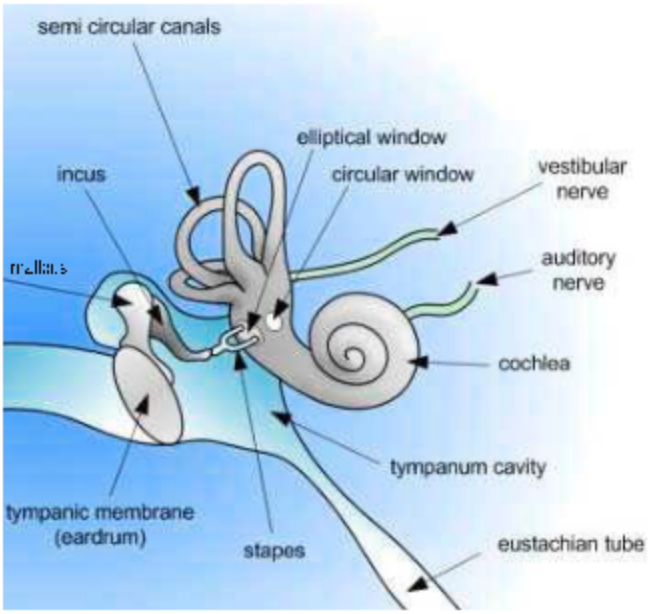
The vitreous fluid is a jelly-like fluid that fills the eyeball, maintaining its round shape.

Hearing

Your ears turn sounds into signals for the sense of hearing. We can only see the outer part of the ear. Sounds in the air travel to a membrane called the eardrum. The eardrum vibrates when sounds hit it.

The middle part of the ear has three tiny bones called ossicles. The ossicles pass on the vibrations to the inner ear. The cochlea, in the inner ear, contains hair-like cells that convert sound waves into electrical signals. The signals travel to the brain via the auditory nerve.

The inner ear also helps us keep our balance and walk erect on two feet. If you have ever suffered an ear infection, you may have found that you lost your balance during the illness.



Inside a human ear

Smell and Taste

The senses of smell and taste are connected. Sensory receptor cells are in your nose and mouth. They respond to chemicals in the air and in food. They generate electrical signals from their interaction with the chemical molecules.

The receptors for smell are in both the nose and mouth. Smell is important for the sense of taste. You may not be able to taste food when you have a cold.

The receptors for taste are the taste buds on your tongue. The four basic tastes you perceive are sweet, bitter, sour, and salty.

Nasal Spray That Boosts Your Memory New research from Harvard and Tel Aviv Universities, devised a nasal vaccine that activated immune cells in the brain that cleared away

waxy plaques from blood vessels—plaque believed to contribute to Alzheimer's disease. After receiving the sniffable vaccine, mice with a genetic predisposition to Alzheimer's had fewer plaque deposits and performed much better on mouse memory tests.

Lollipops usually have a sweet taste.

Lemons have a sour taste.

Touch

The sense of touch includes pressure, cold, warmth, and pain. Different receptors in the skin respond to different types of touch. They allow us to distinguish between rubbing and pressure, to identify shapes and textures of things, and to feel the temperature around us or of objects touching us.

Find out more

Sometimes when all the senses do not function right, our other senses become more acute. People with limited or no sense of sight can use their sense of touch to learn about their environment. They can read using the Braille system, which converts our alphabet into raised bumps.

Words to know

acute (uh-KYOOT): able to detect things easily

membrane (mem-BRAYN): a very thin layer of tissue that lines or covers organs or cells

molecule (MOL-uh-kyool): the smallest part of a substance that displays the characteristics of that substance

via (vye-uh): by way of

Circulation

Circulation is the movement of blood through your body. The circulatory system is actually two systems, systemic and pulmonary circulation. Pulmonary circulation carries oxygen depleted blood to the lungs. Systemic circulation carries oxygenated blood to the body. Blood moves through your body when your heart and skeletal muscles contract. The job of your circulation system is to bring oxygen and food to your cells and take away the waste products of metabolism.

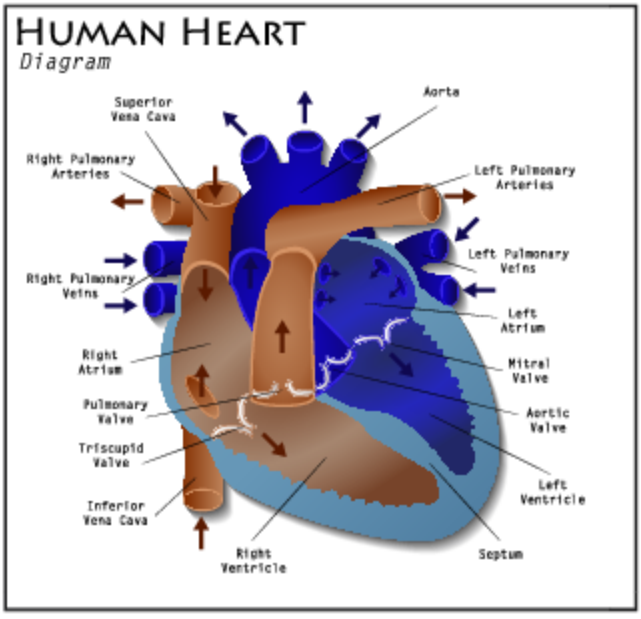
Arteries

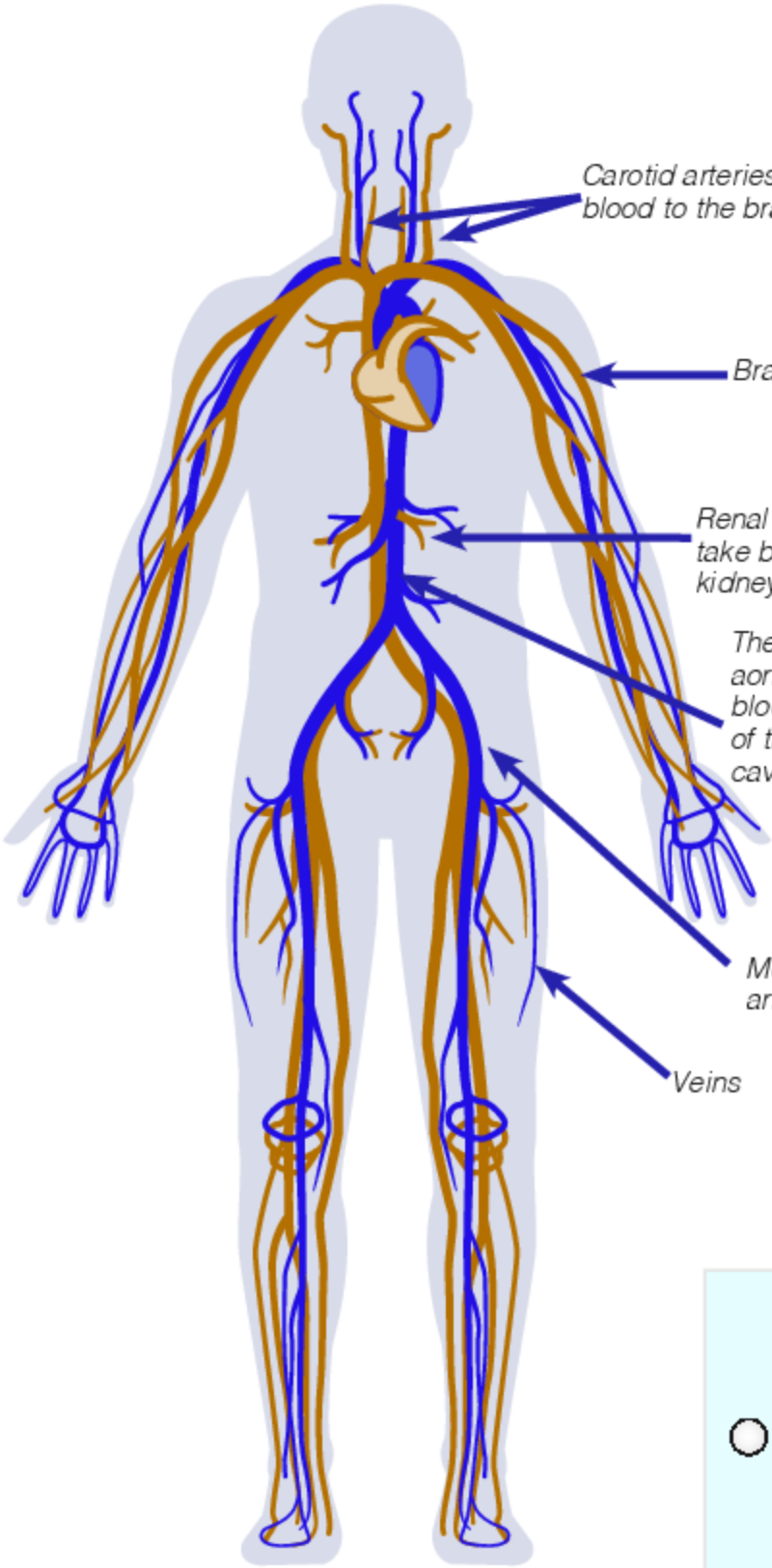
Let's follow your blood on its journey through the body. We will start in the lungs where it picks up oxygen. From the lungs, blood travels through the pulmonary vein to the left atrium of the heart. It passes through a valve into the left ventricle. It travels out the aorta, the largest artery in your body. The aorta divides into smaller and smaller arteries that connect to millions of capillaries. The capillaries supply the body's cells.

