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CK-12 Understanding Biodiversity

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Douglas Wilkin, Ph.D.

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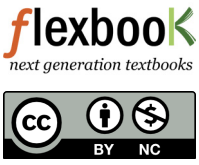

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CHAPTER 1 Understanding Biodiversity: Call for Contributions

A CK-12 Encyclopedia of Life Publication

Understanding Biodiversity is an on-line repository of biodiversity information intended for the secondary-level life science student. The repository will be compiled with individual species pages which contain information relevant to the secondary science classroom, including cell biology, genetics, evolution, ecology, and physiology.

We invite secondary students to become contributing authors to this FlexBook. Submit proposals for contributions via email to **info@ck12.org.** Place [SCIENCE] *Understanding Biodiversity proposal* in the subject line, and include the name of the species for your submission.

After submission of a proposal and upon agreement with *Understanding Biodiversity* editors, students are to use the *Understanding Biodiversity template* to compile information for their selected species. Students may use any

available resource to compile their information, including EOL resources. We ask that students identify relevant information as outlined in the template, realizing that some categories will be more extensive for certain species, and that other categories may contain little or no information. Material should be submitted by email to **info@ck12.org.** Place [SCIENCE] *Understanding Biodiversity submission* in the subject line.

See the *Understanding Biodiversity* FlexBook on the CK-12 website (http://www.ck12.org) for additional information.

Please email questions to: info@ck12.org.

CHAPTER 2 Understanding Biodiversity: Information for Contributors

Chapter Outline

A CK-12 Encyclopedia of Life Publication

Understanding Biodiversity is a CK-12 Foundation and Encyclopedia of Life collaborative on-line publication. *Understanding Biodiversity* is a repository of species information relevant for the secondary level life science classroom. This information includes the cell biology, genetics, evolution, ecology, and physiology of individual species. Expeditions relevant to the biodiversity literature will also be featured.

We invite secondary level students to submit **species pages** of organisms studied in the middle school and high school classrooms. **Expedition pages** may also be submitted.

Please submit proposals for contributions via email to **info@ck12.org**. Place [SCIENCE] *Understanding Biodiversity proposal* in the subject line.

2.1 The Understanding Biodiversity Chapters

Initially, the majority of *Understanding Biodiversity* will be divided into seven chapters - one chapter for each kingdom and one chapter devoted to expeditions. There are also introductory chapters, discussing biodiversity, global climate change and the Encyclopedia of Life. As the repository of information grows, the six kingdom chapters may be divided into a six-volume set, with additional divisions as necessary. However, *Understanding Biodiversity* will be maintained on-line, thus the size of the chapters is not restrictive.

2.2 The Understanding Biodiversity Species Page

As mentioned above, *Understanding Biodiversity* is a repository of species information relevant for the secondary level life science classroom: cell biology, genetics, evolution, ecology, and physiology. This information will be presented through individual species pages. A **species page** is essentially an individual section of a chapter.

Each species page will contain as much relevant information as feasible. Information will include, but not be limited to,

1. Species Name and Common Name
2. Brief Description of the Organism
3. Brief Description of the Habitat
4. Biology of the Species
    a. Cell Biology
    b. Genetics
    c. Evolution
    d. Ecology
    e. Physiology
5. Edit History
6. Attribution
    a. Authors
    b. Affiliations
7. References

See the *Saccharomyces cerevisiae* (Baker's Yeast) species page for an example.

Expedition pages will contain as much relevant information as feasible. Information will include, but not be limited to,

1. Expedition name
    a. Brief Description of Expedition
2. The Expedition Leader
3. Biology of the Expedition
    a. Description of Significant Findings
4. Edit History
5. Attribution
    a. Authors
    b. Affiliations
6. References

Potential

1. Bacteria
    a. *Escherichia coli*
    b. *Pseudomonas aeruginosa*

   c. *Staphylococcus aureus*
2. Archaea
   a. *Halobacterium salinarum*
   b. *Methanobrevibacter smithii*
3. Protists
   a. *Giardia lamblia*
   b. *Paramecium caudatum*
   c. *Trypanosoma brucei*
4. Fungi
   a. *Agaricus bisporus* (Button Mushroom)
   b. *Lobaria pulmonaria* (Lichen)
   c. *Penicillium chrysogenum* (Penicillin)
   d. *Penicillium roqueforti* (Blue Cheese)
5. Plants
   a. *Dionaea muscipula* (Venus Flytrap)
   b. *Equisetum arvense* (Horsetail Fern)
   c. *Ginkgo biloba* (Ginkgo Tree)
   d. *Pisum sativum* (Pea Plant)
   e. *Rhizophora mangle* (Mangrove Tree)
   f. *Sequoia sempervirens* (Redwood Tree)
6. Animals
   a. *Aquila chrysaetos* (Golden Eagle)
   b. *Bubo virginianus* (Great Horned Owl)
   c. *Didelphis virginiana* (Virginia Opossum)
   d. *Elephas maximus* (Asian Elephant)
   e. *Gorilla gorilla* (Western Gorilla)
   f. *Loxodonta africana* (African Elephant)
   g. *Sepia bandensis* (Dwarf Cuttlefish)

Potential

1. Amundsen's South Pole Expedition
2. Peary's Conquering of the North pole
3. Cortés' Conquest of Mexico
4. Przhevalsky's Discovery of Central and East Asia
5. von Jacquin's Expedition to the Caribbean
6. Livingstone's Exploration of Africa
7. de Andrade's Exploration of Tibet
8. Hudson's Voyages
9. Humboldt's Expeditions
10. di Mulazzo's North and South America Exploration
11. Nordenskiöld's Northeast Passage
12. Amundsen's Northwest passage
13. Scott's South Pole Expeditions
14. da Gama's Sea Route to India
15. de Magalhães's Voyage of Circumnavigation
16. Darwin's Voyage of the Beagle
17. Cartier's Voyages to the New World

The

We have provided a template to assist authors in preparing their contributions. The template should be inserted into a word program, and as much relevant information compiled as feasible. Material should be as thorough as possible, using appropriate grade-level language and vocabulary. The template is available in the *Understanding Biodiversity* FlexBook on the CK-12 website (http://www.ck12.org).

2.3 Authorship

Contributors should include their name(s) and school affiliations for inclusion in the **List of Contributors.** Appropriate attributions will be determined by the *Understanding Biodiversity* editors. At this time, authorship is limited to secondary-level students.

2.4 The Review Process

The *Understanding Biodiversity* review process will involve several stages. Initial review should be by the instructor of the submitting students.

Secondary-level review will be provided by the *Understanding Biodiversity* editors. At this time, the publication may be returned to the contributing student(s) with comments for modification, or the contribution may be submitted for peer-review. It is the intention that published work is subject to a scientific peer-review process. Furthermore, at the discretion of the editors, work may be published prior to the peer-review process, however such work will be noted as *published prior to peer-review.*

Upon acceptance, materials will be published to the *Understanding Biodiversity* site in a timely manner. Contributing authors will be able to site their contributions immediately after publication.

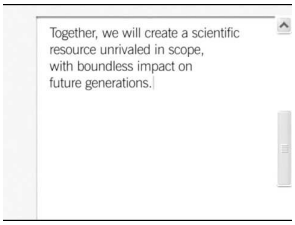
2.5 Contributions

Refer to *Understanding Biodiversity: Call for Contributions* for information on submitting material for publication.

CHAPTER 3 Understanding Biodiversity: The Encyclopedia of Life

Chapter Outline

3.1 The Encyclopedia of Life



MEDIA

Click image to the left for more content.

The **Encyclopedia of Life** (EOL; http://www.eol.org/, http://www.youtube.com/watch?v=6NwfGA4cxJQ) is a free, online collaborative encyclopedia intended to document all of the 1.9+ million living species known to science. It is aggregated or compiled from existing scientific databases, and from contributions by experts and non-experts world-wide. Its goal is to build one "infinitely expandable" page for each species, including videos, sound, images, graphics, and text. As the discovery of new species is expected to continue (the current rate is about 20,000 new species identified per year), EOL will grow continuously. As taxonomy finds new ways to include species identified by molecular techniques, the rate of new species additions will increase - in particular with respect to the microbial world of (eu)bacteria, archaebacteria, and viruses. EOL went live on February 26, 2008 with 30,000 entries and currently has 752,993 entries.

Understanding Biodiversity is made available to the high school student through CK-12 and EOL's collaboration, primarily EOL's Learning + Education group, based in the Museum of Comparative Zoology at Harvard University (http://education.eol.org/). *Understanding Biodiversity,* is an expanding library of biodiversity information aimed at the high school biology classroom. Individual *Understanding Biodiversity* species pages will provide information for each species relevant to the high school biology curriculum: cell biology, genetics, evolution, ecology, and physiology. If you would like to submit a species page to *Understanding Biodiversity,* email your proposal for contributions to **info@ck12.org.**

The EOL has developed web-based tools and services that provide visitors enhanced capability to use EOL content for their own purposes and to contribute to the site and become part of a growing international community interested in biodiversity. Some of those tools and services are listed below.

NameLink

http://www.eol.org/content/page/namelink

NameLink is a service provided by EOL to quickly identify information associated with taxon names and to provide common species names. Students can submit a webpage address and have the taxon names within the page automatically identified and link up to projects which have information about those names. The common names appear within the webpage or on-line article.

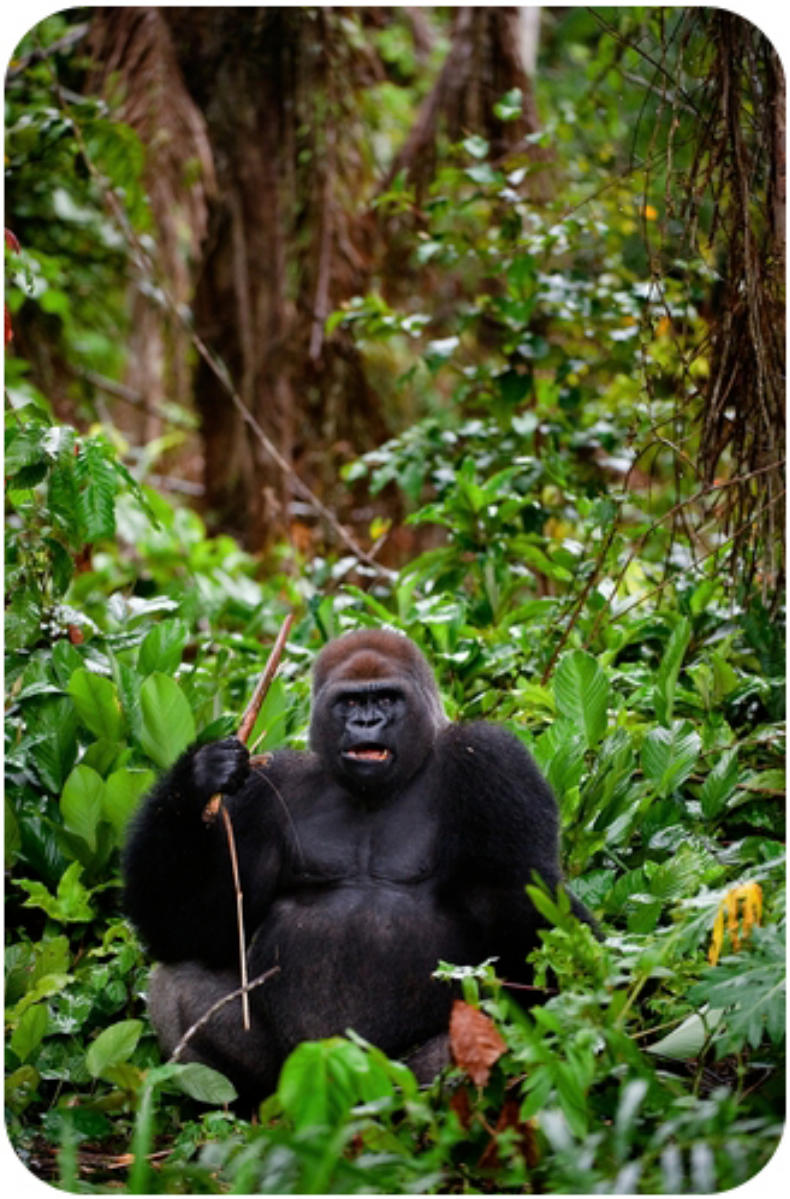
NameLink can be used to identify additional information regarding many species. For example, insert the following URL into the *URL insertion box* on the NameLink page, and explore the information generated by this tool:

A Bioline article and abstract: http://www.mass.gov/dfwele/dfw/nhesp/species_info/mesa_list/mesa_list.htm.

Education LifeDesk

http://www.edulifedesks.org/

Register at http://www.edulifedesks.org/ to join the *CK-12 Biology* group.



A **LifeDesk** is an online environment that provides a collaborative space for creating, editing, and publishing web pages of species information. The goal of using a LifeDesk, in many cases, is to generate content to publish to the EOL, including text and images.

Try using a LifeDesk in a variety of ways. For example, individually or in a small group, research and write or upload images for different sections (e.g., Habitat, Conservation Status, Ecology, etc) of a species page. Alternatively, students can work on the same sections of different species pages and then compare their research findings about the different organisms. Because LifeDesks are on-line, students from different schools or in different locations can collaborate on projects.

When published to EOL, students or classes get credited for the contributions they make to this authentic project. However, there is no requirement to publish content, so LifeDesks can be easily used for class projects that are not visible to external audiences.

LifeDesks have a workflow system that allows groups to set assignments and alert each other when edits have been made or review of work is required. This allows students independence outside of the classroom to work on projects and communicate with their instructors.

Example of student created content published to EOL using an Education LifeDesk: http://eol.org/pages/790463/

overview.

Field Guides

http://education.eol.org/ideas/tools/fieldguide

Field Guides pull selected content from EOL species pages into a format that is easier to view and use for particular projects. Rather than sorting through all 1.9 million species pages and all of the Table of Contents information, users will see information for just the organisms and information they select. Users are able to customize and edit the content in their field guide. Field guides can be made public and print options are available for use in a variety of contexts.

Try creating a field guide for the organisms found in your schoolyard or for the organisms discussed in another chapter of this FlexBook that you are studying. See what information is found in EOL and what is missing. Is there anything you can contribute to EOL, such as an image or some class research information?

Adding Images and Video

You can contribute images of organisms to EOL through popular media sharing sites like Flickr or Wikimedia Commons http://commons.wikimedia.org/wiki/Main_Page. The Encyclopedia of Life Images Flickr group already has over 60,000 images and short video clips, and our members are adding new ones daily.

Basic Flickr accounts are free and it's easy to tag your images for EOL use. See the group page for instructions: http://www.flickr.com/groups/encyclopedia_of_life. EOL harvests the group pool every couple of days, so your images and videos will show up quickly on EOL pages and/or field guides. Uploading images to EOL supports learning of basic technology skills, proper citing of electronic resources and familiarization with scientific and common names for organisms, all while helping to build a global resource.

Short videos can also be uploaded to Flickr. For longer videos, please use EOL's group on Vimeo. http://vimeo.com/groups/encyclopediaoflife

BioBlitzes

http://education.eol.org/bioblitz

A BioBlitz is a snapshot - a limited-time, limited-space species inventory of the organisms that live in an area. BioBlitzes let people get involved in the natural environment, increasing their awareness of and understanding for the environment. BioBlitzes are conducted to learn more about an area's biodiversity (what different life forms live here?), distribution (where do they live?), and abundance (how many of them are there?).

BioBlitzes can be a source of new information that can be shared with local conservation management groups as well as the EOL.

Students can organize BioBlitzes in their school yards or neighborhood parks. Partner with scientists from local conservation groups or universities to help with identification of species or try your best and see how many different species you can find. Put your event on the BioBlitz Worldwide map http://education.eol.org/bioblitz/worldwide, upload your images to EOL, and make a field guide of the species you and your classmates identified.

EOL Podcasts

http://education.eol.org/podcast

The audio series *One Species at a Time* is a tribute to life on Earth http://education.eol.org/podcast/one-species-time. Each episode is a story, a mystery, a riddle, or an exploration of a different creature pulsing, fluttering, surging, respiring, and galloping on this planet. Biodiversity is center stage, from scurrying invasive beetles in Oregon to the threatened cedar trees of Lebanon to Ediacaran fauna from 580 million years ago. There are associated *Extras* and a *Meet the Scientist* section with each podcast.Some have associated educational materials. All podcasts are freely available and can be used in other projects.

Announcement of the Encyclopedia of Life

http://www.youtube.com/watch?v=Drtgib0C8hU

MEDIA

Click image to the left for more content.

E.O. Wilson: Encyclopedia of Life

http://www.youtube.com/watch?v=Lj2vRZ6jtAo

MEDIA

Click image to the left for more content.

Interview with E.O. Wilson at Harvard University (2011),discussing what he loves about science.

3.2 The Biodiversity Heritage Library

http://www.biodiversitylibrary.org/

Fourteen major natural history museum libraries, botanical libraries, and research institutions have joined to form the Biodiversity Heritage Library. The participating libraries have over two million volumes of biodiversity literature collected over 200 years to support the work of scientists, researchers, and students in their home institutions and throughout the world.

The Biodiversity Heritage Library (BHL) consortium cooperates to digitize and make accessible the legacy literature of biodiversity held in their collections and to make that literature available for open access and responsible use as a part of a global "biodiversity commons." Because of the BHL's success in digitizing a significant mass of biodiversity literature, the scientific documentation of the study of living organisms since the time of Linnaeus has became easily accessible.

Anyone can access the BHL website directly or link to it from any EOL species page. When on a species page, click on the "References" tab to access literature directly related to the species under consideration.

The published literature on biological diversity has limited global distribution; much of it is available in only a few select libraries in the developed world. These collections are of exceptional value because the domain of systematic biology depends more than any other science-upon historic literature. Yet, this wealth of knowledge is available only to those few who can gain direct access to significant library collections. Literature about the *life* that exists in developing countries is often not available within their borders. Biologists have long considered that access to the published literature is one of the chief impediments to the efficiency of research in the field. Among other results, free global access to digitized versions of the literature would make available information about the Earth's species to all parts of the world. Many of the texts digitized by the BHL have until now only been held in a few European or North American libraries. Now, with this resource, scientists and student in the developing world have access to them, thereby accelerating biodiversity research.

Since 2009, the BHL has expanded globally. The European Commission's eContentPlus program has recently funded the BHL-Europe project, with 28 institutions, to assemble the European language literature. Additionally, the Chinese Academy of Sciences, the Atlas of Living Australia, Brazil (through SciELO and BIREME), and the Bibliotheca Alexandrina have created regional BHL sites. These projects will work together to share content, protocols, services, and digital preservation practices.

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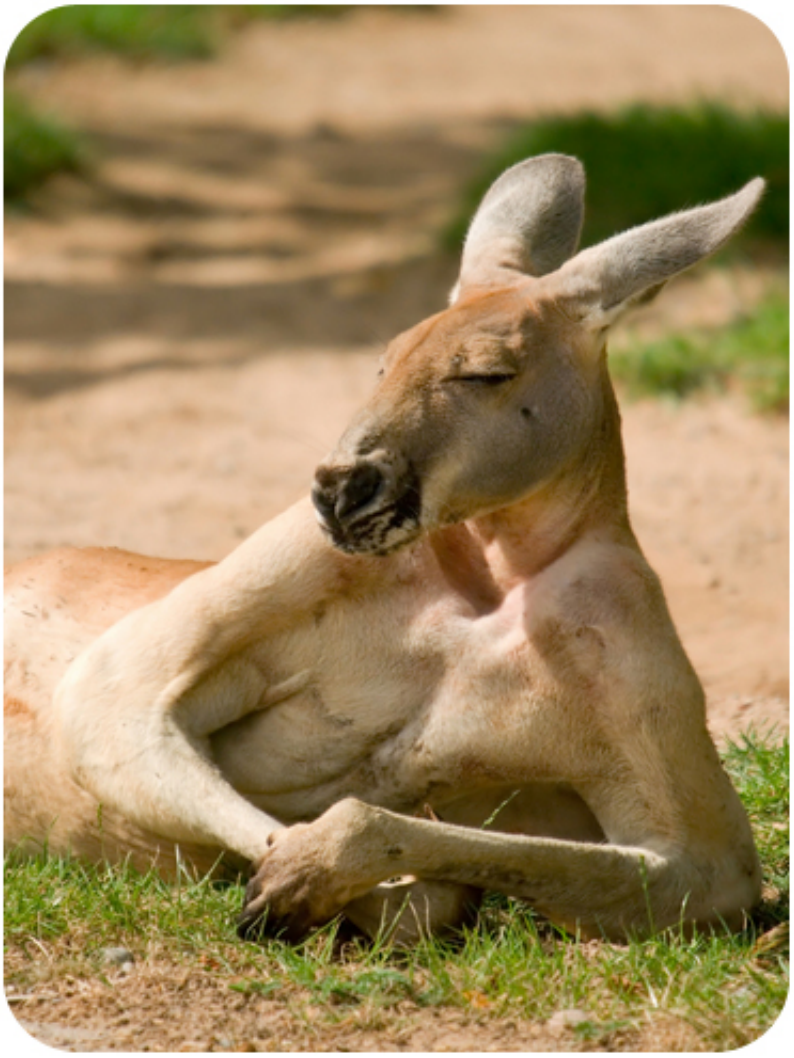
- Fish image copyright Ingrid Prats, 2011. Used under license from Shutterstock.com.

CHAPTER 4 Understanding Biodiversity: An Introduction

Chapter Outline

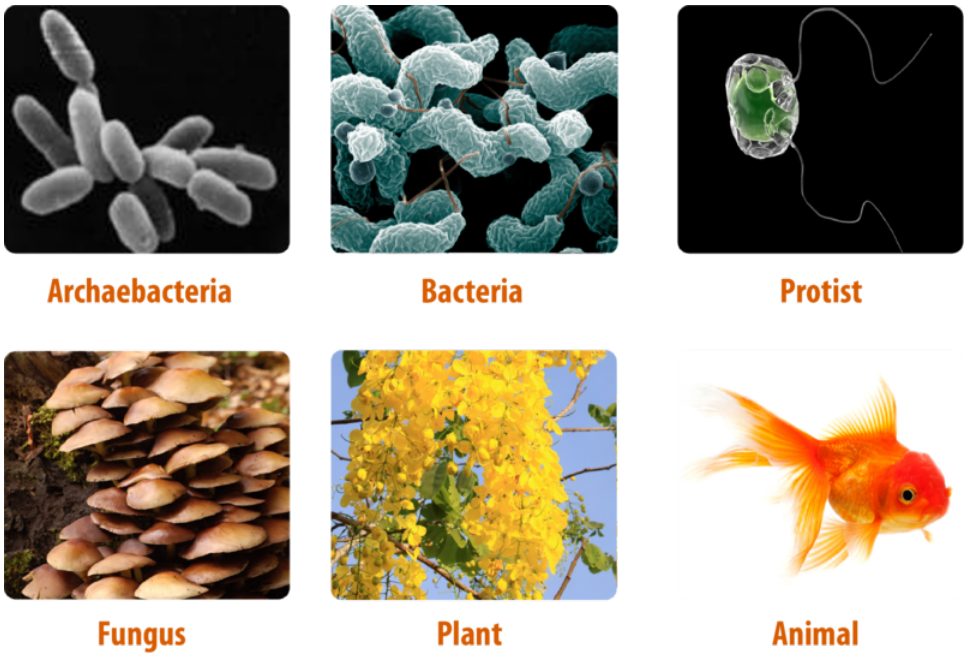


4.1 Biodiversity

Understanding Biodiversity does not attempt to provide a complete review of biodiversity. For additional information about biodiversity, see the *Communities and Populations* chapter in the CK-12 Biology FlexBook at http://www.ck12.org/flexbook/book/2537 and the *Ecology and Human Actions* chapter in the CK-12 Biology I - Honors FlexBook at http://www.ck12.org/flexbook/book/829.

"If names are not correct, language will not be in accordance with the truth of things." Confucius.

Biodiversity refers to 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. Scientists have identified about 1.9 million species alive today, each with their own unique scientific name. They are divided into the six kingdoms of life shown in the **Figure** below. Scientists are still discovering new species. Thus, they do not know for sure how many species really exist today. Most estimates range from 5 to 30 million species.



Diversity of life from Archaebacteria to Plants and Animals.

The Importance of Biodiversity

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. Just a few of these are described below:

- Wild plants and animals maintain a valuable pool of genetic variation. This is important because many domestic species are genetically uniform. This puts the domesticated species at great risk of dying out due to disease.
- Other organisms provide humans with many different products, including timber, fibers, adhesives, dyes, and rubber.
- 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 have yet been studied for their medical potential. Therefore, declining biodiversity can indirectly harm human health.
- Other living things provide inspiration for engineering and technology. For example, the car design in the **Figure** below was based on the structure of a fish.

The rosy periwinkle is an invaluable source of two important cancer-fighting drugs.

The yellow box fish provided a design model for the car shown here. The fish is the result of millions of years of natural selection for two traits that are also important in cars: efficient aerodynamics and maximum interior space.

From flowers to fish, biodiversity benefits humans in many ways.

Ecosystem Services of Biodiversity

Biodiversity generally increases the productivity and stability of ecosystems. A large biodiversity 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 as part of the nitrogen cycle and make the nitrogen available to plants. Other bacteria recycle the nitrogen from organic wastes and the 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 organisms.

Why Study Biodiversity?

The economic services and benefits of biodiversity listed above are just a small sample of the reasons to study biodiversity. Every time a species goes extinct or an ecosystem is harmed, it can be argued that we are affected as well. So, as a species, we need to understand as much as we can about other species, especially the niche of other species and how they benefit their ecosystems. Benefits to humans are bound to result from the study of other species. See *Biodiversity* at http://vimeo.com/14105623 for additional information.

Millions of Unseen Species

A study released in August 2011 estimates that Earth has almost 8.8 million animal, plant, and fungi species, but we've only discovered less than a quarter of them. Recent newly discovered species have been very diverse: a psychedelic frogfish, a lizard the size of a dime, and even a blind hairy mini-lobster at the bottom of the ocean. There are potential benefits from these undiscovered species, which need to be found before they disappear from the planet. The study estimates that of the 8.8 million species, about 6.5 million would live on land and 2.2 million in the ocean. The research estimates there are 7.8 million animal species, followed by fungi with 611,000 and plants with just shy of 300,000 species. See http://news.yahoo.com/wild-world-millions-unseen-species-fill-earth-210051661.html for additional information.

If the 8.8 million estimate is correct, "those are brutal numbers," said Encyclopedia of Life executive director Erick Mata. "We could spend the next 400 or 500 years trying to document the species that actually inhabit our planet."

Biodiversity and Human Actions

Over 99 percent of all species that ever lived on Earth have gone extinct. Five mass extinctions are recorded in the fossil record. They were caused by major geologic and climatic events. Evidence shows that a **sixth mass extinction** is occurring now. Unlike previous mass extinctions, the sixth extinction is due to human actions.

Some scientists consider the sixth extinction to have begun with early hominids during the Pleistocene. They are blamed for over-killing big mammals such as mammoths. Since then, human actions have had an ever greater impact on other species. The present rate of extinction is between 100 and 100,000 species per year. In 100 years, we could lose more than half of Earth's remaining species.

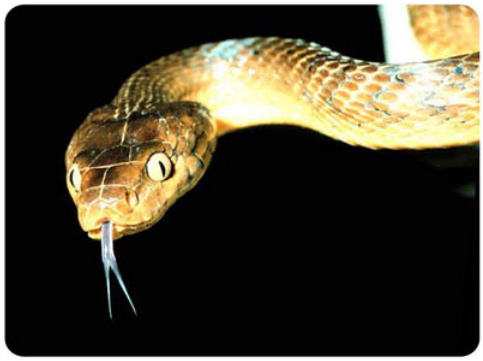
Causes of Extinction

This is one of the most powerful birds in the world. Could it go extinct? The Philippine Eagle, also known as the Monkey-eating Eagle, is among the rarest, largest, and most powerful birds in the world. It is critically endangered, mainly due to massive loss of habitat due to deforestation in most of its range. Killing a Philippine Eagle is punishable under Philippine law by twelve years in jail and heavy fines.

