

Life Science Teacher's Edition (TE)

[CK-12 Foundation](#)

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Chapter 1

Introduction to Life Science (TE)

1.1 Life Science: Teacher's Edition (TE)

Introduction

The impacts of the Human Genome Project and of global warming are just two of the numerous issues that reveal the importance of understanding the life sciences. These issues, and the outcomes of these issues, are changing and advancing at such a rapid rate that it is nearly impossible for most textbooks to stay current.

Is it easier, at times, to get current scientific information from the internet, or even your local newspaper? Of course it is. Do today's students need this information presented to them? Now, more than ever they do.

Is there an alternative to school districts spending millions of dollars every year to buy the latest edition of a textbook? CK12 believes there is. CK-12, a non-profit organization launched in 2006, aims to reduce the cost of textbook materials for the K-12 market both in the US and worldwide. CK12 is developing a series of web-based middle school and high school adaptive textbooks - each termed a FlexBook. These web-based FlexBooks will have unlimited flexibility and variability, allowing continual and immediate updating of the material as new information becomes available.

Flexibility: A Key Feature of CK12 FlexBooks

An important advantage of the FlexBook is the ability it gives you, the teacher, to choose the chapters and lessons that you think are most important for your own classes. You also have the ability to add additional material as you deem appropriate, in essence, creating your own FlexBook, specific for the needs of your students.

CK12's Life Science

Life Science is a complete educational tool for the middle school science student. The FlexBook contains seven units, each unit has two to seven chapters, and each chapter has two to four lessons. Together the seven units of CK12's *Life Science* have 25 chapters and more than 80 lessons. These lessons, written by renowned experts in life science education, are designed to address both state and national standards. In addition to this Teacher's Edition, a Supplemental Workbook filled with worksheets for each lesson is in development.

Contents

Unit 1: Understanding Living Things

Chapter 1: Studying Life

Chapter 2: Introduction to Living Things

Unit 2: Cells: The Building Blocks of Life

Chapter 3: Cells and Their Structures

Chapter 4: Cell Functions

Chapter 5: Cell Division, Reproduction, and DNA

Unit 3: Genetics and Evolution

Chapter 6: Genetics

Chapter 7: Evolution

Unit 4: Prokaryotes, Protists, Fungi, and Plants

Chapter 8: Prokaryotes

Chapter 9: Protists and Fungi

Chapter 10: Plants

Unit 5: The Animal Kingdom

Chapter 11: Introduction to Invertebrates

Chapter 12: Other Invertebrates

Chapter 13: Fishes, Amphibians, and Reptiles

Chapter 14: Birds and Mammals

Chapter 15: Behavior of Animals

Unit 6: The Human Body

Chapter 16: Skin, Bones, and Muscles

Chapter 17: Food and the Digestive System

Chapter 18: Cardiovascular System

Chapter 19: Respiratory and Excretory Systems

Chapter 20: Controlling the Body

Chapter 21: Diseases and the Body's Defenses

Chapter 22: Reproductive Systems and Life Stages

Unit 7: Ecology

Chapter 23: From Populations to the Biosphere

Chapter 24: Ecosystem Dynamics

Chapter 25: Environmental Problems

1.2 The Teacher's Edition

Each unit and chapter will have a general overview. Each chapter section will also include an introduction and teaching strategies. In this TE, the majority of content will be presented by individual lesson.

Pacing the Lesson

Each chapter has guidelines for the minimum number of class periods needed to teach each lesson. We have strived to keep each chapter under a week of class time, which would cover the complete FlexBook in 25 weeks, providing ample time for flexibility. We realize this is a tremendous amount of material, and many teachers may choose not to utilize the complete FlexBook, providing even more time for flexibility. As the teacher, you can determine if your class needs additional (or less) time on certain lessons/chapters, and adjust the pacing accordingly.

Lesson Subtopics

This TE will focus on a number of subtopics for each lesson. These subtopics may include:

1. Key Concept(s)
2. Lesson Objectives
3. Lesson Vocabulary
4. Check Your Understanding
5. Teaching Strategies

General

Differentiated Instruction

Enrichment

6. Laboratory Activities
7. Science Inquiry
8. Reinforce and Review

Review Questions and Answers

9. Points to Consider
10. Lesson Assessment

1.3 Teaching Strategies

Throughout the TE, we will provide numerous examples of strategies that can be used to make the content accessible to students. This will include general teaching strategies, as well as differentiated instruction, enrichment, science inquiry, and reinforcement strategies. Laboratory activities have also been included. Many strategies and activities have been included as web site links, and we recommend that these be previewed before assigning to students.

Science Notebook

For a year study of Life Science, we recommend a **science and/or lab notebook** in which students may:

- answer the “Check Your Understanding” questions
- answer/reflect on the “Points to Consider” questions
- write additional questions about an upcoming lesson/chapter/unit of study
- draw pictures of living organisms and diagrams of life processes
- take notes and define academic vocabulary

- keep a record of pertinent web sites to access relevant information
- write up lab activities
- write up ideas for possible longer term projects
- keep reflections on what they have learned

Students should date each entry and refer back to their ideas earlier in the year, reflecting on their deepening understanding.

Biology Vocabulary and Scaffolding Instruction

Biology vocabulary and concepts can be difficult for students. It is particularly important to use a teaching strategy, such as scaffolding, to help students learn. Think of the scaffolding on the side of a building that helps you reach the top. There are steps along the way that elevate you, or raise your conceptual level higher and higher. In this way, you give students support until they can apply new learning and skills independently. This strategy is one that enables you, the teacher, to accommodate individual needs and individualize instruction for each learner. The goal is to motivate learners, and assist in their success.

Scaffolding instruction is fundamental for quality teaching to all students, but especially important for English Language Learners (ELL) or special needs students. For each lesson, a suggested differentiated instruction lesson has been included, designed for students who may need assistance with English.

The Scaffolding Strategy

As in any good teaching, bring up topics with which students are already familiar to give students a context to assimilate new understandings. Give these topics a “twist” to engage student’s motivation. Break complex tasks into smaller tasks, show examples of quality outcomes, offer hints or verbal cues, use mnemonic devices, chants and/or songs for activities requiring memorization of facts or procedures. Use graphic organizers such as concept maps; teach key vocabulary before reading the FlexBook. Continually ask questions to guide and facilitate students in making predication, or to encourage deeper investigations or thinking on a topic. Model activities before students participate. And, ask for student contributions about their past experiences in the field.

Teaching Strategies

General

1. Appreciate what’s difficult for students, and help them develop scientific ways of thinking.

2. Vary class activities, and use a wide variety of resources to aid students in deepening their understanding of scientific issues.
3. Give students opportunities to participate in scientific investigations to understand “doing science.”

Word Dissection

Biology words can be intimidating for students to read, say, and talk about. As teacher, you can make a game of the words, and take a few minutes to do a daily or weekly dissection in class. Make sure students know that it is not a big deal to not know the word when you first come into contact with it, but to learn to break it down into pieces, figure out the meaning of each piece, and then put it all back together again to find the meaning.

Reading to Learn

Teach your students how to read, comprehend, and summarize scientific text. Each lesson offers an opportunity to use different techniques to guide students to synthesize the core elements of the lesson. Try one or two different techniques each time:

- Model for your students skimming a section of text and summarizing.
- Remind students that they can read in different ways: scan, skim, annotate.
- Ask and discuss whether they read headlines, captions, or summary material first.
- Have the students write down all unfamiliar words.
- Have them summarize important points as bullets, phrases, or short sentences. You may want to assign small groups of students to work together to summarize a lesson, or conduct a large class discussion.
- Students may also summarize lesson points with a partner.
- You may choose to follow with a class discussion on summary points.

Using Visuals

Use an illustration in the student edition or other source as a tool for teaching content, exploring ideas, probing students’ misunderstandings, etc.

Building Science Skills

Have students apply higher-level thinking or other relevant skills as they relate to lesson content (e.g., predicting, forming hypotheses, drawing conclusions, interpreting data, observing, classifying, making inferences, comparing and contrasting, identifying cause and effect, analyzing). This could be through a simple activity, answering questions, class discussion, partner work, etc.

Discussion

Stimulate class discussion of a topic. This could include scripted questions to ask the class. The discussion tips should be specific and focused. For example, don’t ask the class to

“Discuss Darwin’s theory of evolution.” Instead ask the class, “Why was Darwin’s theory not widely accepted in his own lifetime.” Ask, “How did Darwin’s theory of evolution conflict with prevailing views of living things?”

Demonstration

Do (and fully describe) an in-class demonstration to illustrate or explain a process, concept, etc. Keep in mind constraints on classroom time and resources. Include a concluding sentence or scripted question that relates the demonstration to the process or concept.

Activity

Have students do a simple hands-on activity that will help them better understand a topic, process, etc. Explain fully how the activity is to be done. This could be a pencil-and-paper activity or other activity that does not involve materials, although readily available classroom materials could be used. Again, conclude with a sentence or question that ties the activity with the topic or process.

Teaching Strategies: Differentiated Instruction

These strategies can be used for all types of student populations that are typically addressed by DI (i.e., ELL, LPR, SN), but a strategy can be tailored for a particular population. These strategies usually pair students that can benefit from the DI with native English students or other students that can assist/benefit the DI student. Examples of strategies that can be tailored for DI are presented.

KWL

Have students make a KWL chart, where K = Know, W = Want to Know, and L = Learned. Students should fill in the K and W columns before reading and the L column after reading a particular passage or lesson.

Cloze Prompts

Give students cloze sentences (basically, fill-in-the blank sentences) about important lesson concepts. Students are instructed to fill in the missing words as they read the lesson.

Gallery Walk

Divide the class into groups and have groups walk around the room to read and discuss posted questions or topics (each on a large sheet of paper). Each group (using a different color pen) answers the questions or writes comments about the topics. They also read and respond to answers/comments written by other groups. This is followed by discussing the answers/comments with the class or reviewing misunderstandings they reveal, or by groups summarizing what they know about one or more questions/topics.

Think-Pair-Share

Assign questions or topics to individual students to think about. Pair ELL students with native speakers, LPR students with more proficient readers, etc., to work together on answering the questions or discussing the topics.

Fruiter Model

Assign this vocabulary strategy, which involves students drawing a large box and dividing it into four parts labeled **Definition, Drawing, Example, Non-example**. Assign students a vocabulary word and tell them to fill in the parts of the box for that word.

Cluster Diagram

Have individual students, pairs, groups, or the class as a whole make a cluster diagram organizing lesson concepts.

Concept Map

Have individual students, pairs, groups, or the class as a whole make a concept map organizing lesson concepts.

Venn Diagram

Have individual students, pairs, groups, or the class as a whole make a Venn diagram organizing lesson concepts.

Compare/Contrast Table

Have individual students, pairs, groups, or the class as a whole make a compare/contrast table for specific lesson concepts, processes, etc. (e.g., photosynthesis and cellular respiration; mitosis and meiosis). You may need to provide the column and row headings for the table.

Cycle Diagram

Have individual students, pairs, groups, or the class as a whole make a cycle diagram to show the steps in a cyclical process (e.g., life cycle of amphibians, photosynthesis/cellular respiration).

Flow Chart

Have individual students, pairs, groups, or the class as a whole make a flow chart to show the steps in a process (e.g., photosynthesis).

Main Ideas/Details Chart

Have students divide a sheet of paper in half and on the left side write the main ideas from a passage or lesson (skipping several lines between the main ideas). On the right side, students are instructed to fill in important details about each main idea as they read.

Word Wall

Post lesson vocabulary words and their definitions, examples, etc. on a bulletin board or wall. Refer students to the word wall as they study lesson content.

Teaching Strategies: Enrichment

Enrichment activities have been designed for students that need additional challenges. Although online and/or library research is always an option for enrichment, it tends to be overused so try to limit it unless, of course, it is really relevant and likely to be helpful for the other students in the class. Whatever students are assigned to do, they should be given a chance to share their work with the class through an informal oral presentation, a written report, etc. In some cases (e.g., making a board game or crossword puzzle), the product can be used by the class to reinforce or review lesson content. Examples of activities that can be used as enrichment are provided:

Table 1.1:

Research a Topic	Present a Role-Play	Teach a Topic
Create a Video	Create a Poster	Debate an Issue
Interview an Expert	Make a Model	Demonstrate a Process
Take a Survey	Write an Essay	Make a Board Game
Make a Crossword Puzzle	Create a Web site	Make a Diagram
Make a Diorama	Make a Display	Make a Video
Write a Rap (Song)	Write a Research Proposal	Present a PowerPoint Show
Lead a Discussion		

Science Inquiry

These strategies should get students involved in thinking or acting like a scientist. They should help the students learn lesson content by encouraging them to be actively engaged in scientific thinking and/or using scientific methods.

- Ask a Research Question: e.g., based on hypothetical observations
- Formulate a Hypothesis: e.g., based on a research question. Must be specific and testable; could also ask students to describe data that would support or disprove the hypothesis.
- Develop a Research Plan: e.g., to test a specific hypothesis. Could focus on types of variables, controls, etc.
- Analyze Data: Data could be in a graph or table that is provided in the SE or TE or students could find the data online.
- Solve a Problem: requiring application of lesson concepts, procedures, etc.

The 5E Model of Inquiry

This model is used as a pedagogical focus for selected chapters.

Table 1.2:

5Es	-
Engagement	Object, event or question used to engage students. Connections facilitated between what students know and can do.
Exploration	Objects and phenomena are explored. Hands-on activities, with guidance.
Explanation	Students explain their understanding of concepts and processes. New concepts and skills are introduced as conceptual clarity and cohesion are sought.
Elaboration	Activities allow students to apply concepts in context, and build on or extend understanding and skill.
Evaluation	Students assess their knowledge skills and abilities. Activities permit evaluation of student development and lesson effectiveness.

Doing Science: The Process of Scientific Inquiry

A large body of content knowledge is included in this Middle School Life Science FlexBook, but there is more about the scientific enterprise, the viewpoint of science as a way of thinking and investigating, that students can learn. Give students opportunities to learn about the very nature of science and extend learning into inquiry activities and modules such as this NIH module.

<http://science.education.nih.gov/customers.nsf/MSInquiry.htm>

At the website above, you can download the Teacher's Guide or request that the hard copy be sent to you. There are lesson plans and implementation support, and directions for the web version or print version, as well as all materials needed.

Reinforcement Activity

In addition to online quizzes, this could be a quick teacher-directed activity or something students do alone or in pairs to make sure they understand lesson content. It should probably be aimed at the average to below-average students in the class. Some suggestions are listed

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below. The goal is to reveal to the teacher or to students themselves what they know and what they still don't understand. The activity should include a sentence suggesting a way for students to learn what they don't know (e.g., "Find definitions in the FlexBook of any words you did not know.").

Take an Online Quiz Make Flashcards

This activity could be used for boldface vocabulary words or important concepts; have students use the flashcards to quiz a partner.

Label a Drawing

The drawing could be art from the SE with the labels deleted.

Outline the Lesson

This could be done with a partner or as a class using an overhead projector.

Ask Questions

Each student turns in a question on an index card. Then, the teacher answers or reviews material relevant to those questions that are asked most frequently.

List and Discuss

Students make a list of something (e.g., reproductive isolating mechanisms), and then partners compare and discuss their lists.

Use Vocabulary

Students use the lesson vocabulary words in sentences or a brief paragraph.

Make a Quiz

Students write a few fill-in, matching, or true/false questions and then use them to quiz a partner.

Make a Drawing

Students create a simple sketch to demonstrate comprehension of a process (e.g., cell division).

Complete a Chart

Students complete missing parts of a diagram or fill in cells of a table that have missing information.

This can easily be preceded or followed with a **Lesson Review**. Either you or a student(s) leads a discussion to review the lesson. You can use the Lesson Summary from the FlexBook. Clarify any issues and answer any questions students may have.

Check Your Understanding

This section includes questions related to previously presented information that the authors consider important for **the student** to have access to the information in the current lesson.

Points to Consider

Questions in this section serve as a segue into the next lesson (or chapter). Ask students to read the Points to Consider at the end of the lesson in their FlexBook. They can be answered individually or as an opening to lead a class discussion. Use these questions to assess student understanding and misconceptions before beginning the next lesson/chapter/unit of study.

1.4 Contributors

This Teacher's Edition has been developed by Cathleen Galas, M.A., Sherman B. Rosenfeld, Ph.D., Jennifer George, and Douglas Wilkin, Ph.D.

Chapter 2

Standards

Life Science: Standards

California Science Standards: Grade 7: Focus on Life Science

Cell Biology

SCI.CA.7.1. Cell Biology: All living organisms are composed of cells, from just one to many trillions, whose details usually are visible only through a microscope. As a basis for understanding this concept:

Table 2.1:

Standard	-	Chapters and Lessons
1a	Students know cells function similarly in all living organisms.	Introduction to Living Organisms <ul style="list-style-type: none">• What are Living Things Cells and Their Structures Cell Functions
1b	Students know the characteristics that distinguish plant cells from animal cells, including chloroplasts and cell walls.	Cells and Their Structures <ul style="list-style-type: none">• Cell Structures

Table 2.1: (continued)

Standard	-	Chapters and Lessons
1c	Students know the nucleus is the repository for genetic information in plant and animal cells.	Cells and Their Structures <ul style="list-style-type: none"> • Cell Structures
1d	Students know that mitochondria liberate energy for the work that cells do and that chloroplasts capture sunlight energy for photosynthesis.	Cells and Their Structures <ul style="list-style-type: none"> • Cell Structures Cell Functions <ul style="list-style-type: none"> • Photosynthesis • Cellular Respiration
1e	Students know cells divide to increase their numbers through a process of mitosis, which results in two daughter cells with identical sets of chromosomes.	Cell Division, Reproduction, and DNA <ul style="list-style-type: none"> • Cell Division
1f	Students know that as multicellular organisms develop, their cells differentiate.	Reproductive Systems and Life Stages <ul style="list-style-type: none"> • Reproduction and Life Stages

Genetics

SCI.CA.7.2. Genetics: A typical cell of any organism contains genetic instructions that specify its traits. Those traits may be modified by environmental influences. As a basis for understanding this concept:

Table 2.2:

Standard	-	Chapters and Lessons
2a	Students know the differences between the life cycles and reproduction methods of sexual and asexual organisms.	Lesson 9.2: Fungi

Table 2.2: (continued)

Standard	-	Chapters and Lessons
2b	Students know sexual reproduction produces offspring that inherit half their genes from each parent.	
2c	Students know an inherited trait can be determined by one or more genes.	
2d	Students know plant and animal cells contain many thousands of different genes and typically have two copies of every gene. The two copies (or alleles) of the gene may or may not be identical, and one may be dominant in determining the phenotype while the other is recessive.	
2e	Students know DNA (deoxyribonucleic acid) is the genetic material of living organisms and is located in the chromosomes of each cell.	

Evolution

SCI.CA.7.3. Evolution: Biological evolution accounts for the diversity of species developed through gradual processes over many generations. As a basis for understanding this concept:

Table 2.3:

Standard	-	Chapters and Lessons
3a	Students know both genetic variation and environmental factors are causes of evolution and diversity of organisms.	

Table 2.3: (continued)

Standard	-	Chapters and Lessons
3b	Students know the reasoning used by Charles Darwin in reaching his conclusion that natural selection is the mechanism of evolution.	
3c		
3d	Students know how to construct a simple branching diagram to classify living groups of organisms by shared derived characteristics and how to expand the diagram to include fossil organisms.	
3e	Students know that extinction of a species occurs when the environment changes and the adaptive characteristics of a species are insufficient for its survival.	

Earth and Life History

SCI.CA.7.4. Earth and Life History: Evidence from rocks allows us to understand the evolution of life on Earth. As a basis for understanding this concept:

Table 2.4:

Standard	-	Chapters and Lessons
4a	Students know Earth processes today are similar to those that occurred in the past and slow geologic processes have large cumulative effects over long periods of time.	
4b	Students know the history of life on Earth has been disrupted by major catastrophic events, such as major volcanic eruptions or the impacts of asteroids.	
4c	Students know that the rock cycle includes the formation of new sediment and rocks and that rocks are often found in layers, with the oldest generally on the bottom.	
4d	Students know that evidence from geologic layers and radioactive dating indicates Earth is approximately 4.6 billion years old and that life on this planet has existed for more than 3 billion years.	
4e	Students know fossils provide evidence of how life and environmental conditions have changed.	
4f	Students know how movements of Earth's continental and oceanic plates through time, with associated changes in climate and geographic connections, have affected the past and present distribution of organisms.	

Table 2.4: (continued)

Standard	-	Chapters and Lessons
4g	Students know how to explain significant developments and extinctions of plant and animal life on the geologic time scale.	

Structure and Function in Living Systems

SCI.CA.7.5. Structure and Function in Living Systems: The anatomy and physiology of plants and animals illustrate the complementary nature of structure and function. As a basis for understanding this concept:

Table 2.5:

Standard	-	Chapters and Lessons
5a	Students know plants and animals have levels of organization for structure and function, including cells, tissues, organs, organ systems, and the whole organism.	
5b	Students know organ systems function because of the contributions of individual organs, tissues, and cells. The failure of any part can affect the entire system.	
5c	Students know how bones and muscles work together to provide a structural framework for movement.	
5d	Students know how the reproductive organs of the human female and male generate eggs and sperm and how sexual activity may lead to fertilization and pregnancy.	

Table 2.5: (continued)

Standard	-	Chapters and Lessons
5e	Students know the function of the umbilicus and placenta during pregnancy.	
5f	Students know the structures and processes by which flowering plants generate pollen, ovules, seeds, and fruit.	
5g	Students know how to relate the structures of the eye and ear to their functions.	

Physical Principles in Living Systems

SCI.CA.7.6. Physical Principles in Living SYstems: Physical principles underlie biological structures and functions. As a basis for understanding this concept:

Table 2.6:

Standard	-	Chapters and Lessons
6a	Students know visible light is a small band within a very broad electromagnetic spectrum.	
6b	Students know that for an object to be seen, light emitted by or scattered from it must be detected by the eye.	
6c	Students know light travels in straight lines if the medium it travels through does not change.	
6d	Students know how simple lenses are used in a magnifying glass, the eye, a camera, a telescope, and a microscope.	

Table 2.6: (continued)

Standard	-	Chapters and Lessons
6e	Students know that white light is a mixture of many wavelengths (colors) and that retinal cells react differently to different wavelengths.	
6f	Students know light can be reflected, refracted, transmitted, and absorbed by matter.	
6g	Students know the angle of reflection of a light beam is equal to the angle of incidence.	
6h	Students know how to compare joints in the body (wrist, shoulder, thigh) with structures used in machines and simple devices (hinge, ball-and-socket, and sliding joints).	
6i	Students know how levers confer mechanical advantage and how the application of this principle applies to the musculoskeletal system.	
6j	Students know that contractions of the heart generate blood pressure and that heart valves prevent back flow of blood in the circulatory system.	

Investigation and Experimentation

SCI.CA.7.7. Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept and

addressing the content in the other three strands, students should develop their own questions and perform investigations. Students will:

Table 2.7:

Standard	-	Chapters and Lessons
7a	Select and use appropriate tools and technology (including calculators, computers, balances, spring scales, microscopes, and binoculars) to perform tests, collect data, and display data.	
7b	Use a variety of print and electronic resources (including the World Wide Web) to collect information and evidence as part of a research project.	
7c	Communicate the logical connection among hypotheses, science concepts, tests conducted, data collected, and conclusions drawn from the scientific evidence.	
7d	Construct scale models, maps, and appropriately labeled diagrams to communicate scientific knowledge (e.g., motion of Earth's plates and cell structure).	
7e	Communicate the steps and results from an investigation in written reports and oral presentations.	

National Science Education Standards: 8CLS

Grade 5-8: Life Science (8CLS)

Structure and function in living systems

Table 2.8:

Standard	-	Lessons
8CLS1.1	Living systems at all levels of organization demonstrate the complimentary nature of structure and function. Important levels of organization for structure and function include cells, organs, tissues, organ systems, whole organisms, and ecosystems.	Lesson 3.1: Introduction to Cells
8CLS1.2	All organisms are composed of cells — the fundamental unit of life. Most organisms are single cells; other organisms, including humans, are multicellular.	Lesson 3.1: Introduction to Cells Lesson 3.2: Cell Structures
8CLS1.3	Cells carry on the many functions needed to sustain life. They grow and divide, thereby producing more cells. This requires that they take in nutrients, which they use to provide energy for the work that cells do and to make the materials that a cell or an organism needs.	Lesson 3.1: Introduction to Cells

Table 2.8: (continued)

Standard	-	Lessons
8CLS1.4	Specialized cells perform specialized functions in multicellular organisms. Groups of specialized cells cooperate to form a tissue, such as a muscle. Different tissues are in turn grouped together to form larger functional units, called organs. Each type of cell, tissue, and organ has a distinct structure and set of functions that serve the organism as a whole.	Lesson 3.1: Introduction to Cells
8CLS1.5	The human organism has systems for digestion, respiration, reproduction, circulation, excretion, movement, control, and coordination, and for protection from disease. These systems interact with one another.	
8CLS1.6	Disease is a breakdown in structures or functions of an organism. Some diseases are the result of intrinsic failures of the system. Others are the result of damage by infection by other organisms.	

Reproduction and Heredity

Table 2.9:

Standard	-	Lessons
8CLS2.1	Reproduction is a characteristic of all living systems; because no individual organism lives forever, reproduction is essential to the continuation of every species. Some organisms reproduce asexually. Other organisms reproduce sexually.	Lesson 2.1: What are Living Things? Lesson 5.2: Reproduction
8CLS2.2	In many species, including humans, females produce eggs and males produce sperm. Plants also produce sexually — the egg and sperm are produced in the flowers of flowering plants. An egg and sperm unite to begin development of a new individual. That new individual receives genetic information from its mother (via the egg) and its father (via the sperm). Sexually produced offspring never are identical to either of their parents.	Lesson 5.2: Reproduction Lesson 10.1: Introduction to Plants
8CLS2.3	Every organism requires a set of instructions for specifying its traits. Heredity is the passage of these instructions from one generation to another.	Lesson 6.2: Modern Genetics

Table 2.9: (continued)

Standard	-	Lessons
8CLS2.4	Hereditary information is contained in genes, located in the chromosomes of each cell. Each gene carries a single unit of information. An inherited trait of an individual can be determined by one or by many genes, and a single gene can influence more than one trait. A human cell contains many thousands of different genes.	Lesson 6.2: Modern Genetics Lesson 6.3: Human Genetics
8CLS2.5	The characteristics of an organism can be described in terms of a combination of traits. Some traits are inherited and others result from interactions with the environment.	Lesson 6.2: Modern Genetics

Regulation and behavior

Table 2.10:

Standard	-	Lessons
8CLS3.1	All organisms must be able to obtain and use resources, grow, reproduce, and maintain stable internal conditions while living in a constantly changing external environment.	Lesson 2.1: What are Living Things?

Table 2.10: (continued)

Standard	-	Lessons
8CLS3.2	Regulation of an organism's internal environment involves sensing the internal environment and changing physiologic activities to keep conditions within the range required to survive.	
8CLS3.3	Behavior is one kind of response an organism can make to an internal or environmental stimulus. A behavioral response requires coordination and communication at many levels, including cells, organ systems, and whole organisms. Behavioral response is a set of actions determined in part by heredity and in part from experience.	
8CLS3.4	An organism's behavior evolves through adaptation to its environment. How a species moves, obtains food, reproduces, and responds to danger are based in the species' evolutionary history.	Lesson 7.1: Darwin's Theory of Evolution Lesson 7.3: Macroevolution

Populations and ecosystems

Table 2.11:

Standard	-	Lessons
8CLS4.1	A population consists of all individuals of a species that occur together at a given place and time. All populations living together and the physical factors with which they interact compose an ecosystem.	
8CLS4.2	Populations of organisms can be categorized by the function they serve in an ecosystem. Plants and some microorganisms are producers — they make their own food. All animals, including humans, are consumers, which obtain food by eating other organisms. Decomposers, primarily bacteria and fungi, are consumers that use waste materials and dead organisms for food. Food webs identify the relationships among producers, consumers, and decomposers in an ecosystem.	
8CLS4.3	For ecosystems, the major source of energy is sunlight. Energy entering ecosystems as sunlight is transferred by producers into chemical energy through photosynthesis. That energy then passes from organism to organism in food webs.	

Table 2.11: (continued)

Standard	-	Lessons
8CLS4.4	The number of organisms an ecosystem can support depends on the resources available and abiotic factors, such as quantity of light and water, range of temperatures, and soil composition. Given adequate biotic and abiotic resources and no disease or predators, populations (including humans) increase at rapid rates. Lack of resources and other factors, such as predation and climate, limit the growth of populations in specific niches in the ecosystem.	

Diversity and adaptations of organisms

Table 2.12:

Standard	-	Lessons
8CLS5.1	Millions of species of animals, plants, and microorganisms are alive today. Although different species might look dissimilar, the unity among organisms becomes apparent from an analysis of internal structures, the similarity of their chemical processes, and the evidence of common ancestry.	Lesson 2.1: What are Living Things? Lesson 7.2: Evidence of Evolution Lesson 7.3: Macroevolution Lesson 7.4: History of Life on Earth Lesson 8.1: Bacteria Lesson 9.1: Protists Lesson 9.2: Fungi

Table 2.12: (continued)

Standard	-	Lessons
8CLS5.2	Biological evolution accounts for the diversity of species developed through gradual processes over many generations. Species acquire many of their unique characteristics through biological adaptation, which involves the selection of naturally occurring variations in populations. Biological adaptations include changes in structures, behaviors, or physiology that enhance survival and reproductive success in a particular environment.	Lesson 7.1: Darwin's Theory of Evolution Lesson 7.3: Macroevolution Lesson 7.4: History of Life on Earth Lesson 8.2: Archaea
8CLS5.3	Extinction of a species occurs when the environment changes and the adaptive characteristics of a species are insufficient to allow its survival. Fossils indicate that many organisms that lived long ago are extinct. Extinction of species is common; most of the species that have lived on the earth no longer exist.	Lesson 7.2: Evidence of Evolution Lesson 7.4: History of Life on Earth

American Association for the Advancement of Science Project 2061 Standards

Benchmark 5: The Living Environment: Grades 6-8

A. Diversity of Life

Table 2.13:

Standard	-	Lessons
5A/M1	One of the most general distinctions among organisms is between plants, which use sunlight to make their own food, and animals, which consume energy-rich foods. Some kinds of organisms, many of them microscopic, cannot be neatly classified as either plants or animals.	Lesson 2.3: Classification of Living Things Lesson 8.1: Bacteria Lesson 8.2: Archaea Lesson 9.1: Protists Lesson 9.2: Fungi Lesson 10.1: Introduction to Plants
5A/M2	Animals and plants have a great variety of body plans and internal structures that contribute to their being able to make or find food and reproduce.	Lesson 10.1: Introduction to Plants
5A/M3a	Similarities among organisms are found in internal anatomical features, which can be used to infer the degree of relatedness among organisms.	Lesson 2.3: Classification of Living Things Lesson 7.2: Evidence of Evolution
5A/M3b*	In classifying organisms, scientists consider details of both internal and external structures.	Lesson 2.3: Classification of Living Things Lesson 7.2: Evidence of Evolution
5A/M4*	Traditionally, a species has been defined as all organisms that can mate with one another to produce fertile offspring.	Lesson 2.3: Classification of Living Things
5A/M5*	The cycles continue indefinitely because organisms are decomposed after death to return food materials to the environment.	

B. Heredity

Table 2.14:

Standard	-	Chapters and Lessons
5B/M1a	In some kinds of organisms, all the genes come from a single parent.	Lesson 5.2: Reproduction
5B/M1b*	In organisms that have two sexes, typically half of the genes come from each parent.	Lesson 5.2: Reproduction
5B/M2a	In sexual reproduction, a single specialized cell from a female merges with a specialized cell from a male.	Lesson 5.2: Reproduction
5B/M2c	The same genetic information is copied in each cell of the new organism.	Lesson 5.2: Reproduction
5B/M3	New varieties of cultivated plants and domestic animals have resulted from selective breeding for particular traits.	Lesson 7.1: Darwin's Theory of Evolution

C. Cells

Table 2.15:

Standard	-	Chapters and Lessons
5C/M1a	All living things are composed of cells, from just one to many millions, whose details usually are visible only through a microscope.	Lesson 2.1: What are Living Things? Lesson 3.1: Introduction to Cells
5C/M1b	Different body tissues and organs are made up of different kinds of cells.	Lesson 2.1: What are Living Things? Lesson 3.1: Introduction to Cells

Table 2.15: (continued)

Standard	-	Chapters and Lessons
5C/M1c	The cells in similar tissues and organs in other animals are similar to those in human beings but differ somewhat from cells found in plants.	Lesson 2.1: What are Living Things? Lesson 3.1: Introduction to Cells
5C/M2a	Cells repeatedly divide to make more cells for growth and repair.	Lesson 5.1: Cell Division
5C/M2b	Various organs and tissues function to serve the needs of all cells for food, air, and waste removal.	Lesson 5.1: Cell Division
5C/M3a	Within cells, many of the basic functions of organisms—such as extracting energy from food and getting rid of waste—are carried out.	Lesson 2.1: What are Living Things? Lesson 3.2: Cell Structures Lesson 4.3: Cellular Respiration
5C/M3b	The way in which cells function is similar in all living organisms.	Lesson 2.1: What are Living Things? Lesson 3.2: Cell Structures Lesson 4.3: Cellular Respiration
5C/M4	About two thirds of the weight of cells is accounted for by water, which gives cells many of their properties.	

D. Interdependence of Life

Table 2.16:

Standard	-	Chapters and Lessons
5D/M1a*	In all environments, organisms with similar needs may compete with one another for limited resources, including food, space, water, air, and shelter.	
5D/M1b*	The world contains a wide diversity of physical conditions, which creates a wide variety of environments: freshwater, marine, forest, desert, grassland, mountain, and others. In any particular environment, the growth and survival of organisms depend on the physical conditions.	
5D/M2*	Interactions between organisms may be for nourishment, reproduction, or protection and may benefit one of the organisms or both of them. Some species have become so dependent on each other that neither could survive without the other.	
5D/M2b	One organism may scavenge or decompose another.	
5D/M3** (NSES)	Given adequate resources and an absence of disease or predators, populations of organisms in ecosystems increase at rapid rates. Finite resources and other factors limit their growth.	

Table 2.16: (continued)

Standard	-	Chapters and Lessons
5D/M4** (BSL)	All organisms, both land-based and aquatic, are interconnected by their need for food. This network of interconnections is referred to as a food web. The entire earth can be considered a single global food web, and food webs can also be described for a particular environment. At the base of any food web are organisms that make their own food, followed by the animals that eat them, then the animals that eat those animals, and so forth.	

E. Flow of Matter and Energy

Table 2.17:

Standard	-	Chapters and Lessons
5E/M1a	Food provides molecules that serve as fuel and building material for all organisms.	Lesson 4.2: Photosynthesis
5E/M1b	Plants use the energy from light to make sugars from carbon dioxide and water.	Lesson 4.2: Photosynthesis
5E/M1c	Plants can use the food they make immediately or store it for later use.	Lesson 4.2: Photosynthesis

Table 2.17: (continued)

Standard	-	Chapters and Lessons
5E/M1de	Organisms that eat plants break down the plant structures to produce the materials and energy they need to survive. Then they are consumed by other organisms.	Lesson 4.2: Photosynthesis
5E/M2	Over a long time, matter is transferred from one organism to another repeatedly and between organisms and their physical environment. As in all material systems, the total amount of matter remains constant, even though its form and location change.	
5E/M3a	Energy can change from one form to another in living things.	
5E/M3b*	Organisms get energy from oxidizing their food, releasing some of its energy as thermal energy.	
5E/M3c	Almost all food energy comes originally from sunlight.	

F. Evolution of Life

Table 2.18:

Standard	-	Chapters and Lessons
5F/M1	Small differences between parents and offspring can accumulate (through selective breeding) in successive generations so that descendants are very different from their ancestors.	Lesson 7.1: Darwin's Theory of Evolution
5F/M2a	Individual organisms with certain traits are more likely than others to survive and have offspring.	Lesson 7.1: Darwin's Theory of Evolution
5F/M2b	Changes in environmental conditions can affect the survival of individual organisms and entire species.	Lesson 7.1: Darwin's Theory of Evolution
5F/M3a	Many thousands of layers of sedimentary rock provide evidence for the long history of the earth and for the long history of changing life forms whose remains are found in the rocks.	Lesson 7.2: Evidence of Evolution Lesson 7.4: History of Life on Earth
5F/M3b	More recently deposited rock layers are more likely to contain fossils resembling existing species.	Lesson 7.2: Evidence of Evolution Lesson 7.4: History of Life on Earth
5F/M4** (NSES)	Most species that have lived on the earth are now extinct. Extinction of species occurs when the environment changes and the individual organisms of that species do not have the traits necessary to survive and reproduce in the changed environment.	

Table 2.18: (continued)

Standard	-	Chapters and Lessons
5F/M5*	Reproduction is necessary for the survival of any species.	

Chapter 3

Introduction to Life Science (TE)

3.1 Unit 1: Understanding Living Things

Outline

This unit, *Understanding Living Things*, includes two chapters to introduce middle school students to the study of life science,

Chapter 1. Studying Life

Lesson 1.1: The Nature of Science

Lesson 1.2: Scientific Method

Lesson 1.3: Tools of Science

Lesson 1.4: Safety in Scientific Research

Chapter 2. Introduction to Living Things

Lesson 2.1: What are Living Things?

Lesson 2.2: Chemicals of Life

Lesson 2.3: Classification of Living Things

Overview

The unit serves as an introduction to the life sciences. The two chapters overview science in general and living organisms. Chapter 2 also discusses what living organisms are made of (chemistry of life) as well as how they are classified.

Chapter 4

TE Studying Life

4.1 Chapter 1: Studying Life

Outline

Science is the study of the natural world and natural phenomena based on evidence. Scientists use scientific methodology and tools to study the patterns of natural events and to solve problems.

The chapter *Studying Life* consists of four lessons that introduce students to the idea of science and the study of science itself:

- Lesson 1.1: The Nature of Science
- Lesson 1.2: The Scientific Method
- Lesson 1.3: Tools of Science
- Lesson 1.4: Safety in Scientific Research

Overview

In the first two lessons of the chapter (The Nature of Science and Scientific Method), science is presented as a way of knowing about the physical world that is based on **evidence**.

- There is an important distinction to be made between the nature of science and religion or myths.
- Science is based on evidence and it has changed through time as human understanding and increased sophistication in experimentation has evolved.
- Teaching about and embracing the changing nature of science is critical for our students of the twenty first century.

- Students need to learn to adapt to changing understanding as evidence changes.

In the last two lessons (Tools of Science and Safety in Scientific Research), the big ideas center on the tools and safety measures needed by scientists to do their work.

- The development of microscopes, sensors and other research tools are essential for research.
- Students should learn to identify possible risks involved in certain types of scientific research and become aware that there are regulatory commissions that are designed to protect researchers.
- Students will need to learn when caution is required, and be responsible in following safety rules for their own and others safety.
- Students need to know that the world of science is open to them now more than any time in the past because of the breakthroughs in technology.

Teaching Strategies

Always have students read through the FlexBook. The concept of the *FlexBook* is to be flexible, allowing the teacher to “pick and choose” sections he or she wants to use. A teacher can go onto the CK12 site (www.ck12.org) and design their own version of the FlexBook, removing or rearranging material to fit their individual teaching style.

- To introduce students to this material, you may wish to create a classroom climate of questioning and curiosity in students that motivates them to find out the “whys” and “hows” of science.
- Engaging students in science at the beginning of the course is critical to igniting their desires to pursue a deeper understanding later in the school year, when more advanced content concepts and vocabulary appear.

Included in the TE are nine lessons to complement the chapter.

- One lesson (5E) on concept mapping combines concepts covered in lessons one and two.

The 5E Lesson

- *Nature of Science and Scientific Method* Concept Map
1. Read the lesson description under **Science Inquiry**.
 2. Assign students to teams of 4.

3. Make sure students have science/lab notebooks.
 4. Have large construction paper or pieces of butcher paper for teams to construct their concept maps.
- Four lessons are included in the National Institutes of Health (NIH) module *Doing Science: The Process of Scientific Inquiry*, which provides students experience and practice in the nature of science, formulating testable questions, conducting and evaluating a scientific investigation (See Appendix).

Pacing the Lessons

Use the **Class Periods per Lesson** table below as a guide for the time required to teach the lessons of this chapter.

Table 4.1:

Lesson	Number of Class Periods*
Lesson 1.1: The Nature of Science	1.0
Lesson 1.2: Scientific Method	2.0
Lesson 1.3: Tools of Science	1.0
Lesson 1.4: Safety in Scientific Research	1.0

- Class periods are assumed to be 60 minutes long.

5E Concept Mapping. We recommend combining two lessons of the FlexBook, the Nature of Science and the Scientific Method, allowing 1 class period (added into lesson 2 above).

a. Students make basic concept maps of the nature of science, scientific method, and what is life science, individually, and in pairs. They explore the material and photos in the FlexBook to add to their maps and understandings. Finally, they create basic maps of Studying Life Science in teams, evaluate their team maps, and then make their own individual map for homework.

- NIH.gov module, *Doing Science: The Process of Scientific Inquiry* (4 lessons, 5-7 additional class periods).

Managing Materials

The materials listed in the **Materials List** table below are needed to teach the strategies and activities described in the Teachers Edition of the FlexBook for this chapter.

Table 4.2:

Lesson	Strategy or Activity	Materials Needed
1.1	1) 2)	1) 2)
1.2	1)	1)
1.3	1)	1)
1.4	1)	1)

Additional Web-Based Resources

You may find these additional Web-based resources helpful when teaching this chapter:

- The Bay Area Science Education Collaboratory. This site contains many science museum resources. <http://www.designworlds.com/collab/collab-7th/> <http://www.designworlds.com/collab/collab-7th/7th-Investigation.html>
- The National Science Digital Library <http://nsdl.org/search/?n=10&q=scientific+method+life+sciences&grade%5B%5D=L3&s=0&verb=Search> <http://strandmaps.nsd.org/?chapter=SMS-CHP-0857>
- Quick Quiz <http://evolution.berkeley.edu/evosite/nature/IIIQuiz.shtml> This site has interesting discussion questions. Have student teams explore this site and click on raised student hands. Discuss each of the seven questions with your class.

Making the FlexBook Flexible

An important advantage of the FlexBook is the ability it gives you, the teacher, to choose the chapters and lessons that you think are most important for your own classes. The following information is provided to help you decide whether to include this chapter or certain lessons in this chapter in your students' FlexBook. You should also consult the standards correlation table when selecting chapters and lessons to include in the FlexBook.

- As the introductory chapter in this FlexBook, CK12 recommends the inclusion of the material within this chapter in any course on the Life Sciences.
- Students should read this entire chapter before reading the remaining chapters of the FlexBook.
- It is recommended that you include all the lessons of this chapter in the FlexBook.

Common Misconceptions

Thinking Like a Scientist

In the lesson The Nature of Science, students are asked to understand that “thinking like a scientist” is different from “everyday thinking.” This is a difficult concept for middle-school students.

1. How do scientists think differently than the “average” person?
2. Why is this important?
3. What can this sort of thinking achieve?

Scientific Knowledge is Based on Evidence, Not on Authority

- Another difficult concept in The Nature of Science is the concept that scientific knowledge is based on *evidence, not on authority*.
1. If the most respectable and authoritative scientist makes a claim that cannot be backed up by evidence, his or her claim will be discarded.
 2. On the other hand, the claim of a young and unknown scientist, who bases his claim on reliable evidence, will be accepted.

Scientific Understanding Evolves Through Time

- Finally, it is difficult for beginning science students to accept that scientific understanding evolves through time, not only in the past, but also in the present.
1. Schooling often socializes students to think that there is one correct answer to most questions which can be found “in the back of the book.”
 2. While this may be true for many school textbooks, it is equally true that what was once considered true in one time period was shown later to be **untrue** — when contradictory evidence was presented, in a later time period.
- How might science teachers deal with these student difficulties and misconceptions?
1. First, we must appreciate what’s difficult for students, and understand that helping them develop more scientific ways of thinking (also called “The Nature of Science” or NoS for short).
 2. Second, we can try different activities, and use a wide variety of resources to aid students in deepening their understanding of such issues as the importance of evidence in making a scientific argument and the difference between data and conclusions.

These resources include:

1. studying how scientific knowledge is developed by scientists (using case histories as well as daily news items)
 2. participating in the inquiry process, describing and giving examples for processes and practices of the scientific community.
- Students may naturally think that scientific knowledge is “just there, waiting to be studied.”
 - Over their years of exposure to scientific practices (and their engagement in these practices and the scientific community), they may learn that scientific knowledge is actually discovered and constructed by human beings. This will take time.

Data vs. Conclusions

In the lesson Scientific Method, students have difficulty separating ***data*** from ***conclusions***.

1. Data is what results from experiments or observations (which themselves are the result of research questions).
 2. However, the data themselves are not the same as the conclusions which can be drawn from the data.
 3. Different scientists often draw different conclusions from the same data!
 4. As a result, it is important for students to understand that the scientific method is a combination of experimentation and explanation.
 5. In other words, knowing how to design a good experiment is only part of the scientific method.
 6. Knowing how to make a good argument (or explanation), based on the data, is another important part of the scientific method.
- Students also need to understand that ***experiments are only one expression of the scientific method.***
1. Observations often precede experiments.
 2. For example, in Scientific Method, the example of the Barnacle Geese is presented. It was once believed that these Geese originated in barnacles, organisms that live in the sea. Systematic observations later proved this belief to be wrong.
 3. Personal computer inventor and visionary, Dr. Alan Kay, has said, “Point of view is worth 80 IQ points”, and Nobel Laureate in medicine/physiology, the late Dr. Abert Szent-Gyorgy said, Discovery consists of seeing the same thing that everyone else sees, but thinking what no one else has thought.”
 4. So perception, asking good questions and making careful observations are all vitally important parts of the scientific method.

4.2 Lesson 1.1: The Nature of Science

Key Concept

Science is the study of natural phenomena based on evidence, testing, and reason. As new evidence is gathered, our understanding of the natural world may change.

Lesson Objectives

- Understand that science is a system based on evidence, testing, and reasoning.
- Describe what the life sciences are and some of the many life science specialties.
- Describe the scientific method and why it is important.
- Define the words “fact,” “theory,” and “hypothesis.”
- Describe some of the tools of life science.
- Know that scientists are required to follow strict guidelines.

Lesson Vocabulary

Table 4.3:

Lesson 1.1 Vocabulary		
anecdotal evidence	biogeography	ecology
evidence	life science	population biology
science	science theories	

Check Your Understanding

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Teaching Strategies

Discussion: Introduction to Science

Keep in mind that this lesson can be the first lesson of this class. You may wish to begin with a general discussion to begin to understand your students background, as related to this class. You may ask your students:

“What is science?”

“How is science done?”

“What is evidence?”

“What are the life sciences?”

Building Science Skills: Forming a Hypothesis

Scientists need to be skeptical about and question their assumptions, including what often seems like common sense. Questioning ideas can often lead to surprising results. For example, if you ask people whether it’s easier to keep a plastic cutting board clean or a wooden one clean, most people will think that the plastic board is easier to keep clean and has fewer germs.

Have students form a hypothesis about the cutting boards. Which one is easier to keep clean? Have the students include their reasoning into the hypothesis.

Discussion: Theory

Discuss with students the meaning of the word “theory.” The word “theory” has a very different meaning in daily life than it does in science. Ask students if they know what that difference is, and make sure they understand that a scientific theory is based on evidence and testing that supports the explanation. Scientific theories are so well studied and tested that it is extremely unlikely that new data will discredit them. Continue with a general discussion of the Cell Theory and the Theory of Evolution.

Differentiated Instruction: Word Wall

Post the lesson vocabulary on the board or wall. This will have students understand that this class will incorporate many academic vocabulary words. Pair native English speakers with ELLs. Ask students what they think the definitions are, then have the class find the definitions in the FlexBook. Have the students write the vocabulary words and definitions into their notebooks.

Enrichment: Create a Poster

Have students examine the tables in the **What are the Life Sciences** section. Have the students create a poster depicting what they envision a life science subspecialty or field is. Post the posters around the classroom.

Science Inquiry: Develop a Research Plan

In this lesson, the example of a plastic vs. wood cutting board is given. Ask students to develop a research plan involving other everyday items. First, students must develop a hypothesis, then formulate a plan to test their hypothesis. They may base their research plan around different brands of medicine (such as tylenol vs. advil) or different brands of food (such as soda), or other items they can think of.

The 5E Instructional Model: A Studying Life Concept Map

See this cumulative 5E lesson below. You can have students complete part 1 (Engage) during Lesson 1.1.

Reinforce and Review

Make Flashcards

Have students make flashcards of boldface vocabulary words or important concepts; have students use flashcards to quiz a partner. This activity will stress the importance of academic vocabulary throughout the course, and sets an important precedent.

Lesson Worksheets

Copy and distribute the lesson worksheets in the Supplemental Workbook. Ask students to complete the worksheets alone or in pairs as a review of lesson content.

Review Questions

Have students answer the Review Questions that are listed at the end of the lesson in their FlexBook.

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Points to Consider

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Next we are going to discuss the scientific method. You may have heard someone say that you can ruin your eyes if you sit too close to the television set.

- Describe how “thinking like a scientist” could help you figure out if this common sense idea is true or false.

Lesson Assessment

Provided to teachers upon request. Please send an email to teachers-requests@ck12.org.

Copy and distribute the lesson quiz. Provide class time for the students to complete this assessment.

4.3 Lesson 1.2: The Scientific Method

Key Concept

Scientific methods are used to investigate questions and to solve problems.

Lesson Objectives

- Consider how the scientific method is one of the most important reasons for how modern science is advancing more rapidly than in the past.
- Describe the scientific method as a process.
- Explain why the scientific method allows scientists and others to examine the physical world more objectively than other ways of knowing.
- Describe the steps involved in the scientific method.

Lesson Vocabulary

Table 4.4:

Lesson 1.2 Vocabulary		
applied science	basic science	falsifiable
hypothesis	predict	scientific method
scientific theory		

Check Your Understanding

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Teaching Strategies

Discussion

Ask students to describe a “science experiment” they have done before? Ask if they followed certain procedures for those experiments? Ask them to think about what would happen if they did not follow those procedures? Have this lead into a discussion on why the “scientific method” is important.

Using Visuals

Have students examine **Figure 2**. Ask students to make a list of what they would like to know, based on the observation of **Figure 2**. Begin a discussion of how they may go about determining what they would like to know.



Figure 4.1: A frog with an extra leg. (1)

Differentiated Instruction: Concept Map

Pair less proficient readers with native speakers of English. Have students make concept maps about science and the process of science. Be sure to refer students back to the FlexBook for

specific examples. Students share their maps and examples.

Enrichment: Make a Display

The scientific method will be an important theme throughout the course. “How did she do that? How was that discovered? What was the hypothesis? What observations were made? What was the conclusion?” These and similar questions could come up practically every day. Ask students who need extra challenges to make a display depicting the scientific method. Have them explain their display to the class, and leave the display visible for all to see throughout the course.

Science Inquiry: Analyze Data

You may wish to write the following on the board, or print and hand out as a worksheet. Scientists working on the question of frog deformities have narrowed down their investigations to three possible causes:

- increased UV radiation
- chemical pollution
- trematode parasites

To test these causes, scientists: (A) reared frogs in ponds with or without atrazine (a herbicide), (B) in cages with or without trematodes (a parasitic worm), (C) 3 ponds per treatment, (D) 4 replicate cages per pond, and (E) 10 tadpoles raised to frog stage per cage. They found the following data (averages of the 4 cages per pond):

Table 4.5:

Treatment	% of frogs with deformities (3 ponds)
No Atrazine/No Trematodes	0, 0, 0
No Atrazine/Trematodes	5, 5, 10
Atrazine/No Trematodes	0, 0, 0
Atrazine/Trematodes	22, 30, 2

Have students discuss the data in their groups, then answer the following questions:

1. What does the data demonstrate?
2. Is there any evidence related to the effects of atrazine or trematodes on frog development? If so, what is that evidence?

You can also have the students formulate a hypothesis and a conclusion. You may choose to have a class discussion after allowing ample time for students to complete the assignment. The discussion may include the experimental design, as well as the hypothesis, results and conclusion.

[Data from: Kiesecker JM. 2002. Synergism between trematode infection and pesticide exposure: A link to amphibian limb deformities in nature? Proc. Nat. Acad. Sci. 99(15): 9900-9904.]

The 5E Instructional Model: A Studying Life Concept Map

See this cumulative 5E lesson below. You can have students complete part 2 (Explore) during Lessons 1.2 or 1.3.

Reinforce and Review

Review

- Biology4kids.com Teams Review the information about the scientific method online, and then take the online quiz together. http://www.biology4kids.com/files/studies_scimethod.html

Online Quiz

- Biology4Kids.com Scientific Method Quiz: A quick paced quiz designed to measure a student's understanding of terms associated with the scientific method. http://www.biology4kids.com/extras/quiz_studyscimeth/index.html
- Do you understand the scientific method? http://mset.rst2.edu/portfolios/1/lautz_s/Science%20Fair%20Handbook/SFquiz.html
- Discovery Online Scientific Method Quiz. This is an advanced quiz and may best be done as a class lesson. <http://school.discoveryeducation.com/quizzes15/biolessonscom/BasicsQuiz.html>
- Teams Review the information about the scientific method online, and then take the online quiz together. http://www.biology4kids.com/files/studies_scimethod.html

Lesson Worksheets

Copy and distribute the lesson worksheets in the Supplemental Workbook. Ask students to complete the worksheets alone or in pairs as a review of lesson content.

Review Questions and Answers

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Have students answer the Review Questions that are listed at the end of the lesson in their FlexBook.

Points to Consider

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Next we consider the tools of the scientist.

- How do you think scientific “tools” can help a scientist?
- What do you think is one of the more common tools of the life scientist?

Lesson Assessment

Provided to teachers upon request. Please send an email to teachers-requests@ck12.org.

Copy and distribute the lesson quiz. Provide class time for the students to complete this assessment.

4.4 Lesson 1.3: Tools of Science

Key Concept

Scientists use tools and new technologies to experiment and collect data as evidence.

Lesson Objectives

- Describe the growing number of tools available to investigate different features of the physical world.
- Describe how microscopes have allowed humans to view increasingly small tissues and organisms that were never visible before.

Lesson Vocabulary

Table 4.6:

Lesson 1.3 Vocabulary		
applied research microscopes	basic research microscopy	electron microscopes optical (light) micro- scopes
scanning acoustic micro- scopes	scanning electron micro- scopes	

Check Your Understanding

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Teaching Strategies

Discussion: Science Tools and Equipment

Begin by asking students to generate ideas about tools and equipment used in science.

- Ask what kinds of tools they have heard of in the news, experienced at the doctor's office, or used in science experiences in the past.
- Write the list on the board as they come up with answers. Model some mapping on the board by circling items such as microscope, and then drawing lines out from that to get students to come up with kinds of microscopes they know about.
- Ask what is the opposite of a microscope? (telescope) and then do the same for kinds of telescopes.
- Ask which of these is more useful for life scientists, microscopes or telescopes? Discuss why.

Using Visuals

As a class, examine **Figures 3** and **4**. These figures show drawings of the microscopes owned by Antonie van Leeuwenhoek and Robert Hooke. Then read together about the four general kinds of microscopes and look at the photo of the scanning electron microscope. Ask if any students have been in laboratories and seen different equipment. Have them share experiences and let students ask questions. Discuss various types of biomedical/biological research laboratories and what they might study.

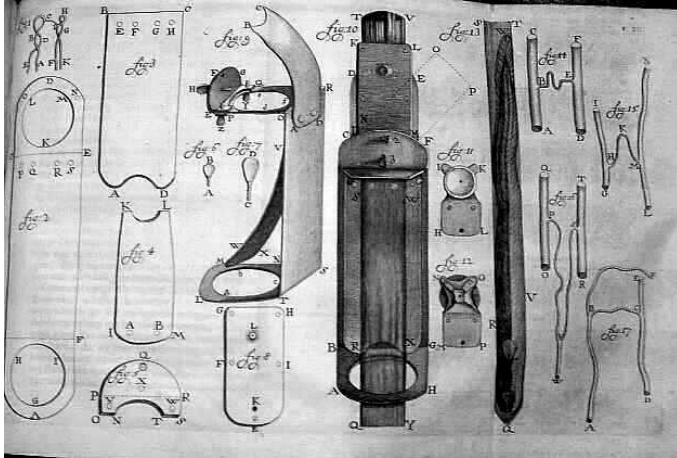


Figure 3: Drawing of microscopes owned by Antoine van Leeuwenhoek. Bacteria were discovered in 1683 when Antoine Van Leeuwenhoek used a microscope he built to look at the plaque on his own teeth.