Veins

At the cells, the blood's red blood cells give up the oxygen and pick up carbon dioxide. Now, the blood returns to the heart. The capillaries connect to small veins. The small veins join larger and larger veins.

The two largest veins, called the *venae cavae*, merge just before they enter the right atrium of the heart. The blood they carry passes through a valve into the right ventricle. The right ventricle pumps the blood out the pulmonary artery into the lungs. The lungs take carbon dioxide from the blood and put in oxygen. The blood returns to the left atrium. The trip starts all over again.





Average Heart Rates Of Animals

In beats per minute

Large Whale: 20
Elephant: 25
Horse: 44
Giraffe: 65
Large Dog: 75
Humans: 60 -70
Small dog: 100
Cat: 150
Rabbit: 205
Hamster: 450
Mouse: 500

(Notice the relationship between the heart rate and size of animals)

Words to know

contract (kuhn-TRAKT): to get smaller

merge (murj): to join together to become one thing

metabolism (muh-TAB-uh-liz-uhm): the process of changing food, water, and oxygen into energy and body cells

Respiration

Respiration is another word for breathing. Most living things need oxygen (O_2) to produce energy from the food they take in. Your body cells convert food and oxygen to energy in a process called metabolism. Carbon dioxide (CO_2) is a by-product of metabolism. Your lungs are the organs taking in O_2 and getting rid of the CO_2.

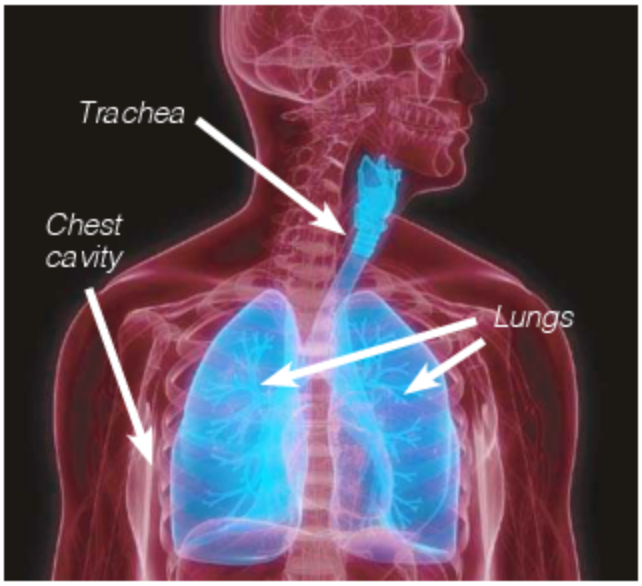
Lungs at Work

A large muscle (diaphragm), located at the bottom of your chest, controls breathing. When you inhale, your diaphragm contracts and moves downward. That creates a vacuum. Air comes in through your nose or mouth to fill that vacuum.

Air travels down the trachea into your lungs. The muscles in the wall of your chest also help you inhale by expanding the chest cavity.

A voice teacher shows a student how to breathe from her diaphragm.

The air travels deeper into the lungs through the bronchi and bronchioles. When it gets into the grape-like sacs, called alveoli, oxygen in the air moves into the blood through the capillaries. At the same time, carbon dioxide moves out of the blood and into the alveoli.

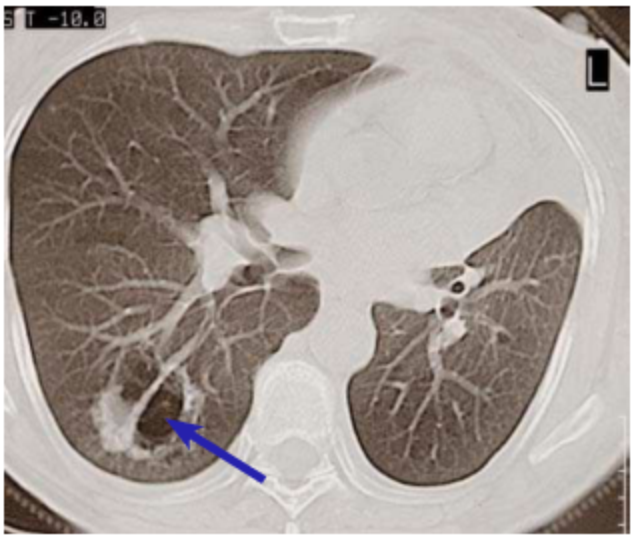


When you exhale, the diaphragm relaxes and moves upward. This compresses the lungs and air rushes out of the lungs, taking carbon dioxide with it.

Rebuilt Lungs

Until recently, the lung had resisted all attempts to replicate itself. But in May, 2014, researchers in Boston announced that they had isolated the first-known human lung stem cells.

Injected into injured mouse lungs, the cells sprouted mouse-sized human bronchioles, alveoli, and blood vessels. The research on this project is in the early stages and the actual procedure is still a long way off.



This photograph shows the inside of a lung. The black spot is cancer. One of the causes of lung cancer is smoking cigarettes.

Asthma is a disease that affects your airways—the tubes that carry air in and out of your lungs. People with asthma often use inhalers to help with their symptoms.

Find out more

Hiccups, Sneezes, and Stitches

Hiccups, sneezes, and stitches are all involuntary body phenomena.

Hiccups are short and very sudden gasps for breath. They occur when the diaphragm jerks or spasms involuntarily.

In a sneeze, air rushes down your nose at over 100 miles an hour (161 kph). Test this fact: You can't sneeze with your eyes open.

A side 'stitch', or sharp pain in your side when you run, is a cramp in the diaphragm. Running causes an up and down movement stressing the diaphragm and the ligaments holding all your organs in place. One way to relieve a side stitch is to stop running and place your hand on the right side of your belly. Then gently push up as you breathe in and out deeply.

Words to know

by-product (BYE-prod-uhkt): something left over when another thing is produced

cavity (KAV-uh-tee): a hole or hollow space in something solid

compress (kuhm-PRESS): to press or squeeze something until it is smaller

cramp (kramp): pain caused by a muscle tightening suddenly

phenomenon (fe-NOM-uh-nom): an event or a fact that can be seen or felt

vacuum (VAK-yuhm): a sealed place from which air has been emptied

Digestion

Digestion is the process that turns the food you eat into very small components that your cells can use. Your cells can handle sugars, amino acids, and fatty acids, but not spaghetti and tacos.

In the Mouth

First, your teeth tear and grind the food into smaller pieces. The saliva in your mouth makes food softer and easier to swallow. It also contains an enzyme that starts the breakdown process. The enzyme converts starches in the food to sugars. Your tongue and other muscles in your mouth push food into your throat. When you swallow, the food travels down your esophagus and into your stomach.

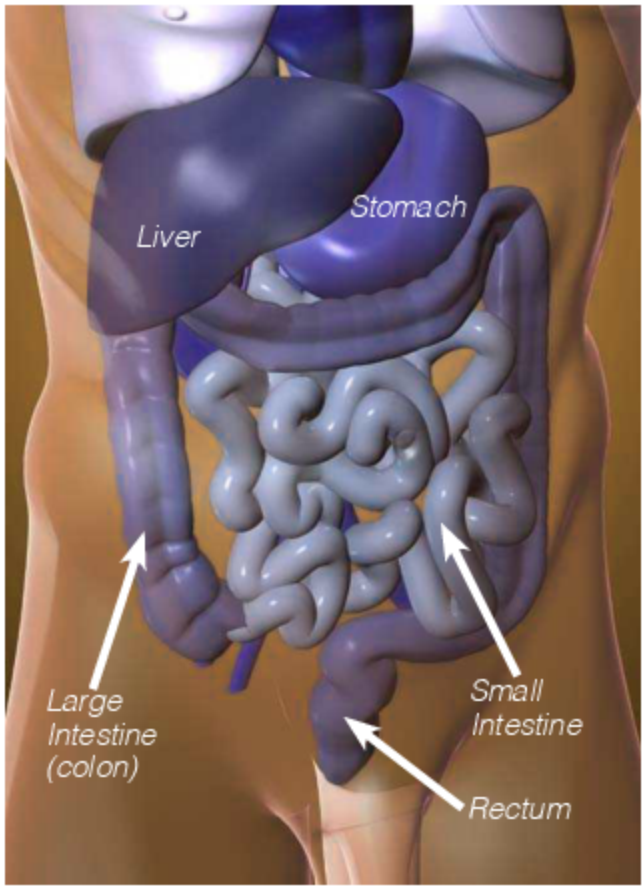
It's important to chew your food well before swallowing.

In The Stomach

The digestive process continues in your stomach. There, food mixes with chemicals the stomach produces called enzymes and acids. Sometimes, as the food is being digested, gases are released making you burp.