The single biggest cause of extinction today is **habitat loss**. Agriculture, forestry, mining, and urbanization have disturbed or destroyed more than half of Earth's land area. In the U.S., for example, more than 99 percent of tall-grass prairies have been lost. Other causes of extinction today include:

- **Exotic species** introduced by humans into new habitats. They may carry disease, prey on native species, and disrupt food webs. Often, they can out-compete native species because they lack local predators. An example is described in the Brown Tree Snake **Figure** below.
- Over-harvesting of fish, trees, and other organisms. This threatens their survival and the survival of species that depend on them.
- Global climate change, largely due to the burning of fossil fuels. This is raising Earth's air and ocean temperatures. It is also raising sea levels. These changes threaten many species.
- Pollution, which adds chemicals, heat, and noise to the environment beyond its capacity to absorb them. This causes widespread harm to organisms.
- Human overpopulation, which is crowding out other species. It also makes all the other causes of extinction more severe.

Brown Tree Snake



Brown tree snakes "hitch-hiked" from their native Australia on ships and planes to Pacific Islands such as Guam. Lacking local island predators, the snakes multiplied quickly. They have already caused the extinction of many birds and mammals they preyed upon in their new island ecosystems.

Brown Tree Snake. The brown tree snake is an exotic species that has caused many extinctions on Pacific islands such as Guam.

Effects of Extinction

The results of a study released in the summer of 2011 have shown that the decline in the numbers of large predators like sharks, lions, and wolves is disrupting Earth's ecosystem in all kinds of unusual ways. The study, conducted by scientists from 22 different institutions in six countries, confirmed the sixth mass extinction. The study states that this mass extinction differs from previous ones because it is entirely driven by human activity through changes in land use, climate, pollution, hunting, fishing, and poaching. The effects of the loss of these large predators can be seen in the oceans and on land.

- Fewer cougars in the western US state of Utah led to an explosion of the deer population. The deer ate more vegetation, which altered the path of local streams and lowered overall biodiversity.
- In Africa, where lions and leopard are being lost to poachers, there is a surge in the numbers of olive baboons who are transferring intestinal parasites to human who live nearby.

- In the oceans, industrial whaling led a change in the diets of killer whales, who eat more sea lion, seals, and otters and dramatically lowered those population counts.

The study concludes that the loss of big predators has likely driven many of the pandemics, population collapses, and ecosystem shifts the Earth has seen in recent centuries. See http://news.yahoo.com/loss-big-predators-disrupts-earth-ecosystem-study-181200945.html for additional information.

Disappearing Frogs

Around the world, frogs are declining at an alarming rate due to threats like pollution, disease and climate change. Frogs bridge the gap between water and land habitats, making them the first indicators of ecosystem changes. Meet the California researchers working to protect frogs across the state and across the world at http://www.kqed.org/quest/television/disappearing-frogs. Learn about the plight of the yellow-legged frog at http://www.kqed.org/quest/radio/plight-of-the-yellowlegged-frog.

MEDIA

Click image to the left for more content.

Nonnative Species

Scoop a handful of critters out of the San Francisco Bay and you'll find many organisms from far away shores. Invasive kinds of mussels, fish and more are choking out native species, challenging experts around the state to change the human behavior that brings them here. See http://www.kqed.org/quest/television/san-francisco-bay-invaders for more information.

MEDIA

Click image to the left for more content.

How You Can Help Protect Biodiversity

There are many steps you can take to help protect biodiversity. For example:

- Consume wisely. Reduce your consumption wherever possible. Re-use or recycle materials rather than throwing out and buying new. When you do buy something new, choose products that are energy efficient and durable.
- Avoid plastics. Plastics are made from petroleum and produce toxic waste.
- Go organic. Organically grown food is better for your health. It also protects the environment from pesticides and excessive nutrients in fertilizers.
- Save energy. Unplug electronic equipment and turn off lights when not in use. Take mass transit instead of driving.

Lost Salmon

Because of a sharp decline in their numbers, the entire salmon fishing season in the ocean off California and Oregon was canceled in both 2008 and 2009. At no other time in history has this salmon fishery been closed. The species in the most danger is the California coho salmon. Examine efforts to protect the coho in Northern California and explores the important role salmon play in the native ecosystem at http://www.kqed.org/quest/television/californias-lost-salmon and http://www.kqed.org/quest/television/coho-salmon-in-muir-woods.

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CHAPTER 5 Understanding Biodiversity: Global Climate Change

Chapter Outline

5.1 Global Climate Change and Biodiversity

Understanding Biodiversity does not attempt to provide a complete review of climate change. For additional information about climate change, see the *Communities and Populations* chapter in the CK-12 Biology FlexBook at http://www.ck12.org/flexbook/book/2537 and the *Ecology and Human Actions* chapter in the CK-12 Biology I - Honors FlexBook at http://www.ck12.org/flexbook/book/829.

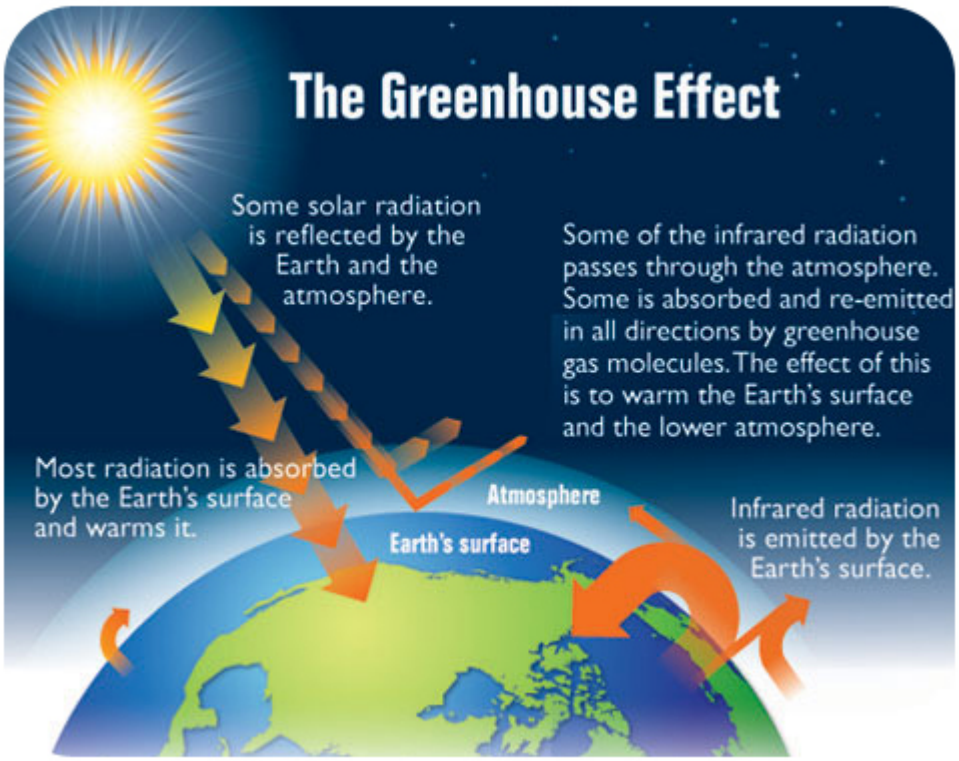
Does global climate have an effect on biodiversity? How could it not?

A major problem caused by increased air pollution is global climate change. Global climate change refers to a worldwide significant and lasting change in the distribution of weather patterns over periods ranging from decades to millions of years. This change may be a change in average weather conditions or the distribution of events that influence the average weather conditions.

What causes this change? It is probable that gases such as carbon dioxide from the burning of fossil fuels increase the natural greenhouse effect. This raises the temperature of Earth's surface. This has numerous consequences. Does this climate change affect biodiversity? Of course it does. And probably in a negative fashion.

What Is the Greenhouse Effect?

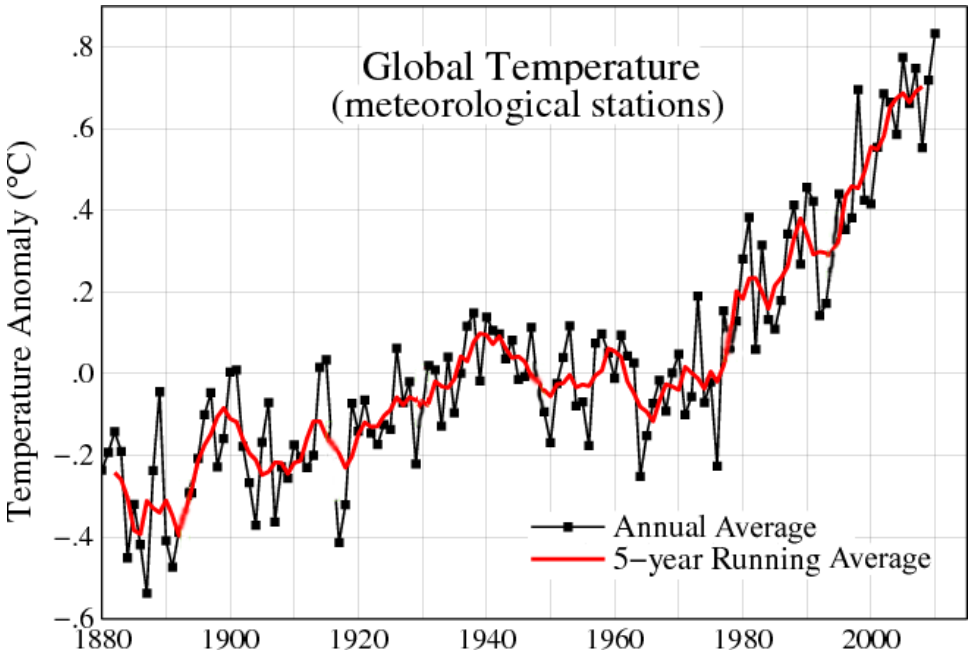
The **greenhouse effect** is a natural feature of Earth's atmosphere. It occurs when gases in the atmosphere radiate the sun's heat back down to Earth's surface (see The Greenhouse Effect **Figure** below). Otherwise, the heat would escape into space. Without the greenhouse effect, Earth's surface temperature would be far cooler than it is. In fact, it would be too cold to support life as we know it.



The Greenhouse Effect. Without greenhouse gases, most of the sun's energy would be radiated from Earth's surface back out to space.

Global Warming

Global warming refers to a recent increase in Earth's average surface temperature (see Global Temperatures **Figure** below). During the past century, the temperature has risen by almost 1°C (about 1.3°F). That may not seem like much. But consider that just 10°C is the difference between an ice-free and an ice-covered Earth.



The average annual temperature on Earth has been rising for the past 100 years.

Most scientists agree that global warming is caused by more carbon dioxide in the atmosphere. This increases the greenhouse effect. There is more carbon dioxide in the atmosphere mainly because of the burning of fossil fuels. Destroying forests is another cause. With fewer forests, less carbon dioxide is removed from the atmosphere by photosynthesis.

Effects of Climate Change

How has global warming affected Earth and its life? Some of its effects include:

- Decline in cold-adapted species populations, such as the polar bears.
- Melting of glaciers and rising sea levels.
- Coastal flooding and shoreline erosion.
- More droughts and water shortages.
- Changing patterns of precipitation.
- Increasing severity of storms.
- Major crop losses.

With Deaths of Forests, a Loss of Key Climate Protectors, (http://www.nytimes.com/2011/10/01/science/earth/01forest.html) published October 1, 2011 by the New Your Times, discusses the effects of shrinking forests on the global climate. Forests remove greenhouse gases from the atmosphere, and with shrinking forests, less of these gases can be removed. Scientists state that to ensure that forests are preserved for future generations, society needs to limit the fossil-fuel burning that is altering the climate of the world.

In November 2011, the Nobel Prize-winning Intergovernmental Panel on Climate Change issued a special report on global warming and extreme weather (http://news.yahoo.com/science-panel-ready-extreme-weather-104156773.html). They warned of more severe droughts, floods and heat waves due to the warming world. They went on to further say that without proper preparedness, crazy weather extremes may overwhelm some locations, making some places unlivable.

KQED Quest: Climate Watch: California at the Tipping Point

The world's climate is changing and California is now being affected in both dramatic and subtle ways. In 2008, scientists determined that California's temperatures increased by more than 2.1°F during the last century. What's more, the data showed that human activity has played a significant role in that climate change. "What's just 2 degrees?" you may wonder. But, as the science shows, just 2 degrees is extremely significant.

What does all this temperature change mean? For starters, declining mountain snowpack and prolonged drought conditions could pose a threat to limited water supplies. Heat waves are projected to be longer, bringing increased danger from wildfires and heat-related deaths. Rising sea levels due to temperature shifts jeopardize life in coastal areas, both for human communities and the plants and animals that rely on intertidal and rich wetland ecosystems. Also, more precipitation is expected to fall as rain rather than snow, thereby increasing the risk of floods. And, as heat increases the formation of smog, poor air quality could get even worse.

Climate change may also profoundly affect the economy in California and elsewhere. Shorter ski seasons and damage to the marine ecosystem mean a reduction in tourism. Water shortages mean issues with the commercial and recreational fishing industry, and higher temperatures will affect crop growth and quality, weakening the agricultural industry, to name just a few of the economic issues associated with climate change.

Get an in-depth look at the science behind climate change at http://www.kqed.org/quest/television/climate-watch-california-at-the-tipping-point-part-one.

MEDIA

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KQED Quest: Giant Redwoods and Global Warming

Forest ecologist Steve Sillett is leading a team of scientists as they climb and measure every branch of some of the last and tallest old growth redwoods in California. Their goal is to learn how these ancient giants have historically responded to climatic shifts and to monitor how they are being impacted today by global warming. See http://www.kqed.org/quest/television/science-on-the-spot-measuring-redwood-giants for additional information.

MEDIA

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KQED Quest: Acidic Seas

Melting glaciers, rising temperatures, and droughts are all impacts of global warming. But how does global warming actually affect the oceans? The sea, it turns out, absorbs carbon dioxide emissions. These emissions are causing the oceans to become more acidic. Changing pH levels threaten entire marine food webs, from coral reefs to salmon.

As you can probably guess, the ocean is an incredibly complex system. So ocean acidification poses an interesting question to scientists: what will the impacts be on marine species and ecosystems? What scientists know already is

that some creatures will do fine, while others won't be able to adapt in time. Either way, food webs may feel the effects. Clearly, understanding the potential consequences is important.

Another major concern has to do with marine animals with certain kinds of shells. Corals, clams, and others all use carbonate in the water to build their shells out of calcium carbonate. But ocean acidification reduces the amount of carbonate in the water, making it more difficult for them to make shells. That could be devastating for coral reefs, who are already facing a number of stresses. See http://www.kqed.org/quest/radio/acidic-seas for additional information.

MEDIA

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What Can Be Done?

Efforts to reduce future global warming mainly involve energy use. We need to use less energy, for example, by driving more fuel-efficient cars. We also need to switch to energy sources that produce less carbon dioxide, such as solar and wind energy. At the same time, we can increase the amount of carbon dioxide that is removed from air. We can stop destroying forests and can plant new ones.

http://www.youtube.com/watch?v=-gRJLAA4tDY

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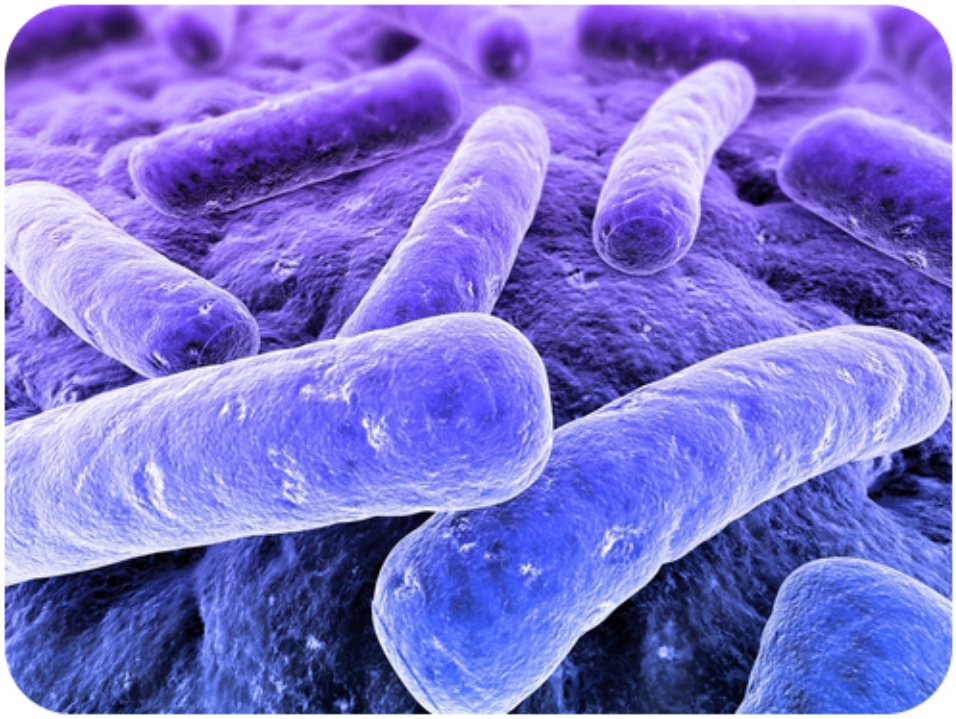
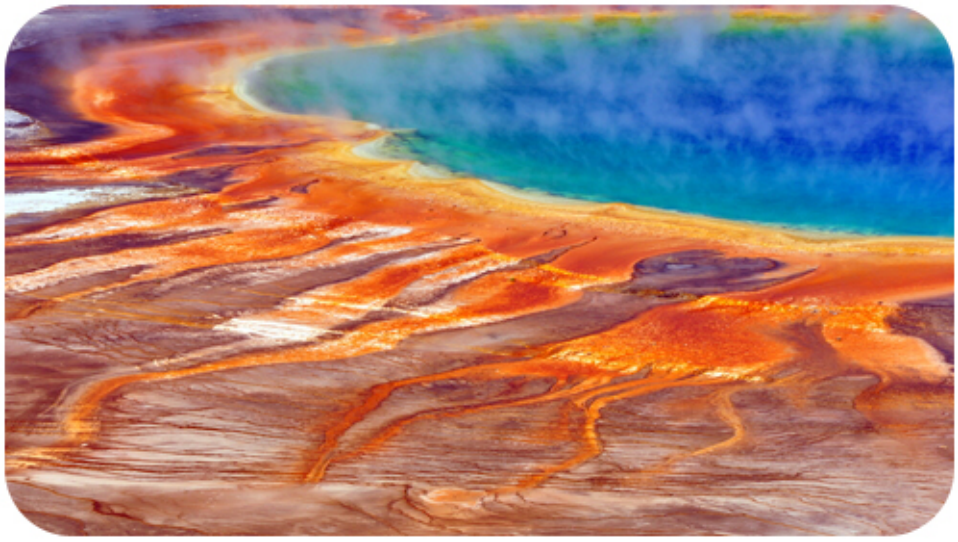
CHAPTER 6 Understanding Biodiversity: Bacteria



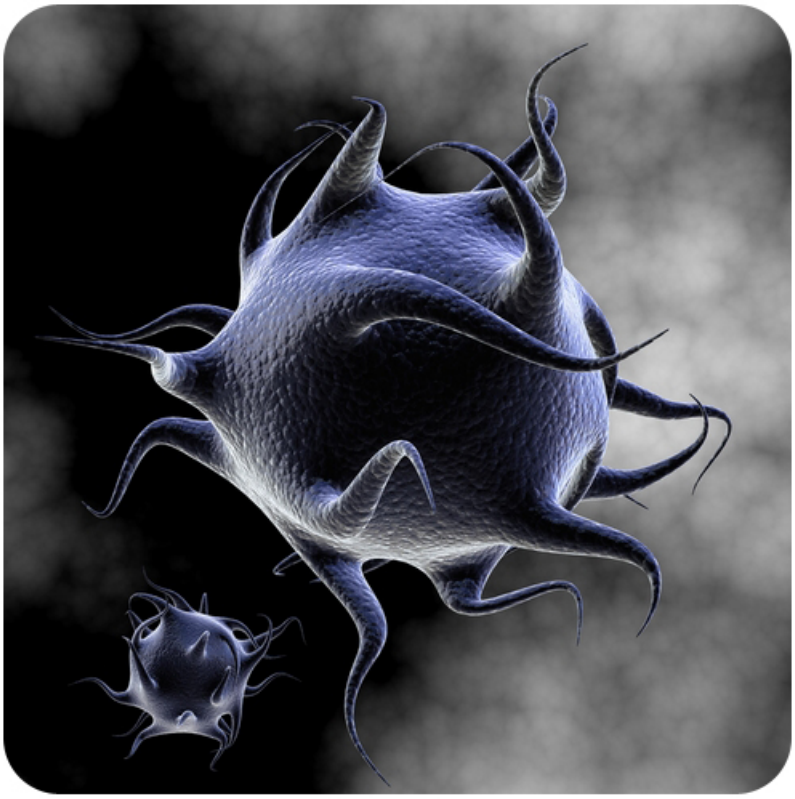
- Escherichia coli
- Pseudomonas aeruginosa
- Staphylococcus aureus

CHAPTER 7 Understanding Biodiversity: Archaea



- Halobacterium salinarum
- Methanobrevibacter smithii

CHAPTER 8 Understanding Biodiversity: Protists



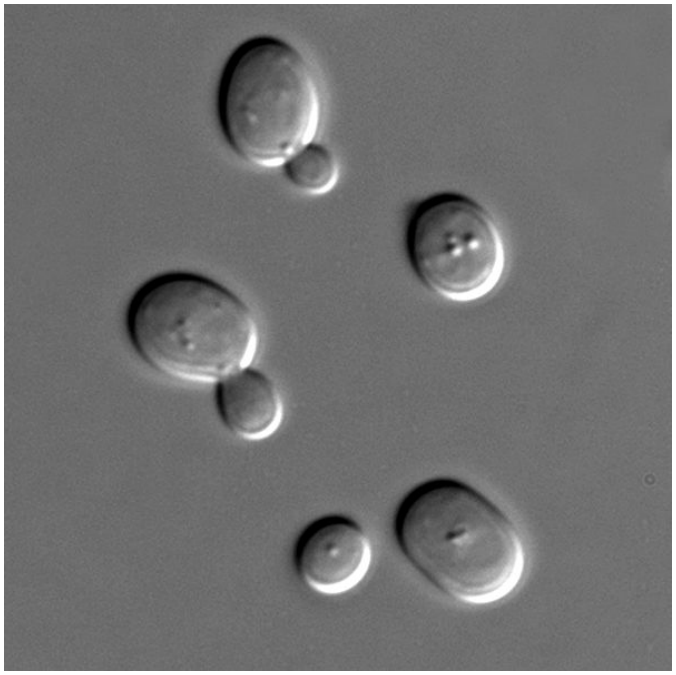
- Giardia lamblia
- Paramecium caudatum
- Trypanosoma brucei

CHAPTER 9 Understanding Biodiversity: Fungi

Chapter Outline

- Saccharomyces cerevisiae (Baker's Yeast)
- Agaricus bisporus (Button Mushroom)
- Lobaria pulmonaria (Lichen)
- Penicillium chrysogenum (Penicillin)
- Penicillium roqueforti (Blue Cheese)

9.1 Saccharomyces cerevisiae



Status

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Common Names

- Yeast
- Baker's Yeast
- Brewer's Yeast
- Budding Yeast

Description

Saccharomyces cerevisiae, which in Latin means "sugar fungus," is a species of the fungi yeast. It is a single-celled eukaryotic organism. *S. cerevisiae* has been instrumental in baking and brewing for thousands of years. *S. cerevisiae* reproduces by budding. Often when using the general term *yeast,* scientists are referring to *S. cerevisiae.*

Saccharomyces is perhaps the most useful and one of the best studied single-celled eukaryotes. As such, *S. cerevisiae* is considered a eukaryotic model organism in molecular and cell biology, and has been instrumental in research on the cell cycle, metabolism, signal transduction, protein interactions, and regulatory networks.

- Domain: Eukarya
- Kingdom: Fungi
- Phylum: Ascomycetes
- Class: Saccharomycetes or Hemiascomycetes
- Order: Saccharomycetales
- Family: Saccharomycetaceae
- Genus: Saccharomyces
- Species: *S. cerevisiae*

Habitat

S. cerevisiae's natural habitat is on the surface of fruit, but it is best known for its role in the baking and brewing industries.

Biology

Cell Biology

S. cerevisiae can exist as both haploid and diploid cells. The haploid cells undergo a simple life cycle of growth followed by mitosis. Under stressful conditions, the cells will die. The diploid cells also undergo growth and mitosis, although under stressful conditions, they will undergo meiosis and produce haploid spores. Under favorable conditions, the spores will then *mate,* producing a diploid cell.

Saccharomyces are heterotrophes, obtaining their energy from glucose, utilizing both aerobic and anaerobic respiration.

S. cerevisiae is a model organism in molecular and cell biology studies. Many signalling pathways of importance in many eukaryotic organisms were first discovered in this species. Many common cell and molecular characteristics of eukaryotic cells were also identified in yeast.

Yeast two-hybrid screening is a molecular biology technique used to discover protein–protein interactions and protein–DNA interactions by testing for physical interactions between two proteins or binding between a single protein and DNA. This technique was developed in 1989, and was originally designed to detect protein–protein interactions using the GAL4 transcriptional activator of *S. cerevisiae*. GAL4 is a nuclear protein, acting as a positive regulator of gene expression for galactose-induced genes. The basic idea behind the test is the activation of downstream reporter gene(s) by the binding of a transcription factor onto an upstream activating sequence (UAS) on the DNA.

Genetics

The genome of *S. cerevisiae* was the first eukaryotic genome that was completely sequenced. The sequence was released to the public on April 24, 1996. The genome is composed of about 12,156,677 base pairs and 6,275 genes, distributed on 16 chromosomes. Only about 5,800 of these genes are believed to be functional. This species is estimated to share about 23% of its genome with that of humans.

One of the first groups of growth mutants isolated from yeast were those that required adenine, one of the bases in DNA and RNA nucleotides and a component of ATP. There are several genes in yeast that are involved in adenine synthesis, and a mutation in any one of these genes requires that adenine be added to the growth medium. The first

two adenine-requiring mutants discovered were in yeast, and are known as *ade1* and *ade2*. The functional alleles of these genes are the *ADE1* and *ADE2* genes.

Evolution

Recent studies estimate the arrival of fungal organisms at about 760–1060 million years ago (Ma) on the basis of comparisons of the rate of evolution in closely related groups. For much of the Paleozoic Era (542–251 Ma), fungi lived in water. Moving onto land required fungi to develop other methods to obtain nutrients, including parasitism, saprobism, and the development of mutualistic relationships, such as mycorrhiza and lichen. Recent studies suggest that the ancestral ecological state of the Ascomycota was saprobism.

The fungi probably colonized the land during the Cambrian (542–488.3 Ma), long before land plants. Fungal fossils do not become common until the early Devonian (416–359.2 Ma). At about this same time, approximately 400 Ma, the Ascomycota and Basidiomycota diverged. Yeast is a member of the phylum Ascomycota.

Ecology

Physiology

S. cerevisiae can exist as both haploid and diploid cells. Haploid *S. cerevisiae* cells exist as two mating types: **a** and α. Both haploid and diploid *S. cerevisiae* cells may reproduce asexually by budding. But yeasts, like all fungi, may have also have sexual reproductive cycles. Under stressful conditions, haploid cells will generally die; but under the same conditions, diploid cells can enter sexual reproduction processes. Under stressful conditions, diploid yeast cells, can undergo meiosis to produce four haploid spores: two **a** spores and two α spores. Upon favorable conditions, cells of opposite mating type can fuse to form a diploid cell. There are two alleles that determine the mating types of haploid strains. Alternative alleles of the *MAT* gene, *MAT*a and *MAT*α, determine the two opposite mating types.

Yeast have simple nutritional requirements. As yeast are fungi, they are unable to carry out photosynthesis. They obtain their carbon from carbon containing compounds, which can be as simple as the two-carbon acetate. In addition, they also require a source of nitrogen, which can be as simple as the single-nitrogen containing ammonium sulfate. Yeasts can also use a variety of organic nitrogen compounds containing both carbon and nitrogen, such as urea and various amino acids. The only other complex compound that yeast require is the vitamin, biotin. In addition, they also require more simple molecules including a variety of salts and trace elements.