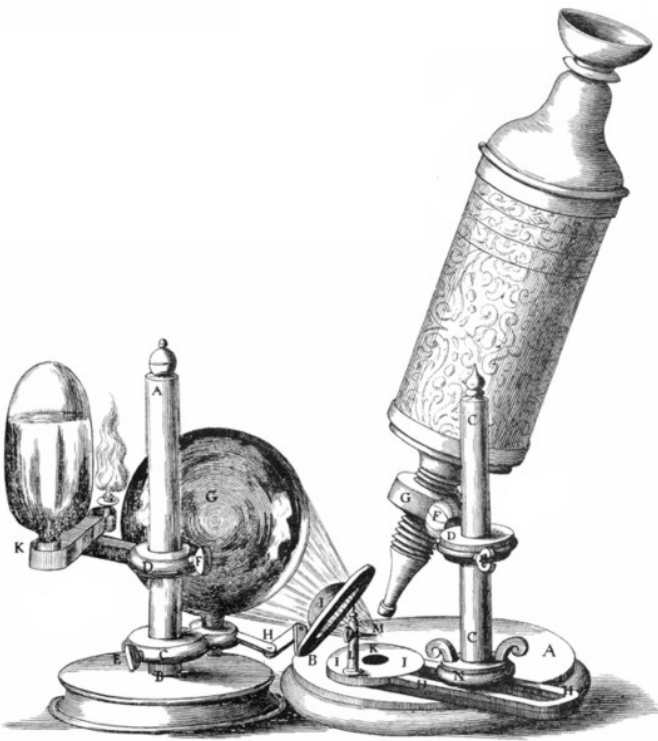


Figure 4: Robert Hooke's early microscope.

Building Science Skills: Predicting

Show students pictures of scientific models and ask the students to predict how they were/are useful. Possible examples of models can be found at these sites:

- James Watson and Francis Crick DNA model <http://faculty.ksu.edu.sa/17257/Pictures%20Library/WatsonJames-CrickFrancis.jpg>
- Volcano model <http://www.dkimages.com/discover/previews/1079/10288979.JPG>
- Anatomy model <http://cache.eb.com/eb/image?id=91885&rendTypeId=4>

Differentiated Instruction: Frayer Model

Pair students who may need extra assistance with vocabulary (for example ELL, LEP) with native English speakers. Assign this vocabulary strategy, which involves students drawing a large box and dividing it into four parts labeled **Definition**, **Drawing**, **Example**, **Non-example**. Then assign students a vocabulary word and tell them to fill in the parts of the box for that word. You may choose to focus on the tools of science, such as various microscopes, chemicals, fume hoods, PCR machine, centrifuge, notebooks, and computers.

Enrichment: Interview a Scientist

For students that may need an extra challenge, ask them to interview a scientist. They can choose a scientist from a local university or medical school, or a national institution, and send him/her an email asking the scientist to describe what they do and some of the tools/methods they use. Examples could be:

- UCLA Department of Human Genetics <http://www.genetics.ucla.edu/dept/research>
- The National Cancer Institute, National Institutes of Health <http://www.cancer.gov/researchandfunding/intramural>
- The San Diego Zoo <http://www.sandiegozoo.org/conservation/science> Have students present their findings to the class.

Science Inquiry

The 5E Instructional Model: A Studying Life Concept Map

See this cumulative 5E lesson below. You can have students complete parts 2 - 5 (Explore, Explain, Elaborate, Evaluate) during Lesson 3. Part 5 (Evaluate) may be done after lesson 4.

Reinforce and Review

Review Questions and Answers

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Have students answer the Review Questions that are listed at the end of the lesson in their FlexBook.

Points to Consider

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Lesson Assessment

Provided to teachers upon request. Please send an email to teachers-requests@ck12.org.

Copy and distribute the lesson quiz. Provide class time for the students to complete this assessment.

4.5 Lesson 1.4: Safety in Scientific Research

Key Concept

There are hazards and safety risks associated with doing scientific research. Laws and regulations have been developed to assure the safety of the researchers and the public.

Lesson Objectives

- Recognize how the kind of hazards that a scientist faces depends on the kind of research they do.
- Identify some potential risks associated with scientific research.
- Identify who and what safety regulations are designed to protect.

Lesson Vocabulary

Table 4.7:

Lesson 1.4 Vocabulary		
anecdotal evidence	applied research	basic research
biohazard	evidence	falsifiable
hypothesis	pathogen	scientific model
theory		

Check Your Understanding

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Teaching Strategies

Discussion: Hazards and Safety

Ask: What hazards could face scientists in the laboratory or in the field? When we go into the lab, will we have rules about handling equipment, chemicals, and protecting ourselves? Why? Do you think there should be laws that protect scientists? Is this similar to having rules in our science class?

Have the class focus on the list of potential hazards from the lesson. Make sure the students understand what each hazard is. Have students write definitions for each hazard in their notebooks as you discuss the hazards. Links to images depicting some of the hazards are below.

- pathogenic (disease-causing) viruses, bacteria or fungi <http://emmetcole.files.wordpress.com/2009/02/virus.jpg>
- parasites (be careful discussing human parasites so as not to scare some students) <http://www.sciencedaily.com/images/2007/07/070716191846-large.jpg>
- wild animals http://www.whale-images.com/data/media/2/wild-animals_11.jpg
- radioactive materials http://www.ehs.psu.edu/images/rad_sign02.gif http://davidsantoyo.com/yahoo_site_admin/assets/images/RadioActiveMaterial_Small10.28250009_std.jpg
- pollutants in air, water, or soil <http://www.peternjenga.com/blogs/greenkenya/wp-content/uploads/2009/03/air-pollution.jpg>
- toxins
- teratogens
- carcinogens http://www.rsc.org/images/b514317a-250_tcm18-48745.jpg
- radiation

Differentiated Instruction: Think-Pair-Share

Pair ELL students with native speakers to review and discuss lab safety. Below are example sites listing lab safety rules.

http://nobel.scas.bcit.ca/debeck_pt/science/safety.htm

http://www.carnegieinstitution.org/first_light_case/horn/labsafety.html

http://www.sanbenito.k12.tx.us/teachers/science_safety/Safety_And_Lab_Rules.html

Have teams of students read through one of the lists. Teams should discuss safety issues to make sure all team members understand the issues. This can be followed with a safety quiz. See **Reinforce and Review** below.

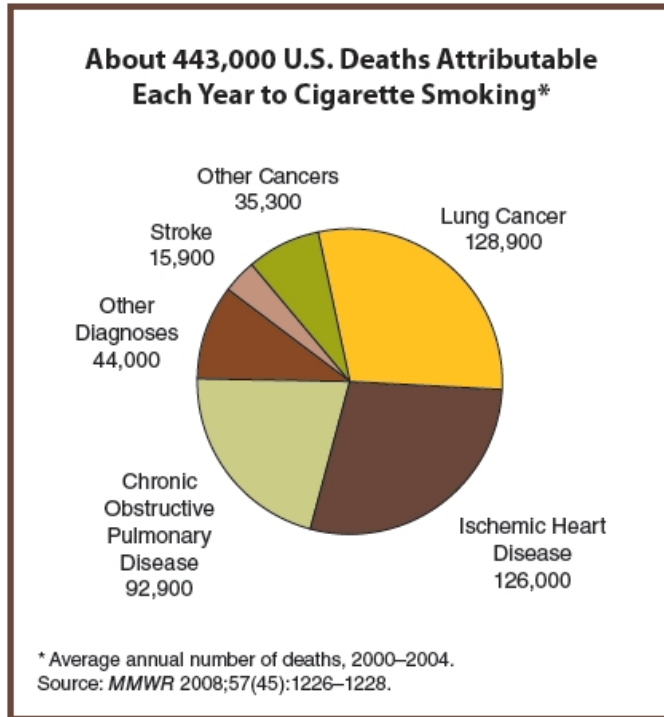
Enrichment: Create a Poster

Students who need additional challenges can create a poster depicting lab safety and its importance. Have the students share their posters with the class through an oral presentation. Place posters on classroom walls.

Laboratory Activity

Science Inquiry: Analyze Data

As discussed above, carcinogens are a potential hazard, with one of the most recognizable carcinogens smoking. Have students analyze the graph and write a paragraph on what this graph tells us. See the CDC (Centers for Disease Control and Prevention) web site (<http://www.cdc.gov/NCCDPHP/publications/aag/osh.htm>) for more information.



Tobacco use is the single most preventable cause of disease, disability, and death in the United States. For every person who dies from smoking, about 20 more people suffer from at least one serious tobacco-related illness.

The harmful effects of smoking do not end with the smoker. More than 126 million nonsmoking Americans, including children and adults, are regularly exposed to secondhand smoke. Even brief exposure can be dangerous because nonsmokers inhale many of the same carcinogens and toxins in cigarette smoke as smokers. Secondhand smoke exposure causes serious disease and death, including heart disease and lung cancer in nonsmoking adults and sudden infant death syndrome, acute respiratory infections, ear problems, and more frequent and severe asthma attacks in children.

The 5E Instructional Model: A Studying Life Concept Map

See this cumulative 5E lesson below. You can have students complete part 5 (Evaluate) after lesson 1.4.

Reinforce and Review

Lab Safety Quiz

Have each student complete the safety quiz independently. An example of a safety quiz can be found at:

http://www.flinnsci.com/Documents/miscPDFs/Safety_exam_HS.pdf

Review the quiz as a class.

Review Questions and Answers

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Have students answer the Review Questions that are listed at the end of the lesson in their FlexBook.

Points to Consider

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Lesson Assessment

Provided to teachers upon request. Please send an email to teachers-requests@ck12.org.

Copy and distribute the lesson quiz. Provide class time for the students to complete this assessment.

4.6 The 5E Instructional Model: A Studying Life Concept Map

About the Lesson

This lesson asks students to draw or create (can use software tools such as *Inspiration* or *The Brain*) three simple concept maps about science, the scientific method, and the life sciences, and compare their maps with partners. Students then form teams and create an overall concept map for **Studying Life**. Teams begin by generating a list of key words and concepts, grouping them into similar categories, deciding what the bigger, middle and

intermediate concepts are, and drawing the map. Teams evaluate their own map, and present their maps to the class. While the class discusses and evaluates the maps, students create their own individual map in their notebook.

This beginning concept map about Studying Life can serve as a formative assessment, and later, in comparing another map generated by each student, as a summative assessment of what students have learned about the big concept of life science.

Guide student understanding of these concepts during all activities and discussions, and refer back to the content in the FlexBook lessons one and two, as outlined in the section of the Teacher’s Edition on **Common Misconceptions**.

This 5E lesson will encompass the whole chapter. Various aspects of the lesson can be done during or after each FlexBook lesson.

Engage

Part of Lesson 1

- Ask students “What is Science?”
- Draw on the board a circle with “What is Science?” inside. Students should write in the center of a page in their notebook “What is Science?” This will be the beginning of their concept map.
- Ask students to begin reflecting individually on what defines science, what their past experiences in science have been, and how science is conducted. What is special about how science is done that is different from other endeavors? After a few minutes, ask them to share their results with a partner, and add and/or subtract from their map appropriately as they share. Have pairs share with the class and record responses, eliciting as many responses related to knowing about our world, explaining based on evidence, testing, and reason. Add to the map on the board.
- Ask students “How is Science Done?” and have them go to a new page and again brainstorm about doing science, first individually, and then with a partner.
- Go to a third page in their science/lab notebooks and ask, “What are the Life Sciences?” again brainstorming, alone and then with a partner.

Explore

Can be done after Lesson 2 or 3

- Ask students to use the FlexBook to find specific examples about the nature of science, the scientific method, and the life sciences. Students should identify concepts, processes and skills in their FlexBooks.

Explain

Can be done after Lesson 3

- Pairs/teams share their maps with the class, adding ideas from each other and the book to their original maps. They explain the concepts they have been exploring, with guidance from peers and teacher to aid correct understanding. Students discuss their understanding of science, and relationships between different concepts. Encourage students to add pictures or icons to their maps at this stage. Teacher can introduce explanations, examples, definitions for concepts, processes, or behaviors.

Elaborate

Can be done after lesson 3

- Ask students *What is “Studying Life?” What do life scientists do? Use the FlexBook Lessons 2 and 3.*
- Introduce the idea of a concept map as a diagram to show the relationship among concepts. Move them into teams of 4 with large pieces of paper to construct their final map.
- Ask students to generate team concepts and key words list from the maps they have built, and then cluster similar concepts together. To begin drawing the concept map, put the concepts and key words on the page in a graphic representation with linking lines between the concepts. Concepts should be circled, with general concepts at the top of the map, intermediate concepts below general and specific concepts on the bottom. Draw lines between concepts that are related, and label the lines with linking words that describe how they are related to each other. Encourage students to practice making connections and adding linking words to maps to develop deeper understandings of the major concepts, get more information, and refine their skills and concept map. Use the Student Edition FlexBook as a reference in building your maps.

Evaluate

Can be done after lesson 3 or 4

- Ask teams to post their maps around the room. Give students sticky notes and have teams move in one direction around the room, giving them a short time with each team map. They evaluate each other’s maps and each student posts one sticky note with an evaluative comment. Encourage them to assess their own and others understandings as demonstrated by their product, the concept map.

Post a sign for them to refer to as they evaluate each other's maps:

Accuracy and Thoroughness: Are there concepts missing? Are the concepts and relationships correct? Are there any misconceptions?

Organization: Is it easy to make sense of the map? Can you tell the higher-level concepts from the lower level concepts?

Creativity: Do some elements added communicate more clearly, or are some distracting to understanding the ideas?

- Student teams should retrieve their own maps and write some comments in their science notebooks to help them create their own Studying Life map for homework.

Here are some examples of concept maps:

- Nature of Science <http://www.geocities.com/jjmohn/sciencemap.htm>
- Scientific Method http://www.birds.cornell.edu/schoolyard/Research/scientific_method.html

NOTE: If your students are not familiar with making concept maps, you may want to start with making maps about the nature of science and the scientific method, which students revise for homework after getting feedback from team evaluations.

4.7 Worksheet Answer Keys

- Worksheet Answer Keys available upon request. **Please send an email to teachers-requests@ck12.org to request answers.**

Image Sources

- (1) *A frog with an extra leg.*. Public Domain.

Chapter 5

TE Introduction to Living Organisms

5.1 Chapter 2: Introduction to Living Organisms

Outline

The chapter *Introduction to Living Organisms* consists of three lessons that introduce students to living organisms:

- Lesson 2.1: What are Living Things?
- Lesson 2.2: Chemicals of Life
- Lesson 2.3: Classification of Living Things

Overview

The chapter introduces the big ideas of biology including:

- What defines a living organism and the main properties of living organisms.
- What living organisms are made of, covering elements, molecules and compounds to organic compounds (carbohydrates, lipids, proteins and nucleic acids) and chemical reactions.
- How living organisms are classified.

Six Characteristics

This chapter sets the stage for the study of life, **biology** – life, as we know it from algae to elephants to us. Some forms of life are visible, such as the plants and animals in our daily

life, and some are invisible to our eyes, such as bacteria or a paramecium, without the aid of tools such as microscopes. Students of life science need to know what are the characteristics of living organisms, how those characteristics are different from what is not living, and what characteristics all organisms possess.

- Living things have a complex organization around the basic unit, the **cell**.
- Living creatures take in energy in the form of food, which is processed for survival.
- Life grows, develops, repairs itself.
- Organisms must reproduce to make the next generation.
- Life also responds to stimuli, the way you do if you hit your funny bone and immediately grab your elbow in pain.
- Life adapts to changes in the environment with three basic kinds of adaptation. One way of adapting is to temporary changes in the environment, such as those temporary changes that occur when you increase altitude. The second adaptation is in result to longer changes in the environment, such as going to live in the mountains, where your body adapts and heart slows and breathing is normal. The third adaptation is not reversible, the result of mutation (a change in the DNA sequence), such as bacteria becoming resistant to antibiotic drugs.

Therefore, to be considered alive, organisms must exhibit ALL of these six characteristics:

1. Living things are made of cells
2. Living things take in and use energy.
3. Living things grow, develop, and repair themselves.
4. Living things reproduce.
5. Living things respond to their environment
6. Living things adapt to their environment

Biology is based on five main scientific principles: the cell theory, gene theory, evolution, homeostasis, and the laws of thermodynamics. In the previous chapter, students were introduced to the cell theory and the theory of evolution. In this chapter, students will learn about homeostasis.

Six Kingdoms

For many years biologist organized life into five kingdoms:

Monera: prokaryotes or single-celled organisms that do not have a nucleus (e.g., blue-green algae)

Protocista: simple eukaryotes or single-celled organisms that do have a nucleus (e.g., slime moulds)

Fungi: Nonmobile eukaryotes that lack flagella and develop from spores (e.g., yeast, moulds, and mushrooms).

Plantae: Eukaryotes that develop from embryos and also use chlorophyll (e.g., mosses and vascular plants)

Animalia: Eukaryotes which are multi-cellular and develop from a blastula (hollow ball of cells) (e.g. worms, arthropods and animals)

However, now many biologists refer to Six Kingdoms, separating **Archaea**, single celled prokaryotes (without nuclei) that were discovered in the early 1970s.

Note that **viruses** are not part of any of these six kingdoms of life. *Are viruses living?* According to the definition of a living organism, viruses are not living. This is an excellent topic for discussion, as most people (both students and adults) do not understand the reason behind this — as viruses are not made of cells and cannot reproduce on their own without being embedded in a host organism.

see <http://en.wikipedia.org/wiki/Virus> for additional information

Take this opportunity to reinforce the changing nature of science, making sense of the world using evidence, and changing our understanding and classifications as we discover new evidence. See the Wikipedia article on this area as an example of how this traditional classification system is still an active area of research and discussion:

[http://en.wikipedia.org/wiki/Kingdom_\(biology\)](http://en.wikipedia.org/wiki/Kingdom_(biology))

Teaching Strategies

Word Dissection: Biology

Demonstrate to students the word dissection process:

Pneumonoultramicroscopicsilicovolcanoconiosis

1. Pneu- or pneumo- means lung (heard of pneumonia?)
2. Ultra means extreme (ultra is the best?)
3. Microscopic means small (we need a microscope to see?)
4. Silico-means silicon
5. Volcano mineral particles out a of volcano
6. Coni-comes from Greek konis meaning dust
7. -osis means affected with

pneumono + ultra + microscopic + silico + volcano + coni + osis

which means:

lungs + extremely small + silicon + volcanic + dust particles + affected with

- So, this is a disease of the lungs due to inhaling small silicon, silicate, or quartz dust.

By the way, Wikipedia touts this 45-letter word as the longest word in the English language. Your students will be delighted to amaze their friends and family saying and explaining this one, and will feel empowered to take apart the many new words they will come across in their study of life.

Biology

1. Bio = life
2. -ology = study of

- Biology = study of life

Pacing the Lessons

Use the **Class Periods per Lesson** table below as a guide for the time required to teach the lessons of this chapter.

Table 5.1:

Lesson	Number of Class Periods*
2.1: What are Living Things?	1.5
2.2: Chemicals of Life	2.0
2.3: Classification of Living Things	1.0

- Class periods are assumed to be 60 minutes long.

Managing Materials

The materials listed in the **Materials List** table below are needed to teach the strategies and activities described in the Teachers Edition of the FlexBook for this chapter.

Table 5.2:

Lesson	Strategy or Activity	Materials Needed
2.1	1) science inquiry	1) lion stuffed animal, large rock, poster paper and markers, sticky note paper

Table 5.2: (continued)

Lesson	Strategy or Activity	Materials Needed
2.2	1)	1)
2.3	1)	1)

Additional Web-Based Resources

1. Web Elements: the periodic table on the web <http://www.webelements.com/>

2. Interactive Periodic Table of the Elements

This site is interactive, complete, and gives views of name, atomic number, atomic mass, electron configuration, number of neutrons, melting point, boiling point, date of discovery, and crystal structure. The site is especially interesting for students because it was originally created by an eighth grader as a science fair project. He still maintains the site, and his story is on the link “About this Site”. <http://www.chemicalelements.com/>

3. Kingdoms of Living Things in the Linnaean Classification System

A nice chart with an overview of the kingdoms. http://anthro.palomar.edu/animal/table_kingdoms.htm

4. Scientific Method Interactive Online Lab

This site contains an interactive lab that teaches what the scientific method is, how scientists follow this method. http://aspire.cosmic-ray.org/labs/scientific_method/sci_method_main.html

5. Printout of Microscope and parts for students to label if using microscopes in lab <http://www.biologycorner.com/resources/microscope-boxed.gif>

6. Virtual Microscope (needs Flash, click on The virtual scope) <http://www.udel.edu/biology/ketcham/microscope/>

7. Introduction to the Light Microscope

Worksheet to use in a lab to acquaint students with the microscope, magnification, using slides, depth perception <http://www.biologycorner.com/worksheets/e-lab.html>

8. Eekoworld, PBS Kids, Building a Creature Game, mostly fun, students design their own creature using parts of other existing creatures and then find a place in the world for them to live. They can feed them, change them, or save them. <http://pbskids.org/eekoworld/index.html>

9. Kratts Creatures, PBS Kids In this game, students explore the world to find the right animals given classifications of babies, skulls, tracks, markings and more. <http://pbskids.org/>

Making the FlexBook Flexible

An important advantage of the FlexBook is the ability it gives you, the teacher, to choose the chapters and lessons that you think are most important for your own classes. The following information is provided to help you decide whether to include this chapter or certain lessons in this chapter in your students' FlexBook. You should also consult the standards correlation table that follows when selecting chapters and lessons to include in the FlexBook.

- To understand the content of this chapter, students should have read the *Studying Life* chapter.
- Students should read this entire chapter before reading the remaining chapters of the FlexBook.
- It is recommended that you include all the lessons of this chapter in the FlexBook.

Common Misconceptions

Living vs. Nonliving

Understanding what is living and what is not living is usually decided by movement or death to make the distinction. *Some young students may believe that clouds and fire are alive, and plants and certain animals do not live.* They have little understanding of the basic building blocks of cells, or of DNA.

Evidence

Students in middle school tend to use evidence from their own personal experience to justify their ideas. They think evidence is derived from personal experience, not necessarily as data from an experiment. When their beliefs are confronted with available evidence that opposes their personal belief system, their personal belief system triumphs.

Classifying

Middle school students are capable of grouping and classifying organisms, when asked, so teachers need to remind them of the organizational structures to classify organisms¹. Middle school students still may have narrow definitions of the word “animal”, *often believing the vertebrates are the only animals.* More exposure and practice using different attributes

to classify animals and being introduced to invertebrates can expand student understanding. Because students are not used to using classification systems, they may have difficulty understanding that organisms may be classified as two or more attributes.

Middle School students also define “plants” narrowly, *not understanding that trees and grass are also plants*.

Because students are not familiar with classifying an organism as a fish AND as an animal, using Venn diagrams for reinforcement and for relearning concepts can be an effective teaching strategy to push students out of their narrower realm of thinking. Working in pairs, and teams, and stimulating discussion with others about the Venn diagrams and other evidence is another important tool to aid in deeper student understanding. Nurture student discourse and reinforce it as they learn to engage using evidence to justify their point.

¹NDSL Science Literacy Maps, The Living Environment, The Nature of Science <http://strandmaps.nsdsl.org/?id=SMS-MAP-1200>

5.2 Lesson 2.1: What are Living Things?

Key Concept

To be a living organism, certain characteristics must be evident. All living organisms:

- Need energy to carry out life processes
- Are composed of one or more cells (the cell theory)
- Evolve and share an evolutionary history
- Respond to their environment
- Grow, reproduce themselves, and pass on information to their offspring in the form of genes
- Maintain a stable internal environment (homeostasis)

Lesson Objectives

- List the defining characteristics of living things.
- List the needs of all living things.

Lesson Vocabulary

Table 5.3:

Lesson 2.1 Vocabulary		
cell	DNA	heredity
homeostasis	organism	reproduction
homeotherms	heterotherms	embryos

Check Your Understanding

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

- How do life scientists study the natural world?
- Are scientific theories just a “hunch” or a hypothesis?

Teaching Strategies

Building Science Skills: The 5E Lesson

See the **Science Inquiry** section.

Discussion: Living vs. Nonliving

See the 5E lesson in the **Science Inquiry** section.

Using Visuals: Living Organisms

See the 5E lesson in the **Science Inquiry** section.

Word Dissect: Homeostasis

Explain that homeostasis is a recurring theme throughout this course: living organisms consistently maintain homeostasis, and use a number of mechanisms to do so.

The process of maintaining a stable internal condition:

Homeo- or Homo- = staying the same

-Stasis = stable, static

Homeo + stasis = keeping the same stable condition

Differentiated Instruction: Concept Map

To reinforce the concepts that all organisms share, a concept map is helpful. Pair students into supportive teams/groups and have them develop a concept map organizing the six characteristics of living organisms. At the top of the map, it may read “All Living Organisms.” Students then continue with the six characteristics, giving examples and/or other information for each characteristic.

- For example, for **cells**, students could say: All living organisms are made out of cells, which are the smallest units that demonstrate all functions of life.

Enrichment: Lead a Discussion

Students who may need extra challenges can lead a discussion centered around the six characteristics of organisms. Students can begin their discussion by giving an example of homeostasis, and then asking the class to give examples of the other characteristics, making sure the students leading the discussion keep the class on track and that all six characteristics are included in the discussion.

Science Inquiry

5 E Lesson: What are living things? What are the main properties of living things?

Discussion

ASK: “What is the difference between living and nonliving things?” Generate a list on the board as students make suggestions.

Engage

Using Visuals

Put a lion stuffed animal and a large rock in the front of the room, or have students look at **Figures 1** and **2**. These figures do not correspond to figures in the lesson and are added here for your convenience. Again, **Ask** “What is the difference between a rock and a lion?”

Ask students to share their ideas with their neighbor for a few minutes and then share out to the class. Have students take out their lab notebooks and make a chart with two columns, headed “Rock” and “Lion,” and begin generating as many items as they can about the two, sharing with partners as they work.

Explore

Move partners into teams of four to generate jeopardy style answers to questions that will help them describe a rock or a lion. For example, one answer might be: “A large mass formed from materials that have been deposited on land and solidified,” question: “What is a rock?” OR Answer: “A large feline animal found in Africa and Southern Asia. The male in several varieties has a large mane.” Question, “What is a lion?”

Explain to students that they need to then take apart the words in the answers that they have assumed definitions for, and begin defining words like *mass*, *animal*, *mane* to further specify differences between living organisms and nonliving objects. Have students create another chart in their notebook with the words they are defining and their definitions.

Explain

Teams give a short 1-2 minute presentation on their explanation of the difference between a rock and a lion.

Elaborate

Students in teams make a Venn diagram on the large sheet of paper and draw a lion over one side and a rock over the other. They generate characteristics of each, putting lions on the left and rocks on the right. In the middle intersection, they list characteristics that rocks and lions share.

Evaluate

Teams post their Venn Diagrams around the room, and move around to view and evaluate all team diagrams. Give them sticky notes to leave comments about additions to the diagram, or corrections. After all teams have circulated around the room to look at all the diagrams and discuss within their team, they return to seat for a class discussion.

Facilitates a class discussion about rocks and lions, focusing on what is the difference between living organisms and non-living things.

Outcome: Guide students toward making a list of the six characteristics of living things. Create a list of student responses on the board, and have students write this list in their notebooks.

Reflection: Write on the board “I didn’t realize that living things...”, giving students a few minutes to respond and reflect in their notebooks to the prompt.

Homework: Read the FlexBook lesson on **What are Living Things?** Answer two ques-

tions:

1. What are the characteristics of living things?
2. What more do I want to know about living things?

Reinforce and Review

The basic understanding of what is living and what is not is central to studying life. Students must gain comfort in understanding “living and non-living” using the characteristics they have brainstormed and then learned about. Let them practice and reinforce this understanding in different ways.

Generating Charts

Students develop a chart in their science/lab notebooks. An example is shown below. The chart should contain multiple entries of at least two living and two non-living things.

Table 5.4:

OBJECT	Does it need food?	Does it need air?	Does it need water?	Does it produce young?	Is it living?
such as a soil, rock, tree, dog, insect, grass, water	yes/no	yes/no	yes/no	yes/no	yes/no

Homeostasis: Multimedia Resources

This set of five short animations on homeostasis explains homeostasis and why it is important, feedback, in humans, in animals, and shows a lab experiment step by step that illustrates the concept for students. Have students discuss in groups after viewing each module

- <http://www.phys.unsw.edu.au/biosnippets/>

Online Quiz

If you have Internet access in the classroom, have teams complete the activity quiz about living/nonliving things. If you do not have classroom access, print out the page and copy

for each team.

- <http://www.saburchill.com/questions/lanlt001.html>

Lesson Worksheets

Copy and distribute the four Lesson 2.1 worksheets in the Supplemental Workbook. Ask students to complete the worksheets alone or in pairs as a review of lesson content.

Review Questions

Have students answer the Lesson 2.1 Review Questions that are listed at the end of the lesson in their FlexBook.

- Sample answers to these questions will be provided upon request. **Please send an email to teachers-requests@ck12.org to request sample answers.**

Points to Consider

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Lesson Assessment

- Have students complete the Lesson 2.1 Quiz.

The lesson quiz and answer key are available upon request. Please send an email to teachers-requests@ck12.org to request material.

5.3 Lesson 2.2: Chemicals of Life

Key Concept

Lesson Objectives

- Distinguish between an element and a compound.
- Explain how elements are organized on the periodic table.
- Explain the function of enzymes.
- Name the four main classes of organic molecules that are building blocks of life.

Lesson Vocabulary

Table 5.5:

Lesson 2.2 Vocabulary		
aminoacids	atom	ATP
carbohydrates	electron	element
enzyme	functionalgroups	lipids
matter	neutrons	nucleicacid
organiccompounds	phospholipids	product
protein	proton	reactants
waxes		

Check Your Understanding

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

- What are the main properties of all living things?
- What is homeostasis?

Teaching Strategies

Discussion

1. **Ask:** “What are elements? What are compounds? Have you heard these words before, what do you think they are?”

After a brief class discussion, have students draw a chart with elements and compounds – and atoms and molecules – have students write attributes of each as you read and talk about the first part of the FlexBook chapter. Have students draw pictures to understand vocabulary (gases, product, oxidation).

2. If you have Internet access, show and discuss Web Elements: the periodic table on the web *<http://www.webelements.com/>

3. Organic molecules: draw pictures and write basic chemical formulas as you discuss carbohydrates, proteins, lipids, and nucleic acids. Activate prior knowledge by asking if students have heard of “low carb diets” or proteins. Many students may say that proteins are in meat.

Differentiated Instruction

Enrichment

Science Inquiry

Reinforce and Review

Lesson Worksheets

Copy and distribute the four Lesson 2.2 worksheets in the Supplemental Workbook. Ask students to complete the worksheets alone or in pairs as a review of lesson content.

Review Questions

Have students answer the Lesson 2.2 Review Questions that are listed at the end of the lesson in their FlexBook.

- Sample answers to these questions will be provided upon request. **Please send an email to teachers-requests@ck12.org to request sample answers.**

Points to Consider

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

- Do you expect the genetic information in the DNA of a cow to be the same or different from that in a crow?
- If we are all composed of the same chemicals, how do all organisms look so different?
- What characteristics would you use to distinguish and classify living things?

Lesson Assessment

- Have students complete the Lesson 2.2 Quiz.

The lesson quiz and answer key are available upon request. Please send an email to teachers-requests@ck12.org to request material.

5.4 Lesson 2.3: Classification of Living Things

Key Concept

Lesson Objectives

- Explain what makes up a scientific name.
- Explain what defines a species.
- List the information scientists use to classify organisms.
- List the three domains of life and the chief characteristics of each.

Lesson Vocabulary

Table 5.6:

Lesson 2.3 Vocabulary		
archaea	bacteria	binomial nomenclature
cyanobacteria	DNA	eukarya
fossils	nucleus	species
taxonomy		

Check Your Understanding

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

- What are the basic characteristics of life?

- What are the four main classes of organic molecules that are building blocks of life?

Teaching Strategies

Differentiated Instruction

Enrichment

Laboratory Activity

Science Inquiry

Reinforce and Review

Lesson Worksheets

Copy and distribute the four Lesson 2.3 worksheets in the Supplemental Workbook. Ask students to complete the worksheets alone or in pairs as a review of lesson content.

Review Questions

Have students answer the Lesson 2.3 Review Questions that are listed at the end of the lesson in their FlexBook.

- Sample answers to these questions will be provided upon request. **Please send an email to teachers-requests@ck12.org to request sample answers.**

Points to Consider

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Lesson Assessment

- Have students complete the Lesson 2.3 Quiz.

The lesson quiz and answer key are available upon request. Please send an email to teachers-requests@ck12.org to request material.

Image Sources

- (1) http://en.wikipedia.org/wiki/Image:Balanced_Rock.jpg. GNU Free Documentation.
- (2) [*CK-12 Foundation*]. CC-BY-SA.

Chapter 6

Introduction to Life Science (TE)

6.1 Unit 2: The Building Blocks of Life

Outline

This unit, *The Building Blocks of Life*, includes three chapters that

Chapter 3: Cells and Their Structures

Lesson 3.1: Introduction to Cells

Lesson 3.2: Cell Structures

Chapter 4: Cell Functions

Lesson 4.1: Transport

Lesson 4.2: Photosynthesis

Lesson 4.3: Cellular Respiration

Chapter 5: Cell Division, Reproduction, and DNA

Lesson 5.1: Cell Division

Lesson 5.2: Reproduction

Lesson 5.3: DNA, RNA, and Protein Synthesis

Overview

Chapter 7

TE Cells and Their Structures

7.1 Chapter 3: Cells and Their Structures

Outline

The chapter *Cells and Their Structures* consists of two lessons that introduce students to the cell and how the cell is the basic unit of structure and function of living organisms:

- Lesson 3.1: Introduction to Cells
- Lesson 3.2: Cell Structures

Overview

Cell Theory is one of the fundamentals of biology. In the 1600's, Robert Hooke first observed cork cells, and Leewenhoek discovered bacteria. Both were using primitive microscopes. Early biology concerned itself with developing tools to see smaller things, and as imaging technology increasingly becomes more sophisticated, more has been discovered. Schleiden and Schwann first proposed cell theory in 1838, changing our ideas of biology henceforth.

The cell is the smallest unit of life that is still considered living. Cells make up all organisms, from uni-cellular, simple life forms, to more complex life forms such as humans. Cell theory is one of the basic theories of biology and states that : 1) all organisms are composed of cells; 2) cells are alive and the basic living units of organization in all organisms; and 3) All cells come from other cells. Cells were first observed in the 1600's and technology advances have made it easier to discover more about the structure and function of different kinds of cells. There are two types of cells, prokaryotic and eukaryotic cells, classified by their structure. Prokaryotic cells are bacteria and archaea, and have no nucleus or organelles

enclosed by a membrane. Eukaryotic cells include fungi, animals, plants, and protists, and have a nucleus with membrane enclosed organelles.

Teaching Strategies

- Observing cells is a key hands-on approach to understanding cells, structures, and functions. Students can take part in lab experiences that allow them to observe cells and structures, to use stains to actually see the differences between prokaryotic and eukaryotic cells, as well as the differences between plant and animal cells, and observing the structure related to cell function. Making cell models reinforces the understanding of the cell, its structures, and the functions of the different structures in different cells.
- In this chapter students should draw and label different cell diagrams. These should go into their science notebooks.
- Materials

For the labs, you will need classroom microscopes, toothpicks, slides and cover slips, stain, sketchbooks, colored pencils, potatoes, onion, yogurt.

- Advance Preparation

Slice the potato with a razor and chill in water before the lab. Have the onion skin pieces ready before the lab. Keep the yogurt chilled in a baggie full of ice prior to the lab.

Pacing the Lessons

Use the **Class Periods per Lesson** table below as a guide for the time required to teach the lessons of this chapter.

Table 7.1:

Lesson	Number of Class Periods*
Lesson 3.1: Introduction to Cells	1.5
Lesson 3.2: Cell Structures	2.0

- Class periods are assumed to be 60 minutes long.

Lab Links

Managing Materials

Students should be used to using their science lab notebook daily for notes, diagrams, and labs. Depending on your class and structure, you may want to keep the notebooks in the classroom. You then have anytime access to look through and make comments to students in their notebooks.

The materials listed in the **Materials List** table below are needed to teach the strategies and activities described in the Teachers Edition of the FlexBook for this chapter.

Table 7.2:

Lesson	Strategy or Activity	Materials Needed
3.1	1) 2)	1) 2)
3.2	1)	1)

Additional Web-Based Resources

- CELLS ALIVE! <http://www.cellsalive.com/>
- Incredible Edible Cells Jello animal or plant cell models, student directions, assessment rubric <http://www.sciencespot.net/Media/cellpjcta.pdf>
- Brain Pop Educators/Science/Cell Structures

Print out the activity sheet to label cell parts, print out graphic organizer to help students structure ideas about cells, print out basic vocabulary sheet to have students write in own word definitions. Brain Pop Movies- view movies about Cellular Life and Genetics <http://www.brainpop.com/science/cellularlifeandgenetics/>

- Cell Structure and Cell Processes at Northwest LINCS for Adult Education <http://www.nwlincs.org/mtlincs/pilotproject/science/lscell.htm>
- Cell Structure and Process (links to cell parts with definitions and diagrams of parts and functions) <http://www.tvdsb.on.ca/westmin/science/sbi3a1/Cells/cells.htm>
- Plant and Animal Cell Worksheets <http://www.teach-nology.com/worksheets/science/cell/>
- Cell Websites for Science Teachers http://www.teach-nology.com/teachers/subject_matter/science/biology/cells/ Some teach-nology resources require subscriptions, but there are many free samples on the site too!
- Virtual Cell Web page <http://www.ibiblio.org/virtualcell/index.htm> The Virtual Cell is a zip file that is downloaded. There are worksheets and a link to a textbook

download on “Cell biology”

- Cell Theory Rap <http://www.biologycorner.com/worksheets/cellrap.html>
- How Stuff Works: How Cells Work <http://science.howstuffworks.com/cellular-microscopic-cell14.htm> Cells, cell part, proteins, enzymes, making enzymes, DNA, and more.

Making the FlexBook Flexible

An important advantage of the FlexBook is the ability it gives you, the teacher, to choose the chapters and lessons that you think are most important for your own classes. The following information is provided to help you decide whether to include this chapter or certain lessons in this chapter in your students' FlexBook. You should also consult the standards correlation table that follows when selecting chapters and lessons to include in the FlexBook.

- To understand the content of this chapter, students should have read the *Introduction to Living Organisms* chapter.
- Students should read this entire chapter before reading the remaining chapters of the FlexBook.
- It is recommended that you include all the lessons of this chapter in the FlexBook.

Common Misconceptions

7.2 Lesson 3.1: Introduction to Cells

Key Concepts

Cells are the basic building blocks of life. The Cell Theory is a central organizing theme in biology. The first level of organization in living organisms is the cell. At least one cell is necessary for life.

Lesson Objectives

- Explain how cells are observed.
- Recall the cell theory.
- Explain the levels of organization in an organism.

Lesson Vocabulary

Table 7.3:

Lesson 3.1 Vocabulary			
cell	electron microscope	transmission microscopes	electron
scanning electron microscopes	cell theory	organ	
organ system	tissue		

Check Your Understanding

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

- What are the main characteristics of living things?
- Name the four main classes of organic molecules that are building blocks of life.

Teaching Strategies

Discussion

Start this lesson by asking the class 1) What is a cell? and 2) How do we visualize cells?

Have students write short responses in their science notebooks and then call on volunteers to share their answers with the class. It is important that at this time every student understand the fundamental concept of the cell. Make sure students have the following in their notes:

A **cell** is the smallest unit of an organism that is still considered living. Cells are the basic units that make up every type of organism.

- Note that these are the **Check Your Understanding** questions from lesson 3.2. You may wish to save this discussion for the beginning of the next lesson.
- Alternatively, you can ask your students:
 1. What are cells made of? Direct responses towards carbohydrates, lipids, proteins and nucleic acids.
 2. Do all these components of cells have special roles/functions within the cell? Yes, review the roles of the categories of the four organic compounds.

Discussion

Review the cell theory. Make sure students write the three parts of the cell theory in their notes. Ask if anyone knows why it is a scientific theory (*no evidence found to disprove it*). Ask students if they can think (and list) of some ways the cell theory will relate to other aspects of life science that we will study during this course.

Using Visuals: Structure-Function Relationship

Have students examine **Figures 4, 5, and 6**. Ask the students to describe the shape and function of the cell, and ask them to write a sentence discussing how the structure of the cell can relate to or influence its function. Stress (and briefly review) the structure-function relationship of the four categories of organic compounds and how this is a theme consistent throughout the life sciences.

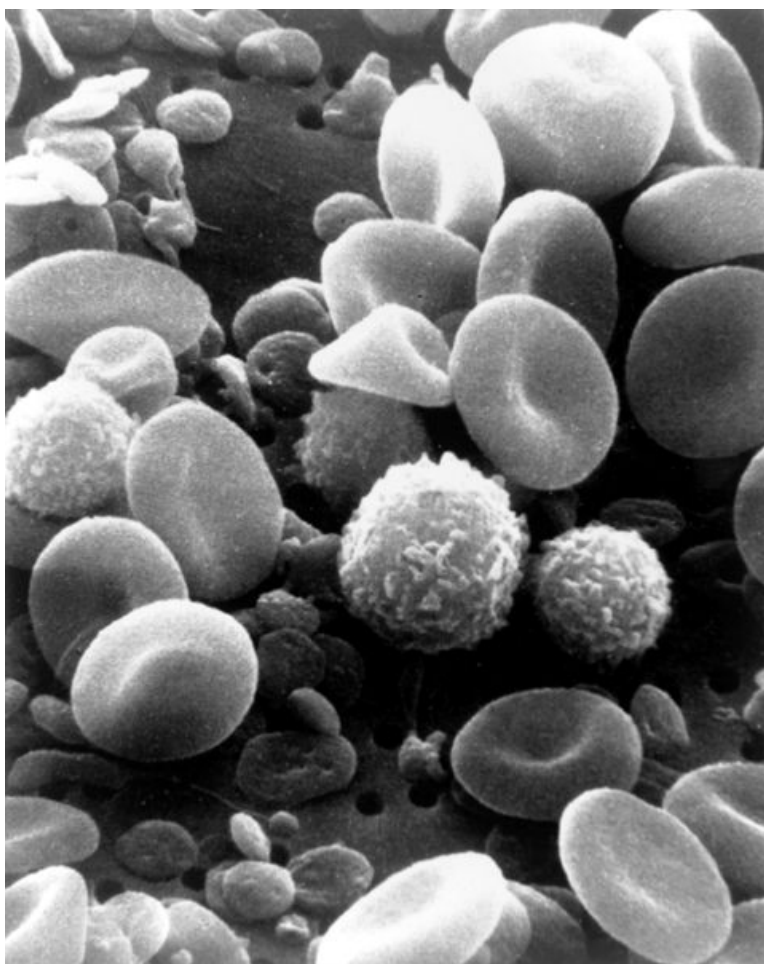


Figure 7.1: Red Blood cells are specialized to carry oxygen in the blood. (4)

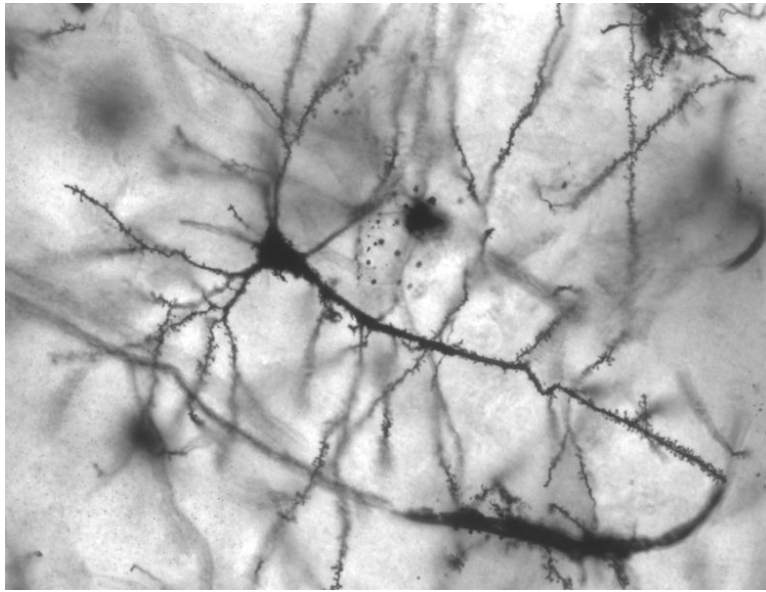


Figure 7.2: Neurons are shaped to conduct electrical impulses to many other nerve cells. (3)

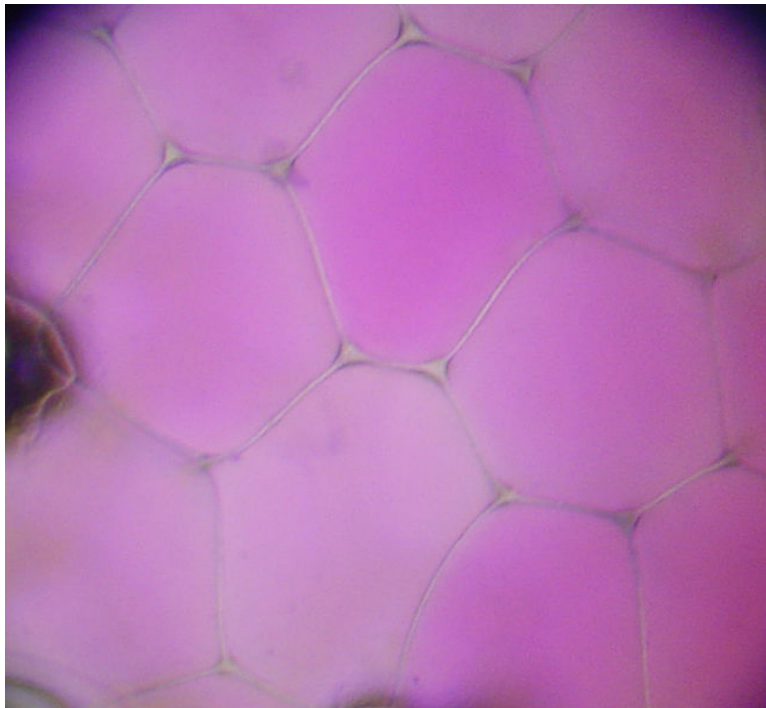


Figure 7.3: These epidermal cells make up the “skin” of plants. Note how the cells fit tightly together. (5)

Differentiated Instruction: Main Ideas/Details Chart

Have less proficient readers make a main ideas/details chart as they read the lesson. Instruct them to divide a sheet of paper down the middle and record the main ideas on the left side and the details for each main idea on the right side. Advise them to write one main idea for each of the main headings in the lesson (Introduction, Observing Cells, Cell Theory, Levels of Organization). Suggest that students save their tables for reviewing lesson content.

Enrichment: Class Presentation

Ask students who need extra challenges to give a class presentation linking the structure-function relationship of organic compounds to that of cells. Remind student to include in their presentation that these four categories of compounds come together to form the basics of a cell. Ask them to discuss the roles of these compounds within the cell, as the roles (functions) are determined by the structure of the molecule.

Enrichment: Research a Topic

Students who need extra challenges can identify the ten specimens with the Discovery School Virtual Electron Microscope. Students examine the specimens using the virtual microscope, identify the specimens, and sort them. Have students draw and write the descriptions of three of the specimens into their notebooks.

<http://school.discoveryeducation.com/lessonplans/interact/vemwindow.html>

Laboratory Activities

Science Inquiry

Activity Type

[Examples: Analyze Data, Develop a Research Plan]

Reinforce and Review

Cell Theory Rap

Lyrics are provided at the site below. Have teams of students practice the rap (can be assigned as homework) and then present their version to the class.

<http://www.biologycorner.com/worksheets/cellrap.html>

Lesson Worksheets

Copy and distribute the four Lesson 3.1 worksheets in the Supplemental Workbook. Ask students to complete the worksheets alone or in pairs as a review of lesson content.

Review Questions

Have students answer the Lesson 3.1 Review Questions that are listed at the end of the lesson in their FlexBook.

- Sample answers to these questions will be provided upon request. **Please send an email to teachers-requests@ck12.org to request sample answers.**

Points to Consider

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Lesson Assessment

- Have students complete the Lesson 3.1 Quiz.

The lesson quiz and answer key are available upon request. Please send an email to teachers-requests@ck12.org to request material.

7.3 Lesson 3.2: Cell Structures

Key Concepts

Cell structures are different in different kinds of cells. These structures affect the function of those cells. Prokaryotic cells do not have a nucleus or membrane enclosed organelles and eukaryotic cells have a nucleus and membrane enclosed organelles. Plant and animal cells are both eukaryotic cells; plant cells have a cell wall, which does not exist in animal cells.

Lesson Objectives

- Compare prokaryotic and eukaryotic cells.
- List the organelles of the cell and their functions.

- Discuss the structure and function of the cell membrane and cytosol.
- Describe the structure and function of the nucleus.
- Distinguish between plant and animal cells.

Lesson Vocabulary

Table 7.4:

Lesson 3.2 Vocabulary		
prokaryotic	eukaryotic	cell wall
plasmid	nucleus	organelle
plasma membrane	semi-permeable	cytosol
cytoplasm	ribosome	Golgi apparatus
mitochondria	ATP	endoplasmic reticulum
chloroplast	lysosomes	nucleus
nuclear envelope	vacuoles	cytoskeleton
plastids	leucoplasts	chromoplasts
central vacuole	chromosome	homeostasis
vesicle		

Check Your Understanding

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Teaching Strategies

Using Visuals

Compare prokaryotic and eukaryotic cells by comparing **Figures 1** and **2** in the FlexBook. Have students point out and discuss the different organelles. Students sketch the drawings with labels in their science notebooks. Notice that **Table 1** compares the features in these cells.

Table 7.5: Comparison of Prokaryotic and Eukaryotic Cells

Feature	Prokaryotic cells	Eukaryotic cells
DNA	Single “naked” circle; plasmids	In membrane-enclosed nucleus

Table 7.5: (continued)

Feature		Prokaryotic cells	Eukaryotic cells
Membrane-enclosed ganelles	or-	No	Yes
Examples		Bacteria	Plants, animals, fungi

Activity: Cell Model

Assign students the building of a sandwich baggie plant cell model. They can use construction paper pieces, clay pieces made to look like organelles, or other household items to go into the baggie. For a school-practical model, eliminate the cytosol in the cell, and just have students put the organelles in. If you use double zip-lock bags, one for the cell wall, one for the cell membrane, you may add the cytosol at school, by pouring karo syrup inside. Students must know this ahead of time, and use other than paper (modeling clay, household items) that they know will be coated with the karo syrup. Can be assigned as homework.

Activity: The Cell Factory

To help students understand the different functions of cell structures, have them think in terms of analogies. How is a cell like factory? a city? a car? a sports team? a farm? Have each student choose an analogy and create a diagram or model or poster depicting how the functions of the different organelles (mitrochondria, nucleus, cell membrane, ribosomes, Golgi apparatus, lysosome, etc.) compare to the functions of different entities in their analogy.

Differentiated Instruction: Main Ideas/Detail Chart

Group students and assign each group one of the four sections from the FlexBook: **The Plasma Membrane and Cytosol**, **The Nucleus and Chromosomes**, **The Cell Factory**, or **Plant Cells**.

- Have each group create a Main Ideas/Detail Chart for their assigned section. Each group will then orally present their chart to the class.

Enrichment: Research a Topic

Stem Cells

This unit, *The Building Blocks of Life*, is a unit on cell biology. Cell biology has an important place in medicine, arguably more so than ever before. Have students who need additional

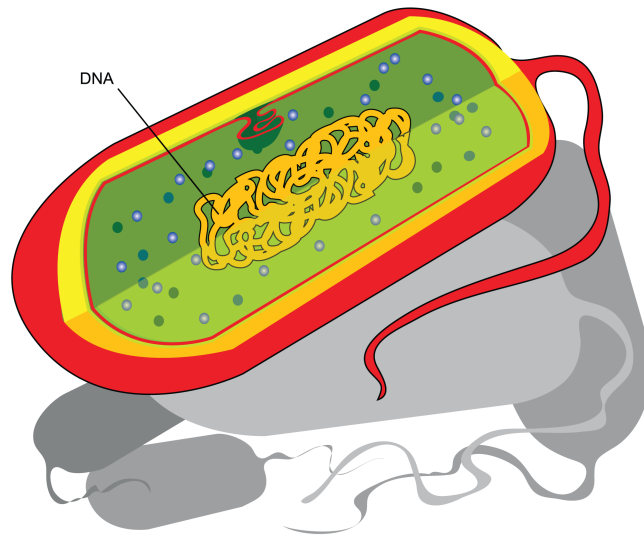


Figure 7.4: Prokaryotes do not have a nucleus. Instead, their genetic material is a simple loop of DNA. (2)

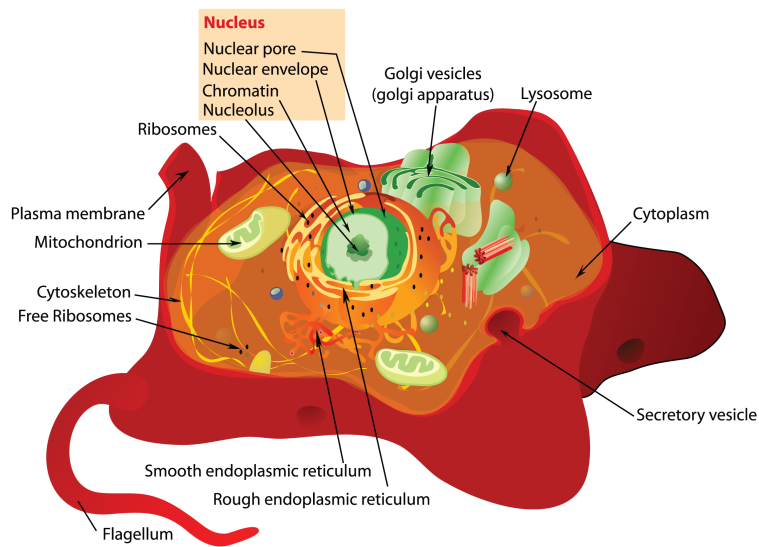


Figure 7.5: Eukaryotic cells contain a nucleus (where the DNA “lives,” and surrounded by a membrane) and various other special compartments surrounded by membranes, called “organelles.” For example, notice in this image the mitochondria, lysosomes, and peroxisomes. (1)

challenges research stem cells and write a one page summary of their research. Have them start at the National Institutes of Health resource for stem cell research:

- <http://stemcells.nih.gov/>

This site has information on what stem cells are, their ability to cure disease, and ethical issues.

Laboratory Activities

Different Kinds of Cells

- Cheek Cells

One team member scrapes inside of their cheek with a toothpick and puts on a slide with stain. Label a page in the student lab notebook “Cheek Cell Lab.” View the slide under the microscope and sketch the cell, labeling structures, at low and high resolution. Have students answer questions in their notebook:

1. Do the cheek cell move on their own? What are the organelles that are missing?
2. Is the cheek cell a prokaryote or a eukaryote? How can you tell?
3. Since you took these cells from your mouth, what organelle would be most numerous?

- Epidermal Cells

Repeat process with toothpick to obtain epidermal cells from another team member’s wrist. Wash wrist, stick tape on wrist and then place sticky side up on the slide and stain. View, sketch, label.

- Potato Cells

You may wish to slice potato with razor blades for students: make a thin slice near the edge of the potato and include the skin. View, sketch, label. Stain. Observe, sketch, label

- Onion Cells

Use a thin layer of onion tissue or red onion tissue, cover, observe, sketch, label. Discuss the cell types, cell shapes, identifiable structures, and major classifications, have students record these in their lab notebooks.

- **If you do not have classroom microscopes, or as an additional activity, use the Virtual Microscope at <http://www.udel.edu/biology/ketcham/microscope/>**

Cell Structure: Using the Microscope Virtual Lab

http://bio.rutgers.edu/~gb101/lab1_cell_structure/section2_frames.html

This virtual lab teaches students about the microscope, magnification, field of view, image formation, and continues with an onion plant cell and a cheek animal cell.

Science Inquiry

Cell Webquest

This cell webquest teaches students about plant and animal cells, requires research, completing worksheets and creating a powerpoint about a cell part. Notes to the Teacher is especially helpful.

<http://www.scsc.k12.in.us/SMS/Teachers/Martin/intro.htm>

Reinforce and Review

- Cells Alive

This site has diagrams and photos of cells, bacteria, and viruses. Students can find the interactive animation of an animal cell and/or plant cell and review the organelles. Have them draw a picture of the labelled cell into their notebooks. <http://www.cellsalive.com/>

- Cell Structure Active Art <http://www.phschool.com/webcodes10/index.cfm?fuseaction=home.gotoWebCode&wcprefix=cbp&wcsuffix=3072>
- Cell Structures and Processes. Interactive review of organelles. Students can review this site at home and then complete the online quiz. <http://www.tvdsb.on.ca/westmin/science/sbi3a1/cells/cells.htm>
- Cell Structure and Function Quiz. An interactive quiz on cellular organelles. Have students take this online quiz. Can be completed at home. Students should use this quiz as an informal assessment and evaluate their learning. <http://www.tvdsb.on.ca/westmin/science/sbi3a1/cells/cellquiz.htm>

Lesson Worksheets

Copy and distribute the four Lesson 3.2 worksheets in the Supplemental Workbook. Ask students to complete the worksheets alone or in pairs as a review of lesson content.

www.ck12.org

Review Questions

Have students answer the Lesson 3.2 Review Questions that are listed at the end of the lesson in their FlexBook.

- Sample answers to these questions will be provided upon request. **Please send an email to teachers-requests@ck12.org to request sample answers.**

Points to Consider

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Lesson Assessment

- Have students complete the Lesson 3.2 Quiz.

The lesson quiz and answer key are available upon request. Please send an email to teachers-requests@ck12.org to request material.