In the Small Intestine

Next, the food mass, now called chyme, moves into your small intestine. Here, some more enzymes, produced in your pancreas, help break down the food further. The pancreas also adds insulin, a hormone that prepares the



body for digesting sugar. Your liver, an organ that aids in digestion and eliminating cellular wastes, adds bile. Bile is a liquid that breaks down fat.

The chyme travels through the small intestine. The muscles along the small intestine squeeze and relax. This motion, called peristalsis, pushes the chyme along. Amino acids, simple sugars (glucose) and fatty acids from the food are taken in, or absorbed, through the capillaries in the intestinal wall.

In the Large Intestine

The large intestine absorbs most of the water in the chyme. Some of the water goes to the kidneys, where it becomes urine. The feces that remain leave the body through the rectum.

My Plate, from the USDA, shows the important food groups for a well-balanced meal.

Find out more

NUTRITION

Good nutrition is eating a balanced diet. One that provides all the nutrients you need: fruits, vegetables, grains, and meat/fish/eggs and milk products. Humans need proteins, fats, carbohydrates, vitamins, and minerals.

Proteins build and repair your body. Protein foods are meat, fish, poultry, dairy products, beans, and many vegetables.

Fats and carbohydrates convert food to energy. Fat sources are meat, eggs, fish, dairy, and vegetable oils. Some carbohydrate sources are vegetables, fruit, grains (rice, pasta, bread, cereal), beans, sugar, and honey.

Vitamins and minerals help your body use food, fight infections, and repair itself. Vitamin C sources are fruit, particularly oranges and lemons. Vitamin C helps you fight infection. Vitamin A and D are in milk, eggs, and vegetables. Additionally, your skin produces Vitamin D when exposed to sunlight. A and D vitamins keep your eyes, bones, and teeth healthy and strong. Minerals are in all foods. Green vegetables such as spinach and broccoli contain iron. Meat is a source of iron too.

Words to know

amino acids (uh-MEEN-o ASS-IDS): chemical compounds with which the body builds protein

component (kuhm-POH-nuhnt): a part of a system

deficient (di-FISH-uhnt): lacking something necessary

Genetics

Humans, like all living things, reproduce. When they do, they pass along a 'code' to their offspring. The code is like a set of instructions or directions. It tells the cells of the offspring how to develop and grow. Genetics is the study of the passing of traits from parent to offspring. Here's how that works.

Chromosomes

All the cells in your body, except red blood cells, have a nucleus. It acts like the cell's headquarters. It contains stick-shaped bits called chromosomes. Every species of plants and animals has a specific number of chromosomes. The chromosomes are arranged in pairs.

Genes are the pieces making up chromosomes. Different combinations of a chemical compound called DNA, **d**eoxyribo**n**ucleic **a**cid, makes up genes. DNA is the set of chemical instructions for cells, telling them what to do.

Humans have 46 chromosomes arranged in 23 pairs. When egg and sperm cells form they contain only one of each pair. When the egg and sperm come together to form a new individual, the matching pairs reform.

Sample of Species and Chromosomes

Species	Number of chromosomes
fruit fly	8
snail	24
cat	38
mouse	40
human	46
horse	64
dog	78
goldfish	104
one kind of fern	630

Each pair contains many genes. Genes control different traits such as your hair type, eye color, height, skin color, the size of your ears, and the way your pancreas works. Traits come from each biological parent. This means they are inherited.

Because of genes, people often look like their parents.

Genes

Thousands of gene pairs determine your physical and mental traits. Some genes dominate over others, controlling the trait.

Dominant and Recessive Genes

Eye color is a trait controlled by dominant genes. The gene for brown eyes (*Br* in this text) is dominant over the gene for blue. The gene for blue eyes (*bl* in this text) is recessive. Some combinations of pairs could be *Br Br*, *Br bl*, or *bl bl*. You will have brown eyes if you inherit a brown eye gene from either biological parent. That means your eye color gene pair is *Br Br* or *Br bl*.

To get blue eyes you need to get the blue eye gene, *bl*, from both biological parents. You need to have two blue eye genes, *bl bl*, to have blue eyes.

To get blue eyes you need to get the blue eye gene from BOTH parents.

Because the brown eye gene is dominant, you only need to get the brown eye gene from ONE parent to get brown eyes.

Boy or Girl

One set of chromosomes, called X and Y chromosomes, tells your cells to develop into a boy or girl. All females have two X chromosomes (XX) and all males have one X and one Y (XY). When eggs and sperm form, the chromosome pairs split. Eggs and sperm thus have just one half of each pair of chromosomes.

All males have one X and one Y (XY) and all females have two X chromosomes (XX).

So an egg, coming from a female, can only have an X chromosome. Sperm, coming from a male, can have either an X chromosome or a Y chromosome. When they combine to form a new individual, they can combine as XX, a girl, or XY, a boy.

Find out more

DNA

Deoxyribonucleic acid, or DNA for short, provides the instructions for growth and activity for each cell of our body. All living animals and plant cells contain DNA.

Human DNA is different from the DNA of plants and other animals. People look different from each other because every person has different DNA (except for identical twins, who have the same DNA). Because everyone's DNA is different, the police can use DNA as a way to identify criminals and victims.

Words to know

combine (kuhm-BINE): to join or mix two things together

chromosome (KROH-muh-sohm): cell part that carries the genes that determine traits

headquarters (HED-kwor-turz): the place from which an organization is run

nucleus (NOO-klee-uhss): the central part of a cell, containing the chromosomes

recessive (ree-SESS-iv): tending to recede, to stay in the background

Genetic Engineering

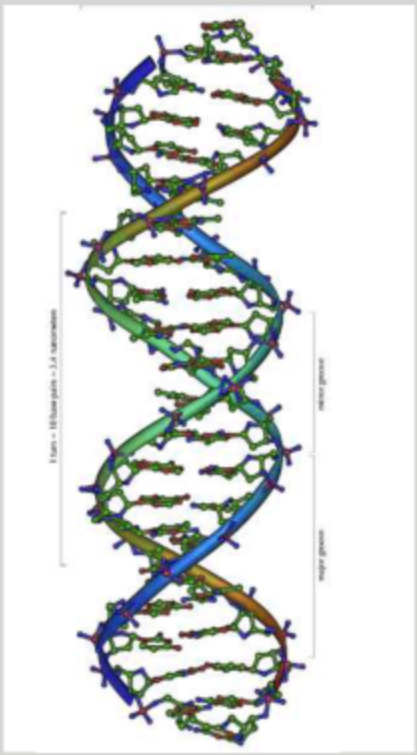
Scientists, who study genetic traits and diseases, focus on DNA's role. They have learned how to change the DNA in a plant or animal cell to change its inherited traits. For example, they have changed the DNA in rice so that it is resistant to certain fungi or molds. This is called genetic engineering.

Getting to know...

James Watson
(1928-)

Francis Crick
(1916-2004)

Two scientists, James Watson and Francis Crick, figured out the chemical structure of the DNA molecule in1953. They found that a DNA molecule looks like a twisted ladder (a double helix). Watson and Crick won the 1962 Nobel Prize, one of the highest awards in science, for their discovery.



The structure of DNA

The Life Cycle

The stages of human life are often described as a life cycle. For each individual, however, life is a straight line. Like a story, it has a beginning, middle, and an end.

The earliest stage of life is a single cell. The cell divides and, with instructions from genes, forms different tissues. These tissues develop into babies. Babies grow up and become children. Children grow up and become adolescents. Adolescents become adults, and some adults become parents. If they have no fatal accidents or illnesses, people grow old and some become grandparents. Then they die.

Life Spans

Humans, like all living things, have a life span. A life span is the maximum length of time that individuals of a species could live. The life span of a human is about 120 years.

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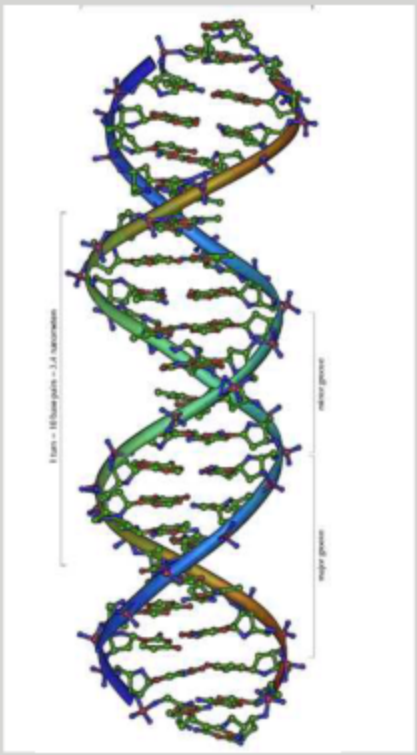

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This photograph of three generations of a family shows the grandparents with their children and their children's children.

Pregnancy and Birth

The start of a life story begins with a pregnancy. Pregnancy refers to the nine months when a single cell develops into a baby inside a mother's body. The pregnancy ends when a baby is born. The nine months of pregnancy are divided into three stages called trimesters. Some mothers feel sick during the first trimester. This is called morning sickness, but it can happen any time of the day.