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Attribution

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CHAPTER 10 Understanding Biodiversity: Plants

Chapter Outline

- Encelia californica (Bush Sunflower)
- Pisum sativum (Pea Plant)
- Toxicodendron diversilobum (Pacific Poison Oak)

10.1 Encelia californica: Bush Sunflower

Common Name

- California Encelia
- Bush Sunflower
- Encelia Daisy
- California Sunflower

Description

The *E. californica* is a bushy perennial shrub, and it is native to San Diego. Its height range is between 20-60 inches tall and it has a rapid growth rate. The *E. californica* head has golden petals with brownish-red disks. Its leaves are about 1 to 2 $\frac{1}{2}$ inches long. Its green, smooth, wavy-edged leaf almost looks and feels like wool. *Encelia californica* is rough, has a strong odor, but is very colorful and attractive to the eye.

- Kingdom: Plantae
- Division: Magnoliophyta
- Class: Magnoliopsida
- Order: Asterales
- Family: Asteraceae
- Tribe: Heliantheae
- Genus: *Encelia*
- Species: *E. californica*

Habitat

E. californica is known to grow in coastal bluffs and open or bushy slopes below 2000 ft. *E. californica* blooms in coastal sage and chaparral from February to June. *E. californica* is not an annual, but it is a perennial, meaning the plant lives for several years. *E. californica* is drought deciduous, meaning it loses its leaves and looks dead in the summer, when it's dry. When rain comes the next season, the plant revives, puts out new green leaves, and begins to flower.

Biology

Cell Biology

Encelia californica, like all other plants, has eukaryotic cells. The difference between eukaryotes and prokaryotes is that eukaryotes have cells with a nucleus and many organelles. The *Encelia californica* cells have the following cell parts: a nucleus, which is similar to a safe that contains the factories trade secrets, a cytoskeleton, part of the cytoplasm that gives the cell its shape, ribosomes, the non-membrane bound organelles where all the proteins are made, and vacuoles, which act like a storage center. Unlike animal cells, plants have organelles called chloroplasts that allow the plant to make its own food using sunlight. *Encelia californica* cells divide in two different ways, through mitosis and through meiosis. Mitosis is when the nucleus divides, and each new cell contains a copy of the DNA in the original cell. Meiosis is when the cell divides to produce gametes with one half of the chromosomes (containing DNA) of the parent cells. *Encelia californica* needs gametes for reproduction.

Genetics

Evolution

Flowers have existed for nearly 140 million years. They have thrived and adapted in their need to survive. They first adapted to become land plants with spores. Spores first were aquatic and adapted to land. Later plants had evolved to produce seeds but had not yet grown flowers. Later when the plants started to first develop flowers, plants thrived, spreading flowers and fruits everywhere. Seeds are spread everywhere by the way of the fruits.

Ecology

The large, bright yellow sunflowers attract a variety of pollinators including bees, flies, and butterflies. These pollinators usually tend to stay put for a good amount of time, in order to drink the nectar or collect all the pollen. Fruits serve as a carrier for the seeds to continue reproduction of the *E. californica*.

Anatomy, Morphology and Physiology

Encelia californica tends to bloom in the late winter/early spring, mid spring, and in the late spring/early summer. The flowering process first begins when the pollen from a flower's anther is transferred to the stigma. There are two types of fertilization- cross-fertilization and self-fertilization. Self fertilization is when the pollen from one flower's anther is transferred to the same flower's eggs. Cross fertilization is when a flower's pollen is transferred to an entirely different plant's stigma. *E. californica* can most likely be fertilized only through cross pollination. When the eggs become fertilized, they evolve into seeds. When the petals of a flower fall off only to leave the ovary, they will soon develop into the flowering plant's fruit. *Encelia californica* is a dicot. Dicots are plants with seeds that sprout two leaves when they germinate.

E. californica and members of its plant family are unique in many different ways. They have flower heads which look like single flowers, but are clusters of individual flowers. These individual flowers can be disk flowers that are located in the center part or ray flowers that look like petals. Most sunflower species have both disk and ray flowers, but some just have disk flowers, and some just have ray flowers. *E. californica* has both: the brown in the middle are disk flowers, and the yellow on the outside are ray flowers.

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Attribution

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10.2 Pisum sativum: Pea Plant

Status

Published prior to review.

Common Name

- Pea Plant
- Garden Pea

Description

Scientifically, the pea plant *Pisum sativum* may be once of the most important members of the plant kingdom. This plant was used by Gregor Mendel, the father of genetics, to develop the basic concepts of inheritance.

The pea plant, like all angiosperms, is classified as an autotroph, meaning it uses photosynthesis to convert the energy of the sun to glucose. This plant has been cultivated across the world for thousands of years. Also, it is a legume, so it has the ability to fix nitrogen through a symbiotic relationship with the bacteria, *Rhizobium.*

Pea Plants are useful for studying heredity due to the duality of their various phenotypes. For example, their flower color is purple or white, the seed form is round or wrinkled, or the stem is tall or short. This means that there are no intermediate phenotypes. Also, the male and female reproductive parts of the plant are enclosed in the same flower, and mating/pollination can be controlled. It can also grow easily and mature in a short period of time, which allows results to be obtained quickly. Mendel studied about 29,000 pea plants during his studies.

The taxonomic classification of *P. sativum* is as follows:

- Domain: Eukarya
- Kingdom: Plantae
- Phylum: Anthophyta
- Class: Eudiotyledones
- Order: Fabales
- Family: Fabaceae
- Genus: *Pisum*
- Species: *P. sativum*

Habitat

The pea plant can be grown in any area with moderate temperatures; it isn't localized to any one ecosystem or biome. *P. sativum* can be found across the world today either in garden's for personal use or for commercial sale. The plant is native to the eastern Mediterranean areas and began to grow in rocky areas, from the regions of Turkey east to Syria, Iraq, and Iran. The pea plant thrives at temperatures between 13-18°C (55-64°F), developing best in the spring, cool summers, or the beginning of fall.

Biology

Cell Biology

Like all plants, *P. sativum* is an autotroph, absorbing sunlight to start the photosynthesis process. Together with carbon dioxide and water, the plant produces glucose, releasing oxygen as a waste product. The pea plant is also known as a producer, forming the energy that will benefit itself and other organisms in the ecosystem. This energy is stored within the plant as the carbohydrate starch, which is a polysaccharide of thousands of glucose molecules bonded together.

The pea plant, like all vascular plants, uses a vascular system comprised of phloem and xylem to transport water, sugars and other substances. The pea plant cells have a central vacuole used to store water. The phloem is used to transport sugars and nutrients. The xylem is used to transport water.

Genetics

P. sativum has a large and complex genome. It contains 4,300 mega base pairs or 4,300,000,000 base pairs. The *P. sativum's* genome contains 14 chromosomes. The Pea Plant was used by Gregor Mendel to develop of his two laws of genetics. These principles of Mendelian genetics are the foundation of modern genetics.

Mendel investigated seven different characteristics in pea plants including seed shape, flower color, stem size, pod shape and pod color. Mendel cross-pollinated pure-bred parent plants, referred to as the P-generation. The offspring of the P generation, called the F1 generation, all had phenotypes representing one parental characteristic. When individuals from the F1 were allowed to self-pollinate, the next generation, the F2 generation, had 3 of 4 individuals with one P generation characteristic, and 1 of 4 individuals with the other P generation characteristic. This led to Mendel's law of segregation. This law 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.

Additional experiments analyzing two pea plant characteristics, such as pod shape and color, resulted in Mendel developing his second law, the law of independent assortment. This law states that factors controlling different characteristics are inherited independently of each other.

Evolution

Evolutionary scientists believe that the *P. sativum* first evolved in Egypt in the Nile Delta area around 4800-4400 BC. The Pea Plant has not evolved over time or from a specific organism but it has made adaptations. The adaptations that it has made over time are self-pollination, nitrogen fixation, and the development of xylem and phloem. Self-pollination allows the pea plant to reproduce without the need of an organism to move its pollen. The downside to self-pollination is that there is less of a chance for greater genetic variability and change.

Ecology

The pea plant's ecological role in the environment is a producer.

The pea plant is able to carry-out nitrogen fixation because of a symbiotic relationship relationship with certain bacteria and fungus. The bacteria receive extra sugars that the pea plant has made through photosynthesis, and the bacteria provides the plant with nitrogen. The plant, like all organisms, incorporates the nitrogen into its nucleic acids. The fungus provides the plant with additional nutrients that it usually receives from the soil. The fungus also receives glucose from the plant.

Physiology

Like all plants, *P. sativum* has an alternation of generations life cycle. This type of life cycle has separate times when either the haploid or diploid organism is dominant. Like all angiosperms, the pea plant has separate male and female reproductive structures, though both are located in the same flower.

Like most vascular plants, *P. sativum* maintains homeostasis through the use of xylem and phloem, self-pollination, and nitrogen fixation. Since the pea plant is a legume, it has developed a relationship with the bacteria *Rhizobium*. This bacteria enters the roots of the pea plant and forms nodules. Through this symbiotic relationship, the bacteria receive carbohydrates and other substances in exchange for fixing/converting nitrogen gas. The pea plant obtains and produces glucose during the process of photosynthesis, which it supplies to the bacteria. The pea plant has also developed a symbiotic relationship with a fungus. The fungus provides the plant with additional nutrients from the soil, and the fungus receives sugars from the plant.

The development of plant vascular tissue, xylem and phloem, occurred when plants migrated onto land. This vascular system allowed for the movement of water up the plant, and sugars made in their leaves during photosynthesis down the plant. The xylem moves water and the phloem moves dissolved solutes like sugars and amino acids. With this adaptation, the pea plant, like all plants is able to grow taller.

Photosynthesis converts water and carbon dioxide into sugars and oxygen, with the help of sunlight. *P. sativum* has two separate layers in the walls of the pods that are involved in photosynthesis. The outer layer is used to collect carbon dioxide from the atmosphere, and the inner layer is used to collect carbon dioxide that is coming off from the developing seeds inside the pod.

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Attribution

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Level

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10.3 Toxicodendron diversilobum: Pacific Poison Oak

Common Name

- Pacific Poison Oak
- Western Poison Oak
- Poison Oak

Description

Toxicodendron diversilobum, or poison oak, can both grow as a shrub and a vine. It's leaves are made of three leaflets with small teeth on each of the leaflets. They are two to six feet in height. If it gets hold of a sapling, or new tree, it could possibly kill it. When you touch it, the sap from it gets on your skin, eventually causing an allergic reaction that feels like a stinging sensation. It takes 100 nanograms of the allergen urushiol to get a reaction in more sensitive people. Also, this plant, as well as poison ivy, cause very painful reactions. So it's a good idea not to touch poison ivy or poison oak, and especially to be careful in areas such as abandoned mines, forests, near rivers, ghost towns, and abandoned fields, which is where they flourish. The plant blooms in March and April.

The complete taxonomic classification is:

- Kingdom: Plantae
- Phylum: Magnoliophyta
- Class: Magnoliopsida
- Order: Sapindales
- Family: Anacardiaceae
- Genus: *Toxicodendron*
- Species: *T. diversilobum*

Habitat

Western poison oak appears at the southwestern point of Canada, stretching down through the Pacific Coast down to Baja California. They grow in moist soil with plenty of sunlight in elevations below 1,650m. There are some other sightings of western poison oak in other regions of California and some unregistered sightings of western poison oak in Nevada.

Biology

Cell Biology

As a member of the Kingdom Plantae, *T. diversilobum* is made of eukaryotic cells. The cells of *T. diversilobum* have a protective barrier called the plasma membrane. They are also made of many organelles, structures like small organs that help the cell function. The nucleus contains the DNA with instructions for the cell, making it a eukaryotic cell. mRNA is produced by the nucleus, and ribosomes translate mRNA into proteins. The mitochondria produces ATP (adenosine trisphosphate), which powers the cell. Vesicles transport materials within the cell or outside the cell. Lysosomes, a type of vesicle, take all the waste from the cell and takes it away. Endoplasmic reticulum is split into two parts, the rough endoplasmic reticulum and the smooth endoplasmic reticulum. The rough endoplasmic reticulum has ribosomes attached to it which create proteins that are released inside of the endoplasmic reticulum. It is then sent to the Golgi apparatus. The smooth endoplasmic reticulum creates lipids. The Golgi apparatus tells where the proteins from the endoplasmic reticulum where to go. The cytoskeleton gives the cell it's shape. Since *T. diversilobum* is a plant, it has a couple of extra organelles. One is a large, central vacuole that stores the cell's water and nutrients. The cell wall acts as extra protection in addition to the plasma membrane and provides structure. Chloroplasts make the plant green and allow for photosynthesis.

T. diversilobum cells divide by mitosis, where the nucleus divides, and the new cells have the same chromosomes (they are genetically identical) as their parent. Another way that cells divide is through meiosis, where the new cells

have only half the chromosomes of the parent cell.

Evolution

The first plant ever was ancestral green algae. The first plants that were found on solid ground were bryophytes such as hornworts, liverworts, and mosses. They were low-growing plants since they didn't have any vascular tissue. Vascular tissue are tubes inside the plant that carry nutrients and water to the leaves so that they can use photosynthesis. They also carry the sugar made by the photosynthesis to other parts of the plant for storage. Ferns and some similar plants have vascular tissue which helps them grow tall. These plants reproduce with spores, and the spores need moisture.

After the ferns came the gymnosperms. Some gymnosperms include pines and firs. Their seeds are enclosed in cones but not completely enclosed. The last of the phases in evolution is the flowering plants. They produce seeds after having their flowers pollinated. Their seeds are inside the part of the flower that becomes the fruit. Flowering plants are the most abundant. *T. diversilobum* is a flowering plant.

Ecology

There are many animals that can eat *T. diversilobum*, such as deer, rats, sheep, and goats. Birds would eat then disperse *T. diversilobum* seeds.

Anatomy and Physiology

T. diversilobum is a dicot, which means that it has both female and male reproductive systems on the same plant. As *T. diversilobum* is a vine, it has a long stem that have other stems coming out of the main vine. The leaves then come out of those smaller stems. It's leaves are made of three leaflets with small teeth on each of the leaflets. Its sap contains urushiol, which can cause an allergic reaction. *T. diversilobum* has tiny, white flowers.

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CHAPTER 11 Understanding Biodiversity: Animals: Mammals

Chapter Outline

Class Mammalia

- Canis latrans (Coyote)
- Didelphis virginiana (Virginia Opossum)
- Enhydra lutris (Sea Otter)

- Loxodonta africana (African Elephant)
- Lynx rufus (Bay Lynx)
- Mirounga angustirostris (Elephant Seal)
- Ovis canadensis nelsoni (Desert Bighorn Sheep)
- Peromyscus californicus (California Mouse)
- Phascolarctos cinereus (Koala)
- Procyon lotor (Raccoon)
- Puma concolor (Mountain Lion)
- Sylvilagus audubonii (Audubon Cottontail Rabbit)
- Tursiop truncatus (Bottlenose Dolphin)

11.1 Canis latrans: Coyote

Common Name

- Coyote
- Brush Wolf
- American Jackal
- Prairie Wolf

Description

Coyotes have gray-brown to yellow-brown fur on the upper half torso and the tail, and whitish fur on the underbelly, under the muzzle, and on the legs. They have big, tawny ears, a long muzzle with a large black nose, yellow eyes, a long torso, and a long, bushy tail. Their scientific name, *Canis latrans*, is Latin for barking dog. The common name comes from the Nahuatl Indian word coyote. To Native Americans, they were thought to be tricksters and clowns, but were a god-like being that had a lot to do with the creation of the world and what went on after it.

The complete taxonomic classification is:

- Kingdom: Animalia
- Phylum: Chordata
- Class: Mammalia
- Order: Carnivora
- Family: Canidae
- Genus: *Canis*
- Species: *C. latrans*

Habitat

Coyotes live in North America and Central America. They live mostly in southwestern states of the United States, however, some live as far north as Alaska. Some live in deserts of Arizona. They also live in urban settings such as New York, Chicago, San Diego, and Washington, D.C. Their population may continue to spread due to the fact that they are very adaptable. They make their dens in rocky crevices, logs, coves or dens of other animals. They usually don't dig their own dens. They find an abandoned den of a badger or fox, and they make it bigger.

Biology

Cell Biology

Coyotes have eukaryotic cells, like all other animals. Eukaryotic cells are found in animals, fungi, and plants. These cells are made up of the cell membrane, nucleus, which contains the DNA, ribosomes, the endoplasmic reticulum, Golgi bodies, and the mitochondria, as well as other organelles. The cell membrane separates the inner and the outer parts of the cell. The next part of a cell is the DNA. DNA is a cell's genetic code that has the blueprints for the rest of the living organism. The ribosome makes proteins, essential for a cell. The endoplasmic reticulum can either be rough, which is used for protein synthesis, or smooth, which is used for lipid metabolism, carbohydrate metabolism, and detoxification. The Golgi body carries proteins inside the cell before they are sent to where they are needed. The mitochondria is where sugars are burned for energy.

Cells can divide in two ways, mitosis and meiosis. Mitosis is the process in which a cell divides the chromosomes in its nucleus into two identical sets in two new nuclei. Meiosis is the process in which DNA divides to create a cell with only half the chromosomes needed. This process is used to make gametes for reproduction.

The blood of coyotes and all other mammals has red blood cells without a nucleus. Nerve cells are a vital part of the body. Nerve cells transfer information around the body. They are used for sound, touch, sight, movement, and other senses. Skin cells are use primarily for protection. Muscle cells have 3 types: skeletal, which is used for locomotion (movement), smooth, which are used in the walls of intestines, and cardiac, which are used in the heart.

Genetics

The results of genetic analysis show that, on average, roughly 10 to 15 percent of the genetic makeup of the eastern coyotes is wolf. Coyotes in the eastern United States and Canada are actually gray wolf hybrids.

Evolution

The first animal fossils were found 630 million years ago. Amniotes evolved about 350 million years ago. Amniotes were the first land vertebrates. Amniotes are animals that produce eggs with internal membranes that let gases pass through but not water. In the amniotic egg, an embryo can breathe without drying. Amniotic eggs were the first eggs that could stay on land. One important amniote group to evolve was the synapsids, which then evolved into mammals. *Canis* is about 5 million years old, while the coyote evolved about 1.18 million years ago.

Ecology

Coyotes are prey to only two animals, the gray wolf and the mountain lion, and are hunted by humans. Ninety percent of their diet is made up of mammals like voles, prairie dogs, eastern cottontail rabbit, ground squirrel, and

mice. They will also eat small birds, snakes, lizards, deer, javelina, cattle, and small insects. Coyotes are omnivores and also eat fruits.

Anatomy and Physiology

Coyotes have keen hearing and sense of smell but have a limitation to the colors they can see. Coyotes have blade-like teeth for ripping meat off, but they have flat teeth for chewing plants. They have a gland in their nose, like all canids, called the Jacobson's organ, which is used for a better sense of smell. The ears of the coyote have a chain of three tiny bones that pick up sound waves. Coyotes have long, black -tipped tails that they use for balance when running, and non-retractable claws to provide gripping. Coyotes stand at less than two feet tall with ears that appear pointed. They have a four-chambered heart used to pump blood in their body. The heart is used to pump blood into the arteries, and two lungs to pump oxygen into the blood. Coyotes are warm blooded, which means that they can maintain body temperature. Coyotes, like all mammals, have mammary glands, so they feed their young milk. The coyote, like other mammals, gives birth to live young.

Behavior

Coyotes usually live in packs, but hunt in pairs. Coyotes are nocturnal. Coyotes are very vocal animals. It has a number of calls for different reasons. The male coyote might mate with more than one female. Coyotes mate between January-March. Two months later (April-June) the babies are born. The mother can have as low as one pup and up to 19 pups. The normal amount of pups is six. The pups are born blind and floppy-eared. They open their eyes after 10-14 days. After 3-4 weeks they come out of their den for the first time. They are weaned when they are one month old. When they are fully weaned, the parents start to give them regurgitated food. Male pups stay with their mom for nine months. Females stay with their mother's pack. Males and females pair off and mate together for several years. Coyotes have a lifespan of ten years.

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11.2 Didelphis virginiana: Virginia Opossum

Common Name

- Virginia Opossum
- Possum
- Common Opossum

Description

Didelphis virginiana, also known as the Virginia opossum, is a species of the class Mammalia. The Virginia Opossum is the only marsupial that inhabitants North America. The Virginia opossum is a slow mover, and it can be found in urban areas. The Opossum is the size of a regular domesticated cat, and it has a grey grizzly coat of fur. Possums can be found often in a backyard. They scavenge leftover food and compost from your trash cans. The opossum is famous for its signature move, "playing possum". If harmed or threatened, the Virginia opossum will collapse to the ground, and release a foul smell. It convinces predators the prey is dead, and they will leave the "dead body" alone.

The complete taxonomic classification is:

- Kingdom: Animalia
- Phylum: Chordata
- Class: Mammalia
- Order: Didelphimorphia
- Family: Didelphidae
- Genus: *Didelphis*
- Species: *D. virginiana*

Habitat

D. virginiana lives in North and Central America. It lives in many areas including rainforests, urban settings, and wetlands.

Biology

Cell Biology

D. virginiana, like all mammals and other animals, has eukaryotic cells. Eukaryotic cells have nuclei and other organelles. Organelles are like micro-sized organs. They include the endoplasmic reticulum, Golgi bodies, ribosomes and mitochondria. The Golgi bodies are carry protein within and out of the cells. Ribosomes produce protein in the cell, and mitochondria is where the cell burns sugar for energy. All animals have eukaryotic cells in their body, so that is not unique to the opossum.

Evolution

Marsupial evolution has dated back to 130 million years ago during the Cretaceous period. The Cretaceous period was the the time period when the dinosaurs died out. The earliest form of the marsupial was *Sinodelphys*, which is an extinct animal now. Early marsupials were very small, and ate small insects.

Ecology

Possums don't interact with other species as much because the Virginia opossum is prey to many animals. Opossums are prey to coyotes, bears, foxes, mountain lions, and other large mammals. The opossum's diet however consists of insects, frogs, snakes, small mammals, roadkill, and trash. Opossums mate 2-3 times a year, so they could possibly give birth to 75 young a year. The mother can have 25 babies at a time. When the babies are born, they attach to the mother's feeding stations. However, the mother only has 13 feeding stations, so 12 out of 25 will not survive. Even for the fortunate babies that have latched on to the mother, they can grow ill very quickly.

Anatomy and Physiology

Virginia Opossums have 50 teeth, more than any mammal. Male opossums have a forked penis, and female opossums have a forked vagina. Virginia opossums tend to have many young. When Opossums give birth, they can have up to 25 offsprings. The Virginia Opossum, like all other mammals, has mammary glands.

Behavior

Opossums are not normally aggressive, but they will be if threatened or harmed. They will hiss defensively, warning the predator to stay back. If in terror, they will drop and mimic death.

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11.3 Enhydra lutris: Sea Otter

Common Name

- Sea Otter

Description

The sea otter is the smallest marine mammal species and weighs 49- 99 pounds. They are usually 1.2- 1.5 m long and have light and dark brown fur. The sea otter pup usually weighs about 1-3 pounds at birth. The sea otter is related to weasels, badgers, and minks. They are also the heaviest member of the Mustelidae family.

- Kingdom: Animalia
- Phylum: Chordata
- Class: Mammalia
- Order: Carnivora
- Family: Mustelidae
- Genus: *Enhydra*
- Species: *E. lutris*

Habitat

The sea otter lives in Russia, Alaska, British Columbia, Washington, Oregon, and California. In the ocean, they burrow themselves in kelp forests during the day, but sleep on the waves during the night. They usually live in waters up to 100 ft. in depth, but they can dive down up to 325 ft. Sea otters occasionally travel to land, but are

mostly at sea. Able to give birth and raise their young in water, they can also go without fresh water for as long as they live. Sea otters can live in the water without ever coming out of the water. They can come on land if they want to, but they rarely do because of predators.

Biology

Cell Biology

Sea otters have eukaryotic cells, which have a nucleus and many organelles. Organelles are like miniature organs in a cell. Organelles include the nucleus, which contains the genetic material, the mitochondria, which provides the energy, vesicles, which transport materials, vacuoles, which are the storage centers, and lysosomes, which have digestive enzymes. Ribosomes are where the proteins are made.

Sea otters have red blood cells and white blood cells. The red blood cell is shaped with a pocket that traps oxygen and brings it to the rest of the body. Interestingly enough, mature red blood cells do not have nuclei. White blood cells are used for fighting off bacteria, disease, and infection. The sea otter also has nerve cells and skin cells. Nerve cells are long and stringy. They create a line of communication between other nerves and can quickly send signals throughout the body. Skins cells are flat and fit tightly together to protect the body.

Sea otter cells divide in two ways, mitosis and meiosis. Mitosis is when one cell replicates its chromosomes, then divides them equally in two replicated cells. Meiosis produces cells necessary for sexual reproduction. Meiosis creates gametes, or sperm and egg cells.

Evolution

No one knows exactly where sea otters came from, but they believe they arose from a fish-eating, otter-like mammal about 5 to 7 million years ago near the Pliocene and Miocene periods. Their ancestors were originally land mammals that went into water to hide from predators and look for food. Once their ancestors entered the water, they began developing permanent characteristics to adapt to the water like their waterproof coat, flippers, and webbed feet.

Ecology

The sea otter's main predators are the great white shark and humans. People still skin them and eat their meat, but it's not as popular as it used to be. Their prey includes sea urchins, clams, abalone, mollusks, and snails. There is a cat parasite that is currently infecting sea otters. This parasite is a protozoan and is named Toxoplasma gondii.

Amazingly sea otters can help save the world from climate change. While eating lots of sea urchins, the sea otters help the kelp beds and create less carbon dioxide. Sea urchins feed on kelp beds, which are like our trees, keeping the water clean and removing the carbon dioxide. When sea otters eat the urchins, they save the kelp beds and keep them alive.

Birth takes place around May and June in northern regions and January and February in southern regions. They usually give birth once a year, to only one pup. If there are twin pups, one will be abandoned and left to fend for itself, while the other stays with its mother and hopefully lives a full and happy life.

Physiology

The sea otter is a mammal and is also a vertebrate. Mammals can adapt quicker to an environment than any other class of animals. They are able to keep their body temperatures warmer or cooler than the environment they are currently in. Their fur is thick and keeps them warm in colder temperatures. The sea otter's lower jaw is connected

right to the skull, while other vertebrates have a different bone connecting them. There are three small bones the carry sound waves through the ear. The diaphragm creates a barrier between the heart and the lungs from the abdominal cavity.

Behavior

The behavior of the sea otter is unknown to most. Although there have been sea otter taggings, sea otters have very confusing behavior, being passive in certain situations and aggressive in others. The sea otter is diurnal, meaning they are active during the day and sleep at night. Sea otters sleep on the water and hold hands when they sleep so that they won't float away from each other. They are solitary during the day, but in Alaska they can be seen in groups up to 2,000 otters at a time at night. Collecting food takes place under water. When gathering food, they dive down to the bottom of the ocean and collect clams and sea urchins. They then swim back to the surface and lay on their back, using a rock to crush the shell of their food. Instead of fighting their predators, they run and hide in the safety of the kelp forests. Then they climb up to land and keep safe there.

Their territories are divided by sex, and they only come together when mating season comes along. During mating season, the males have multiple partners. Mating takes place in the water. During mating, the male bites the female's nose, leaving scars, and pushes her head underwater until they are finished. The average sea otter is pregnant for 4-12 months. Usually, her pup weights around 1.4-2.3 kg (3-5 lb). Usually nursing lasts around 6-8 months. Her pup will usually drink from her two lower nipples as they are floating across the water. The pup will be fully weaned at the age of 6-8 months. Sadly, only 25% of the pups last their first year or life. If so, their mothers will carry the pup's body for months on end after it death.