Image Sources

- (1) http://commons.wikimedia.org/wiki/Image:Animal_cell_structure.svg. Public Domain.
- (2) *Prokaryotic*. Public Domain.
- (3) http://commons.wikimedia.org/wiki/Image:Pyramidal_hippocampal_neuron_40x.jpg. CC-BY-SA 2.5.
- (4) http://commons.wikimedia.org/wiki/File:SEM_blood_cells.jpg. Public Domain.
- (5) http://commons.wikimedia.org/wiki/Image:Rhoeo_Discolor_epidermis.jpg. GNU- FDL.

Chapter 8

TE Cell Functions

8.1 Chapter 4: Cell Functions

Outline

The chapter *Cell Functions* consists of three lessons that introduce students to specific aspects of cell biology, including diffusion and passive and active transport, and the energy metabolic functions, photosynthesis and cellular respiration.

- Lesson 4.1: Transport
- Lesson 4.2: Photosynthesis
- Lesson 4.3: Cellular Respiration

Overview

Transport, photosynthesis and cellular respiration are some of the fundamental cell functions necessary for life. Transport across the membrane as either an active or passive process is discussed in the first lesson of this chapter. Photosynthesis and cellular respiration work together to supply energy to cells, with photosynthesis using the energy from sunlight to produce glucose, and cellular respiration taking that glucose and converting its energy into ATP.

Teaching Strategies

This chapter includes some complex topics that deal with transport in the cell. Students should understand and observe movement of molecules into and out of cells; the details involve understanding the differences between passive transport (diffusion, osmosis, and

diffusion) and active transport. These concepts will also become part of the discussion of photosynthesis and cellular respiration.

- Begin with the diffusion demonstration(s).
- Go through the FlexBook Lesson 4.1, Transport, and have students complete the Diffusion Lab.

Incorporate Teaching Strategies and Activities that benefit your particular students/class.

- Teach the FlexBook lesson 4.2, Photosynthesis, incorporating the Teaching Strategies and Activities that benefit your students/class. Have students complete the Photosynthesis Simulation and worksheet in teams. Follow up with reinforcement simulations that benefit your students/class.
- Classroom Cellular Respiration Activity, followed by FlexBook Lesson 4.3 on Cellular Respiration. Incorporate any Teaching Strategies and Activities that benefit your students/class.

Pacing the Lessons

Use the **Class Periods per Lesson** table below as a guide for the time required to teach the lessons of this chapter.

Table 8.1:

Lesson	Number of Class Periods*
Lesson 4.1: Transport	1.0
Lesson 4.2: Photosynthesis	2.0
Lesson 4.3: Cellular Respiration	2.0

- Class periods are assumed to be 60 minutes long.

Lab Links

Managing Materials

The materials listed in the **Materials List** table below are needed to teach the strategies and activities described in the Teachers Edition of the FlexBook for this chapter.

Table 8.2:

Lesson	Strategy or Activity	Materials Needed
4.1	1) 2)	1) 2)
4.2	1)	1)
4.3	1)	1)

Additional Web-Based Resources

- CELLS alive! <http://www.cellsalive.com/> Film and computer-enhanced images of living cells and organisms for education and medical research.
- The Biology Corner: Diffusion and Osmosis <http://www.biologycorner.com/bio1/diffusion.html> Animation of diffusion and osmosis, and explanations of solution types.
- The Biology Corner: Active Transport <http://www.biologycorner.com/bio1/active.html> Diagrams and explanation of active transport.

Making the FlexBook Flexible

An important advantage of the FlexBook is the ability it gives you, the teacher, to choose the chapters and lessons that you think are most important for your own classes. The following information is provided to help you decide whether to include this chapter or certain lessons in this chapter in your students' FlexBook. You should also consult the standards correlation table that follows when selecting chapters and lessons to include in the FlexBook.

- To understand the content of this chapter, students should have read the *Cells and Their Structures* chapter.
- Students should read this entire chapter before reading the remaining chapters of the FlexBook.
- It is recommended that you include all the lessons of this chapter in the FlexBook.

Common Misconceptions

In regards to cell functions, middle school students typically have difficulties in the following areas:

Osmosis and Diffusion

Students often confuse these two processes. In the big picture, these are two examples of passive transport, processes in which water or solutes (particles) move across semi-permeable

cell membranes. The significant difference between these two processes is that osmosis involves the movement of water (from an area of low solute concentration to an area of high solute concentration) while diffusion involves the movement of solutes (from an area of high solute concentration to an area of low solute concentration). In both processes, the end result is equilibrium between the concentration inside and outside the cell. Help students understand cellular diffusion by discussing three types of solutions with red-blood cells: isotonic (equal concentrations inside and outside, no net movement of fluid inside or outside the cell), hypotonic (lower concentration outside, net movement of fluid into the cell, the cell eventually shrinks), and hypertonic (higher concentration outside, net movement of fluid outside the cell, cell eventually bursts). Refer the students to **Figure 3** in lesson 1. Have them draw diagrams showing the movement of fluid for each condition.

Photosynthesis

To address the common student view that plants get their food from the ground, discuss the famous experiment by van Helmont (done in 1649), which showed that plants do not increase their mass due to food from the ground. The following site provides a nice description of this experiment.

- http://www.odec.ca/projects/2002/food_for_life/history_of_plants.htm

Unfortunately, air gases were unknown during van Helmont's time, so he erroneously believed that the plants increased their mass only due to water. On a novice level, it does seem strange that most of the world's plant biomass, and hence the biomass of all organisms on Earth, is derived from the carbon dioxide in the air. A good strategy to help students realize this fact is to use computer simulations of photosynthesis, which help students visualize carbon dioxide, as it enters a plant and becomes part of its organic molecules (try: <http://www.pbs.org/wgbh/nova/methuselah/photosynthesis.html#>). These simulations can reinforce the idea that photosynthesis provides plants with its only source of food. Minerals useful to plants have other functions, such as catalyzing certain reactions, but they are not used as food by plants.

Cellular Respiration

Discuss with students the differences between everyday language and scientific language. For example, what do you call a salad of cut tomatoes and cucumbers? A vegetable salad, in everyday language, but a fruit salad in scientific language: tomatoes and cucumbers are botanical fruits. Science has its own language, which often needs to be distinguished from everyday language. Cellular respiration is the process that releases energy from food substances in living cells. It is not the same as breathing, an every-day term for respiration. Ask students: In chemical terms, is respiration the reverse reaction of photosynthesis? Do plants

need to release energy from food substances? If so, do they need to engage in respiration? Photosynthesis and respiration are reversible chemical reactions, meaning that the products of one process are the exact reactants for the opposite process. Since plants need to release energy from the food created in photosynthesis, they also need to engage in respiration.

8.2 Lesson 4.1: Transport

Key Concept

The cell membrane is semi-permeable and allows some molecules to move through the membrane easily in both directions. Forms of passive transport, such as diffusion, do not require energy; active transport requires energy and a carrier protein. Transport in and out of the cell helps the cell to maintain its stable internal environment, homeostasis.

Lesson Objectives

- Describe several methods of transporting molecules and ions into and out of the cell.
- Distinguish between active and passive transport.
- Explain how diffusion and osmosis work.

Lesson Vocabulary

Table 8.3:

Lesson 4.1 Vocabulary		
selectively permeable	diffusion	concentration
osmosis	hypotonic solution	hypertonic solution
isotonic solution	ion channel proteins	facilitated diffusion
passive transport	active transport	sodium-potassium pump
exocytosis	endocytosis	phagocytosis
pinocytosis		

Check Your Understanding

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Teaching Strategies

Demonstration: Odor Diffusion

- Preparation: Check to be sure there are no students with ammonia allergies or lung conditions, such as asthma. Have one student ready to record time and distance when students signal that they smell the ammonia.
- Procedure: Stand far away from students and open a bottle of ammonia. Have students signal when they smell the ammonia and the timer/recorder keeps a record of how long it takes to reach many of the students. Because the ammonia gas concentration can be quite strong, do not wait until the odor reaches all students to recap the bottle. During the diffusion period, you may have students involved in other work or discussion. After the demonstration, have students discuss how the odor gets from the bottle to them. Substances with odor give off gas, the gas particles move, and they slowly move through the room. That process is diffusion.
- Optional second diffusion demonstration

Fill a large, clear, slender bottle or test tube with water. Have students observe as you put ONE drop of food coloring in the bottle. Allow the bottle to stand for awhile as students are involved in the Diffusion Lab, observe and discuss. Molecular motion is slower in liquid than gasses.

Using Visuals: The Cell Membrane

Discuss homeostasis and the concept of diffusion. Introduce the concept of transport, including special methods for moving some molecules across the plasma membrane. Have students look at **Figure 1** and analyze the structure, comparing it to a wall around a building to keep things in or out.

- Ask the students How does the makeup of the membrane move things in and out of the cell? Together, read the section below **Figure 1** describing charged atoms, ions, and balancing the cell charge.

Differentiated Instruction: Word Wall

This lesson introduces a lot of new vocabulary. Post vocabulary words and their definitions on the board or wall prior to beginning the lesson. This will provide a convenient source for you to refer back to during the lesson.

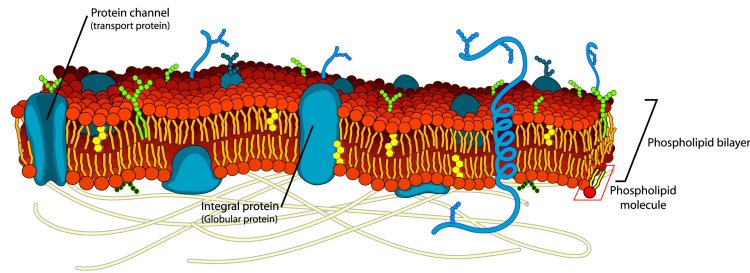


Figure 8.1: The plasma membrane is made up of a phospholipid bilayer with embedded proteins. (1)

Differentiated Instruction: Main Ideas/Detail Chart

Have students divide a sheet of paper in half and on the left side write the main ideas from the lesson (skipping several lines between the main ideas). These main ideas can include: what is transport, the semipermeable nature of the cell membrane, diffusion and osmosis (including facilitated diffusion), active transport, and transport through vesicles.

On the right side, students are instructed to fill in important details about each main idea as they read through the lesson. Encourage students to work with a partner.

Enrichment: Review a Topic

- The Biology Corner: Diffusion and Osmosis

<http://www.biologycorner.com/bio1/diffusion.html>

Site reviews transport using animations and cartoon descriptions. Have students present this site to the class. Students should describe the processes on the site and take questions from the class.

Laboratory Activity: Diffusion

Conduct diffusion lab: to observe diffusion:

- Give teams a plastic baggie with a spoonful of cornstarch and a half- cup of water.
- Fill a clear glass jar or beaker with water and add ten drops of iodine.
- Teams put the baggie in the beaker, submerging the cornstarch.

- After about 10-15 minutes, have teams observe and record their observations in their science notebooks. Make a table for the solution in the beaker, the solution in the bag, and record starting color and ending color.
- Have students answer the following questions: What is a semi-permeable membrane? Is the baggie an example of this? Record conclusions in notebooks.

Science Inquiry

Reinforce and Review

1. How Stuff Works: How Cells Work <http://science.howstuffworks.com/cellular-microscopic-cell14.htm> Cells, cell part, proteins, enzymes, making enzymes, DNA, and more.
2. The Biology Corner: Diffusion and Osmosis <http://www.biologycorner.com/bio1/diffusion.html> Animation of diffusion and osmosis, and explanations of solution types.
3. Wisc-Online: The Cell: Passive Transport Diffusion http://www.wisc-online.com/objects/index_tj.asp?objID=AP1903 Interactive animated learning activity.
4. Smith College, Biology 231: Electron Transport Chain <http://www.science.smith.edu/departments/Biology/Bio231/etc.html> Animated demonstration of the ETC.

Review Questions and Answers

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Have students answer the Review Questions that are listed at the end of the lesson in their FlexBook.

Points to Consider

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Lesson Assessment

Provided to teachers upon request. Please send an email to teachers-requests@ck12.org.

Copy and distribute the lesson quiz. Provide class time for the students to complete this assessment.

8.3 Lesson 4.2: Photosynthesis

Key Concept

Photosynthesis is a process that uses sunlight to create energy for much of life on earth.

Lesson Objectives

1. Explain the importance of photosynthesis.
2. Write and interpret the chemical equation for photosynthesis.
3. Describe what happens during the light reactions and the Calvin cycle.

Lesson Vocabulary

Table 8.4:

Lesson 4.2 Vocabulary		
ATP synthase	Calvin cycle	chlorophyll
chloroplast	cyanobacteria	electron transport chain
light reactions	NADPH	photosynthesis
stomata	stroma	thylakoid

Check Your Understanding

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Teaching Strategies

Connections

Connect to the changing nature of science: We observe life on earth on the surface and in the ocean. When scientists were able to go deep into the ocean, geothermal vents and hot springs, were discovered near mid-oceanic ridges. Could life exist at these hot vents? In 1977, scientists found abundant sea life at the site of these vents, far below where sunlight could reach. The energy source of this deep ocean life is therefore not sunlight, but a process called chemosynthesis (energy from a chemical reaction). Until that time, we thought that photosynthesis was the origin of all life.

- Exploring the deep ocean floor: Hot springs and strange creatures. Article and photos on deep sea life. <http://pubs.usgs.gov/gip/dynamic/exploring.html> Have students explore this site, writing a paragraph summary of what they observe.

Demonstration

Simulate photosynthesis by manipulating light intensity and wavelength. The simulation can be done as a class interactive demonstration.

- Johnson Explorations: Photosynthesis Simulation http://www.mhhe.com/biosci/genbio/biolink/j_explorations/ch09expl.htm This interactive allows students to trace the path of electrons through the two photo systems, seeing how and where specific molecules and ions are involved, and where ATP is produced.

Differentiated Instruction

Enrichment: Photosynthesis Rap

Rhythm, Rhyme, Results: Educational Rap Music: Photosynthesis Rap <http://www.educationalrap.com/62/photosynthesis.html> Educational rap recording and lyrics on photosynthesis.

Enrichment: Photosynthesis Jeopardy

Jeopardy PowerPoint: Photosynthesis / Cell Respiration / Enzymes / Light <http://askeric.org/Virtual/Lessons/Science/Biology/BI00202.html> Advanced students can play the PowerPoint Jeopardy-like game, an advanced activity that can be used as a review of biology concepts.

Laboratory Activity

Massengale's Biology Junction: The Heat is On-The Energy Stored in Food http://www.biologyjunction.com/energy_in_food.htm Explanations, directions, materials, procedure, worksheet tables, questions and conclusions for a lab to measure the energy available from three kinds of nuts (calorimetry).

Science Inquiry

Reinforce and Review

Photosynthesis Animation

<http://www.science.smith.edu/departments/Biology/Bio231/ltrxn.html> Animation of the the synthesis of ATP and NADPH. Show animation and review processes.

Review the Lesson

Either you or a student(s) leads a discussion to review the lesson. You can use the Lesson Summary from the FlexBook. Clarify any issues and answer any questions students may have.

- The net reaction for photosynthesis is carbon dioxide and water, together with energy from the sun, producing glucose and oxygen.
- During the light reactions of photosynthesis, solar energy is converted into the chemical energy of ATP and NADPH.
- During the Calvin cycle, the chemical energy of ATP and NADPH is used to convert carbon dioxide into glucose.

Review Questions and Answers

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Have students answer the Review Questions that are listed at the end of the lesson in their FlexBook.

Points to Consider

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Lesson Assessment

Provided to teachers upon request. Please send an email to teachers-requests@ck12.org.

Copy and distribute the lesson quiz. Provide class time for the students to complete this assessment.

8.4 Lesson 4.3: Cellular Respiration

Key Concept

Cellular respiration is a process to create energy for the cell by breaking down glucose into carbon dioxide and water.

Lesson Objectives

- Write and explain the chemical formula for cellular respiration.
- Explain the two states of cellular respiration.
- Compare photosynthesis with cellular respiration.
- What occurs in oxidation and reduction reactions?

Lesson Vocabulary

Table 8.5:

Lesson 4.3 Vocabulary		
aerobic respiration	alcoholic fermentation	anaerobic respiration
ATP	cellular respiration	citric acid cycle
cristae	electron transport chain	FADH ₂
fermentation	glycolysis	lactic acid fermentation
matrix	mitochondria	NADH

Check Your Understanding

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Teaching Strategies

Differentiated Instruction

Enrichment

Science Inquiry

Review and Reinforce

Review Questions and Answers

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Have students answer the Review Questions that are listed at the end of the lesson in their FlexBook.

Points to Consider

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Lesson Assessment

Provided to teachers upon request. Please send an email to teachers-requests@ck12.org.

Copy and distribute the lesson quiz. Provide class time for the students to complete this assessment.

Image Sources

- (1) http://commons.wikimedia.org/wiki/File:Cell_membrane_detailed_diagram_en.svg. Public Domain.

Chapter 9

TE Cell Division, Reproduction, and DNA

9.1 Chapter 5: Cell Division, Reproduction, and DNA

Outline

The chapter *Cell Division, Reproduction, and DNA* consists of three lessons that finish cell biology and introduce molecular biology.

- Lesson 5.1: Cell Division
- Lesson 5.2: Reproduction
- Lesson 5.3: DNA, RNA, and Protein Synthesis

Overview

This chapter contains many important concepts in modern biology. The lessons in this chapter lay the groundwork for the following unit, *Genetics and Evolution*. DNA and proteins are key molecules in the cell nucleus. DNA contains four bases that code for making proteins. The bases are A, adenine, G, guanine, C, cytosine, and T, thymine. A pairs with T, and C pairs with G; these are the base-pairing rules, and students need to memorize these pairings.

Cells divide to foster growth of an organism, to repair damaged cells, or to replace worn-out cells. In humans, a sperm fertilizes an egg, forming the first cell. From that one cell, an entire baby with trillions of cells will develop. That first cell divides in half, creating two cells. Then those two cells divide. The new cells continue to grow and divide until a complete organism is formed. Even after wards, the body's cells continue to divide, depending on their type, for the lifespan of the individual.

Teaching Strategies

The key understanding to cell division and reproduction is understanding the difference between mitosis and meiosis. Give many opportunities over time to interact with online simulations, to use genscope to see meiosis, use the pipe cleaner chromosomes kits to become familiar with these two important concepts. The study of DNA can be intimidating; however, using many hands-on modeling, building molecules, labs, viewing photos online, and -if possible- extracting DNA from a kiwi or an onion help students “connect” with the idea of DNA, making greater understanding possible.

Pacing the Lessons

Use the **Class Periods per Lesson** table below as a guide for the time required to teach the lessons of this chapter.

Table 9.1:

Lesson	Number of Class Periods*
Lesson 5.1: Cell Division	1.0
Lesson 5.2: Reproduction	2.0
Lesson 5.3: DNA, RNA, and Protein Synthesis	3.0

- Class periods are assumed to be 60 minutes long.

Managing Materials

The materials listed in the **Materials List** table below are needed to teach the strategies and activities described in the Teachers Edition of the FlexBook for this chapter.

Table 9.2:

Lesson	Strategy or Activity	Materials Needed
5.1	1) 2)	1) 2)
5.2	1)	1)
5.3	1)	1)

Additional Web-Based Resources

- PBS: NOVA Online: Cracking the Code of Life <http://www.pbs.org/wgbh/nova/genome/program.html> Two-hour on-line video program divided into 16 chapters, each from 4-9 minutes long. (QuickTime or Real Video required.)
- The Biology Corner: Plant Cells Internet Lab <http://www.biologycorner.com/worksheets/plantcell-virtual.html> Virtual lab worksheet using the virtual microscope and slide “Onion”
- The University of Arizona: The Biology Project: Online Onion Root Tips http://www.biology.arizona.edu/cell_bio/activities/cell_cycle/cell_cycle.html Interactive activity on mitosis. Student determine time spent in different phases of the cell cycle. This site needs teacher guidance and instruction to help students understand content.
- National Human Genome Research Institute: Online Education Kit: Understanding the Human Genome Project <http://www.genome.gov/25019879> Multimedia downloads.
- National Human Genome Research Institute: Chromosome Analysis <http://www.genome.gov/Pages/Education/Modules/ChromosomeAnalysis.pdf> Slideshow (.pdf).
- BA Education: DNA Extraction <http://www.ba-education.com/for/science/dnaextraction.html> Lab: the recipe for making DNA.
- BA Education: The People Responsible for the Discovery of DNA <http://www.ba-education.com/for/science/dnadiscovery.html> Information page.
- BA Education: Mitosis Diagram <http://www.ba-education.com/dna/mitosis.jpg> Great diagram of each phase of mitosis.

Making the FlexBook Flexible

An important advantage of the FlexBook is the ability it gives you, the teacher, to choose the chapters and lessons that you think are most important for your own classes. The following information is provided to help you decide whether to include this chapter or certain lessons in this chapter in your students’ FlexBook. You should also consult the standards correlation table that follows when selecting chapters and lessons to include in the FlexBook.

- To understand the content of this chapter, students should have read the previous chapters in this unit.
- Students should read this entire chapter before reading the remaining chapters of the FlexBook.
- It is recommended that you include all the lessons of this chapter in the FlexBook.

Common Misconceptions

In regards to cell division, reproduction, and DNA, middle school students typically have difficulties in the following areas:

- In the cell's nucleus, the DNA codes for the instructions necessary to make all of the necessary proteins that will dictate the structure and function of the organism. Students often miss this “big picture” which is behind cell division, reproduction and DNA.
- Students often find it hard to distinguish between asexual reproduction and sexual reproduction.
- Students often have troubles distinguishing between mitosis and meiosis.

Proteins as an Organizing Concept

A key concept that integrates the major concepts of this chapter – cell division, reproduction and DNA – is the concept of proteins. Students need to know that a cell's ability (or an organism's ability) to carry out a particular function depends on the cell's ability to make the particular proteins that do that work. Each organism has thousands of different proteins that carry out essential cellular functions, such as storage, transport, defense, and catalyzing other cell activities. Students often have the misconception that only meat, fish or eggs have proteins. In the world of cells, a specific cell's proteins defines what it can or cannot do. If you help your students understand this “big picture” perspective about a cell's proteins, they will have a better understand of how cells divide and (transferring copies of the parental DNA to the offspring cells) and how DNA works (duplicating itself and serving as a template for RNA and protein synthesis).

To start to understand how DNA works:

Ask students: Are the 4 bases of DNA the same in every organism? Are the 4 bases of the DNA of an amoeba the same as the 4 bases of the DNA of a giraffe? The answer is a resounding **Yes!** The chemical makeup of DNA is the same in every organism, though the combinations of these 4 bases are different for each organism. DNA is the universal language of life on earth, the language which all organisms use to code for the thousands of different proteins that determine what each of its cell does.

Sexual vs. Asexual Reproduction

Students do not understand other mechanisms of sexual reproduction besides mammalian reproduction, so they may be surprised that plants and flowers use sexual reproduction. Students erroneously believe that asexual reproduction is restricted to microorganisms only and that asexual reproduction results in some sort of weakness. You can help students confront

these misconceptions through guided discussions which point out the diverse possibilities of both sexual and asexual reproduction in the biological world.

Mitosis vs. Meiosis

Sometimes, students erroneously claim that meiosis gives rise to haploid offspring rather than haploid gametes, and that meiosis reduces the chromosome number of the offspring by half. When meiosis is presented, students think they understand it, and often think meiosis is just mitosis twice. They don't see that metaphase (in mitosis) is different from metaphase 2 (in meiosis). They often think chromatids and chromosomes are the same. An effective teaching strategy to deal with these misconceptions is the use of modeling the process of mitosis and meiosis.

9.2 Lesson 5.1: Cell Division

Key Concept

Cells division is necessary to life. Cells divide to produce a new embryo, to allow an organism to grow and develop, and to replace worn cells.

Lesson Objectives

1. Explain why cells need to divide.
2. List the stages of the cell cycle and explain what happens at each stage.
3. List the stages of mitosis and explain what happens at each stage.

Lesson Vocabulary

Table 9.3:

Lesson 5.1 Vocabulary		
cell cycle	interphase	mitosis
cytokinesis	chromosomes	chromatids
prophase	anaphase	metaphase
telophase	spindle	

Check Your Understanding

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Teaching Strategies

Discussion

ASK: Why do you think you might need new cells throughout your life? Wait a few moments then ask the class for possible answers. Stress that they do not need to be correct. Use this to begin a discussion of cell division: Human cells are constantly being replaced as they grow old or are injured. This is a natural process. For example, when you cut yourself, the cut heals with the formation of new cells. When you grow, new cells are made. Read through the first two sections of the FlexBook.

Differentiated Instruction

Enrichment

Laboratory Activity: Onion-Root Mitosis

- Materials:

prepared onion-root tip slides, onion root tips to make own slides, slides, coverslips

An onion is made of layers, each separated by a thin skin or membrane. For this activity, you can also use the onion membrane.

See: http://en.wikibooks.org/wiki/Botany/How_to_prepare_an_onion_cell_slide

- Thinly slice an onion root, put it on a glass slide, and stain the root (using iodine or methylene blue stain). Have students observe the onion root under high magnification, looking for dividing cells in the onion root tip. Have them sketch what they see in their lab notebook.

Have students open lab notebooks and title new page “Mitosis.” Tell students they are going to make action drawings of the 4 chromosomes during mitosis.

On the left half of the notebook page, make eight circles vertically down the page (large enough to fit the chromosomes and nuclear envelope). The outside edge of the circle represents the plasma membrane of the cell. On the right half of the page next to each circle, with room to add text below each diagram title, write:

1. Interphase
2. Interphase: What is the key event?
3. Prophase: What is the key event?
4. Metaphase: What is the key event?
5. Anaphase, a partially dividing cell: What is the key event?
6. Early telophase, dividing cell: What is the key event?
7. Late telophase, nearly completely divided cell: What is the key event?
8. Two new daughter cells

Follow-up the onion-root lab with the following online onion root mitosis lab: How do cells reproduce? http://bio.rutgers.edu/~gb101/lab2_mitosis/index2.html Have students complete all four parts of the online lab, and add to their drawings of phases of mitosis.

Science Inquiry

Discussion: Regulation of the Cell Cycle

ASK: What do you think could happen if your cells divided uncontrollably? Give the students a few moments to think about this concept. Ask the class for possible answers.

Normal cells naturally die and are replaced by new ones as they divide. Different types of cells have different cycles of time to grow and divide - and die. The cell cycle has signals (or regulators) that tell the cell when it is down with one part of the cycle and ready to move on to the next part. When a cell does not obey these signals, it rapidly divides into two cells; in essence, the cells are growing *out of control*. These cells keep dividing, producing more and more out of control cells. These are cancer cells and the growth that develops is a tumor. The cells can break away and travel elsewhere in the body, beginning a new growth in a new place. **Cancer** is characterized by an abnormal, uncontrollable growth of cells in the body.

Review and Reinforce

1. Cornell University: Biology 101: Cell Division Construction Kit http://biog-101-104.bio.cornell.edu/BioG101_104/tutorials/cell_division/CDCK/cdck.html

Interactive cell-division simulator. Students choose cell and chromosome configuration for appropriate stage of mitosis or meiosis. Can be assigned as homework. Students can use this site to review their understanding of cell division. Can be used in Lesson 2 as well.

The University of Arizona: The Biology Project: Meiosis Tutorial HYPERLINK "http://www.biology.arizona.edu/cell_bio/tutorials/meiosis/page3.html" http://www.biology.arizona.edu/cell_bio/tutorials/meiosis/page3.html Animations, photos, and explanations.

The University of Arizona: The Biology Project: Online Onion Root Tips HYPERLINK “http://www.biology.arizona.edu/Cell_BIO/activities/cell_cycle/cell_cycle.html”
http://www.biology.arizona.edu/Cell_BIO/activities/cell_cycle/cell_cycle.html

Interactive activity on mitosis. Student determine time spent in different phases of the cell cycle. This site needs teacher guidance and instruction to help students understand content.

Cornell University: Biology 101: Whitefish Mitosis HYPERLINK “http://biog-101-104.bio.cornell.edu/biog101_104/tutorials/cell_division/wf_review_fs.html” http://biog-101-104.bio.cornell.edu/biog101_104/tutorials/cell_division/wf_review_fs.html Pictures and descriptive commentary of each phase.

Review Questions and Answers

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Have students answer the Review Questions that are listed at the end of the lesson in their FlexBook.

Points to Consider

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Lesson Assessment

Provided to teachers upon request. Please send an email to teachers-requests@ck12.org.

Copy and distribute the lesson quiz. Provide class time for the students to complete this assessment.

9.3 Lesson 5.2: Reproduction

Key Concept

Cellular division is the process by which all living things reproduce. Reproduction can occur through binary fission, asexual reproduction, and sexual reproduction.

Lesson Objectives

1. Name the types of asexual reproduction.
2. Explain the advantage of sexual reproduction.
3. List the stages of meiosis and explain what happens in each stage.

Lesson Vocabulary

Table 9.4:

Lesson 5.2 Vocabulary		
allele	asexual reproduction	binary fission
crossing-over	cross-pollination	diploid
gametes	gonads	haploid
internal fertilization	external fertilization	meiosis
ovaries	parthenogenesis	sexual reproduction
sister chromatids	testes	zygote

Check Your Understanding

- Can something that does not reproduce still be considered living?
- What stores the genetic information that is passed on to offspring?
- How many chromosomes are in the human nucleus?

Teaching Strategies

Discussion

Introduce the concepts of binary fission, asexual reproduction, parthenogenesis, and sexual reproduction using the FlexBook.

Point out the diagram of binary fission, **Figure 1** and have students take notes. Discuss the komodo dragon born by parthenogenesis and the various ways of reproducing sexually (flowers, fish, humans). Read together the section on meiosis and gametes, having students draw diagrams to help understanding.

Activity: Pipe-Cleaner Chromosomes

Have student teams build pipe-cleaner chromosomes. Pipe-cleaner chromosome models are routinely used in many biology classes. The following, by Larry Flammer, is an especially

thorough write-up, including teacher directions, and worksheets, as well as directions for putting the kits together.

This activity is designed to help students learn the critical distinctions between mitosis and meiosis. Students manipulate pipe-cleaner chromosomes on a template showing stages of mitosis with one pair of chromosomes. Then they repeat the exercise for meiosis. After each phase, students draw the chromosomes on a summary sheet. Students then show the same thing using two pairs of chromosomes. Students usually gain a clearer understanding of these two processes.

- Materials

Large bag of 60-100 pipe cleaners in four or more colors, large bag of beads (small holes to stay in place on the pipe cleaner), box of large paperclips, quart ziplock baggies. Give student teams each a chromosome kit baggie that contains: Two sets of four single stranded chromosomes, each clipped together. Clipped bundles in quart baggies (one per team).

- Advance Preparation

You may have the class make the chromosome kits. Cut four colors of pipe cleaners into large and small sizes. Place matching beads on pipe cleaners, using the paper clip, clip together one of each type of pipe cleaner to make four single stranded chromosomes. Use Larry Flammer's Mitosis and Meiosis Lesson directions for making the student kits: <http://www.indiana.edu/~ensiweb/lessons/gen.mm.html>

Differentiated Instruction

Enrichment

Laboratory Inquiry

Review and Reinforce

Review Questions and Answers

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Have students answer the Review Questions that are listed at the end of the lesson in their FlexBook.

Points to Consider

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Lesson Assessment

Provided to teachers upon request. Please send an email to teachers-requests@ck12.org.

Copy and distribute the lesson quiz. Provide class time for the students to complete this assessment.

9.4 Lesson 5.3: DNA, RNA, and Protein Synthesis

Key Concept

DNA, deoxyribonucleic acid, is the genetic material in most living organisms, including humans. Almost every cell in your body contains the same DNA, most of which is in the nucleus of the cell. DNA's double helix structure allows it to copy itself during cell division.

Lesson Objectives

1. Explain the chemical composition of DNA.
2. Explain how DNA synthesis works.
3. Explain how proteins are coded for and synthesized.
4. Describe the three types of RNA and the functions of each.

Lesson Vocabulary

Table 9.5:

Lesson 5.3 Vocabulary		
amino acid	DNA	DNA replication
double helix	gene	mutagen
mutation	nucleotide	RNA
semiconservative replication	transcription	translation

Check Your Understanding

Teaching Strategies

Differentiated Instruction

Enrichment

Laboratory Activity

Science Inquiry

Review and Reinforce

University of Utah: Online Tour of the Basics of Genetics HYPERLINK “<http://learn.genetics.utah.edu/content/begin/tour/>” <http://learn.genetics.utah.edu/content/begin/tour/> This site answers: What is DNA? What is a Gene? What is a Chromosome? What is a Protein? What is Heredity? What is a Trait?

Review Questions and Answers

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Have students answer the Review Questions that are listed at the end of the lesson in their FlexBook.

Points to Consider

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Lesson Assessment

Provided to teachers upon request. Please send an email to teachers-requests@ck12.org.

Copy and distribute the lesson quiz. Provide class time for the students to complete this assessment.

9.5 Worksheet Answers

Provided to teachers upon request at teachers-requests@ck12.org.

Chapter 10

Introduction to Life Science (TE)

10.1 Unit 3: Genetics and Evolution

Outline

This unit, *Genetics and Evolution*, includes two chapters that

Chapter 6: Genetics

Lesson 6.1: Gregor Mendel and the Foundations of Genetics

Lesson 6.2: Modern Genetics

Lesson 6.3: Human Genetics

Lesson 6.4: Genetic Advances

Chapter 7: Evolution

Lesson 7.1: Evolution by Natural Selection

Lesson 7.2: Evidence of Evolution

Lesson 7.3: Macroevolution

Lesson 7.4: History of Life on Earth

Overview

Chapter 11

TE Genetics

11.1 Chapter 6: Genetics

Outline

This chapter has four lessons:

- Lesson 6.1: Gregor Mendel and the Foundations of Genetics
- Lesson 6.2: Modern Genetics
- Lesson 6.3: Human Genetics
- Lesson 6.4: Genetic Advances

Overview

Teaching Strategies

Pacing the Lessons

Use the **Class Periods per Lesson** table below as a guide for the time required to teach the lessons of this chapter.

Table 11.1:

Lesson	Number of Class Periods*
Lesson 6.1: Gregor Mendel and the Foundations of Genetics	2.0
Lesson 6.2: Modern Genetics	1.0

Table 11.1: (continued)

Lesson	Number of Class Periods*
Lesson 6.3: Human Genetics	1.5
Lesson 6.4: Human Advances	1.0

- Class periods are assumed to be 60 minutes long.

Lab Links

The Mighty Mutation Maker (online game)

- http://nature.ca/genome/04/0413_e.cfm

Managing Materials

Students should be used to using their science lab notebook daily for notes, diagrams, and labs. Depending on your class and structure, you may want to keep the notebooks in the classroom. You then have anytime access to look through and make comments to students in their notebooks.

The materials listed in the **Materials List** table below are needed to teach the strategies and activities described in the Teachers Edition of the FlexBook for this chapter.

Table 11.2:

Lesson	Strategy or Activity	Materials Needed
6.1	1) 2)	1) 2)
6.2	1)	1)
6.3	1)	1)
6.4	1)	1)

Additional Web-Based Resources

- Human Genome Landmarks Poster http://public.ornl.gov/hgmis/external/poster_request.cfm This 24" by 36" wall poster lists selected genes, traits, and disorders associated with each of the 24 human chromosomes. Request a free copy of this poster online, or order a class set.
- Human Genome Landmarks Poster: Chromosome Viewer <http://www.ornl.gov/sci/>

techresources/Human_Genome/posters/chromosome/chooser.shtml View the chromosomes online to see the selected traits and disorders of each chromosome.

- Cracking the Code of Life: NOVA Online <http://www.pbs.org/wgbh/nova/genome/> Two hour video in sixteen chapters, with links to classroom resources and teacher's guide
- University of Utah Genetics Science Learning Center <http://learn.genetics.utah.edu/> Virtual labs and animated basic tours of genetics and technology. DNA Extraction, Transcribe and Translate a Gene, Make a Karotype.
- Blood Type Simulation <http://www.agentsheets.com/education/teacher-material/applets/blood-type/index.html> Requires Java

Making the FlexBook Flexible

An important advantage of the FlexBook is the ability it gives you, the teacher, to choose the chapters and lessons that you think are most important for your own classes. The following information is provided to help you decide whether to include this chapter or certain lessons in this chapter in your students' FlexBook. You should also consult the standards correlation table that follows when selecting chapters and lessons to include in the FlexBook.

- To understand the content of this chapter, students should have read the *Cell Division, Reproduction, and DNA* chapter.
- Students should read this entire chapter before reading the remaining chapters of the FlexBook.
- It is recommended that you include all the lessons of this chapter in the FlexBook.

Common Misconceptions

Traits

In everyday language, a trait can be most anything connected to an organism; there are physical, psychological and emotional traits. In biological language, traits can be also be physical (e.g., eye color, wrinkled or smooth skin on peas) but they can also involve non-observable traits (e.g., specific metabolic processes, such as the ability to synthesize amino acids or to break down specific molecules). Even if students understand the difference between hereditary and non-hereditary traits, they may not understand that not all all inherited traits are observable. Give your students practice is identify both observable and non-observable traits. Bring in articles which report about genetics research, and ask the students to identify the different traits studied in each.

Hereditary vs. Non-Hereditary Traits

Students often find it difficult to distinguish between the two. Which traits are hereditary (eye color), which traits are non-hereditary but influenced by environmental exposure (amount of tanning from the sun), and which skills might be a combination of both types of traits (ability to dance, sing, or play soccer)? Discuss these categories with your students, until they develop an understanding of the key differences. Discuss biographies of famous people who inherited certain traits, but who rose above them due to their own, non-hereditary efforts: Helen Keller, Stevie Wonder, etc.

Phenotype and Genotype

Understanding this difference is crucial in genetic reasoning and problem-solving. Discuss with students specific examples of biological traits (the phenotype) and how these traits are connected to the organism's DNA (the genotype). For example, one biological trait is the ability to break down lactose, a sugar found in milk; a person who doesn't have this trait, the gene for breaking down lactose, cannot digest milk. In previous biology studies, students should have learned that every structure and function of an organism is controlled by proteins. The section of the DNA that codes for a specific protein is called a gene. Therefore, an observed biological trait (phenotype) is represented by an unseen gene (genotype). The information contained in the DNA molecule is transcribed into a RNA molecule, from which the information is translated into a protein.

Ask students to create representations of how the hidden (genotype) is related to the observed (phenotype). In all organisms, the formation a biological trait is linked to certain proteins, and the information of how these proteins are formed is determined by genes on the organism's DNA. Have students draw a diagram or concept map showing the connection between the trait and its gene. Have them present, discuss and defend their representations.

Another way to help students is to have students engage in "effect-to-cause" reasoning. Present them with the results of a specific genetic cross (effect) and have them analyze the genetic background of the parents (cause). Many computer simulations provide students with problem-solving opportunities, which are based on this time of deductive reasoning.

Using Punnet Square Diagrams

Most students are capable of using Punnett Square diagrams to explain the results of genetic crosses, but cannot express their answers logically in words. In other words, they have learned how to solve genetics problems technically, in a stereotyped way, without understanding the relevant underlying principles. To help solve this difficulty, teachers should model how to reason about how to solve genetics problems using a Punnett Square diagram, and how to explain the logic of the results. They should give students opportunities to express and

defend the logic behind their work.

11.2 Lesson 6.1: Gregor Mendel and the Foundations of Genetics

Key Concept

This lesson introduces the father of genetics, Gregor Mendel, whose observations and conclusions about inheritance were later proved correct with the discovery of DNA. Mendel's law of segregation says that an organism has two factors, now known as alleles, for each trait.

Lesson Objectives

1. Explain Mendel's law of segregation.
2. Draw a Punnett Square to make predictions about the traits of the offspring of a simple genetic cross.

Check Your Understanding

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

- What is the genetic material of our cells?
- How does meiosis affect the chromosome number in gametes?

Teaching Strategies

Using Visuals

Read *Grandfather's Nose: Why we Look Alike or Different* by Dorothy Hinshaw Patent. This is a great picture book that introduces genetic inheritance and Mendel's experiments with peas and flowers.

Activity: Pea Experiment Simulation

<http://www.sonic.net/%7Enbs/projects/anthro201/exper/> Students breed their own hybrid pea plants.

Activity: Punnett Squares

Practice solving Punnett Squares using different traits.

Table 11.3:

”	T	t
T	TT	Tt
t	Tt	tt

Square 1

Table 11.4:

”	B	B
b	Bb	Bb
b	Bb	Bb

Square 2

In **Square 1**, both parents are heterozygous for the tall gene, each carrying one allele for short (t), and one allele for tall (T). The Punnett Square shows the probability of offspring genotype and phenotype. Probability is that one of four will be homozygous for tall (TT), two will be heterozygous for tall (Tt), and one will be homozygous recessive for short (tt).

Use the second example (**square 2**) with students with two homozygous parents, one homozygous dominant for brown eyes (BB), and one homozygous recessive for blue eyes (bb). Be sure to point out to students that eye color is actually the product of multiple genes, and we have simplified it for this example. Figure out probabilities.

Observation

Individual and Class Comparison of Traits (need to explain in more detail)

- Dominant and Recessive Phenotypes.

A. Define, discuss, students write examples in notebooks:

a. Alleles- variations of a gene,

b. Diploid organism- reproduces sexually, and gets one set of alleles from one parent and the other set of alleles from the other.

- c. Homozygous- has an identical pair of alleles for the same trait, RR, rr.
- d. Heterozygous-has two different alleles for the same trait, Rr. In simple inheritance, the organism carries the dominant and the recessive allele for that trait.
- e. A capital letter describes a dominant gene; a lower case letter describes a recessive gene. Heterozygous (Bb) for crooked little finger, homozygous (BB) for crooked little finger.
- B. Students make a chart of the following traits, with a column for themselves, family members, and peers. Students examine themselves and see if they have the dominant or recessive traits.

- a. Tongue rolling: RR, Rr (can't roll tongue rr)
- b. Detached earlobe: EE, Ee (attached earlobe ee)
- c. Index finger longer than ring finger
- d. Hitchhiker's thumb: HH, Hh (straight thumb hh)
- e. Dimples: DD, Dd (no dimples dd)
- f. Vulcan: VV, Vv (Earthling vv)
- g. Left-thumbbed: LL, Ll (right-thumbbed ll)
- h. Right-handed: RR, Rr (left-handed rr)
- i. Freckles: FF, Ff (no freckles ff)
- j. Curly Hair: CC, Cc (straight hair cc)
- k. Widow's Peak: Ww, Ww (straight hairline ww)
- l. PTC paper taste: PP, Pp (no PTC taste pp)
- m. Second toe longer than big toe: TT, Tt (second toe shorter tt)
- n. Crooked little finger: BB, Bb (straight little finger bb)

C. Challenge students with biological parents at home to try to determine their genotype. Knowing that they can't roll their tongue gives them the phenotype of not rolling their tongue. This means that they had to inherit each of the lower case r, r. from each parent. If both parents can roll their tongue, both parents would have to have the genotype Rr to produce a child rr. Review Punnett Squares for clarity. Explain to students that Punnett Squares can be used to analyze possible inheritance.

- After charting their own and others traits, use examples from above to make Punnett Squares and compute the probability of different genotype and phenotype in the offspring.

Discussion

- What is the purpose of DNA?

DNA contains all of the genetic instructions for building the organism.

- When is DNA replicated?

A cell must replicate its DNA before it divides.

Enrichment

- The Biology Project: Monohybrid Cross Problem Set http://www.biology.arizona.edu/mendelian_genetics/problem_sets/monohybrid_cross/01t.html Two online problem sets on the Monohybrid Cross and Mendel's First Law, with answers using Punnett Squares. Students practice setting up and predicting outcomes with Punnett Squares.
- Ishihara Color Blindness Test http://www.geocities.com/alfredo_71/vidaurri_5.html Students test themselves online for red-green color deficiency.
- The Biology Project: Color Blindness Test Problem Set http://www.biology.arizona.edu/human_bio/problem_sets/color_blindness/color_blindness.html Use pedigree charts to understand how red-green colorblindness is an X-linked, recessive trait, and how it is inherited.
- NOVA DNA Fingerprinting Lab <http://www.pbs.org/wgbh/nova/sheppard/analyze.html> Students review DNA and gel electrophoresis as they create a DNA fingerprint from saliva in a virtual lab. Requires Shockwave. Lab Worksheet (Print for students before they do the lab): <http://www.biologycorner.com/worksheets/fingerprint.html>
- The Biology Project: Karyotyping Activity (English or Spanish) http://www.biology.arizona.edu/human_bio/activities/karyotyping/karyotyping.html Simulation of human karyotyping. Students use human digital images of chromosomes, becoming familiar with human genetic studies. Directions and Student Lab Sheet for Analyzing Karyotypes: <http://www.biologycorner.com/worksheets/karyotyping.html>
- Virtual Bacterial Identification Lab http://www.hhmi.org/biointeractive/vlabs/bacterial_id/index.html DNA Lab Tools, HHMI, picture and description of basic Genetics Lab Equipment. Students become familiar with modern DNA sequencing equipment.

Laboratory Activities

Science Inquiry

Activity Type

Reinforce and Review

Activity Type

Review Questions and Answers

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Have students answer the Review Questions that are listed at the end of the lesson in their FlexBook.

Points to Consider

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Lesson Assessment

Provided to teachers upon request. Please send an email to teachers-requests@ck12.org.

Copy and distribute the lesson quiz. Provide class time for the students to complete this assessment.

11.3 Lesson 6.2: Modern Genetics

11.4 Lesson 6.3: Human Genetics

11.5 Lesson 6.4: Genetic Advances

11.6 Review Answer Repository

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

11.7 Worksheet Answers

Provided to teachers upon request at teachers-requests@ck12.org.

Chapter 12

TE Evolution

12.1 Chapter 7: Evolution

Outline

The chapter Evolution consists of four lessons that introduce students to this extremely important topic - the change in species over time.

- Lesson 7.1: Evolution by Natural Selection
- Lesson 7.2: Evidence of Evolution
- Lesson 7.3: Macroevolution
- Lesson 7.4: History of Life on Earth

Overview

Darwin's Theory of Evolution by Natural Selection is arguably the most important theory of the biological sciences. Some scientists believe this theory ties together every aspect of the life sciences. These lessons discuss evolution and how the theory was developed. Evidence supporting evolution is also presented. Lastly, the history of life on Earth, or how life first may have formed, is discussed.

Pacing the Lessons

Use the **Class Periods per Lesson** table below as a guide for the time required to teach the lessons of this chapter.

Table 12.1:

Lesson	Number of Class Periods*
Lesson 7.1: Evolution by Natural Selection	2.0
Lesson 7.2: Evidence of Evolution	1.5
Lesson 7.3: Macroevolution	1.0
Lesson 7.4: History of Life on Earth	1.0

- Class periods are assumed to be 60 minutes long.

Managing Materials

Students should be used to using their science lab notebook daily for notes, diagrams, and labs. Depending on your class and structure, you may want to keep the notebooks in the classroom. You then have anytime access to look through and make comments to students in their notebooks.

The materials listed in the **Materials List** table below are needed to teach the strategies and activities described in the Teachers Edition of the FlexBook for this chapter.

Table 12.2:

Lesson	Strategy or Activity	Materials Needed
7.1	1) 2)	1) 2)
7.2	1)	1)
7.3	1)	1)
7.4	1)	1)

Additional Web-Based Resources

- Exploring Evolution WebLab <http://www2.edc.org/weblabs/ExploringEvolution/ExploringEvolutionMenu.html> Students examine the evolutionary history of a whale using three types of evidence.
- PBS: Evolution <http://www.pbs.org/wgbh/evolution/> Evolution library for teachers or students and short QuickTime videos on Darwin, Change, Extinction, Survival, Sex, Humans, and Religion.
- ThinkQuest: Forensic Science http://library.thinkquest.org/04oct/00206/text_index.htm Students explore forensic science through blood, hair, and DNA analysis. Includes Teacher and Student Notes, advanced experiments, informational text, pho-

tos, diagrams. Forensic Science Lesson Plans: http://library.thinkquest.org/04oct/00206/text_lesson.htm

- PBS: Scopes Trial http://www.pbs.org/wgbh/evolution/library/08/2/1_082_01.html Historical perspective on evolution and science curriculums in the United States. QuickTime video and text background.
- PBS NOVA: Judgement Day: Intelligent Design on Trial <http://www.pbs.org/wgbh/nova/id/> Video and audio presentations, interactive investigations, expert discussions, and Teachers' Guide.

Making the FlexBook Flexible

An important advantage of the FlexBook is the ability it gives you, the teacher, to choose the chapters and lessons that you think are most important for your own classes. The following information is provided to help you decide whether to include this chapter or certain lessons in this chapter in your students' FlexBook. You should also consult the standards correlation table when selecting chapters and lessons to include in the FlexBook.

- To understand the content of this chapter, students should have read the *Genetics* chapter.
- Students should read this entire chapter before reading the remaining chapters of the FlexBook.
- It is recommended that you include all the lessons of this chapter in the FlexBook.

Common Misconceptions

In regards to Evolution, middle school students typically have difficulties with the following concepts:

Natural Selection

A major hindrance to understanding natural selection appears to be students' inability to integrate two distinct processes in evolution, the occurrence of new traits in a population and their effect on long-term survival. Many students believe that environmental conditions are responsible for changes in traits, or that organisms develop new traits because they need them to survive, or that they over-use or under-use certain bodily organs or abilities. By contrast, students have little understanding that chance alone produces new heritable characteristics by forming new combinations of existing genes or by mutations of genes. Some students believe that a mutation modifies an individual's own form during its life rather than only its germ cells and offspring (see almost any science fiction movie). Students also have difficulties understanding that changing a population results from the survival of a few individuals that preferentially reproduce, not from the gradual change of all individuals in the population.

Explanations about “insects or germs becoming more resistant” rather than “more insects or germs becoming resistant” may reinforce these misunderstandings.

One effective strategy for demonstrating natural selection is the simulation game for students developed by G. Ledyard Stebbins, et al. It can be found at:

- Regents Biology: Natural Selection Lab <http://209.85.229.132/search?q=cache:NQGic7zxQosJ:www.explorebiology.com/documents/LE/LabNaturalSelection2008.pdf+Stebbins+natural+selection+game&cd=4&hl=en&ct=clnk> Classroom game representing the natural selection of butterflies with paper dots.

Evolutionary Reasoning

Some research suggests that students’ understanding of evolution is related to their understanding of the nature of science and their general reasoning abilities. Findings indicate that poor reasoners tend to retain nonscientific beliefs such as “evolutionary change occurs as a result of need,” because they fail to examine alternative hypotheses and their predicted consequences, and they fail to comprehend conflicting evidence. Thus, they are left with no alternative but to believe their initial intuitions or the misstatements they hear.

12.2 Lesson 7.1: Evolution by Natural Selection

Key Concept

Evolution is change in living organisms that occurs over many generations through natural selection. Charles Darwin developed the Theory of Evolution after he, and others, collected evidence from various sources.

Lesson Objectives

- Know that inherited traits, such as the basic color of skin or a person’s bone structure, are passed on to future generations.
- Know that acquired traits, such as a tan or being good at soccer, are not passed on to future generations (they are not inherited).
- Know that evolution is change of an inherited trait in a population over many generations, such as the change of the color of moths living on an island over many generations.
- Know that natural selection means that organisms with traits that help them survive in their environment are more likely to survive than organisms without that beneficial trait.

- Know how evolution explains:
 1. Why populations change.
 2. Why there are so many different kinds of organisms on earth.
 3. Why some organisms that look alike only distantly related.
- Know that both Darwin and Wallace developed the theory of evolution by natural selection at the same time.

Lesson Vocabulary

Table 12.3:

Lesson 7.1 Vocabulary		
acquired trait evolution	adaptation evolution by natural selection	artificial selection Galapagos Islands
inherited traits trait	natural selection	species

Check Your Understanding

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

- What does the word evolution refer to when used in day to day conversations?
- What does biological evolution mean?
- Who primarily proposed the theory of evolution by natural selection?

Teaching Strategies

Building Science Skills: Forming a Hypothesis

Before you begin this lesson, ask the students to form a hypothesis about evolution and how it occurs. Tell them to incorporate their knowledge of genetics. Ask them to be creative. They may work with a partner, but have each student write the hypothesis into their notebooks.

Ask brave individuals to share their hypothesis with the class. Stress that it took Darwin over 20 years to develop his findings into his hypothesis.

Using Visuals

Have students discuss the map of the voyage of the Beagle. Point out the many stops along South America and the position of the Galapagos Islands. Also point out the additional stops around the world, and how this led to the vast amounts of data Darwin was able to collect.



Figure 12.1: Charles Darwin's famous five year voyage was aboard the HMS Beagle from 1831-1836. (1)

Using Visuals: Sex and the Single Guppy

PBS Evolution: Sex and the Single Guppy http://www.pbs.org/wgbh/evolution/sex/guppy/ed_pop.html

Slideshow on male guppy defensive camouflage and mating colors. Worksheet for Sex and the Single Guppy: <http://www.biologycorner.com/worksheets/guppy.html>

Activity: Evolution Lab Simulator

Learn about evolution by participating in a computer simulation to track organisms as they evolve.

- start at: <http://www.biologycorner.com/worksheets/evolutionlab.html>
- go to: <http://www.BiologyInMotion.com>: Evolution Lab Directions

- a. Simulation 1: How mutation rate affects evolution
- b. Simulation 2: How selection strength affects evolution

- <http://www.biologyinmotion.com/evol/index.html>
- NCES Kids' Zone: Create a Graph <http://www.nces.ed.gov/nceskids/createagraph/default.aspx> Graph data from simulations.
- Lab Conclusions

Study the effects of mutations and selection on evolution.

Show how natural selection leads to evolution of adaptation.

Discussion

- **Ask:** What is a fossil?

Ask the class to provide sample definitions and examples. Develop a list of examples on the board and have the students copy the list into their notebooks.

(A fossil is the remains of a once-living organism from a long time ago. Fossils come in all sizes; they give us clues to previous forms of life.)

Differentiated Instruction

Word Wall

Post the vocabulary and their definitions from the FlexBook on the wall during this lesson. It is important for students to understand the concepts of traits and adaptations.

Enrichment

Debate an Issue

Divide students into teams and have them debate the issue of evolution. Ask students to pretend to be living in England around the 1859, when Darwin's book was published. Students may need to research English society and culture from that time. This may be done over a few class periods or aspects of this assigned as homework. Students will have to act out their debate, with each student participating.

Laboratory Activity

- BiologyCorner.com: Peppered Moth Simulation http://www.biologycorner.com/worksheets/peppermoth_paper.html This paper and pencil lab explores the evolutionary effect on certain moths of industrial soot coloration of trees.

Reinforce and Review

Make a Drawing

Have students create a simple sketch to demonstrate their comprehension evolution by natural selection. They can include what they know about an existing species or you can ask them to create a novel species. Have the students include a description of the evolutionary process for their species. If they choose to create a novel species, make sure they name their species.

Lesson Worksheets

Copy and distribute the four Lesson 7.1 worksheets in the Supplemental Workbook. Ask students to complete the worksheets alone or in pairs as a review of lesson content.

Review Questions

Have students answer the Lesson 7.1 Review Questions that are listed at the end of the lesson in their FlexBook.

- Sample answers to these questions will be provided upon request. **Please send an email to teachers-requests@ck12.org to request sample answers.**

Points to Consider

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

- Evolution by natural selection is supported by extensive scientific evidence. What do you think this evidence consists of?

Lesson Assessment

- Have students complete the Lesson 7.1 Quiz.

The lesson quiz and answer key are available upon request. Please send an email to teachers-requests@ck12.org to request material.

12.3 Lesson 7.2: Evidence of Evolution

Key Concept

Life has existed on earth for billions of years and has changed over time.

Lesson Objectives

- Know the scientific theory of biological evolution is based on extensive physical evidence and testing. This includes:
 1. Differences between fossils in different layers of rock
 2. The age of rocks and fossils
 3. Vestigial structures
 4. Similarities between embryos of different organisms
 5. The same DNA and RNA materials found in all organisms
 6. Similar genomes found in almost all organisms

Lesson Vocabulary

Table 12.4:

Lesson 7.2 Vocabulary		
embryo	embryology	fossil
fossil record	genetics	genome
paleontologists	radiometric dating	vestigial structure

Check Your Understanding

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

- Where did Charles Darwin collect evidence of evolution and what kinds of evidence did he find?
- What is natural selection?

- What kinds of traits change through evolution?

Teaching Strategies

Using Visuals

Have students critique **Figure 1**, evaluating the changes that occur at each evolutionary step depicted.

Discussion

1. Evolution by natural selection is supported by extensive scientific evidence.

- PBS Evolution: Library: Isn't Evolution Just a Theory? http://www.pbs.org/wgbh/evolution/library/11/2/real/e_s_1.html 6 minute RealPlayer video

No evidence has been found on earth that is not explained by evolution. Discuss how much evidence has been discovered, why evolution is such a widely-held scientific theory, and what future discoveries may show.

Evolution as a theory does not simply mean a guess; it has been tested and supported by massive amounts of biological evidence from the fossil record and living species. Evolution can explain all evidence from the past two centuries of searching. In the future, we may find more about new species and their genomes from the fossil record, rainforests, and oceans.

Differentiated Instruction

Gallery Walk: Evidence

Place large paper around the room with the following categories:

1. The Fossil Record
2. Physiological Evidence
3. Molecular Evidence.

Teams of students are to provide an example from the category of evidence of evolution. Each group (using a different color pen) provides at least one example. They also read and respond to the examples written by other groups. This is followed by the teacher discussing the examples with the class or reviewing misunderstandings they reveal, or by groups summarizing what they know about one or more examples.