The First Trimester

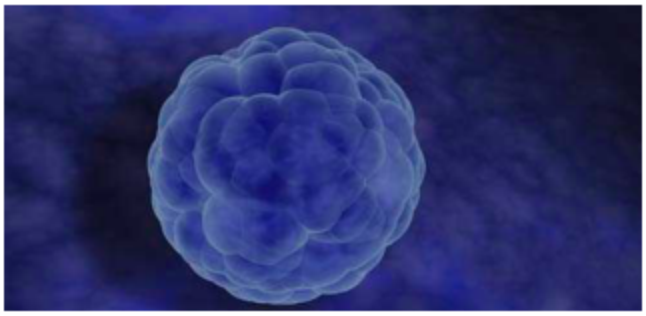
Pregnancy begins at the moment of conception. An egg from the mother's ovary is released into the fallopian tube each month. Conception takes place if the egg is joined by a sperm cell. This is called fertilization. The fertilized egg, or zygote, divides. It grows into a clump of cells no bigger than the head of a pin, called a blastocyst.

A Sample of Animal Life Spans

Animal	Years	Animal	Years
Guinea Pig	8	Grey Squirrel	20
Hippopotamus	45	Hog	18
Horse	40	Kangaroo	9
Koala	8	Lion	35
Muskrat	6	Opossum	4
Ox	20	Painted Turtle	11
Porcupine	20	Prairie Dog	10
Rabbit	9	Rattlesnake	22
Rhinoceros	40	Snapping Turtle	57
Sheep	15	Toucan	6
Tiger	22	Woodchuck	15
Wolf	18		

This magnified picture shows a sperm fertilizing an egg.

Embryo. The blastocyst travels from the fallopian tube into the uterus. It attaches to the tissue inside the uterus. The cells in the blastocyst keep dividing. They form the embryo and placenta.



A magnified blastocyst

Embryo and Placenta. The embryo is the developing child. The placenta is a membranous vascular organ lining the uterine wall and partially surrounding the fetus. It is attached to the embryo by the umbilical cord. The umbilical cord brings blood, carrying nutrients and oxygen, from the mother to the embryo.

An amniotic sac forms around the embryo. The amniotic sac contains fluid in which the developing embryo floats. This fluid protects the embryo. Different parts of the embryo grow and develop into the different organs and parts that make up a human being. The embryo has formed all of its organs by the end of the eighth week of pregnancy.

The amniotic sac protects the baby throughout the entire pregnancy.

Dr. Apgar (1909-1974)

Getting to know...

Virginia Apgar was born in New Jersey in 1909. She earned a medical degree in 1933 from Columbia University in New York City. Apgar became an anesthesiologist. An anesthesiologist is a doctor who gives drugs to patients during surgery to prevent pain. Apgar helped during thousands of births. She saw that most of the attention was on the mother. Sometimes, the newborn baby had problems that no one noticed.

In 1952, she created a way to judge whether a baby is healthy. It is called the Apgar Score. A baby is evaluated for color, pulse, reflexes, activity, and breathing. Babies with low scores need help.

The Second Trimester

The second trimester begins with the fourth month of the pregnancy. The developing baby is now called a fetus.

This ultrasound of a 21 week old fetus shows the fetus is sucking its thumb.

The Fetus continues to grow and develops fingers, toes, and nails. The uterus gets bigger, or expands, as the fetus grows. The mother's uterus expands to accommodate that growth. In this trimester doctors can test to determine if the fetus is a boy or a girl.

Find out more

HUMANS HAVE TAILS

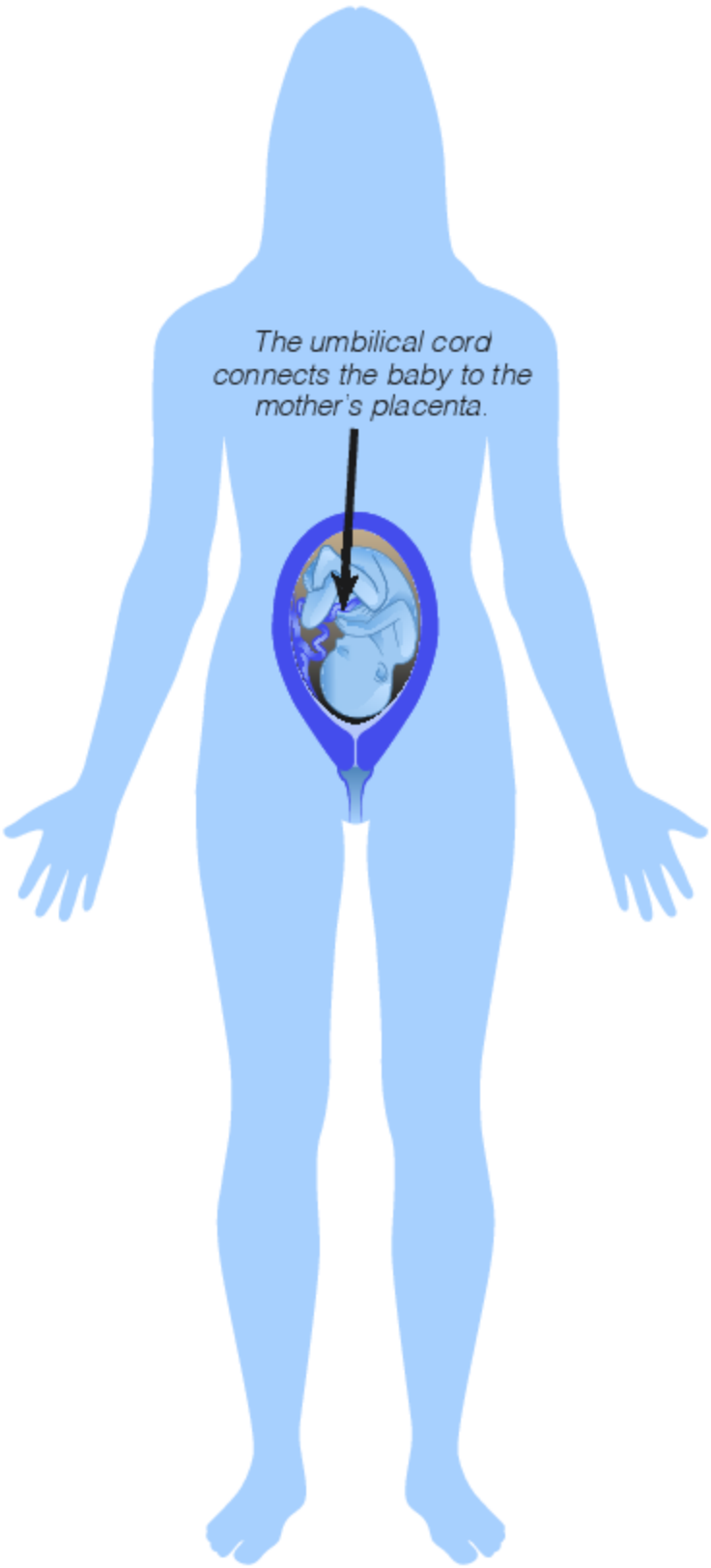
A human embryo in the fourth week of pregnancy has small bumps for arms and legs and a tail. It is hard to tell a human embryo from a reptile embryo at this point! The tail disappears by the eighth week.

The Third Trimester

The third trimester begins with the seventh month of the pregnancy. The fetus gains weight and moves often. The mother can sometimes feel it kick inside her. The third trimester ends with labor and birth.

Labor and Birth. Giving birth is known as labor. It begins when the muscles of the uterus start to push the fetus out of the body. These movements are called contractions. Contractions cause the cervix, a muscle at the bottom of the uterus, to open wider, or dilate. The baby is born when the cervix is fully dilated.

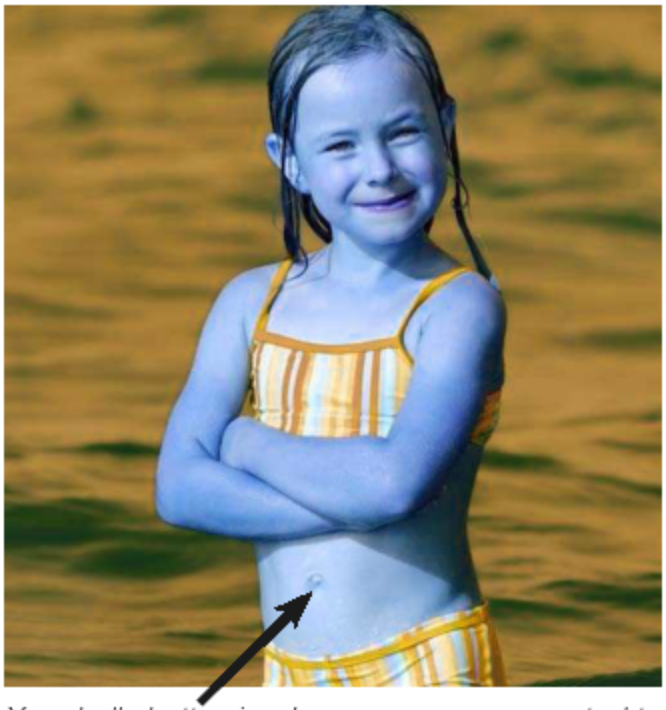
Sometimes, problems arise during labor. The baby may be too big to fit through the cervix or turned sideways. A doctor can perform a cesarean section to remove the baby. A cut is made in the skin below the mother's belly button and through the uterus.