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11.4 Loxodonta africana: African Elephant

Common Name

- African Elephant
- African Bush Elephant
- African Savanna Elephant

Description

The African Bush Elephant, scientifically classified as *Loxodonta africana,* is an organism under the Eukarya domain and present in the animal kingdom. Its full biological classification is

- Kingdom: Animalia
- Phylum: Chordata
- Class: Mammalia
- Order: Proboscidea
- Family: Elephantidae
- Genus: *Loxodonta*
- Species: *L. africana*

Physically, the African Bush Elephant is the largest land living animal alive today, with the male weighing around 15,000 pounds and reaching a length of about 6 to 7.5 meters (about 20-25 feet), and a shoulder height of 3.3m (over 10.5 ft). Females are much smaller, reaching 5.4 to 6.9m (about 17.5 to over 22 ft) in length, and 2.7m (almost 9 ft) in height at the shoulder, and weighing around 6,600 pounds.

Regarding its diet, the African Bush Elephant is a herbivore, consuming various types of plants. The average elephant from this species consumes about 225 kilograms of food daily, and it actively washes down its food with nearly 200

liters of water.

Socially, the African Bush Elephant interacts immensely with other elephants of its kind, associating in groups to protect each other from predators. Among these groups, the elephants mate with each other. The female emits mating calls from her trunk when she is receptive and ready to mate. The female is pregnant for roughly twenty two months.

Habitat

L. africana are present the continent of Africa, which is susceptible to climates of high temperature and sunlight. Specifically, the African Bush Elephant is commonly found in the central and the southern regions of the African continent, where they inhabit the plains and the multiple grasslands/savannahs present in this region. Both of these habitats express an abidance of grass but relatively few trees, and are sometimes surrounded by water springs. The climate of the savannah is hot during the summer, with occasional rainfall in either the summer or the winter seasons. With the rainfall, water holes and small ponds accumulate in the habitat, yet there is not enough rainfall to completely promote the growth of many trees in the habitat. Other animals that live in the savannah and grassland habitats alongside the elephants include the black mamba, the lion, the zebra, the Nile crocodile, and many other animals.

Biology

Cell Biology

L. africana is capable of producing both haploid and diploid cells. Haploid cells are produced by cells in the organism's reproductive system, where these cells divide by the process of meiosis, forming four gamete cells for each starting cell that undergoes this process. Male gametes (sperm), and female gametes (eggs), come together during fertilization to form a diploid zygote, with double the genetic material of haploid cells. Diploid, or somatic cells, which consist of the elephant cells excluding gametes, replicate by mitosis in order to promote the growth and envelopment of the elephant and its internal organs and organ systems.

L. africana is a heterotrophic organism, consuming autotrophs, including many different types of vegetation. Like other animals, *L. africana* abtains energy by breaking down organic molecules via cellular and aerobic respiration.

In addition, *L. africana* has the unique facet of large red blood cells present in its circulatory system. These large cells naturally have a higher affinity for oxygen due to an increased amount of hemoglobin, the protein in the red blood cells that is responsible for carrying oxygen throughout the elephant's body. This high affinity for oxygen greatly increases the efficiency of cellular respiration in the organism.

Genetics

The genome of the *L. africana* is very important, as its unique composure is able to distinguish it from the very similar genome of the African Forest Elephant, *L. cyclotis*. Through consecutive analysis of both of the genomes, together with a comparison of the genomes of the Wooly Mammoth and Mastodon, numerous species differences can be observed. Differences in the base sequences of the two elephant's genomes proved that both of these elephants were in fact, distinct species. In 2010, sequencing efforts proved the two elephant species to be distinct. The DNA sequencing of 375 genes, demonstrated that the two species diverged around the same time as the Asian elephant and the woolly mammoth around 2.6 to 5.6 million years ago.

Evolution

L. africana is part of the Mammalian class, where its ancestors where the largest land dwellers, having originated about 60 million years ago. One of the first ancestors that the *L. africana* originated from was the Moeritherium, which lived about 37 million years ago and is considered one of the first ancestors of the African Bush Elephant. The Moeritherium was the ancestor that created the transition between aquatic and terrestrial inhabitation, living the lifestyle similar to a hippo, yet slowly inclining towards inhabiting land itself.

One of the next ancestors of *L. africana* after the Moeritherium was the Gomphotherium, which inhabited terrestrial land about 10 million years ago. This ancestor of the *L. africana* had now evolved from the Moeritherium by means of adapting to a much more fully terrestrial lifestyle. Acquired characteristics in exposure to land habitats included tusks to defend itself from terrestrial predators on both its upper and lower jaws. Its jaws also evolved to a much more durable shape in order to help digest vegetation that this organism consumed on land.

Finally, the Gomphoterium evolved into two separate species, the Mastodon and the Wooly Mammoth. Both of these species of animals specialized in the development of strong tusks fashioned out of ivory in their upper jaw. Both of these species became extinct during the Ice Age about 12,000 years ago, with more modern elephants now arising from these ancestors to form the three current species of elephants present today in our world; the African Bush Elephant, the African Forest Elephant, and the Asian Elephant.

Ecology

L. africana species interacts with its woodland and savannah environments in many different ways that make up its overall ecological background. We see that the African Savannah Elephant, in order to obtain food and resources, such as vegetation to consume or water to drink, must interact with their environment in many ways to do so. For instance, the African Bush Elephant is active either day or night, looking for food and resources at both of these time periods. The African Bush Elephant sleeps and uses periods of rest to restore its energy needed to scavenge the environment for resources. *L. africana* may also embark frequently on long migrations of up to several miles to find water to drink in order to survive.

In order to receive protection from predators of the habitat, the African Bush Elephant actually congregates in matriarchal, or female led packs of about ten or more elephants. Between the ages of 8 and 20 years, the male elephants in a pack are abandoned. Once puberty begins in the male, the males can live alone without the aid of the pack. While this occurs, the male African Bush Elephant enters a state of mating classified as musth, a complex state of arousal that is triggered by an increased amount of the hormone of testosterone. This increased amount of testosterone causes male elephants to become aggressive and at the same time trigger an increase in sexual activity in these elephants. This state of musth lasts a few days to about a month in male elephants, but it is enough to promote conception of a future generation of elephants during mating season. After mating, a female elephant, now impregnated by the male, has to undergo a very long period of gestation of 22 months before giving birth to a young elephant.

Finally, the African Bush Elephant serves a very important niche in the savannah and the woodland. For example, this species of elephant converts areas of the forest into grassland by modifying the terrain in order to aid their search for food. Finally, the African Bush Elephant actually digs holes in the ground as they travel through their habitat, which provide areas where water can collect, providing water for other animals to consume.

Physiology

L. africana, the largest living terrestrial animal in the world, possesses several unique features that truly distinguish it from other species of elephants in Africa and Asia. Male elephants possess a length that ranges from 6 to about 7.5 meters, while females are much smaller, with a length of about 5.4 to 6.9 meters. The males are also much heavier, weighing a full 7 tons on average (about 15,000 pounds), while females weigh less at around 3 tons (about 6,000 pounds) on average.

Features in the African Bush Elephant's body are also adapted to suit the needs of the survival of this species in this habitat. This species of elephant possesses 2 large and flappy ears, which enable excess heat to radiate out of the elephant's body, cooling its internal body temperature in the hot savannah habitat. In addition, the African Bush Elephant has thick strong skin that prevents parasites and other small bugs of the savannah habitat from infecting it with deadly diseases. Along with its skin, the African Bush Elephant has a very long and powerful trunk made purely out of muscle that allows this organism to obtain and store water for consumption at a later time. Two large ivory tusks at opposite ends of the elephant's jaw help the elephant move powerfully through objects obstructing its path in the savannah, and in some cases, are utilized as a defense mechanism against predators, such as lions or cheetahs.

Finally, the African Bush Elephant's internal body system has adapted functionally to the vegetarian diet of the organism. Four large molars in the elephant's jaw enable it to chew and thoroughly digest its food before it is sent to the digestive organs of the elephant for further digestion. The digestive system of the African Bush Elephant, which is specifically modified for a vegetative diet via specialized digestive juices and enzymes, eventually absorbs the nutrients of the food the elephant consumes, and disposes the waste of the food as nutrient rich waste. This soon fertilizes the savannah land and allows for more vegetative growth, allowing the food cycle of the African Bush Elephant to continue for generations to come.

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11.5 Lynx rufus: Bay Lynx

Common Name

- Wildcat
- Bay Lynx
- Barred Bobcat
- Pallid Bobcat
- Redlynx

Description

The bobcat is a wild cat that weighs about 7 to 10 kg or 15 to 20 pounds. The bobcats' colors are brown, with black spots. It has the appearance of a large house cat, but with a short signature bobtail. Their colors can vary; the brown can be a reddish-brown to yellowish-brown, with spots being black to grey. Its spots fade with age.

The complete taxonomic classification is:

- Kingdom: Animalia
- Phylum: Chordate
- Class: Mammalia
- Order: Carnivora
- Family: Felidae
- Genus: *Lynx*
- Species: *Lynx rufus*

Habitat

The bobcats' habitats are fairly varied. With this it can go about its business very easily. The general home range of the bobcat is about 100 square km. The bobcat's range can vary depending on how much resources there are. It can range from about 2 square km to over 100 square km. The home range is where the bobcat finds its food, while the territory is the space that the bobcat protects most. The male and female mark their territories with scent markings. Due to the animal's great sense of smell, it not only will remember its home, but other bobcats'. It picks its range near its prey for more efficient hunting. When a bobcat shelters, it likes to stay in high areas so it can get an advantage on prey. Its shelters are small little holes/caves in which they keep warm, while simple to make and keep.

Biology

Cell Biology

The bobcat, like all living multicellular organisms, has eukaryotic cells to function. The important parts of a eukaryotic cell are the nucleus and organelles. The nucleus holds the bobcats' DNA. In the word organelles, is "organ"- they are like body organs in that different cell parts do different things. The ribosomes help with making proteins. Surrounding the cell, the cell membrane holds the cell with anything else in it being cytoplasm. Other organelles are the mitochondria, the Golgi bodies, and the lysosomes. The mitochondria's process is respiration and energy production. Golgi bodies are an organelle in the cell which gathers molecules within the cell (in particular simple ones) and combines them to make new molecules (complex ones). Then it holds the new molecules in vesicles, then goes to store the newly created molecules or sends them throughout the cell. The lysosomes are small organelles throughout the cell that break down unwanted materials using enzymes held within it. All three of these organelles are in most animal eukaryotic cells.

Evolution

The bobcat is a mammal, which evolved from the cynodonts. The believed ancestor of the placental mammals is the Eomaia.

Ecology

The male and female bobcat have very few predators. Humans, cougars, gray wolves, and sometimes coyotes will kill both kitten and adult bobcats. The kitten are killed by owls, eagles, or foxes. The other ways bobcats can die are diseases, hunters, starvation, automobiles, and accidents. Bobcats might have external parasites like ticks and fleas, plus the parasites of their prey, rabbits and squirrels. Internal parasites, (endoparasites) are common in bobcats. Fifty-two percent of bobcats have Toxoplasmosis gondii, a type of endoparasite. Lynxacarus morlani is only found in bobcats.

Bobcats eat a variety of prey like amphibians, reptiles, birds, and mammalian prey. They can kill anything that weighs 1.5 pounds to 12 pounds. Cottontail rabbits are the primary prey for bobcats except for bobcats in Minnesota and New England, where the primary prey is white tailed deer and snowshoe hare. The bobcats are meat eaters. They will stealthily stalk their prey, pounce, and if successful, they kill the prey with a bite to a neck vertebra or closer. Bobcats are very important in the food chain. The only known predators of bobcats are the red fox, coyotes, and large owls. The bobcats prey on over 50 different species. Open patches of land make prey easy to catch and make prey vulnerable to attack. Most bobcats breed in February and March. The breeding seasons vary depending on longitude, latitude, climate and altitude. Female bobcats mature at one year of age. Males mature at two years of age. Both can reproduce throughout their lives from that point on. Bobcat liters are usually two to three cats per liter. Bobcats are born eyes closed. They open around the first eleven days. Juvenile bobcats get released from their mom during the first fall or spring. Most bobcats live for 2-5 years in wild, and some can live 15 years.

Anatomy and Physiology

The bobcat's anatomy is like a cat's. It walks on all fours and is a very locomotive creature. With its outer layers, it has fur, most is colored light brown, with marks of black or brown. It has tufts of hair on top of ears. It has lighter hairs on the belly and has some dark marks on the face. It has a short tail barred with black. It has long legs, with big paws for easier movement, it being a cat. The front paw print is about the same size as the hind leg paw print, the hind leg being slightly smaller. The bobcat has every body part a housecat has, just larger. It has whiskers, tall pointed ears, and other similarities to a housecat. The bobcats' average sizes are 8.9-13.3 kg for adult males, and

females 5.8-9.2 kg. Their class of Mammalia (mammal) means that they are nourished with milk from the special mammary glands of the mother. The bobcat is a warm-blooded mammal with vertebrae.

Behavior

The bobcat is a stealthy predator who stalks its prey as silently as possible, then leaps onto its prey, killing it. With migration it only goes about 1.6 to ten kilometers and will do this mainly because of their prey moving. The bobcat, as a carnivore, can eat 3 lbs of meat at a time. The bobcat eats over fifty animals, according to studies that were done in South Florida, Arizona, Montana, and the Sonoran Desert.

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11.6 Mirounga angustirostris: Elephant Seal

Common Name

- Elephant Seal
- Northern Elephant Seal

Description

The elephant seal is a humongous brown, marine mammal. This means that they live in the ocean. Other marine mammals are dolphins, whales and other seals. The northern elephant seal is quite a bit smaller than its southern relative. They range over the Pacific Coast of United States, Canada and Mexico. The seals are slaughtered because of their blubber. They have oil-enriched blubber that hunters want. They were almost extinct. In 1892, there were about 100 elephant seals left, and the only remaining colony was located in the Guadalupe Islands off the coast of Baja California. Like all other marine mammals, the elephant seal is protected under the Marine Mammal Protection Act.

Habitat

Elephant seals live from the Gulf of Alaska to Baja California on the coast where it is sandy and muddy. They like the sand because it acts like a sunscreen. They rub it up on their body, and it protects them from getting a bad sunburn in the hot sun. A popular breeding spot for elephant seals is the rocks of Race Rock, which is located on the southern tip of the Vancouver Island in the Strait of Juan de Fuca. They are excellent divers. This helps in foraging for food and avoiding their biggest predator, larger sharks.

Biology

Cell Biology

Like other plants and animals, the elephant seal has eukaryotic cells. Eukaryotic cells have a nucleus and many organelles. The nucleus contains DNA (deoxyribonucleic acid - the genetic instructions that make each species unique). Organelles are microscopic structures that make up a cell. Organelles include Golgi bodies, which transport proteins either in or out of the cell. Cells also have cellular membranes and ribosomes. Ribosomes are responsible for proteins in all living cells.

The elephant seal, and other mammals, has red blood cells. Red blood cells are in blood and help carry oxygen to organs and other places in the body using a protein called haemoglobin. About 33% of the red blood cell is the hemoglobin. Mature red blood cells in mammals lack a nucleus. (All of the other vertebrates have nucleated red blood cells.)

Evolution

Some things that have changed in general with almost all animals is a symmetrical body, a complete digestive system, a brain and sensory organs, tissues, organs, and organ systems, a body divided into segments, and a fluid-filled body cavity.

Ecology

The elephant seals like to eat sharks and squid. The elephant seal is a carnivorous animal, which means they only eat meat. The elephant seal can go an extended period of time not eating. One animal that preys on an elephant seal is the killer whale, better know as the orca.

Anatomy and Physiology

The elephant seal males can mate at age nine, and females can at age four. The elephant seal, like all other mammals, feed milk to their young from mammary glands. Mammals have many other characteristics that define them as mammals, such as hair, which is a typical feature. Elephant seals have hair on their eyebrows and nose. A chain of three tiny bones transmits sound waves across the middle ear. A strong diaphragm separates the heart and lungs from the abdominal cavity. All mammals were born alive. All the young are carried in the mother's womb. The male's nose helps attract females and helps the males keep in more moisture when they are not in the water. With this nose, they can stay out of the water for more than three months. The females do not have the big nose, just the male. The females have a short, stubby nose.

Behavior

Elephant seals can be very aggressive. The male elephant seal fights over the female seal because it wants to mate. Sometimes they trample and kill the babies when they are fighting over the female elephant seal. They make each other bleed. In the breeding season, the males defend their territories. In a year, the seals will migrate about 11,000 to 13,000 miles, making two round trips between the offshore feeding areas. The females travel to foraging areas and feed over a wide area ranging from the Gulf of Alaska to Baja California and as far as 3,000 miles off the coast of California to the Aleutian Islands. In May and April they go back to their southern rookeries to haul out and molt. They go back to their foraging areas in late June and May to spend the next six to eight months feeding. They return to their pups and breeding in January.

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11.7 Ovis canadensis nelsoni: Desert Bighorn Sheep

Common Name

- Desert Bighorn Sheep
- Mountain Sheep
- Sierra Bighorn
- Borrego Cimarron

Description

Ovis canadensis, or the desert bighorn sheep, is a species of sheep in North America named for their big horns. The desert bighorn sheep is about 5 feet long and 4 to 5 feet tall. Males, otherwise know as rams, are about 120 to 220 pounds. Females, otherwise know as ewes, are about 100 to 150 pounds. The desert bighorn sheep has a lifespan of about 10 to 20 years. The desert bighorn sheep is light brown, gray, and dark brown. They can go long periods of time without drinking water. They are really good at living in really hot weather. They are excellent climbers and good swimmers. They have white on the back of their legs and padded hooves. The desert bighorn sheep has very good eyesight that helps it spot predators such as mountain lions, bobcats, and coyotes.

The complete taxonomic classification is:

- Kingdom: Animalia
- Phylum: Chordata
- Class: Mammalia
- Order: Artiodactyla
- Family: Bovidae
- Genus: *Ovis*
- Species: *O. canadensis*

Habitat

The desert bighorn sheep lives in eastern California, Nevada, northwestern Arizona, New Mexico and southern Utah. The desert bighorn sheep mostly lives in the high desert areas. It is very hot in the desert, and the highest temperatures can be in July, when it can get to be well over 100°F, sometimes over 120°F. The lowest temperatures during winter can easily be lower than 40°F. They have also been seen is Yellowstone National Park in Wyoming. They live in high, steep, rocky mountains and open terrain with rocky slopes. They have a home range but not a territory. They climb up the mountains every day and have to be good swimmers because there are many oases around the desert mountains.

Biology

Cell Biology

The desert bighorn sheep has eukaryotic cells. There are two different types of cells: eukaryotic and prokaryotic. Eukaryotic cells are found in animals (including humans) and plants (and protists and fungi), and prokaryotic cells are in bacteria. Most eukaryotic cells are larger than prokaryotic cells. A eukaryotic cell is a cell that has a nucleus, whereas prokaryotic cells have no nucleus. The nucleus contains DNA, and the DNA carries the genetic information. There are also ribosomes in the cell which make proteins. The soft, outer shell of the cell is called the cell membrane or plasma membrane. The cell membrane is semipermeable, allowing only certain molecules to pass in or out of the cell. To give the cell energy, the mitochondria burns sugars (glucose) during cellular respiration. Those are some examples of organelles, or cell parts, that have different functions in the cell.

Evolution

The desert bighorn sheep is a mammal. The earliest mammals evolved from the cynodonts, but they continued to evolve. The desert bighorn sheep is a placental mammal. The first placental mammal evolved about 110 million years ago. The oldest placental mammal, now extinct, belonged to the genus *Eomaia*. The *Eomaia* lived in China and were only 10 cm (about 4 inches) long. They ate bugs and worms and climbed trees. Placental mammals became the more dominant animals, and the marsupials and monotreme mammals started dying out. Interestingly, today marsupials are still the largest type of mammals on the continent of Australia.

Ecology

The desert bighorn sheep have their breeding season in the early winter. When they are born, they feed on their mother's milk. After about 6 or 7 months the lambs are fully grown. As herbivores, they feed on grasses, small baby plants, and leaves such as yucca and agave. They graze on different species of grass and shrubs. They drink from surface water such as springs and creeks.

Anatomy and Physiology

Like all mammals, the desert bighorn sheep have hair on their bodies. Once a year the desert bighorn sheep shed their fur. The desert bighorn sheep can go long periods of time without water. They can get water from snow and from the plants they eat. They eat grass, and have a nine-stage digestive process. When the ram is 7 or 8 years old, he has a full set of horns. The desert bighorn sheep have good eyesight at night.

Behavior

The desert bighorn sheep lives in herds. There are about 100 to 150 sheep in each herd. The desert bighorn sheep is a very active animal. They are very fast when they run up and down mountains. When they want to mate, the males engage in a head-to-head (or horn-to-horn) contest to win the right to mate. Those contests can last for up to 24 hours and more. They bang their horns together, which can weigh up to about 30 pounds.

The desert bighorn sheep zigzag up and down cliffs with a lot of speed. They use ledges that can be as small as 2 inches long as footholds. They have the ability to climb very tall, rocky mountains. They can run very fast on both rocky and flat areas. They usually walk when they are foraging and traveling. Bighorn sheep are diurnal, but can also be active during the night.

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11.8 Peromyscus californicus: California Mouse

Common Name

- California Mouse

Description

The California mouse's fur is usually yellow and brown or gray mixed with black above, whitish below, often with black spots on the breast. It has a length of two hundred to two hundred eighty-five millimeters. *Peromyscus californicus* is the largest species in its genus. California mice generally live for 9 to 18 months. Populations tend to be fairly stable and at low densities, as compared to other Peromyscus species.

- Kingdom: Animalia
- Phylum: Chordata
- Class: Mammalia
- Order: Rodentia
- Family: Cricetidae
- Genus: *Peromyscus*
- Species: *P. californicus*

Habitat

The California mouse can be found from southwest Canada and throughout the whole West Coast of the United States. They can be found in any bushy or wooded area. They can also be found in the redwood forests in Santa Cruz. They also live in homes as pets or as pests.

Biology

Cell Biology

The California mouse has eukaryotic cells. Eukaryotic cells have a nucleus and many organelles. New cells come from other cells that divide. When cells divide for healing of the body or growth, it's called mitosis, and when the cells divide to make gametes for reproductive purposes, it's called meiosis.

This species has red blood cells, which are the main source of delivering oxygen to the tissue. Red blood cells are the most common type of blood cell. The skin cells of the California mouse are similar to the skin cells of a human.

Genetics

Evolution

The earliest forms of mammals started to evolve about 110 million years ago. The known ancestor of mammals is an extinct animal of the genus Eomaia. Some fossils of the Eomaia were found in China. Eomaia had several traits of mammals. The Eomaia were about 10 inches long. The Eomaia were tree climbers.

Ecology

California mice eat seeds, grasses, flowers, fungi, berries and insects. The California mouse also eats shrubs, fungi, and spiders. Weasels and barn owls are among the California mouse's chief predators.

The California mouse is a very reproductive rodent. Both the mothers and the fathers play very critical roles in raising their pups. Without their mother and father they would have no chance. The average weaning age for California mouse pups is five weeks. The average number of pups given birth to is two. The life span in the wild is 9 to 18 months and 5.5 years in captivity.

Anatomy and Physiology

Behavior

The California mouse spends most of it's time in its nest with its pups. This behavior starts the day the pups are born. This mouse is nocturnal and is alway out at dusk to night time. The California mouse will mostly never be out during the day.

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11.9 Phascolarctos cinereus: Koala

Common Name

- Koala

Description

With fur so pleasantly touchable and eyes as black as night, the koala has indeed been one of the world's most fascinating creatures. The koala originally acquired its unique name in the eighteenth century when Europeans arrived in Australia. When in Australia, the Europeans became familiar with the foreign creature and they soon discovered that the Aboriginal people had already identified the koala with words such as: cullawine, koolewong, koolah, kaola, karbor, boorabee and so forth. The word *koala* originates from the language of Katang, sometimes described as meaning "no water" or "does not drink." Undeniably, koalas are not known to drink water for they replenish their dehydrated bodies with the water from the leaves of eucalyptus trees. Koalas generally live an average of 13-17 years and females often live longer than males, whose life expectancy is often less than 10 years due to injuries during fights, attacks by dogs, and being hit by cars.

Alongside their modest nature and enchanting personality, *Phascolarctos Cinereus* are described to be usually ash grey with a white chest. They have very thick fur, fluffy ears (with long white hairs on the tips) and an extensive flat nose. Their strong limbs and large hands help them to climb trees, which also provide their main source of food. Koalas are, in fact, not bears but marsupials. The genus and species name together, *P. cinereus*, translates to "ash colored pouched bears." The complete taxonomic classification is:

- Kingdom: Animalia
- Phylum: Chordata
- Class: Mammalia
- Infraclass: Marsupialia
- Order: Diprotodontia
- Family: Phascolarctidae
- Genus: *Phascolarctos*
- Species: *P. cinereus*

Habitat

Koalas inhabit the large Eastern part of Australia and can be found in greater numbers in the Northeast and Southeast of this vast territory. The koala is an arboreal animal which means "living in trees". But koalas live only in certain types of trees, called eucalyptus trees, where they eat the leaves. Their distribution has a lot to do with the type of eucalyptus that exists in each area. Koalas are highly specialized to survive only in one type of habitat: in woodland areas with plenty of eucalyptus trees, also known as gum trees. These habitats provide the koala with food, water, safety from ground predators, and all other needs. Koalas do not have dens, tree-holes, or nests. They sleep, eat, and breed on the branches. Unlike most mammals, koalas never make dens or permanent homes. They do have home territories, but they will not stay in one particular tree. Males koalas have a special area on their chest that leaves a scent. They rub their chests on their "home trees" to leave their scent and mark the trees as their own.

Biology

Cell Biology

Genetics

The Koala, which resembles a type of bear and was given the name "koala bear," is definitely not a bear. Although new information has proved that the the koals is not a bear, this animals is still referred to as a bear. The complex genetics of this animal proves its uniqueness. Koalas are the only living member of their family.

Evolution

Marsupials belong to a class of animals that are among the oldest inhabitants of our planet. Koalas go back over 5 million years, in fact, to the period before the separation of the land masses into what we recognize today as the continents. There are three subspecies of the koala. First, are the Northern koalas (P.c adjustus) which are found in the state of Queensland in northeast Australia. They weigh around eleven to seventeen pounds, with short silvery gray fur. Second, are the Southern koalas (P.c victor victoria) in the state of Victoria and the males are at times twice as large as Northern koalas, weighing at about twenty six pounds, while females are a little smaller at seventeen pounds. The southern koalas have much thicker cinnamon-colored fur used as shield from the harsh cold weather. The last subspecies (P.c cinereus) with their grayish fur are located in New South Wales, which lies in between Victoria and Queensland.

Other subspecies of koalas have been discovered in southern Australia, with fossils dating back 2 to 5 million years. Some fossil finds have shown that the koalas were twice as large as koalas nowadays. These wonderful remnants have provided scientists with clues about prehistoric koalas. In 1953, the teeth and jaw fragments of a cousin of

the modern koala were found in a site dating back 24 million years in central Australia, which show us that earlier koalas also lived in trees and ate tree leaves.

Ecology

The koala, which is an exceptional tree hugger, can be found only in areas like forests and woods. Not only do they survive on the leaves given by the preferred eucalyptus trees, but they eat only a small percentage of the many eucalyptus trees in the world. With their picky diet and limited environment, the koalas must continuously adapt to their habitat.

Koalas can endure many types of weather change. Their fur coats protect from the harsh bitter cold and from the sweltering heat, which is occasionally found in their areas. Amazingly enough, the female koala has a pouch where their offspring crawl into during the first 6 months of their lives. It is in this pouch that the newborn koala feed, are nurtured, and protected from the weather. A mother koala will do anything to protect her precious, “Joey.”

The koala finds itself at peace whilst sitting in a tree. They spend most of their time up there and rarely on land. They particularly use trees for protection from harsh weather changes such as: snow, rain, hail, etc. The tree, is a safe haven for all koalas large or small, male or female.

Physiology

The koala in its outside appearance has areas of black and white, with a thick fur which is a grey color. The middle part of the body is stout, they have small eyes, a large nose and they can weigh from ten to thirty pounds. They have front limbs that are much longer than the back ones and have powerful claws with fingernails. They have opposable thumbs that allow them to easily grip as well as to climb. While the males and females look the same, the males are larger in size. They also have a wider face. The mature males develop a brown gland on their chest area. This allows them to leave scents behind.

When a koala is born, the females have a pouch that the newborn koalas enter immediately after birth. For the first six months the pouch will ensure safety and comfort. By contracting her stomach muscles the female koala can "zip up" the pouch.