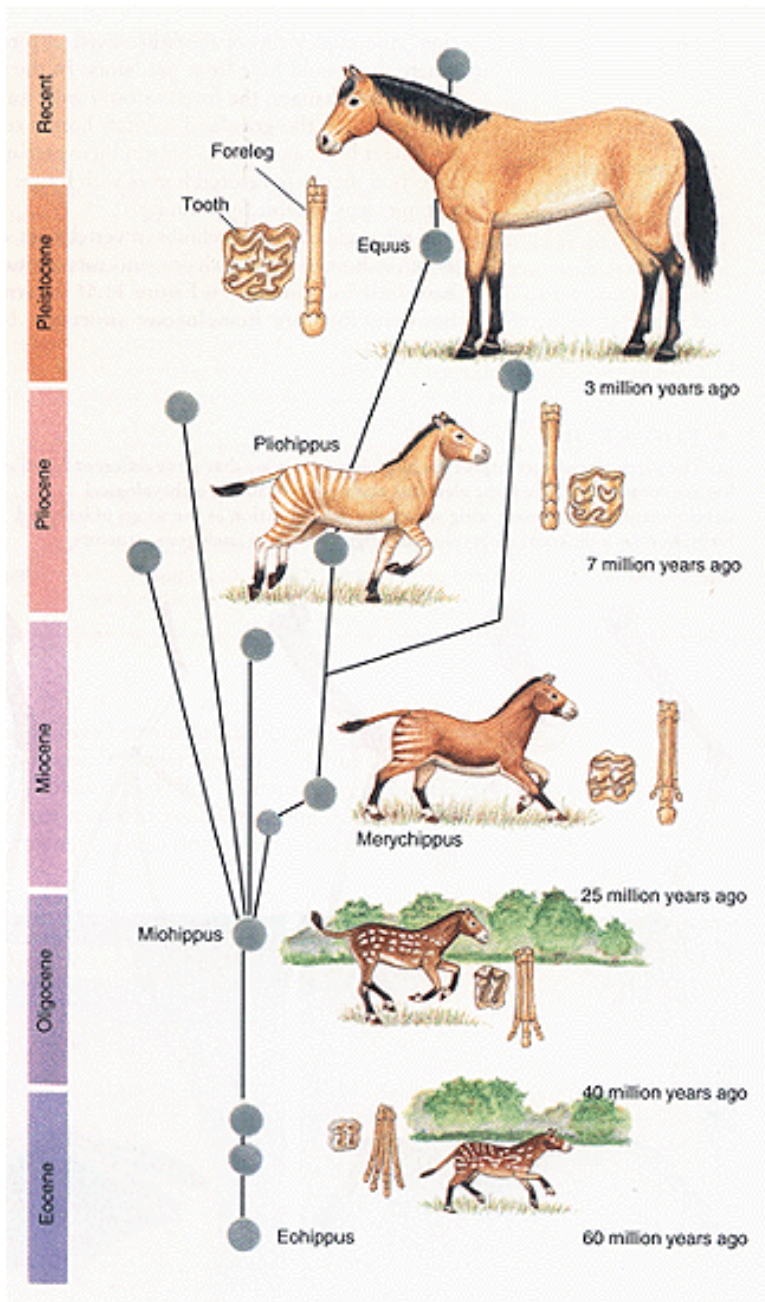


Figure 12.2: Evolution of the horse. Fossil evidence, depicted by the skeletal fragments, demonstrates evolutionary milestones in this process. (2)

Enrichment: Research a Topic

Evidence for Evolution

Divide the class up into 4 teams to research evidence for evolution (fossil evidence, homologies, distribution in time and space, and evidence by example).

- Beginning research sites:
 - a. Understanding Evolution: Lines of Evidence: The Science of Evolution http://evolution.berkeley.edu/evolibrary/article/_0_0/lines_01 Breaks down lines of evidence into 4 areas: fossil evidence, homologies, distribution in time and space, and evidence by example. From U.C. Berkeley.
 - b. PBS Evolution: Evidence for Evolution Webquest <http://www.pbs.org/wgbh/evolution/educators/lessons/lesson3/act2.html> Students investigate a variety of types of evidence for evolution.
- Student teams research evidence for evolution and create a class presentation of their data. They may use a chart like the one at the Evidence for Evolution Webquest site, or they may design their own.

Laboratory Activity

- Indiana University, ENSI: Mystery of the Matching Marks OR Search for the Tell-Tale Telomere <http://www.indiana.edu/~ensweb/lessons/mmm.html> Activity investigating similarity of human and ape DNA, based on the fact that modern apes and humans evolved from a shared common ancestor.

This activity is a molecular analysis into human evolution with a forensic science twist. When bullet marks from bullets at a crime scene match bullets fired from a suspect's gun, this provides compelling evidence of a common origin of the bullets - from the same gun. The same comparison of chromosome banding patterns of the chromosomes from humans and chimpanzees likewise offers compelling evidence of a common origin - a common ancestor. Furthermore, the existence of two shorter chromosomes in chimps that together closely match the long human chromosome #2 suggests the hypothesis that our #2 chromosome formed by the fusion of those two shorter chromosomes after we branched off from that common ancestor. Students test that hypothesis by searching for telomere DNA in the supposed fusion area of our #2 chromosome, and find it! This lesson includes a PowerPoint presentation that orchestrates the above series of experiences: background, preparation for the short lab, and follow-up. It also provides a somewhat more accessible version of the ENSI lesson: "Chromosome Fusion," where students actually search online DNA databases for the telomere sequences.

Science Inquiry

Reinforce and Review

Ask Questions

Students are to explore the following PBS:Evolution site

- <http://www.pbs.org/wgbh/evolution/>

This site is an evolution library for teachers and students featuring short Quick Time videos on Darwin, Change, Extinction, Survival, Sex, Humans, and Religion. Either individually, in groups or as a class, watch selected videos on evolution. Students are to write questions or make comments. This will be followed by a class discussion. Give students the opportunity to answer other student's questions or address their comments.

Review Questions and Answers

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Have students answer the Review Questions that are listed at the end of the lesson in their FlexBook.

Points to Consider

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Lesson Assessment

Provided to teachers upon request at teachers-requests@ck12.org.

Copy and distribute the lesson quiz. Provide class time for the students to complete this assessment.

12.4 Lesson 7.3: Macroevolution

Key Concept

Most evolutionary changes are small and do not lead to the creation of a new species, these are called microevolution. Macroevolution refers to bigger evolutionary changes that result in new species.

Lesson Objectives

- Students will understand the differences between macroevolution and microevolution.
- Students will understand that speciation is the formation of new species
- Students will understand the mechanisms of speciation.

Lesson Vocabulary

Table 12.5:

Lesson 7.3 Vocabulary		
allopatric speciation	artificial selection	behavioral isolation
evolutionary tree	genotype	geographic isolation
macroevolution	microevolution	natural selection
primate	reproductive isolation	speciation
sympatric speciation	temporal isolation	

Check Your Understanding

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

- Why can't an individual person evolve? Why can only groups evolve over many generations?
- What causes a species or a population to evolve?

Teaching Strategies

Building Science Skills: Identifying Cause and Effect

Student teams watch this U.C. Berkeley presentation together, taking notes and discussing.

- Understanding Evolution: Evolution at Different Scales: Micro to Macro

http://evolution.berkeley.edu/evolibrary/article/0_0_0/evoscales_01 Ask students to identify the cause and effect of macroevolution.

Building Science Skills: Classifying

Using Visuals

Differentiated Instruction

Enrichment

Laboratory Activity

Science Inquiry

Reinforce and Review

1. Teachers' Domain: How New Species Evolve http://www.teachersdomain.org/resource/tdc02.sci.life.evo.lp_newspecies/ Two-part speciation lesson with Quicktime videos and Flash interactive presentations.
2. PBS Evolution: Evolution of Camouflage http://www.pbs.org/wgbh/evolution/library/01/1/1_011_03.html QuickTime Video, 58 seconds, on adaptation of praying mantis' camouflage
3. PBS Evolution: Evolution of the Eye [/01/1/1_011_01.html](http://www.pbs.org/wgbh/evolution/library/01/1/1_011_01.html) http://www.pbs.org/wgbh/evolution/library/01/1/1_011_01.html Quick Time video, 4 minutes, of a possible evolutionary path toward the modern human eye.

Review Questions and Answers

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Have students answer the Review Questions that are listed at the end of the lesson in their FlexBook.

Points to Consider

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Lesson Assessment

Provided to teachers upon request at teachers-requests@ck12.org.

Copy and distribute the lesson quiz. Provide class time for the students to complete this assessment.

12.5 Lesson 7.4: History of Life on Earth

Key Concept

Modern geologists have determined the age of the Earth to be about 4.54 billion years old, according to radiometric dating.

Lesson Objectives

- Know that geologists and paleontologists use evidence to determine the history of Earth and life on earth.
- Know that geologists and paleontologists measure the radioactivity in certain rocks to determine the age of the earth and fossils.
- Know that the earth is between four and five billion years old
- Know that scientists need to know what the environment (what chemicals were around, the temperature, etc.) was like on earth billions of years ago to know how life formed.

Lesson Vocabulary

Table 12.6:

Lesson 7.4 Vocabulary		
Cambrian explosion	extinct	mass extinction
radiometric dating	stromolites	

Check Your Understanding

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

- What are fossils?
- How does the fossil record contribute to the evidence of evolution?

Teaching Strategies

1. Stretch a piece of butcher paper around the room, covering 4 walls. Tell students that this will be a timeline of the history of life on earth that they will build.
2. The first wall covers 4.6 billion years ago (bya) – ~ 3.5 billion years, the second wall ~ 3.5 bya– ~ 2 bya, third wall ~ 2 bya– ~ 1 bya, fourth wall, the last billion years on earth.
3. With class input, post the four major periods of life on earth listed below and divide the four walls up appropriately, putting a title of each period and making a vertical line to separate the periods. Guide students to divide the last one billion years into tenths on the wall, to make it easier for organism placement later in the activity.

- Period 1 1: Precambrian

- a. ~ 4.6 billion years ago to ~ 544 million years ago (mya).
- b. mostly microscopic primitive life
- c. about 88% of all Earth history

- Period 2: Paleozoic

- a. ~ 590 mya to 248 mya
- b. Ancient life
- c. Begins with aquatic life, first mass extinction,
- d. first land plants, animals, and amphibians, first bony fishes and sharks, second mass extinction
- e. first reptiles and conifers, insects, reptiles, third mass extinction

- Period 3: Mesozoic

- a. ~ 248 mya to 65 mya
- b. Middle life
- c. Era of reptiles, first dinosaurs, fourth mass extinction
- d. Dinosaurs dominate, first birds, first mammals, fifth mass extinction

- Period 4: Cenozoic

- a. ~ 64 mya to present time
- b. Recent life
- c. Placental mammals, modern mammals, primates, origin of humans, modern humans worldwide distribution, sixth mass extinction

The last three, Paleozoic, Mesozoic, Cenozoic are grouped together in the Phanerozoic Eon (age of multicellular organisms). 4. Give pairs of students large sticky notes and assign them to an organism: bacteria, birds, first mammals, Java man, Peking woman, cyanobacteria, first reptiles, Cro-Magnon man, Lucy, modern day humans, invertebrates, fish, amphibians, sharks, first bony fishes, or insects.

5. Students research their organism, draw a picture and label on their sticky note, put date first appeared on earth on sticky, add their names, and post the sticky note in the appropriate place on the earth timeline.

6. When students are finished, have students tour the timeline with their science notebooks, noting questions and possible corrections.

7. Students take their seats. Class discusses the time line with questions and corrections. When students are challenged on their research or placement, have them defend their choices, listen to class comments, and decide whether to change their organism placement based on the evidence the class has given.

Building Science Skills: Classifying

Discussion

1. Are humans causing the sixth mass extinction? How? Why? What should be done?

Humans are destroying ecosystems and living species around the world at an unprecedented rate; in some estimates, more than 30,000 species per year. We exploit both species and natural resources. The human population is growing and overpopulating as agriculture replaces natural environments. Human pollution from manufacturing, building, and living environments also contributes to the extinction of species.

- The Daily Galaxy: The Earth's 6th Great Mass Extinction is Occurring As You Read This

http://www.dailygalaxy.com/my_weblog/2008/02/the-6th-great-m.html Article documenting the rate of destruction of species

2. How did the discovery of radioactivity enable the measurement of geologic time and estimations on the age of the earth?

Dating methods using radiocarbon, potassium-argon, rubidium-strontium, and uranium lead are based on the transformation of one element to another; they measure the half-life specific to each element. Potassium-argon, rubidium-strontium, and uranium lead half-lives on the order of billions of years, and so are most useful for geological dating of the earth.

Using Visuals

Differentiated Instruction

Enrichment

Laboratory Activity

Science Inquiry

Reinforce and Review

- University of California Museum of Paleontology: History of Life Through Time

<http://www.ucmp.berkeley.edu/exhibits/historyoflife.php> To start exploring this online exhibit, click on one of the three domains of life: bacteria, eukaryota, or archaea.

- PBS: Scopes Trial http://www.pbs.org/wgbh/evolution/library/08/2/1_082_01.html Historical perspective on evolution and science curriculums in the United States. QuickTime video and text background.

PBS NOVA: Judgement Day: Intelligent Design on Trial <http://www.pbs.org/wgbh/nova/id/> Video and audio presentations, interactive investigations, expert discussions, and Teachers' Guide.

Review Questions and Answers

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Have students answer the Review Questions that are listed at the end of the lesson in their FlexBook.

Points to Consider

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Lesson Assessment

Provided to teachers upon request at teachers-requests@ck12.org.

Copy and distribute the lesson quiz. Provide class time for the students to complete this assessment.

12.6 Worksheet Answers

Provided to teachers upon request at teachers-requests@ck12.org.

Image Sources

- (1) http://en.wikipedia.org/wiki/Image:Voyage_of_the_Beagle.jpg. GNU Free Documentation.
- (2) <http://www.bringyou.to/apologetics/HorseEvolution.gif>.

Chapter 13

Introduction to Life Science (TE)

13.1 Unit 4: Prokaryotes, Protists, Fungi, and Plants

Outline

This unit, *Prokaryotes, Protists, Fungi, and Plants*, includes three chapters that ...

Chapter 8: Prokaryotes

Lesson 8.1: Bacteria

Lesson 8.2: Archaea

Chapter 9: Protists and Fungi

Lesson 9.1: Protists

Lesson 9.2: Fungi

Chapter 10: Plants

Lesson 10.1: Introduction to Plants

Lesson 10.2: Seedless Plants

Lesson 10.3: Seed Plants

Lesson 10.4: Plant Responses

Overview

Chapter 14

TE Prokaryotes

14.1 Chapter 8: Prokaryotes

Outline

The chapter *Prokaryotes* consists of two lessons that introduces students to the two prokaryotic kingdoms, Bacteria and Archaea:

- Lesson 8.1: Bacteria
- Lesson 8.2: Archaea

Overview

Teaching Strategies

Pacing the Lessons

Use the **Class Periods per Lesson** table below as a guide for the time required to teach the lessons of this chapter.

Table 14.1:

Lesson	Number of Class Periods*
Lesson 8.1: Bacteria	2.0
Lesson 8.2: Archaea	2.0

- Class periods are assumed to be 60 minutes long.

Lab Links

Managing Materials

The materials listed in the **Materials List** table below are needed to teach the strategies and activities described in the Teachers Edition of the FlexBook for this chapter.

Table 14.2:

Lesson	Strategy or Activity	Materials Needed
8.1	1) 2)	1) 2)
8.2	1)	1)

Additional Web-Based Resources

- BiologyCorner.com: Prokaryote Coloring http://www.biologycorner.com/worksheets/prokaryote_color.html Prokaryote parts worksheet
- BiologyCorner.com: Animal Cell Coloring <http://www.biologycorner.com/worksheets/cellcolor.html> Animal cell parts worksheet
- BiologyCorner.com: Plant Cell Coloring <http://www.biologycorner.com/worksheets/cellcolor-plant.html> Plant cell parts worksheet

Making the FlexBook Flexible

An important advantage of the FlexBook is the ability it gives you, the teacher, to choose the chapters and lessons that you think are most important for your own classes. The following information is provided to help you decide whether to include this chapter or certain lessons in this chapter in your students' FlexBook. You should also consult the standards correlation table that follows when selecting chapters and lessons to include in the FlexBook.

- To understand the content of this chapter, students should have read the *Cells and Their Structures* and the *Cell Division, Reproduction, and DNA* chapters.
- Students should read this entire chapter before reading the remaining chapters of the FlexBook.
- It is recommended that you include all the lessons of this chapter in the FlexBook.

Common Student Misconceptions

In regards to prokaryotes, middle school students typically have difficulties with the following concepts:

The Two Main Types of Cells

Students need to understand that the two main types of cells in living things are prokaryote and eukaryote, not plant and animal. This is one of the major distinctions between organisms. One strategy to help students understand the difference between these two types of cells is to have them understand what the terms mean: prokaryote means “before or lacking a nucleus” while eukaryote means “true nucleus.” Have students compose a table listing other differences between these two types of cells. Have students look at a variety of various eukaryotic and prokaryotic cells; for example, students can associate the familiar bacterium *E. coli* with prokaryotic cell characteristics.

Are All Prokaryotes Bacteria?

The answer is “no.” In order for students to understand this fact, have them distinguish between prokaryotes, such as *E. coli*, with examples of archaea, which are not prokaryotes but not bacteria.

Are All Bacteria Connected to Dirt, Disease and Death?

As it turns out, most bacteria are completely harmless. While some species of bacteria are dangerous to other organisms, including people, the majority are not. Have students explore and report about the many bacteria species which are either neutral or beneficial to people.

Importance of Bacteria to People

It may come as a surprise to many students that our bodies cannot survive without certain bacteria. About 25 species of bacteria live inside of our mouth, and other species live in our stomach and intestines, to help us to digest our food and produce essential vitamins. Have students distinguish between harmful and helpful bacteria (see Lesson 8.1).

Importance of Prokaryotes on Earth

Students should appreciate that if one took all of the biomass of prokaryotes, and compared it with the biomass of all eukaryotes on Earth, the former would outweigh the latter!

Prokaryotes live everywhere, often in great quantities, and they are quite diverse – metabolically, structurally, and biochemically. Because of their vital functions, such as in the soil and in our bodies, without prokaryotes, eukaryotes like ourselves wouldn't be able to survive on Earth.

14.2 Lesson 8.1: Bacteria

Key Concept

Lesson Objectives

1. Describe the cellular features of bacteria.
2. Explain the ways in which bacteria can obtain energy.
3. Explain how bacteria reproduce themselves.
4. Identify some ways in which bacteria can be helpful.
5. Identify some ways in which bacteria can be harmful.

Vocabulary

Lesson 8.1 Vocabulary

Table 14.3:

bacilli	binary fission	cocci
chemotrophs	Conjugation	cyanobacteria
decomposers	flagella	nucleoid
peptidoglycan	plasmid	prokaryotes
transduction	transformation	spirilli

Check Your Understanding

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

- How do prokaryotic and eukaryotic cells differ?
- What are some components of all cells, including bacteria?

Teaching Strategies

Building Science Skills: Forming Hypothesis

Explain to students that because bacteria reproduce so rapidly, they can evolve and change rapidly. This is why they may have heard about antibiotic resistant drugs. Ask students to develop a hypothesis that explains how antibiotic resistance bacteria evolve.

When the bacteria develop a mutation that is resistant to the antibiotic used, that new population grows as the old population dies off in response to the drug. Each time a new antibiotic is introduced, the same thing can happen.

Have students draw four Petri dishes in their notebooks. In # 1, have them draw several black bacteria and one blue. If an antibiotic was used that killed the black bacteria, draw the result in the next Petri dish. (They should draw one blue bacterium in dish # 2.) In dish #3, have the students draw the result of reproduction of the population from # 2. (Students should draw many blue bacteria.) Now, a new bacteria evolves in the # 3 dish, color in one new red bacterium. If a new antibiotic is used in dish #3 to kill the blue bacteria, draw the result in the # 4 dish. (Students should draw one red bacterium in #4.)

Building Science Skills: Classifying

Direct students to this article in the Why Files about bacteria, their population, their size, and microbiologists' guesses of the size of earth's bacteria population (5×10^{30}). You may print the article or use it online. Several links from this page provide additional information on bacteria, as well.

- **Why Files.org: Microbial Population Explosion**

http://whyfiles.org/shorties/count_bact.html

Have students read the lesson with a partner, listing all of the characteristics of bacteria from the FlexBook and from the Why Files article. Report out to the class.

- Bacteria:

Are single-celled, microscopic, have no nucleus and no mitochondria,

The genetic material of bacteria is composed of a single DNA strand.

Usually live on something, and live and grow in colonies.

Take three main shapes: rod, cocci, or spirilli.

Sometimes have flagella for movement.

Are decomposers; they break down waste to get energy.

Sometimes are photosynthetic, or make their own food - but without chloroplasts.

Sometimes are chemotrophs that get energy by breaking down chemical compounds.

Bacteria reproduce through binary fission.

Discussion

1. Discuss with your class what they think are some of the characteristics, and some of the differences, of prokaryotic organisms.

Prokaryotes are defined by the fact that they lack a cell nucleus or any other membrane-bound organelles. Most prokaryotes are unicellular, but some bacteria have multi-cellular stages at some point in their life cycles. Prokaryotes include the bacteria and the archaea. Prokaryotes are known to be the first living organisms on earth, with fossil records dating back over three billion years. Even now, they are the most successful life forms on earth. They have greatly diversified through the years, obtaining energy from inorganic compounds in harsh environmental conditions.

2. What are the three shapes of bacteria?

The bacilli are rod-shaped, the cocci are sphere-shaped, and the spirilli are spiral-shaped.

3. How do bacteria reproduce?

Through binary fission, producing genetically identical organisms.

4. How can bacteria be harmful?

Bacteria can cause diseases such as strep throat. They can also be involved with food poisoning and biological warfare.

5. Some doctors and scientists encourage people to only take antibiotics if absolutely necessary, because taking antibiotics gives bacteria opportunities to adapt and mutate. What are their reasons for this viewpoint?

When antibiotics are used, the bacteria evolve quickly and become resistant. The cycle continues with each new iteration of a drug to treat that bacterial infection. Doctors and scientists are concerned that we will not be able to continually produce new drugs, and that bacteria may evolve into “super bugs” that we cannot find a drug to treat. Using antibiotics when truly necessary is important and encouraged.

Differentiated Instruction

K-W-L Chart

Ask students what they know about bacteria. Prokaryotes, bacteria and archaea are single-celled organisms that lack a nucleus.

Log their responses about bacteria on one side of the board or poster paper. Then ask for some questions, asking them what they don't know and what they would like to know. Have the students copy this chart into their notebook and fill in the L column as they find the answers.

Enrichment

Make a crossword puzzle.

Have students use the lesson vocabulary words and definitions to create a crossword puzzle.

Vocabulary

Table 14.4:

bacilli	Rod-shaped bacteria or archaea.
binary fission	Type of asexual reproduction where a parent cell divides into two identical daughter cells.
cocci	Sphere-shaped bacteria or archaea.
chemotrophs	Organisms that obtain energy by oxidizing compounds in their environment.
conjugation	The transfer of genetic material between two bacteria.
cyanobacteria	Photosynthetic bacteria.
decomposers	Organisms that break down wastes and dead organisms and recycle their nutrients back into the environment.
flagella	Long, tail-like appendages that allow movement.
nucleoid	The prokaryotic DNA consisting of a condensed single chromosome.
peptidoglycan	Complex molecule consisting of sugars and amino acids that makes up the bacterial cell wall.
plasmid	Ring of accessory DNA in bacteria.
prokaryotes	Organisms that lack a nucleus and membrane-bound organelles; bacteria and archaea.
transduction	Transfer of DNA between two bacteria with the aid of a bacteriophage.

Table 14.4: (continued)

bacilli	Rod-shaped bacteria or archaea.
transformation	Changing phenotypes due to the incorporation (“taking up”) of foreign DNA from the environment.
spirilli	Spiral-shaped bacteria or archaea.

Laboratory Activity

Bacteria Lab: Where are bacteria?

- Materials:

Each 2 or 4 student team will need: 1 Petri dish with agar, 2-4 cotton Qtips, marker, warm place to have bacteria grow.

- In Advance:

Prepare the Petri dishes a few days in advance. Leave one Petri dish out in the room for one day, cover and let students discuss why the bacteria grew in that dish.

Make a list of places you will send teams to collect bacteria.

Mark a line in the middle of each Petri dish if student pairs are sharing a dish.

- Procedure:

Assign each group a location to find bacteria: water fountain, bathroom toilet lid or handle, doorknob, locker room bench, gym floor, stair handrails, cafeteria table.

Students carefully get a Qtip, holding the middle or one end only. At their assigned location, they swab an area, lightly running it over the sterile agar in the Petri dish. They cover their dish, tape it closed, write their initials on it, attach a card that describes themselves and their partner, and the location, time, and method of obtaining the sample. They leave the card under the dish.

Students make a Bacteria Lab Notebook entry with all of the procedural information and draw their Petri dish at the time the sample was taken. Make a chart to record their data over time. They check dishes each day, count colonies, and draw their dish each day.

After a week, the class analyzes the collection of dishes to discover how many clusters or colonies are growing in each dish. Figure out which dish had the most or least growth.

Students write results and conclusions in their lab notebooks.

Science Inquiry

Reinforce and Review

Take an online quiz

- ActionBioScience.org: Bacteria: Friend or Foe? <http://www.actionbioscience.org/biodiversity/lessons/wassenaarlessons.pdf> Have students take the quiz embedded in this web site. This site also contains useful news article discussion and questions, four student project descriptions, bacterial growth lab, and four more student project descriptions on soil.

Review Website

- ScotCal: Murray the Bacterium <http://www.scotcal.co.uk/murray.asp> This is a humorous and educational website about bacteria.

Review Questions and Answers

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Have students answer the Review Questions that are listed at the end of the lesson in their FlexBook.

Points to Consider

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Lesson Assessment

Provided to teachers upon request at teachers-requests@ck12.org.

Copy and distribute the lesson quiz. Provide class time for the students to complete this assessment.

Lesson Assessment: Key

Provided to teachers upon request at teachers-requests@ck12.org.

Copy and distribute the lesson quiz. Provide class time for the students to complete this assessment.

Prokaryotes: Lesson 8.1 Quiz

14.3 Lesson 8.2: Archaea

Key Concept

Lesson Objectives

1. Identify the differences between archaea and bacteria.
2. Explain how the archaea can obtain energy.
3. Explain how the archaea reproduce.
4. Discuss the unique habitats of the archaea.

Vocabulary

Lesson 8.2 Vocabulary

Table 14.5:

archaea	halophiles	methanogens
thermophiles		

Check Your Understanding

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

- What are the three shapes of bacteria?
- How do bacteria reproduce?
- How can bacteria be harmful?

Teaching Strategies

Building Science Skills: Compare and Contrast

Ask students to construct a two column table in their notebook, with “Bacteria” at the top of one column and “Archaea” at the top of the next column. Have them list briefly what they have learned about bacteria.

- Bacteria:

usually live on something, live and grow in colonies

three main shapes include rod, cocci, spirilli

some have flagella for movement

bacteria are decomposers that break down waste to get energy

some bacteria are photosynthetic and make their own food

some are chemotrophs that get energy by breaking down chemical compounds.

some can be parasites and cause diseases.

bacteria reproduce through binary fission.

Have students fill in the Archaea column as they identify characteristics of these prokaryotes.

- Archaea:

can have flagella to move (have them move this bacteria characteristic to the center section)

cell walls are different from bacterial cell walls; they are made from proteins that provide chemical and physical protection for the cell. Think of the extreme environments in which they thrive!

lack peptidoglycan in cell walls

ribosomal proteins resemble eukaryotes, different from those of bacteria.

most are chemotrophs, breaking down chemicals in their environment to get their energy and nutrients

reproduce asexually, some through binary fission, but can also reproduce through budding and fragmentation.

types include: halophiles, salt loving, thermophiles, living in extremely hot environments, methanogens, live in swamps, cow guts, termite guts, helping these animals break down cellulose.

Discussion

Viruses. Is a virus a prokaryotic organism? Are viruses living or non-living? Ask the students what they think. (Viruses were briefly discussed in the Introduction to Living Organisms chapter.)

- Explain to students that viruses are basically DNA or RNA in a shell made of protein. They can be inert, and then infect and take over.
- CellsAlive!: How Big is a ...? <http://www.cellsalive.com/howbig.htm> Interactive demo on cells compares sizes of organisms on a pinhead.

We have discussed the Archaea. “Archaea” shares the same root word as “archives” and “archaic,” so what do you think it means?

From Greek *arkhaios*, meaning ancient.

What do you think the earliest life forms on Earth looked like?

Bacteria may have had RNA regulating the cell activity. This was bacteria with no DNA yet, and perhaps no proteins.

Science Daily: Glimpses Of Earliest Forms Of Life On Earth: Remnant Of Ancient ‘RNA World’ Discovered <http://www.sciencedaily.com/releases/2008/07/080717140459.htm>
July 18, 2008

How do you think these early life forms obtained energy?

See above article.

Differentiated Instruction

Enrichment

Review microbes: Protists, fungi, bacteria, archaea, and viruses.

- Microbe World: Meet the Microbes: Types of Microbes <http://www.microbeworld.org/microbes/types.aspx>

Laboratory Activity

Science Inquiry

Reinforce and Review

- RedOrbit: Suspended Animation on the Ocean Floor http://www.redorbit.com/news/science/410771/suspended_animation_on_the_ocean_floor/index.html This article discusses sedimentary ocean deposits.
- ActionBioScience.org: My Name is LUCA - The Last Universal Common Ancestor <http://www.actionbioscience.org/newfrontiers/poolepaper.html> A single cell from about 3-4 billion years ago from which all life evolved.
- Foundation of Bacteriology and the Society for Applied Microbiology: Virtual Museum of Bacteria <http://www.bacteriamuseum.org/>

Review Questions and Answers

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Have students answer the Review Questions that are listed at the end of the lesson in their FlexBook.

Points to Consider

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Lesson Assessment

Provided to teachers upon request at teachers-requests@ck12.org.

Copy and distribute the lesson quiz. Provide class time for the students to complete this assessment.

Prokaryotes: Lesson 8.2 Quiz

Answer Key

Provided to teachers upon request at teachers-requests@ck12.org.

Prokaryotes: Lesson 8.2 Quiz

Chapter 15

TE Protists and Fungi

15.1 Chapter 9: Protists and Fungi

Outline

The chapter *Protists and Fungi* consists of two lessons that introduce students to these two eukaryotic kingdoms:

- Lesson 9.1: Protists
- Lesson 9.2: Fungi

What are protists and fungi? Students will learn that they are neither plants nor animals, but they are eukaryotic organisms.

Overview

So what's a protist? Is it an animal or plant? Neither. Nor are they fungi. Protists are organisms that belong to the kingdom Protista. These organisms do not fit neatly into any of the other kingdoms. Even among themselves, they have very little in common – very simple structural organization and a lack of specialized structures are all that unify them as a group.

How about fungi? Is a fungi a plant? Scientists used to debate about which kingdom to place fungi in. Finally they decided that fungi were plants. Some look like plants. Many people think mushrooms are plants. Fungi don't seem to move, like the blue-green mold growing on a loaf of bread, and plants don't move. However, fungi are organisms that belong to the kingdom Fungi. Our ecosystem needs fungi. Fungi help decompose matter and make nutritious food for other organisms.

Pacing the Lessons

Use the **Class Periods per Lesson** table below as a guide for the time required to teach the lessons of this chapter.

Table 15.1:

Lesson	Number of Class Periods*
Lesson 9.1: Protists	2.0
Lesson 9.2: Fungi	2.0

- Class periods are assumed to be 60 minutes long.

Managing Materials

For this chapter, students need the student worksheets and a science notebook in which to keep the returned forms as part of their science portfolio.

- You may choose to have students affix the worksheets into their science notebooks if using composition books, or having an additional binder for worksheets.

The materials listed in the **Materials List** table below are needed to teach the strategies and activities described in the Teachers Edition of the FlexBook for this chapter.

Table 15.2:

Lesson	Strategy or Activity	Materials Needed
9.1	1) 2)	1) 2)
9.2	1)	1)

Additional Web-Based Resources

- The Mushroom Club: Experiments <http://www.herbarium.usu.edu/fungi/funfacts/experiment.htm> Students explore the growth of fungi by using different mediums.
- The Mushroom Club: Try Growing Your Own Molds in a Moist Chamber http://www.herbarium.usu.edu/fungi/funfacts/moist_chamber.htm Students use a moist chamber to let mold grow.
- Fun Facts About Fungi: Guide for Teachers <http://www.herbarium.usu.edu/fungi/funfacts/StudyGuide.htm> Informational links for teachers on fungi, mushroom col-

lection, spores, medical uses, diversity of fungi, etc.

- The Science Spot: Fungus Jeopardy <http://www.sciencespot.net/Pages/fungus.html> Set of class questions on fungi for use in a Jeopardy game.
- The Mushroom Club: Try Growing Your Own Yeast Fungus http://www.herbarium.usu.edu/fungi/funfacts/Yeast_exp.htm Experiment for growing yeast in soda bottles.
- Bill Nye Home Demos <http://www.billnye.com/> Home demos, life science, mold madness.
- BiologyCorner.com: Insects of the World <http://www.biologycorner.com/quests/insectquest/index.html> Webquest project for investigating insect species.
- 4Teachers.org: WebPoster Wizard <http://poster.4teachers.org/> Create online lessons, worksheets, or class pages on life science topics.

Making the FlexBook Flexible

An important advantage of the FlexBook is the ability it gives you, the teacher, to choose the chapters and lessons that you think are most important for your own classes. The following information is provided to help you decide whether to include this chapter or certain lessons in this chapter in your students' FlexBook. You should also consult the standards correlation table that follows when selecting chapters and lessons to include in the FlexBook.

- To understand the content of this chapter, students should have read the *Cells and Their Structures*, *Cell Division, Reproduction, and DNA*, and *Prokaryotes* chapters.
- Students should read this entire chapter before reading the remaining chapters of the FlexBook.
- It is recommended that you include all the lessons of this chapter in the FlexBook.
- However, if time is limited, you can abbreviate the discussion of this material to two class periods.

Common Misconceptions

In regards to protists and fungi, middle school students typically have difficulties with the following concepts:

Confusing Protists with Prokaryotes

While the terms are confusing, it is not true that protists are prokaryotes. Protists are eukaryotes. Students should note that there are “plant-like” as well as “animal-like” protists. One strategy to use to help students make the proper connections is through using Venn diagrams, to contrast the characteristics of prokaryotes with eukaryotes, with examples of each.

Seeing Yeast as Living Organisms

A common misconception that many students have is, “If it’s not moving, it’s not living.” This is one reason that many students fail to understand that yeast are living organisms. Have students research and report about the various uses of yeast (e.g., bread-making and wine-making).

Expanding Students’ Notions of Fungi

While mushrooms are indeed fungi, there are many other kinds of fungi. Have students research and report on the many different species of fungi other than mushrooms.

15.2 Lesson 9.1: Protists

Key Concept

Protists are a very diverse group of organisms that belong to the kingdom Protista. You can think about protists as all eukaryotic organisms that are neither animals, nor plants, nor fungi. Even among themselves, they have very little in common – very simple structural organization and a lack of specialized structures are all that unify them as a group.

Lesson Objectives

1. Explain why protists cannot be classified as plants, animals, or fungi.
2. List the similarities that exist between most protists.
3. Identify the three subdivisions of the organisms in the kingdom Protista.

Vocabulary

Table 15.3:

Lesson 9.1 Vocabulary		
autotroph	cilia	filter-feeding
flagellum	heterotroph	protist
protozoa	transient pseudopodia	

Check Your Understanding

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

- What are some basic differences between a eukaryotic cell and a prokaryotic cell?
- List some characteristics that all cells have.

Teaching Strategies

Building Science Skills: Classifying

Classifying Protists

- The FlexBook section titled “What are Protists?” states they are sometimes classified as the “junk drawer kingdom,” a descriptive title. They are eukaryotes that may be quite different from each other. However,
 - a. All are eukaryotes.
 - b. Most have mitochondria.
 - c. Many are parasites.
 - d. All are aquatic.

Ask students to discuss the following: Why is this kingdom sometimes referred to as the “junk drawer kingdom?”

Discussion

- Ask the class: How do you think protists are different from archaea and bacteria?

Have students discuss this question with a partner and then share their answers with the class.

Students may refer to the Venn diagram they created (see Differentiated Instruction). Archaea and bacteria do not have a nucleus and therefore are prokaryotes. Some archaea thrives in extreme environments. Protists are microscopic organisms that are not bacteria, plants, animals, or fungi.

Using Visuals

A Virtual Pond Dip

- <http://www.microscopy-uk.org.uk/index.html>
- <http://www.microscopy-uk.org.uk/ponddip/index.html>

This activity stimulates interest in pond life, and gives students basic background information for identification and exploration of a real pond. Mouse over the organisms in the jar to learn about them, and get an idea of relative size based on the drawing. Students draw and label the organisms in the jar.

Differentiated Instruction

Venn Diagrams and Charts

- Students research and make a Venn diagram of Paramecium and Amoeba. Teams present their diagrams, and make corrections and additions to the diagram.

Enrichment

Laboratory Activity

Pond Life Identification Kit

- <http://www.microscopy-uk.org.uk/index.html>
- <http://www.microscopy-uk.org.uk/ponddip/index.html>

A. Students explore this site that includes a chart of the group, diagrams, key features, and more links to information. Students research each group, making a chart in their notebooks. Names of group, the drawings, and key features.

B. Find a creek or pond in your area and have students collect or bring in a water sample to investigate. Whoever collects the specimens should note where the sample was taken, date, and weather conditions. This page has great links to more information on protists. How to Collect Microscopic Pond Life

- <http://www.microscopy-uk.org.uk/pond/collect.html>

C. Observe the protozoan life forms from a local creek (or other source) under the microscope. There are plenty of online sites describing how to make a wet mount slide.

- http://www.hpcnet.org/cgi-bin/global/a_bus_card.cgi?SiteID=305762

Science Inquiry

Reinforce and Review

- Molecular Expressions Digital Video Gallery: Pond Life <http://micro.magnet.fsu.edu/moviegallery/pondscum.html> Streaming RealPlayer video on the many forms of microscopic life in a North Florida pond.
- How Stuff Works: Life Science: Protists and Fungi <http://videos.howstuffworks.com/hsw/19660-life-science-protists-and-fungi-video.htm> Streaming video on types of fungi.
- How Stuff Works: Life Science: Killer Algae <http://videos.howstuffworks.com/hsw/11904-protists-and-fungi-killer-algae-video.htm> Algae and protests video.
- Carolina Biological Supply Company: Protist and Fungi Slides <http://www.carolina.com/category/life+science/microscope+slides/protist+slides.do> <http://www.carolina.com/category/life+science/microscope+slides/fungi+slides.do> Observe prepared slides of prokaryotes, protists, and fungi. Look for the nucleus.

Review Questions and Answers

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Have students answer the Review Questions that are listed at the end of the lesson in their FlexBook.

Points to Consider

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Lesson Assessment

Provided to teachers upon request at teachers-requests@ck12.org.

Copy and distribute the lesson quiz. Provide class time for the students to complete this assessment.

Protists and Fungi: Lesson 9.1 Quiz

Answer Key

Provided to teachers upon request at teachers-requests@ck12.org.

15.3 Lesson 9.2: Fungi

Key Concept

Lesson Objectives

1. Describe the characteristics of fungi.
2. Identify structures that distinguish fungi from plants and animals.
3. Explain how fungi can be used in industry.

Vocabulary

Table 15.4:

Lesson 9.2 Vocabulary		
asexual reproduction	budding	chitin
fruiting body	heterotroph	hyphae
lichen	meiosis	mycelial fragmentation
mycelium	mycorrhizal symbiosis	parasite
spores		

Check Your Understanding

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

- What is a significant difference between a protist and other eukaryotic organisms?
- What are some of the distinguishing characteristics of fungus-like protists?

Teaching Strategies

Using Visuals

Students analyze **Figure 1**, describing the five various types of fungi. They then continue reading the lesson either in class or as homework. Fungi is classified in four divisions: Chytridiomycota (chytrids), Zygomycota (bread molds), Ascomycota (yeasts and sac fungi), and the



Figure 15.1: These many different kinds of organisms demonstrate the huge diversity within the kingdom Fungi. (1)

Basidiomycota (club fungi). Can the students classify the fungi into the divisions based on the figure?

Discussion

1. Fungi reproduce by spores. How are spores different from seeds? Is a spore sexual or asexual?

Spores are different from seeds in that they are haploid, unicellular, and produced by meiosis. Seeds are small embryonic plants. Seeds have a seed covering called a seed coat, which serves as stored food. Seeds are the product of a ripened ovule and growth in the female organism. Spore reproduction is asexual reproduction, the organism does not need a second partner, and no fertilization is necessary.

2. Are there advantages or disadvantages to reproducing through spores?

Advantages: doesn't require a second partner for reproduction, since they are so small, the organism can release many of them, increasing probability of reproduction, faster and easier than sexual reproduction, more reliable and less can go wrong than sexual reproduction. Disadvantages: will only develop into a new individual organism if conditions are right, doesn't allow genetic variation.

3. Is a mushroom autotrophic or heterotrophic? Explain.

Mushrooms are heterotrophs because they consume nutrients from the soil, they decompose, and they are not green and therefore not capable of photosynthesis.

4. Mushrooms produce millions of spores? What is it about the gills that enable such a large production?

Gills have greater surface area.

Differentiated Instruction

Venn Diagram

Now that students have learned about protists and fungi, have students make a Venn diagram in their notebooks, labeling the center intersection *Protists and Fungi*, and the two sides, *Protists*, and *Fungi*.

Enrichment

Laboratory Activities

Mushroom Lab

- Materials: one mushroom per student team (Mushrooms are in phylum Basidiomycota, grocery store button mushroom in the genus *Agaricus*), magnifying glasses, paper towels, microscopes, slides, tweezers
- Procedure:
 - a. Wash hands before and after handling mushrooms. No eating allowed.
 - b. Label a new page in notebooks, *Fungi: Mushroom Lab*. Copy procedure.
 - c. Observe mushroom and draw mushroom: label the cap, stem, and gills.
 - d. Look closely at the underside of the mushroom cap and where the cap joins the stem. If the gills cannot be seen, carefully pull on the thin veil on the underside of the cap.
 - e. Carefully pull off the cap from the stem, wiggling to make the break.
 - f. Pinch stem to break it into pieces. The thin filaments you see are the hyphae. Put the hyphae on a slide and examine under the microscope. Draw, label, and describe hyphae in lab notebook.
 - g. Look at the underside of the mushroom cap gills. The basidia are small structures lining each gill. Use tweezers to remove one gill gently where it attaches to the cap. (Mushrooms are in phylum Basidiomycota, their spores are produced on the basidium.)

- h. Place the gill on a slide and examine under the microscope under low and then high power. Look for spores on the basidia. Draw, label, and describe the basidia, gill, and spores.
- i. Clean up everything according to teacher directions. Have the students add questions they may have and any conclusions.
- j. Class discussion. *Why doesn't the mushroom have green leaves?*

Yeast Lab

- Materials: sugar, yeast, 5 flasks with rubber stoppers (have one hole opening), warm water, 5 balloons.
- Procedure: Divide class into five groups, each in charge of a flask with differing amounts of yeast and sugar.
- <http://www.middleschoolscience.com/yeast.htm> The above link has the lab instructions and teacher notes.

Bread Mold Lab

- Materials: Ziploc sandwich bags, marker to label, damp paper towel, different growing materials, substrates, such as slice of bread, fruit, vegetable, plant leaf.
- Procedure: Label bags with numbers and keep a record of what was placed in each bag. Put different items in different bags with a damp paper towel. Put the bags in a warm place but out of direct sunlight. Check the bags every day and record results: record number, color, size of the colonies.
- Conclusions: Different numbers and kind of fungi on different substrates? Different kinds of bread? Bread with preservative have different numbers and mold? Bread mold versus vegetable, for example, carrot, mold?

Science Inquiry

The 5E Instructional Model of Inquiry Lesson Description

There's a Fungus Among Us: A Webquest for Seventh Grade Life Science

- <http://www.crews.org/curriculum/science/Webquest/fungus%20webquest1.htm#>

Introduction: Students are botanists for NASA making recommendations on which types of fungi should be brought to a new planet. Research the different types of fungi and learn how they impact the ecosystem. Take a position on which fungi you think should be brought to the new planet and write a persuasive paper on why your choice is correct. Present the paper to the scientific community at NASA during the planning phase of this project.

Reinforce and Review

- EHow: How to Make a Spore Print from a Mushroom http://www.ehow.com/how_2079354_make-spore-print-from-mushroom.html Lab directions for viewing mushroom spores.
- MyKo Web: Mushrooms, Fungi, and Mycology <http://www.mykoweb.com/> Catalog of 573 species of California fungi, indexed by geographic place, species, genera, and edibility.
- The Smallest Page on the Web http://www.microscopy-uk.org.uk/mag/wimsmall/x_small1.html This site is dedicated to the microscopic organisms found in a freshwater pond.

Review Questions and Answers

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Have students answer the Review Questions that are listed at the end of the lesson in their FlexBook.

Points to Consider

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Lesson Assessment

Provided to teachers upon request at teachers-requests@ck12.org.

Copy and distribute the lesson quiz. Provide class time for the students to complete this assessment.

Protists and Fungi: Lesson 9.2 Quiz

Lesson Assessment: Key

Provided to teachers upon request at teachers-requests@ck12.org.

Copy and distribute the lesson quiz. Provide class time for the students to complete this assessment.

Image Sources

- (1) http://en.wikipedia.org/wiki/Image:Fungi_collage.jpg. CC-BY-SA 2.5.

Chapter 16

TE Plants

16.1 Chapter 10: Protists and Fungi

Outline

The chapter *Plants* consists of four lessons that gives students a fairly detailed overview of plant kingdom:

- Lesson 10.1: Introduction to Plants
- Lesson 10.2: Seedless Plants
- Lesson 10.3: Seed Plants
- Lesson 10.4: Plant Responses

Overview

There is such a tremendous diversity among the plant kingdom. Why? This chapter will start to allow students to understand this question.

Teaching Strategies

Pacing the Lessons

Use the **Class Periods per Lesson** table below as a guide for the time required to teach the lessons of this chapter.

Table 16.1:

Lesson	Number of Class Periods*
Lesson 10.1: Introduction to Plants	1.0
Lesson 10.2: Seedless Plants	1.0
Lesson 10.3: Seed Plants	2.0
Lesson 10.4: Plant Responses	1.0

- Class periods are assumed to be 60 minutes long.

Lab Links

Managing Materials

For this chapter, students need the student worksheets and a science notebook in which to keep the returned forms as part of their science portfolio.

- You may choose to have students affix the worksheets into their science notebooks if using composition books, or having an additional binder for worksheets.

The materials listed in the **Materials List** table below are needed to teach the strategies and activities described in the Teachers Edition of the FlexBook for this chapter.

Table 16.2:

Lesson	Strategy or Activity	Materials Needed
10.1	1) 2)	1) 2)
10.2	1)	1)
10.3	1)	1)
10.4	1)	1)

Additional Web-Based Resources

- Plants and Their Structure <http://www.emc.maricopa.edu/faculty/farabee/BIOBK/BioBookPLANTANAT.html> Information site, diagrams, clickable definitions, text.
- Monocots and Dicots <http://www.emc.maricopa.edu/faculty/farabee/BIOBK/BioBookPLANTANAT.html>
- Flowering Plant Reproduction <http://www.emc.maricopa.edu/faculty/farabee/BIOBK/BioBookflowers.html>

- Fertilization and Fruits <http://www.emc.maricopa.edu/faculty/farabee/BIOBK/BioBookflowers.html>
- Deep Sea Invasion NOVA <http://www.pbs.org/wgbh/nova/algae/> A toxic aquarium plant released in the Mediterranean, Information site, Video for purchase at PBS Store, links and books, TV Transcript.

Making the FlexBook Flexible

An important advantage of the FlexBook is the ability it gives you, the teacher, to choose the chapters and lessons that you think are most important for your own classes. The following information is provided to help you decide whether to include this chapter or certain lessons in this chapter in your students' FlexBook. You should also consult the standards correlation table that follows when selecting chapters and lessons to include in the FlexBook.

- To understand the content of this chapter, students should have read the *Cells and Their Structures* and the *Cell Functions* chapters.
- Students should read this entire chapter before reading the remaining chapters of the FlexBook.
- It is recommended that you include all the lessons of this chapter in the FlexBook.
- However, if time is limited, you can skip Lesson 10.4, or incorporate aspects of this lesson into previous chapter discussions. No standards are associated with Lesson 10.4.

Common Student Misconceptions

In regards to plants, middle school students typically have difficulties in the following areas:

Seed vs. Seedless Plants

This chapter makes an important distinction between these two types of plants. About 300,000 different species of plants exist on Earth and only about half of them reproduce sexually, as seed plants. The rest reproduce via vegetative reproduction, which is an asexual process. Have students discuss examples of each type of plant, as well as the evolutionary pros and cons of seed plants (sexual reproduction) versus seedless plants (asexual reproduction). As a challenge, have students explore the many varieties of these two types of plant reproduction, by finding examples of plants that reproduce by buds, bulbs, cones, corms, cuttings, flowers, grafts, rhizomes, spores and tubers.

Sea Plants

While the majority of plants are land organisms, sea grasses are flowering plants that live in shallow ocean waters.

Plant Nutrition

Although students should have already studied topics like photosynthesis and plant respiration, student misconceptions on these topics are so common and so deeply-rooted that it makes sense to reinforce the proper concepts whenever possible. Review the relevant teaching material on photosynthesis and plant respiration and use the “drip-irrigation” method to gently teach your students how to avoid them.

16.2 Lesson 10.1: Introduction to Plants

Key Concept

Lesson Objectives

1. Describe the major characteristics that distinguish the Plant Kingdom.
2. Describe plants’ major adaptations for life on land.
3. Explain plants’ reproductive cycle.
4. Explain how plants are classified.

Vocabulary

Table 16.3:

Lesson 10.1 Vocabulary		
alteration of generations	angiosperms	cuticle
gamete	gametophyte	gymnosperms
nonvascular plants	sporophyte	stomata
vascular tissue		

Check Your Understanding

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

- What are the major differences between a plant cell and an animal cell?
- What is photosynthesis?

Teaching Strategies

Building Science Skills: Observing

Take a brief walking tour of the campus with sketchpad or notebook. Have students make notes and sketches of what they see. Remind them to use their observational skills in noticing similarities and differences in the plants. Point out that they should notice different characteristics of each plant: root, stem, leaves, fruit, seeds, flowers.

Discussion

1. Plants are fascinating and widely diverse organisms. Although scientists used to think fungi were plants, we now know that plants and fungi are separate. Think about what sets plants apart from fungi.

Fungi are eukaryotic, heterotrophic and absorptive organisms that reproduce asexually or sexually by spores. Fungi are eukaryotic because they contain a well-defined nucleus- and membrane-bound organelles. Fungi are heterotrophic in that they require food that has been processed by other organisms. In other words, they are not able to make their own food. Plants are autotrophic, in that they use water, carbon dioxide, and sunlight to make their own food and energy.

2. What part (roots, stem, fruit, seed, or leaf) of the following plants do you eat? Orange, green pepper, tomatoes, spinach, cucumber, carrots, asparagus, coffee, lettuce, radish, apple.

Orange (fruit), green pepper (fruit), tomatoes (fruit), spinach (leaf), cucumber (fruit), carrots (root), asparagus (stem), coffee (seed), lettuce (leaf), radish (root), apple (fruit).

3. What is the difference between a fruit and a vegetable?

Fruit - a plant becomes a fruit after the flower stage.

Vegetable - other plant parts.

Using Visuals

Reproduction

- Explain the plant reproductive cycle to students. Refer them to **Figure 5** in the FlexBook. Review mitosis and meiosis as you look at the process below. There are two stages in reproduction: gametophyte and sporophyte.

- The gametophyte produces the gametes, sperm and egg, by mitosis. Remember, gametes are haploid.
- The sperm fertilizes the egg, producing a diploid zygote that develops into the sporophyte.
- The sporophyte produces haploid spores by meiosis.
- The haploid spores undergo mitosis, developing into the gametophyte.

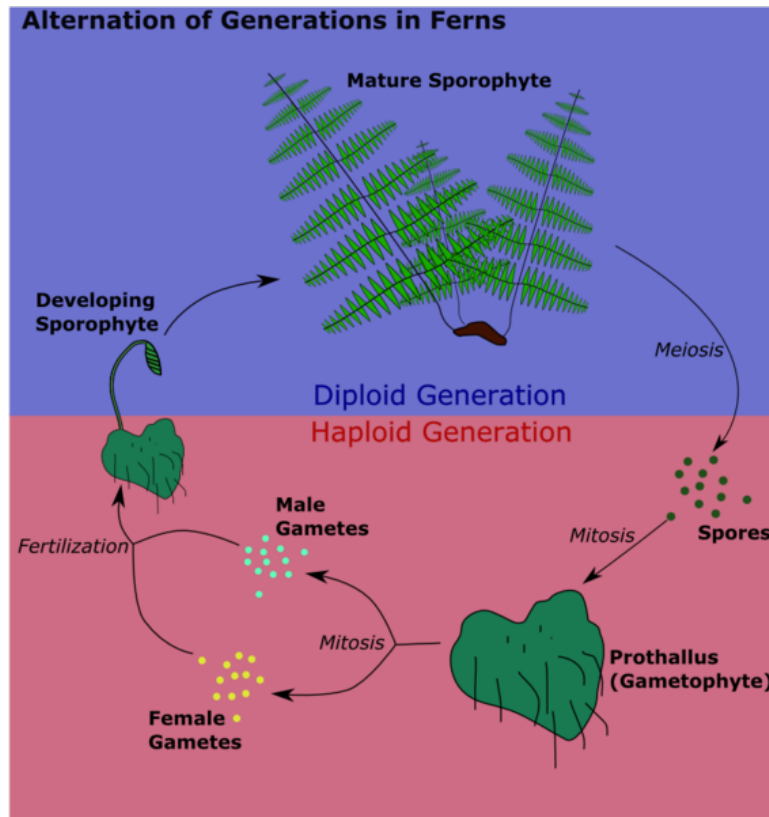


Figure 16.1: In ferns, the sporophyte is dominant and produces spores that germinate into a gametophyte; after fertilization the sporophyte is produced. Ferns will be discussed in further detail in the next lesson. (2)

Differentiated Instruction

Venn Diagram

To sort out the differences between plants, other eukaryotic organisms, and adaptations of plants, have students make a Venn diagram with a partner using the FlexBook lesson. Set up the Venn diagram with plants on one side and eukaryotic organisms on the other.

Plants-photosynthetic, embryo develops and is retained within the plant, stomata for gas

exchange, waxy cuticle layer to prevent water loss, vascular tissue to transport water and nutrients, evolved from green algae.

Eukaryotic organisms-animals, protists, fungi, some are multicellular, some are unicellular, algae.

Both-eukaryotic.

Enrichment

Research A Topic: Plant Adaptations

<http://www.mbgnet.net/bioplants/adapt.html>

Plants have adaptations to help them survive in different areas. Adaptations are special features that allow a plant or animal to live in a particular place or habitat. Remind students that we discussed adaptations during our discussion of evolution. Adaptations which allow plants to survive in one habitat, might make it very difficult (or impossible) for the plant to survive in a different habitat. For example, you wouldn't see a cactus living in the Arctic. Nor would you see lots of really tall trees living in grasslands. This link discusses eight different areas in which plants live. Have students explore this web site and write a summary of the adaptations plants need to survive in at least four different habitats.

Laboratory Activities

Carnation and Celery Lab: Understanding the plant vascular system.

- Materials: celery, carnations, water, sugar, salt, food coloring, 6 cups.
- Preparation: Label six cups, fill $\frac{3}{4}$ full of water. In #1, add 1 tbsp salt and stir; in #2, add 1 tbsp sugar and stir; in #3, tap water only, no additions; in #4, add two drops of food coloring; in #5, add four drops of food coloring; in #6, replace tap water with distilled water.
- Procedure: Students measure celery base and stalks and carnations before placing them in the solutions. #1 carnation, #2 carnation, #3 celery, #4 celery, #5 celery, #6 celery and carnation. Record their information and make charts in their notebooks to accommodate the 6 different cups, the base before, the base after, the length before and after, flexibility of celery stalk before, after 1 day, 2 days. Students write observations over 2-5 days, with conclusions about the plant vascular systems.

Yummy Plant Parts

- <http://school.discoveryeducation.com/lessonplans/programs/plantparts/>



Figure 16.2: Celery cross-section (3)

Follow up to discussion of classification of parts. This is a Discovery lesson to identify structure, function, plant parts, and importance of plants to humans. Students will identify the parts of a plant by looking at an entire plant or a part of a plant. They will also understand the importance of plants for animals' (including humans') existence.

- Materials

Various market-fresh vegetables such as an uncut carrots, radishes, celery, broccoli, potatoes, sweet potatoes, spring onions, brussel sprouts, asparagus, beets, leeks, ginger, lettuce, parsley

Magnifying glass

Paring knife

- The procedures are outlined on the web site.

Science Inquiry

Reinforce and Review

Students review Plant and Animal Cells at this simulation site on the web.

- <http://www.forgefx.com/casestudies/prenticehall/ph/cells/cells.htm>

Review Questions and Answers

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Have students answer the Review Questions that are listed at the end of the lesson in their FlexBook.