Births are easier when the baby is coming head first. When a baby is coming feet first, it is called a breach birth.

The baby is pulled out through the opening. A cesarean section may be planned if the doctor thinks that the mother or baby will be in danger.

The umbilical cord is cut after the baby is born. You can see where your umbilical cord was connected. Just look at your belly button.



Your belly button is where you were connected to the umbilical cord.

Words to know

accommodate (uh-KOM-uh-date): to provide room for

fatal (FAY-tuhl): causing death

reflex (REE-fleks): an automatic action without a person's control

vascular (VASS-kyoo-lur): having a network of blood vessels

Growth

You continue to grow from infancy to adulthood. Growth happens much faster when you are young. No wonder you want to sleep all the time. Your bones keep growing until you reach adulthood. Girls usually stop growing around eighteen and boys, around twenty-one.

Different parts of the body grow at different rates. Your arms and legs grow faster than the head and the rest of your body.

Using Fat to Make You Thin?

After Johns Hopkins researchers genetically reprogrammed a small part of the DNA in the brains of rats, some of the animals' lumpy white fat transformed into brown fat, the type that actually burns calories. The scientists hypothesize that messages from the altered hypothalamus woke dormant brown-fat stem cells and prompted them to make new tissue. Afterward the mice gained little weight, even when fed fattening chow. Scientists hope to relate this technique to humans within a decade.

Words to know

batch (bach): a group of things that arrive together or are made together

incisor (in–SIZH-ur): a front cutting tooth

molar (MOH-lur): a broad, flat grinding tooth at the back of the mouth

Babies sleep a lot and grow quickly.

Childhood

Your bones are soft at birth. As you learn to roll over, sit up, and crawl, your bones grow harder and your muscles get stronger. Most babies stand and walk by about fourteen months of age.

Your brain grows and changes as you learn new things. When you learn, the number of synapses between nerve cells, called neurons, increases.

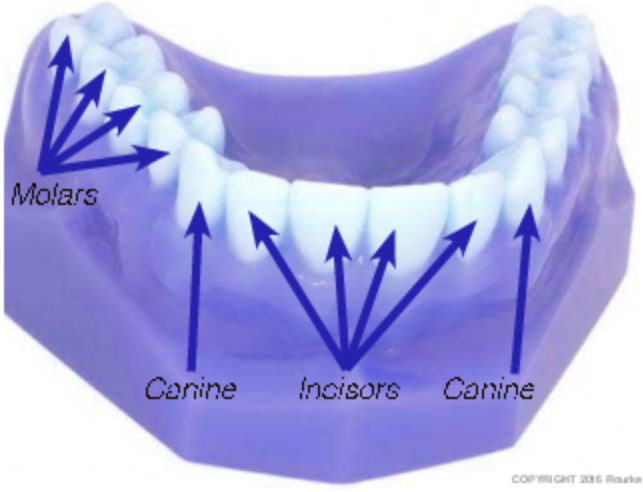
Babies usually stand and walk between the ages of 12-14 months.

Teeth

Your teeth grow in then fall out and grow in again. Humans have two sets of teeth. Your baby teeth start to come in when you are about 6 months old. They fall out sometimes as early as three years of age. Your second batch of teeth are your permanent teeth.

Most people have 32 permanent teeth. Your front teeth are called incisors. The pointed teeth on either side of the incisors are called canines because they resemble a dog's fangs. The flat teeth in the back of the mouth are the molars.

The last teeth to come in are the four back molars, called wisdom teeth.



Very often they do not come in at all. Because they may decay under your gums later in life, dentists often remove them when you are in your teens.

Adolescence and Puberty

Children enter a stage of life called adolescence generally between the ages of 9 and 12.
It is the time when the bodies of children begin to grow into their adult sizes. Adolescence begins with puberty and ends with adulthood.

Puberty

Puberty is when the bodies of males and females change and it becomes possible for them to reproduce. Puberty lasts from two to four years. Hormones control the changes that happen during puberty. Puberty is different for boys and girls.

In boys, the hormone testosterone is released into the blood. Testosterone makes the larynx grow and the voice get lower, and hair grows all over the body.

Boys grow tall quickly in a growth spurt. Boys usually have a growth spurt between the ages of 11 and 15. Testosterone and other hormones also make the testes and penis grow larger and be able to release sperm.

Girls go through puberty anywhere between the ages of 9 and 17. Hormones cause girls to have a growth spurt usually between ages 9 and 12. The hormone estrogen is released into the blood by the ovaries. Estrogen makes the breasts and other parts of the reproductive system grow.

Menarche is the first time that a girl's body releases an egg from the ovary. Blood and tissue from the uterus leave the body if the egg is unfertilized. This is menstruation. It is also called a period because it happens about once a month.

Adolescence ends when males and females look like adults and physical growth stops.

Hormones can sometimes cause acne, a disease that affects the skin.

Aging

Humans continue to change after adolescence. At maturity they are usually healthy and able to reproduce. Their physical growth has stopped but they continue to change.

Skin and Hair

As adults age, their skin becomes less elastic, or flexible. When the fat below the skin shrinks and the skin above it grows less elastic, they get wrinkles. Skin also becomes drier.

As we get older our skin sags and wrinkles.

As people age their hair may get thinner, lose its color, or pigment, and turn gray. Some people lose their hair and become bald.

Words to know

larynx (LA-ringks): the upper part of the trachea (windpipe) containing your vocal cords

hormone (HOR-mohn): a chemical substance produced in body glands that controls growth and development

Haircolor that Lasts: In June, 2011, scientists from NYU Langone Medical Center announced their discovery that specialized in signaling molecules that can dictate the color of hair cells. Once they learn more about this process, they hope to develop a treatment for gray hair.

Some people lose hair as they age.

Bones

By the age of 65, some people have begun to get shorter. One of two things can cause this. If their back muscles become weak through lack of exercise and do not support their spine, the vertebrae can squeeze, or compress, the discs between them. Additionally, bones may lose calcium, become brittle, and deteriorate or break. We call this osteoporosis.

The Senses

The shape of the eyes and lens change during middle adulthood. People often need glasses or contact lenses to read. Older adults may also have trouble seeing in the dark. As people age, they are less able to hear high-pitched noises. They may need hearing aids. The sense of taste and smell lessens as well.

Some older people need glasses.

Some older people need hearing aids.

Reproduction

As humans age, they lose their ability to reproduce. Women usually stop ovulating and menstruating between the ages of 45 and 50. The amount of the hormone estrogen also decreases. This is menopause. After menopause, women cannot become pregnant.

How Life Ends

Death is the natural end of life. People die when their heart stops pumping blood and when their brain stops sending electrical signals. Humans can die at any point during their lives. They may die from many different causes.

Some people die because of an accident. A fatal accident injures organs in the body that cause the heart or brain to stop working. Most people die from an illness or disease. A terminal illness is one with no cure and causes death.

Life Expectancy

Most people who live past childhood will live until about the age of 78. We call this their average life expectancy. Many people live to be much older but very few achieve the potential human life span of 115-120 years.

Many older people live in nursing homes when they cannot take care of themselves.

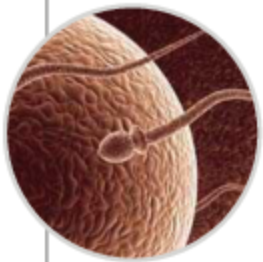
As medical science has developed, human life expectancy has increased. Vaccination against childhood diseases, refrigeration of foods, and the use of medical procedures and drugs to combat illnesses all work to prevent premature deaths and allow people to live to their potential life span.

Find out more

CENTENARIANS

Centenarians, men and women who are 100 years old or older, are a fast growing segment of the world's population.

The stages of life



A sperm fertilizes an egg.

A baby grows inside its mother.

A baby is just at the beginning of his life span.

The baby grows into a child.

The child grows into an adult.

Average human life span per Country

Country	Male (years)	Female (years)	Male and Female Combined (years)
Zambia	37.08	37.41	37.24
Botswana	38.63	39.93	38.31
Haiti	47.46	51.06	49.21
Pakistan	60.27	61.91	61.07
Egypt	61.29	65.47	63.33
Russia	61.95	72.69	67.19
China	69.60	73.33	71.38
Mexico	68.47	74.66	71.49
United States	74.24	79.90	77.12
Israel	76.57	80.67	78.57
Italy	75.85	82.41	79.03
Canada	76.02	83.00	79.43
Australia	76.90	82.74	79.75
Japan	77.51	84.05	80.70

Many middle age adults have children and grandchildren.

Some adults live well past middle age, until they are elderly.

Words to know

- **combat** (kom-BAT): to fight against something
- **fatal** (FAY-tuhl): causing death
- **hearing aid** (hihr-ing ayd): a device to help a person hear
- **segment** (seg-MUHNT): a part or section of something
- **terminal** (TUR-muh-nuhl): ending

Health and Illness

People are healthy when all of their body parts work well. Most of the time, we can stay healthy by eating good food, using our muscles in exercise, getting plenty of sleep, and resting if we start to feel sick. But sometimes, we can suffer injuries or become sick even when we take care of ourselves.