It is known that the koala has a very small brain. They aren’t viewed as highly intelligent however they do have the ability to problem solve and to adapt on various levels. They have a very simple existence that many find to be boring. Nevertheless, the design of their body as well as their brain has allowed this species to survive for many millions of years.

Overall, the body works well for the koala. They have an excellent method of balancing themselves without any problems. They can sit upright for most of the day without fear of falling from the trees. They have a thigh muscle that is located lower on the body than for most other animals which gives them an amazing amount of strength to use for climbing.

The koala’s excellent sense of balance, lean, muscular body, and long length make it born to live life in trees. Their arms and legs are almost equal in length and their climbing strength comes from the thigh muscle joining the shin. Climbing trees is easy for the koala. Their paws are especially adapted with rough pads on the palms and soles for helping with grip on tree trunks and branches. Each paw has five claws and on the front paw, two fingers are contrasting to the other three, similar to a human thumb.

The fur of a koala is used to protect it from both high and low temperatures. It repels moisture when it rains and the color varies from light grey to brown, decorated with patches of white on the chest, neck, inside arms, legs and the ears.

An adult male Koala, which usually weights around 17 pounds to 30 pounds, and a female Koala, which weighs around 13 to 24 kilograms, have adapted to the colder climate. To do this, the heavier animals from the southern areas have increased their body weight and adapted thicker fur. An example of this are the koalas that reside in

Queensland, Australia. They are noticeably smaller than the koalas that live in Victoria since the temperature there is less cold.

Climate has greatly affected the lifestyle of the Koala. As a result of the weather patterns of their homeland, they are nocturnal, since they are less likely to lose precious moisture and energy during the night. In average, they spend eighteen to twenty hours each day resting and sleeping. With the rest of their time, Koalas feed, move around, groom, and engage themselves in social interaction.

An interesting feature about the Koalas is their nose, which is highly developed in order for them to be able to differentiate between different types of gum leaves and to detect whether the leaves are poisonous or not. Still, the Koalas digestive system is especially adapted to detoxify the poisonous chemicals in the leaves, which are thought to be produced by the gum trees. These leaves are poisonous as a way for the tree to protect itself from leaf-eating animals like insects. As a result, Koalas only eat certain types of eucalypt trees and try to avoid trees that grow on less fertile soil, since those are the most toxic.

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11.10 Procyon lotor: Raccoon

Common Name

- Raccoon
- Blind Bandit

Description

Raccoons have a black mask, with a bushy ring tail with about 4 to 10 rings. Their total length is 603 to 950 mm. Raccoons weigh 4.0 to 10.4 kg. Raccoons have four paws with five long nails. Humans like to catch raccoons because they are fun to catch, and they are a challenge. Humans also like to catch raccoons because they like to use raccoons' fur and tails to make hats, but it is dangerous if they are protecting their young. Raccoons have been known to live up to 16 years in the wild, though most raccoons die at their second year. If they survive their childhood, raccoons can live an average of 5 years in the wild.

The complete taxonomic classification is:

- Kingdom: Animalia
- Phylum: Chordata
- Class: Mammalia
- Order: Carnivora
- Family: Procyonidae
- Genus: *Procyon*
- Species: *P. lotor*

Habitat

Raccoons are mostly found in North America. Raccoons are very adaptable and like to live near humans. They live near humans because they like to eat their food. Raccoons must have access to water. Raccoons like moist woodlands. Raccoons like to live on the coast, and in the woodlands. They can also be found in farmlands, suburban and urban areas. Raccoons prefer to make their den in trees, but they also use caves, mines, deserted buildings, barns, rain sewers, or even houses. Raccoons can live in areas with cold or warm weather. Hollow trees are very good for newborns. Raccoons look for an uninhabited place and move in. They like to make a den in hollow tree trunks. Raccoons also like to live in caves, barns, and even houses.

Biology

Cell Biology

Like all mammals, raccoons have eukaryotic cells. The eukaryotic cells have organelles. Some of the organelles are a nucleus, ribosomes, Golgi bodies, vesicles, and the endoplasmic reticulum. They also have a cell membrane. The cells in the raccoon divide by mitosis and meiosis. In mitosis, the nucleus of the cell divides and two new cells are made with same chromosomes as the original cell. In meiosis, cells divide and gametes (ex. eggs, sperm) are made with 1/2 the chromosomes of the original cell. Chromosomes are made of DNA with genes that are "codes" for traits.

Evolution

The first animal fossils were found around 630 million years ago. They evolved from water to land. When animals went from water to land, they had to adapt, for example they had to be able to support their own body weight. Raccoon fossils were found in Europe, so they are thought to have lived in Europe first, about 25 million years ago.

Ecology

Raccoons are omnivores, and they are not very picky about what they eat. They eat almost anything they can find. In the fall and winter they like nuts, fresh fruit, and corn. They also like to eat eggs sometimes. Raccoons may also eat birds and turtles. Raccoons just need a little water and they are happy. Raccoons are helpful because they clean trash in the woods. Raccoons do have some enemies: bobcats, wolves, coyotes, red foxes, owls, and alligators.

When it is mating season, males expand their home ranges so they can find more females. The mating season is February to June. The only time males and females encounter is during the mating season. Their gestation period is about two months. Females have one litter per year, and they have about three to seven but usually four babies. Raccoon babies are called kits. There are seven different calls that are used between mothers and their kits to communicate. It is usually a squeal or a "twitter". A group of females often associate and take care of the young even if the kits are not theirs. They also protect each other.

Anatomy and Physiology

Males engage with females when they are about two years old, and females mate when they are about one year old. When baby raccoons are born and they are blind. Raccoons eyes open at about 18 to 24 days old. Raccoons and other mammals have a special gland called the mammary gland. That is how mammals get their name. That is how baby mammals get milk from their mother. At only 20 weeks old, they are foraging with their mothers.

Raccoons have been know to live up to 16 years, but most die at age two. If raccoons get past their childhood, they usually live up to five years. Climbing is a very important skill for a young raccoon. Young raccoons' sharp claws help them climb up tall trees. When raccoons look for food in tall trees, they might take a nap in a shady branch.

Raccoons are omnivorous. Their stomach is very simple. A raccoon's intestines are longer than a dog's or cat's, and it is 2.7 times longer than their total body length. The joints in their ankles can rotate 180 degrees both ways when climbing down trees.

Behavior

Adult raccoons are very ferocious and can protect themselves. The males are very solitary. They are most active at night time. They sometimes eat around midnight. Sometimes multiple families hunt together in urban areas. They walk in a swinging motion. They use their front paws like hands and catch their food by hand. They also have been seen to rinse or wash their food. When it is very, very cold weather, they have been seen sleeping for long periods of time, but not hibernate. Raccoons have been found to climb trees as high as 36 feet. They use the bathroom usually in the ground.

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11.11 Puma concolor: Mountain Lion

Common Name

- Mountain Lion
- Cougar

Description

Puma con color, the mountain lion, is a fierce cat. They are 21-27 inches tall at the shoulders. Baby mountain lions are colored with black spots. When they grow older, their spots begin to go away. Mountain lions are shy, elusive and solitary animals. They are more active during dawn than at dusk. Mountain lions make territories and guard them.

The complete taxonomic classification is:

- Kingdom: Animalia
- Phylum: Chordata
- Class: Mammalia

- Order: Carnivora
- Family: Felidae
- Genus: *Puma*
- Species: *P. concolor*

Habitat

Mountain lions live in western North America and throughout South America. Mountain lions can live near the coast and in the mountains. Mountain lions can also live in the forest.

Biology

Cell Biology

Like all mammals and other animals, the mountain lion is made from eukaryotic cells, which have DNA, ribosomes and cytoplasm among many other organelles. The DNA contains genes with codes to make proteins. New cells come from existing cells that grow and divide.

Cells have different shapes. Circular red blood cells pick up oxygen in the lungs and transports it to cells around the body. In mammals, mature red blood cells have no nuclei. Nerve cells have a long, stringy extension called the axon. This shape allows the neuron (nerve cell) to connect with other neurons to send signals from different parts of the body to the brain. Skin cells protect the mountain lion's body by fitting tightly together.

Evolution

Mountain lions are one of two surviving species in the genus Puma. About thirteen thousand years ago, there were several types of cats like *Panthera atrox, Miracinonyx trumani*, saber-toothed Smilodon, and saber-toothed Homotherium. Research has shown that *M. trumani* is genetically more similar to the mountain lions than to the surviving African cheetah of today.

Ecology

Mountain lions are ambush predators. The main diet in Texas is deer, specifically white-tailed deer in Southern Texas and mule deer in Western Texas. Mountain lions eat specifically white-tailed deer and mule deer. Mountain lions eat 19-40 deer per year. They also eat other animals such as mice, squirrels, porcupines, raccoons, rabbits, and beavers. They approach their kill slowly and try to stay unseen unseen as they move quietly toward their prey.

Anatomy and Physiology

Mountain lions' hind legs are longer than their front legs for running and jumping. They have a long spinal column that increases flexibility when running. Cubs are born with spots to provide better camouflage. Their color can vary: gray, dark brown, tawny, buff, or cinnamon red depending on their geographic location.

Behavior

Mountain lions are shy, elusive, and solitary animals. They establish a territory which they mark and guard. Mountain lions nurse their young, clean them and teach them how to hunt.

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11.12 Sylvilagus audubonii: Audubon's Cottontail Rabbit

Common Name

- Audubon's Cottontail Rabbit
- Desert Cottontail

Description

Sylvilagus audubonii is the common cottontail rabbit. The length of the cottontail is 372mm- 397mm, and the weight of *S. audubonii* is an average of 755-1250g. The females are larger than the males. Being that they are mammals, this species has fur. They have rufous (reddish-brown) fur on the nape of their neck. *S. audubonii* are hunted for their meat and fur. They have good hearing though it's not because of their large ears.

The complete taxonomic classification is:

- Kingdom: Animalia
- Phylum: Chordata
- Class: Mammalia
- Order: Lagomorpha
- Family: Leporidae
- Genus: *Sylvilagus*
- Species: *S. audubonii*

Habitat

The range that this rabbit lives in is the western United States, as far north as eastern Montana and south into Mexico. *S. audubonii* can be found in several communities: grasslands, desert areas and woodlands. The plant communities that can be found where this organism lives are sagebrush and shrublands. You can find this rabbit in elevations from below sea level to 6,000 feet.

Biology

Cell Biology

Audubon's cottontail rabbit has eukaryotic cells. This means they have a nucleus and lots of organelles. Organelles are like microscopic organs. These organelles include the Golgi bodies, cellular membrane, and the ribosomes. The DNA (deoxyribonucleic acid) is not an organelle but a chemical and consists of genes with "codes" to make proteins. Ribosomes are where proteins are made. The Golgi bodies help transport the proteins in the cell or to the cellular membrane.

Many animals have red blood cells, but in mammals they have no nuclei. Red blood cells carry oxygen from the lungs all around the body using hemoglobin.

Mitosis is a form of a kind of cell division, where the nucleus of a cell divides, and two new cells with the same DNA as the original cell are formed. Another form of cell division is meiosis, in which gametes are made with one half the chromosomes of the original cell.

Evolution

The first species of *S. audubonii* were found in mountains of Texas, Mexico and other southern mountains. Later a subspecies was found in the Guadalupe Mountains of Texas and New Mexico. The first of the family's fossils were found in North America.

The earliest traces of mammals came from cynodonts. Placental mammals are thought to have evolved just after the extinction of dinosaurs about 65 million years ago.

Ecology

Since *S. audubonii* eats grass, fruit, and nuts, they are herbivores. Audubon's cottontail eats things that are mostly low in protein, high in fiber. These rabbits are a good source of food for coyotes, foxes, hawks, badgers, and the bobcat. The cottontail is also a disperser of seeds. This means that the cottontail helps plants grow by carrying the seeds all around.

On average *S. audubonii* has three young per litter, and up to five litters a year. Audubon's cottontail rabbit gives birth during mid winter and late summer. Their age of maturity is three months. The lifespan in captivity is around 7.8 years, but the lifespan in the wild is about 1-3 years.

Anatomy and Physiology

S. audubonii, like other mammals, has mammary glands in the mother, and babies drink milk. When a cottontail is born it is blind and naked. Audubon's cottontail can run as fast as 15-18 mph. They have large back legs with large

feet. Audubon's cottontail also has large eyes. The large ears help to keep them cool from the heat. The Audubon cottontail rabbits have no canine teeth, though they have a space between the molars and incisors. There are six incisors. There's a lower pair on the jaw, a pair on top, and a second very small pair on the top just behind the long front incisors.

Behavior

This species is not very social. They are the most active in the early morning and evening. Audubon's cottontail never goes far from its birthing area, and loves to burrow to keep cool. The rabbit often goes to cover when being chased. When this species is frightened or afraid, it may freeze or run for cover. This rabbit runs in a zig-zagged pattern.

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11.13 Tursiop truncatus: Bottlenose Dolphin

Common Name

- Bottlenose Dolphin

Description

The bottlenose dolphin's scientific name is *Tursiops truncates*, which means "dolphin with a cut face." *T. truncates* has a gray top and a white belly. *T. truncates* are small cetaceans that have a long snout, a dorsal fin that's curved like a sickle, and round, sharp teeth. These dolphins are about 9 feet in length. The dolphin's life span is about 35 years. *T. truncates* weighs about 440-660 lbs.

Since people polluted the ocean, lots of dolphins have died. We sometimes kill dolphins for their blubber. Boats with propellers can affect their hearing because the propellers are loud, and their hearing is sensitive. The predators of the *T. truncates* are great white sharks, bull sharks, tiger sharks and killer whales.

The complete taxonomic classification is:

- Kingdom: Animalia
- Phylum: Chordata
- Class: Mammalia
- Order: Cetacea
- Family: Delphinidae
- Genus: *Tursiops*
- Species: *T. truncatus*

Habitat

T. truncates lives in the Indian Ocean, Caribbean Sea, Mediterranean Sea, Atlantic Ocean, and the Pacific Ocean. *T. truncates* lives in both warm and cold water. *T. truncates* follow fish to eat them if they need to.

Biology

Cell Biology

T. truncates (like all plants and animals) has eukaryotic cells. Eukaryotic cells have a nucleus and many other organelles. Organelles are tiny parts within a living cell. One example of an organelle is the nucleus, and another is the ribosome, which makes proteins.

Red blood cells in mammals have no nuclei. The red blood cells carry oxygen better in dolphins than in humans. Hemoglobin concentration in the red blood cell is higher. Nerve cells are used for senses like sight, taste, and movement.

Evolution

Around 500 million years ago, four-legged animals started spending more and more of their time in the water. (An animal with fossil records from around this time named *Pakicetus* may represent this type of stage). For some reason, this change must have suited them as they gradually evolved, and their bodies changed form so that they eventually lost ability to move on to the land at all. About 30 million years ago, a toothed whale appeared. It appeared to use echolocation. There were various extinct dolphins that were small and medium sized.

Ecology

There are a few sharks that eat dolphins, like the bull shark. There are two other sharks that fight over the animal's carcass. Large species of sharks eat small species of dolphins or calves. The great white and the killer whale (orca) eat dolphins. *T. truncates* diet is fish, smaller fish, squid, mullet, shrimp, herring, cod or mackerel, and octopuses. They capture prey by hunting using sight in clear water, detecting noises made by their prey, or by using echolocation. *T. Truncatus* can have 1-3 babies.

Anatomy and Physiology

Every dolphin has a blowhole, a beak, two eyes, two ears, two flippers, a dorsal fin, two flukes, and a median notch. The auditory cortex of the brain is highly developed for hearing. Blood vessels, nerves and connective tissues are found in the dermis, which is a layer of skin. The outer skin is not waterproof, but consists a soft coating on a hard, fatty inner skin.

Behavior

Baby dolphins rely on their mom's back when they are first born so that the mom can direct the baby around. They swim in pods. When they are attacked by sharks, they send a caution shriek, meaning back off. When hunting, they sneak up behind the prey, and before the prey knows it, they are attacked. Dolphins are the only other animals that

mate almost similar to a human being. They are active during the day and float at the bottom of the sea at night, when they sleep.

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CHAPTER 12 Understanding Biodiversity: Animals: Birds

Chapter Outline

Class Aves

- Archilochus alexandri (Back Chinned Hummingbird)

- Asio otus (Long-eared Owl)
- Buteo jamaicensis (Red-tailed Hawk)
- Calypte anna (Anna's Hummingbird)
- Cathartes aura (Turkey Vulture)
- Couvs branchyrhynchos (American Crow)
- Falco Peregrinus (Peregrine Falcon)
- Geococcyx californianus (Roadrunner)
- Haliaeetus leucocephalus (Bald Eagle)
- Meleagris gallopavo (Wild Turkey)
- Mimus polyglottos (Mockingbird)
- Phainopepla nitens (Phainopepla or Black Cardinal)
- Rynchops niger (Black Skimmer)

12.1 Archilochus alexandri: Back Chinned Hummingbird

Common Name

- Black Chinned Hummingbird

Description

The black-chinned hummingbird is a green-backed hummingbird of the West, with no brilliant colors on its throat except a thin strip of purple bordering the back of the bird. Some of the black chinned hummingbird family members are the ruby throated hummingbird, Anna's hummingbird, Costa's hummingbird, and the broad tailed hummingbird. This hummingbird is found from the desert to the mountains to the forest. The length of this hummingbird is 3.5 in, or 9 cm.

- Kingdom: Animalia
- Phylum: Chordata
- Class: Aves
- Order: Trochiliformes
- Family: Trochilidae
- Genus: *Archilochus*
- Species: *A. alexandri*

Habitat

The black chinned hummingbird feeds on small insects such as spiders, nectar from different types of flowers, and sugar water from feeders. They are pollinators. They catch insects in the air, and eat them from vegetation or take them from spider webs. This bird is a pollinator for some rare plants: the golden columbine, eastwood and the monkey flower. The black chinned hummingbird nest has been found 6 to 12 feet off the ground. When a nest is newly built, the nest is compact in the shape of a deep cup.

Evolution

Feathers first evolved for insulation. Some species of hummingbirds, especially with an unusual bill shape such as the sword billed hummingbird and the sickle billed hummingbird, are co-evolved with a small number of flowers species. Scientist believe that birds' wings have evolved from birds ancestors that have jumped into the air to avoid predators or get their prey. Scientists also believe that birds' wings may have evolved in a bird ancestor that have lived in trees, and wings were modified arms that helped animals glide from branch to branch. Scientists still don't know how flight evolved, but scientists still search and study for answers.

Ecology

The black chinned hummingbird has eukaryotic cells, like all plants and animals. Eukaryotic cells contain a nucleus and organelles. Organelles are like miniature organs in a cell. In the eukaryotic cell, you will find the nucleus, which is an organelle that contains genetic material. The mitochondria is the powerhouse of the cell; they provide lots of energy. The vesicles are like small sacs that transport materials around the cell. Ribosomes are the non-membrane-bound organelles where the proteins are made. The Golgi bodies work like a mail room. The Golgi body receives proteins from the endoplasmic reticulum and transports them in the cell or to the cell membrane. During mitosis the cell divides, and each new cell contains a copy of the DNA in original cell. During meiosis the cell divides to produce gametes with one half of the chromosomes of the original cell. Chromosomes are made of DNA, which has genes with codes for traits such as the color of the bird's feathers.

Anatomy and Physiology

The black chinned hummingbird lays only two eggs during her cycle. The eggs are most always white. The black chinned hummingbird has parts such as the bill, chin, crow, wings, chest, flank, foot, tail, throat, and rump. The average hummingbird heartbeat is about 408 beats per minute. On cold nights they go into a state of torpidity, and then their heart rate drops to 45 to 180 beats per minute.The breath rate when sleeping is 245 breaths per minute. They have a four-chambered heart. The four-chambered heart is important because it delivers oxygen for the hummingbird's high metabolism.

Behavior

The black chinned hummingbird hovers over flowers and darts directly at swarming bugs to chase them off. The female incubates the eggs for 13 to 14 days. She feeds and covers for her young for 20 to 21 days till they become independent. The males dive off of trees almost as high as 66-100 feet in the air for territorial defense.

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12.2 Asio otus: Long-eared Owl

Common Name

- Long-eared Owl

Description

Asio otus is called the long-eared owl due to the long tuft of feathers on their forehead. They are often a brownish-gray color, with helping them to blend in with their surroundings.They also have pale patches near the forehead that give the illusion of eyebrows. When they perch, long-eared owls will elongate their wings and compress their feathers.

Female long-eared owls are typically larger and are richer in color than the males, generally ranging from 27 to 40 cm in length and weigh around 260 to 435 g. Males are typically around 35 to 37.5 cm in length and weigh around 260 to 305 g.

The complete taxonomic classification is:

- Kingdom: Animalia
- Phylum: Chordata
- Class: Aves
- Order: Strigiformes
- Family: Strigidae
- Genus: *Asio*
- Species: *A. otus*

Habitat

Long-eared owls' habitats range all throughout the Northern Hemisphere, in areas such as North America, Japan, and Europe. More isolated populations are found near North and East Africa, and the Canary Islands. They are known to inhabit inland, coastal, and desert areas. The long-eared owl can often be found near areas with many tree groves, wetlands surrounded by thickets, grasslands, marshes, and areas near farmlands. During nesting season, long-eared owls will create nests in the old homes of hawks, crows, magpies, and squirrels, or occasionally in natural tree cavities.

Biology

Cell Biology

Like all animals, long-eared owls have eukaryotic cells, which are cells that are found in all plants, animals, and fungi (and protists). All eukaryotic cells contain a nucleus and also have many different types of organelles. Organelles basically means "little organs" due to the fact that each organelle plays an important part in the cells function. The organelles of a eukaryotic cell include, aside from the nucleus, the endoplasmic reticulum, which is network of membranes inside the cell; the Golgi bodies, which transport proteins out of the cell and other places throughout the cell; ribosomes, which are particles consisting of RNA and additional proteins, and mitochondria, which is an organelle in which the biochemical processes of cellular respiration and energy production occur. Eukaryotic cells also contain deoxyribonucleic acid, DNA for short. DNA consist of genes with "codes" that serve to make protein for the cells.

The cells of the long-eared owl divide through the process of mitosis and meiosis. Mitosis is when the nucleus of the cell divide is followed by cytokinesis, producing two new cells with the same DNA as the original cell. These cells are said to be genetically identical. This is similar to meiosis, which is the division process of cells in which gametes, which include eggs and sperm cells, are created with half of the chromosomes of the original cell. These chromosomes are compiled of DNA and include "codes" that are responsible for your many traits (ex. hair color, eye color, etc.).

Long-eared owls get their oxygen from the red blood cells in their blood. These red blood cells take oxygen from the lungs and transport it throughout all the organs in the body, including the heart. Like all birds and unlike mammals, the red blood cells of the long-eared owl contains a nucleus. (In mammals, the lack of the nuclei allows higher levels of oxygen to be transported throughout the body.)

Evolution

The owl species, along with many other birds, are thought to have evolved from theropods, a type of bipedal dinosaurs. Many believe the ancestor of birds was similar to a specific theropod known as *Deinonychus*. The *Deinonychus* was a predatory carnivore with many birdlike features such as feathers and wings, along with similar respiratory, circulatory, and digestive systems to modern-day birds. Before the fossils of the *Deinonychus* were discovered in the 1960s, many scientists did not believe that birds had evolved from dinosaurs. The discovery of these fossils helped to convince the many scientists who had debated the evolution of birds, an idea that had been challenged for close to a century.

Scientists have always pondered on the topic of the evolution of the flight of birds. Several hypotheses and scientific ideas have been presented over many years by various scientists about how and why birds have wings and how these wings evolved. Two of these many theories are listed below.

Theory #1: Some scientists believe that the wings of birds evolved from an ancestor that would leap into the air to either capture prey or avoid predators. Based on this hypothesis, scientists conclude that wing were once modified arms that helped these bird ancestors to leap higher.

Theory #2: Scientists have also introduced the theory that wings evolved from an ancient bird ancestor that lived in trees. Based on this, these scientist believe that the wings were simply modified arms that helped these ancestors to glide from tree to tree with much more speed and ease.

Even though there are many theories on how birds took flight, it is a topic that scientists continue the search for answers, examining fossils of ancient bird ancestors to find out exactly how birds developed wings.

Ecology

Long-eared owls are the hosts of many internal and external parasites.They mainly hunt animals weighing under 100g. Their key prey includes, but is not limited to, voles and deer mice. Additional prey includes kangaroo rats, pocket gophers, shrews, juvenile rabbits, and other types of rats. They will also occasionally eat small birds, small snakes, and insects. They also relate to hawks, crows, and magpies, as they have been known to settle in the old nests of these animals that have been deserted.

Anatomy and Physiology

Long-eared owl pairs will begin to breed anywhere from the beginning of February to mid-July. Females will lay eggs, generally around 2-10, on 2-day intervals, and will raise 1 brood per season. The eggs have a glossy, smooth texture and generally have a whitish-grayish coloration. These fledglings generally become independent around 11 months, and the average male and female long-eared owl are sexually mature around the age of 1 year old.

The average lifespan for long-eared owls living in the wild is high, around 27.8 years. Long-eared owls have excellent low-light eye site and especially great hearing, both helping them capture concealed prey during nighttime. The flight sounds of long-eared owls are muffled by special wing feathers that allow them to use stealth to sneak up on prey. Like all owls, long-eared owls are unable to chew their food. Instead, they will swallow their smaller prey whole, while tearing larger prey to pieces before consumption. Unlike most birds, owls have no crop. The crop is a loose sac located in the throat that helps most bird species store excess food that will be consumed later. Because owls lack this special feature, all food is passed directly into the digestive system for immediate consumption.

The long-eared owl, along with all birds, have stomachs that consist of two major parts.The first vital organ is the proventriculus. This is part of the anterior glandular stomach that produces gastric acids and digestive enzymes, helping to start the digestive process. The second major part of birds stomachs are the ventriculus or gizzard, which is located in the posterior muscular stomach.The gizzard is the site of chemical digestion and is designed to grind food. It serves a filter to long-eared owls, keeping down indigestible items such as bones, teeth, feathers, and fur.

Before it passes through the rest of the digestive system, muscular contractions will grind down the softer parts of foods. The ground food then passes through the small intestine, where digestive enzymes are released to by the pancreas and liver.

Several hours after eating, the insoluble materials still in the gizzard (bones, feathers, fur, teeth) are compressed into a pellet in the same shape as the gizzard. This pellet is then transferred back up to the proventriculus, where it can remain for up to 10 hours before the regurgitation process begins. Once the regurgitation process is complete, the long-eared owl is allowed to eat once more, due to the fact that the stored pellet partially block the digestive system, which prevents the digestion of new prey before the pellet is ejected. However, if various prey are eaten within a one hour period, the myriad of remains are collected into one large pellet.

Owl pellets differ from the pellets of other birds of prey because they contain more material residue, due to less acidic digestive juices. Owl pellets are released on a regular cycle, regurgitating them once all nutrients have been extracted from the pellet by the digestive system.

Behavior

Long-eared owls are mainly monogamous, meaning that they will have one mate at a time. Pairs will begin forming in late winter, the males using aerial displays and songs to attract a mate. Females are very protective of the eggs, only leaving the nests for brief periods at night. Long-eared owls arenocturnal, hunting during the night.

The feathers of a long-eared owl can be a key figure on reading its emotions. When long-eared owls are relaxed, their plumage is loose and fluffy. However, as soon as long-eared owls feel threatened, they will make themselves slim looking by pulling their feathers in tightly against the body, and will stick their forehead tufts straight up.

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12.3 Buteo jamaicensis: Red-tailed Hawk

Common Name

- Red-tailed Hawk
- Chickenhawk
- Buzzard Hawk
- Hen Hawk
- Mouse Hawk
- Red Hawk

Description

Buteo jamaicensis, the red-tailed hawk, has brown wings and an orangish red tail. It has a wingspan of about 3.7 ft. The red-tailed hawk's call is used in Hollywood as the symbol of power. "Red-tailed" refers to the brick-red tail of adult hawks. *Hawk* comes from the base word hab, meaning "to seize or take hold of". The word evolved into Middle English hauk from which now is said "hawk". *Buteo* is a Latin term for falcon or hawk and *jamaicensis* is in reference to Jamaica, where the bird was first scientifically studied.