Points to Consider

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Lesson Assessment

Provided to teachers upon request at teachers-requests@ck12.org.

Copy and distribute the lesson quiz. Provide class time for the students to complete this assessment.

Introduction to Plants: Lesson Quiz

16.3 Lesson 10.2: Seedless Plants

Key Concept

Lesson Objectives

1. Name examples of nonvascular seedless plants.
2. Name examples of vascular seedless plants.
3. Explain the reproduction strategies of seedless plants.
4. Describe the ways seedless plants impact humankind.

Vocabulary

Table 16.4:

Lesson 10.2 Vocabulary		
club mosses	ferns	hornworts
horsetails	liverworts	mosses

Table 16.4: (continued)

Lesson 10.2 Vocabulary
whisk ferns

Check Your Understanding

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

- What is a plant?
- How are plants classified?

Teaching Strategies

Building Science Skills: Comparing - Contrasting

1. Direct students to make a chart in their notebooks to fill in as they go through the FlexBook lesson on Seedless Plants.

Table 16.5:

Nonvascular Seedless Plants		Vascular Seedless Plants	
Types	Characteristics	Types	Characteristics
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-

2. Direct students to make another chart about moss and ferns to review the difference between nonvascular and vascular seedless plants.

Table 16.6:

Characteristic	Moss	Fern
Size	-	-
Body Parts	-	-

Table 16.6: (continued)

Characteristic	Moss	Fern
Environment	-	-
Reproductive Generation	-	-
True Vascular System	-	-

Discussion

1. What are the two types of seedless plants?

Nonvascular and vascular

[ADD DESCRIPTIONS OF THESE 2 TYPES OF PLANTS]

Differentiated Instruction

Word Wall This lesson introduces names of plants that may be confusing to students. Post lesson vocabulary words and their definitions, examples, etc. on a bulletin board or wall, so that you can refer students to the word wall as they study lesson content.

Table 16.7:

club mosses	Seedless vascular plants that resemble mosses.
ferns	Seedless vascular plants that have large, divided fronds.
hornworts	Seedless nonvascular plants with hornlike sporophytes.
horsetails	Seedless vascular plants with hollow, rigid stems.
liverworts	Seedless nonvascular plants that can have flattened bodies resembling a liver.
mosses	Seedless nonvascular plants with tiny stem-like and stem-like structures.
whisk ferns	Seedless vascular plants that have branching stems and yellow globular sporangium.

Enrichment

Research a Topic

- Bryophytes <http://bryophytes.plant.siu.edu/frontpic.html>

Web site has information on bryophytes, including a description of mosses, liverworts and hornworts, images, and classification information. Have students explore this site and add to their table they created earlier.

Make a Diagram

- Photosynthesis <http://www.ftexploring.com/me/photosyn1.html>

Site has excellent examples of drawings that illustrate photosynthesis. Encourage students to add similar drawings that help them make sense of the plant kingdom to their notebooks.

Make a Poster

- Draw, label, and describe an alternation of generations life cycle. The description should be incorporated into the poster. Have students work in teams and share their posters with the class.

<http://faculty.clintoncc.suny.edu/faculty/Michael.Gregory/files/Bio%20102/Bio%20102%20lectures/Seedless%20Plants/seedless%20plants.htm#Alternation%20of%20Generations>

This website has a good example of a alternation of generations life cycle with an informative description.

Laboratory Activity

Science Inquiry

Reinforce and Review

Make Flashcards

This activity could be used for the lesson vocabulary words and/or important concepts. Instruct students to make at least 10 flashcards and have students use the flashcards to quiz a partner.

Review Questions and Answers

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Have students answer the Review Questions that are listed at the end of the lesson in their FlexBook.

Points to Consider

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Lesson Assessment

Provided to teachers upon request at teachers-requests@ck12.org.

Copy and distribute the lesson quiz. Provide class time for the students to complete this assessment.

Seedless Plants: Lesson Quiz

16.4 Lesson 10.3: Seed Plants

Key Concept

Lesson Objectives

1. Describe the importance of the seed.
2. Explain the ways in which seeds are dispersed.
3. Define and give examples of Gymnosperms.
4. Define and give examples of Angiosperms. (Monocots, dicots)
5. Explain some uses of seed plants.

Vocabulary

Table 16.8:

Lesson 10.3 Vocabulary		
angiosperms	anther	calyx

Table 16.8: (continued)

Lesson 10.3 Vocabulary		
carpel	complete flowers	conifers
corolla	dormant	ginkgo
gnetophytes	gymnosperms	incomplete flowers
ovary	sepals	stamens
stigma		

Check Your Understanding

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

- What are the two types of seedless plants?
- How do seedless plants reproduce?

Teaching Strategies

Building Science Skills: Classifying

Have students write a list in their notebooks of 10 plants they know. Ask the class to share their lists. Try to construct a list of as many plants as possible. Most will be seed plants. Have students try to break up the list into two groups based on seed types.

Activity

Have students observe and characterize gymnosperm cones and angiosperm seeds. Angiosperm seeds can be used from cucumber, walnut, tomato, orange, apple, or cherry.

Using Visuals

Have students draw the flower parts and label the diagram in their notebooks, using **Figure 9** from the lesson. Tell students that most (about 90%) of the plant kingdom is made up of flowering plants.

Discussion

What is the relevance of ornamental plants to humans?

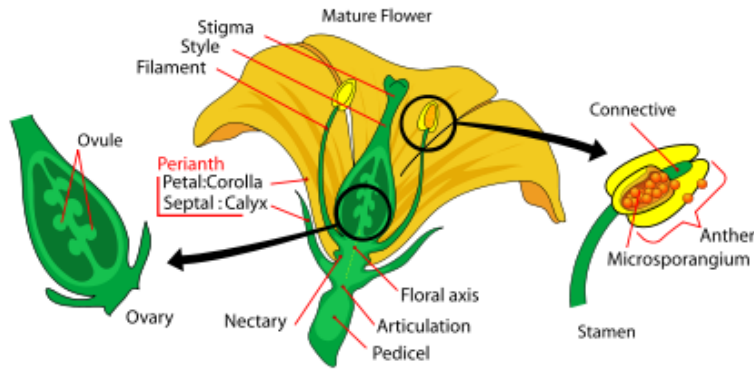


Figure 16.3: A complete flower has sepals, petals, stamens, and one or more carpels. (1)

From these we get much of the food we eat, clothes we wear, wood in our homes, fruit, and furniture.

Differentiated Instruction

Enrichment

Research a Topic

Tell students that conifers are classified by the size and shapes of their needles and cones. The web site, Tree Anatomy and Identification, has information about trees. Have students explore this site and write a summary of a characteristic of trees described on this site.

- http://forestry.about.com/cs/treeid/a/tree_id_web.htm

Laboratory Activity

Plant Experiment

- Place four geranium plants on windowsill, numbered 1-4. Students keep charts and drawings of all four plants in their notebooks.
- For number 1, put petroleum jelly on one large leaf. Ask the class what they think will happen? (The leaf will die.) Observe the plant for a week, and have students keep notes and sketches in their notebook.
- Keep number 2 in a sunny window. Explain to students we are only changing one variable in each setting to be sure we understand that it is that variable causing the change we may see.
- Place number 3 in a closet or under a box.

- Do not water number 4.

Class Discussion: What happened to different plants and why? Discuss tropisms with the class.

Science Inquiry

Reinforce and Review

On-line Activity: Tree-rings

- NOVA Build a Tree-Ring Timeline <http://www.pbs.org/wgbh/nova/vikings/treering.html>

Review Questions and Answers

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Have students answer the Review Questions that are listed at the end of the lesson in their FlexBook.

Points to Consider

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Lesson Assessment

Provided to teachers upon request at teachers-requests@ck12.org.

Copy and distribute the lesson quiz. Provide class time for the students to complete this assessment.

Seedless Plants: Lesson Quiz

16.5 Lesson 10.4: Plant Responses

Key Concept

Lesson Objectives

- List the major types of plant hormones and the main functions of each.
- Define tropism and explain examples of tropisms.
- Explain how plants detect the change of seasons.

Vocabulary

Table 16.9:

Lesson 10.4 Vocabulary		
abscisic acid	abscission	apical dominance
auxin	cytokinins	ethylene
gibberellins	gravitropism	hormones
phototropism	senescence	thigmotropism
tropism		

Check Your Understanding

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

- Why do plants need sunlight?

Teaching Strategies

Building Science Skills: Cause and Effect

Review the plant hormones in **Table 1**. Have students copy this chart into their notebooks as you go through the lesson. Have students add to the chart, identifying the cause of hormone action and the effect of this action.

Table 16.10:

Hormone	Function
Ethylene	Fruit ripening and abscission
Gibberellins	Break the dormancy of seeds and buds; promote growth
Cytokinins	Promote cell division; prevent senescence
Abscisic Acid	Close the stomata; maintain dormancy
Auxins	Involved in tropisms and apical dominance

Table 1: Each plant hormone has a specific function.

(*Source:* Jessica Harwood, *License:* CC-BY-SA)

Building Science Skills: Forming a Hypothesis

Have the class discuss the plants that are growing in the classroom from the last lesson. What is happening to each plant. Have the students form hypotheses on why the plant had the observed outcome. Ask students to hypothesize about how the plant has adapted to its environment.

Discussion

1. How do plants respond to stimuli in their environment?

Stimulus is a change in the environment that affects the plant. Tropisms are growth movements toward or away from a certain stimulus. Phototropism is away or toward light. Geotropism is from the pull of gravity. Hydrotropism is plants growing towards a water source. Plants respond to tropisms because of the hormones they produce.

2. What are tropisms? What is thigmotropism?

Tropisms are growths toward or away from a stimulus. Have students note the three kinds of tropism relating to light, gravity and touch. Explain about hydrangeas to students: PH can change the color of a plant. Hydrangeas usually produce blue flowers, but when their soil PH is changed to a basic soil with greater than 7.0 PH, they have pink flowers. The soil condition with acidic soil will produce blue flowers again.

Thigma comes from the Greek word for touch. Thigmotropism is plant movement in response to touch or contact. Ivy growing on walls is an example.

Using Visuals

Have students look at **Figure 6** and describe what is happening to the plant, and have them discuss the cause of the plant's response.

You might have noticed that plants tend to bend towards the light. This is an example of a tropism where light is the stimulus, known as **phototropism** (**Figure 6**). To obtain more light for photosynthesis, it's advantageous for leaves and stems to grow towards the light. On the other hand, roots are either insensitive to light or actually grow away from light. This is advantageous for the roots since their purpose is to obtain water and nutrients from deep within the ground.



Figure 16.4: These seedlings bending toward the sun are displaying phototropism. (4)

Differentiated Instruction

K-W-L Chart

Have students make a KWL chart, where K = Know, W = Want to Know, and L = Learned. This chart can apply to this lesson or to the whole chapter. Students can fill in the K, W and L columns for lessons 1-3, the K and W columns for lesson 4, and complete the L column for lesson 4 after reading a particular passage. You should demonstrate the chart for the class by giving some examples.

Enrichment

Demonstrate a Process: Tropisms

Have students watch short videos demonstrating tropisms. Plants-in-Motion <http://plantsinmotion.bio.indiana.edu/plantmotion/starthere.html> This site has other time-lapse short videos depicting germination, photomorphogenesis, nastic movements, circadian responses, general growth, flowers, and cellular responses.

Laboratory Activity

The Importance of Tropisms: Discovery School Experiment. <http://school.discoveryeducation.com/lessonplans/programs/tropisms/>

- Students will do the following:
 1. Complete a scientific experiment testing a single variable.
 2. Understand how plants respond to different environmental conditions.
 3. Identify how geotropism affects plants.
- Materials

For the class:

Computers with Internet access (optional but very helpful)

Reference materials: books and encyclopedias

For groups of three students:

One petri dish

Four soaked corn seeds

One piece of filter paper

One graduated cylinder

Water (If there is not a sink in the classroom, water needs to be brought to class in a bucket.)

Cotton

Cellophane tape

Grease pencil

Scissors

For each student:

Classroom Activity Sheet: Geotropism Data (see printable version online)

Take-Home Activity Sheet: Tropisms in Your Neighborhood (see printable version online)

- Procedures: see web site

Science Inquiry

Reinforce and Review

List and Discuss

Students make a list plant responses and then partners compare and discuss their lists. This can be used as an informal assessment to help the students understand their learning.

Review Questions and Answers

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Have students answer the Review Questions that are listed at the end of the lesson in their FlexBook.

Points to Consider

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Lesson Assessment

Provided to teachers upon request at teachers-requests@ck12.org.

Copy and distribute the lesson quiz. Provide class time for the students to complete this assessment.

Seedless Plants: Lesson Quiz

Image Sources

- (1) [Mature_flower_diagram.svg](#) . Public Domain.
- (2) [Alternation_of_generations_in_ferns.png](#) . GNU-FD.
- (3) [Celery cross-section](#). GNU-FD.
- (4) <http://www.flickr.com/photos/rneches/2081938105/>. CC-Attributio.

Chapter 17

Introduction to Life Science (TE)

17.1 Unit 5: The Animal Kingdom

Outline

This unit, *The Animal Kingdom*, includes five chapters that ...

Chapter 11: Introduction to Invertebrates

- Lesson 1: Overview of Animals
- Lesson 2: Sponges and Cnidarians
- Lesson 3: Worms

Chapter 12: Other Invertebrates

- Lesson 1: Mollusks
- Lesson 2: Echinoderms
- Lesson 3: Arthropods
- Lesson 4: Insects

Chapter 13: Fishes, Amphibians, and Reptiles

- Lesson 1: Introduction to Vertebrates
- Lesson 2: Fishes
- Lesson 3: Amphibians
- Lesson 4: Reptiles

Chapter 14: Birds and Mammals

Lesson 1: Birds

Lesson 2: Mammals

Lesson 3: Primates and Humans

Chapter 15: Behavior of Animals

Lesson 1: Understanding Animal Behavior

Lesson 2: Types of Animal Behavior

Overview

Chapter 18

TE Introduction to Invertebrates

18.1 Chapter 11: Introduction to Invertebrates

Outline

The chapter *Introduction to Invertebrates* consists of three lessons that introduce students to the animal kingdom, starting with the simplest of animals, sponges and cnidarians, and progressing to the slightly more complex, worms:

- Lesson 11.1: Introduction to Animals
- Lesson 11.2: Sponges and Cnidarians
- Lesson 11.3: Worms

Overview

Teaching Strategies

Pacing the Lessons

Use the **Class Periods per Lesson** table below as a guide for the time required to teach the lessons of this chapter.

Table 18.1:

Lesson	Number of Class Periods*
Lesson 11.1: Introduction to Animals	1.5
Lesson 11.2: Sponges and Cnidarians	1.0

Table 18.1: (continued)

Lesson	Number of Class Periods*
Lesson 11.3: Worms	1.0

- Class periods are assumed to be 60 minutes long.

Lab Links

Managing Materials

The materials listed in the **Materials List** table below are needed to teach the strategies and activities described in the Teachers Edition of the FlexBook for this chapter.

Table 18.2:

Lesson	Strategy or Activity	Materials Needed
11.1	1) 2)	1) 2)
11.2	1)	1)
11.3	1)	1)

Additional Web-Based Resources

Making the FlexBook Flexible

An important advantage of the FlexBook is the ability it gives you, the teacher, to choose the chapters and lessons that you think are most important for your own classes. The following information is provided to help you decide whether to include this chapter or certain lessons in this chapter in your students' FlexBook. You should also consult the standards correlation table that follows when selecting chapters and lessons to include in the FlexBook.

- To understand the content of this chapter, students should have read the *Cells and Their Structures* chapter.
- Students should read this entire chapter before reading the remaining chapters of the FlexBook.
- It is recommended that you include all the lessons of this chapter in the FlexBook.

Common Misconceptions

Some students have the following misconceptions:

- There are many more vertebrate than invertebrate animal species.
- The sponges from we use in our showers all come from the sea.
- Corals are plants.
- Earthworms have separate sexes and they carry diseases.

Vertebrate vs. Invertebrate Animal Species

It is interesting to note that invertebrate animals are named by what they are not ! As a result, some students may think that there are more vertebrate species in the world. Nothing could be farther from the truth! About 97% of all animal species are invertebrate, and about 3% are vertebrate. The French biologist Jean Baptiste Lamarck coined the terms “vertebrate” and “invertebrate” in 1809, but he knew that invertebrates represent most of the animals on Earth.

Biological vs. Artificial Sponges

As it turns out, most of the sponges we use in our lives are artificial, i.e., they are made of wood pulp (cellulose), sodium sulphate crystals, hemp fibers and chemical softeners. Another common type of artificial sponge is made of polyurethane foam. Some of the sponges we use are biological, i.e., they are harvested from the sea. Because they reproduce by free-swimming larva that settle on a surface, when these sponges are harvested, these larva are often released, leading to increased colonies of sponges.

Corals vs. Plants

Although they can look like plants, all corals are animals. Like other Cnidarians, they have true tissues.

Earthworms

Earthworms in fact are hermaphrodites, i.e., each individual contains male and female organs. Earthworms reproduce in pairs; each individual inseminates the eggs of the other. While some flatworms and roundworms (such as nematodes) carry diseases, segmented worms such as earthworms do not. Earthworms may seem like lowly creatures, but they have played a very important role for people; they are largely responsible for creating the “topsoil” throughout the world that leads to productive farming.

18.2 Lesson 11.1: Overview of Animals

Key Concepts

Lesson Objectives

Vocabulary

Check Your Understanding

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Teaching Strategies

[minimum of 3 general teaching strategies?]

Strategy Type

[Examples: Use Visuals, Discuss [Topic], Demonstrate [Something], Do [Activity], Build Science Skills]

Strategy Type

Strategy Type

Differentiated Instruction

Type of Learners [Examples: English Language Learners, Vision- (or) Hearing-Impaired Students, Below-Level Readers]

Enrichment

Type of Enrichment Strategy [Examples: Debate, Board Game, Teach a Topic, Research, Survey, Interview an Expert, Create a Bulletin Board, Connect with [Another Subject]]

Laboratory Activities

Science Inquiry

Activity Type

[Examples: Analyze Data, Develop a Research Plan]

Reinforce and Review

Activity Type

[Examples: Take an Online Quiz, Pair with a Partner]

Review Questions and Answers

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Have students answer the Review Questions that are listed at the end of the lesson in their FlexBook.

Points to Consider

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Lesson Assessment

Provided to teachers upon request at teachers-requests@ck12.org.

Copy and distribute the lesson quiz. Provide class time for the students to complete this assessment.

Introduction to Invertebrates

Lesson 1 Quiz: Overview of Animals

Answer Key

Provided to teachers upon request at teachers-requests@ck12.org.

18.3 Lesson 11.2: Sponges and Cnidarians

Key Concepts

Lesson Objectives

Vocabulary

Check Your Understanding

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Teaching Strategies

[minimum of 3 general teaching strategies?]

Strategy Type

[Examples: Use Visuals, Discuss [Topic], Demonstrate [Something], Do [Activity], Build Science Skills]

Strategy Type

Strategy Type

Differentiated Instruction

Type of Learners [Examples: English Language Learners, Vision- (or) Hearing-Impaired Students, Below-Level Readers]

Enrichment

Type of Enrichment Strategy [Examples: Debate, Board Game, Teach a Topic, Research, Survey, Interview an Expert, Create a Bulletin Board, Connect with [Another Subject]]

Laboratory Activities

Science Inquiry

Activity Type

[Examples: Analyze Data, Develop a Research Plan]

Reinforce and Review

Activity Type

[Examples: Take an Online Quiz, Pair with a Partner]

Review Questions and Answers

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Have students answer the Review Questions that are listed at the end of the lesson in their FlexBook.

Points to Consider

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Lesson Assessment

Provided to teachers upon request at teachers-requests@ck12.org.

Copy and distribute the lesson quiz. Provide class time for the students to complete this assessment.

Introduction to Invertebrates

Lesson 2 Quiz: Sponges and Cnidarians

Answer Key

Provided to teachers upon request at teachers-requests@ck12.org.

18.4 Lesson 11.3: Worms

Key Concepts

Lesson Objectives

Vocabulary

Check Your Understanding

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Teaching Strategies

[minimum of 3 general teaching strategies?]

Strategy Type

[Examples: Use Visuals, Discuss [Topic], Demonstrate [Something], Do [Activity], Build Science Skills]

Strategy Type

Strategy Type

Differentiated Instruction

Type of Learners [Examples: English Language Learners, Vision- (or) Hearing-Impaired Students, Below-Level Readers]

Enrichment

Type of Enrichment Strategy [Examples: Debate, Board Game, Teach a Topic, Research, Survey, Interview an Expert, Create a Bulletin Board, Connect with [Another Subject]]

Laboratory Activities

Science Inquiry

Activity Type

[Examples: Analyze Data, Develop a Research Plan]

Reinforce and Review

Activity Type

[Examples: Take an Online Quiz, Pair with a Partner]

Review Questions and Answers

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Have students answer the Review Questions that are listed at the end of the lesson in their FlexBook.

Points to Consider

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Lesson Assessment

Provided to teachers upon request at teachers-requests@ck12.org.

Copy and distribute the lesson quiz. Provide class time for the students to complete this assessment.

Introduction to Invertebrates

Lesson 3: Worms

Answer Key

Provided to teachers upon request at teachers-requests@ck12.org.

Chapter 19

TE Other Invertebrates

19.1 Chapter 12: Other Invertebrates

Outline

The chapter *Other Invertebrates* consists of four lessons that introduce students to the remainder of the invertebrate animals:

- Lesson 12.1: Mollusks
- Lesson 12.2: Enchinoderms
- Lesson 12.3: Arthropods
- Lesson 12.4: Insects

Overview

Teaching Strategies

Pacing the Lessons

Use the **Class Periods per Lesson** table below as a guide for the time required to teach the lessons of this chapter.

Table 19.1:

Lesson	Number of Class Periods*
Lesson 12.1: Mollusks	1.0
Lesson 12.2: Enchinoderms	1.0

Table 19.1: (continued)

Lesson	Number of Class Periods*
Lesson 12.3: Arthropods	1.0
Lesson 12.4: Insects	1.0

- Class periods are assumed to be 60 minutes long.

Lab Links

Managing Materials

The materials listed in the **Materials List** table below are needed to teach the strategies and activities described in the Teachers Edition of the FlexBook for this chapter.

Table 19.2:

Lesson	Strategy or Activity	Materials Needed
12.1	1) 2)	1) 2)
12.2	1)	1)
12.3	1)	1)
12.4	1)	1)

Additional Web-Based Resources

Making the FlexBook Flexible

An important advantage of the FlexBook is the ability it gives you, the teacher, to choose the chapters and lessons that you think are most important for your own classes. The following information is provided to help you decide whether to include this chapter or certain lessons in this chapter in your students' FlexBook. You should also consult the standards correlation table that follows when selecting chapters and lessons to include in the FlexBook.

- To understand the content of this chapter, students should have read the *Introduction to Invertebrates* chapter.
- Students should read this entire chapter before reading the remaining chapters of the FlexBook.
- It is recommended that you include all the lessons of this chapter in the FlexBook.

Common Misconceptions

Here are some common student misconceptions:

- Regarding mollusks, students often think that they all have shells.
- Regarding echinoderms, students often confuse them with mollusks.
- Regarding arthropods, some students equate this phylum with insects.
- Regarding insects, students commonly make errors of (a) nomenclature (insects really aren't animals; all insects are "bugs") (b) anatomy (insects have 6 legs, attached to the abdomen; any insect with 8 legs is a spider; small insects with wings are baby insects) and (c) behavior (all insects live on land; insects sing with their mouths; all spiders build webs).

Regarding mollusks, not all of them have shells

This phylum includes groups such as squid/octopus, chitons, tusk shells, bivalves and univalves. The squid and octopus have no shell. Of course, many mollusks do have shells.

Regarding echinoderms, not only average students have mistaken echinoderms for mollusks

Even the great taxonomist, Carl Linnaeus did not recognize the echinoderms as a separate group; he classified the echinoderms that were known to him in his "Mollusca" group. One defining characteristic of echinoderms is that they have radial symmetry, while mollusks have bilateral symmetry.

Regarding arthropods: While all insects are arthropods, not all arthropods are insects

In addition to the insects, this phylum includes crustaceans, arachnids, centipedes and millipedes. In order to stress this whole-part relationship, students should be encouraged to draw and label Venn diagrams with the relevant information.

Regarding insects

(Reference 1)

Nomenclature

All insects are indeed animals. However not all insects are “bugs”; this latter term is strictly associated with the order of Hemiptera. Other insects not in this order include spiders, beetles, ticks and flies.

Anatomy

All insects have 6 legs, but their legs are attached to the thorax and not to the abdomen. All Arachnids have 8 legs, but not all Arachnids are spiders; other 8-legged insects in this group include mites, ticks and scorpions. Small insects with wings are small adult insects, not baby insects. As it turns out, every insect which has wings is an adult insect! The only time when insects grow is when they are in the nymph or larvae stage. By the time insects have wings, they have reached adulthood and won't grow larger.

Behavior

While most insects live on land, some insects live in aquatic environments, e.g., such as caddisflies, stoneflies, mayflies, dragonflies and damselflies; also, intertidal rove beetles live near the ocean shores and marine midges live in tidal pools. Insects do not have vocal cords and do not sing with their mouths like us, but create sounds by causing different body parts to vibrate; for example, locusts rub their legs against their wings, crickets rub their forewings together and cicadas vibrate special organs called tymbals. While all spiders produce “spider silk” (also called gossamer) some spiders, do not build webs, e.g., wolf spiders, jumping spiders, and trapdoor spiders.

Reference (1): Hadley, D. “15 Misconceptions Kids Have About Insects” About.com Retrieved from: <http://insects.about.com/od/teachingaboutinsects/tp/15misconceptions.01.htm>

19.2 Lesson 12.1: Mollusks

Key Concepts

Lesson Objectives

Vocabulary

Check Your Understanding

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Teaching Strategies

[minimum of 3 general teaching strategies?]

Strategy Type

[Examples: Use Visuals, Discuss [Topic], Demonstrate [Something], Do [Activity], Build Science Skills]

Strategy Type

Strategy Type

Differentiated Instruction

Type of Learners [Examples: English Language Learners, Vision- (or) Hearing-Impaired Students, Below-Level Readers]

Enrichment

Type of Enrichment Strategy [Examples: Debate, Board Game, Teach a Topic, Research, Survey, Interview an Expert, Create a Bulletin Board, Connect with [Another Subject]]

Laboratory Activities

Science Inquiry

Activity Type

[Examples: Analyze Data, Develop a Research Plan]

Reinforce and Review

Activity Type

[Examples: Take an Online Quiz, Pair with a Partner]

Review Questions and Answers

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Have students answer the Review Questions that are listed at the end of the lesson in their FlexBook.

Points to Consider

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Lesson Assessment

Provided to teachers upon request at teachers-requests@ck12.org.

Copy and distribute the lesson quiz. Provide class time for the students to complete this assessment.

Other Invertebrates

Mollusks: Lesson Quiz

Answer Key

Provided to teachers upon request at teachers-requests@ck12.org.

19.3 Lesson 12.2: Echinoderms

Key Concepts

Lesson Objectives

Vocabulary

Check Your Understanding

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Teaching Strategies

[minimum of 3 general teaching strategies?]

Strategy Type

[Examples: Use Visuals, Discuss [Topic], Demonstrate [Something], Do [Activity], Build Science Skills]

Strategy Type

Strategy Type

Differentiated Instruction

Type of Learners [Examples: English Language Learners, Vision- (or) Hearing-Impaired Students, Below-Level Readers]

Enrichment

Type of Enrichment Strategy [Examples: Debate, Board Game, Teach a Topic, Research, Survey, Interview an Expert, Create a Bulletin Board, Connect with [Another Subject]]

Laboratory Activities

Science Inquiry

Activity Type

[Examples: Analyze Data, Develop a Research Plan]

Reinforce and Review

Activity Type

[Examples: Take an Online Quiz, Pair with a Partner]

Review Questions and Answers

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Have students answer the Review Questions that are listed at the end of the lesson in their FlexBook.

Points to Consider

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Lesson Assessment

Provided to teachers upon request at teachers-requests@ck12.org.

Copy and distribute the lesson quiz. Provide class time for the students to complete this assessment.

Other Invertebrates

Echinoderms: Lesson Quiz

Answer Key

Provided to teachers upon request at teachers-requests@ck12.org.

19.4 Lesson 12.3: Arthropods

Key Concepts

Lesson Objectives

Vocabulary

Check Your Understanding

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Teaching Strategies

[minimum of 3 general teaching strategies?]

Strategy Type

[Examples: Use Visuals, Discuss [Topic], Demonstrate [Something], Do [Activity], Build Science Skills]

Strategy Type

Strategy Type

Differentiated Instruction

Type of Learners [Examples: English Language Learners, Vision- (or) Hearing-Impaired Students, Below-Level Readers]

Enrichment

Type of Enrichment Strategy [Examples: Debate, Board Game, Teach a Topic, Research, Survey, Interview an Expert, Create a Bulletin Board, Connect with [Another Subject]]

Laboratory Activities

Science Inquiry

Activity Type

[Examples: Analyze Data, Develop a Research Plan]

Reinforce and Review

Activity Type

[Examples: Take an Online Quiz, Pair with a Partner]

Review Questions and Answers

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Have students answer the Review Questions that are listed at the end of the lesson in their FlexBook.

Points to Consider

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Lesson Assessment

Provided to teachers upon request at teachers-requests@ck12.org.

Copy and distribute the lesson quiz. Provide class time for the students to complete this assessment.

Other Invertebrates

Arthropods: Lesson Quiz

Answer Key

Provided to teachers upon request at teachers-requests@ck12.org.

19.5 Lesson 12.4: Insects

Key Concepts

Lesson Objectives

Vocabulary

Check Your Understanding

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Teaching Strategies

[minimum of 3 general teaching strategies?]

Strategy Type

[Examples: Use Visuals, Discuss [Topic], Demonstrate [Something], Do [Activity], Build Science Skills]

Strategy Type

Strategy Type

Differentiated Instruction

Type of Learners [Examples: English Language Learners, Vision- (or) Hearing-Impaired Students, Below-Level Readers]

Enrichment

Type of Enrichment Strategy [Examples: Debate, Board Game, Teach a Topic, Research, Survey, Interview an Expert, Create a Bulletin Board, Connect with [Another Subject]]

Laboratory Activities

Science Inquiry

Activity Type

[Examples: Analyze Data, Develop a Research Plan]

Reinforce and Review

Activity Type

[Examples: Take an Online Quiz, Pair with a Partner]

Review Questions and Answers

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Have students answer the Review Questions that are listed at the end of the lesson in their FlexBook.

Points to Consider

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Lesson Assessment

Provided to teachers upon request at teachers-requests@ck12.org.

Copy and distribute the lesson quiz. Provide class time for the students to complete this assessment.

Other Invertebrates

Insects: Lesson Quiz

Answer Key

Provided to teachers upon request at teachers-requests@ck12.org.

19.6 Review Answers Repository

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Have students answer the Review Questions that are listed at the end of the lesson in their FlexBook.

Chapter 20

TE Fishes, Amphibians, and Reptiles

20.1 Chapter 13: Fishes, Amphibians, and Reptiles

Outline

The chapter *Fishes, Amphibians, and Reptiles* consists of four lessons that introduce students to vertebrate animals, including fish, amphibians and reptiles:

- Lesson 13.1: Introduction to Vertebrates
- Lesson 13.2: Fishes
- Lesson 13.3: Amphibians
- Lesson 13.4: Reptiles

Overview

Teaching Strategies

Pacing the Lessons

Use the **Class Periods per Lesson** table below as a guide for the time required to teach the lessons of this chapter.

Table 20.1:

Lesson	Number of Class Periods*
Lesson 13.1: Introduction to Vertebrates	1.0

Table 20.1: (continued)

Lesson	Number of Class Periods*
Lesson 13.2: Fishes	1.0
Lesson 13.3: Amphibians	1.0
Lesson 13.4: Reptiles	1.0

- Class periods are assumed to be 60 minutes long.

Lab Links

Managing Materials

The materials listed in the **Materials List** table below are needed to teach the strategies and activities described in the Teachers Edition of the FlexBook for this chapter.

Table 20.2:

Lesson	Strategy or Activity	Materials Needed
13.1	1) 2)	1) 2)
13.2	1)	1)
13.3	1)	1)
13.4	1)	1)

Additional Web-Based Resources

Making the FlexBook Flexible

An important advantage of the FlexBook is the ability it gives you, the teacher, to choose the chapters and lessons that you think are most important for your own classes. The following information is provided to help you decide whether to include this chapter or certain lessons in this chapter in your students' FlexBook. You should also consult the standards correlation table that follows when selecting chapters and lessons to include in the FlexBook.

- To understand the content of this chapter, students should have read the *Introduction to Invertebrates* chapter.
- Students should read this entire chapter before reading the remaining chapters of the FlexBook.
- It is recommended that you include all the lessons of this chapter in the FlexBook.

Common Misconceptions

Here are some common student misconceptions:

There are many more vertebrate than invertebrate animal species

Vertebrate vs. Invertebrate Animal Species. Some students may think that there are more vertebrate species in the world. Nothing could be farther from the truth! About 97% of all animal species are invertebrate, and about 3% are vertebrate. The French biologist Jean Baptiste Lamarck coined the terms “vertebrate” and “invertebrate” in 1809, but he knew that invertebrates represent most of the animals on Earth. To emphasize this point, ask students: “If an invertebrate animal were setting up a classification system for animals, what key characteristic might it choose? Which group would have the most species?” (One possibility: an exoskeleton. Insects, crustaceans and other animals with exoskeletons would be in one group, while “non-exoskeleton” animals, such as all of the vertebrates, would be in another group. Clearly the “Exoskeletons” would have many more species than the “Non-Exoskeletons”).

All vertebrates evolved at the same time

Evolution of the Vertebrates. Based on the fossil record and other evidence, the lobe-finned fishes evolved into Amphibia (the amphibians). Reptilia (the reptiles) evolved from the amphibians. Both Aves (the birds) and Mammalia (the mammals) evolved from different branches of the reptiles. Have students review the basics of evolution in Chapter 7 and use the internet to explore how the vertebrates evolved. Over millions of years, how did 4 classes of vertebrates successfully “invade terrestrial habitats”? Answering this question, by focusing on the adaptations of each group, will help your student understand and remember the different characteristics of these groups.

Fish don’t breathe oxygen. Sharks aren’t fish. No fish can fly.

Two of the most common misconceptions about fish are that they don’t breathe oxygen and that sharks aren’t fish. Fish indeed breathe oxygen, while in the water, but they do it in a way that is hard to observe, i.e., via their gills. Have students watch fish in an aquarium. Point out that they open and close their mouths and that their gills move; these are indications that fish take in water and pass it over their gills, where oxygen is extracted and used by the fish. Regarding the second common misconception, many students over-generalize one type of fish (a bony fish). Show them that there are many other kinds of fish, such as cartilaginous fish (e.g., sharks, rays and skates) as well as jawless fish (e.g., lampreys and hagfish). Regarding the third misconception, which sounds like a fishy story, while nearly all fish don’t fly, about 50 species do. These fish are characterized by their large

pectoral fins, which help them glide in the air, above the water for distances between 50 to several hundred meters. (Reference 1) Ask your students: What might be some evolutionary advantages for such behavior?

Reference 1: Piper, Ross (2007). *Extraordinary Animals: An Encyclopedia of Curious and Unusual Animals*. N.Y.: Greenwood Press.

Frogs and toads are the same thing. Salamanders are a type of lizard. Toads can give you warts. Today, amphibian species are doing just fine.

Regarding Amphibians. Students often find it difficult to distinguish between related amphibians (e.g., frogs and toads) and between some amphibians (e.g., salamanders) and reptiles. Often, this is because students have little experience with amphibians. Review with your students the physical and behavioral characteristics of these animals. (See “Discussion Questions and Answers” in the Cells and their Structures chapter.) Also, while the skin of toads is warty, it does not cause human warts, which are caused by a virus. Finally, amphibians today are not doing fine. Rather, over 30% of all amphibian species are now threatened with extinction, while over 40% are experiencing population decline. Possible reasons for this sad state of affairs: water pollutants, habitat destruction and climate change. (Reference 2)

Reference 2: Rohr, J., Raffel, T., Romansic, J., McCallum, H. and Hudson, P. (2008) Evaluating the links between climate, disease spread, and amphibian declines *Proceedings of the National Academy of Science*, 105(45): 17436–17441.

All snakes feel slimy and are poisonous. Snakes chase people. When they move their tongues, they are making a threatening gesture. There is no significant difference between turtles, tortoises and terrapins.

Regarding Reptiles. Snakes seem to move almost effortlessly, hence the misconception that they are slimy. But they are dry to the touch. Also, while some snakes are poisonous (e.g., the coral snake, the rattlesnake) the overwhelming majority are not. Snakes do not chase people; in most cases they actively try to avoid them. When snakes move their forked tongues out of their mouths, they are actually “smelling and tasting” what’s in the air. And regarding turtles, tortoises and terrapins: all three are reptiles in the taxonomic order Chelonia (Greek for tortoise), have scales, lay eggs, and are ectothermic. What are the differences? Turtles spend most of their lives in water and tend to have webbed feet. Tortoises spend most of their lives on land and do not have webbed feet. Terrapins spend their lives on land and in water; they always live near water, along lakes, rivers and ponds.

20.2 Lesson 13.1: Introduction to Vertebrates

Key Concepts

This chapter is the third chapter in the Animal Kingdom unit. This chapter has four lessons:

1. Introduction to Vertebrates
2. Fishes
3. Amphibians
4. Reptiles.

This lesson introduces the vertebrates, animals with backbones.

Lesson Objectives

1. Describe the general features of chordates.
2. List the three groups of chordates with their characteristics.
3. List the general features of vertebrates.
4. Describe the classification of vertebrates.

Lesson Vocabulary

Check Your Understanding

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

- What is the function of the notochord in lower vertebrates?
- What happens to the notochord in higher vertebrates?

Teaching Strategies

[minimum of 3 general teaching strategies?]

Strategy Type

[Examples: Use Visuals, Discuss [Topic], Demonstrate [Something], Do [Activity], Build Science Skills]

Strategy Type

Strategy Type

Differentiated Instruction

Type of Learners [Examples: English Language Learners, Vision- (or) Hearing-Impaired Students, Below-Level Readers]

Enrichment

Type of Enrichment Strategy [Examples: Debate, Board Game, Teach a Topic, Research, Survey, Interview an Expert, Create a Bulletin Board, Connect with [Another Subject]]

Laboratory Activities

Science Inquiry

Activity Type

[Examples: Analyze Data, Develop a Research Plan]

Reinforce and Review

Activity Type

[Examples: Take an Online Quiz, Pair with a Partner]

Review Questions and Answers

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Have students answer the Review Questions that are listed at the end of the lesson in their FlexBook.

Points to Consider

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Lesson Assessment

Provided to teachers upon request at teachers-requests@ck12.org.

Copy and distribute the lesson quiz. Provide class time for the students to complete this assessment.

Introduction to Vertebrates: Lesson Quiz

20.3 Lesson 13.2:

Key Concepts

Lesson Objectives

Vocabulary

Check Your Understanding

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Teaching Strategies

[minimum of 3 general teaching strategies?]

Strategy Type

[Examples: Use Visuals, Discuss [Topic], Demonstrate [Something], Do [Activity], Build Science Skills]

Strategy Type

Strategy Type

Differentiated Instruction

Type of Learners [Examples: English Language Learners, Vision- (or) Hearing-Impaired Students, Below-Level Readers]

Enrichment

Type of Enrichment Strategy [Examples: Debate, Board Game, Teach a Topic, Research, Survey, Interview an Expert, Create a Bulletin Board, Connect with [Another Subject]]

Laboratory Activities

Science Inquiry

Activity Type

[Examples: Analyze Data, Develop a Research Plan]

Reinforce and Review

Activity Type

[Examples: Take an Online Quiz, Pair with a Partner]

Review Questions and Answers

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Have students answer the Review Questions that are listed at the end of the lesson in their FlexBook.

Points to Consider

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Lesson Assessment

Provided to teachers upon request at teachers-requests@ck12.org.

Copy and distribute the lesson quiz. Provide class time for the students to complete this assessment.

Fishes: Lesson 2 Quiz

20.4 Lesson 13.3:

Key Concepts

Lesson Objectives

Vocabulary

Check Your Understanding

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Teaching Strategies

[minimum of 3 general teaching strategies?]

Strategy Type

[Examples: Use Visuals, Discuss [Topic], Demonstrate [Something], Do [Activity], Build Science Skills]

Strategy Type

Strategy Type

Differentiated Instruction

Type of Learners [Examples: English Language Learners, Vision- (or) Hearing-Impaired Students, Below-Level Readers]

Enrichment

Type of Enrichment Strategy [Examples: Debate, Board Game, Teach a Topic, Research, Survey, Interview an Expert, Create a Bulletin Board, Connect with [Another Subject]]

Laboratory Activities

Science Inquiry

Activity Type

[Examples: Analyze Data, Develop a Research Plan]

Reinforce and Review

Activity Type

[Examples: Take an Online Quiz, Pair with a Partner]

Review Questions and Answers

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Have students answer the Review Questions that are listed at the end of the lesson in their FlexBook.

Points to Consider

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Lesson Assessment

Provided to teachers upon request at teachers-requests@ck12.org.

Copy and distribute the lesson quiz. Provide class time for the students to complete this assessment.

Amphibians: Lesson 3 Quiz

20.5 Lesson 13.4:

Key Concepts

Lesson Objectives

Vocabulary

Check Your Understanding

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Teaching Strategies

[minimum of 3 general teaching strategies?]

Strategy Type

[Examples: Use Visuals, Discuss [Topic], Demonstrate [Something], Do [Activity], Build Science Skills]

Strategy Type

Strategy Type

Differentiated Instruction

Type of Learners [Examples: English Language Learners, Vision- (or) Hearing-Impaired Students, Below-Level Readers]

Enrichment

Type of Enrichment Strategy [Examples: Debate, Board Game, Teach a Topic, Research, Survey, Interview an Expert, Create a Bulletin Board, Connect with [Another Subject]]

Laboratory Activities

Science Inquiry

Activity Type

[Examples: Analyze Data, Develop a Research Plan]

Reinforce and Review

Activity Type

[Examples: Take an Online Quiz, Pair with a Partner]

Review Questions and Answers

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Have students answer the Review Questions that are listed at the end of the lesson in their FlexBook.

Points to Consider

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Lesson Assessment

Provided to teachers upon request at teachers-requests@ck12.org.

Copy and distribute the lesson quiz. Provide class time for the students to complete this assessment.

Reptiles: Lesson 4 Quiz

20.6 Review Answers Repository

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Chapter 21

TE Birds and Mammals

21.1 Chapter 14: Birds and Mammals

Outline

The chapter *Birds and Mammals* consists of three lessons that introduce students to higher animals, including humans:

- Lesson 14.1: Birds
- Lesson 14.2: Mammals
- Lesson 14.3: Primates and Humans

Overview

Teaching Strategies

Pacing the Lessons

Use the **Class Periods per Lesson** table below as a guide for the time required to teach the lessons of this chapter.

Table 21.1:

Lesson	Number of Class Periods*
14.1: Birds	1.0
14.2: Mammals	1.5
14.3: Primates and Humans	1.5

- Class periods are assumed to be 60 minutes long.

Lab Links

Managing Materials

The materials listed in the **Materials List** table below are needed to teach the strategies and activities described in the Teachers Edition of the FlexBook for this chapter.

Table 21.2:

Lesson	Strategy or Activity	Materials Needed
14.1	1) 2)	1) 2)
14.2	1)	1)
14.3	1)	1)

Additional Web-Based Resources

Making the FlexBook Flexible

An important advantage of the FlexBook is the ability it gives you, the teacher, to choose the chapters and lessons that you think are most important for your own classes. The following information is provided to help you decide whether to include this chapter or certain lessons in this chapter in your students' FlexBook. You should also consult the standards correlation table that follows when selecting chapters and lessons to include in the FlexBook.

- To understand the content of this chapter, students should have read the *Fishes, Amphibians, and Reptiles* chapter.
- Students should read this entire chapter before reading the remaining chapters of the FlexBook.
- It is recommended that you include all the lessons of this chapter in the FlexBook.

Common Misconceptions

Here are some common student misconceptions about birds and mammals:

- Adaptations of birds, mammals and primates evolved because the animals needed them to survive (e.g., “Porcupines needed to have spines, to protect them from their enemies, so they developed spines.”)

- Bird feeders keep birds from migrating. Parent birds will leave their offspring if touched by human hands. Many birds mate for life.
- Most bats feed on blood. Polar bears are the only mammals in the Arctic. Marine mammals are really different types of fish.
- Humans evolved from monkeys.

How Adaptations Evolved

Students often attribute a given adaptation to the “will” of the animal. While such “teleological claims” (teleos means “end” in Greek) are often used in casual conversations (as a heuristic to understand the value of animal adaptations), such arguments should be avoided in scientific thinking. These claims cloud over the true cause of adaptations: random mutations which contributed to a given species’ survival. As a strategy to deal with these sorts of claims, review with students the process of evolution by natural selection (see the [Evolution Chapter](#)).

Bird Stories

There are many misconceptions about birds. For example, adding bird feeders does not keep birds from migrating. Specific environmental cues act as triggers for these birds to migrate; the presence of “extra food” does not change migration behavior. Also, human touching of young birds does not cause their parents to avoid them. While some textbooks note that *some birds mate for life*, these birds are more likely to retain their partners for one or more breeding seasons. Explore these and other misconceptions about birds with your students.

Mammal Stories

There are many misconceptions about mammals. For example, there are only three species of vampire bats; they feed on the blood of some mammals – though not people – and need as little as 2 tablespoons of blood a day. The other 800 or so species of other bats do not do so; most bats are herbivores. Also, the Arctic is home to a wide variety of terrestrial (caribou, musk ox, lemmings, rabbits) and marine (seals, walruses, whales) mammals. (Reference 1)

Some students categorize aquatic mammals as fish, because both swim. A good teaching strategy is to guide students to examine these animals in light of the questions: What makes a mammal? What makes a fish?

Human Evolution

While there are some biological similarities between monkeys and humans, the latter did not evolve from the former, according to evolutionary evidence. Rather, both groups evolved

from a common ancestor. Although this chapter does not delve into human evolution at length, this popular topic can motivate students to engage in biological thinking and research. See the Smithsonian Institution's on-line web site on human evolution:

- <http://anthropology.si.edu/humanorigins/ha/primate.html>

Reference 1: Fries-Gaither, J. (2009) Common Misconceptions about Mammals. Issue 10, January 2009 OnRamp NSDL. http://onramp.nsd1.org/eserv/onramp:16249/jan09_pl_m.html

21.2 Lesson 14.1: Birds

Key Concepts

This lesson is an introduction to birds, their adaptation for flight, breeding, diversity, and their importance.

Lesson Objectives

- List and describe general traits of birds.
- Explain how birds are adapted for flight.
- List different breeding systems in birds and describe nesting, incubation and parental care.
- Illustrate the diversity of birds with examples of some of the varied groups.
- Explain how birds are important, both economically and ecologically.

Lesson Vocabulary

Table 21.3:

Lesson 14.1 Vocabulary		
aerofoil	altricial	monogamous
polygamous	precocial	generalists

Check Your Understanding

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

- Birds and reptiles have some traits in common. For example, birds are egg-layers and most reptiles are also oviparous. What do the eggs of both groups have in common?
- What traits are there in birds as a result of them being warm-blooded?

Teaching Strategies

Using Visuals

Have students examine **Figure 1**, a photo of ostriches.



Figure 21.1: The ostrich can reach a height of 9 feet! Pictured here are ostriches with young in Namibia, Africa. (6)

- Ask students to quickly write down their description of a bird, with as many traits as they can think of. Share these with the class, and start a list of characteristics on the board.
- Did they come up with a variety of characteristics? Discuss the wide diversity of birds, and this definition:
 - a. Birds (class *Aves*) are warm-blooded.
 - b. Vertebrate animals with two legs (bipedal).
 - c. Which lay eggs.
- Have the class generate a list of bird traits: Defining characteristics of modern birds include:

- a. Feathers
- b. High metabolism
- c. A four-chambered heart
- d. A beak with no teeth
- e. A lightweight but strong skeleton
- f. Production of hard-shelled eggs

Research and Inquiry

1. Pairs or teams of students research birds, and the evolution and anatomy of flight, at this PBS web site: <http://www.pbs.org/lifeofbirds/classroom/lesson1.html>
2. Students may explore briefly the different links. Then, ask students to choose a research topic of either “Bird Brains”, “Evolution”, “Champion Birds”, “Parenthood”, or “Bird Songs”.
3. Pairs should present their findings to the class by: interviewing each other, performing a skit, using a PowerPoint presentation, or showing a short video.

Hands-on, Simulation, Inquiry

What Darwin Never Saw: Survival of the Finches

<http://www.chias.org/www/edu/cse/wdn1x.html>

Students will role play birds migrating, gather data, analyze data, and determine factors affecting environmental conditions for wildlife. They should have some background information on the finches of Darwin Island and on the beak sizes of these birds.

The following article has a good diagram of finch beaks to acquaint students with the problem. http://www.biology-online.org/2/11_natural_selection.htm

Hands-on, Simulation, Inquiry

Changing Attitudes About Nature Through Bird Identification

Access Excellence http://www.accessexcellence.org/AE/AEC/AEF/1996/dawson_bird.php

In this hands-on lab, students learn to identify groups of 10-20 birds. Students will work in cooperative teams to learn to identify the birds. The lesson, using or making flash cards, is complete with extensions involving nest collections.

Differentiated Instruction

The live webcam on chicks and the accompanying information in the second website give special education or ELL students real world experiences, as they watch the live hatchings. They then can then discuss the process with each other to better understand bird reproduction.

Live 4-H EGG Cam; watch chicks hatch live, U of Nebraska, requires Real Player plug-in

- <http://lancaster.unl.edu/4h/Embryology/EggCamera.shtml>

Embryology Resources from U of Nebraska

- <http://lancaster.unl.edu/4h/embryology/resources.shtml>

Students make a poster of the process, sketching, coloring, labeling, and adding captions to show what they learned. Students write a brief description of what they observed. **ELL**

Enrichment: Research/Build Science

Many advanced students enjoy the challenges of becoming experts on different topics and in various disciplines. Have students you need extra challenges to prepare and present a PowerPoint presentation of bird identification. They can use the following sites to gather information and start their presentations:

1. Bird identification and Matching Interactive Games

- <http://caplter.asu.edu/explorers/protocol/birds/gameintro.htm>

2. World Bird Gallery: A Sampler of the World's Birds

- <http://www.camacdonald.com/birding/Sampler.htm>

3. Bird Beaks and Feet Worksheet and Analysis

- http://www.biologycorner.com/worksheets/beaks_feet.html

4. Bower Bird Blues

- <http://www.pbs.org/wnet/nature/episodes/bower-bird-blues/introduction/2109/>

5. Bird Net

- <http://www.nmnh.si.edu/BIRDNET/index.html>

6. National Audubon Society

- <http://www.audubon.org/>

Laboratory Activity

Owl pellets contain many clues to the feeding history of the owl. Students will find feathers, bones, teeth, hair, and exoskeletons of animals. Students will need to identify various parts of animals. Students discover the history of the owl and its food supply, while conducting the pellet investigation.

- Owl Brand Discovery Kits: <http://www.obdk.com/index.html> Site includes virtual dissection demonstration.
- Owl Pellet Lab and Bone Chart <http://www.hometrainingtools.com/article.asp?ai=1244&bhcd2=1246854714>
- Procedure and Analysis: <http://www.biologycorner.com/worksheets/owlpellet.html>
- Owl Pellet Lab (description, procedure, student directions.) http://www.lpscience.fatcow.com/jwanamaker/download/owl_pellet_lab.pdf

Science Inquiry

Analyze Data, Develop a Research Plan

The Beak of the Finches Access Excellence Lesson Plan http://www.accessexcellence.org/AE/AEC/AEF/1996/sprague_beaks.php

1. Before the lab section of this lesson, students will read about natural selection and Darwin's finches. They will then write a short response to three quotes from Gould, Lweontin, and Campbell.
2. The inquiry activity involves students exploring different kinds of seeds and instruments that can pick up and open the seeds. Students repeat trials of the instruments ability to pick up and open seeds and keep observation notes during the process.
3. You may have a discussion after the activity, and/or ask students to write their own lab reports.

Reinforce and Review

Lesson Summary

Either you or a student(s) leads a discussion to review the lesson. You can use the Lesson Summary from the FlexBook. Clarify any issues and answer any questions students may have.

Online Quiz

Bird Online Self-Correcting Multiple Choice Quiz http://www.biologycorner.com/bio2/bird_quiz.html

Students take an online quiz with a partner. You can have them take the quiz once together. They should note their scores and discuss the results. Then take the quiz again and see if they have improved.

Activity/Label and Color

“Which came first, the chicken or the egg?”

Amniotes Egg coloring (see site for specific coloring instructions)

- Print and copy: <http://www.biologycorner.com/worksheets/amniote-egg.html>

Review Questions and Answers

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Have students answer the Review Questions that are listed at the end of the lesson in their FlexBook.

Points to Consider

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Lesson Assessment

Provided to teachers upon request at teachers-requests@ck12.org.

Copy and distribute the lesson quiz. Provide class time for the students to complete this assessment.

Birds and Mammals: Lesson 14.1 Quiz

Answer Key: Lesson 14.1 Quiz

Provided to teachers upon request at teachers-requests@ck12.org.

21.3 Lesson 14.2: Mammals

Key Concepts

Mammals (class Mammalia), another diverse group of vertebrates, are warm-blooded, vertebrate animals with a number of unique characteristics.

Lesson Objectives

- List and describe general traits of mammals.
- Compare reproduction in monotremes, marsupials and placental mammals.
- Describe how mammals can be grouped according to their anatomy and their habitats.
- Explain how non-human mammals can benefit people and how they play an ecological role.

Lesson Vocabulary

Table 21.4:

Lesson 14.2 Vocabulary		
mammary glands	neocortex	monotremes
vivipary	marsupial	placenta
estrus	harem	

Check Your Understanding

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

- What traits are there in mammals as a result of them being warm-blooded?
- Describe courtship displays in birds. As you learn about mammals, think about how their courtship is similar or different to that of birds.

Teaching Strategies

Use Visuals

1. Introduce mammals. Ask students to write down a definition of mammals. Share these and discuss.

Have students characterize **Figures 1-5** and **7** from the FlexBook.

Have them write a list of 10 characteristics/observations of these mammals. Call on students to give one example and make a list on the board. Humans are mammals, as are many other animals.

Mammals (class *Mammalia*) are warm-blooded, vertebrate animals with a number of unique characteristics. In most mammals, these include:

- The presence of hair.
- Sweat glands.
- Glands specialized to produce milk (mammary glands).
- Three middle ear bones.
- A neocortex region in the brain.
- Specialized teeth.
- A four-chambered heart.

Write **monotreme** on the board. Refer students to **Figure 1** and **2** in the FlexBook.

Ask “Why might these animals be called monotreme?”

(Like other mammals, monotremes are warm-blooded with a high metabolic rate (though not as high as other mammals, see below). They have hair on their bodies; produce milk through mammary glands to feed their young; have a single bone in their lower jaw; and have three middle ear bones. Monotremes were very poorly understood for many years, and to this day some of the 19th century myths that grew up around them endure. Monotremes are sometimes still thought of as inferior mammals. However, it seems clear that modern monotremes are the survivors of an early branching of the mammal tree; a later branching is thought to have led to the marsupial and placental groups.)



Figure 21.2: The echidna is a member of the monotremes, the most primitive order of mammals. (7)



Figure 21.3: Another monotreme, the platypus, like other mammals in this order, lays eggs and has a single opening for the urinary, genital, and digestive organs. (3)



Figure 21.4: A marsupial mammal, this Eastern grey kangaroo has a joey (young kangaroo) in its abdominal pouch. (4)



Figure 21.5: A mating system with a harem of many females and one male, as seen in the seal species, *Callorhinus ursinus*. (5)



Figure 21.6: A Caracal, hunting in the Serengeti. (2)

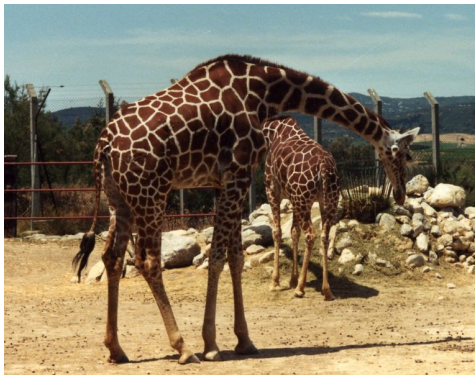


Figure 21.7: (1)

Discussion

Discuss the diversity of Mammalia with students: There are approximately 5,400 mammalian species, ranging in size from the tiny 1-2 in (30 – 40mm) bumblebee bat to the 108ft (33m) blue whale.

Bumblebee bats: These bats were given their names because they are about as small as a bumblebee and weigh no more than a dime. They hover like humming birds as they feed on insects at the top of certain trees. Unfortunately, it is considered one of the twelve most endangered species in the world. They are found in only a small area of Thailand that has been hugely impacted by deforestation. In 1982 the Thailand government could only find about 160 of these bats living in three limestone caves. Let's hope they have not already disappeared.