Injuries

Every day, you have a chance of getting hurt. You can suffer an injury or a wound. You may fall down and sprain an ankle or even break a bone. You may hit your head on the ground. You may cut yourself with a pair of scissors or with a piece of paper. These injuries cause pain but are usually not life threatening.

Bruises

If you fall or hit something, you will probably develop a bruise. You can see a bruise because blood vessels break under the skin and the area turns red, purple, yellow, and even green.

The brain can bruise, too. If you fall and hit your head or get hit with a hard object, you might bruise your brain. Bruising to the brain is a concussion. A concussion is dangerous because there is usually internal bleeding. You may become dizzy or feel sleepy. Most contusions heal with plenty of rest.

You can get injured falling off your bicycle.

Broken Bones and Sprains

Injuries happen to bones also. They can crack or break so badly the two parts separate. A fracture is a small break in a bone. It may heal by itself with rest.

The blue and purple area on this foot shows bruising.

A sprain is an injury to a joint such as the ankle or wrist. A sprain happens when the ligaments or tendons twist fast and hard.

You should clean and cover all of them. If a skin wound is deep, you might need a tetanus shot.

This picture of an x-ray shows a broken radius bone in an arm.

A fall on concrete may cause an abrasion on an elbow, as seen here.

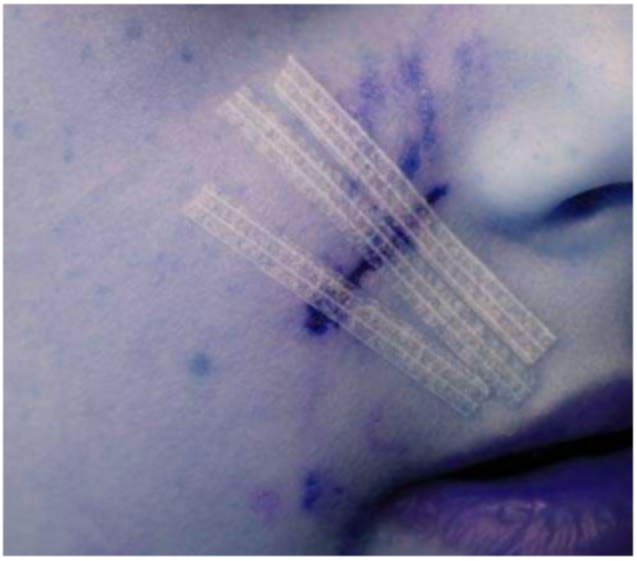
Wounds

We call wounds to the skin abrasions, lacerations, and punctures. An abrasion is a scrape, a laceration is a cut, and a puncture is a hole.

This girl is receiving a tetanus shot to protect her from getting lockjaw.

Healing

Healing starts as soon as a wound occurs. In a cutting wound, the first thing that happens is that the blood vessels near the cut become narrower, or constrict. This keeps you from losing too much blood. Then, the blood becomes thick and forms a clot. This clot hardens to make a scab.



If a wound is deep and won't stop bleeding, adhesive strips or stitches are used.

Sometimes, the new skin that forms is shiny and smooth. We call it scar tissue. A scar may fade over time or last for years.

A broken bone is more serious. A doctor must put the two pieces together and put a hard cast around the injured part. This keeps the bones from moving while they are healing. Bone cells form a clump, or callus, between the ends of the broken bone. The callous grows and develops into cartilage. Finally, the cartilage turns into bone.

A cast and crutches help your bones heal.

Words to know

clot (klot): a solidified clump of blood cells and plasma

internal (in-TUR-nuhl): inside the body

suffer (SUHF-ur): to experience pain, discomfort, or sorrow

tetanus (TET-nuhss): a sometimes fatal bacterial disease that causes your muscles to become rigid.

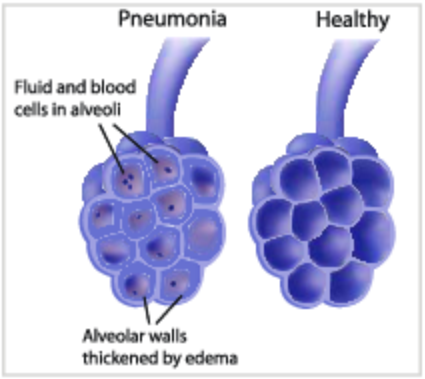
Infections

Our environment is full of small organisms that can live in our bodies. They may be microscopic bacteria or viruses, parasitic worms, or fungi and molds. Some can make us sick. They can cause an infection.

Bacterial infections. Antibiotics can treat most bacterial infections. Some of the infectious diseases bacteria causes are tetanus, pneumonia, whooping cough, tuberculosis, and food poisoning.

Some common bacterial infections cause the following symptoms:

Pneumonia:



lungs filling with fluid, coughing, weakness

Strep throat:

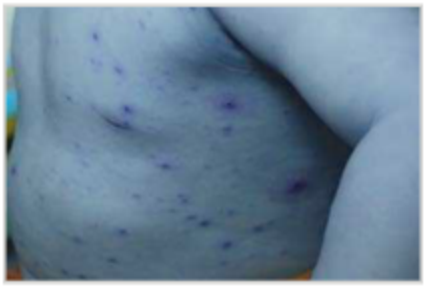
sore and red throat with white spots, difficulty swallowing, fever

Pink eye:

red rimmed eyes, excessive mucus, itching

Viral Infections. The symptoms caused by a virus can go away, but the virus never leaves the body completely.

Some common viral infections cause the following symptoms:

Common cold:		stuffy head, sneezing, sore throat, runny nose
Flu:		muscle aches, fever
Stomach flu:		stomach pain, vomiting, diarrhea
Chicken pox and measles:		spots or skin rash
Viral pneumonia:		fever, headache, muscle aches, sweating, sore throat, weakness

Other Infections. Parasites, fungus, and mold infections include such things as ringworm and athletes foot. Drugs can treat these infections.

Contagious Infections

A disease or illness is contagious if the germs that cause it can be passed between people. Some illnesses pass very easily from person to person.

The viruses that cause colds or the flu are in saliva in the mouth and in mucus in the nose. You can "catch" a cold or the flu if you touch a sick person or things that the person has touched.

Viruses can also live in the air. They come out when the sick person coughs or sneezes. If you are sick, it is important to use tissues and to cover your mouth when you cough and sneeze. Washing your hands is an important defense against all germs.

Washing hands fights germs.

Louis Pasteur (1822-1895)

Getting to know...

French born scientist Louis Pasteur studied chemistry and physics in Paris and became a professor. Pasteur became interested in why foods spoiled and how diseases spread. He found that small organisms called yeast turn sugar into alcohol. We call this fermentation. He also studied how organisms turn milk sour. Pasteur showed that heating things kills the organisms. The process has his name – pasteurization.

Before Pasteur's time, people thought that bad smells spread illnesses. Pasteur showed that germs cause disease. He also developed vaccines to give people immunity. He used a rabies vaccine to save a boy bitten by an infected dog.

Some viral diseases, such as AIDS (acquired immune deficiency syndrome), are not easily passed between people. AIDS is a dangerous disease that makes it hard for the body to fight infections. A virus called HIV causes AIDS.

HIV passes between people only in blood and during sexual contact. A pregnant woman who is HIV positive may give the virus to her developing fetus.

You cannot get HIV or AIDS through touching or by breathing the air around a person who has the disease.

Immunization

Your body is constantly threatened from the outside. Besides injury, you are open to attack from bacteria, viruses, and fungi. Your immune system is your main defense against these invaders, also known as pathogens or antigens.

Active Immunity

One of the ways your immune system protects you is by making antibodies. Antibodies are special proteins created by your white blood cells to fight antigens. Some antibodies remain active long after the antigen has been defeated. The body is ready to fight if it meets the antigen ever again. You are immune or have a resistance to the disease caused by that antigen.

Vaccination can also deliberately create immunization in the body. Scientists develop vaccines for specific diseases. A vaccine is either a solution or a culture of a strain of the germ that does not cause disease. The vaccine is made by changing or killing the germ.

A nurse is preparing to administer a flu vaccine to a patient.

Words to know

antibiotic (an-ti-bye-OT-ik): a drug that kills bacteria

mucus (MYOO-kuhss): a slimy fluid that coats and protects your mouth, nose, throat, and breathing passages

parasite (PA-ruh-site): an organism that gets its food by living inside another plant or animal

rabies (RAY-beez): a viral disease that attacks the nervous system. Often fatal, it is transmitted by the bite of an infected bat, dog, raccoon, or other infected animal

It causes your body to produce the antibodies against the germ.

Immunity develops slowly but lasts a long time. The response of the immune system is faster and better every time the body meets an antigen. We call this active immunity.

There are vaccines for many diseases such as smallpox, chicken pox, polio, measles, mumps, tetanus, and rabies.

The End of Smallpox. The United States Center for Disease Control District of Somalia on October 26, 1977. Less than 3 years later, in May 1980, the World Health Organization declared the world free of naturally occurring smallpox.

Passive Immunity

Sometimes a person not vaccinated against a disease is exposed to it. Medical help is available. Doctors can inject the person with antibodies produced in other humans or in animals. The antibodies give immediate immunity to the disease for a short time. The antibodies will fight the germs if they try to infect the body. We call this passive immunity.