The complete taxonomic classification is:

- Kingdom: Animalia
- Phylum: Chordata
- Class: Aves

- Order: Falconiform
- Family: Accipitridae
- Genus: *Buteo*
- Species: *B. jamaicensis*

Habitat

The red-tailed hawk lives in southern Canada and the northern and southern United States. It lives in both urban and rural areas.

Biology

Cell Biology

The red-tailed hawk has eukaryotic cells. Some parts of eukaryotic cells include a nucleus, cell membrane, cytoplasm, ribosome, and other organelles. The cell membrane is the border of the cell. Ribosomes makes proteins.

Evolution

The earliest known fossil of birds dates back to somewhere around the Jurassic period, over 130 million years ago. These fossils, named *Archaeopteryx lithographic* due to the fact that it was found in stone, resembled reptiles in their skeleton structure, but were covered in feathers.

Ecology

The environment of the red-tailed hawk usually includes trees, cliffs, small animals, mountain lions, bobcats and other common plants and animals. The red-tailed hawk preys on small rodents and mammals such as rabbits and mice.

Anatomy and Physiology

Red-tailed hawks usually don't become sexually active until their third year of life. Females can breed earlier and males often a little later than this. The red-tailed hawk builds a large stick nest, often in a tall tree or on a cliff ledge.

Behavior

The red-tailed hawk can be aggressive when defending territories. They frequently chase off other hawks, eagles, and owls. Courting birds fly with legs hanging beneath them, or chase and swoop after each other. Mated pairs typically stay together until one of the pair dies.

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12.4 Calypte anna: Anna's Hummingbird

Common Name

- Anna's Hummingbird

This bird was named after Anna Masséna, Duchess of Rivoli.

Description

Calypte anna is a very common hummingbird on the West Coast of North America. They are stocky, medium-sized hummingbirds. Anna's hummingbird is about 10 cm (4 in.) in length, with a wingspan of 12 cm (5 in.), and weighs about 3 - 6 grams. *C. anna* has a bronzy green dorsal area, a medium-length bill, and a broad tail. The males can be identified by their bright rose throats and dark tails. Females have a dull mix of gray and white, or gray and brown, and a white-tipped tail.

Males are well known for their mating rituals of flying up to a height of 130 feet to plummet to the ground, pulling up at the last second, making beautiful noises with their tail feathers. Hummingbirds are the only birds that can fly backwards.

The complete taxonomic classification is:

- Kingdom: Animalia
- Phylum: Chordata
- Class: Aves
- Order: Trochiliformes
- Family: Trochilidae
- Genus: *Calypte*
- Species: *C. anna*

Habitat

C. anna lives on the western coast of North America. Their breeding range is from British Columbia to Arizona. They are permanent residents on the West Coast of the United States. Anna's hummingbird lives in open woods, shrubs, gardens, and parks. During breeding season, males live on canyon sides and hill slopes, while the females live in trees, such as oak and evergreens. In the summer Anna's hummingbird lives in higher elevations, and in the winter they live in lower elevations.

Biology

Cell Biology

C. anna has many eukaryotic cells, like all birds and other animals. Eukaryotic cells have a nucleus and many organelles. Organelles are a number of specialized structures within a cell. Some examples of organelles are the nucleus, mitochondria, vacuoles, ribosomes, and the endoplasmic reticulum. These organelles all have different functions to keep the cell healthy, so the body can keep working. The nucleus contains DNA that has information on how to build thousands of proteins. The mitochondria provides the energy (ATP - adenosine triphosphate) the cell needs. Ribosomes produce proteins. Vacuoles act as storage centers, storing water and nutrients. The endoplasmic reticulum transports proteins within the cell.

Evolution

Theropods are a group of bipedal dinosaurs that birds are thought to be evolved from. The ancestor of birds is very similar to a theropod called *Deinonychus*. *Deinonychus* is an extinct predatory carnivore with very many bird-like features. They lived about 110 years ago in North America. Evolution of flight is still unknown, for scientists have some theories, but are not 100% sure yet. One of their theories is that wings were evolved from a bird ancestor that lept to catch prey or to avoid predators, therefore developing wings from their arms to help them leap higher. Another theory was that the wings were evolved from a bird ancestor that lived up high in trees. Therefore wings were modified arms that helped the animal glide from tree to tree. Birds have evolved over thousands of years, to what they are today.

Ecology

Some predators of Anna's hummingbird are western scrub-jays, American kestrels, greater roadrunners, and curved-billed thrashers. *C. anna* is a pollinator. Its favorite flowers are long, tubular flowers in red, orange, violet hues. Some of these flowers are azaleas, fuchsias, pitcher-sage, Indian warrior, and the monkey flower. *C. anna* eats small insects, spiders, nectar, sap, and sugar-water mixtures from feeders. Apparently male hummingbirds have a close coevolutionary relationship with *Ribes specious*, commonly known as fuchsia-flowered gooseberry. We benefit from the Anna's hummingbird because it pollinates a wide variety of flowers.

Anatomy and Physiology

These hummingbirds have long, extendable, straw-like tongues that help them get the nectar that are deep inside flowers. They have a lifespan of 8.5 years, reaching sexual maturity at a year old. Anna's hummingbirds lay about two eggs per breeding season. These eggs take about 14-19 days to hatch. *C. anna* has wing flexibility, and their wings can beat at a speed of 25 beats per second or 1500 beats per minute. Anna's hummingbirds have the largest

brain-to-body size of any bird, giving them a phenomenal memory. The pneumatic bones of an Anna's hummingbird are hollow and only air-filled. *C. anna* has a four-chambered heart. That is very important since hummingbirds have such a high metabolism. Their respiration is in two cycles, unlike mammals who only have one cycle. These two cycles provide huge amounts of air and helps remove excess body heat. During the first cycle, they inhale air from the posterior air sacs and then exhale air from the posterior air sacs to the lungs. When the air enters the lungs, this is the oxygen/carbon dioxide exchange site. During the second cycle, air inhaled from lungs go into anterior air sacs. From the anterior air sacs, air is exhaled out of the primary bronchus. The primary bronchus is one of the two main air passages that branch from the trachea.

Digestion is a very important part of the bird's body. The crop is an enlarged extension of the the esophagus. Here they store food for digesting later or to feed their chicks. The proventriculus is the anterior glandular stomach that produces gastric acids and digestive enzymes, just like in our stomachs. After the proventriculus, the food goes to the gizzard. The gizzard is the posterior muscular stomach. Its main purpose is to grind food. The gizzard may need to be aided with rocks or stones, called gastrolith.

Behavior

Anna's hummingbirds are not social animals. They will dive at anything that comes near their territory. The Anna's hummingbird migrate in the fall and spring. To conserve energy, the Anna's hummingbird are active during the day and become torpid at night. Male Anna's hummingbirds have a special mating ritual. The male flies to a height of 130 feet, and plummets down to the ground pulling up at the last minute, making a beautiful sound through their tail feathers.

See *The Courtship of Anna's Hummingbird (Britannica.com)* at http://www.youtube.com/watch?v=NMErQg0dFDs for a further description of this mating ritual and these birds.

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12.5 Cathartes aura: Turkey Vulture

Common Name

- Turkey Vulture
- Turkey Buzzard
- Buzzard
- Johns Crow
- Carrion Crow

Description

The turkey vulture's length is 2- 2.7 ft., and its weight is 1.8 - 5.1lb. It's is color ranges from black with some or no brown with silver under the flight feathers. In flight its wings are angled a slight V shape. Up close, it has an ivory-colored beak, its head is bald-red and may have a few feathers on its head (around the eyes, nose, etc). The turkey vulture's eggs are white with spots from red to brown to black. Some spots may be clustered some spread out. Chicks are white and fluffy with a beak and head that are black. It will gain color and useful feathers as it ages. Females and males look alike.

- Kingdom: Animalia
- Phylum: Chordata
- Class: Aves
- Order: Incertae sedis
- Family: Cathartidae
- Genus: *Cathartes*
- Species: *Cathartes aura*

Habitat

Turkey vultures live in North, Central and South America. They live in forests (rarely), coastlines, deserts, grasslands, and savannas. It only comes inland in summer, and it goes to Canada during mating season (March to April-May).

Cell Biology

Turkey vultures have eukaryotic cells. Eukaryotic cells have many organelles (parts in a cell that are like tiny organs). One organelle is the mitochondria, which makes energy for the cell. Another organelle is the ribosome, which makes protein. The nucleus, which is one of the most important organelles in a cell, is where the DNA is. The endoplasmic reticulum transports proteins. Mitosis is when the cells divide either to grow or for cell repair. Meiosis is where the cells divide for reproductive purposes to make sperm and eggs, cells with only half of the chromosomes of the original cell.

Evolution

Turkey vultures evolved from the ancient bird called *Teratornis merriami*. All birds evolved from a dinosaur that lived in the late Jurassic called Archeopteryx. *Archaeopteryx* had the flight feathers of a bird, but it was missing the correct collar bone for flight. The close relative *Microraptor* was able to fly with not just its arms, but also its legs.

Ecology

The turkey vulture's prey is mainly carrion, but it will rarely kill small animals and will eat fruit. The turkey vulture is threatened by humans (traps, power lines, poachers). Great horned owls and raccoons will kill young or eat eggs. The turkey vulture cleans up decaying animals, so disease does not spread.

Turkey vultures lay 1-3 eggs in a cave or hollow tree. They do not build nests or rarely do. The eggs take about 30-40 days to hatch. The parents will feed and take care of the young for 70-80 days, and independence comes after 80-90 days. Two out of three of the young will most likely survive to adulthood. Turkey vultures can live up to 17 years in the wild and about 20 years in captivity.

Anatomy and Physiology

Birds have a four-chambered heart. A crop is a sack in the throat that carries food for young and for a stage of digestion and for food storage. A gizzard is basically a stomach and a primary grinding stage for digestion. They may have stones in them called gastroliths. It also has intestines, eight different air sacs for lots of air, and a vent (where waste leaves the body).

Of course all birds have feathers, but most people don't know how the feather is shaped and created. The five types of feathers are contour feathers (the flight feathers), down feathers (for insulation), semi-plumes (between contour and down feathers), bristles (located on head to protect objects to get in eyes and nostrils), and filoplumes. All feathers are made from the follicles in the bird's skin. The feathers have two main parts, the quill or rachis (the spine of the feather), and the vane (all the fine, hair-like strands). At each end of the larger barb are smaller barbs (barbules) that weave together for a tight fit. At each end of the barbules are hooks that keep the feather from falling apart.

Vultures have bald heads so that meat does not stick to the head. From the side view of a turkey vulture, you can see through nose (nostrils), which means that it's well developed, which is not common for birds.

Behavior

The turkey vulture roosts in the morning alone or with other vultures in large or minimal numbers. When it's gliding, the turkey vulture's wings are angled in a slight V shape. With its sensitive nose (which is not common among most birds) it finds it's food. Since the turkey vulture can't really hunt (or seldom does), it smells for carrion (decomposing carcasses). When it finds a carcass, it will land and start to eat it. If the animal that killed the prey is still eating the kill, the turkey vulture will wait its turn. The turkey vulture is often evicted from a kill by black vultures and other birds and animals. It communicates with grunts and hisses and bark-like calls.

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12.6 Couvs branchyrhynchos: American Crow

Common Name

- Crow
- American Crow

Description

The crow varies in height from 16-21 inches. The crow is distinguished by the dark black feathers, beak, and feet. This bird is known for its black, raven-like coloring and large size. The bird is known for being intelligent and a great problem solver, and for having a habit of stealing shiny objects. Because of this, often near crow nests people find jewellery and other objects.

Humans affect the crow in many ways. One of the most impactful ways is human waste. As humans today we are producing trash hazardous to our environment, dangerous to our animals and other plant species. The American crow tends to hang around human areas to scavenge for food.

The American crow was first discovered and described by Christian Ludwig Brehm in 1822. It's scientific name, Corvus Brachyrhynchos means "short-billed crow", from the Ancient Greek language brachy- (βραχυ-) "short-" and rhynchos (ρυνχος) "billed".

- Kingdom: Animalia
- Phylum: Chordata
- Class: Aves
- Order: Passeriformes
- Family: Corvidae
- Genus: *Corvus*
- Species: *C. brachyrhynchos*

Habitat

The American crow tends to live in urban areas in which they can scavenge for food. The crow thrives throughout North America; they are very versatile and adaptive animals. They are most typically found in the inland areas. They tend to stay in urban areas, in which they live in an inorganic environment. This is because they wait for food, and while doing so interact with humans.

Biology

Cell Biology

The American crow species contains eukaryotic cells. This type of cell features many different types of organelles. All of these organelles serve a specific purpose. For example, the nucleus contains genetic material. The cellular membrane is a skin around the cell that acts as a shield and keeps all the inner parts of the cells together. The lysosomes are a crucial part of the cells. Its their job is to discard of any waste in the cell. The Golgi apparatus is important because it sends protein to different places in the cell. There are still many more important organelles in the eukaryotic cell.

Evolution

The American crow is to believed to have evolved in central Asia and spread to North America, where they adapted to the climate very quickly. All birds first originated from a certain branch of dinosaurs called theropods. A dinosaur fossil discovered in the 1960s named Deinonychus showed evidence of the evolution of flight. Dinosaur experts believe that dinosaurs that lived among the trees lept into the air to run away from predators or to catch food, resulting in wings. Another theory is that the early bird ancestors lived among the trees. The power of flight allowed them to jump from branch to branch.

The American crow is often confused with the northwestern crow (*C. caurinus*). Its ancestors became separated by Ice Age glaciation west of the Rocky Mountains. The two species are much alike. There is a marked difference in voice, however.

Anatomy and Physiology

All birds are vertebrates, modified so they have the ability to fly. Birds are known to be the last existence of prehistoric dinosaurs. Birds are warm blooded, unlike lizards and most reptiles. Birds have thrived throughout history evolving, over the years to thrive in existence. They are unique to the kingdom of Animalia for their pneumatic bones, meaning they are hollow. Their hollow bones allow them to fly and carry themselves in the air easier. Birds have a four-chambered heart, which serves to deliver oxygen to the rest of the body. The four-chamber heart helps to circulate blood so the body properly receives oxygen.

Behavior

The peregrine falcon is non-aggressive toward humans and animals that aren't prey. This animal is solitary except during mating seasons, when they mate, then care for young. They kill small animals like rabbits for food.

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12.7 Falco Peregrinus: Peregrine Falcon

Common Name

- Peregrine Falcon

Description

The peregrine falcon is the fastest animal on earth, going as fast as 200 mph. The peregrine falcon's average weight is 1,500 grams, and it's average length, from head to tail, is 51 cm.

- Kingdom: Animalia
- Phylum: Chordata
- Class: Aves
- Order: Falconiformes
- Family: Falconidae
- Genus: *Falco*
- Species: *F. peregrinus*

Habitat

The peregrine falcon can live in urban areas and rural areas that don't reach below freezing temperatures. They live in every biome except frozen or snowy ones. It is the most widely spread raptor, living in every continent. The peregrine lives all across United States, Mexico, Oceania, western Europe, South America, and South Africa. They are spread thinly across Asia and Canada.

Biology

Cell Biology

The peregrine falcon has eukaryotic cells (cells with nuclei) that include several organelles such as lysosomes and cytosol. Ribosomes are used in the process of creating proteins for the cells, the cytosol is used to fill in the cell outside of the organelles, and the lysosomes are used to break down foreign material.

The peregrine falcon has red blood cells, which are specialized cells that remove waste and deliver oxygen. They are classified as specialized eukaryotic cells.

The cells divide with mitosis and meiosis. Mitosis is when a cell divides and the daughter cells share the same amount of chromosomes as the parent cell. Meiosis is a similar process but the daughter cells only share 1/2 of the chromosomes of the parent cell. Meiosis also produces gametes (cells for reproduction).

Evolution

Birds evolved from winged Theropod (carnivorous) dinosaurs that were less advanced in flying and walking because of the thin layer of skin connecting the forelimbs and the legs. Birds are a type of reptile, but are warm blooded.

Ecology

The peregrine falcon's carnivorous diet consists of small mammals and birds. It uses several types of trees for nesting and usually nests in tall trees. In urban environments it can nest on rooftops, windowsills, trees, and other high places. The peregrine falcon's diet consists of small birds such as pigeons, crows, etc. and small mammals such as rabbits and mice. It's reproductive maturity is at 1-3 years of age. It lives to about age 15 in the wild.

Anatomy and Physiology

The peregrine falcon is a two-legged vertebrate with limbs modified for flight. The feathers are made of keratin and wear down easily and become replaced. The feathers also are important for display, communication, flight, and insulation. Feathers are modified scales developed from previous flying reptiles. Contour feathers are for basic flying, rectrices are the tail feathers, and the remiges are the wing feathers. All birds have skeletal modifications for flight including hollow bones, lightweight skeletons, and fused clavicles (acts like a spring during flight). Birds have to deal with weight, lift, drag, and thrust. Birds have a four-chambered heart and two cycles of respiration (mammals only have one respiration cycle). Both respiration cycles happen at the same time. The crop is the enlarged portion of the bird's esophagus that can store food and is used to feed baby birds. Birds have a gizzard (muscular stomach) which is used to grind food.

Behavior

The peregrine falcon is non-aggressive toward humans and animals that aren't prey. This animal is solitary except during mating seasons, when they mate, then care for young. They kill small animals like rabbits for food.

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12.8 Geococcyx californianus: Roadrunner

Common Name

- Greater Roadrunner
- California Roadrunner
- Chaparral Cock

Description

The greater roadrunner (Geococcyx californianus) length is 58 cm. Its wingspan is 43-61 cm. The greater roadrunner is a dark brown-black, the breast is white, and its eyes are a bright yellow. After the ostrich, it is the fastest bird alive. However, unlike the ostrich, it is capable of weak flight as well as running.

- Kingdom: Animalia
- Phylum: Chordata
- Class: Aves
- Order: Cuculiformes
- Family: Cuculidae
- Genus: *Geococcyx*
- Species: *Geococcyx californiaus*

Habitat

The habitat of the greater roadrunner is in the Southwest of the United States of America, and Northern Mexico. It lives in the desert, coastal, and inland regions and it tends to inhabit areas with chaparral and coastal sage scrub.

Biology

Cell Biology

Geococcyx californianus, like all other animals, has eukaryotic cells. Eukaryotic cells have a nucleus, whereas a prokaryotic cell has no nucleus. Eukaryotic cells have many organelles, which are like small organs. One of these organelles is the nucleus. The nucleus is like the brain of the cell, the cell membrane is the skin of the cell. There are two type of cell division. Mitosis is when cells grow and divided with the same DNA. Meiosis is when the new cells have half of the chromosomes in the original cell.

Evolution

Although nobody knows what the *Geococcyx californius* exactly evolved from, all birds branched off of dinosaurs called Theropods. The most bird-like *Theropod* was Deinonychus. Living 110 million years ago, *Deinonychus* was a carnivorous non-bird dinosaur that shared similar features to modern birds, such as talons, feathers, wings, and other parts. Scientists don't know how the wings evolved into what they are today, but there are theories on why. One of the theories is that ancient bird-like ancestors used their wings to glide or jump over their enemies and/or catch their prey.

Ecology

The predators of the greater roadrunner are hawks, coyotes, house cats, skunks, and raccoons. The greater roadrunner is an omnivore, meaning it eats meat and vegetation. Its diet includes birds, small mammals, reptiles, eggs, insects, fruit, and seed. Since the greater roadrunner is an omnivore, it can hydrate itself by collecting water among its moisture-rich diet when a water source can't be found or accessed. The lifespan of the greater roadrunner ranges from 7-8 years in the wild. The greater roadrunner lays 2-8 eggs.

Anatomy and Physiology

Like other birds, the greater roadrunner has a four-chambered heart. Its digestive system includes a crop for food storage and feeding young, and a gizzard for grinding food. They also have hollow bones to allow flight, even though the flight of the greater roadrunner is weak. The greater roadrunner can run as fast as 17-26 mph.

Behavior

The *Geococcyx californianus* is not a migratory bird. Its song is made up of six slow chirps in a continuously deepening pitch. Both parents tend their young for 17 to 19 days after hatching, until the young leave the nest. Even when the young leaves the nest, the parents still tend to them for up to 30 to 40 days. The greater roadrunner mates for life and is very territorial. The greater roadrunner protects itself by running. The roadrunner sometimes gets its food by using a rock and smashing its prey.

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12.9 Haliaeetus leucocephalus: Bald Eagle

Common Name

- Bald Eagle
- American Bald Eagle
- American Eagle
- Fishing Eagle
- White-Headed Eagle
- White-Headed Sea Eagle

Description

Haliaeetus leucocephalus, which means "The sea eagle with a white head," is a species of the family *Accipitridae*, the eagle family. Within this family is the genus Haliaeetus, or the fish eagles, which include birds like *Haliaeetus pelagicus* (Steller's sea eagle) or *Haliaeetus albicilla* (grey sea eagle/white tailed eagle). The white tailed eagle looks almost identical to the *Haliaeetus leucocephalus* from a distance, in part because of the head color, which is light grey. *H. leucocephalus* is by far the most famous of the genus *Haliaeetus*, mostly because it is a symbol of the United States of America. It is on the seals of the President, Air Force, Navy, Department of Defense, FBI, and most other government offices, and also US 101st Airborne division's shoulder patch insignia. The bald eagle has a wingspan of 5.9-7.5 ft (1.8-2.3 metres), and a body length of 2.3-3.3 ft (0.7-1 metres). It has a dark brown body as well as a white head and tail. It has a yellow beak.

- Kingdom: Animalia
- Phylum: Chordata
- Class: Aves
- Order: Accipitriformes
- Family: Accipitridae
- Genus: *Haliaeetus*
- Species: *H. leucocephalus*

Habitat

Haliaeetus leucocephalus usually has its nests near water sources, such as lakes, marshes, rivers, or the ocean. It breeds all over North America from Alaska to Baja California, from eastern Canada to the Aleutian Islands. It usually builds its nests at the tops of tall trees.

Biology

Cell Biology

Haliaeetus leucocephalus has, like all animals, eukaryotic cells, which are cells that has a nucleus several organelles. Organelles include the nucleus, which contains the DNA (genetic material), and the mitochondria, the powerhouse of the cell. The vesicles are the transportation organelles, vacuoles, the storage centers, and ribosomes are the protein factories. The endoplasmic reticulum is a membrane which helps transport the proteins. The Golgi apparatus is kind of like the post office of the cell, in that it "puts the delivery address" on the cell and helps transport it. Finally the cell membrane is the outer protection membrane.

Specialized cells in bald eagles include cones. Cones are cells in your eyes, which help with sharp vision, colors, details, and night vision. Humans (*Homo sapiens*) also have cones, but bald eagles have thousands more in their eyes, which gives them their incredible eyesight, which is about 4 times better than a humans eyesight, and can spot a small fish from a mile away. An average Homo sapiens has 20/20 eyesight. An average *Haliaeetus leucocephalus* has at least 20/5 eyesight, if not better.

Evolution

The first official *Haliaeetus leucocephalus* ever was found in 1766, although fossil evidence of what could possibly be bald eagles appears to be one million years old. They seem to have evolved from a species of bird called a kite. Like *Haliaeetus leucocephalus*, this ancestor hunted fish and scavenged them. Many other details, such as featherless feet, are in common between the two animals. Birds in general all evolved from Theropod dinosaurs, such as Tyrannosaurus and Velociraptor, which are very well known because of the very famous movie *Jurassic Park* (1993). Most bodily structures in birds seem to be similar to the theropod Deinonychus. The first flying dinosaur was Archeopteryx, which developed arms that allowed it to glide, and eventually fly

Ecology

Haliaeetus leucocephalus is a predator, preying mostly on fish, but will not pass up the opportunity to catch rodents it sees on the ground, and it will also steal food from other animals. Unlike most other bird species, the bald eagle's nests are actually reusable, so it does not have to build a new one every time it will reproduce. It also builds the largest nest of any North American bird, up to 13 feet deep and 8.5 feet wide. For the majority of the twentieth century, the bald eagle was an endangered species as a result as a pesticide called DDT. DDT actually affects an adult bird's calcium metabolism, causing it to lay a bad egg with a thin, brittle shell, making it nearly impossible to hatch. At its lowest point, there were only 412 nesting pairs in the United States in the 1950s. There were also illegal shootings, some for mistaken beliefs, or others because it was mistaken for other species, such as one that was shot because it was mistaken for a white tailed eagle. Juveniles are often mistaken for the *Aquila chrysaetos* (Golden Eagle), however this should not result in death as both are protected by US Law.

Anatomy and Physiology

Like all other birds, the bald eagle has a four-chambered heart. It also has a two-cycle respiration system, as well as a one-way flow for respiration. Both of the breathing cycles occur at the same time. The bald eagle never reaches speeds that would interfere with their breathing. The bald eagle has about 7,000 feathers. Its eyes are almost as big as a human's, and it can see at least four times sharper. Its eyes have two eyelids, which protect their very powerful eyes. The outer eyelid is thick and provides great protection when both eyelids are closed. The inner eyelid is very thin, but still provides good protection. Interestingly, it can see through its inner eyelid, so it can have both eyes closed but still see! It is diurnal, and is not renowned for its hearing which, unlike its eyesight, is about as good

as a humans. Its wings are not designed for low flying, as the bald eagle is normally a high-flying eagle. The bald eagle reaches sexual maturity at age four to five. A bald eagle lays 1-3 eggs a time. The eggs are then incubated by both parents for 34-36 days before they hatch. For about 5 weeks after it has hatched, a baby bald eagle cannot walk. When it first takes to the skies, interestingly, is a dark black all over! Even more interesting, it is a little larger than its parents. In over the next few years, its plumage changes, the top looks like it is from a bird in the process of shedding feathers, the bottom appears to have white wings and black feathers coming out from them. This can be very confusing to birdwatchers. It is believed by many that Washington's eagle, "discovered" by John James Audubon, was an immature bald eagle. Interestingly, Audubon knew what an immature bald eagle looked like, and he had made paintings of them. *Haliaeetus leucocephalus* lives for about 20-25 years in the wild, but has been known to live longer in captivity, as one was recorded to have lived about twice as long as the life expectancy in the wild.

Behavior

The *Haliaeetus leucocephalus* is can be an aggressive species, and it mates for life. The bald eagle is known to steal food from other animals. Because of this, scientist, American founding father and revolutionary, Benjamin Franklin, was appalled, and said precisely in a letter "he is a bird of bad moral character". Instead, he suggested that *Meleagris gallopavo* (the wild turkey) become the national bird. *Haliaeetus leucocephalus* lacks a gizzard, so it must catch and kill everything it eats.

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12.10 Meleagris gallopavo: Wild Turkey

Common Name

- Wild Turkey

Description

The wild turkey is colorful, with red, black and brown. They can weigh 7,400 grams. Wild turkeys don't get very old, living only a few years. They weigh 3.6 to 11 kg, and the average length of a wild turkey is 117cm. The wild turkey has a brown and white pattern for feathers. Benjamin Franklin proposed it should be our national bird instead of the bald eagle!

- Kingdom: Animalia
- Phylum: Chordata
- Class: Aves
- Order: Galliformes
- Family: Phasianidae
- Genus: *Meleagris*
- Species: *M. gallopavo*

Habitat

The wild turkey lives in most of the United States, mainly in woodland and grassland areas. They also live in Europe and New Zealand.

Biology

Cell Biology

The wild turkey has eukaryotic cells (cells with nuclei). Eukaryotic cells have many different organelles such as nuclei, ribosomes, lysosomes, and mitochondria. The nucleus is the core of the cell and contains genetic information. The ribosomes are used in the process of creating protein. The lysosomes break down foreign material, and the cytoplasm fills in the cell. The cell membrane coats the outside of the cell and protects it.

The cells divide with mitosis and meiosis. Mitosis is when a parent cell multiplies, and the daughter cell shares the same amount of chromosomes as the parent cell. Meiosis is almost the same process, but the new cell shares 1/2 of the chromosomes as the original cell. Meiosis produces reproductive cells called gametes.

Evolution

Most scientists think birds evolved from bipedal and/or theropod dinosaurs. Wings may have come from a bird ancestor that was living in trees and leapt into the air to avoid predators or to capture prey. The bird ancestor *Deinonychus* evolved about eleven million years ago in North America.