- picture: <http://grahamten.files.wordpress.com/2009/05/bat11.jpg>

Blue Whale: Blue whales grow to be about 80 feet (25 m) long on average, weighing about 120 tons. The largest specimen found was a female about 108 feet long. The females are larger than males, as with all baleen whales. The largest of the blue whales (150 tons) has a heart that weighs about 1,000 pounds (450 kg) and has 14,000 pounds (6,400 kg) of blood circulating in its body. The heart is about the size of a Volkswagen bug car. A human could crawl through the aorta (a major blood vessel).

- picture: <http://www.freewebs.com/cetaceanrc/BlueWhale1.jpg>

Research and Gather Information, Build Science Skills

The following links offer pdf documents that give entire units with lessons, vocabulary, flash cards, photos, and assessments for learning about marine mammals. Choose one to two lessons from each set to give students an introduction to marine mammals. Marine Mammal Lessons:

- Seals, Sea Lions <http://www.seaworld.org/just-for-teachers/guides/pdf/s&s1-4-8.pdf>
- Whales <http://www.seaworld.org/just-for-teachers/guides/pdf/whales-4-8.pdf>

Mammal Chart

Print out the Mammal chart and have students work in pairs or teams to complete charts. <http://www.biologycorner.com/worksheets/mammalchart.htm>

FlexBook Micro-Lab

In the FlexBook, there is a Micro-Lab: Matching Adaptations of Teeth and Limbs in their Respective Diets and habitats

Differentiated Instruction

English Language Learners

1. Mammal Worksheet to print and copy: <http://www.biologycorner.com/worksheets/mammals.htm>
2. Comparing a Human and Avian Skeleton Information and Worksheet http://www.biologycorner.com/worksheets/comparing_avian_human.html

ELL students may partner with native speakers to complete these worksheets.

Enrichment

These activities may be done either as pre-labs to introduce students to the internal anatomy of mammals, as a substitute for those students for whom dissection is distasteful, or as post lab reviews and assessments.

- Internal Organs of a Female African Elephant <http://www.biologycorner.com/worksheets/elephant.html>
- Fetal Pig Dissection Online Self-Correcting Quiz <http://school.discoveryeducation.com/quizzes6/muskopf/fetal.html>
- Fetal Pig Dissection Online Self-Correcting Quiz II <http://www.biologycorner.com/pig/quiz2.html>

Laboratory Activities

Choose one or both dissection activities for students to learn about mammals. These web sites offer complete descriptions of the lab, student procedures, materials, and assessments. If you are short on time, send student teams to the online fetal pig or virtual pig dissection and have them work through the fetal pig review sheet.

- Sheep Brain dissection <http://www.zerobio.com/dissect.htm>
- Fetal Pig Dissection: External Anatomy http://www.biologycorner.com/worksheets/fetal_pig_dissection.html

- Fetal Pig Review Sheet http://www.biologycorner.com/bio2/fetalpig_review.html
- Online Dissection with Pictures: Fetal Pig <http://faculty.clintoncc.suny.edu/faculty/Michael.Gregory/files/Bio%20102/Bio%20102%20Laboratory/Fetal%20Pig/Fetal%20Pig.htm>

The following sites can add to the understanding of the fetal pig dissection:

- Clickable Fetal Pig Pictures <http://www.biologycorner.com/pig/fetal.html>
- Virtual Pig Dissection <http://www.whitman.edu/biology/vpd/main.html>
- <http://www.hillstrath.on.ca/moffatt/bio3a/fetalpig/fpdsf01.html> - Digestive
- <http://www.hillstrath.on.ca/moffatt/bio3a/fetalpig/fprsf01.html> - Respiratory
- <http://www.hillstrath.on.ca/moffatt/bio3a/fetalpig/fpugf01.htm> - Urogenital

Science Inquiry

Analyze Data, Develop a Research Plan

Ocean Quest Webquest

Students take on the role of a marine biologist and learn about marine life, especially marine mammals. Students choose a marine mammal about which they will become an expert. They will write articles and create fun activities for others on their animals and then contribute these to a large Marine Mammal Magazine to be enjoyed by the entire class.

<http://www.caz.cnyric.org/Middle%20School/WebQuest5/WebQuestYellow/OQyellow.htm>

Reinforce and Review

Lesson Summary

Either you or a student(s) leads a discussion to review the lesson. You can use the Lesson Summary from the FlexBook. Clarify any issues and answer any questions students may have.

Online Quiz

1. Mammals Online Self-Correcting Multiple Choice Quiz http://www.biologycorner.com/bio2/qz_mammal.html

2. Mammals Orders Online Self-Correcting Match-up Quiz I <http://www.biologycorner.com/flashquiz/mammals1.swf>
3. Mammals Orders Online Self-Correcting Match-up Quiz II <http://www.biologycorner.com/flashquiz/mammals2.swf>

Review Questions and Answers

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Have students answer the Review Questions that are listed at the end of the lesson in their FlexBook.

Points to Consider

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Lesson Assessment

Provided to teachers upon request at teachers-requests@ck12.org.

Copy and distribute the lesson quiz. Provide class time for the students to complete this assessment.

Birds and Mammals: Lesson 14.2 Quiz

Answer Key: Lesson 14.2 Quiz

Provided to teachers upon request at teachers-requests@ck12.org.

21.4 Lesson 14.3: Primates and Humans

Key Concepts

The biological order Primates, which are mostly **omnivorous** (eating both plant and animal material) mammals, contains all the species commonly related to the lemurs, monkeys and apes. The later includes humans. All primates have five fingers, a generalized dental pattern, a primitive (unspecialized) body plan and certain eye orbit characteristics, such as a postorbital bar (a bone, which runs around the eye socket). While an opposable thumb (the

only digit on the hand able to turn back against the other four fingers, thereby refining the grip in order to hold objects) are characteristic of this group, other orders, such as opossums, also have this feature.

Lesson Objectives

- List and describe general traits of primates.
- Summarize mating systems of primates.
- Review the types of habitats primates can be found in.
- Describe the three main groupings of primates.
- List the traits of the hominids, their diet, reproduction and social system.

Lesson Vocabulary

Table 21.5:

Lesson 14.3 Vocabulary		
omnivorous	pentadactyl	sexual dimorphism
quadrupedal	hybrid	

Check Your Understanding

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

- What are the general traits of mammals?
- Describe the mating systems in mammals.

Teaching Strategies

Make Charts, Use Visuals

1. Begin by explaining to students that primates are a group of mammals that are members of the biological order Primates, the group that contains lemurs, the Aye-aye, lorises, galagos, tarsiers, monkeys, and apes, with the last category including great apes.

a. Show photos of these primates at these web sites:

- Aye-aye: http://news.nationalgeographic.com/news/2005/04/images/050419_aye-aye.jpg
- Lemur: <http://www.erikvp.com/Images09/ring-tailed-lemur.jpg>
- Lorisids: http://www.loris-conservation.org/database/Div_figs/Baby_face.jpg
- Galagos: http://www.mnh.si.edu/mammals/pages/where/africa/bushbaby_info.htm

(You can also hear the bushbabys clicks, barks, and cries.)

- Tarsiers: <http://scienceblogs.com/afarensis/upload/2006/09/tarsiers%202.jpg>
- Monkeys: <http://animals.nationalgeographic.com/animals/enlarge/rhesus-monkeys-groom-image.html>
- Apes: <http://www.planetware.com/picture/gibraltar-upper-rock-nature-reserve-apes-ro.htm>
- Great Apes: http://www.fws.gov/international/DIC/species/great_apes/great_apes.html

2. The Primates order has traditionally been divided into two main groupings: prosimians and simians.

3. Students make two columns in their notebooks, headed prosimians and simians. As they go through the FlexBook lesson with their partners, have them list the animals in each column. Share these lists with the class.

4. What are the traits of primates? Ask students to brainstorm with each other, use the FlexBook, and, if possible do some web research. Have the class generate a list of primate traits.

Debate

1. Explain to students that only humans are recognized as persons and protected in law by the United Nations Universal Declaration of Human Rights. The legal status of non-human primates (NHPs), on the other hand, is the subject of much debate, with organizations such as the Great Ape Project (GAP) campaigning to award at least some of them legal rights. In June 2008, Spain became the first country in the world to recognize the rights of some NHPs when its parliament's cross-party environmental committee urged the country to comply with GAP's recommendations. They are that chimpanzees, bonobos, orangutans, and gorillas are not be used for animal experiments.
2. On the other hand, thousands of non-human primates are used around the world in research because of their supposed psychological and physiological similarity to humans. In particular, the brains and eyes of NHPs more closely parallel human anatomy than those of any other animals. NHPs are commonly used in preclinical trials, neuroscience, ophthalmology studies, and toxicity studies.

3. Assign students to one side or the other, not necessarily on the basis of their opinion. Have each team research all possible points on their side and develop a fact set, along with arguments in favor of or in opposition to allowing NHPs to be used in research. The following web sites could be of use:
 - (a) Wapedia Wiki: Animal Testing on Non-Human Primates http://wapedia.mobi/en/Animal_testing_on_non-human_primates
 - (b) The Humane Society of the United States, An Introduction to Primate issues http://www.hsus.org/animals_in_research/general_information_on_animal_research/an_introduction_to_primate_issues.html
 - (c) The Use of NHPs in Research 5.2.2009 http://www.eskoseppanen.net/index.php?option=com_content&view=article&id=619:the-use-of-nhps-in-research-38;catid=23&Itemid=57
4. Each side presents their fact sets and arguments in favor, followed by a discussion.
5. Discussion:
 - (a) How are NHP brains like human brains? How are they different?

The International Union for Conservation of Nature (IUCN) lists more than a third of primates as critically endangered or vulnerable. Common threats to primate species include deforestation, forest fragmentation, monkey drives (resulting from primate crop raiding), and primate hunting for use in medicines, as pets, and for food. Is this a problem? What can be done about it?

Film: Planet of the Apes

1. Ask students if they have seen either the 1968 or 2001 movie version “Planet of the Apes”.
 - a. Note the reversals in the movie: the apes, who can talk, in control and divided into a strict class system: the gorillas as police, military, and hunters; the orangutans as administrators, politicians and lawyers; and the chimpanzees as intellectuals and scientists. Humans, who cannot talk, are considered feral vermin and are hunted and either killed outright, enslaved for manual labor or used for scientific experimentation.
 - b. The movie ideas may serve to excite student interest and motivation to discuss primates, humans, differences and similarities.
 - c. You may recommend the 1968 version. Here is the 1968 movie trailer:

- <http://www.britannica.com/blogs/2008/09/bensons-top-ten-films-of-19686-planet-of-tl>

You may also download the 1968 version at this site:

- <http://www.zml.com/movie/planet-of-the-apes-339923.htm>

2. If many have not seen the movie when you are ready to discuss it, read the plot summary to students: [http://en.wikipedia.org/wiki/Planet_of_the_Apes_\(1968_film\)](http://en.wikipedia.org/wiki/Planet_of_the_Apes_(1968_film))

3. Use the ideas of the movie to generate interest in discussing the similarities and differences in humans and apes, and humans and other NHPs.

a. The apes in the movie exhibit a low opinion of man's intelligence. This concept from the movie allows for a discussion of evolution and natural selection.

b. In 2001, Planet of the Apes was selected for preservation in the United States National Film Registry by the Library of Congress as being "culturally, historically, or aesthetically significant". Ask students to discuss why this sci-fi film would be deemed worthy of being culturally or historically significant.

Differentiated Instruction

Students who are having difficulty understanding primates, or need extra support or review, would benefit from working with others to view these slideshows and discuss primates at the following web site.

Slidesets on Primates: <http://pin.primite.wisc.edu/av/slidesets/>

There are three separate slide shows:

1. Behavior of Social Animals
2. Conservation of Endangered Species
3. Taxonomic Classification

Enrichment: Research

1. African Primates at Home

See photos, hear sounds, learn about primates.

- <http://www.indiana.edu/~primate/primates.html>

2. The Emergence of Primates at How Stuff Works

- <http://animals.howstuffworks.com/mammals/emergence-of-primates-info.htm>

Primate Info Net: <http://pin.primite.wisc.edu/>

Primate Factsheets: <http://pin.primite.wisc.edu/factsheets>

Laboratory Activities

Science Inquiry

Discuss, Design and Analyze

This Discovery School lesson plan, at the web site below, on the Great Apes explains how students can learn about the ongoing controversy regarding the great apes intelligence. There is a video from the Discovery Channel that can be purchased to complement the lesson, but it can be effective by using class discussion and internet research opportunities.

The Great Apes

- <http://school.discoveryeducation.com/lessonplans/programs/greatapes/index.html>

Reinforce and Review

Lesson Summary

Either you or a student(s) leads a discussion to review the lesson. You can use the Lesson Summary from the FlexBook. Clarify any issues and answer any questions students may have.

Play a Card Game

Four Great Apes Card Game

Students play a card game with cards of images of different primate species. The object is to find the great apes, and collect four of them. Students familiarize themselves with the images and are able to differentiate different primates on sight.

- <http://pin.primate.wisc.edu/edu/game.html>

Reading

Recommended Reading on Primates for Students

Have students choose a book about primates from the list at this web site. Assign the reading as homework and have students write reports as book advertisements on posters.

- <http://pin.primate.wisc.edu/av/slidesets/RecomendedReading.html>

Review Questions and Answers

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Have students answer the Review Questions that are listed at the end of the lesson in their FlexBook.

Points to Consider

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Lesson Assessment

Provided to teachers upon request at teachers-requests@ck12.org.

Copy and distribute the lesson quiz. Provide class time for the students to complete this assessment.

Birds and Mammals: Lesson 14.3 Lesson Quiz

Answer Key: Lesson 14.3 Quiz

Provided to teachers upon request at teachers-requests@ck12.org.

Image Sources

- (1) <http://commons.wikimedia.org/wiki/Image:Giraf.jpg>. GNU-FD.
- (2) http://commons.wikimedia.org/wiki/Image:Caracal_hunting_in_the_serengeti.jpg. GNU-FDL.
- (3) <http://commons.wikimedia.org/wiki/Image:Platypus.jpg>. GNU-FDL.
- (4) http://commons.wikimedia.org/wiki/File:Kangaroo_and_joey05.jpg. GNU-FDL.
- (5) http://commons.wikimedia.org/wiki/File:Callorhinus_ursinus_and_harem.jpg. Public Domain.
- (6) http://commons.wikimedia.org/wiki/Image:Struthio_camelus.jpg. GNU-FDL.

(7) http://commons.wikimedia.org/wiki/File:Echidna_-_melbourne_zoo.jpg.
GNU-FDL.

Chapter 22

TE Behavior of Animals

22.1 Chapter 15: Behavior of Animals

Outline

The chapter *Behavior of Animals* consists of two lessons that introduce students to living the behavior of animals:

- Lesson 15.1: Understanding Animal Behavior
- Lesson 15.2: Types of Animal Behavior

Overview

Teaching Strategies

Pacing the Lessons

Use the **Class Periods per Lesson** table below as a guide for the time required to teach the lessons of this chapter.

Table 22.1:

Lesson	Number of Class Periods*
Lesson 15.1: Understanding Animal Behavior	2.0
Lesson 15.2: Types of Animal Behavior	2.0

- Class periods are assumed to be 60 minutes long.

Lab Links

Managing Materials

The materials listed in the **Materials List** table below are needed to teach the strategies and activities described in the Teachers Edition of the FlexBook for this chapter.

Table 22.2:

Lesson	Strategy or Activity	Materials Needed
15.1	1) 2)	1) 2)
15.2	1)	1)

Additional Web-Based Resources

Making the FlexBook Flexible

An important advantage of the FlexBook is the ability it gives you, the teacher, to choose the chapters and lessons that you think are most important for your own classes. The following information is provided to help you decide whether to include this chapter or certain lessons in this chapter in your students' FlexBook. You should also consult the standards correlation table that follows when selecting chapters and lessons to include in the FlexBook.

- To understand the content of this chapter, students should have read the *Fishes, Amphibians, and Reptiles* and *Birds and Mammals* chapters.
- Students should read this entire chapter before reading the remaining chapters of the FlexBook.
- It is recommended that you include all the lessons of this chapter in the FlexBook.
- If time is limited, you may choose to complete this chapter in two class periods.

Common Misconceptions

- Bats fly into people's hair. Ostriches stick their necks in the sand. Bears are slow. Hippos are clumsy. Rattlesnakes rattle their tails before their strike.
- Animals don't have any emotions.

Animal Behavior Myths

Bats fly into people's hair. Ostriches stick their necks in the sand. Bears are slow. Hippos are clumsy. Rattlesnakes rattle their tails before their strike. Many myths regarding the behavior of animals are common in the general public. For example, it's simply not true that bats fly into people's hair. Since their sonar system is so sophisticated that they can detect the location of flying insects (which they eat), bats can easily (and do) avoid human hair. Not once have ostriches been observed to bury their heads in the sand. However, as a defense against predators, they have been observed to lie down, stretching their long necks on the ground; views of these ostriches from a distance may be the reason for this common myth. Both bears and hippos can run up to 30 mph, faster than an Olympic sprinter. Rattlesnakes don't rattle before they strike. They rattle when they are frightened, very likely as an adaptation to prevent them from being stepped on by larger animals. Identify and explore these and many other "animal behavior myths" with your student. Discuss the origins of these myths (e.g., classic horror films, unfounded superstitions, etc.).

Animal Emotions: Animals don't have any emotions

In 1872, the great British biologist, Charles Darwin, published a book, *The Expression of the Emotions in Man and Animals*, which explored the evolution of emotions. Since then, ethologists (scientists who study animal behavior) have debated the issue of animal emotions. It is clear that some animals do have emotions – such as fear, curiosity, grief, love, anxiety and the like. Anyone who has a pet dog can attest to this. Some ethologists add a cautionary word about the heed to avoid "anthropomorphism," or ascribing human emotions to non-human animals. Other ethologists defend this practice, saying that they need to anthropomorphize because people and animals share many traits (including emotions) and because human language is needed to communicate what they observe. (References 1 and 2). Challenge your students to investigate and discuss this issue in your classroom.

Reference 1: Bekoff, N. (2007). Do animals have emotions? *New Scientist*, May 23. <http://www.newscientist.com/article/mg19426051.300>

Reference 2: Bekoff, N. (2007). *The Emotional Lives of Animals: A Leading Scientist Explores Animal Joy, Sorrow, and Empathy — and Why They Matter*. N.Y: New World Library.

22.2 Lesson 15.1: Understanding Animal Behavior

Key Concepts

This lesson introduces the concept of animal behavior as any way that animals act, either alone or with other animals. Key concepts include: innate behavior, drawback of innate behavior, learned behavior, habituation, observational learning, conditioning, learning by playing, and insight learning.

Lesson Objectives

- Give examples of animal behavior.
- Explain why animal behavior is important.
- Describe innate behavior and how it evolves.
- List ways that behavior can be learned.

Lesson Vocabulary

Table 22.3:

Lesson 15.1 Vocabulary		
animal behavior	innate behavior	instinct
reflex behaviors	learned behavior	habituation
observational learning	conditioning	insight learning

Check Your Understanding

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

- What is an animal?

- Give examples of a wide variety of animals.

Teaching Strategies

KWL/Compare and Contrast Chart

1. Ask students to title a page in their science notebooks, “What I Know,” then make two columns, and head them as “What I Just Knew”, and “What I Learned.” Ask them to brainstorm all of the things they do during the days or nights and put these behaviors in one column or the other.
2. Discuss with a partner and share your behaviors, add to your lists.
3. Read the FlexBook sections on habituation, observational learning, conditioning, learning by playing, and insight learning.
4. Ask students to label their learned lists with each of these types of learned behavior. Have them discuss their lists with a partner.
5. Follow with a class discussion and sharing of information.

Activity

1. The following activity is written in two parts. The first part is a pre-aquarium visit using ethograms of fellow students or animals in the classroom. (Ethograms are inventories of animal behaviors that help scientists develop an understanding of species behaviors and how they help the organisms survive and reproduce.)
2. You might have your students do the first part, the ethogram activity, in the classroom. Then assign the second piece, making several ethograms of various animals, for students to do at home with pets, at a local zoo, or a local aquarium in your area.
3. Animal Behavior:

- http://www.sheddaquarium.org/SEA/lesson_plans.cfm?id=94

Ethogram Worksheet for Students for above activity:

- http://www.sheddaquarium.org/SEA/pdf/SEA_ws-ethogram.pdf

4. My Sketches sheets for science notebook:

- http://www.sheddaquarium.org/SEA/pdf/SEA_notebook-science.pdf

Using Visuals

1. Students look at **Figures 1a-1g** in the FlexBook. These photos include a cat, spider, dog with puppies, bird, wasp, rabbit, and lizard. Ask students to look at each of the

- photos with their partner, discuss why animals behave in these ways, and write 10 observations (bulleted list).
2. Write *innate* on the board. Explain that: An **innate behavior** is any behavior that occurs naturally in all animals of a given species. An innate behavior is also called an **instinct**. The animals they observed through photos in the first part of this exercise are acting naturally, that is, they did not need to learn to do any of those behaviors.
 3. Have students look at **Figure 2, 3a, 3b, and 4** in the FlexBook. These are more examples of innate behavior.
 4. Have students read *Drawback of Innate Behavior* in the FlexBook and follow with a class discussion.

Review: Animal Behavior

The following web site gives a brief review of animal behavior, definitions, and includes an informative section with dog diagrams and the meanings of different behaviors. Ask student pairs to review these behaviors together, noting whether these are behaviors they have previously observed in dogs. Students take notes on the behavior and note their observations.

- http://www.biologycorner.com/bio2/notes_animal_behavior.html

Differentiated Instruction

English Language Learners, Below-Level Readers

Students who need support to understand the ideas behind studying animal behavior will enjoy and learn from the games, activities, and visuals at the following web site, which shows how bats and dolphins use sonar and how those signals form images.

- BioSonar, Seeing with Sound, Bat Sonar, press preview <http://www.biosonar.bris.ac.uk/>
- Puzzles and matching games to understand animal behavior. Animal Behavior Interactive <http://www.indiana.edu/%7Eanimal/fun.html>
- Croak, a game about frog extinction, by Access Excellence <http://www.accessexcellence.org/AE/mspot/croak/intro4.php>

Play Croak Interactive and use the clues to discover the answer to the mystery. Email the answer to find out if you are right. Gives problem solving and team work opportunities for learning about frogs and figuring out plausible explanations based on evidence.

Enrichment: Research

Cats Meow: http://www.sciencenetlinks.com/sci_update.php?DocID=11 Learn how cats use meowing and purring to communicate:

- Ask students to write down what they know about cats and what they think about purring and meowing. Then they read the transcripts, and write out answers for the 8 questions at the end of the transcript.

Enrichment: Research/Analysis

Orangutan U

http://www.sciencenetlinks.com/sci_update.php?DocID=34

Learn how primates communicate with humans.

- Ask students to write down what they know about orangutans and their behaviors. Students should then read the transcripts, and write out answers for the 5 questions at the end of the transcript.

Laboratory Activities

Students use a wellness quiz to find out about their own pets or a neighbor or friend's pet dog or cat. They then discuss the different outcomes and reasons to explain the differences. Students read these articles and use the Behavior Articles to explain their pet's behavior. Behavior Articles

http://www.animalbehaviorassociates.com/rmn_articles.htm

Pet/dog Behavior Wellness Quiz

http://www.animalbehaviorassociates.com/quiz_dog.htm

Pet/cat Behavior Wellness Quiz

http://www.animalbehaviorassociates.com/quiz_cat.htm

Science Inquiry

Analyze Data

Field Diaries with Lincoln Park Zoo scientists in Tanzania and Uganda.

- http://www.lpzoo.org/articles/features/Field_Diaries/index.html

Students follow the diaries of several scientists, use Google Earth within the diaries to download a file that “fly” them to the location.

Students choose one scientist and report on their studies.

Observation of Behavior

See the Appendix for a comprehensive activity of animal behavior.

Reinforce and Review

Online Quiz

Animal Behavior Quiz:

<http://www.quizmoz.com/quizzes/Animal-Quizzes/a/Animal-Behavior-Quiz.asp>

Animal Functions Quiz, self-correcting:

<http://www.mcwn.org/Animals/AnFunction.html>

Review Questions and Answers

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Have students answer the Review Questions that are listed at the end of the lesson in their FlexBook.

Points to Consider

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Lesson Assessment

Provided to teachers upon request at teachers-requests@ck12.org.

Copy and distribute the lesson quiz. Provide class time for the students to complete this assessment.

Behavior of Animals: Lesson 15.1 Quiz

Answer Key: Lesson 15.1 Quiz

Provided to teachers upon request at teachers-requests@ck12.org.

22.3 Lesson 15.2: Types of Animal Behavior

Key Concept

Animal behavior is any way that animals act, either alone or with other animals.

Lesson Objectives

- List ways that animals communicate.
- Describe social behavior in animals.
- Explain the purpose of mating behavior.
- Describe how animals defend their territory.
- Identify animal behaviors that occur in cycles.

Lesson Vocabulary

Table 22.4:

Lesson 15.2 Vocabulary		
communication	language	social animals
cooperation	mating	courtship behaviors
display behavior	hibernation	migration
circadian rhythms	biological clock	

Check Your Understanding

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

- What is an animal?
- Give examples of a wide variety of animals.

Teaching Strategies

Discussion, Jigsaw

1. Ask students to think of different kinds of animal, including human, behaviors. Make a list of the kinds of behaviors that students generate. (Some may be behaviors needed for survival, for communication, for social purposes, for mating or courtship, parental behaviors, defensive behaviors, and behaviors that happen annually or daily.)
2. Jigsaw: Assign groups of students to different behaviors listed above. Students should generate as many examples of that kind of behavior in animals, including humans. Teams share with all other teams individually, adding to their lists. Share out with the class and discuss.

Activity: Animal Observations, Design and Conduct Experiments, Build Science Skills

Set up a classroom animal zoo with rats, mice, goldfish, parakeets, or a tropical aquarium. If students have animals at home that they would like to have live at school during the week and go home on weekends and holidays, you could set up a temporary zoo during the unit of study.

- Students design their own experiments to teach behaviors to the classroom animals. These behaviors might include teaching parakeets to talk, mice to run mazes, fish or rats to associate tapping the cage or bowl with feeding time. Let students brainstorm ideas, write up their experimental design, keep observation notes and report back to the class on their experimental results.
- Pet observations at home. Students observe their own pets at home for instinctive and learned behaviors. Students reflect on their pet's behavior history, including training sessions, and report on their pet. Students also report on the pet's behavior, success or not of training, and behaviors unique to their pet, and to the breed or type of pet.

Puzzles

- Animal Slide Puzzles

<http://www.indiana.edu/~animal/fun/slide/squirrel1b.html>

- Animal Smart Puzzles

<http://www.indiana.edu/~animal/fun/smartpuz/caribou1.html>

Use Virtual Models

StarLogo Ant Pattern Models

Download the model and run to observe ant behavior. There are explorations and things to notice on the website. Have students make observations about ant behavior that they note by running the model.

<http://education.mit.edu/starlogo/models/library/AntPatterns>

More about StarLogo Ants:

<http://www.cs.uwo.edu/~wspears/courses/CS5010/ants.html>

Differentiated Instruction

English Language Learners

Spanish Pet Behavior Tip Sheets:

http://www.hsus.org/pets/pet_care/our_pets_for_life_program/spanish_pet_behavior_tip_sheets_2.html

Animal Crossword Puzzles:

<http://www.indiana.edu/~animal/fun/crossword.html>

Enrichment: Learning About Careers

Careers in Animal Behavior <http://www.indiana.edu/~animal/help/careers.html>

Students read about careers in animal behavior, and report to class on their findings.

Laboratory Activities

Animal Observations

1. Animal Behavior: Observations at the Zoo Comprehensive lesson description, observations 1, 2, and 3 defined for students.

http://www.accessexcellence.org/AE/AEC/AEF/1994/peebles_behavior.php

2. Animal Behavior Project at the Zoo Student Worksheet

<http://gk12.asu.edu/Lessons/Anthropology/Animal%20Behavior/studentworksheets.pdf>

Use Virtual Animations

The Animal Brain: Pavlov's Dog Audio explanation of conditioned response and conditioning.

<http://www.brainviews.com/abFiles/AniPavlov.htm>

The Animal Brain: Associative Learning: Instrumental Appetite Conditioning Ask students to watch the animation and discuss with their team. Have them make changes and predict what will happen as a result.

Animation of mouse in cage and response to food.

<http://www.brainviews.com/abFiles/AniPavlov.htm>

Science Inquiry

Analyze Data, Develop a Research Plan

These activities are also included in the previous lesson.

Students use a wellness quiz to find out about their own pets or a neighbor or friend's pet dog or cat. Then discuss the different outcomes and reasons to explain the differences. Students read these articles and use the Behavior Articles to explain their pet's behavior.

Behavior Articles:

http://www.animalbehaviorassociates.com/rmn_articles.htm

If students observed dogs in the previous lesson, ask them to observe cats in this lesson. Discuss the differences in the behaviors of these two animals in class.

- Pet/dog Behavior Wellness Quiz

http://www.animalbehaviorassociates.com/quiz_dog.htm

- Pet/cat Behavior Wellness Quiz

http://www.animalbehaviorassociates.com/quiz_cat.htm

Reinforce and Review

Online Quiz

Animals Habitats and Behaviors Quiz <http://web.dps.k12.va.us/ParkAve/aniquiz.htm>

www.ck12.org

Animal Behavior Quiz http://www.wwnorton.com/college/biology/discoverbio4/_full/ch/30/quizplus.aspx

Review Questions and Answers

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Have students answer the Review Questions that are listed at the end of the lesson in their FlexBook.

Points to Consider

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Lesson Assessment

Provided to teachers upon request at teachers-requests@ck12.org.

Copy and distribute the lesson quiz. Provide class time for the students to complete this assessment.

Behavior of Animals: Lesson 15.2 Quiz

Answer Key: Lesson 15.2 Quiz

Provided to teachers upon request at teachers-requests@ck12.org.

Chapter 23

Introduction to Life Science (TE)

23.1 Unit 6: The Human Body

Outline

This unit, *The Human Body*, includes seven chapters that ...

Chapter 16: Skin, Bones, and Muscles

- Lesson 1: Organization of Your Body
- Lesson 2: The Integumentary System
- Lesson 3: The Skeletal System
- Lesson 4: The Muscular System

Chapter 17: Food and the Digestive System

- Lesson 1: Food and Nutrients
- Lesson 2: Choosing Healthy Foods
- Lesson 3: Digestive System

Chapter 18: Cardiovascular System

- Lesson 1: Introduction to the Cardiovascular System
- Lesson 2: Heart and Blood Vessels
- Lesson 3: Blood
- Lesson 4: Health of the Cardiovascular System

Chapter 19: Respiratory and Excretory Systems

Lesson 1: Respiratory System

Lesson 2: Health of the Respiratory System

Lesson 3: Excretory System

Chapter 20: Controlling the Body

Lesson 1: The Nervous System

Lesson 2: The Eyes and Vision

Lesson 3: Other Senses

Lesson 4: Health of the Nervous System

Chapter 21: Diseases and the Body's Defenses

Lesson 1: Infectious Diseases

Lesson 2: Noninfectious Diseases

Lesson 3: First Two Lines of Defense

Lesson 4: Immune System Defenses

Chapter 22: Reproductive Systems and Life Stages

Lesson 1: Male Reproductive System

Lesson 2: Female Reproductive System

Lesson 3: Reproduction and Life Stages

Lesson 4: Reproductive System Health

Overview

Chapter 24

TE Skin, Bones, and Muscles

24.1 Chapter 16: Skin, Bones, and Muscles

Outline

The chapter *Skin, Bones, and Muscles* consists of four lessons that introduce students to the human body and three organ systems:

- Lesson 16.1: Organization of Your Body
- Lesson 16.2: The Integumentary System
- Lesson 16.3: The Skeletal System
- Lesson 16.4: The Muscular System

Overview

Teaching Strategies

Pacing the Lessons

Use the **Class Periods per Lesson** table below as a guide for the time required to teach the lessons of this chapter.

Table 24.1:

Lesson	Number of Class Periods*
Lesson 16.1: Organization of Your Body	1.0

Table 24.1: (continued)

Lesson	Number of Class Periods*
Lesson 16.2: The Integumentary System	1.0
Lesson 16.3: The Skeletal System	1.0
Lesson 16.4: The Muscular System	1.0

- Class periods are assumed to be 60 minutes long.

Lab Links

Managing Materials

The materials listed in the **Materials List** table below are needed to teach the strategies and activities described in the Teachers Edition of the FlexBook for this chapter.

Table 24.2:

Lesson	Strategy or Activity	Materials Needed
16.1	1) 2)	1) 2)
16.2	1)	1)
16.3	1)	1)
16.4	1)	1)

Additional Web-Based Resources

Making the FlexBook Flexible

An important advantage of the FlexBook is the ability it gives you, the teacher, to choose the chapters and lessons that you think are most important for your own classes. The following information is provided to help you decide whether to include this chapter or certain lessons in this chapter in your students' FlexBook. You should also consult the standards correlation table that follows when selecting chapters and lessons to include in the FlexBook.

- To understand the content of this chapter, students should have read the _____ chapter.
- Students should read this entire chapter before reading the remaining chapters of the FlexBook.
- It is recommended that you include all the lessons of this chapter in the FlexBook.

Common Misconceptions

Here are some common student misconceptions (See reference 1):

- Bones are not living structures. Bones aren't made of living cells.
- Muscles are only used for voluntary physical actions like walking, running, or throwing. Your muscles turn to fat if you quit exercising.
- Diseases like osteoporosis or arthritis affect only old people, so teenagers do not need to be concerned about them.
- Acne is caused by eating chocolate or greasy foods.
- Body piercings and tattoos are completely safe.

Living Bones

Bones are indeed living structures made of cells. Bones grow, heal when broken and play an essential role in the creation of both white and red blood cells. Discuss these dynamic bone functions with your students.

The Meaning of Muscles

Students often overgeneralize skeletal muscles (used for voluntary physical activities) as being the only muscles. But there are other types of muscle which function in an involuntary way: cardiac muscles in the heart, and smooth muscles in blood vessels and the intestinal tract. Also, the lack of exercise cannot change muscle cells into fat cells! Not exercising can reduce a person's muscle volume while increasing his or her fat volume, which may be the source of this common misconception.

Osteoporosis and Arthritis

While it is true that older people often suffer from these two disorders, young people also need to take care of their bones. Care for your bones (or lack of it), can influence the onset of these disorders later in people's lives. Good bone care equals regular exercise and adequate calcium intake (1,300 milligrams per day for children ages 9 to 18).

Acne

Acne is a common teenage disorder. Almost 85% of adolescents and young adults develop it. While its exact cause is unknown, several interacting factors seem to be responsible: changing hormone levels in females (e.g., before their menstrual periods), irritants such as

pollution, friction (rubbing the skin) and squeezing the lesions. A person's diet seems to play a small or nonexistent role.

Body Piercings and Tattoos

These body modifications, which involve breaking the skin, can cause infection. In fact, people with tattoos are nine times more likely to be infected with hepatitis C virus than people without them.

Reference 1:

“Looking Good, Feeling Good: From the Inside Out” Teachers Guide National Science Education Standards (NSES) http://science.education.nih.gov/supplements/nih6/bone/guide/info_musculo_skin-a.htm

24.2 Lesson 16.1: Organization of Your Body

Key Concepts

This lesson begins the introduction to the human body, outlining the organization in terms of tissues, organs, and organ systems.

Lesson Objectives

- List the levels of organization in the human body.
- Identify the four types of tissues that make up the body.
- Identify 12 organ systems.
- Describe how organs and organ systems work together to maintain homeostasis.

Check Your Understanding

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

- What is a cell?

(Cells are the structural and functional unit of living organisms.)

- What are some of the differences between a prokaryotic cell and a eukaryotic cell?
- What are some of the basic functions of animal cells?

Teaching Strategies

Virtual Tutorial

1. Student pairs go to computers to complete the Organization of the Human Body Tutorial.
 - http://www.wisc-online.com/objects/index_tj.asp?objID=AP15505
2. Students take notes and draw sketches of the body and parts, label, and note vocabulary. They click on next or continue to work their way through the tutorial. Flash Player is required. Have students turn in their notes for credit.
3. The second part of the tutorial is a check yourself section. Students must drag the term to the correct location.

Flash Cards, Sequencing

1. Write key words on the board: cell, tissue, organ, organ system, and organism.
2. Hand out index cards and have students make flash cards with the above words.
3. Define the words and have students write definitions on the other side.
4. Ask them to put them in order from the smallest unit to the largest. Hands off the cards. Look around, check each other's cards. Shuffle. Put cards in order largest to smallest. Hands off the cards. Look around, check each other's cards.
5. Have students work together in teams to research and design a lab wherein these five levels of body organization are studied. Use the FlexBook lesson as a reference. They give several examples of each level of organization. The final example for the organism level is seeing themselves in a body that has all levels of organization working.

Movement

1. Students stand up in the room and follow the teacher's directions.
2. Give directions to have students move in the room. Give them a variety of tasks, using different capabilities of the body: balance on one foot, hop, jump in place, close eyes and balance, close eyes and jump only when you hear the teacher clap, open eyes and jump only when you see the teacher's hand go up. How did they do all of those things so easily? All body systems working together at all levels of organization. If you have any disabled students, make allowances for what they can do.
3. Ask for a volunteer to demonstrate turning in the center of the room that you've cleared of furniture. The volunteer should turn until dizzy, and have spotters catch the person by the shoulders for safety. Why did they get dizzy?

Differentiated Instruction

English Language Learners

- Spanish Human Body Vocabulary <http://www.studyspanish.com/vocab/body.htm>
 - Human Body Chart in Spanish and English http://www.migrantclinician.org/files/08_spanish_creole_body_parts.pdf
 - Review the tutorial: Organization of the Human Body Tutorial. http://www.wisc-online.com/objects/index_tj.asp?objID=AP15505
 - Review of the Human Body <http://training.seer.cancer.gov/anatomy/body/review.html>
1. Pair ELL and native speakers to review these sites and teach each other body vocabulary in their own native language. They can point to body parts and show movement.
 2. Each should ask the other to pronounce the word and correct each other's pronunciation.
 3. Students make a body chart in their notebooks with parts labeled in both English and Spanish.

Enrichment: Virtual Interactive

The Virtual Human Body, El Cuerpo Virtual, Interactive in English and Spanish. This includes all systems of the body. <http://www.medtropolis.com/vbody.asp>

Laboratory Activities

1. Lab Activity with Torso Model and Terminology Review and Matching.

Students will review body parts from the FlexBook and then locate the same parts on the torso models and/or skeletons in the classroom. They then complete a matching list to identify which cavity of the body particular organs are located at.

- <http://www.bioprof.org/AnatText/lab1planes,cavities.pdf>

2. Lab#1: Body Organization and Terminology

After completing the torso lab above, students may use this set of terms to review their answers with each other and reinforce vocabulary and concept of positions, sections, regions, and cavities of the body.

- <http://www.spc.cc.tx.us/biology/lsimpson/Biol2401/Labs/Lab1.pdf>

Science Inquiry

Interactive Model 1

1. Exploratorium Online Interactive: Visible Human, Revealing Bodies

- <http://www.exploratorium.edu/bodies/vhuman.html> (Real Player required)

2. Students work in teams to explore this website.

- a. Photos and webcasts of the Revealing Bodies exhibit.
- b. MRI information, Resonant Imaging movie about MRI
- c. Visible Human

- <http://www.exploratorium.edu/body/vhuman.html>

Students navigate the “slices” of the body.

3. After exploring the web site, students should write down notes and questions for debriefing with the entire class. Discuss the site, how it was done, and the thoughts of the artists and technologists who worked to create Revealing Bodies.

Interactive Model 2

1. Virtual Skull: Use this web site to click on the parts of the skull and learn the terminology.

- <http://www.gwc.maricopa.edu/class/bio201/skull/skulltt.htm>

2. Virtual Skull Interactive: Use this site to manipulate the bones of the skull for observation.

- <http://www.gwc.maricopa.edu/class/bio201/skull/skulltt.htm>

Print off this page for students to use as a guide when learning the parts of the skull.
<http://www.biologycorner.com/worksheets/skullanatomy.html>

Reinforce and Review

Flash Cards

1. Review vocabulary list at this site and print selected cards. Fold down the middle and paste or tape together. One side of the card will be the term, the other side the definition. <http://quizlet.com/flashcards/371581/>
2. Print the Quizlet Term List. <http://quizlet.com/print/371581/>

Online Quiz

1. Study Stack: Body Cavities, Abdominal Regions and Quadrants

Questions and answers are on the site and may each be hidden or shown as desired by the user.

- <http://www.studystack.com/studytable-23552>

2. Quiz: Introduction to the Human Body, the National Cancer Institute

This is a self-correcting quiz. One submits their answers and then pushes the submit button to see the corrections. Students may take this multiple times to correct their answers.

- <http://training.seer.cancer.gov/anatomy/body/quiz.html>

Review Questions and Answers

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Have students answer the Review Questions that are listed at the end of the lesson in their FlexBook.

Points to Consider

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Lesson Assessment

Provided to teachers upon request at teachers-requests@ck12.org.

Copy and distribute the lesson quiz. Provide class time for the students to complete this assessment.

Skin, Bones, and Muscles: Lesson 16.1 Quiz

Answer Key: Lesson 16.1 Quiz

Provided to teachers upon request at teachers-requests@ck12.org.

24.3 Lesson 16.2: The Integumentary System

Key Concept

This lesson introduces the skin as the largest organ of the body.

Lesson Objectives

- List the functions of skin.
- Describe the structure of skin.
- Describe the structure of hair and nails.
- Identify two types of skin problems.
- Describe two ways to take care of your skin.

Check Your Understanding

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

- What is homeostasis?
- What is epithelial tissue?

Teaching Strategies

Online Interactive

Introduce the Integumentary System to students through this online interactive. Students work in pairs or teams on computers to go through the interactive. There is a skin diagrams

with labels where students move the cursor to see the label and click on terms to see the definition. There is also a melanocyte cell diagram.

The Skin and the Integumentary System

- http://www.wisc-online.com/objects/index_tj.asp?objID=AP12204

Online Lesson, Note Taking

1. Students go online in teams to learn about skin and the Integumentary system.
2. Review the organ systems listed and take notes: http://www.sciencenetlinks.com/interactives/organsystem_resource.html
3. Learn about the Integumentary system and take notes. Ask students to be sure they understand the purpose of the integumentary system. http://www.sciencenetlinks.com/interactives/integsystem_resource.html
 - (a) What are the parts of the system?
 - (b) What role does the system play in maintaining homeostasis?
 - (c) What other systems does it interact with and how?
4. Go to the following website at the Franklin Institute, Integumentary System: Cutting Dead Cells, to see how the organs and systems work together. Students should take notes. <http://www.fi.edu/learn/heart/systems/integumentary.html>
 - (a) Read about the Integumentary System. Take notes
 - (b) Click on the Excretory System. Take notes.
 - (c) Review note taking and extracting key points during reading. Pull up either of the above articles and ask students to read their notes. Go through the articles with students to clarify how to find the important points in note taking.

Lesson Worksheet

Print out the worksheet at this website for each student. After they have completed the Online Lesson above, pass out the worksheets and have them complete for review. May be used as an assessment at the end of the study of this system.

Skin Connections Worksheet

- http://www.sciencenetlinks.com/pdfs/skinorgan2_actsheet.pdf

Wrap-up Discussion

1. Begin class discussion asking what students now know about the Integumentary system, what it is, and its purpose.

- (a) Skin acts as a barrier that keeps particles and water out of the body.
 - (b) The skin helps to cool the body in hot temperatures and keeps the body warm in cool temperatures. It also help you to sense your surroundings.
 - (c) Skin is made up of two layers, the epidermis and the dermis. Hair and nails are made of the same type of protein as skin is.
 - (d) Nails grow from nail beds and hairs grow from hair follicles in the skin.
 - (e) Acne is a skin problem that happens when the skin makes too much sebum.
 - (f) Skin cancer can be caused by excess exposure to ultraviolet light from the sun or tanning beds.
 - (g) Bathing frequently helps keep the skin clean and healthy.
 - (h) Wearing sunblock and a hat when outdoors can help prevent skin cancer.
2. Since the study of the human body connects with the subject of health, you may separate the final three points (f-h) as health objectives for students.
 3. As students study all of the body systems, they may keep a separate health journal with health-related information for their lives outside of the classroom. Addressing health issues is personally relevant to students and the teacher may see students that have not participated as much becoming more involved in discussions.
 4. Encourage students to learn health information and practice healthy behaviors in their daily-decision making.

Differentiated Instruction

English Language Learners

1. Students learn about health issues related to skin at a site written in Spanish. The site, Teens Health, includes information on multiple health issues. From this web site, click on the heading *Su Cuerpo*, and then on *Consejos para cuidarte la piel* (Taking Care of Your Skin), which will give a list of items that may be of interest to teens, including eczema, body piercing, tattoos, acne, cellulite, melanoma, and many more.
2. Direct students to the *Consejos para cuidarte la piel* page and ask them to choose 3-5 areas of interest, and write up a health brochure for teens from information on the site.
3. Teens Health, Your Body, Su Cuerpo. http://kidshealth.org/teen/en_espanol/index.html#cat20285
4. If you have Spanish and English learners working on this activity at the same time, you may ask two teams to work together to create a bilingual health brochure for teens.

Enrichment: Connect with Health

1. Students learn about health issues related to skin. The site, Teens Health, includes information on multiple health issues. From this site, click on the heading Skin Stuff,

which will give a list of items that may be of interest to teens, including eczema, body piercing, tattoos, acne, cellulite, melanoma, and many more.

2. Direct students to the Skin Stuff page and ask them to choose 3-5 areas of interest, and write up a health brochure for teens from information on the site.
3. Teens Health, Your Body. http://kidshealth.org/teen/your_body/

Laboratory Activities: Skin Lab

1. Integumentary System Lab: Print out the directions and worksheet (7 pgs.) for individual students, pairs or teams. Students should work in the lab in pairs or teams, but may complete their own lab write-ups.
2. Materials: magnifier or dissecting scope, forceps, microscope slide and cover slip, pipette and water, compound light microscope, prepared microscope slide of scalp, prepared slide of thick skin.
3. The handout for students includes the purpose, materials, introduction, procedure, diagrams to label, matching terms and definitions, and short answer questions about the lab.

- <http://www.msad54.org/sahs/science/team1/Anat/Integ/IMAGES/SkinLab.pdf>,

4. The lab asks students to use their own hand and hair follicles as well as investigating a slide of scalp and skin, as well as labeling and answering questions about the lab.

Science Inquiry

Research and Analyze Data, Presentation to Class

1. Directions for the activity: Dermatology in the Cinema

- <http://www.mhhe.com/biosci/ap/vdgconcepts/student/olc/ch07intact.html>

2. Dermatology in the Cinema: A dermatologist and film buff, Vail Reese, wrote the *Dermatology in the Cinema* site. Skin conditions are presented about celebrities with skin conditions, villains with problem skin, and realistic roles. Recent additions include Sarah Palin and Barack Obama.

- <http://www.skinema.com/>

3. Ask students to research three celebrities, varying the conditions and actors. Schedule an Insider: Celebrities Skin Day when students present their findings to the class.

Reinforce and Review

Online Quiz

Students try an online quiz. Challenge advanced students to try the more advanced quiz also.

The Integumentary System Quiz (Flash required)

- <http://www.funtrivia.com/flashquiz/index.cfm?qid=58008>

More Advanced Level: Integumentary System Matching Quiz

- <http://www.quia.com/mc/7248.html>

Review Questions and Answers

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Have students answer the Review Questions that are listed at the end of the lesson in their FlexBook.

Points to Consider

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Lesson Assessment

Provided to teachers upon request at teachers-requests@ck12.org.

Copy and distribute the lesson quiz. Provide class time for the students to complete this assessment.

Skin, Bones, and Muscles: Lesson 16.2 Quiz

Answer Key: Lesson 16.2 Quiz

Provided to teachers upon request at teachers-requests@ck12.org.

24.4 Lesson 16.3: The Skeletal System

Key Concepts

This lesson introduces the skeletal system of the human body.

Lesson Objectives

- Identify the main tissues and organs of the skeletal system.
- List four functions of the skeletal system.
- Describe three movable joints.
- Identify two nutrients that are important for a healthy skeletal system.
- Describe two skeletal system injuries.

Check Your Understanding

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

- What is an organ system?
- What is connective tissue?

Teaching Strategies

Use Models, Demonstrate

1. If you have a human skeleton, or a skeleton model, or a large poster, use it to present the skeletal system to students. Please add an online skeleton site – either the site below or another one. <http://www.beabonebuilder.com/worksheets/page3a.html>
2. Before presenting the skeleton, ask students to observe the skeleton and count or estimate the number of bones in the human body. Quickly write all of the estimates on the board, and then tell students that the human body actually consists of 206 bones, from the longest, the femur, our thighbone, to the tiniest stirrup bone in the ear.
3. Point to the skull of the model. Explain that when we are born, we actually have close to 300 bones, but these fuse together as a child grows. Explain that the bones are not fused at birth to make an easier transition through the birth canal. This is why we are more protective of an infant's head.

4. Lift the arm of the skeleton and move the elbow joint back and forth. Explain to students that joints are where bones are connected to other bones. There are several kinds of joints. As you discuss the kinds of joints, find the joints on the skeleton and demonstrate the movement of: (a) fixed joints, like the skull; (b) ball-and-socket joints, like the shoulder and hips; and (c) finger joints.

5. Point to the twenty major bones in the body. Use this key to point out the bones:

- <http://www.beabonebuilder.com/worksheets/page3a.html>.

Table 24.3:

carpals	clavicle	coccyx	cranium	femur	fibula
humerus	mandible	metacarpals	metatarsals	patella	pelvis
phalanges	radius	rib	sacrum	scapula	sternum
tarsals	tibia	ulna	vertebral column		

6. Talk about bones. If using a model, show how the bones fit together. Encourage students to come up and move and touch the bones of the skeleton.

7. Challenge students to come up and present the skeleton to the class, naming as many bones as they can remember.

Use Visuals

1. Student pairs or teams go to computers to work online exploring the human skeletal system.

2. InnerBody: Your Guide to Human Anatomy Online

On the menu on the left hand side, click on *Skeletal*, under Systems. This will give you a menu of all of the possible views of the skeletal system front and back, and skull, and so on.

- <http://www.innerbody.com/image/skelfov.html>

3. Go to Learn the Bones! To complete a Skeletal system game and learn the major bones of the skeletal system.

- http://www.abcya.com/skeletal_system.htm

Worksheet of the Skeletal System

1. After completing the activity above: Print out an unlabeled skeleton for students to label with the correct bones.

- <http://www.beabonebuilder.com/worksheets/page3a1.html>

2. Have students correct, or the answer key if used as an assessment is here:

- <http://www.beabonebuilder.com/worksheets/page3a.html>

Use Visuals

1. Ask students to first get parent permission, and then bring in any x-rays they have at home of broken bones, fractures, or chest x-rays. If no x-rays are available, examples can be found on-line.
2. Look at the broken bones and fractures and discuss what forces would cause the bones to break or fracture. Immobilizing the break in a cast or splint allows the body to heal itself in correct alignment.

Differentiated Instruction

Foss Human Body: A skeleton appears and then breaks apart into all of its bones. Students have to put the skeleton back together again, using the correct bones. Bone name are available.

- <http://sv.berkeley.edu/showcase/pages/bones.html>

Differentiated Instruction

Osteoporosis Prevention Slide Show targeted at Girl Scout leaders, but appropriate content for anyone. Instructs about osteoporosis and prevention through life style. Introduction to Bone Builders

- <http://www.beabonebuilder.com/cow-rev.html>

Another Osteoporosis Animation:

- <http://www.spineuniverse.com/videos/osteoporosis/>

Discuss the need for calcium and vitamin D in the diet to prevent the gradual onset of osteoporosis

Enrichment: Read and Discuss

What is a Bone Marrow Transplant and How Does it Work? Newton's Apple

- <http://www.reachoutmichigan.org/funexperiments/agesubject/lessons/newton/marrow.html>

Broken Bones: Newton's Apple

- <http://www.reachoutmichigan.org/funexperiments/agesubject/lessons/newton/BrknBones.html>

Laboratory Activities: Human Skull Observation

1. Skull Module:

- <http://www.csuchico.edu/anth/Module/skull.html>

2. QuickTime VR of the skull:

Students “examine the skull” by manipulating the QuickTime VR of a human skull.

Students read about the cranium, the individual bones of the skull, and click on each of the names of the bones or the color coordinated bones in the graphic to find out more.

- <http://www.csuchico.edu/tlp/info/projects/skull/skull.mov>

Science Inquiry: Investigate

What would happen if humans didn't have bones? Read and discuss.

- <http://yucky.discovery.com/noflash/body/pg000124.html>

Reinforce and Review

Online Quiz

Skeletal System Multiple Choice:

- <http://www.vtaide.com/png/skeletal-mcq.htm>

Review Questions and Answers

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Have students answer the Review Questions that are listed at the end of the lesson in their FlexBook.

Points to Consider

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Lesson Assessment

Provided to teachers upon request at teachers-requests@ck12.org.

Copy and distribute the lesson quiz. Provide class time for the students to complete this assessment.

Skin, Bones, and Muscles: Lesson 16.3 Quiz

Answer Key: Lesson 16.3 Quiz

Provided to teachers upon request at teachers-requests@ck12.org.

24.5 Lesson 16.4: The Muscular System

Key Concepts

This lesson introduces the human muscular system, different types of muscles, and the interaction of the skeleton and the muscles to afford movement.

Lesson Objectives

- Identify the three muscle types in the body.
- Describe how skeletal muscles and bones work together to move the body.
- Describe how exercise affects the muscular system.
- Identify two types of injuries to the muscular system.

Check Your Understanding

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

- What is muscle tissue?
- What is the function of the muscular system?

Teaching Strategies

Use Visuals

1. Student pairs or teams go to computers to work online exploring the human muscular system.
2. InnerBody: Your Guide to Human Anatomy Online. On the menu on the left hand side, click on Muscular, under Systems. This will give you a menu of all of the possible views of the muscular system front and back.

- <http://www.innerbody.com/image/musfov.html>

3. Learn about the muscles of the body.

Worksheet of the Muscular System

1. After completing the activity above: Print out an unlabeled muscle worksheet for students to label with the correct muscles. Ask students to be sure to learn at least the following eleven muscles of the body:

Table 24.4:

biceps	triceps	latissimus dorsi	trapezius
rectus abdominus	gluteus maximus	hamstrings	quadriiceps
gastrocnemius	deltoid	pectoralis major	

2. Have students correct, or the answer key if used as an assessment is here:

- <https://healthsciencetechnology.wikispaces.com/The+Muscular+System>

View Video

Use this fun, animated, musical video to introduce or review function of the skeleton: *Them Not So Dry Bones*.

This video introduces the main concepts of the skeleton system to students, namely that the skeleton is the framework to support them and to protect their organs. The video also shows the names of several of the bones and how the bones work together with muscles to allow movement. It is a three-minute introduction and review of the big ideas about the skeletal system and muscles.

- <http://www.youtube.com/watch?v=Ns2dkT2sIug>

Differentiated Instruction: Tutorials

ELL

These online tutorials are based on the site of muscle actions. Students can go to the home page and then click on muscles that act on the arm for descriptions. There is also a quiz menu for all the parts of the body. Students can use the site individually or in teams to review, to reinforce, or as an assessment of their learning the muscles of the body. Get Body Smart:

- <http://www.getbodysmart.com/ap/muscularsystem/menu/menu.html>

Enrichment: Online Interactive

Students can review and learn more about the muscular system. At this site, read the article on muscles, and then click on the Muscles and Joints diagram to see and follow the interactive of how muscles and bones move in the knee joint to create motion.

- <http://kidshealth.org/kid/htbw/muscles.html>

Laboratory Activities: Muscle Lab

Making Muscles Move

1. Materials: cardboard, paper fasteners, tape, hole punch, two colors of balloons.
2. Students make models of arm muscles and learn how the muscles and bones work together to make movement.

3. Print out the lab sheet for students. This handout has materials listed, methods, conclusion questions, and movement activities that help students learn about how their body uses muscles.

- <http://www.learnnc.org/lp/media/uploads/2008/08/4muscles.pdf>

Science Inquiry

Exploration, Collect Data, Graph, Research

How Do Muscles Work? A Journey Through Time. This Webquest gives tasks in various time periods from Leonardo da Vinci to the present to teach about how humans learned about muscles through time.

- <http://bama.ua.edu/~hsmithso/class/Web/muscle.htm>

Reinforce and Review

Online Quiz

1. Your Muscles Quiz

- http://kidshealth.org/PageManager.jsp?dn=familydoctor&article_set=58212&lic=44&cat_id=20607

2. Arm Muscle Quiz

- <http://phs.psd3.org/science/anatomy/assess/armquiz.html>

3. Leg Muscle Quiz

- <http://phs.psd3.org/science/anatomy/assess/legquiz.html>

Review Questions and Answers

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Have students answer the Review Questions that are listed at the end of the lesson in their FlexBook.

Points to Consider

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Lesson Assessment

Provided to teachers upon request at teachers-requests@ck12.org.

Copy and distribute the lesson quiz. Provide class time for the students to complete this assessment.

Skin, Bones, and Muscles: Lesson 16.4 Quiz

Answer Key: Lesson 16.4 Quiz

Provided to teachers upon request at teachers-requests@ck12.org.

Chapter 25

TE Food and the Digestive System

25.1 Chapter 17: Food and the Digestive System

Outline

The chapter *Food and the Digestive System* consists of three lessons that introduce students to the

- Lesson 17.1: Food and Nutrients
- Lesson 17.2: Choosing Healthy Foods
- Lesson 17.3: The Digestive System

Overview

Teaching Strategies

Pacing the Lessons

Use the **Class Periods per Lesson** table below as a guide for the time required to teach the lessons of this chapter.