Since the body has not made its own antibodies, the protection does not last after the injected antibodies are gone.

Edward Jenner (1749-1823)

Getting to know...

Edward Jenner, an English doctor, researched the disease smallpox in the late 1700s. He noticed that dairy workers did not get smallpox. He wondered if cowpox, a disease cows suffered, was like smallpox. He wondered if exposure to cowpox gave dairy workers immunity to smallpox. In 1796, Jenner used the germs that cause cowpox to vaccinate a boy against smallpox. It worked.

Jenner's method of vaccination was the start of the control and prevention of other diseases.

Words to know

culture (KUHL-chur): a growing population of an organism in a lab dish

expose (ek-SPOZE): to come in contact with a disease organism

hypothesize (hye-POTH-uh-size): to make a temporary prediction or educated guess about the cause or outcome of an event

passive (PASS-iv): to let something happen without a fight or resistance

strain (strayn): a variety or kind

Genetic Diseases

Some diseases pass from parent to child as part of the genetic material in chromosomes. Such illnesses are genetic diseases. A disease may develop if a certain dominant or recessive gene is inherited. A disease may also develop if an important gene is damaged or missing.

A person who inherits a dominant gene for a genetic disease will develop that disease. Luckily, recessive genes cause most genetic diseases. That means both parents have to have the gene in their chromosomes and their offspring have to inherit both genes to get the disease.

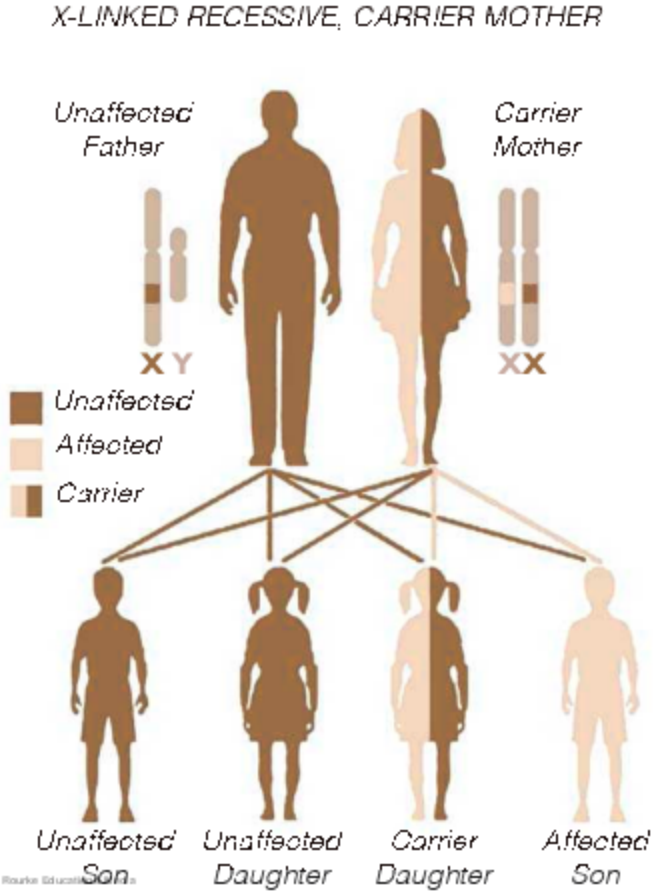
People who inherit one recessive gene for such a disease will not develop that disease. But since they have the gene, they are called carriers, meaning they could pass it along to their offspring.

Examples of Genetic Diseases

Cystic fibrosis is a genetic disease. It affects the glands that make sweat and mucus. People with cystic fibrosis have thick mucus in their lungs that makes it hard to breathe. They are prone to lung infections.

Hemophilia is a blood-clotting disorder. It is a genetic disease linked to the sex chromosome. The recessive gene that causes hemophilia is on the X chromosome in some families. Girls have two X chromosomes and if they inherit an X chromosome with the recessive gene, their other normal X chromosome dominates and they do not get the disease. But boys only have one X chromosome. So, if they inherit the X chromosome with the hemophilia gene, they get the disease. We call hemophilia a sex-linked disease.

Affects of genetic diseases. Some genetic diseases affect a child at birth or develop during childhood. Other genetic diseases do not develop for many years. Some are very serious. The people who develop them do not live long. Other diseases get worse slowly. Drugs or changes in eating habits can manage some of these diseases.



Real Replacement Teeth: As we age, sometimes our teeth due to lack of proper care or genetics can fall out. Dentists at Columbia University were able to grow new teeth in rats by implanting a tiny scaffold in the socket left empty by a lost tooth, then saturating the space with dental stem cells and growth factors (substances strained from the blood and jawbone that promote tissue growth). Today, it is possible to get tooth impants which restore and replace missing teeth.

Genetic Predisposition. Some diseases are not inherited directly but seem to be common in certain families. Heart disease, diabetes, and some types of cancer may have a genetic link. A person who has several family members with a disease may have inherited a higher chance of developing the disease. Doctors say the person has a genetic predisposition for that disease.

CANCER

A tumor is a lump of tissue that grows in the body. Some tumors are harmless, or benign. Benign tumors do not interfere with body functions and do not spread to other parts of the body. Most do not cause pain. But some tumors are harmful. A tumor is malignant if it interferes with how the body works, if it destroys tissues, and if it spreads to other places. We call such a malignant tumor cancer.

Cancer can grow almost anywhere in the body, such as the brain, lungs, breasts, intestines, bones, liver, stomach, and skin. Cancer cells grow very fast and take nutrients from surrounding tissue. Doctors can remove a tumor if it has not spread too far.

They can also use drugs, or chemotherapy, and radiation to destroy it. It is difficult to cure cancer if the cells have spread to the blood or to the lymph nodes that contain white blood cells.

We are still learning why normal cells become cancer cells. Some people seem to inherit a higher chance of getting certain cancers. Some pollutants in our environment, such as asbestos, increase the risk. Other people do things that increase the risk. Smoking cigarettes can cause lung cancer. Eating a diet high in fat has been linked to colon cancer.

Some types of chemotherapy can make your hair fall out while the drug is being administered.

Many people are allergic to pollen.

Some people receive allergy shots to help with allergic reactions.

Allergies

Other kinds of antigens challenge your health. They include environmental pollutants (particles and chemicals in the air, food, and water) as well as toxins from insect bites and plants. Your immune system again is your main defense against these foreign materials.

Most antigens are harmless to most people. But someone who is sensitive to dust, pollen, smoke, perfume, animal hair, mold, fungus spores, some metals, certain foods, poison ivy, or insect bites may become sick. The immune system produces an allergic reaction. Symptoms include sneezing, sniffles, coughing, swelling, skin rashes and itchiness, or breathing difficulty.

Words to know

- **clot** (klot): a solidified clump of blood cells and plasma

colon (KOH-luhn): the last half of the large intestine

lymph node (limf noad): small organs that hold the colorless liquid lymph that bathe your cells and tissues

- **membrane** (MEM-brayn): a thin layer of tissue that covers or lines organs and cells

radiation (ray-dee-AY-shuhn): X-rays or other electromagnetic waves or particles

One sneeze can send about 40,000 water and mucus droplets into the air.

Hay Fever

Many people are allergic to plant pollen. We call this allergy hay fever. Your nose runs and your eyes itch. Hay fever treatment often includes drugs called antihistamines. They stop the body from making a substance called histamine that causes the symptoms of allergies.

Springtime flowers often trigger hay fever.

Asthma

Many children and adults have a disease called asthma, another allergic reaction. People with asthma have episodes of breathing difficulty. The bronchioles in their lungs get smaller during an allergic reaction. A device called an inhaler can help them breathe in medication and open the passages in the lungs.

An estimated 300 million people worldwide have asthma.

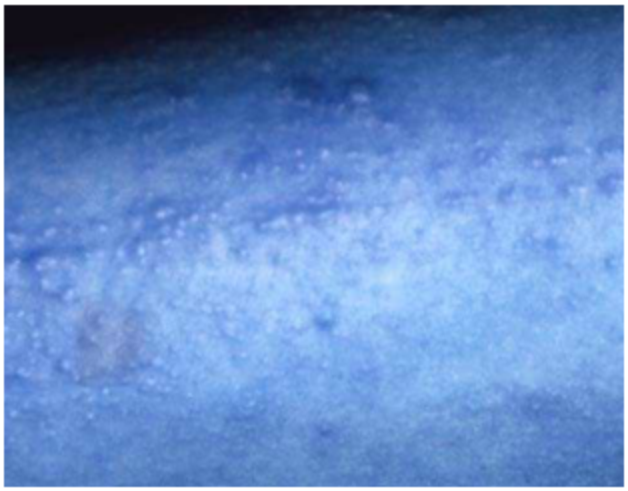
Life-Threatening Allergies

Other antigens are more harmful and can cause serious and life-threatening allergic reactions. Plant and animal toxins such as venom from a snake or a bee sting are particularly dangerous. If you are allergic to bee stings you may have to carry special medications to use if you are stung.

Some people have a very strong reaction to an antigen the first time they meet it. Other people may have stronger and stronger reactions every time they come in contact with the antigen.