Ecology

Raccoons, opossums, striped skunks, grey foxes, birds, woodchucks, rodents, spotted skunks, bobcats, rat snakes, bull snakes, coyotes, mountain lions, golden eagles, great horned owls, and humans eat the wild turkey. The wild turkey is an omnivore but eats mostly plants. Wild turkeys eat acorns, nuts, and various trees.

Anatomy and Physiology

Birds are two-legged vertebrates and are a form of reptile that evolved from bipedal/theropod dinosaurs (see evolution section). All birds have four-chambered hearts in which both the atrium and ventricle are divided. They also have two respiration cycles instead of one (which mammals have). Both respiration cycles happen at the same time. Birds have remiges (wing feathers) and rectrices (tail feathers). They are used for both mating display and flight. Birds have special skeletal modifications for flight. They have hollow bones which reduce frame weight. This feature has developed most in larger birds, such as the wild turkey.

Behavior

An adult turkey is aggressive in self-defense. The wild turkey can fly/glide at 60 miles per hour. They roost in trees at night for shelter and they sometimes walk along forest roads and look for food. They do not migrate.

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12.11 Mimus polyglottos: Mockingbird

Common Name

- Northern Mockingbird
- Jamaican Mockingbird

Description

Northern mockingbirds are gray, white, and black. They can be 8.3 to 10.2 inches long. Their wingspan can be 12.2 to 13.8 inches long. They weigh anywhere from 45 to 58 grams.

- Kingdom: Animalia
- Phylum: Chordata
- Order: Passeriformes
- Family: Mimidae
- Genus: *Mimus*
- Species: *Mimus polyglottos*

Habitat

The range that the northern mockingbird lives in is from Canada south to Mexico. The areas where they live include backyards, forests, parks and edges of cliffs. They can live in the savanna, on the coast, in the desert, and in forests.

Biology

Cell Biology

Mimus polyglottos has eukaryotic cells, which have a nucleus. Organelles are cell parts within a cell. Some examples of cell organelles are the cell nucleus, which contains DNA with genes, mitochondria, which provide energy, ribosomes, which produce proteins, and lysosomes, which carry waste away.

The northern mockingbird has red blood cells. Red blood cells' main function is to carry oxygen to other cells in the body. It also removes carbon dioxide from the body.

A cell can divide in two ways. In mitosis, it duplicates all of the cell's contents including it's chromosomes, and it splits to form two new, identical cells. Through meiosis, it reduces chromosome number by half to form sperm and egg cells.

Evolution

Wings may have evolved from a bird ancestor that leapt into the air to avoid predators. Therefore, bird wings are modified arms that may have helped them leap higher. Birds are thought to have evolved from a group of bipedal dinosaurs called theropods. The ancestor of birds was probably similar to the theropod called Deinonychus. Deinonychus was a dinosaur that is considered to be one of the closest non-bird relatives of modern birds. It lived in North America about 110 million years ago.

Ecology

Mockingbirds are omnivores, which means they eat both plants and animals. Their main diet is insects, seeds, berries, earthworms, sometimes small animals, and small crustaceans. They help disperse seeds. They affect the population of species that they eat by eating them, so the population of those species decreases. Northern mockingbirds host several ectoparasites, which are parasites on the skin or feathers. These parasites include blowfly larvae (family Calliphoridae), fleas and mites. Finally, three Molothrus are brood parasites of northern mockingbirds. This means that the cowbirds lay eggs in the northern mockingbirds' nests. Sometimes the northern mockingbirds will incubate the egg and raise the cowbird chicks along with their own chicks.

Anatomy and Physiology

After the eggs are laid, it takes eleven days to two weeks for them to hatch. It takes them 10 to 12 days to leave the nest. They reach sexual maturity in one year. They breed in spring and early summertime. They can live eight years in the wild and twenty years in captivity.

Mockingbirds have four chambers in their heart. Their crop stores food for later, which they process for their nestlings. They have something called a gizzard, which they use for grinding/chewing their food. They have a two-cycle respiratory system, unlike mammals, which only have one. Their feathers are made of keratin, which is a type of protein that wears down easily and it has to be replaced.

Behavior

The mockingbird mimics fifty other birds. It usually sits on fences or telephone wires, runs or hops on the ground. They are alone or in pairs throughout the year. They aggressively chase off intruders in their territory. They perform thirty-nine songs and fifty calling notes. They can also imitate certain sounds such as dogs barking, pianos, sirens and squeaking. Songs are important in mating. Males sing to attract females and to defend their territory against other males. They sing often, at night and during the day.

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12.12 Phainopepla nitens: Black Cardinal

Common Name

- Black Cardinal
- Phainopepla

Description

The height for the black cardinal is 16 centimeters and the length is 20 centimeters. The male has a shiny black chest and has two white wing patches with a long tail and red eyes. The female has brown eyes and white wing patches. They travel in small flocks. The young phainopepla has rounded wings as well as long tails.

- Kingdom: Animalia
- Phylum: Chordata
- Class: Aves
- Order: Passeriformes
- Family: Plethodontidae
- Genus: Phainopepla
- Species: Phainopepla nitens

Habitat

The black cardinal is native to San Diego, California as well as southwestern Colorado, Nevada, southwestern Utah, New Mexico, and the Sonoran Desert. The black cardinal is rarely found in Arizona, Texas and Mexico. It can be found in woodlands, desert scrub, and canyon foothills.

Biology

Cell Biology

Phainopepla nitens has cells called eukaryotic cells. Eukaryotic cells are cells with a nucleus, which contains genetic material, as well as many other organelles. Organelles are tiny cell parts within the cell. Some examples of organelles are ribosomes, which are non-membrane bound organelles where proteins are made. Another example is vesicles, and they are small, membrane-bound sacs that transport materials around the cell and to the cell membrane. A final example is mitochondria, which basically provides energy needed to power chemical reactions. The Phainopepla has specialized cells called red blood cells which transport oxygen through the entire body.

The Phainopepla have cells that divide into two ways, and those two ways are called mitosis and meiosis. There is a difference between the two. In mitosis, the cell divides the nucleus, and each new cell contains a copy of the DNA in the original cell. Meiosis on the other hand has the cell divide to produce gametes(ex: eggs, sperm) with one half the chromosomes (containing DNA) of the parent cell.

Evolution

All birds overall evolved from dinosaurs. Birds probably evolved from dinosaurs called theropods, which lived about 150 million years ago. The ancestor of birds was probably similar to a theropod called Deinonychus. Fossils of *Deinonychus* were first identified in the 1960s. This was an extremely important find because it convinced most scientists that birds had descended from dinosaurs.

Ecology

Black cardinals pick berries from mistletoe clusters and eat about 1,100 berries a day. They catch insects in the air by their wings to prevent their food from escaping the beak. They can also can try to catch their food by two of them working together. The black cardinal, like many birds, lives on trees.

The black cardinal is found in desert ecosystems. The black cardinals are primarily found in washes which are in Pacific Southwest areas. Those areas are riparian areas and other areas that support arid scrubs. They are found in coastal areas such as San Diego and prefer to live in oak chaparral and also riparian oak woodlands, which have rivers or streams.

The black cardinal has a unique relationship with its main food source, mistletoe berries. Mistletoe berries are dependent on the bird to plant them on the branch of a tree. It does this by eating the berry, yet not harming the seeds. The bird's droppings, which contain the seeds, will hit a branch, and then the seed will start to germinate. When there is an abundance of mistletoe berries, black cardinals will gather in the hundreds; otherwise, they are hard to find.

Anatomy and Physiology

This bird has a four-chambered heart and has two respiration cycles as well. Its digestive system includes a crop for storing food and feeding babies, and a gizzard for grinding food. It has hollow bones and feathers made of keratin.

Behavior

Phainopepla do not have a long migration, and some do not migrate at all. They travel in small flocks. They build their nests 4-50 feet off the ground.

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12.13 Rynchops niger: Black Skimmer

Common Name

- Black Skimmer

Description

The black skimmer is a common bird found mostly on coasts. These birds are medium sized. They range from 15-20 inches and weigh about 15 oz. They are commonly known for their big red bill and red-orange legs that have webbed feet. Their top bill is longer than the bottom bill so that they skim along water to catch food, hence its name black skimmer.

The complete taxonomic classification is:

- Kingdom: Animalia
- Phylum: Chordata
- Class: Aves
- Order: Charadriiformes
- Family: Rynchopidge
- Genus: *Rynchops*
- Species: *R. niger*

Habitat

Black skimmers have a wide range of places they live. They are commonly found on the east and west coasts of South America and southern North America. Since they live on the coast, they make a home on sandy shores, shallow bays, or at public beaches.

Biology

Cell Biology

The black skimmer has many eukaryotic cells. Just like every other eukaryotic cell, they have many organelles inside. One of these organelles is the mitochondria, which is the ¨power plant¨ of the cell where sugar is burned for energy. There are other very important organelles such as the vacuoles, which act as a storage center, the nucleus that contains genetic information about how to build thousands of proteins, and the ribosomes, which are non-membrane bound organelles that produce proteins.

Some cells need to grow and divide. This process is called cell division, and this happens when a cell is repairing tissue, embryos are growing, and for any growth. Mitosis is when the nucleus divides, and each new cell contains a copy of the DNA of the original cell. Meiosis is a form of cell division in which the cell divides to produce gametes with one half of the chromosomes of the parent cell. Chromosomes contain the cell's DNA.

Evolution

The black skimmer is a bird that evolved from bipedal dinosaurs, theropods. Theropods are similar to Deinonychus, which was discovered in the 1960s and was a very important discovery. Deinonychus is an extinct dinosaur that was a predatory carnivore. It lived in North America 110 million years ago, and had bird-like features. These bird-like features consisted of having feathers, wings, and clawed feet.

Scientist are still not sure how wings and flight evolved, but they do have some hypotheses. Some believe that wings were modified arms to help animals jump higher. Others think that it came from ancestors who lived in trees.

Ecology

Black skimmers prey on shrimp and small crustaceans. They have a wide variety of predators. Here is a list of their known predators:

- black-crowned night herons
- boat-tailed grackles
- common grackles
- fish crow
- red-winged blackbirds
- thief ants
- mound building ants
- pavement ants
- great horned owls
- short eared owls
- ruddy turnstones
- peregrine falcons

- marsh hawks
- Norway rats
- domestic cats
- domestic dogs
- gray squirrel
- minks
- long-tailed weasels
- striped skunks
- raccoons
- red foxes

These birds' egg-laying process lasts about eight days. Their clutch size is about four to five eggs. They are able to mate when 48 months (male) and 36 months (female) old. Black skimmers usually mate during the end of April until early September.

Anatomy and Physiology

This bird has a four-chambered heart that delivers oxygen for a high metabolism. They also have two respiratory cycles, unlike mammals, who have one. The first cycle is to inhale air in posterior air sacs, then exhale from posterior sacs. The second cycle is when the air is inhaled from the lungs to anterior air sacs, then exhaled from anterior air sacs. These cycles happen at the same time and help remove extra body heat during flight. The black skimmer has three parts in their digestive system: the crop, gizzard, proventriculus. The crop is a food storage for later processing or feeding nestlings. The gizzard is a posterior muscular stomach. Its basic task is to grind food. The proventriculus is an anterior glandular stomach that makes gastric acid and digestive enzymes. Most birds, including the black skimmer, lack in having a good sense of smell, but their vision and hearing are good. The black skimmer is also the only bird whose pupil has a narrow vertical slit that protects eyes from sun, sand, and water during the day.

Behavior

The black skimmer hunts for their food at night by skimming along the water until they catch something. One of their interesting characteristics is that they never dive or swim in water because they can't. These birds are very social and associate with other black skimmers during the day. Most of the time these birds try to stay in group living so they can avoid predation. Both sexes attend to their eggs during the incubation period. The black skimmers are also monogamous, and the male protects his mates.

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CHAPTER 13 Understanding Biodiversity: Animals: Reptiles, Amphibians and Fish

Chapter Outline

Class Reptilia

- Crotalus ruber (Red Diamond Rattlesnake)
- Lampropeltis getulus californiae (California King Snake)

Class Amphibia

Class Actinopterygii

13.1 Crotalus ruber: Red Diamond Rattlesnake

Common Name

- Red Diamond Rattlesnake
- Credos Island Rattlesnake
- San Lorenzo Island Rattlesnake
- San Lucan Rattlesnake

Description

Crotalus rubber, the red diamond rattlesnake, is three to five feet long with reddish-brown scales and vague white diamonds crisscrossing the back. At the end of the tail is a rattle, used to warn and signal its existence to anything that could stand out as a threat.

The complete taxonomic classification is:

- Kingdom: Animalia
- Phylum: Chordata
- Class: Reptilia
- Order: Squamata
- Family: Viperidae
- Genus: *Crotalus*
- Species: *C. ruber*

Habitat

The range of this species can be found in southwestern California and throughout the Baja California peninsula. It also lives on some islands in the California Gulf. It often inhabits and rests inside rock outcrops. *C. ruber* can be found in desert scrub, coastal sage scrub, mesquite cactus and pine or oak forests.

Biology

Cell Biology

Like all reptiles, *C. ruber* has eukaryotic cells, which have many organelles, and are found in all plants, animals, and even fungi. Examples of these organelles are the nucleus, vacuoles and vesicles. Another organelle called the mitochondria provides energy needed to power chemical reactions. An example of an organelle that is very important is called the ribosomes, where proteins are made. The part of the cell that takes care of waste is known as the lysosome. Endoplasmic reticulum is a folded membrane that transports proteins.

Cells multiply through mitosis, or when the nucleus divides, and each new cell contains a copy of the DNA in the cell before it. Another way cells multiply is through meiosis for reproduction. In meiosis, the cell divides to make gametes, with half the chromosomes of the parent cell. *C. ruber* has red blood cells, which transport oxygen around the body, and nerve cells, among other specialized cells.

Evolution

The earliest reptiles, or amniotes, evolved around 350,000,000 years ago. Then 30 million years later is when they would separate into two groups, synapsids and sauropsids. Ancestors of modern snakes were sauropsids.

Ecology

C. ruber is hunted by birds of prey like hawks. It uses scrub and cactus for shelter and will also hide in rock outcrops. *C. ruber* mates in spring, delivering three to twenty young in summer. Its diet consists mainly of small rodents. Examples are woodrats, small birds, rabbits, other reptiles and ground squirrels. Also, ground squirrels are immune to the snake's venom, and they will attack threatening rattlesnakes.

Anatomy and Physiology

C. ruber is cold blooded, which means it relies on the environment to control its body temperature. They have scales covering the entire body. *C. ruber* has a forked tongue used for smelling. The snake will hunt at night with pit organs that allow for thermal vision. Another set of organs, called Jacobson's organs, are connected to the nose and let the snake "taste" the air. Even after death, this snake should still be treated as a dangerous threat, due to neurological reflexes that allow the snake to bite. The venom, which is a complicated mixture of proteins that affects blood tissue, can be fatal. The rattle is made of keratin. During each shedding, a new segment is added to the rattle. Depending on how much the snake sheds, rattles can vary in size.

Behavior

This snake is normally non-aggressive and solitary (except during mating season). *C. ruber* will normally not attack unless it is disturbed. It is sometimes territorial, and it is very active during mating season (spring to summer). It hunts mostly at night and is more social in cold temperatures.

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13.2 Lampropeltis gentulus californiae: California King Snake

Common Name

- California Kingsnake
- California King Snake

Description

The California kingsnake is black or brown and yellow or white. The pattern is bands of white or yellow on a black or brown body. The California kingsnake can lay 20 or more eggs. The kingsnake weighs about 33 pounds and measures 48 inches in length (2.8 to 3.5 feet).

Habitat

The California kingsnake lives in old rodent burrows. You can find it on the coast, in mountains, deserts, chaparral, grasslands, and in woodlands. You can find the California kingsnake in southwestern Oregon, Nevada, Southern Utah, Southern Colorado, Arizona, New Mexico, California, and northwest Mexico.

Cell Biology

Every cell in the California kingsnake's body is a eukaryotic cell. Eukaryotic cells are cells that have a nucleus, and organelles . Organelles are parts of a cell, for example the nucleus, ribosomes, and Golgi bodies. The nucleus is an important part for growth because it contains the DNA . Ribosomes are small parts of cells that make protein. Finally Golgi bodies carry proteins in the cell and to the cell membrane. Red blood cells are cells that carry oxygen around the kingsnake's body. Meiosis is a type of cell division used for reproduction. Mitosis is another type of cell division used to repair tissue and for growth.

Evolution

The California kingsnake is a reptile. The very first reptiles come from amniotes. The first known amniotes appeared 350 million years ago. Amniotes are very similar to reptiles because they would also lay eggs. Then about 30 million years later they split into two other groups called synapsids and sauropsids. The synapsids eventually evolved into modern day mammals. Then the sauropsids evolved into reptiles. About 5 million years later the first reptiles appeared. The very first reptile was called Hylonomus. Synapsids were much better off during that era than sauropsids. Then when the mass extinction happened 245 million years ago, most of the synapsids went extinct. Then later the tuataras came along. The tuataras were a group that would eventually evolve into the lizards and snakes.

Ecology

The kingsnake's diet is mostly rodents, lizards, and smaller snakes. The California kingsnake is called "kingsnake" because it hunts other snakes. The kingsnake's predators are hawks, owls, coyotes, possums, and skunks.

Anatomy and Physiology

The California kingsnake lays eggs, and the babies leave when they are one week old. The kingsnake, like other snakes, has a forked tongue he uses for smelling the air. The kingsnakes are mature when they are one to four years old. The California kingsnake, like other snakes, has no eyelid. The California kingsnake has strong scales for many reasons, and one reason is for protection. The California kingsnake has no hips, arms, legs, or shoulders, and the California kingsnake's ribs do not extend into the tail.

Behavior

When the weather is hot or too cold, the kingsnake goes underground to get shade or to stay warm. When it comes to hunting, the kingsnake can be very aggressive. The kingsnake attacks his prey by wrapping around them and squeezing until they die.

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CHAPTER 14

Understanding Biodiversity: Animals: Invertebrates

Chapter Outline

Invertebrates

- Bothriocyrtum californicum (Trapdoor Spider)
- Danaus plexippus (Monarch Butterfly)
- Hylephila phyleus (Fiery Skipper)
- Maevia inclemens (Dimorphic Jumping Spider)
- Patiria miniata (Bat Star Starfish)
- Pepsis thisbe (Tarantula Hawk Wasp)
- Vespula pensylvanica (Yellow Jacket Wasp)

14.1 Bothriocyrtum californicum: Trapdoor Spider

Common Name

- California Trapdoor Spider

Description

The trapdoor spider was once very common in Southern California but became less common due to loss of habitat. It can measure from 0.79 in. to 1.26 in. long and is black, brown, and yellow in color. They resemble tarantulas but with smaller, shinier bodies.

- Kingdom: Animalia
- Phylum: Arthropoda
- Class: Arachnida
- Order: Araneae
- Family: Ctenizidae
- Genus: *Bothriocyrtum*
- Species: *B. californicum*

Habitat

The trapdoor spider lives in grassy areas, hillsides, and dirt embankments. They're range is the southern half of the U.S. from Virginia, south to Florida, and then west to California. The spider builds it's burrow underground. The length of a trapdoor spider's burrow can range from 2.5 cm. to 5 cm. Larger burrows have multiple entrances, and the spider will cover each entrance with a door that opens and closes on a hinge of silk. The burrow usually faces directly into sunlight and is near vegetation.

Cell Biology

Trapdoor spiders have eukaryotic cells. Eukaryotic cells contain a nucleus and many other organelles. An organelle is a special subunit within a cell that has its own function. Cells in a species can divide through two ways: mitosis and meiosis. Mitosis is the entire process of cell division including the nucleus and the cytoplasm. Meiosis is the process of cell division in a sexually reproducing way that reduces the number of chromosomes in reproductive cells. Through the process of meiosis, the trapdoor spider makes sperm and eggs that have half the chromosomes of the original cell. Chromosomes are made of DNA, which has genes with codes for the spider's traits.

Evolution

The spider has been evolving for at least 400 million years. Their ancestors were more crab-like in appearance. The spider's use of silk has also evolved with the changing plant and insect population as well. The silk may have originally been used as a protective covering for eggs, but later utilized as a home and a tool for hunting by species like the trapdoor spider.

Ecology

The trapdoor spider eats small insects and other smaller spiders. Female spiders will capture their prey and regurgitate it to feed their spiderlings. Enemies of the trapdoor spider include certain kinds of spider wasps. The wasp will sting the spider, inserting its eggs into the spider's body. When the eggs hatch, the larvae will eat the spider alive.

In the fall, the male leaves its burrow to look for female spiders for mating. The female, however, never travels far from her burrow, especially if she has an egg sack.

Anatomy and Physiology

Trapdoor spiders are a medium-sized spider. The spider has a bulky body and legs. They have large venom glands that have been known to be harmful to humans. They also have special spines on their jaws called a rastellum that help them dig their holes. As with many spiders, the female trapdoor spider is larger than the male and can lay up to 10,000,000,000 eggs at a time.

Behavior

The trapdoor spider is a solitary spider. It digs the hole that it hides in 6-7 inches deep into the side of a hill using its fangs, and then lines the inside if it with silk. It makes the "trapdoor" part of the hole with saliva, dirt, and silk. They have poor eyesight, so they rely on the vibrations that an insect causes when it walks by. It is non-aggressive in general but will hold its ground when cornered.

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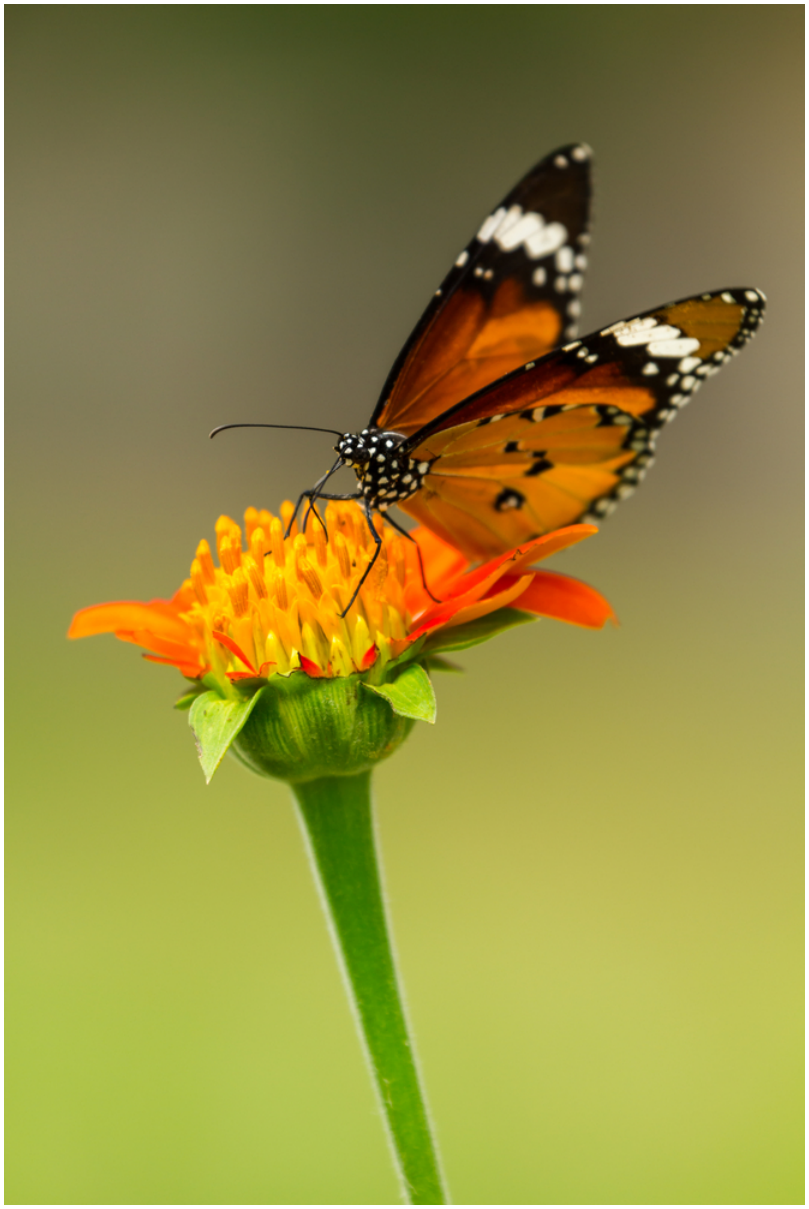
14.2 Danaus plexippus: Monarch Butterfly



Common Name

- Monarch Butterfly
- Milkweed Butterfly

Description

The monarch butterfly has a black outline, and inside of the black border is orange color. On the edge there are white dots. Altogether, it looks like a stained glass window. The monarch weighs between .0095 to 0.026 ounces and is about 4 inches wide when the wings are open.

Man affects the monarch butterfly by using the fields and meadows that they live in to make buildings, so the butterfly's home is taken away.

The complete taxonomic classification is:

- Kingdom: Animalia
- Phylum: Arthropoda
- Class: Insecta
- Order: Lepidoptera
- Family: Nymphalidae
- Genus: *Danaus*
- Species: *D. plexippus*

Habitat

The monarch butterfly population is split into two sides of the United States; the two sides are the east and west of the continental divide. They live in milkweed plant communities. They live in places with warm temperatures. The population on the eastern side spends its winters in Mexico, and the rest of the year in the United States and Canada. In winter they can be found in high altitudes in Central Mexico. The population on the western side of the continental divide can be found in Idaho, Utah, Arizona, Colorado, and California in the summertime. At the end of summer the butterflies migrate back towards the coast, and they stay in areas ranging from Baja to San Francisco. When they migrate, they look for big tall trees like eucalyptus trees. During the winter, the butterflies live on moisture and body fat until milkweed grows again in the spring, and then they fly inland.

Biology

There are four stages in the life of the butterfly. The four stages are:

1. Egg: The first stage is an egg. This butterfly will only lay it's eggs on milkweed plants.

2. Larva: The second stage is when the caterpillar hatches from the egg. It is hard to see at first, but later within two weeks it gets to be a few inches long. Usually the caterpillar has stripes or a pattern on it of yellow and black, and it has to keep shedding about 4 or more times. Caterpillars need to eat a lot.

3. Pupa: After the caterpillar has grown to a certain size, it makes itself into a light green chrysalis and changes inside.

4. Adult: The last stage is the butterfly stage. Adults reproduce in this stage.

Cell Biology

Like all other plants and animals, the monarch butterfly has eukaryotic cells. Eukaryotic cells have a nucleus and many other organelles. New cells are made when existing cells grow and divide. Some reasons cells divide are that

they have to repair tissue, growth, or reproduction. Mitosis happens when the nucleus of the cell divides, and two new cells with the same DNA as the original one are formed.

Meiosis is cell division in which gametes (example: egg, sperm) are made with half the chromosomes of the original cell. Chromosomes are made of DNA with genes that have "codes" for the butterfly's traits.

Evolution

Scientists say that the butterflies separated from moths 150 million years ago. Butterflies are in the moth family.

Ecology

Some predators of the monarch butterfly are wasps, bees, snakes and birds. The predators who eat the monarchs won't want to eat them again because they don't like the taste. The monarch butterfly eats the milkweed plant (as a caterpillar), which gives the butterfly a strange taste to its predators. The predators don't like the strange taste. Their unique color of orange and black make them stand out and will keep predators away. The bad taste, together with the bright colors provide a successful defense mechanism. Monarchs share the defense of bad taste with the similar-looking viceroy butterfly in what is perhaps one of the most well-known examples of mimicry. Mimicry is the similarity in appearance of one species to another which protects one or both of them.

This butterfly will only lay it's eggs on milkweed plants, which becomes a food source for the caterpillar as the eggs hatch.

When monarch butterflies on the West Coast of the United States come south towards southern California, to area such as San Diego, they search for big trees like Torrey pines, redwood and eucalyptus trees.

Anatomy and Physiology

The main parts of the butterfly are the head, thorax (the section of the body that binds the abdomen and the head) and the abdomen. Other parts include the leg, fore wing, hind wing, wing veins, compound eye, proboscis (long mouth part), and antenna.

Behavior

In the fall, monarch butterflies migrate in millions from north to south. In the spring, they migrate from south to north. Monarchs stay in groups when they migrate. The monarch butterfly is the only butterfly that migrates both north and south as birds do regularly.