Table 25.1:

Lesson	Number of Class Periods*
Lesson 17.1: Food and Nutrients	1.0
Lesson 17.2: Choosing Healthy Foods	1.0
Lesson 17.3: The Digestive System	1.0

- Class periods are assumed to be 60 minutes long.

Lab Links

Managing Materials

The materials listed in the **Materials List** table below are needed to teach the strategies and activities described in the Teachers Edition of the FlexBook for this chapter.

Table 25.2:

Lesson	Strategy or Activity	Materials Needed
17.1	1) 2)	1) 2)
17.2	1)	1)
17.3	1)	1)

Additional Web-Based Resources

Making the FlexBook Flexible

An important advantage of the FlexBook is the ability it gives you, the teacher, to choose the chapters and lessons that you think are most important for your own classes. The following information is provided to help you decide whether to include this chapter or certain lessons in this chapter in your students' FlexBook. You should also consult the standards correlation table that follows when selecting chapters and lessons to include in the FlexBook.

- To understand the content of this chapter, students should have read the ———— chapter.
- Students should read this entire chapter before reading the remaining chapters of the FlexBook.
- It is recommended that you include all the lessons of this chapter in the FlexBook.

Common Misconceptions

Here are some common misconceptions, related to this chapter:

- If you want to lose weight, it's a good idea to eat only fruits and vegetables.
- Potatoes make you fat. Grapefruit helps you burn off fat.
- Ulcers are caused by eating spicy foods or enduring too much stress.
- Smoking relieves heartburn.

- Diverticulosis is an uncommon and serious problem.
- Cirrhosis is only caused by alcoholism.

How to lose weight

If all you eat is only fruits and vegetables, you may lose weight in a few days, but you won't be able to sustain this diet. Nor should you, because it's a bad diet! A good diet is one that gives your body the right balance of all the food groups it needs (carbohydrates, protein and fat) along with essential vitamins and minerals, fiber, and water. At the same time, it's important that you engage in an exercise program (30 minutes at least 3 times a week), so that the amount of calories you burn off is greater than the amount of calories in the food you eat. But a good diet takes time to be effective. Losing weight quickly – called “binge dieting” – is not healthy and it doesn't produce lasting results.

Special foods

Your body needs carbohydrates, which are the body's energy source. Potatoes – like spaghetti and rice – are a high carbohydrate food and they are broken down by the digestive system into glucose, which is the body's main fuel. Excess glucose is stored in the liver and muscle tissue as glycogen, which is used to increase blood sugar levels between meals. But any glycogen left over will be converted into body fat, which is a more permanent form of energy storage. So simply eating a potato won't make you fat. At the same time, be careful what topping you use; butter and sour cream are high in fats! Also, it is not true that grapefruit (or any other food) helps you burn off fat. There are no “magic foods.” If you want to lose weight, you simply need to consume fewer calories (in a balanced diet – see above) than you burn off.

Stomach ulcers

Once it was “common knowledge” that ulcers were caused by eating spicy foods or enduring too much stress. Now it is known that the real cause of ulcers is either (a) through infection by a bacterium (*Helicobacter pylori*) or (b) by the use of pain medications such as aspirin, ibuprofen, or naproxen, the so-called non-steroidal anti-inflammatory drugs (called NSAIDs). Most *H. pylori*-related ulcers can be cured with antibiotics. NSAID-induced ulcers can be cured with time.

The real cause of heartburn

Heartburn occurs when the lower esophageal sphincter (LES) - a muscle between the esophagus and stomach - relaxes, allowing the acidic contents of the stomach to splash back (reflux)

into the esophagus. Cigarette smoking may actually contribute to heartburn. This is because people who smoke more frequently have inflammation of the esophagus (esophagitis), presumably caused by increased reflux of acid. In other words, the basis of heartburn seems to be due to the fact that cigarette smoking causes the LES to relax.

Diverticulosis

The majority of Americans over age 60 have diverticulosis, but only a small percentage has symptoms or complications. Diverticulosis is a condition in which little sacs or out-pouchings, called diverticula, develop in the wall of the colon. These sacs tend to appear and increase in number as individuals age. Most people have no symptoms and learn that they have diverticula after an X-ray or intestinal examination (for example, colonoscopy or barium enema) that is being done for a purpose unrelated to the diverticulosis. Less than 10 per cent of people with diverticulosis ever develop complications such as infection (diverticulitis), bleeding, or perforation of the colon.

Cirrhosis

Alcoholism is just one of many causes of cirrhosis. Cirrhosis is scarring and decreased function of the liver. In the United States, alcohol causes less than one-half of cirrhosis cases. The remaining cases are from diseases that cause liver damage. For example, in children, cirrhosis may result from cystic fibrosis, alpha-1 antitrypsin deficiency, biliary atresia, glycogen storage diseases, and other rare diseases. In adults, cirrhosis may be caused by hepatitis B or C, primary biliary cirrhosis, diseases of abnormal storage of metals (like iron or copper) in the body, severe reactions to prescription drugs, injury to the ducts that drain bile from the liver and the most common liver disease in the U.S., nonalcoholic steatohepatitis (NASH).

Reference 1: “Digestive Disease Myths Slideshow: Common Misconceptions.” From E-MedicineHealth: Practical Guide to Health. http://www.emedicinehealth.com/slideshow_digestive_disease_myths/article_em.htm

25.2 Lesson 17.1: Food and Nutrients

Key Concepts

The body needs food to give us energy and to provide building materials for the body. The body also needs water as well as vitamins and minerals, to help control important body processes.

Lesson Objectives

- Explain why the body needs food.
- Identify the roles of carbohydrates, proteins, and lipids.
- Give examples of vitamins and minerals, and state their functions.
- Explain why water is a nutrient.

Check Your Understanding

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

- What are the four types of organic compounds?
- What do all cells need in order to function?
- What are muscles made of?

Teaching Strategies

Discussion: Connection to Music

1. Introduce the study of food and the digestive system with the song from *Oliver*, “Food, Glorious Food!” Discuss the context of the song in the musical.
2. The orphan boys were poor and had to fend for themselves, often stealing just to eat. Food and finding food to eat was a large part of their existence. Many times these boys went hungry. The song is sung when the workhouse boys are dreaming and fantasizing about food.
3. Discuss the feeling that all of us may have when we’ve gone without food or worked out hard and are ready to eat. Can the students relate to the passion about food, our energy source for our sustenance?
4. Lyrics for “Food, Glorious Food”: <http://www.lyricsondemand.com/soundtracks/o/oliverlyrics/foodgloriousfoodlyrics.html>
5. Watch at: <http://www.youtube.com/watch?v=hEQD1lvuy1I>

Activity: Jigsaw

1. Divide class into six teams.
2. Assign each team one class of nutrients (carbohydrates, proteins, lipids, vitamins, minerals, water).

3. Each team uses the FlexBook lesson to explore the function and food source for their assigned nutrient.
4. Teams present their findings to the class. Students take notes on each team presentation.
5. Class discussion on comparison of the differences and similarities of the nutrients. Either you or students complete a chart on the board comparing/contrasting the characteristics and functions of the nutrients.

Activity: Lunch Menu

1. Teams from above activity are each assigned to come up with a lunch menu which supplies all six nutrients.
2. Teams meet, decide on their menu, and chart the menu on a large piece of construction paper or poster board.
3. All teams post their menus around the classroom. Teams take a Gallery Walk to view all the lunch menus and critique each on whether or not they supply the correct nutrients. Groups may also comment on low-fat, high fat menus, or low-sugar and high sugar menus.
4. Reconvene as a class. Brief discussion.

Activity: Keep a Food Journal

1. Assign students a food journal for the week. Assure them that you are the only one that will read the journal and have them track everything they eat and drink for a week. This activity will be done during the course of the whole chapter.
2. At the end of the week, they should write a reflection on what they understand about their eating habits.
3. Ask them to consider whether they changed what they ate knowing that they needed to write it down, and include any goals for eating habit improvement that they want to incorporate into their lives.
4. The assignment is turned in to the teacher as an assessment of their understanding of the importance of food

Differentiated Instruction: KWL

Have students make a KWL chart, where K=Know, W=Want to Know, and L=Learned. Students fill in the K and W before reading the FlexBook with a partner. After they have read the FlexBook lesson, they fill in the L section independently and then compare with their partner. They should then discuss their understanding of why the body needs food, what nutrients it needs, and that carbohydrates, proteins, and lipids provide energy to the

body, and vitamins and minerals help the body function, and water is needed by the body.
ELL

Enrichment: Create a Video

1. Ask students to create video about the six nutrients and why they are important to teach younger students.
2. Videos can be shown to the rest of the class.
3. Videos can also be shown to younger classes. Students can also volunteer to go to the elementary school to give a talk on food and nutrition.

Laboratory Activities

1. Food Nutrient Analysis Lab <https://www.delsearegional.us/Academic/Classes/highschool/science/mnicastro/Labs%20Academic%20Biology/Food%20Nutrient%20Analysis%20Lab.doc>
2. The purpose of this lab is to have students test for the presence of sugar, starch, lipid, and protein.
3. Materials needed:
 - (a) glass vials or test tubes
 - (b) starch solution sodium hydroxide
 - (c) hot plate
 - (d) protein solution (albumin)
 - (e) iodine solution
 - (f) 250 ml beaker
 - (g) sugar solution (glucose)
 - (h) Benedict solution
 - (i) toothpick
 - (j) Sudan fat Stain
 - (k) test tube rack
 - (l) 10 ml graduated cylinder
 - (m) vegetable oil
4. Introduction to nutrients, the purpose, materials, and procedure are all included in this lesson.
5. Materials for this lab may be purchased at Carolina Biological. This lab kit also contains directions, 30 eyedroppers, and 30 students worksheets.
 - (a) Lab–Aids Food Nutrient Analysis Kit:
 - <http://www.carolina.com/product/lab-aids+food+nutrient+analysis+kit.do?keyword=nutrient&sortby=bestMatches>

Science Inquiry

Formulate a Hypothesis

1. Ask students in teams to formulate a hypothesis on some aspect of food and nutrients.
2. Ask them to consider the effects of diets that are low in specific nutrients (can you provide an example – low carb diets?) and come up with possible effects of low or high intakes of the six nutrients.
3. Description and examples of low carb diets can be found at the Mayo Clinic site: <http://www.mayoclinic.com/health/low-carb-diet/NU00279>

Reinforce and Review

Make a Quiz

1. Student pairs each write a quiz using fill-in, true/false, and matching questions from the FlexBook lesson. Students write the answer key for their quiz on another sheet of paper.
2. Students trade quizzes and take each other's quiz.
3. Students hand the quiz back to their partner, who corrects the quiz.
4. You may have students return the quiz to each other, or turn them in.

Review Questions and Answers

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Have students answer the Review Questions that are listed at the end of the lesson in their FlexBook.

Points to Consider

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Lesson Assessment

Provided to teachers upon request at teachers-requests@ck12.org.

Copy and distribute the lesson quiz. Provide class time for the students to complete this assessment.

Food and the Digestive System: Lesson 17.1 Quiz

Answer Key: Lesson 17.1 Quiz

Provided to teachers upon request at teachers-requests@ck12.org.

25.3 Lesson 17.2: Choosing Healthy Foods

Key Concepts

This lesson presents the MyPyramid and teaches students how to use this tool, how to read food labels, and exercise to create a healthy lifestyle.

Lesson Objectives

- State how to use MyPyramid to get the proper balance of nutrients.
- Describe how to read food labels to choose foods wisely.
- Explain how to balance food with exercise.

Check Your Understanding

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

- What is a nutrient?

Teaching Strategies

Strategy Type: Use Visuals

1. Use the MyPyramid from the FlexBook lesson, **Figure 1**.
2. Print out a large copy or have students view the pyramid while discussing.
 - (a) Print a mini poster: <http://www.mypyramid.gov/downloads/MiniPoster.pdf>
 - (b) Print a mini poster in Spanish: <http://www.mypyramid.gov/downloads/sp-MiniPoster.pdf>
 - (c) Anatomy of MyPyramid: http://www.mypyramid.gov/downloads/MyPyramid_Anatomy.pdf

- (d) Anatomy of MyPyramid in Spanish: http://www.mypyramid.gov/downloads/sp-MyPyramid_Anatomy.pdf
3. Discuss the groups on the pyramid. Have they heard of the food groups before? What have they heard? What do they know about food groups and the importance of balance in menu planning?
 4. What do the colors of the chart mean? (Orange=grains, green=vegetables, red=fruits, yellow=oils, blue=milk, purple=meat and beans.)
 5. Students should look at the thickness of the segments in the pyramid and guess the percentage of each food group recommended. (Orange=grains, green=vegetables, red=fruits, yellow=oils, blue=milk, purple=meat and beans.) Students should each look at their own pyramid, based on their age, gender, weight, height, and activity level. Then they should estimate their own percentages, as well as the general guidelines shown in the logo for MyPyramid.
 - (a) Grains ~ 30%
 - (b) Vegetables ~ 25%
 - (c) Fruits ~ 15%
 - (d) Oils ~ 8%
 - (e) Calcium Rich Foods ~ 12%
 - (f) Meat and Beans ~ 10%
 6. Give students the worksheet Your Personal Path: Steps to a Healthier You <http://www.mypyramid.gov/downloads/resource/MyPyramidBrochurebyIFIC.pdf>
 - (a) After students read through and discuss this worksheet in their teams, ask them each to write up a list of goals they want to include in their own menu planning.
 - (b) Divide the worksheet into parts and have each group read and summarize one section, and present that section to the class.

Activity: Chart

1. Students take a piece of paper and fold it in half, then fold the half in thirds, so that they end up with six folded sections.
2. Ask them to label each of the sections with one of the food groups. If you have colored pencils or markers, have them do this color-coded. (Orange=grains, green=vegetables, red=fruits, yellow=oils, blue=milk, purple=meat and beans.)
3. In each of the boxes, write all of the examples of that food group they can think of:
 - (a) Grains—such as bread, rice, pasta, and cereal.
 - (b) Vegetables—such as spinach, broccoli, carrots, and sweet potatoes.
 - (c) Fruits—such as oranges, apples, bananas, and strawberries.
 - (d) Oils—such as vegetable oil, canola oil, olive oil, and peanut oil.
 - (e) Milk or Calcium Rich Foods—such as milk, yogurt, cottage cheese, and other cheeses.
 - (f) Meat and beans—such as chicken, fish, soy and kidney beans.

Activity: Keep a Food Journal

Continued from Lesson 17.1.

Ask students to write down everything they eat in one day and then analyze it against the healthy eating guidelines in the lesson.

Differentiated Instruction: Cluster Diagram

1. Students should work in their teams. Each team should have a large piece of butcher paper.
2. Have each team make a cluster diagram that organizes the lesson concepts.
3. Refer students to the “Lesson Summary” section of the lesson to be sure they have covered all of the important concepts.
4. Post diagrams in the room and have teams walk and view other team work. **ELL**

Enrichment: Personal Menu Planning

1. Student use their personal nutritional plan from My Pyramid to create a week menu of foods they like. The menu must include the correct amount of each of the food groups.
2. Ask students to consider how to determine if they are getting all of the six nutrients in their menu plan. They may use the Menu Planner feature at My Pyramid, or check their menu against the Menu Planner.
3. Students print out or write up their menu and include it in their science notebook.

Laboratory Activities

1. Do this activity before the inquiry activity.
2. Students use the Healthy Eating Plan Calculator at Kids Nutrition of the USDA to discover their general dietary guidelines. http://www.bcm.edu/cnrc/HealthyEating_calculator.htm
3. Ask students to chart themselves and one to two family members (must be 18 years or under to use chart). Make notes on the eating guidelines. Ask them to consider why they are the same or different for different age or sex.
4. After charting the guidelines, ask them to reflect on how well the guidelines match their own eating patterns. Are there changes they might want to make in their food choices?

Science Inquiry

Online Personalized Plan

1. Do the lab activity first.
2. Pairs or teams go online to My Pyramid Plan <http://www.mypyramid.gov/mypyramid/index.aspx>
3. Each student should enter their personal information including age, weight, height, and physical activity. The computer program will deliver a personal plan for grains, vegetables, fruits, milk, and meat and beans for each student. If possible, let each student print out his or her personalized plan for lifestyle use. If you cannot print each student's plan, have them copy the chart and information into their student notebooks.
4. Students discuss their plans in teams. Students then write a reflection on how the plan compares to their normal diet and how it differs. Ask them to comment on how they will reconcile these differences in their lives?

Reinforce and Review

Online Quiz

1. Healthy Eating Quiz: <http://www.trustyguides.com/healthy-eating-quiz.html>
2. Healthy Fridge Kids Quiz: <http://www.healthyfridge.org/kids.html>
3. Pair students to take the two quizzes. As they take the quizzes, have them discuss what they now know about food and nutrition and whether they think their diet would need to change to be considered a healthy diet.

Review Questions and Answers

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Have students answer the Review Questions that are listed at the end of the lesson in their FlexBook.

Points to Consider

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Lesson Assessment

Provided to teachers upon request at teachers-requests@ck12.org.

Copy and distribute the lesson quiz. Provide class time for the students to complete this assessment.

Food and the Digestive System: Lesson 17.1 Quiz

Answer Key: Lesson 17.2 Quiz

Provided to teachers upon request at teachers-requests@ck12.org.

25.4 Lesson 17.3: Digestive System

Key Concepts

The cells of your body need nutrients in the foods you eat. How do the nutrients in foods get to your body cells? What organs and processes break down the foods and make the nutrients available to cells? The organs are those of the digestive system. The processes are digestion and absorption.

Lesson Objectives

- State the functions of the digestive system.
- Explain the role of enzymes in digestion.
- Describe the digestive organs and their functions.
- Explain the roles of helpful bacteria in the digestive system.
- List ways to help keep your digestive system healthy.

Check Your Understanding

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

- What is a chemical reaction?
- What is an enzyme?
- What are bacteria?

Teaching Strategies

Read to Learn

1. Ask students what they have eaten so far today. Have them write a list of all the food in their journal. Now, read aloud to them from the “Your Digestive System” from the Yuckiest Site on the Internet: <http://yucky.discovery.com/noflash/body/pg000126.html>
2. This webpage describes what happens to the food as you eat it.
3. Ask students to visualize this entire process happening inside their bodies as you read the text to them.
4. At the end of this text, there is a section of “Factoids.” Read and discuss these with the class. Have them take notes on interesting factoids.
5. Pair share quickly with a partner what they have learned.

Activity: Demonstration

1. Break the class up into four groups, each representing part of the digestive system.
 - (a) Mouth: a small cup and a cracker for every member of the group. Students crumble the cracker and place in the cup.
 - (b) Stomach: gallon zip loc bag with crumbled crackers, a bottle of vinegar.
 - (c) Small intestine: a gallon zip loc bag filled halfway with oil and water, a bottle of dish detergent.
 - (d) Large intestine: one leg of nude colored pantyhose with both ends cut off. Stuff with small sponges, tennis balls, and ping pong balls.
2. Tell the class that each group represents one stage of the digestive process. Optional: Designate one or two class members to make a video of the class digestive system demonstration.
3. Begin with the mouth. Mouth students begin spitting into their cups of crumbled crackers. After spitting a lot into the cups, walk through the rest of the system, showing students the results in the cup. Students should see that the enzymes in the saliva from the mouth begin to break down the crackers. (Dry oatmeal may also be used.)
4. Next, the stomach. The stomach holder walks around the class, showing that the crackers are in the bag. The bag returns to the group. Another member pours vinegar into the bag and walks around to show the class that the crackers are dissolving. The stomach acids are beginning to digest the food.
5. Now, the small intestine. The small intestine member holds the bag and walks around the class so that all can see that the oil and water do not mix. Then, the bag returns to the group. One member squirts some dish detergent into the bag. Another holder

- carefully zips the bag and gently swirls the bag to mix. Another group member carries the bag around for the class to see that the detergent is breaking the oil down the way the bile in the stomach breaks down the lipids.
6. Last, the large intestine. The pantyhose is stuffed with sponges and balls that represent the microbes. If the sponges were wet, they could hold water. The group as a team parades the large intestine around the class, letting everyone see that the large intestine is full of microbes.
 7. Students return to their seats and draw the digestive system process with labels on a large piece of paper. They may refer to the FlexBook for further information.

Online Animations

1. Pair students to view, discuss, take notes, and draw diagrams in their notebooks about the following animations.
2. Animations of the digestive system:
 - (a) How Stuff Works: The Digestive System: <http://health.howstuffworks.com/adam-200142.htm> (Shockwave required)
 - (b) Digestive System Animation: <http://www.youtube.com/watch?v=q3986Yf15cU>
 - (c) Digestive System Animation 2: <http://www.youtube.com/watch?v=8zAHESCVxR4> (2:24)
3. Have students view the animations above in teams to learn the steps of the digestive process: the mouth, the stomach, the small intestine, and the large intestine. They should discuss with their group the functions of each step of the process, and talk about what is needed in each step to make digestion occur (microbes).
4. If students have already done the above demonstration and drawn the digestive process, have them add more labels, notes, and refine their drawings as they watch these animations.

Gallery Walk

1. Students post their drawings from the preceding demonstration around the room.
2. Divide the class into groups and have the groups walk around the room to see each other's digestive system diagrams.

Differentiated Instruction: System Charts A

Digestive System Spanish Chart: <http://www.edupics.com/en-coloring-pictures-pages-photo-digestive-system-spanish-chart.html>

Digestive System Fill in the Blank Chart: <http://www.edupics.com/en-coloring-pictures-pages-photo-digestive-system-fill-in-the-blank-chart.html>

Digestive System English Chart: <http://www.edupics.com/en-coloring-pictures-pages-photo-digestive-system-english-chart.html>

1. Download and print the three versions of the chart, the Spanish, the English, and the blank chart.
2. Pair strong native English speakers with ELL students to translate the Spanish chart to English.
3. Give them the English chart to check their answers and make corrections on their chart.
4. Collect the charts.
5. Give students the fill in the blank chart to write in English digestive vocabulary.

Differentiated Instruction: System Charts B

1. Print out the page with two digestive system diagrams on one page. <http://www.health-lesson-plans-teacher.com/support-files/digestivesystemandprocesslabelling.pdf>
2. Pair native English and ELL students to complete the labeling one diagram in English and the other diagram in Spanish.
3. Check answers and share the ELL learning the English words, and the native English speaker learning the Spanish words. (Use checks sheets for both languages from the previous lesson.) **ELL**

Enrichment: Pretzel Prediction Activity

1. Pretzel Prediction Activity <http://www.mcrel.org/whelmers/whelm46.asp>
2. Materials: pretzels and stopwatch.
3. This is a fun activity in which students are to predict how many pretzels they can eat in one minute. Keep in mind, it requires only a portion of one pretzel to absorb all of the saliva in a student's mouth.
4. Students use science process of observation, number relations, measurement, space-time relation, communication, and prediction to complete the activity. Students compare, induce, analyze errors, and problem solve.
5. All lesson procedures and assessment are included.

Science Inquiry

Starch Activity

1. Print out the following lesson description for student teams.

2. Digestive System: Body System Inquiry: <http://www.ucumberlands.edu/academics/biology/faculty/tyetter/courses/ch8.pdf>
3. This inquiry lesson describes the assignment to help students learn more about the digestive system, vocabulary, starch lab experiments, and has a digestive system diagram to label.
4. Have students work in teams to complete the assignments outlined. Depending on your class experience with solutions in labs, you may wish to demonstrate the starch test for all students, as the Lugol's solution does have a health risk of 1.
 - (a) Lugol's Solution Materials Safety Data: <http://docs.google.com/gview?a=v&q=cache:cjAbkAKz8g0J:www.premusa.com/Downloadablefiles/MSDS/MSDSLugolsREV2.pdf+Lugol's+solution+safety+data&hl=en&gl=us>
5. Collect lab papers.
6. IKI solution, or Lugol's solution is a solution of elemental iodine and potassium iodide in water. It is commonly used as an antiseptic and disinfectant, for emergency disinfection of drinking water, and in routine laboratory and medical test as a reagent for starch detection. IKI solution is commonly used in biology labs for starch detection. You can often buy this under the name Lugol's solution at aquarium supply stores or pet supplies.
7. Lugol's Solution at Carolina Biological: <http://www.carolina.com/product/872793.do>

Reinforce and Review

Online Quiz

1. Pair students to take these quizzes, check, discuss answers, and write notes in their notebooks on questions and answers missed. They should retake the quiz.
2. Digestive System Quiz: http://kidshealth.org/kid/htbw/_bfs_DSquizsource.html

Review the Digestive System

1. Pair students to review the digestive system on these pages. They should draw diagrams, label, discuss, and review vocabulary in their science notebook.
2. My Body: Digesting Food: <http://www.kidcyber.com.au/topics/bodydigest.htm>
3. Kids health The Digestive System: http://kidshealth.org/kid/htbw/digestive_system.html

Review Questions and Answers

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Have students answer the Review Questions that are listed at the end of the lesson in their FlexBook.

Points to Consider

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Lesson Assessment

Provided to teachers upon request at teachers-requests@ck12.org.

Copy and distribute the lesson quiz. Provide class time for the students to complete this assessment.

Food and the Digestive System: Lesson 17.3 Quiz

Answer Key: Lesson 17.3 Quiz

Provided to teachers upon request at teachers-requests@ck12.org.

Chapter 26

TE Cardiovascular System

26.1 Chapter 18: Cardiovascular System

Outline

The chapter *Cardiovascular System* consists of four lessons that introduce students to

- Lesson 18.1: Introduction to the Cardiovascular System
- Lesson 18.2: Heart and Blood Vessels
- Lesson 18.3: Blood
- Lesson 18.4: Health of the Cardiovascular System

Overview

Teaching Strategies

Pacing the Lessons

Use the **Class Periods per Lesson** table below as a guide for the time required to teach the lessons of this chapter.

Table 26.1:

Lesson	Number of Class Periods*
Lesson 18.1: Introduction to the Cardiovascular System	1.0
Lesson 18.2: Heart and Blood Vessels	2.0

Table 26.1: (continued)

Lesson	Number of Class Periods*
Lesson 18.3: Blood	1.0
Lesson 18.4: Health of the Cardiovascular System	1.0

- Class periods are assumed to be 60 minutes long.

Lab Links

Managing Materials

The materials listed in the **Materials List** table below are needed to teach the strategies and activities described in the Teachers Edition of the FlexBook for this chapter.

Table 26.2:

Lesson	Strategy or Activity	Materials Needed
18.1	1) 2)	1) 2)
18.2	1)	1)
18.3	1)	1)
18.4	1)	1)

Additional Web-Based Resources

Making the FlexBook Flexible

An important advantage of the FlexBook is the ability it gives you, the teacher, to choose the chapters and lessons that you think are most important for your own classes. The following information is provided to help you decide whether to include this chapter or certain lessons in this chapter in your students' FlexBook. You should also consult the standards correlation table that follows when selecting chapters and lessons to include in the FlexBook.

- To understand the content of this chapter, students should have read the _____ chapter.
- Students should read this entire chapter before reading the remaining chapters of the FlexBook.
- It is recommended that you include all the lessons of this chapter in the FlexBook.

Common Misconceptions

Here are some common student misconceptions, related to this chapter:

- The heart is the source of human emotion.
- The heart may be a pump, but it's really just one pump.
- It's unclear how the circulatory system is connected to the lungs.
- Blood cells are suspended in red liquid. Red blood cells lack an intercellular liquid. Blood changes color, when it moves from systemic to the pulmonary circulation.
- "Stroke" is another name for heart attack. High blood pressure has symptoms like nervousness, sweating and difficulty sleeping.

The function of the heart and the circulatory system

For much of human history, the heart was understood as the source of human emotion. Much of our literature uses language which reflects this view. However, a scientific understanding of the heart recognizes it as a pump, which moves food, waste, hormones, oxygen, carbon dioxide, and many other important substances throughout the body.

In fact, most students don't understand that one of the main functions of the circulatory system is to serve as a master transport system. This system takes substances from other body systems and moves these substances to and from each cell in the body. An effective teaching strategy to deal with these misconceptions is to:

1. Ask students: "What are the needs of each of the trillions of cells in the human body? (receiving food and oxygen – to help break down the food, to produce energy, removing waste products and carbon dioxide, etc.)."
2. Then ask students: "How would you design a transport system to deliver and remove these substances to every cell in the body?"
3. Question students: "How does the body do it?" The discussion that follows will help students see the connections between the arteries, veins, and capillaries (Note that the capillaries reach each of the body's cells). This discussion should also help students see the vital connections of the body's most amazing master transport system with the other body systems, such as the pulmonary, digestive, lymphatic, endocrine, respiratory and excretory systems. (Reference 1)

The heart as a dual pump

Even after students learn that the heart is a pump, they often fail to understand that it is a dual pump. Many students imagine that the heart pumps blood to the body, then receives the blood back from the body, to pump again – without it ever reaching the lungs. An effective strategy to deal with this misconception is to challenge students to describe how

oxygen is transported to the body's cells and how carbon dioxide is transported away from them. Have them analyze the structure of the human heart, as a clue to the solution. Define the terms "systemic circulation" and "pulmonary circulation" after students see the need for the heart to function as a "dual pump."

How the lungs are connected to the heart

Even after students learn that the heart is a dual pump, they often have misconceptions about how the lungs are connected to the heart. Have students create their own simplified diagrams showing how the blood flows through the two pumps, via the 4 chambers of the heart and how two of these chambers (the right ventricle and the left atrium) connect with the lungs.

Misconceptions about blood

Many students think that "red blood" is really a red liquid with blood cells in it; they fail to realize that the blood cells have a red-color intercellular liquid. Also, many students have the misconception that blood cells change color when oxygen is added. This latter misconception may arise from instructional diagrams that use blue and red as representative colors for deoxygenated and oxygenated blood, respectively.

The above misconceptions about the heart, circulation system and blood are very common. They apparently are the result of students' everyday experience and language. Students do not come into direct contact with the complex and abstract phenomena related to circulation. The following instructional strategies have been effective in dealing with student misconceptions: cognitive conflict, analogies, metacognitive methods, as well as knowledge of the constructivist approach of teaching. The constructivist approach of education is based on the understanding that students have "prior knowledge" that may conflict with "scientific knowledge" and that teachers need to create learning environments that expose students to new experiences, as a basis for "reconstructing" their understanding. (References 2 and 3)

Cardiovascular disorders

Students often confuse strokes with heart attacks. While both are caused by a lack of flow of blood (often caused by blood clots), strokes result from decreased blood flow to the brain while heart attacks result from decreased blood flow to the heart muscle. It is also common to think that high blood pressure has recognizable symptoms. The fact is that high blood pressure has no symptoms! This is the reason it's called "the silent killer" and why it's so important for everyone, even children, to periodically check their blood pressure. (Reference 4)

- Reference 1: Arnaudin, M. W., & Mintzes, J. J. (1985). Students' alternative conceptions of the human circulatory system: Across age study. *Science Education*, 69(5), 721-733.
- Reference 2: Yip, D. Y. (1998). Teachers' misconceptions of the circulatory system. *Journal of Biological Education*, 32(3), 207-216.
- Reference 3: Krajcik, J., Czerniak, C., & Berger, C. (2003). *Teaching children science in elementary and middle school classrooms: A project-based approach* (second edition). Boston: McGraw-Hill, p. 53.
- Reference 4: "Common Misconceptions about High Blood Pressure." American Heart Association. Located at: <http://www.americanheart.org/presenter.jhtml?identifier=3008517>

26.2 Lesson 18.1: Introduction to the Cardiovascular System

Key Concepts

The cardiovascular system acts a message delivery service, a pump, a heating system, and a protector of the body against infection. Every cell in our body depends on our cardiovascular system. Students will learn how their cardiovascular system works and how it helps to maintain homeostasis.

Lesson Objectives

- Identify the main structures of the cardiovascular system.
- Identify three types of blood vessels.
- Describe the differences between the pulmonary and systemic circulation.
- Identify the main structures of the lymphatic system.
- Outline how the cardiovascular and the lymphatic systems work together.

Check Your Understanding

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

- What is an organ system?
- What are the three types of muscles found in the human body?

Teaching Strategies

Demonstration

Ask students to hold their fist out and explain that their heart is about as big as their fist. Ask students to jump up and down for about 30 seconds and/or swing their arms vigorously (being careful not to hit someone). Now, take two fingers on the inside of the wrist blood vessel and see if they can find their pulse or their heartbeat. Tell them you will time them for ten seconds and they are to count the beats. Say “start” and at the end of the ten seconds, “stop”. Students share their heartbeat and multiply by six to get their beats per minute (bpm).

Use Visuals/Discussion

1. Ask students to look at **Figure 1**, the cardiovascular system. Ask what they know about the system. Take all comments and write notes about them on the board.
2. Explain that the cardiovascular system has many important roles in maintaining homeostasis. It moves nutrients, hormones, gases, and wastes to and from your body cells. It also helps to keep you warm by moving warm blood around your body. To do these tasks, your cardiovascular system works with other body systems such as the respiratory, endocrine, and nervous systems.
3. Ask students to look at **Figure 2**, the heart. Again, ask what students know about the heart.
4. Explain that the heart is connected to many blood vessels that bring blood all around the body. The cardiac muscle contracts and pumps blood through the heart and blood vessels.
5. Ask students to look at **Figure 3**, arteries. Every cell in the body needs oxygen, but arteries are too large to bring oxygen and nutrients to single cells. Further from the heart, arteries form smaller ones. These smaller arteries branch into smaller vessels. The smaller blood vessels help to bring nutrients and oxygen and take away waste from body tissues.
6. The tiniest blood vessels in the body are called capillaries. The walls of capillaries are only a single layer of cells thick. Capillaries connect arteries and veins together, as shown in **Figure 4**. Capillaries also allow the delivery of water, oxygen and other substances to body cells. They also collect carbon dioxide and other wastes from cells and tissues. Capillaries are so narrow that blood cells must move in single file through them.
7. Again ask students to look at **Figure 4** showing capillaries connecting arteries and veins.
8. Explain that a capillary bed is the network of capillaries that supply an organ with blood. The more metabolically active a tissue or organ is, the more capillaries it needs to get nutrients and oxygen.

9. Ask students to look at **Figure 5**, veins.
10. Explain that blood is carried back to the heart in blood vessels called veins. Veins have thinner walls than arteries do, as you can see in **Figure 5**. The blood in veins is not under pressure. Veins have valves that stop blood from moving backward. Blood is moved forward in veins when the surrounding skeletal muscles squeeze the veins. Blood that is carried by veins is usually low in oxygen. The exception is the pulmonary veins that return oxygen-rich blood to the heart from the lungs.
11. Have student pairs review the figures in the lesson, explain them to each other, and discuss.
12. Ask for questions and clarify understandings.

Online Animation

1. Explain to students the importance of the lymphatic system. The lymphatic system in vertebrates is a network of conduits that carry a clear fluid called lymph. The system also includes all the structures dedicated to the circulation and production of lymphocytes, which includes the spleen, thymus, bone marrow, and the lymphoid tissue associated with the digestive system.

2. Send student pairs to the Lymphoma web site and ask them to click on the body diagram “Click here to learn more.” Pairs watch the demo, discuss, and take notes on the lymphatic system.

a. Lymphoma-net.org:

- <http://www.lymphoma-net.org/the-lymphatic-system.cfm>

3. Send student pairs to the heart animations. They watch the animation, discuss, draw diagrams and label, and take notes in their science notebooks.

4. View animations of the heart:

a. Cincinnati Children’s (Flash Required):

- <http://www.cincinnatichildrens.org/health/heart-encyclopedia/anomalies/graphicsummaheart-components.htm>

b. Electrical System of the Heart:

- <http://www.cincinnatichildrens.org/health/heart-encyclopedia/anomalies/graphicsummaecgswf.htm>

Differentiated Instruction: KWL

Have students make a KWL chart, where K = Know, W = Want to Know, and L=Learned. Students fill in the K and W before reading the FlexBook with a partner. After they have read the FlexBook lesson, they fill in the L section independently and then compare with their partner. They should then discuss their understanding of the cardiovascular system together.

Enrichment: Debate an Issue

1. Students should choose a topic within the lesson and create a question of controversy to discuss and debate. They may work individually or in teams.
2. You may assign sides, or let students choose the side they wish to debate.
3. Students learn about debate, researching, using evidence, and presenting a case when they debate both sides of an issue. Remind them that they may need to debate a side they do not agree with, but need to learn how to present and argue the other side.
4. Encourage students to debate based on facts, not feelings.
5. Students then gather information, make any visuals they want to use, and prepare their presentation. Give them a time limit of 3 to 5 minutes to present each side.
6. Both sides may be presented to teams or to the entire class. Either way, the listening members should take notes on the facts presented by each side. Then teams should discuss the debate and the thoroughness of each side's arguments.

Enrichment: Make a Heart Poster

1. Children's Heart Institute (includes coloring pages):

- <http://www.childrenheartinstitute.org/educate/eduhome.htm>

a. Students should visit the links on, 'How The Heart Works', 'The Heart House', 'The Heart Electric System', 'Blood Flow Diagram', 'Blood Flow Slide Show', 'How The Heart Pumps', 'The Aorta', and 'How Blue Blood Turns Red.' The articles on this web site use house, electric system, and garden-hose analogies to explain the workings of the heart.

2. Students make a heart poster, using ideas, pictures, and information they have found at the web site, and display in class.

Reinforce and Review

Online Quiz

1. Pair students to take a multiple choice interactive quiz online. Answers are provided immediately. Students should discuss any questions they miss.
2. The Circulatory System: Multiple Choice Quiz:
 - <http://www.vtaide.com/png/blood-mcq.htm>

Review Animations and Discuss

1. Student pairs view the following animations for review, discussing them and taking notes.
2. ElectroCardioGram animation:
 - <http://library.med.utah.edu/kw/ecg/animations/ecg.html>

Circulatory System clickable animation:

- http://www.kscience.co.uk/animations/blood_system.swf

Cardiovascular System animation, How Stuff Works, (requires Shockwave):

- <http://health.howstuffworks.com/adam-200081.htm>

Cardiovascular System animation, simplified then bent into real life:

- <http://www.biologyinmotion.com/cardio/index.html>

Review Questions and Answers

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Have students answer the Review Questions that are listed at the end of the lesson in their FlexBook.

Points to Consider

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Lesson Assessment

Provided to teachers upon request at teachers-requests@ck12.org.

Copy and distribute the lesson quiz. Provide class time for the students to complete this assessment.

Cardiovascular System: Lesson 18.1 Quiz

Answer Key: Lesson 18.1 Quiz

Provided to teachers upon request at teachers-requests@ck12.org.

26.3 Lesson 18.2: Heart and Blood Vessels

Key Concepts

The heart is divided into four chambers, the left and right atria and the left and right ventricles. An atrium is one of the two small, thin-walled chambers on the top of the heart that blood first enters. A ventricle is one of the two muscular V-shaped chambers that pump blood out of the heart.

Lesson Objectives

- Describe the structure of the heart.
- Outline how blood moves through the heart.
- Describe the importance of valves in the heart.
- Describe the coronary circulation.

Check Your Understanding

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

- What is the role of the cardiovascular system?

- What is the main function of the heart?

Teaching Strategies

Research a Topic

1. Students research what causes a heartbeat.
2. Students go through the articles at the How Stuff Works web site and the video to learn and be able to explain the heartbeat.
3. Students create a model or diagram to explain heartbeat. They can use modeling clay or poster board. Display the model and the posters.
4. What Causes the Sound of a Heartbeat web site:

- <http://health.howstuffworks.com/sound-of-heartbeat.htm>

Video Lesson on the Web A

1. Student teams go to this lesson to learn about the heart.
2. Pulse of Life lesson: Students need a worksheet and a watch with a second hand.

- <http://www.smm.org/heart/lessons/lesson1.htm>

3. Respiratory (breaths/minute) Worksheet

- <http://www.smm.org/heart/lessons/respChart.htm>

Class Circulatory System

1. Obtain a large poster of the circulatory system, or print one per student team of the following poster at the Ashlands School web site:

- http://www.ashlandschools.org/morgan_cottle/body/circ.gif

2. Explain to students that the heart and circulatory system make up the cardiovascular system. The heart muscle is made of one kind of muscle tissue, cardiac muscle. The heart beats through the conduction system and pumps blood through the body.
3. Turn the classroom into the human body circulatory system. Have lots of blue and red construction paper and/or streamers.

4. Assign one team the function of the heart. They should be in the center of the room. They need to break into two halves to show the oxygen rich (red) and oxygen poor (blue) blood.
5. The “blue” blood, the oxygen poor blood will return to the heart.
6. The right side of the heart, the right atrium and ventricle, will collect and pump the blood through the pulmonary arteries to the lungs.
7. Assign one team to be the lungs. They stand next to the heart. The lungs refresh the blood with oxygen, it turns red and enters the left side of the heart, the left atrium and left ventricle.
8. The blood is then pumped through the aorta to travel through the body and supply tissues with oxygen.
9. One team may be assigned the parts of the aorta and the valves of the heart. The heart valves are optional, but explain to students that they are gatekeepers and keep the blood flowing in the right direction.
10. Now, label the heart, including the right and left sides, ventricles, and atriums, the lungs, the aorta. Other teams become the blood that will move through the body, the heart, and the lungs.
11. Each blood cell is given a red or blue streamer to begin their path through the body. One side of the room is red and the other side is blue. As they pass through the heart, the heart team will collect the blue streamer and give out the red streamer as the oxygen poor blood becomes the oxygen rich blood, and vice versa.
12. One more student is placed at the end of the room to exchange red streamers for blue streamers when the oxygen rich blood has depleted its oxygen.
13. Review the paths and jobs, and get students to begin making the sound of the heartbeat rhythm. This sound is sometimes called “lub dub.”
14. The Following web site has a sample heartbeat sound:
 - http://www.csulb.edu/org/college/bme/respiratory_sounds/heart.wav
15. The heartbeat begins, and at the teacher’s signal, the movement of blood through the body begins, moving through the heart, into the lungs, out of the aorta, through the body, losing their oxygen, and moving through the body to again enter the heart.
16. Try the activity a few times until the class has really gotten their performance and jobs down with the heartbeat.
17. Afterward, discuss the process. Have students draw and label the process in their science notebooks.

Connections: Math

1. Students determine their own at rest heartbeat. Use a second hand to have students time their heartbeat for fifteen seconds.
 - (a) Multiply by 4 to get beats per minute _____
 - (b) Multiply answer a by 60 to get beats per hour _____
 - (c) Multiply answer b by 24 to get beats per day _____
 - (d) Multiply answer c by 365 to get beats per year _____
 - (e) Multiply answer d by years old to get beats in lifetime _____
2. Record this information in science notebooks.
3. Check your calculations on the online calculator!

- <http://www.smm.org/heart/tools/calculator.html>

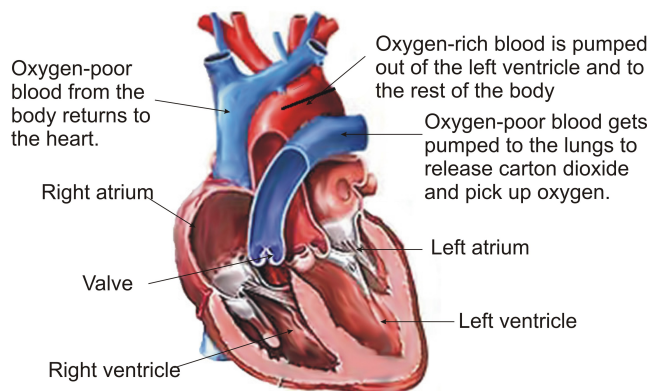
Video Lesson on the Web B

1. Students view the heart animation, and draw the heart and arrows to show blood flow through the heart.
2. Ask students to create a flow chart depicting the flow of blood through the heart. Refer students to **Figure 1** in this lesson for guidance.

- <http://www.smm.org/heart/heart/pumping.htm>

3. Students view the heart animation with and without labels. Students draw the heart and then turn off the labels and try labeling their own diagram. The habits of the heart animation with interactive labels.

- <http://www.smm.org/heart/heart/in-out.htm>



Online Animation

Student pairs should read and discuss the amazing heart facts below.

1. Amazing heart facts from PBS NOVA episode “Cut to the Heart.”;

- <http://www.pbs.org/wgbh/nova/heart/heartfacts.html>

2. Click on the link at the bottom of the above web page to learn about the valves of the heart. Students view and discuss the map of the human heart. There is an animation with numbered explanations.

3. Students go to Troubled Hearts web site:

- <http://www.pbs.org/wgbh/nova/heart/troubled.html>

4. At the web site, students should look at each photo, read the caption, and discuss what the problem is in each heart and how they can tell from the photo after reading the caption. Students should take notes on each photo.

Online Animations

1. Put the following Virtual Lab up on a big screen in the classroom.
2. You should lead the discussion and show students the workings of the virtual lab. Show students that there are two parts of the lab: the interactive window and the lab notebook.
3. Model going through the lab, explaining the material to students, and then allow student pairs to go through on their own and write in their own lab notebook.
4. Howard Hughes Medical Institute Virtual Cardiology Lab, Heart Pumping Animations, (Shockwave and Flash required.) There are 3 animations at this web site that show the heart pumping blood with different view of the chambers and the valves.

- <http://www.hhmi.org/biointeractive/vlabs/cardiology/index.html>

Differentiated Instruction: KWL

Pair English language learners with native speakers. Have students make a KWL chart where K = Know, W = Want to Know, and L = Learned. Students should fill in the K and W columns before reading. Then they read the FlexBook lesson with a partner and fill in the L section. Students should then share out with the pair next to them. **ELL**

Enrichment: Video

1. “The Heart: An Online Investigation” from the Franklin Institute Online. Reading with clickable vocabulary and photos about the heart development, structure, vessels, blood, systems, monitoring, health, and history. Also includes a short video of bypass surgery.

- <http://sln.fi.edu/biosci/heart.html>

2. Have students research and report on an aspect on this web site.

Laboratory Activities: Sheep Heart Dissection

1. Conduct a sheep heart dissection.

a. Purchase sheep hearts here:

i. Home Science Tools:

- <http://www.hometrainingtools.com/heart-sheep/p/PM-HEARTSH/>

ii. Carolina Biologica:

- [http://www.carolina.com/product/preserved+organisms/preserved+animals+\(mammals\)/sheep+organs/sheep+heart,+plain,+pail.do](http://www.carolina.com/product/preserved+organisms/preserved+animals+(mammals)/sheep+organs/sheep+heart,+plain,+pail.do)

2. Students first view the tutorial. Sheep Heart Dissection Tutorial Video:

- http://www.zerobio.com/videos/sheep_heart_anatomy.html

3. Prepare for the class dissection by using this lesson with descriptions and photos. Sheep Heart Dissection:

- <http://www.hometrainingtools.com/heart-dissection-project/a/1318/>

4. Give students this worksheet to fill out during and after the dissection:

- http://www.zerobio.com/central/sheepheart_internet.pdf

5. Students label the following photos upon completing the dissection:

a. External Anatomy: Label the Valves:

- <http://www.hometrainingtools.com/images/art/Heart2Blank.pdf>

b. Internal Anatomy: Label the right side:

- <http://www.hometrainingtools.com/images/art/Heart3Blank.pdf>

c. Internal Anatomy: Label the left side:

- <http://www.hometrainingtools.com/images/art/Heart4Blank.pdf>

Science Inquiry

PBS Videos and Inquiry Lessons on the Heart/Watch Videos

1. Students may view each video sequence: 1, 2, and 3, take notes, and then discuss as a class.
2. Send student pairs to computers to view the tour of the heart, heart healthy guide and take notes.
3. Bring the class together and view the history of cardiology and patient updates. Discuss and ask if students have any personal experiences with family members having a heart attack that they would share.
4. PBS Mysterious Human Heart: Episode 1 Endlessly Beating; Episode 2 The Spark of Life, Anatomy of a Pacemaker; Episode 3 The Silent Killer; Myths and Misconceptions; Tour of the Heart; Healthy Heart Guide; History of Cardiology; Patient Updates (Windows Media Player Required):

- <http://www.pbs.org/wnet/heart/healthy/index.html>

Reinforce and Review

Online Quiz

1. Students go in pairs to take the quiz.

a. Human Circulatory System Quiz:

- http://www.syvum.com/cgi/online/mult.cgi/squizzes/biology/circulatory_system.tdf?0

Review Questions

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Have students answer the Review Questions that are listed at the end of the lesson in their FlexBook.

Points to Consider

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Lesson Assessment

Provided to teachers upon request at teachers-requests@ck12.org.

Copy and distribute the lesson quiz. Provide class time for the students to complete this assessment.

Cardiovascular System: Lesson 18.2 Quiz

Answer Key: Lesson 18.2 Quiz

Provided to teachers upon request at teachers-requests@ck12.org.

26.4 Lesson 18.3: Blood

Key Concepts

Blood is a colloidal solution, particles that are suspended in liquid. Blood is a fluid connective tissue that is made up of red blood cells, white blood cells, platelets, and plasma. It moves around the body through the blood vessels by the pumping action of the heart.

Lesson Objectives

- List the components of blood.
- Identify three functions of blood.
- Name the oxygen-carrying protein found in red blood cells.
- Identify the main function of white blood cells.

- Describe the importance of the ABO blood system.
- Identify three blood disorders or diseases.

Check Your Understanding

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

- What is the main function of the blood?
- What is the role of oxygen in aerobic (cellular) respiration?

Teaching Strategies

Use Visuals

1. Students view the circular diagram of the heart and blood flow in pairs, discuss and take notes. They should draw a large circle with arrows and labels.
2. How Does Blood Circulate? <http://www.cincinnatichildrens.org/health/heart-encyclopedia/intro/blood-circulation-swf.htm>

Details Chart

Students divide a sheet of paper in half and on the left side write these words, skipping several lines between each. Have students work in pairs reading the FlexBook lesson. They should fill in the important details about each main idea they read.

- plasma
- red blood cells
- white blood cells
- platelets

Building Science Skills/Write a Scientific Essay

1. Write a short essay on blood pressure, using the student outline: <http://www.az-aall.org/AALL/pages/Lessons/Blood%20Pressure/blood%20pressure%20essay%20form.htm>
2. Use the links in this lesson to aid writing the essay: http://www.az-aall.org/AALL/pages/Lessons/Blood%20Pressure/blood_pressure%20Student%20Lesson.htm

3. Guide students during class to first develop a thesis statement. A one- sentence statement that the essay evidence and text will prove as true.
4. After the development of their thesis statement, students should write a brief introduction to blood pressure, which they follow with the body of the essay.
5. The outline above helps to guide students to write a convincing essay. Learning to write convincingly in science is an important science skill.

Frayer Model

1. Give students the ABO blood vocabulary term.
2. Have them go to the Wikipedia ABO blood group system web page. It includes a diagram of ABO blood groups and their antibodies: http://en.wikipedia.org/wiki/ABO_blood_group_system
3. Have students draw a large box and divide it into four parts labeled: Definition, Drawing, Example, Non-example.
4. Fill in the parts for the above terms.

Differentiated Instruction: KWL

1. Pair English language learners with native speakers of English. Then ask pairs to make a KWL Chart, where K = Know, W = Want to Know, and L = Learned in their science notebooks.
2. Students should describe what they know about how exercise affects the heart and lungs, the cardiovascular system, and the respiratory system, and what you want to know.
3. At the end of this lesson, students may fill in what they learned about the cardiovascular system. At the end of the lessons in the next chapter, they will add other learning about the respiratory system to the list. **ELL**

Enrichment: Research

- a. Students research the positive and negative effects of salt on the body.
- b. Students should visit the heart healthy diet and read the following three articles on the effects of salt on the heart.
- c. Students then should make a poster, citing specific information about the effects of salt on the heart.
- d. Heart Healthy Diet: <http://www.fi.edu/learn/heart/healthy/diet.html>
- e. Salt's Effect on Your Body: <http://www.bpassoc.org.uk/microsites/salt/Home/Whysaltisbad/Saltseffects>

f. For Heart's Sake, Put the Salt Shaker Away: <http://abcnews.go.com/Health/CardiacHealth/story?id=3060939&page=1>

g. Salt Reduction May Offer Cardioprotective Effects Beyond Blood Pressure Reduction: <http://www.sciencedaily.com/releases/2009/01/090116142126.htm>

Enrichment: Virtual Stethoscope

1. Define **auscultation**: the technical term for listening to the internal sounds of the body.
2. Virtual Stethoscope (Real Player required): <http://sprojects.mmip.mcgill.ca/MVS/MVSTETH.HTM>
 - (a) Students may use the virtual stethoscope to hear and see locations of respiratory and cardiovascular sounds. Students should set the left hand menu to Virtual Stethoscope and Respiratory, and then Virtual Stethoscope and Cardiovascular.
3. Draw and take notes on the experiences. Have students write about their own visits to the doctor, and having the doctor listen to their bodies with a stethoscope. What did they think? What do they now know about what the doctor was listening to?

Laboratory Activities

1. Blood Types and Student Blood Typing:

- <http://www.newtonsapple.tv/video.php?id=1032>

2. Newton's Apple lesson includes a lab investigation for students to find out their blood type by asking parents or their doctor and then sorting the class types to make a graph. Questions help students engage in discussion and analysis of the findings to determine whether the class types are similar or not to the national averages.

- <http://www.newtonsapple.tv/TeacherGuide.php?id=1032>

3. There are four extensions to this lesson.

- a. Students find out their blood type.
- b. Conduct a class lesson to sort the class blood types and make a graph.
- c. Compare to the national results and discuss.
- d. A Newton's Apple video episode on blood typing is available.

Science Inquiry

Solve a Problem

Using Blood Tests to Identify Babies and Criminals

1. Students learn about the ABO blood typing system and how it is used to identify types. Two problem-solving scenarios are included.
2. Students apply information learned about blood typing to determine the babies' parents and who committed the murder. Ties to learned genetics concepts are included. http://serendip.brynmawr.edu/sci_edu/waldron/pdf/BloodTypeGeneticsProtocol.pdf Teacher Preparation Notes for the activity. Includes background for discussion of blood types and inheritance of skin color, and information on where to purchase supplies. http://serendip.brynmawr.edu/sci_edu/waldron/pdf/BloodTypeGeneticsTeachPrep.pdf

Reinforce and Review

Online Quiz

1. Pair students to review blood by taking an online quiz and discussing and checking their answers.
2. Blood Quiz at How Stuff Works
 - <http://health.howstuffworks.com/blood-quiz1.htm>

Review Questions and Answers

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Have students answer the Review Questions that are listed at the end of the lesson in their FlexBook.

Lesson Assessment

Provided to teachers upon request at teachers-requests@ck12.org.

Copy and distribute the lesson quiz. Provide class time for the students to complete this assessment.

Cardiovascular System: Lesson 18.3 Quiz

Answer Key: Lesson 18.3 Quiz

Provided to teachers upon request at teachers-requests@ck12.org.

26.5 Lesson 18.4: Health of the Cardiovascular System

Key Concepts

The health of your whole body depends on the good health of your cardiovascular system. The health of the cardiovascular system (CV system) can be overlooked because damage to the CV system often does not have any symptoms.

Lesson Objectives

- Outline the cause of blood pressure in arteries.
- Identify the healthy range for blood pressure.
- Describe three types of cardiovascular disease.
- Identify things you can do to avoid cardiovascular disease.

Check Your Understanding

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

- What is the role of the cardiovascular system?

Teaching Strategies

Use Videos/ Class Demonstration

Learn More about Blood Pressure.

1. Student view the following videos about blood pressure in pairs, take notes, and write questions as well as ideas for changing how they take blood pressure, or experiments they wish to try with the blood pressure cuff. Blood pressure cuffs can be purchased at American Diabetes Wholesale web site:
 - http://www.americandiabeteswholesale.com/-strse-template/Blood-Pressure-Monitors/Page.bok?utm_source=google&utm_medium=cpc&utm_term=blood+pressure+cuffs&utm_campaign=ADW+-+BP+Monitor&gclid=CNf-rZLOhZwCFMSagodFjha-w

2. Videos

a. Interpreting Blood Pressure Readings:

- http://www.ehow.com/video_4398735_interpreting-blood-pressure-readings.html

b. How Activity Affects Blood Pressure:

- http://www.ehow.com/video_4398736_how-activity-affects-blood-pressure.html

c. Blood Pressure Change Demonstration:

- http://www.ehow.com/video_4398737_blood-pressure-change-demonstration.html

d. Importance of Exercise for Blood Pressure:

- http://www.ehow.com/video_4398737_blood-pressure-change-demonstration.html

3. Students share ideas for experimenting with the pressure cuff. As a class, come up with one or two demonstration experiments for all using the cuff. (e.g., Have one student's BP taken calm, they then jump up and down, take the BP again, wait 2 minutes and take BP, wait 5 minutes and take BP.)

4. Discuss the results with the class.

Reading

This is a well-written FAQ page about the cardiovascular system. It is not a technical document, but highlights key concepts about the cardiovascular system. You may use all or part of the article for students to read through.

- <http://www.faqs.org/health/Body-by-Design-V1/The-Cardiovascular-System.html>

Ask a Question

1. Ask students why they feel dizzy when they get up suddenly? Have they had this happen? When and where? Share stories.
2. Ask students to think about what they know about the cardiovascular system and blood flow specifically, to explain the phenomena.

3. Have students meet in teams and discuss, then come up with a hypothesis.
4. Each team presents their idea to the class (1 minute each). Students discuss the team presentations and refine the class idea about the phenomena with teacher guidance. (Guide students to understand that when they rise suddenly, pressure gravity is suddenly greater on their head and upper body. The change in pressure may cause the blood to flow down, decreasing the pressure in those vessels in the head. Receptors in the body quickly signal the change and restore the blood pressure. You again feel normal.)