Venom from a snake or a bee sting can be life threatening.

Poison ivy, poison oak leaves, and some seafood may not cause a reaction the first time you eat or touch them. But the next time you come in contact with them, you may become very sick or develop a severe itchy rash. Some people are so allergic to mussels that one meal, after several exposures, can kill them.



A poison ivy rash may look like this.

Words to know

- **challenge** (CHAL-uhnj): invite to fight
- **episode** (EP-uh-sode): an event
- **pollen** (POL-uhn): tiny yellow grains produced in blossoms, the male cells of a flowering plant
- **toxin** (TOK-sin): a poisonous chemical
- **venom** (VEN-uhm): a poison produced by some snakes and insects

About 90% of reactions to peanuts occur within 20 minutes of exposure.

People Who Study the Human Body

People are curious. They wonder, they observe, they study, and they learn. One of their favorite subjects is living things. Biology is the study of living things. And one of the favorite subjects of biologists is the human body.

People can learn about the human body using microscopes.

People can learn about the human body from medical textbooks.

Scientists examine dead bodies to see what is inside. Studying the body's structure is called anatomy. Studying and learning how the body works is called physiology.

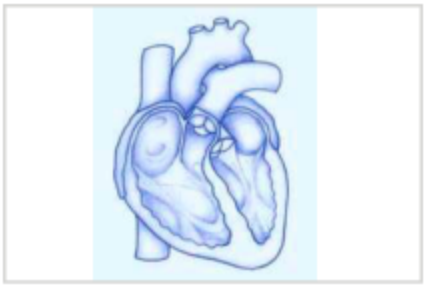
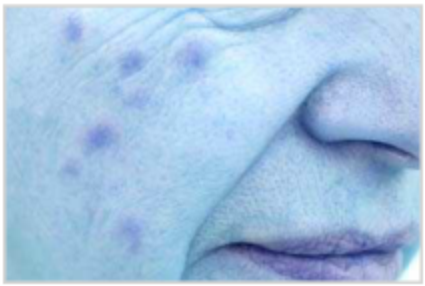
Learning to treat illnesses and injuries is called medicine. A medical doctor, or physician, tries to find out what is wrong with the body. Diagnosing injury and illness is the first step. A doctor then treats injuries and illnesses using drugs, surgery, or other therapies.

Some illnesses have to be treated with surgery.

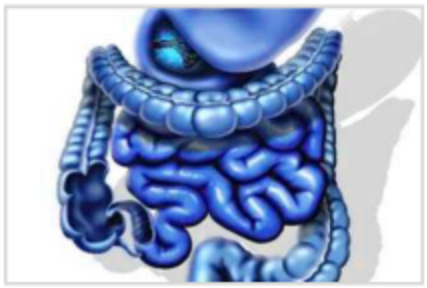
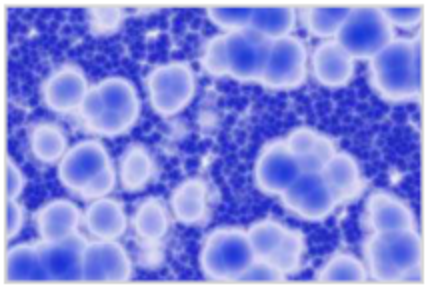
Specialists

Scientists have learned so much about human physiology. Doctors often choose to concentrate, or specialize, on just one system, organ, or disease.

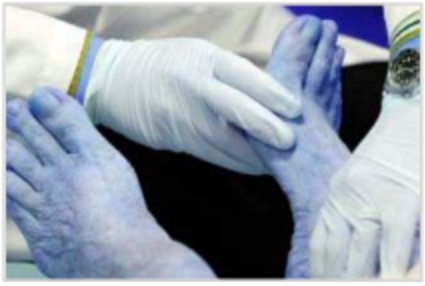
MEDICAL SPECIALISTS

Specialist		System, Organ, or Disease
Allergist		Allergies
Cardiologist		Heart
Dentist		Teeth and gums
Dermatologist		Skin
Endocrinologist		Organs that produce enzymes and hormones

MEDICAL SPECIALISTS

Specialist		System, Organ, or Disease
Gastroenterologist		Digestive system
Gynecologist		Female reproductive organs
Hematologist		Blood
Neurologist		Nervous system, brain
Oncologist		Cancer

MEDICAL SPECIALISTS

Specialist		System, Organ, or Disease
Ophthalmologist		Eyes
Orthopedist		Bones and joints
Pediatrician		Babies and children
Podiatrist		Feet
Surgeon		Repair or removal of internal organs and bones

Daniel Hale Williams (1856-1931)

Getting to know...

Daniel Hale Williams was an African-American born in Pennsylvania in 1856. He became a doctor and a surgeon. Williams introduced new techniques to prevent infection during surgery.

In 1893, he became the first person to perform a successful heart operation. He opened the chest of a patient stabbed in the heart. He proved that surgery on the heart could be performed without causing death from infection. Today, surgeons perform even more complex repairs of both wounded and diseased hearts.

All these kinds of scientists and doctors help us understand the complex organism that is the human body. Every day, we find out more about how the body works.

Milestones in Medicine

Scientists and doctors studying human life have made many important discoveries. Bioengineers, chemists, and doctors have developed medical technology based on that growing body of scientific knowledge. They have developed such things as vaccines, X-rays and MRI scans, anesthesia, prosthetic bones and joints, antibiotics, and powerful drugs to fight infections, diabetes, and cancer.

Their discoveries and technological breakthroughs have led to disease prevention and better medical care. Our life expectancy is longer now than it ever was in the past. Modern life is significantly better medically speaking than in the 'good old days.'

Electronic Eyes

Electronic eyes have restored partial vision to people with deteriorating retinas. The imitation eyes involve an implanted device that receives input from a tiny camera and a transmitter mounted on a pair of glasses. Images from the camera are converted into signals that the implant uses to stimulate retinal cells—allowing the brain's vision center to see a rough version of what the camera sees. The device could be, for many people, a chance at second sight.

Words to know

complex (kom-PLEKS): very complicated

diagnose (dye-ugh-NOHSS): to determine what disease a patient has or what physical or mental problem

examine (eg-ZAM-uhn): to look carefully at

Alexander Fleming (1881-1955)

Getting to know...

Alexander Fleming was born in 1881 on a farm in Scotland. He attended medical school at St Mary's Hospital, in London, England. Alexander qualified for the school with distinction in 1906 and became an assistant bacteriologist. His interest was in vaccine therapy and immunology.

Fleming was the first to notice the antibiotic properties of molds and fungi. The story of how he discovered penicillin is legend:

By 1928, Fleming had developed a reputation as a brilliant researcher, but a quite careless lab technician. He often forgot cultures that he worked on and his lab was usually in chaos.

On one occasion, after returning from a long holiday, Fleming noticed that many of his culture dishes were contaminated with a fungus. He noticed a zone around an invading fungus (mold) where the bacteria could not seem to grow. He concluded that that fungus was keeping the bacteria from growing.

After many tests with the fungus and bacteria cultures, Fleming isolated an extract from the fungus (mold) and correctly identified it as being from the penicillin family. He named the extract penicillin. And the rest is history, as the saying goes.

In 1945 he was the co-winner of the Nobel Prize in Medicine "for the discovery of penicillin and its curative effect in various infectious diseases."

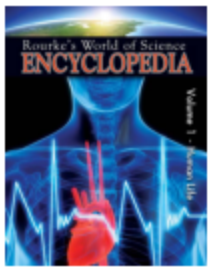
Find out more

THE NOBEL PRIZE

The Nobel Prize is an award that honors men and women "... who, during the preceding year, shall have conferred the greatest benefit on mankind."
The Nobel Prize started in 1895 when Alfred Nobel (1833-1896), a Swedish chemist, engineer, innovator, and inventor of dynamite, wrote his last will, leaving much of his wealth to set up the prizes.

Since 1901, the prize has honored men and women for outstanding achievements in physics, chemistry, medicine, literature, economics, and for work in peace. Many of the scientists and doctors who contributed to the advancement of scientific and medical knowledge won the coveted Nobel Prize for their work.

Book Index



Rourke's World of Science Encyclopedia

Rourke's World of Science Encyclopedia *Marcia S. Freeman. Vol. 1: Human Life. 2nded. Vero Beach, FL: Rourke Educational Media, 2016. 64 pp.*

Teaches the essential concepts for elementary school science instruction. Topics include the basic objects in the sky, life-cycles, and properties of earth materials to the more advanced, structures of living systems, forces and motion and science technology. This volume covers human life.

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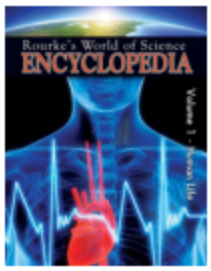

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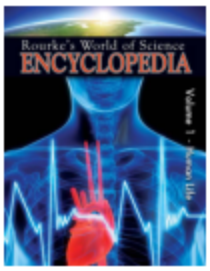

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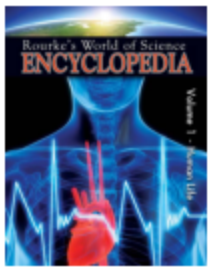

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