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14.3 Hylephila phyleus: Fiery Skipper

Common Name

- Fiery Skipper

Description

Hylephila phyleus is a fast darting butterfly. They are about 1 inch (2.5 cm) long. The *Hylephila phyleus* females have a larger wingspan than the males. The males are orange and yellow with black spots. The females are dark brown with orange and yellow spots. The caterpillars are a pink and green color, and the head is black. *Hylephila phyleus* and all other skippers can hold their wings in a triangle shape.

- Kingdom: Animalia
- Phylum: Arthropoda
- Class: Insecta
- Family: Hesperiidae
- Genus: *Hylephila*
- Species: *H. phyleus*

Habitat

The *Hylephila phyleus* lives in North America, Central America, and South America in open grassy spaces. The type of weather they like is warm or tropical. *Hylephila phyleus* are common around residential lawns.

Cell Biology

Eukaryotes include plants, animals and fungi. The Hylephila phyleus has eukaryotic cells, just like all other animals do. The eukaryotic cell has a nucleus and many other organelles.

The Hylephila phyleus cells divide in two ways. The cells go through mitosis and meiosis. Mitosis is a process in which a cell divides into two and makes two new cells, each with complete chromosomes from the parent. Meiosis is when a cell divides to makes two new cells that have half of the chromosomes of each parent.

Evolution

The first important animal trait to evolve was multicellularity. Multicellular organisms are organisms that consist of more than one cell. Multiple cells could do different jobs. Then animals evolved tissues and symmetry. Later the head, segmented body, and digestive system developed.

Ecology

The *Hylephila phyleus* were introduced in Hawaii in 1970, the species then migrated northward to Ontario and prince Edward in the east, and to oregon in the west (Scott 1986). Host plants are grasses of several species. Habitats are southern urban lawns and grassy places. Females can have 10 to 11 eggs. They like to eat a variety of grasses in the poaceae family, sugar cane and nectar flowers. Eggs are laid on and around the host plant singly.

Anatomy and Physiology

Butterflies have three main body parts: the head, thorax, and abdomen. They have six legs and compound eyes. Butterflies have an exoskeleton. That means they are protected by a hard outer covering called the exoskeleton. Their blood is colorless and different from the blood of humans. The butterfly goes through distinctive larval, pupal, and adult stages. That is a complete metamorphosis.

Behavior

Hylephila phyleus are fast butterflies. *Hylephila phyleus* are skilled in communicating. Butterflies talk to each other with sound and actions. Chemicals and colors define sex and species. Chemicals are used by butterflies to attract each other. Certain colors and chemicals attract butterflies of the other sex. The larvae rolls into a leaf and hangs upside down, and forms a cocoon, which forms the butterfly. During mating, the male butterfly injects a spermatophore, a packet with sperm and nutrients for eggs. The female stores her eggs in a “bursa” until she lays them. The female is very protective of the eggs.

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14.4 Maevia inclemens: Dimorphic Jumping Spider

Common Name

- Dimorphic Jumping Spider

Description

The dimorphic jumping spider, *Maevia inclemens,* is a relatively common and colorful jumping spider of North America. It can vary in color from beige to black, with markings to indicate race. It has eight legs and up to eight eyes. There are two forms, a rare event in zoology. The grey morph has black and white stripes all over its body, orange palls (pedipalps or feelers), and no tufts. The tufted morph has a black body, palps, three tufts on its head, and pale legs.

The complete taxonomic classification is:

- Kingdom: Animalia
- Phylum: Arthropoda
- Class: Arachnida
- Order: Araneae
- Family: Salticidae
- Genus: *Maevia*
- Species: *M. inclemens*

Habitat

The dimorphic jumping spider lives in urban and rural areas in Canada and the United States. It can be found in bushes and small plants, houses, and in wet areas. It is very common in Canada, but not here in California. They can

still be found here, though.

Biology

Cell Biology

Like all animals, the dimorphic jumping spider has eukaryotic cells, which have a nucleus and organelles. When producing new cells, existing cells will divide, known as mitosis or meiosis. The cell created via mitosis has the same chromosomes as the original cell. Meiosis makes a cell with only half the chromosomes of the original cell. Meiosis makes gametes for reproduction.

Evolution

Spiders have been evolving for almost 400 years. The trigonotarbids were some of the first. They were very similar to spiders, with two legs for feeling, and 8 for walking. Then the Attercopus evolved, along with orb-weaving spiders in the Jurassic period, which then evolved into the spiders of today over time.

Ecology

The dimorphic jumping spider eats flying insects, including bees and flies. Instead of making a web, it jumps on its prey. However, it uses a string of silk to protect itself while jumping. It is prey to wasps, who eat it for food.

Anatomy and Physiology

The dimorphic jumping spider, like all other spiders, has eight legs, and two parts of the body, the cephalothorax and the abdomen. All jumping spiders a have great sense of sight. They use that to catch prey and attract mates. The dimorphic jumping spider uses all eight of its legs to jump. The spider has fangs, along with two feelers in its mouth, used for feeling. When it lands on its prey, the dimorphic jumping spider uses its fangs to kill the prey. It also creates a web to ride on. The dimorphic jumping spider has better eyesight than a cat. They have eight eyes, with two on the back of the head. The spider stores its gonads in the abdomen, used for mating.

Behavior

The dimorphic jumping spider is a solitary animal. The male dimorphic jumping spider attracts mates by pushing himself as high as he can with three legs, swinging the abdomen side to side. If the female accepts, she will extend her front legs and tap them. Then both commence in leg clapping and zig-zag dancing. The male makes these mating attempts at least nine centimeters away from the female.

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14.5 Patiria miniata: Bat Star

Common Name

- Bat Star
- Sea Bat
- Webbed Star

Description

The *Patiria miniata*, or Bat star starfish, is commonly reddish-orange or mottled white but can be green, purple, red, yellow, brown, or black. *Patiria miniata* usually have five arms but sometimes as many as nine arms. It has a starlike body, hence the name "starfish." They are related to sea cucumbers, sea urchins, and sand dollars. Bat stars can grow from 4.5 inches to 9.5 inches.

The complete taxonomic classification is:

- Kingdom: Animalia
- Phylum: Echinodermata
- Class: Asteroidea
- Order: Spinulosida
- Family: Asterinidae
- Genus: *Patiria*
- Species: *P. miniata*

Habitat

P. miniata's habitat is kelp forests, rocks, tide pools, and surfgrass. It ranges from Sitka, Alaska to Baja California, intertidal to about 950 feet below sea level.

Biology

Cell Biology

The *P. miniata* has as many as a few million eukaryotic cells. Like all other animals, these cells have many organelles, allowing different cell types to have different functions. Organelles are structures within a cell, like the nucleus. The nucleus is like a safe containing the factory's trade secrets. It contains the organism's genetic material. The mitochondria is the powerhouse of the cell. It provides the energy needed to power chemical reactions. Vesicles are small membrane-bound sacs that transport materials around the cell. Vacuoles are like storage centers. Lysosomes are like recycling trucks; they carry waste. Ribosomes are non-membrane bound organelles where proteins are made. Endoplasmic reticulum float freely in the cytoplasm. Golgi bodies work like a mail room. They receive proteins from the rough endoplasmic reticulum and send them where they need to be. Cytoplasm helps give the cell its shape.

Cells divide when embryos are growing, when cells repair, and for making gametes. Cells come from other cells that grow and divide. In mitosis, the nucleus divides, and each new cell contains a copy of the DNA in the original cell. Meiosis is when the cell divides to produce gametes (ex. eggs and sperm) with one half the chromosomes (containing DNA) of the parent cell.

Evolution

P. miniata is an invertebrate, which means it does not have a backbone. This also makes it one of the earlier animals to evolve. This animal has radial symmetry. Radial symmetry was the first type of symmetry to evolve. Organisms that have radial symmetry have no sense of direction, making controlled movements in a certain direction impossible. Early invertebrates didn't have a complete digestive system; there was just one opening that serves as both its mouth and anus. There are many important traits that have evolved in invertebrates, like multicellularity, tissues and organs.

Ecology

The Bat star starfish has a long breeding season. They can produce millions of eggs a year. The females and males will discharge fertile sperm and eggs all year long, but more during the late spring and winter. The Bat star can live up to thirty-five years.

The Bat star plays an important part in the ecosystem. The predators of the Bat star are crabs, seagulls, fish, sharks, other starfish, mollusks, and crustaceans. Their prey is clams and scallops, saw well as algae, making starfish omnivores. *P. miniata* eats echinoids, algae, sponges, and bryozoans. Bryozoans are tiny, aquatic animals forming mossy colonies. The Bat star is also a scavenger, cleaning up dead animals and algae on the seafloor, making our ocean cleaner.

Anatomy and Physiology

The Bat star can reproduce arms that have fallen off, a process known as regeneration. The mouth of the Bat star starfish is located in the center of the stomach. When eating, starfish push their mouths outside of their body to

digest the prey. Many starfish swallow their prey whole and start to digest it in their stomachs before passing it into the pyloric caeca. Because of the Bat star's ability to digest food throughout their body, they are able to eat larger prey.

The *P. miniata's* nervous system is rather complicated. Their brain is distributed throughout their whole body. Their nerves form an interlacing network that creates a brain all over the body. The feet of a Bat star starfish has skin that contains papullae. Papullae are thin, walled projections of the body cavity. They also absorb oxygen directly from water and distribute the oxygen throughout the Bat star body.

Behavior

The *P. miniata* are aggressive - if one meets another, they will fight. They fight by pushing one another and putting an arm over the other.

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- http://www.sanctuarysimon.org/species/species_info.php?speciesID=52&photoID=562

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14.6 Pepsis thisbe: Tarantula Hawk Wasp

Common Name

- Tarantula Hawk Wasp

Description

The tarantula hawk wasp is a wasp that has a blue and black body with orange wings. Females have coiled antennae. As for the males they have straight antennae. The length of this animal is 44 mm (2 in). What is well known about this animal is its sting. The sting of this wasp is one of the most agonizing stings of all insects. The sting would last at least for three long and painful minutes. People who have been stung by this animal says that it feels like a mild shock throughout the body.

- Kingdom : Animalia
- Phylum: Arthropoda
- Class: Insecta
- Order: Hymenoptera
- Family: Pompilidae
- Genus: *Pepsis*
- Species: *P. thisbe*

Habitat

Tarantula hawk wasps (*Pepsis thisbe*) can be found here in California and in Nevada. Tarantula hawk wasps live in desert scrub and love warm temperatures. They are most active during summer, but they avoid the hottest part of the day by going into cool, shady areas like large, leafy trees or shrubs.

Cell Biology

Pepsis thisbe has eukaryotic cells. Eukaryotic cells have a nucleus and many other organelles. The nucleus has DNA and mRNA. MRNA stands for messenger RNA, and mRNA is the chemical blueprints for protein, so it explains how to make the protein. When mRNA comes out of the nucleus, the mRNA travels into the ribosome. The ribosome is an important part of the cell. What the ribosome does is translate the mRNA into protein. There is a tunnel called the endoplasmic reticulum for the protein to travel through. Sometimes the protein is carried by the Golgi bodies.

When there is cell division, there are two processes that can happen, called mitosis and meiosis. Mitosis is when the nucleus of the cell divides itself into two new cells with the same chromosomes as the original cell. When an insect injures its cells, the cells divide through mitosis so that it can repair itself. Meiosis is when gametes (ex. sperm, eggs) are made with one half of the chromosomes of the original cell. Chromosomes are made of DNA with genes that have “codes” for traits.

Evolution

The first stage of evolution of invertebrates was the multicellularity. With this it would let different cells of the organism do different jobs for the body. The next stage of the evolution of invertebrates was tissue. When the invertebrates were evolving, two cell layers, the ectoderm and the endoderm, helped evolve tissue. The ectoderm is the outer layer, and the endoderm is the inner layer. These cells helped develop different kinds of tissue. Next came the evolution of organs in invertebrates.

Ecology

There are very few predators to this species. Two species that eat a tarantula hawk wasp are the roadrunner and the bull frog. Tarantula hawk wasps are nectivorous, meaning they eat nectar. When they eat fermented fruit, it comes to the point where flight becomes challenging.

Anatomy and Physiology

The insect's body is made up of three major parts: the head, thorax, and abdomen. The head has the eyes and mouth parts. The thorax includes the legs and wings.

Insects usually have a pair of antennae located between or in front of the compound eyes. Compound eyes are eyes that have an array of visual units. Antennae are used for smelling and touching, but insects also use these appendages for hearing, too. Besides the antennae, most insects have two kinds of eyes: simple eyes, called ocelli that are sensitive to light, and compound eyes made up of many tiny lenses that record multiple images.

The mouthparts of the wasp consist of the upper lip (labrum) and the lower lip (labium). There are also jaws (mandibles), and two smaller jaw-like appendages (maxillae). All these mouthparts are used for biting. Insects with biting mouthparts like wasps work their mandibles from side to side. Bees and wasps have biting and lapping mouthparts. All insects have three pairs of legs. Each leg is consisted of 5 parts: the coxa, trochanter, femur, tibia, and tarsus. The tarsus has 2-5 segments, and it often has a pair of claws at the tip and one or more pads. The wasp wings are made of membrane. These wings have large cells with few veins.

Behavior

The Tarantula hawk wasp is a solitary insect. The hawk wasp is very active during daytime, but their prey is active at night, so most of the hunting is during dusk. The wasp also feeds on flowers during daytime. When the male mates with the female, the female will go out hunting for a tarantula with her sense of smell while on ground. When she is finding a male tarantula, she will locate the burrow. When the burrow is found, she touches the silk around the burrow so she can get the tarantula's attention.

When the tarantula comes out, the female fights with the tarantula. She must sting the tarantula in between the legs on the underside. After paralyzing the tarantula, she drags the tarantula to the burrow she has made. When she finishes dragging it, she lays an egg on it. When the egg hatches, the larva creates a hole into the spider, feeding on its organs for as long as possible. When seven weeks pass by, the larva pupates, growing into an adult. Then the reproduction cycle starts all over again.

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14.7 Vespula pensylvanica: Yellowjacket Wasp

Common Name

- Yellowjacket Wasp
- Western Yellowjacket

Description

A yellowjacket wasp is 12 mm (0.75 in.) long. They appear black and yellow, or black and white. The wasp is equipped with a stinger located on the abdomen, and they have antennas on their head. Yellowjacket wasps have six legs, each one as useful as the next. Four wings attached to the wasp's back enable it to swing easily through obstacles, such as humans, cars, bikes, trees, and more. They may build their nests close to humans, but most colonies only stay active one year. Yellowjacket wasps have been symbols all the way back to their discovery. For example, the yellowjacket is the most popular mascot of Georgia Tech, where his name is Buzz. Be careful about handling dead wasps, because they can still sting once deceased, but only for a certain amount of time.

- Kingdom: Animalia
- Phylum: Arthropoda
- Class: Insecta
- Order: Hymenoptera
- Family: Vespidae
- Genus: *Vespula*
- Species: *Vespula pensylvanica*

Habitat

Yellowjackets range across North America. The yellowjacket can live in lawns, the base of tree shrubs, attics, the walls of houses, and storage buildings. The wasp is able to live above and below the ground, and tends to live around meadows, as well as the edge of forests. All yellowjackets live in either colonies, nests suspended from trees, or on the corners of buildings. They can be seen during the late spring, summer, and the early fall. Their nest is made of paper, which is gathered off trees. They then mix it with their saliva and use it to build the nest. Underground nests can be destroyed due to flooding.

Cell Biology

A cell is the tiniest structural and functional part of an organism. New cells come from existing cells. Yellowjacket cells are so small that you can't see them without the help of a microscope, and to be able to see the tiny structures that roam inside of the cells, you need another special type of microscope, an electron microscope. Then you are ready to explore the inside of a cell. Each individual cell in a yellow jacket's body is made for a certain task. For

instance, red blood cells are shaped with a pocket that encloses oxygen, and carries it to other body cells. Then there are nerve cells, which are long and stringy, so that they can form a line of communication with other nerve cells, like a wire. Because of their shape, they can quickly send signals. Cells are shaped in ways that help them do their tasks. Yellowjackets are multicellular organisms and have many types of specialized cells in them.

Evolution

The yellowjacket wasp didn't evolve from honey bees, even though it has been said before. The reason that's been said before is because honey bees and yellow jackets do have a similar ancestor in their background. But they're neither a bee nor ant. Yellowjackets evolved several traits before vertebrates (animals characterized by a segmented spinal column and a differentiated head) even appeared. These traits are found in most animals. The first yellowjacket trait to evolve was "multicellularity", a highly adaptive change. Many cells can do different jobs. They can make special changes that enable them to do their work very well. However, the first invertebrates still needed tissues. Sponges are the first organism at the multicellular stage of invertebrate evolution.

Living cnidarians (invertebrate animals of the phylum Cnidaria) like jellyfish, are the next part of invertebrate evolution. This was the first step in the evolution of organs and organ systems. At first, invertebrates created tissues from just two embryonic cell layers. There was an outer cell layer called "ectoderm" and an inner cell called "endoderm". Both cell layers allow different kinds of tissue to form.

A trait that evolved very early is symmetry. A sponge doesn't have symmetry. This means that it can't be cut in two identical halves. The coral polyp and the beetle have symmetry. The coral polyp has radial symmetry, which was the first type of symmetry to evolve. The coral has a distinct top, as well as bottom, but not distinct ends. It can be split into equal halves like a pie, but not in right and left halves. Animals that have radial symmetry have no sense of direction, which makes controlled movement impossible.

Flatworms are the next level of invertebrate evolution. They evolved cephalization, which is adaptive and gives control of the whole organism. Cephalization was the first part in the evolution of a brain.

Cephalization created bilateral symmetry. This allows the animal to tell the difference between different movements, which is of course it needs to control its direction.

Ancestors of the flatworms also evolved a mesoderm. The mesoderm is the last layer of cells that are in middle of the ectoderm and the endoderm. The evolution of this new cell layer lets animals make new tissues such as muscle.

Early invertebrates didn't have a digestive system. There was only one opening for the mouth and anus. The first roundworms were the start of animals developing a complete digestive system. They had a separate mouth and anus, which allowed food to go through the body in a single direction. This all made up the evolution of the digestive system.

The first roundworms evolved a pseudocoelom. This is a body cavity that is full of liquids. It gives space for the inner organs to develop.

Segmentation evolved next. This is the body breaking up into many parts. The earthworm and the ant both have segmented bodies, which gives them more flexibility. This also gives them better movement. All arthropods also evolved jointed appendages. For example, they evolved jointed legs for walking, and antennas.

Ecology

These types of wasps mainly feed on other insects, and a common favorite is flies. Yellowjacket wasps eat spiders and insects, as well as human food. The human food diet includes meats, sweets, picnic trash, bird feeder seeds, sodas, and fruits. Many adults eat nectar, and larvae feed on pre-chewed food. They look for sources of food within a mile of the nest. They don't leave stingers in skin, unlike bees. The stinger goes in smoothly, so they can sting a person multiple times. The yellow jacket's nest is very easy to see if you're outside, and hard to see if you're inside. You can sometimes hear them in the walls of complexes, if they have built a nest there. Yellow jackets are attracted

to perfumes and fragrances based on a flower odor. If a scent smells like a flower, then they naturally follow the scent. Some fly species try to mimic the yellowjackets, by having the same colours, or stripes as them, in order to create the same fear that wasps give, and be left alone. Most people are fooled by their disguise. A full yellowjacket nest can have up to 600-800 workers.

Anatomy and Physiology

Yellowjackets don't have red blood like humans. Their blood, which is called the hemolymph, is colorless and very different from the blood of humans. Human blood and yellowjacket blood, both are water reservoirs, and bring nutrients, waste, and hormones. Their blood has no oxygen flowing through it, unlike humans. A yellow jacket's heart is located in the back of their abdomen, whereas humans have their hearts in the front of their chest. The heart of a yellow jacket also has little importance. They don't need it to flow blood throughout their body. Blood squeezes through the inner parts of the insect, throughout the body.

Behavior

Unlike bees, the yellowjacket wasp does not produce honey. Yellowjackets are social wasps, which means they live in hives or wasp communities. The queen wasp lays all the eggs, so she keeps the workers from laying eggs. In the spring, females create a tiny nest and bring food daily to the larvae in it until it grows up. Females serve as workers, increasing the nest size and caring for the young. In the summer, the males have unfertilized eggs and mate. After the cold weather comes in, all yellowjackets die except for mated females.

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CHAPTER 15 Understanding Biodiversity: Expeditions

Chapter Outline

15.1 CK-12 Understanding Biodiversity: Expeditions

CK-12 Understanding Biodiversity: Expeditions highlights the greatest and most famous expeditions connected with the natural history literature.

- da Gama's Sea Route to India
- Amundsen's South Pole Expedition
- Peary's Conquering of the North pole
- Cortés' Conquest of Mexico
- Przhevalsky's Discovery of Central and East Asia
- von Jacquin's Expedition to the Caribbean
- Livingstone's Exploration of Africa
- de Andrade's Exploration of Tibet
- Hudson's Voyages
- Humboldt's Expeditions
- di Mulazzo's North and South America Exploration
- Nordenskiöld's Northeast Passage
- Amundsen's Northwest passage
- Scott's South Pole Expeditions
- de Magalhães's Voyage of Circumnavigation
- Darwin's Voyage of the Beagle
- Cartier's Voyages to the New World

CHAPTER 16 List of Contributors

Chapter Outline

Understanding Biodiversity Contributors

16.1 Animals: Mammals

TABLE 16.1: short caption

Species	Author(s)	Affiliation	Status
Canis latrans (Coyote)	Quinn Tribolet and Natalie Vollmer	The Museum School, San Diego, CA	*under review*
Didelphis virginiana (Virginia Opossum)	Orion Silva, Arian Tabatabaei and Luca Addario	The Museum School, San Diego, CA	*under review*
Enhydra lutris (Sea Otter)	Alexa Lawrence and Zoe White	The Museum School, San Diego, CA	*in preparation*
Loxodonta africana (African Elephant)	Steven Prado	Grover Cleveland High School, Reseda, CA	*under review*
Lynx rufus (Bay Lynx)	Josef Darvas, Alex Noriega and Catie Kawamura	The Museum School, San Diego, CA	*in preparation*
Mirounga angustirostris (Elephant Seal)	Tuesday Motch and Greta West	The Museum School, San Diego, CA	*in preparation*
Ovis canadensis nelsoni (Desert Bighorn Sheep)	Chaska Cobalt	The Museum School, San Diego, CA	*under review*
Peromyscus californicus (California Mouse)	Dennis Smith, Jr. and Luna Smith	The Museum School, San Diego, CA	*in preparation*
Phascolarctos cinereus (Koala)	Maria Sol Raiano, Nilufar Haider and Arashjot Kaur	Grover Cleveland High School, Reseda, CA	*under review*
Procyon lotor (Raccoon)	Catie Kawamura	The Museum School, San Diego, CA	*under review*
Puma concolor (Mountain Lion)	Luca Addario and Arian Tabatabaei	The Museum School, San Diego, CA	*in preparation*
Sylvilagus audubonii (Audubon Cottontail Rabbit)	Mia Aust and Sophia Lovell	The Museum School, San Diego, CA	*in preparation*
Tursiop truncatus (Bottlenose Dolphin)	Hailey Andrews, Maya Ensley and Tania Lloyd	The Museum School, San Diego, CA	*in preparation*

16.2 Animals: Birds

TABLE 16.2: short caption

Species	Author(s)	Affiliation	Status
Archilochus alexandri (Back Chinned Hummingbird)	Christine Meggett	The Museum School, San Diego, CA	*in preparation*
Asio otus (Long-eared Owl)	Sydney Fortune	The Museum School, San Diego, CA	*under review*
Buteo jamaicensis (Red-tailed Hawk)	Christopher Nichelson, Drake Borman and Sydney Fortune	The Museum School, San Diego, CA	*in preparation*
Calypte anna (Anna's Hummingbird)	Hilary Castaneda and Victoria Nguyen	The Museum School, San Diego, CA	*under review*
Cathartes aura (Turkey Vulture)	Natalie Moller	The Museum School, San Diego, CA	*in preparation*
Couvs branchyrhynchos (American Crow)	Jalani Taylor and Sophia Fuller	The Museum School, San Diego, CA	*in preparation*
Falco Peregrinus (Peregrine Falcon)	Drake Matthew Borman	The Museum School, San Diego, CA	*in preparation*
Geococcyx californianus (Roadrunner)	Allan S. Amante and Christian E. Moller	The Museum School, San Diego, CA	*in preparation*
Haliaeetus leucocephalus (Bald Eagle)	Maxwell Phillip Hoffman	The Museum School, San Diego, CA	*in preparation*
Meleagris gallopavo (Wild Turkey)	Roan Woolley, Jacob Felix Solomon and Drake Matthew Borman	The Museum School, San Diego, CA	*in preparation*
Mimus polyglottos (Mockingbird)	Jayden Garcia and Morgan Knowles	The Museum School, San Diego, CA	*in preparation*
Phainopepla nitens (Black Cardinal)	Robert Correa, Victoria Nguyen and Hilary Castaneda	The Museum School, San Diego, CA	*in preparation*
Rynchops niger (Black Skimmer)	Alaysja Clark	The Museum School, San Diego, CA	*under review*

16.3 Animals: Reptiles

TABLE 16.3: short caption

Species	Author(s)	Affiliation	Status
Crotalus ruber (Red Diamond Rattlesnake)	Finn J. Morton	The Museum School, San Diego, CA	*under review*
Lampropeltis gentulus californiae (California King Snake)	Robert Khatchatryan and Andoni Sanguesa	The Museum School, San Diego, CA	*in preparation*

16.4 Animals: Ray-finned Fishes

TABLE 16.4: short caption

Species	Author(s)	Affiliation	Status

16.5 Animals: Amphibians

TABLE 16.5: short caption

Species	Author(s)	Affiliation	Status

16.6 Animals: Invertebrates

TABLE 16.6: short caption

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Bothriocyrtum californicum (Trapdoor Spider)		The Museum School, San Diego, CA	*in preparation*
Danaus plexippus (Monarch Butterfly)	Janae N. Beasley, Natalie Vollmer and Quinn Tribolet	The Museum School, San Diego, CA	*under review*
Hylephila phyleus (Fiery Skipper)	Isabella Reyes, Arianna Taba and Jackson D. Sipe	The Museum School, San Diego, CA	*in preparation*
Maevia inclemens (Dimorphic Jumping Spider)	Jackson D. Sipe	The Museum School, San Diego, CA	*under review*
Patiria miniata (Bat Star Starfish)	Isabelle Udasco and Gabby Vargas	The Museum School, San Diego, CA	*under review*
Pepsis thisbe (Tarantula Hawk Wasp)	Mailani Aguila	The Museum School, San Diego, CA	*in preparation*
Vespula pensylvanica (Yellowjacket Wasp)	Zion Lynch	The Museum School, San Diego, CA	*in preparation*

16.7 Plants

TABLE 16.7: short caption

Species	Author(s)	Affiliation	Status
Pisum sativum (Pea Plant)	Christopher Vasquez	Grover Cleveland High School, Reseda, CA	*under review*
Encelia californica (Bush Sunflower)	Celeste Escanuela and Sophia Fuller	The Museum School, San Diego, CA	*in preparation*
Toxicodendron diversilobum (Pacific Poison Oak)	John D. Carpenter and Andoni Sanguesa	The Museum School, San Diego, CA	*under review*

16.8 Fungi

TABLE 16.8: short caption

Species	Author(s)	Affiliation	Status
Saccharomyces cerevisiae (Brewer's Yeast, Baker's Yeast)	Douglas Wilkin	The CK-12 Foundation, Palo Alto, CA	*reviewed by CK-12*

16.9 Bacteria

TABLE 16.9: short caption

Species	Author(s)	Affiliation	Status

16.10 Archaebacteria

TABLE 16.10: short caption

Species	Author(s)	Affiliation	Status

16.11 Protists

TABLE 16.11: short caption

Species	Author(s)	Affiliation	Status

16.12 Expeditions

TABLE 16.12: short caption

Voyage	Author(s)	Affiliation	Status

CHAPTER 17 Understanding Biodiversity Template

Chapter Outline

17.1 Species

Common Name

Description

Habitat

17.2 Biology

17.3 References

17.4 Attribution

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