Discussion: Use Visuals

1. Ask students what they know about diseases of the cardiovascular system. Take any and all responses and write them on the board.
2. Explain that a cardiovascular disease (CVD) is any disease that affects the cardiovascular system. But, the term is usually used to describe diseases that are linked to atherosclerosis. Atherosclerosis is a chronic inflammation of the walls of arteries that causes swelling and a buildup of material called plaque. Plaque is made of cell pieces, fatty substances, calcium, and connective tissue that build up around the area of inflammation. As plaque grows, it stiffens and narrows the artery, which reduces the flow of blood through the artery, shown in **Figure 2** of the FlexBook lesson.
3. Ask students to look at the figure that shows that atherosclerosis is sometimes referred to as hardening of the arteries; plaque build-up reduces the blood flow through the artery.
4. Have they heard of atherosclerosis before? Take comments briefly.
5. Explain that atherosclerosis normally begins in later childhood, and is usually found in most major arteries. It does not usually have any early symptoms. Causes of atherosclerosis include a high-fat diet, high cholesterol, smoking, obesity, and diabetes. Atherosclerosis becomes a threat to health when the plaque buildup interferes with the blood circulation in the heart or the brain. A blockage in the blood vessels of the heart can cause a heart attack. Blockage of the circulation in the brain can cause a stroke. According to the American Heart Association, atherosclerosis is a leading cause of CVD.
6. Ask students if they have heard of coronary heart disease.
7. Explain to students that cardiac muscle cells are fed by the coronary arteries. Blocked flow in a coronary artery can result in a lack of oxygen and the death of heart muscle.
8. Coronary heart disease is the end result of the buildup of plaques within the walls of the coronary arteries. Coronary heart disease often does not have any symptoms. A symptom of coronary heart disease is chest pain. Occasional chest pain, called angina can happen during times of stress or physical activity. The pain of angina means the heart muscle fibers need more oxygen than they are getting.
9. Ask students to look at the figure in the FlexBook on a coronary artery blockage. A blockage in a coronary artery stops oxygen getting to part of the heart muscle; areas of

- the heart that depend on the blood flow from the blocked artery are starved of oxygen.
10. Have them look at the cut away and see the blockage in the artery. Use an analogy of a garden hose being blocked with a rock. Would the water pass freely through it?
 11. Explain that most people with coronary heart disease often have no symptoms for many years until they have a heart attack. A heart attack happens when the blood supply to a part of the heart is blocked. The cardiac muscle that depends on the blood supply from the blocked artery does not get any oxygen. Cardiac muscle fibers that are starved of oxygen for more than about five minutes will die. Cardiac muscle does not divide, so dead cardiac muscle cells are not replaced. Coronary heart disease is the leading causes of death of adults in the United States. **Figure 3** shows how a blocked coronary artery can cause a heart attack, and cause part of the heart muscle to die. Injured cardiac muscle does not contract as well as healthy tissue, so the heart will not work as well as it used to.
 12. Explain that a stroke is a loss of brain function due to a blockage of the blood supply to the brain. It can be caused by a blood clot, a free-floating object that gets caught in a blood vessel, or by a bleeding blood vessel.

Online Animation: Heart Attack

1. Student pairs should view these online animations, take notes, and discuss.
2. Heart Attack Animation Video:
 - <http://www.healthcentral.com/cholesterol/understanding-cholesterol-13-115.html>
3. Heart Attack and Atherosclerosis Animation:
 - http://www.medindia.net/animation/Heart_Attack.asp
4. Stroke Animation Video:
 - http://www.youtube.com/watch?v=M_fo6ytlmD0
5. Stroke (Ischemic) Animation:
 - <http://www.medmovie.com/mmdatabase/MediaPlayer.aspx?ClientID=65&TopicID=748>

Discussion

1. Ask students if they have ideas about ways to keep their cardiovascular system healthy, and reduce the risk of coronary diseases during their lifetime.
2. Accept all responses and write them on the board.
3. Tell students that there are some risk factors that they cannot control, but they should be aware of. These include:
 - (a) Age The older a person is, the greater their chance of developing a cardiovascular disease.
 - (b) Gender Men under age 64 are much more likely to die of coronary heart disease than women, although the gender difference declines with age.
 - (c) Genetics Family history of cardiovascular disease increases a person's chance of developing heart disease.
4. Then explain that lifestyle can change the risk for cardiovascular disease. The choices that they make on a daily basis in terms of exercise, eating right, and not smoking affect their risk for CV disease.
5. With students, create a list of risk factors you can control include:
 - (a) Tobacco Smoking Giving up smoking or never starting to smoke is the single most effective way of reducing the risk of heart disease.
 - (b) Diabetes Having diabetes can cause changes such as high cholesterol levels which are themselves risk factors.
 - (c) High Cholesterol Levels Having high amounts of low density lipids in the blood, also called bad cholesterol, is a significant risk factor.
 - (d) Obesity Being obese, especially if the fat is deposited mostly in the torso, rather than the hips and thighs, increases risk significantly.
 - (e) High Blood Pressure Hypertension can cause atherosclerosis.
 - (f) Lack of Physical Activity Aerobic activities, such as the one shown in **Figure 4**, helps to keep your heart healthy. To reduce the risk of disease, you should be active for at least 60 minutes a day, five days a week (or most days of the week).
 - (g) Poor Eating Habits Eating mostly foods that are nutrient poor (do not have many nutrients other than fat or carbohydrate) leads to high cholesterol levels and becoming overweight, among other things.

Differentiated Instruction

1. Direct student to divide a piece of paper in half and on the left side write the main ideas of the lesson on cardiovascular health. Skip several lines in between.
2. On the right side, have students fill in as much as they know.
3. Share with a neighbor to add to their own chart.
4. Now the pairs go to the FlexBook lesson to discuss and add more to their charts.
5. Discuss together. **ELL, SN**

Enrichment: View Animation

Student pairs view a blood pressure animation to learn about systolic and diastolic pressure, a graph of pressure, and the graph used to measure the blood pressure. Use the following web site:

- <http://www.sumanasinc.com/webcontent/animations/content/bloodpressure.html>

Laboratory Activities: Research a Topic

Blood Pressure: This blood pressure lab allows students to formally devise and test their hypotheses about blood pressure and practice taking each other's pulse and blood pressure. Objectives, teacher notes, student lab sheet are all included at the web site:

- <http://74.125.93.132/search?q=cache:eXlM1ctk1xsJ:www.upenn.edu/ccp/programs/AccessScience/docs/labs/high%2520school/MedicalIntake/Pulse%2520and%2520Blood%2520Pressure%2520Lab.doc+blood+pressure+lab&cd=6&hl=en&ct=clnk&gl=us&client=safari>

Science Inquiry

Research

Lowering Blood Pressure, Personal Relevance

1. Ask students what one needs to do to lower blood pressure. Write what they come up with on the board.
2. Students in pairs go to Blood Pressure web site and answer the following questions:
 - a. What is high blood pressure?
 - b. What is hypertension?
 - c. What effects does high blood pressure have on your body?
 - d. Who is at risk for high blood pressure?

- <http://www.nhlbi.nih.gov/hbp/index.html>

3. Whole class convenes. Students share answers. Host a brief discussion, including personal stories of family members with hypertension or high blood pressure.

4. Students in pairs go to find out about prevention of high blood pressure and how to lower high blood pressure if they, or family members have it.

a. Prevention web site:

- <http://www.nhlbi.nih.gov/hbp/prevent/prevent.htm>

b. Treatment web site:

- <http://www.nhlbi.nih.gov/hbp/treat/treat.htm>

c. Your Guide to Lowering High Blood Pressure web site:

- http://www.nhlbi.nih.gov/hbp/prevent/p_active/quiz.htm

5. Whole class convenes. Discuss the results of research.

6. Now ask students to reflect quietly about any lifestyle changes they want to make. Have them write confidentially to you, either in their notebook, or on a piece of paper they hand in.

7. Homework Lab: Students go home and interview parents, grandparents, or at least two family members about their blood pressure and what they are doing about their condition. Write up results and turn in to the teacher.

8. Class discussion after homework. Anyone wishing to share what they discovered in their families may do so. There should be no compulsion to do so, it should be voluntary. Ask students to again reflect on lifestyle changes they may wish to make. Bring up the notion of smoking. Discuss this decision as a health decision.

Reinforce and Review

Online Quiz

1. Student partners take some online quizzes and discuss their understanding of blood pressure.

2. Blood Pressure Quiz:

- <http://www.healthline.com/sw/qz-blood-pressure-quiz>

3. Blood Pressure Quiz:

- http://psychologytoday.psychtests.com/cgi-bin/health/transfer_health.cgi?partner=pt&test=blood

4. Students discuss and take notes, reflecting on their own lifestyles.

Review Questions and Answers

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Have students answer the Review Questions that are listed at the end of the lesson in their FlexBook.

Points to Consider

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Lesson Assessment

Provided to teachers upon request at teachers-requests@ck12.org.

Copy and distribute the lesson quiz. Provide class time for the students to complete this assessment.

Cardiovascular System: Lesson 18.4 Quiz

Answer Key: Lesson 18.4 Quiz

Provided to teachers upon request at teachers-requests@ck12.org.

Image Sources

Chapter 27

TE Respiratory and Excretory Systems

27.1 Chapter 19: Respiratory and Excretory Systems

Outline

The chapter *Respiratory and Excretory Systems* consists of three lessons that introduce students to

- Lesson 19.1: The Respiratory System
- Lesson 19.2: Health of the Respiratory System
- Lesson 19.3: The Excretory System

Overview

Teaching Strategies

Pacing the Lessons

Use the **Class Periods per Lesson** table below as a guide for the time required to teach the lessons of this chapter.

Table 27.1:

Lesson	Number of Class Periods*
Lesson 19.1: The Respiratory System	2.0
Lesson 19.2: Health of the Respiratory System	1.0

Table 27.1: (continued)

Lesson	Number of Class Periods*
Lesson 19.3: The Excretory System	2.0

- Class periods are assumed to be 60 minutes long.

Lab Links

Managing Materials

The materials listed in the **Materials List** table below are needed to teach the strategies and activities described in the Teachers Edition of the FlexBook for this chapter.

Table 27.2:

Lesson	Strategy or Activity	Materials Needed
19.1	1) 2)	1) 2)
19.2	1)	1)
19.3	1)	1)

Additional Web-Based Resources

Making the FlexBook Flexible

An important advantage of the FlexBook is the ability it gives you, the teacher, to choose the chapters and lessons that you think are most important for your own classes. The following information is provided to help you decide whether to include this chapter or certain lessons in this chapter in your students' FlexBook. You should also consult the standards correlation table that follows when selecting chapters and lessons to include in the FlexBook.

- To understand the content of this chapter, students should have read the ———— chapter.
- Students should read this entire chapter before reading the remaining chapters of the FlexBook.
- It is recommended that you include all the lessons of this chapter in the FlexBook.

Common Misconceptions

Here are some common student misconceptions, related to this chapter:

- Human lungs breathe in only oxygen and breathe out only carbon dioxide.
- Respiration is the same thing as breathing.
- Nicotine is responsible for adverse health effects. Filtered or low-tar cigarettes make smoking safer. Tobacco is natural. Smokers can quit any time they want to do so.
- Bowel regularity means a bowel movement every day.

The Air You Breathe In and Out

Most people mistakenly believe that humans inhale only oxygen and exhale only carbon dioxide. They fail to take into account that air is normally about 78% nitrogen, 21% oxygen and 0.03% carbon dioxide. People inhale this air. The air they exhale is relatively oxygen-poor (about 16%, since much of the inhaled oxygen has been used by the body in cellular respiration) but relatively rich in carbon dioxide (about 4%, since one of the waste products of cellular respiration is carbon dioxide). The nitrogen content of the air is unchanged in the breathing process. A teaching strategy to help students grasp these concepts is to have them make simple drawings in which they represent (with arrows and percentages) the different components of the environmental, inhaled and exhaled air.

Breathing vs. Respiration

Students and teachers often confuse these two terms. (Reference 1) Breathing refers to the mechanism of gas exchange between an organism (in our chapter, people) and the environment. Respiration usually refers to cellular respiration, i.e., the process that releases energy from food substances in all living cells. However, sometimes people use “respiration” as an everyday word to mean breathing. For this reason, in our chapter the distinction is made between external respiration (= breathing) and internal respiration (= cellular respiration). Discuss these important distinctions with students.

Misconceptions About Smoking

While nicotine is a natural occurring substance, derived from the tobacco plant, its main adverse effect in cigarettes is addiction. Other chemicals in cigarettes, not nicotine, are responsible for most of the adverse health effects related to smoking. (reference 2)

There are no safe cigarettes. Low-tar cigarettes are just as harmful as higher tar cigarettes. Although low-tar cigarettes can be slightly less damaging to your lungs over a long period of time, people who smoke these have been shown to take deeper puffs, puff more frequently

and smoke the cigarettes to a shorter butt length. Switching to low-tar cigarettes has few health benefits compared with the benefits of quitting.

People say tobacco is natural because it comes from a plant. But there is more inside a cigarette than only tobacco. A lot of the filling is actually a tip of paper sprayed with tobacco pulp, nicotine and chemicals. These additives include ammonia to enhance nicotine's brain effects. The paper is shredded to look like real tobacco, and then used to fill cigarettes.

Anyone who smokes is at risk of becoming addicted to nicotine. Nicotine stimulates the production of dopamine, which makes you feel happy and more animated when you start smoking. As you continue to smoke your body learns to depend on nicotine and you want to quit, you may feel hungry, sleepy, tired or irritable. In fact, only 7 percent of 35 million people succeed to quit smoking every year!

Normal Bowel Function

The frequency of bowel movements among normal, healthy people varies from three per day to three per week; some perfectly healthy people fall outside both ends of this range. Nevertheless, even three bowel movements a day can be abnormal in someone who usually has one bowel movement a day. People with irritable bowel syndrome (IBS) may have fluctuating numbers of stools each day as well as fluctuating consistency of their stools. (Reference 3)

- Reference 1: Sanders, M. (1993). Erroneous ideas about respiration: The teacher factor. *Journal of Research in Science Teaching*, 30(8), 919-934.
- Reference 2: "Myths and Misconceptions about Smoking" Cancer Council of Australia. See: <http://www.cancer.org.au/cancersmartlifestyle/smokingandtobacco/mythsandmisconceptions.htm>
- Reference 3: "Digestive Disease Myths Slideshow: Common Misconceptions." From E-MedicineHealth: Practical Guide to Health. http://www.emedicinehealth.com/slideshow_digestive_disease_myths/article_em.htm

27.2 Review Answers Repository

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Have students answer the Review Questions that are listed at the end of the lesson in their FlexBook.

Chapter 28

TE Controlling the Body

28.1 Chapter 20: Controlling the Body

Outline

The chapter *Controlling the Body* consists of four lessons that introduce students to

- Lesson 20.1: The Nervous System
- Lesson 20.2: The Eyes and Vision
- Lesson 20.3: Other Senses
- Lesson 20.4: Health of the Nervous System

Overview

Teaching Strategies

Pacing the Lessons

Use the **Class Periods per Lesson** table below as a guide for the time required to teach the lessons of this chapter.

Table 28.1:

Lesson	Number of Class Periods*
Lesson 20.1: The Nervous System	2.0
Lesson 20.2: The Eyes and Vision	1.0
Lesson 20.3: Other Senses	1.0

Table 28.1: (continued)

Lesson	Number of Class Periods*
Lesson 20.4: Health of the Nervous System	1.0

- Class periods are assumed to be 60 minutes long.

Lab Links

Managing Materials

The materials listed in the **Materials List** table below are needed to teach the strategies and activities described in the Teachers Edition of the FlexBook for this chapter.

Table 28.2:

Lesson	Strategy or Activity	Materials Needed
20.1	1) 2)	1) 2)
20.2	1)	1)
20.3	1)	1)
20.4	1)	1)

Additional Web-Based Resources

Making the FlexBook Flexible

An important advantage of the FlexBook is the ability it gives you, the teacher, to choose the chapters and lessons that you think are most important for your own classes. The following information is provided to help you decide whether to include this chapter or certain lessons in this chapter in your students' FlexBook. You should also consult the standards correlation table that follows when selecting chapters and lessons to include in the FlexBook.

- To understand the content of this chapter, students should have read the _____ chapter.
- Students should read this entire chapter before reading the remaining chapters of the FlexBook.
- It is recommended that you include all the lessons of this chapter in the FlexBook.

Common Misconceptions

Here are some common student misconceptions, related to this chapter:

- The human nervous system mostly involves the human brain.
- Humans use only about 10% of their brain or less.
- People see whenever light shines on an object. Color is a property of an object. Balance is controlled by nerves in the hands and feet. There are only four “primary” tastes: salt, sweet, sour, and bitter.

What makes up the human nervous system?

The human brain is connected to the spinal cord: together, they make up the Central Nervous System (CNS), which control all of the other nervous systems. Students often overlook these other nervous systems, which are connected to the CNS. The Peripheral Nervous System includes all the nerves of the body; it is divided into the nerves of the senses (the Sensory Division) and nerves of the muscles (the Motor Division). The Motor Division includes nerves that carry messages to muscles under voluntary control (Somatic NS) and nerves that carry messages to muscles not under voluntary control, such as the organs and glands (Autonomous NS). The Autonomous NS includes nerves that prepare the body for emergencies (Sympathetic NS) and nerves that control the body during non-emergencies (Parasympathetic NS). Challenge students to “map out” the different parts of the nervous system, both before they study this chapter, as well as afterwards. Suggest that they compare their maps to **Figure 7** in lesson 1 (The Nervous System).

Using the human brain

While it’s true that everyone has “room for improvement,” in most any area of endeavor, the notion that people use only about 10% of their brain is a common misconception. This notion is promoted in the public press and electronic media, but there is very strong evidence from neuroscience that people use nearly all of their brains. Brain imaging research techniques, such as PET scans (positron emission tomography) and fMRI (functional magnetic resonance imaging) show that during specific events – reading, running, eating, etc. – people use specific areas of their brains. In this way, during an average day, almost all of the brain is used.

Using the senses

Students have many misconceptions regarding how our senses work. For example, they often believe that people can see an object when light shines on it, with no recognition that light must move between the object and the observer’s eye. Also, they may believe that color is a property of an object; however, color is affected by the illuminating light (which, in

some cases, can “change” the color of the object) as well as the eye-brain system (which, in some cases, can give rise to “color blindness”). The body’s balance is controlled by nerves connected to the semicircular canals in the human ear; these nerves send signals to the cerebellum in the brain, which sends appropriate signals to the body’s muscles, resulting in balance. Taste is a complex sense. In addition to the 4 “primary” tastes of salt, sweet, sour, and bitter, there are additional taste sensations, including astringency (cranberries and tea), pungency (hot pepper and ginger) and even the taste of monosodium glutamate (a primary ingredient in Japanese food, called “umami,” which means delicious). Challenges your students to identify, investigate and report about these and other misconceptions about the human senses.

28.2 Lesson 20.1: The Nervous System

Key Concepts

The nervous system is the body system that controls all the other systems of the body. Controlling muscles and maintaining balance are just two of its roles.

Lesson Objectives

- Identify the functions of the nervous system.
- Describe neurons and explain how they carry nerve impulses.
- Describe the structures of the central nervous system.
- Outline the divisions of the peripheral nervous system.

Check Your Understanding

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

- If groups of cells are called tissues, and groups of tissues are called organs, what are groups of organs called?
- What are examples of human organ systems?
- Which organ system controls all the others?

Teaching Strategies

Explore a Web site

1. Send student teams to the *Neuroscience for Kids* web site, a premier, award-winning web site for learning about the nervous system, the brain, and the senses. Neuroscience for Kids:

- <http://faculty.washington.edu/chudler/neurok.html>

2. Print out this scavenger hunt sheet to allow students to go through the web site and explore, see games, activities, experiments, and demonstrations.

- <http://faculty.washington.edu/chudler/scavold.html>

3. Give ample time for exploration and assign further exploration for homework. There is plenty at Neuroscience for Kids to keep them busy and learning.

4. This site is information-rich. There is much to explore and the scavenger hunt helps students understand what is on the site and where to find different kinds of information. Students start the above scavenger hunt at:

- <http://faculty.washington.edu/chudler/introb.html>

[Note to the teacher: The following strategies all use this web site]

Make a Model Neuron

Materials needed: four colors of modeling clay.

1. Explain to students that they will make a model neuron out of modeling clay. See a picture of the neuron model:

- <http://faculty.washington.edu/chudler/chmodel.html>

2. The neuron has four parts: dendrites, cell body (also called the soma), the axon, and the axon terminal.

a. Dendrites - Extensions from the neuron cell body, which take information to the cell body. Dendrites usually branch close to the cell body.

b. Cell body (soma) - The part of the cell that contains the nucleus.

c. Axon - The extension from the neuron cell body that takes information away from the cell body. A single axon projects out of the cell body.

d. Axon terminal - End part of an axon that makes a synaptic contact with another cell.

3. Students research neurons and look at pictures, photos, and diagrams of neurons to make their models.

- <http://faculty.washington.edu/chudler/cells.html>

4. Students make the model in pairs or individually.

5. Students draw a neuron in their science notebooks and label it.

6. Students paint a neuron (online interactive activity) and check their drawing and labeling against this diagram:

- <http://faculty.washington.edu/chudler/color/cbneuron.html>

Build an Online Model Neuron

Student pairs go to this web site to build models of three kinds of neurons: a bipolar neuron, a multipolar neuron, and a pseudounipolar neuron.

- <http://faculty.washington.edu/chudler/flash/makeec.html>

Students draw and label each type of neuron. Students place drawings in their notebooks.

Research Neurons

Pairs of students research neurons and make a concept map about neurons.

Types of Neurons:

- <http://faculty.washington.edu/chudler/cells.html>

Play Synaptic Tag Outside

1. Students review the parts of the synapse and functions by playing Synaptic Tag.

- <http://faculty.washington.edu/chudler/outside.html#tag>

2. Review these web pages in pairs.
 - a. The Synapse:
 - <http://faculty.washington.edu/chudler/synapse.html>
 - b. Neurotransmitters:
 - <http://faculty.washington.edu/chudler/chnt1.html>
 - c. The Action Potential:
 - <http://faculty.washington.edu/chudler/ap.html>
 - d. Cells of the Nervous System:
 - <http://faculty.washington.edu/chudler/cells.html>
3. Take outside: diagram of synapse, diagram of game on chart, chalk.
4. The procedure is explained on the Lesson Plan page:
 - <http://faculty.washington.edu/chudler/leout.html>

Differentiated Instruction

English Language Learners

1. Pair English speakers and ELLs to read the online comic, Sam's Brainy Adventure, and Nervous System A to Z. Draw pictures and take notes about neurons and dendrites.
 - a. Sam's Brainy Adventure:
 - <http://faculty.washington.edu/chudler/pdf/comic.pdf>
 - b. Nervous System A to Z:
 - <http://faculty.washington.edu/chudler/pdf/az.pdf>
2. Pair English speakers and ELLs to color three different kinds of neurons online, a bipolar neuron, a unipolar neuron, and a multipolar neuron. Draw and label the neurons. Students keep their drawings in their science notebooks.

- <http://faculty.washington.edu/chudler/color/cbcells.html>

3. Sing Brain Songs

- a. Print out the words to some of the brain songs like “Brain of Mine”, “The Dendrite Song”, “Because I have a Brain”, and “Brain Rap.”
- b. Students sing songs or the rap in class, or make up their own brain songs.

- <http://faculty.washington.edu/chudler/songs.html>

Enrichment: Learn about the Autonomic Nervous System

1. Ask students if they have heard of the autonomic nervous system. They have learned about the central nervous system, and the peripheral nervous system, but this is a part of the nervous system that regulates the organs of our body. The areas it regulates includes the heart, stomach, and intestines. The autonomic nervous system includes the sympathetic nervous system and the parasympathetic nervous system.
2. Enrichment students should research this system, make a poster about it, and present their learning to the rest of the class.
3. Neuroscience for Kids: Autonomic Nervous System:

- <http://faculty.washington.edu/chudler/auto.html>

Laboratory Activities: Virtual Dissection

1. Students go through the Exploratorium Virtual Sheep Brain Dissection online as a class or in pairs.
 - a. Real Video required; if you need help with Real Video:

- <http://www.exploratorium.edu/memory/braindissection/help.html>

- b. Sheep Brain Dissection:

- <http://www.exploratorium.edu/memory/braindissection/>

2. Students take notes and draw and label diagrams. Make comparisons of the size and similarity to the human brain.

Laboratory Activities: Hands on Dissection

1. Sheep Brain Dissection Guide with Pictures:

- <http://www.hometrainingtools.com/article.asp?ai=1316&bhcd2=1247802835>

2. The above guide gives explicit directions for students to follow to dissect a sheep brain. Refer to the guide and conduct a hands-on dissection with your students.

3. After the class dissection, print out these diagrams and have students fill in the labels:

a. Internal Anatomy, label the right side:

- <http://www.hometrainingtools.com/images/art/Brain1Blank.pdf>

b. External Anatomy, label the top view:

- <http://www.hometrainingtools.com/images/art/Brain2Blank.pdf>

c. External Anatomy 2, label the bottom view:

- <http://www.hometrainingtools.com/images/art/Brain3Blank.pdf>

4. Discuss the dissection as a class and review the anatomy.

Science Inquiry

Experiments about Reflexes

1. Student pairs go to the reflexes experiments page on the Neuroscience for Kids web site and conduct the following experiments:

- Jump to It.
- Knee Jerk, Patellar Reflex.
- Think Fast (need cotton balls and a screen or plastic or glass window.)
- How Fast Are You?

2. Reflexes:

- <http://faculty.washington.edu/chudler/chreflex.html>

3. Tell students to title each experiment and keep notes, writing down what they did in each experiment and what they learned.
4. The last experiment is longer and requires more time. The How Fast Are You experiment could also be done as a class demonstration of reflexes. You just need a ruler or yardstick, and one to two student volunteers to test their reflexes according to the directions in the lesson.

Reinforce and Review

Online Quiz

1. Students take an online *Parts of Neurons* quiz in pairs:

- <http://faculty.washington.edu/chudler/revcell.html>

2. Have students take the *Neuron Review Test*.

- <http://faculty.washington.edu/chudler/pdf/revtype.pdf>

- a. Answers to the *Neuron Review Test*:

- <http://faculty.washington.edu/chudler/pdf/revtypean.pdf>

Review Questions and Answers

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Have students answer the Review Questions that are listed at the end of the lesson in their FlexBook.

Points to Consider

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Lesson Assessment

Provided to teachers upon request at teachers-requests@ck12.org.

Copy and distribute the lesson quiz. Provide class time for the students to complete this assessment.

Controlling the Body: Lesson 20.1 Quiz

Answer Key: Lesson 20.1 Quiz

Provided to teachers upon request at teachers-requests@ck12.org.

28.3 Lesson 20.2: The Eyes and Vision

Key Concepts

Sight, or vision, is the ability to see light. It depends on the eyes detecting light and forming images. It also depends on the brain making sense of the images, so we know what we are seeing.

Lesson Objectives

- Describe how humans see and explain why vision is important.
- Explain how the eye works to produce images.
- Describe the nature of light.
- Explain how lenses correct vision problems.

Check Your Understanding

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

- What are some ways that people use their eyes?
- Which part of the nervous system carries messages from the eyes to the central nervous system?
- Which part of the brain interprets messages from the eyes?

Teaching Strategies

Use Visuals/Online Learning

1. Student pairs explore the following web pages from Neuroscience for Kids:

a. The Eye. Draw the eye and label, write notes.

- <http://faculty.washington.edu/chudler/bigeye.html>

b. The Retina. Draw retina, make notes on cones and rods.

- <http://faculty.washington.edu/chudler/retina.html>

c. Anatomy of the Eye. Explore and review, watch Quicktime movies going through the anatomy of the eye.

- <http://macula.org/anatomy/>

Activity: the Blind Spot

Blind Spot Activities

1. Student pairs work together to perform the dramatic blind spot experiment, using the online directions from Neuroscience for Kids.

2. The Blind Spot:

- <http://faculty.washington.edu/chudler/chvision.html>

3. They title and label the activity in their science notebooks and draw the blind spot tester. They should draw the diagrams showing where you look to test the blind spot.

4. Print out a template of blind spot testers for students.

- <http://faculty.washington.edu/chudler/pdf/bspots.pdf>

5. Students should try each of the different tester configurations.

6. Students write notes on each in notebooks.

Read, View Diagrams: The Blind Spot

More Blind Spot Activities

1. Student pairs learn more about the blind spot by reviewing this web site.
2. Seeing More Than Your Eye Does:
 - <http://serendip.brynmawr.edu/bb/blindspot1.html>
3. Try the new blind spot situations on this web site:
 - a. More Blind Spots:
 - <http://serendip.brynmawr.edu/bb/blindspot2.html>
 - b. Switching Colors:
 - <http://serendip.brynmawr.edu/bb/blindspot3.html>
 - c. Even More Blind Spots:
 - <http://serendip.brynmawr.edu/bb/blindspot4.html>
 - d. What if things don't get interrupted by the blind spot:
 - <http://serendip.brynmawr.edu/bb/blindspot5.html>
4. Students keep notes on each of these experiments and record in their notebooks.

Activity: Understanding Color Vision

1. This activity is to be done after students read and take notes on the following article.
2. How our environment affects color vision.
 - http://www.accessexcellence.org/AE/AEC/CC/vision_activities.php

3. Materials: construction paper, cardboard, scissors, tape, room to change lighting, chart.
4. The materials and procedure are described in full at the link above.
5. Students work in pairs or teams.
6. Either copy the chart from the activity plan or draw the chart on the board for students to copy into their notebooks.
7. Students complete the activity and record data.
8. Students answer the questions about data and the questions for consideration.
9. Class discussion and debriefing.

Activity: Learn about Vision and Correction

1. Student pairs go to the Neuroscience for Kids web site
2. “Do You Wear Glasses? Here’s Why”:. Draw the nearsighted and farsighted diagrams in science notebooks.

- <http://faculty.washington.edu/chudler/sight.html>

3. Tell students they should find out why people wear glasses, how light comes into the cornea and is focused on the retina, and how glasses, another lens, helps focus the objects on the retina in farsighted or nearsighted people.

Differentiated Instruction

English Language Learners

Activity: Map Your Own Blind Spot

1. Student pairs follow the directions on the java applet web site to map their own blind spot. Bryn Mawr Serendip: Seeing More Than Your Eye Does, Mapping Your Blind Spot:

- <http://serendip.brynmawr.edu/bb/blindspot/>

2. Students write reflections on how it worked and felt. Students keep reflections in their science notebooks.

Enrichment: Read and Understand How We See

1. Student pairs work together to read and take notes about how we see.

2. Draw the diagrams and label in science notebooks.
3. Access Excellence: How We See: The First Steps of Human Vision:

- http://www.accessexcellence.org/AE/AEC/CC/vision_background.php

Laboratory Activities

Cow's Eye Dissection

1. Student pairs go to the Exploratorium Virtual Dissection web page and go through the dissection, step by step.
2. Students take notes and draw diagrams.
3. Virtual Dissection:

- http://www.exploratorium.edu/learning_studio/cow_eye/step01.html

4. Eye diagram. Students should draw and label this diagram in their notebooks.

- http://www.exploratorium.edu/learning_studio/cow_eye/eye_diagram.html

5. You may print off this Eye Diagram for students to put in their notebooks. It contains more descriptions of the anatomical parts of the eye.

- http://www.exploratorium.edu/learning_studio/cow_eye/eye_diagram_print.html

Science Inquiry

Experiment: Eye Anatomy and Function: Peripheral Vision

1. Students will learn ways to explore the sense of sight and how to plan and conduct their own experiments.
2. Print out the entire Teacher Guide with materials, procedure, objectives.

- <http://faculty.washington.edu/chudler/pdf/eyetg.pdf>

3. Print out Student Guide to give to student teams.

- <http://faculty.washington.edu/chudler/pdf/eyesg.pdf>

4. Summary and Background:

- <http://faculty.washington.edu/chudler/eyetr.html#sum>

5. Planning and Teaching the Lab Activity:

- <http://faculty.washington.edu/chudler/eyetr.html#plan>

Reinforce and Review

Online Quiz, Online Crossword and Word Search

1. Student pairs review about the eye online through a quiz, crossword puzzle, and word search game.

2. Eye Vision Review:

- <http://faculty.washington.edu/chudler/java/reveye.html>

3. Vision Crossword Puzzle:

- <http://faculty.washington.edu/chudler/eyecross.html>

4. Interactive Word Search Puzzle - The Eye:

- <http://faculty.washington.edu/chudler/java/searcheye.html>

Review Questions and Answers

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Have students answer the Review Questions that are listed at the end of the lesson in their FlexBook.

Points to Consider

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Lesson Assessment

Provided to teachers upon request at teachers-requests@ck12.org.

Copy and distribute the lesson quiz. Provide class time for the students to complete this assessment.

Controlling the Body: Lesson 20.2 Quiz

Answer Key: Lesson 20.2 Quiz

Provided to teachers upon request at teachers-requests@ck12.org.

28.4 Lesson 20.3: Other Senses

28.5 Review Answers Repository

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Have students answer the Review Questions that are listed at the end of the lesson in their FlexBook.

Chapter 29

TE Diseases and the Body's Defenses

29.1 Chapter 21: Diseases and the Body's Defenses

Outline

The chapter *Diseases and the Body's Defenses* consists of four lessons that introduce students to

- Lesson 21.1: Infectious Diseases
- Lesson 21.2: Noninfectious Diseases
- Lesson 21.3: First Two Lines of Defense
- Lesson 21.4: Immune System Defenses

Overview

Pacing the Lessons

Use the **Class Periods per Lesson** table below as a guide for the time required to teach the lessons of this chapter.

Table 29.1:

Lesson	Number of Class Periods*
21.1: Infectious Diseases	1.0
21.2: Noninfectious Diseases	2.0
21.3: First Two Lines of Defense	1.5
21.4: Immune System Defenses	1.5

- Class periods are assumed to be 60 minutes long.

Managing Materials

The materials listed in the **Materials List** table below are needed to teach the strategies and activities described in the Teachers Edition of the FlexBook for this chapter.

Table 29.2:

Lesson	Strategy or Activity	Materials Needed
21.1	1) 2)	1) 2)
21.2	1)	1)
21.3	1)	1)
21.4	1)	1)

Making the FlexBook Flexible

An important advantage of the FlexBook is the ability it gives you, the teacher, to choose the chapters and lessons that you think are most important for your own classes. The following information is provided to help you decide whether to include this chapter or certain lessons in this chapter in your students' FlexBook. You should also consult the standards correlation table that follows when selecting chapters and lessons to include in the FlexBook.

- To understand the content of this chapter, students should have read the ———— chapter.
- Students should read this entire chapter before reading the remaining chapters of the FlexBook.
- It is recommended that you include all the lessons of this chapter in the FlexBook.

Common Misconceptions

Here are some common student misconceptions, related to this chapter:

- HIV is the same as AIDS. You can get AIDS through casual contact with someone who has the disease. AIDS is transmitted through mosquitoes. Only homosexual men and drug users get AIDS.
- Antibiotics can cure any infectious disease. It's good to take antibiotics to protect yourself against an infectious disease, like the common cold.
- Vaccines are not safe. Vaccines are linked to chronic diseases such as autism, multiple sclerosis (MS), and Crohn's disease. Vaccines are not needed anymore because the diseases are gone.

- Lung cancer is more likely to be caused by living in a polluted city than smoking a pack of cigarettes a day. Cell phones cause cancer. What one does as a young adult has little effect on the chance of getting cancer later in life.

Regarding AIDS

HIV (Human Immunodeficiency Virus) and AIDS (Acquired Immune Deficiency Syndrome) are not the same. HIV is the underlying cause of the disease, while AIDS is the disease itself. Also, not all HIV-positive individuals have AIDS, since the HIV virus can remain in a latent state for many years. Regarding the process of infection, a person cannot become infected with HIV through casual contact with someone with the disease; the virus is not transmitted through shaking hands, hugging, kissing or even being exposed to coughing or sneezing by someone infected by the HIV virus. This virus is transmitted via sexual contact and/or through contact with the blood of someone with AIDS. Mosquitoes do not transmit AIDS, since they do not inject the blood of a previous victim into the person they bite next (Mosquitoes inject their saliva into their victims, which may carry other diseases such as malaria or West Nile virus, so they can infect a bitten person with these diseases.) Finally, the HIV virus can infect anyone, regardless of sex, ethnicity or sexual orientation. (Reference 1)

Regarding antibiotics

Antibiotics can work only on diseases caused by bacteria and some fungi; they do not work on diseases caused by viruses. Using antibiotics when they're not needed is a bad practice because it increases the risk of destroying the "good bacteria" in a person's body, making the body more likely to be infected by disease-causing bacteria. Moreover, some of the bacteria in the body (including those that cause disease) will survive the antibiotics, making these bacteria more likely to become antibiotic-resistant.

Regarding vaccines

Vaccines are extremely effective. They have been developed to successfully fight and limit such diseases as polio, diphtheria, measles and whooping cough. While serious side effects can happen, they are quite rare. Vaccines do not cause chronic disease, despite web-sites to the contrary; medical research provides strong evidence that vaccines do not cause autism, MS, Crohn's disease or other chronic diseases. If a vaccine-preventable disease is uncommon, it can still return quickly if fewer people are immunized. In other words, unless a disease has completely disappeared, small outbreaks can turn into large epidemics, if most of the community is not protected. (Reference 2)

Regarding Cancer

While urban pollution can cause lung cancer, the strongest data consistently show that smoking is the leading cause of the disease; between 80% to 90% of lung-cancer deaths can be attributed to smoking. So far there is no scientific evidence to prove or disprove the relationship between cell-phone use and brain cancer. One reason may be that newer phones emit less potential cancer-causing radiation than older models. Some behaviors early in life (such as excessive sunbathing and smoking) can lead to skin cancer and lung cancer later on. (Reference 3)

- Reference 1: “About AIDS: Myths and Misconceptions.” About AIDS. Health Promotion Board, Singapore. <http://www.hpb.gov.sg/aids/page5.htm>
- Reference 2: “Misconceptions about Vaccine Safety,” Health Canada. <http://www.hc-sc.gc.ca/hl-vs/iyh-vsv/med/misconception-eng.php>
- Reference 3: “Top Five Cancer Misconceptions,” Time Magazine Online. <http://www.time.com/time/health/article/0,8599,1647368,00.html>

29.2 Lesson 21.1: Infectious Diseases

Key Concepts

Infectious diseases are caused by pathogens. A pathogen is a living thing or virus that causes disease. Pathogens are commonly called “germs.” They can travel from one person to another. This is why the diseases they cause are “catching.”

Lesson Objectives

- List common causes of infectious diseases.
- Explain how the virus known as HIV causes AIDS.
- State how infectious diseases can be prevented.

Check Your Understanding

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

- What is bacteria?
- What are the components of blood?

Teaching Strategies

Discussion

1. Ask students if they have ever been sick. Did they go to the doctor's office? What were they told? What causes those diseases? Did they hear the terms flu, virus, bacterial infection, antibiotic?
2. Discuss that some diseases come from bacteria, but not all. Remind students about the neurological disorders they studied in the last lesson.
3. Organisms that cause infectious diseases are called pathogens.
4. Discuss that there are four main groups of organisms that cause disease. Write these on the board: virus, bacteria, fungi, parasites (protists).
5. Explain that the human body provides many of the right conditions for the growth of these organisms.

Use Visuals: Figure 5

1. Have students look at the **Figure 5** in the lesson. Ask students to explain how they think a sneeze can spread a disease.



2. Ask students if they've been told many times to cover their mouths when they sneeze or cough. Do they understand why, especially when looking at the picture?
3. Ask how they think these organisms come in contact with the body. (Food, water, air, touch, sexual contact are all possible answers.)
4. Introduce the word vector.
5. A vector is an organism that carries pathogens from one person or animal to another. Most vectors are insects, such as ticks and mosquitoes. When an insect bites an infected person or animal, it picks up the pathogen. Then it transfers the pathogen to the next person or animal it bites.

6. Do they know any other vectors? (Ticks, mosquitoes, fleas, sand flies.)
7. Wrap up discussion and have students read the FlexBook lesson.
8. Read the FlexBook lesson section on how pathogens spread.
9. Explain to students that: This **Figure 5** shows that thousands of tiny droplets are released into the air when a person sneezes. Each droplet may carry thousands of pathogens. You can't normally see the droplets from a sneeze because they are so small. However, you can breathe them in, along with any pathogens they carry. This is how many diseases of the respiratory system are spread.
10. Look at **Figure 6** and tell students that some diseases are spread by insects. The type of mosquito shown here can spread West Nile virus. The virus doesn't make the mosquito sick. The mosquito just carries the virus from one person or animal to another.



Discussion: HIV/AIDS

1. Ask students if they know the difference between HIV/AIDS. Accept all answers.
2. Make sure students understand that HIV refers to the virus that infects one's immune system. The person infected with HIV may not actually develop the disease AIDS for many years, between one and ten years.
3. Students should understand that the AIDS virus was first named in 1982 and the human immunodeficiency virus was named in 1984.
4. There is no cure or vaccine yet available for HIV, so prevention is the only way to keep the epidemic at bay.
5. Have students brainstorm questions about HIV/AIDS they have; write these on the board. Have students write down five or so questions that are especially interesting or relevant to them.
6. Follow with the next set of activities, as they are relevant to your students.
7. The four brief lessons that follow are from <http://www.avert.org>

Four Activities on HIV and AIDS

Students should participate in each activity below. Be sure to explain to students the goal of each activity. The first activity is done with the whole class in a circle and the teacher can lead the activity. The second activity involves students completing a true false test individually. Then, the teacher should lead a discussion and students may check their own answers and correct their own misconceptions about HIV and AIDS. The third activity is a teacher-led lesson on prejudice. All instructions are on the site. The fourth activity is optional based on your students' ages and parents.

Activity 1: Three Statements about AIDS

- a. Online Lesson <http://www.avert.org/lesson1.htm>
- b. Goal is to help distinguish fact from fiction and deal with students' misconceptions about AIDS.
- c. Put chairs in a circle, have paper and pencils.

Activity 2: Transmission Runaround

- a. Online Lesson <http://www.avert.org/lesson2.htm>
- b. Goal is to understand the variety of transmission routes of HIV.
- c. Print off "True/False Question Sheet" available on the lesson page. You just need one copy for yourself.

Activity 3: Ten Differences

- a. Online Lesson <http://www.avert.org/lesson3.htm>
- b. Goal is to help students understand the effects of prejudice on other people's lives.
- c. Need a "Build a character questionnaire" for each group, available on the lesson page.

Activity 4: Focusing on Sex and HIV

- a. Online Lesson <http://www.avert.org/lesson4.htm>
- b. Two activities are included: Talking about sex and negotiating sex. The first is relevant for middle school, and may be a good lesson before sex education classes. Both are relevant for high school.

Differentiated Instruction

ELL

1. Make a KWL chart for students where K = Know, W = Want to Know, and L=Learned.
2. Students fill in the K and W columns before reading the FlexBook lesson.
3. When they complete each section of the lesson, they should write what they learned under L.

Enrichment

AVERT AIDS Challenge

1. Students play this challenge game to test their knowledge of HIV and AIDS. Turn down the sound if in one large classroom or have students use headphones.
2. AVERT AIDS CHALLENGE Online Game about HIV and AIDS <http://www.avert.org/game.htm>
3. Students who need extra challenges can play this game, though you may find it beneficial for all students. You can ask students to complete it at home.

Laboratory Activities: Tracing Epidemic Source

Track the Spread of Disease

1. Advance Preparations:
 - (a) Make an acid/base indicator by boiling red cabbage. (Red cabbage contains pigments call anthocyanins. The pigments give it the red/purplish color. Anthocyanins belong to group of chemical compounds called flavonoids.)
 - (b) Then make a basic solution by adding some baking soda (sodium bicarbonate) to water.
 - (c) Also have a control solution of (neutral) water - distilled water.
2. Procedure:
 - (a) Put out a set of paper cups filled half way with the control solution, the distilled water, except a few which filled with the basic baking soda solution. There should be no visible difference between the water and the basic solution.
 - (b) Give each student a cup of solution and ask them to walk around chatting with others. When they chat with someone, they then mix solutions. (Student A pours half his/her solution into Student B's and Student B pours half back to Student A.) Each student interacts with as many or as few other students as they wished.

- (c) Students then sit down and ask each to come up as you add the cabbage juice pH indicator to each mixed solution. If the solution is uninfected, it turns green; if it was infected it turns purple/red. (There may be some gasps when the liquid turns color.)
3. Sit down in class to discuss the activity.
4. Use a large sheet of butcher paper to chart who students shared fluids with. Ask them to try to remember the order in which they shared. As they remember correctly, the results can be traced, but the results are only as accurate as the memories. This is exactly how real epidemics are traced.
5. Repeat the activity. Using ideas generated from observations, charting, and discussions of the spread of disease activity, students may identify the presence of the disease source and trace the path of the infection in the real-world classroom.
6. The spread of disease activity is an anchoring experience for students to think about as they develop understanding of the underlying biology disease vectors.

Science Inquiry

Analyze Data, Develop a Research Plan

1. PBS Lesson New Perspectives on the West: Infectious Disease
 - (a) Objectives, Time, Materials, Background, Procedure, Assessment, and Resources are all included at this site.
 - (b) Data Collection Sheet http://www.pbs.org/weta/thewest/lesson_plans/Datacollections.pdf
 - (c) Infectious Disease Rubric http://www.pbs.org/weta/thewest/lesson_plans/Infectiousdiseaserubric.pdf
2. Students will learn about infectious disease, understand the effects of cholera, learn about cholera outbreaks in the 1800's, and learn about other infectious diseases
3. Infectious Diseases http://www.pbs.org/weta/thewest/lesson_plans/lesson09.htm
4. The suggested time frame for this activity is three class periods. Refer to the web site for additional information.

Reinforce and Review

Online Quiz

Pair with a Partner

1. Student pairs take online quizzes, take notes as they go through the quiz.

2. Correct the quiz, find out which ones they missed, look up the answers. Retake the quiz.
3. Quiz-Infectious Disease <http://www.funtrivia.com/trivia-quiz/SciTech/Infectious-Disease.html>
4. Infectious Disease Quiz from National Geographic <http://science.nationalgeographic.com/science/health-and-human-body/human-diseases/infectious-disease-quiz.html>

Online Quizzes: HIV/AIDS

Students share information and questions with partners as they go through the quizzes. (If you would prefer to have students take these quizzes in print form and turn in, print from the second url.)

1. HIV & AIDS quiz from AVERT: Students may pick levels: easy, medium, or hard. <http://www.avert.org/hiv-aids-quiz.php>

Printable: http://www.avert.org/media/pdf_quizzes/hiv_and_aids_quiz.pdf

2. HIV & AIDS Expert quiz from AVERT: Students may pick levels: easy, medium, or hard. <http://www.avert.org/aids-expert-quiz.php>

http://www.avert.org/media/pdf_quizzes/hiv_and_aids_expert_quiz.pdf

3. Women HIV & AIDS quiz from AVERT: Students may pick levels: easy, medium, or hard. <http://www.avert.org/womens-quiz.php>

http://www.avert.org/media/pdf_quizzes/women_hiv_and_aids_quiz.pdf

Review Questions and Answers

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Have students answer the Review Questions that are listed at the end of the lesson in their FlexBook.

Points to Consider

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Lesson Assessment

Provided to teachers upon request at teachers-requests@ck12.org.

Copy and distribute the lesson quiz. Provide class time for the students to complete this assessment.

Diseases and the Body's Defenses: Lesson 21.1 Quiz

Answer Key: Lesson 21.1 Quiz

Provided to teachers upon request at teachers-requests@ck12.org.

29.3 Lesson 21.2: Noninfectious Diseases

Key Concepts

Not all diseases spread from person to person. A disease that does not spread from person to person is called a noninfectious disease. Examples are cancer and diabetes. These diseases may or may not be caused by pathogens.

Lesson Objectives

- List causes of noninfectious diseases.
- Describe causes and treatments of cancer.
- Explain why diabetes occurs.
- Describe autoimmune diseases and allergies.

8State how noninfectious diseases can be prevented.

Check Your Understanding

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

- What is an infectious disease?
- Discuss the stages of the cell cycle.

Teaching Strategies

Discussion: Cancer

1. Ask students if they know people who have cancer. As students share, write on the board the kinds of cancer they mention. Students write notes.
2. Ask students to brainstorm questions about cancer, what they would like to know, and write the questions in their notebooks. Share the questions with the class, as some students may add questions from others to their list.
3. Some of the questions may include these, but make sure they are part of the questions to be answered:
 - (a) What does a cancer cell look like and how does it grow?
 - (b) Can cancer be prevented?
 - (c) Who is at risk for getting cancer?
 - (d) What are carcinogens? What kinds of cancers do they cause?
 - (e) Are some cancers more deadly?
 - (f) What age do you get cancer?
4. Ask students to recall the cheek cell investigation that they did earlier in their studies of life science. In the previous cheek cell investigation, students took cheek cell samples to observe what normal animal cells looked like.
 - (a) Show them some pictures, or have students again scrape the inside of their cheeks and look at the cheek cells under the microscope.
 - (b) Cheek cell photos:
 - i. Low Resolution http://botit.botany.wisc.edu/images/130/Plant_Cell/Animal_cells/cheek_cells.low.jpg
 - ii. High Resolution http://botit.botany.wisc.edu/images/130/symbiosis_images/mitochondria/Cheek_cells.php?highres=true
5. Ask students to read the section in the FlexBook on cancer, looking for answers to questions brought up in class.
6. Students share out answers and discuss.

Research: Cancer

1. Individual students or teams choose a question on cancer to research. They may choose different kinds of cancer. Keep a list of the student topics. Suggested questions can include:
 - (a) Is cancer genetic?
 - (b) Can I catch cancer?
 - (c) How does cancer grow?

- (d) Learn about breast cancer, prostate cancer, ovarian cancer, colon cancer, brain cancer, etc.
 - (e) What are cancer treatments?
 - (f) Why do some people have cancers removed, and others decide to only use chemotherapy or radiation treatments?
2. Students research and present short oral reports along with a visual, either a poster, a brochure, a webpage, or a video.

Cancer Websites that may be useful for students include: <http://www.bccancer.bc.ca/PPI/RecommendedLinks/reliablecancersites.htm> <http://www.cancer.gov/>

Discussion: Diabetes

1. Explain to students that we are going to talk about type 1 and type 2 diabetes. They should take notes and discuss differences.
2. In type 1 diabetes, the body does not produce insulin. Insulin is a hormone that converts sugar (glucose), starches, and other food into energy. People with type 1 need to check their insulin levels throughout the day, and manage their blood glucose levels.
3. Ask if anyone wishes to share if they have diabetes, or know of a family member and friend with type 1. What do they know about their daily life? Do they need to be constantly aware of their blood glucose level? Check it often?
4. Explain that type 2 diabetes is more common. In this type of diabetes, the body does not produce enough insulin or the body cells do not use the insulin.
5. Read the FlexBook section on type 1 and type 2 diabetes with the class.

Create Flowcharts: Allergies vs. Viruses

1. Students will learn how a virus and an allergen infect the body.
2. Students will create flowcharts.
3. Students will understand the differences in colds and allergies.
4. Lesson with objectives, materials, procedure, and discussion questions: <http://school.discoveryeducation.com/lessonplans/programs/allergiesviruses/>
5. Students need internet access. They will research various topics of an allergic reaction to pollen (more commonly known as hay fever) or a viral cold.
6. The video on Body Story: Fighting Disease is available here for a cost: <http://store.discoveryeducation.com/?di=40588027&ti=9000003&ps=767624>

Differentiated Instruction: Gallery Walk

ELL, SN

1. Student teams meet and discuss what they know about noninfectious diseases and the cause. They write their ideas and questions on one large sheet of paper. Each is color coded for that team.
2. Post all of the papers around the room.
3. Teams walk around the room to read and discuss posted questions and topics within infectious disease.
4. Each team answers the questions or writes comments about the topics. They use a different colored pen.
5. Follow the walk by a class discussion, reviewing questions and misunderstandings.
6. Ask groups to summarize what they know using their chart, comments, and class discussion.

Enrichment

1. Student teams choose a noninfectious disease to make an information poster about.
2. Students research the disease, find the names of agencies and support that help people with the disease, and learn about lifestyle changes that help either prevent or lessen the impact of their disease.
3. Students teams design a poster.
4. Display posters in class.

Science Inquiry

Analyze Data, Develop a Research Plan: Diabetes

1. Ask students what they know about diabetes and why they think it is a growing concern, especially in their age group. Discuss
2. Ask students to generate questions about diabetes and write their questions down. Have students meet in teams and generate more questions and ideas for projects about diabetes.
3. Student teams develop a research question based on their questions and ideas about diabetes.
4. Students work on projects, and present to class and other classes.
5. Some beginning information: What is Diabetes? What is Type 2 Diabetes.
 - (a) Download information:
 - (b) NDEP Fact Sheet http://ndep.nih.gov/media/YouthTips_LowerRisk_Eng_BW.pdf
 - (c) Tips for Teens: Lower Your Risk for Type 2 Diabetes View Online <http://ndep.nih.gov/teens/LowerYourRisk.aspx> Print color http://ndep.nih.gov/media/YouthTips_LowerRisk_Eng.pdf Print B&W http://ndep.nih.gov/media/YouthTips_LowerRisk_Eng_BW.pdf

- (d) Tips for Teens with Diabetes: What is Diabetes? View Online <http://ndep.nih.gov/teens/WhatIsDiabetes.aspx>

Reinforce and Review

Online Quiz

Pair with a Partner

1. Student pairs take quizzes online, discuss their answers, write down new vocabulary, research things they need to find out. Retake quizzes.
2. Cancer Quiz from Web MD <http://www.webmd.com/cancer/cancer-facts-quiz>
3. Basic Knowledge Cancer Quiz <http://cancer.about.com/library/quizzes/blbasiccancerquiz.htm>
4. The Diabetes Quiz <http://www.diabetes.co.il/>
5. Diabetes Quiz <http://www.iknowdiabetes.org/quiz.html>

Review Questions and Answers

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Have students answer the Review Questions that are listed at the end of the lesson in their FlexBook.

Points to Consider

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Lesson Assessment

Provided to teachers upon request at teachers-requests@ck12.org.

Copy and distribute the lesson quiz. Provide class time for the students to complete this assessment.

Diseases and the Body's Defenses: Lesson 21.2 Quiz

Answer Key: Lesson 21.2 Quiz

Provided to teachers upon request at teachers-requests@ck12.org.

29.4 Lesson 21.3: First Two Lines of Defense

Key Concepts

Your body's first line of defense is like a castle's moat and walls. It keeps most pathogens out of your body. The first line of defense includes different types of barriers. The second line of defense is inflammation, which increases blood flow and white blood cells to the damaged area.

Lesson Objectives

- Describe your body's first line of defense against pathogens.
- Explain how inflammation helps protect you from pathogens.

Check Your Understanding

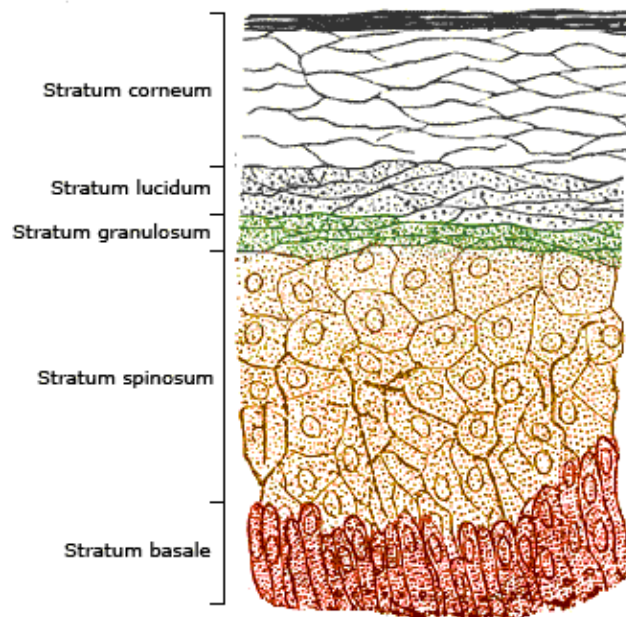
Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

- What are some of the functions of your skin?
- What is a pathogen? Give some examples.

Teaching Strategies

Use Visuals: Figure 1

1. Have student teams read through the section of the FlexBook lesson on the First Line of Defense.
2. Students should analyze **Figure 1**, the layers of skin and draw the diagram of the skin and mucous membranes.
3. Discuss the first lines of defense of the body's systems.



This drawing shows that the skin has many layers. The outer layer is so tough that it keeps out most pathogens.

Play a Game: Learn about Germs

1. Students play a game at the American Museum of Natural History web site. They play Infection Detection Protection. The game demonstrates that bacteria are everywhere, the ways infection can occur, and the body's responses, the first and second lines of defenses. <http://www.amnh.org/nationalcenter/infection/> (have students click on the "Infection!" link)
2. After the game, students go to the Kids Health website to learn about germs.
3. Student partners should read, discuss and take notes:
 - (a) Germs in English <http://kidshealth.org/kid/talk/qa/germs.html>
 - (b) Germs in Spanish http://kidshealth.org/kid/en_espanol/preguntas/germs_esp.html
4. Class discussion on germs, including first and second line of defense.

Differentiated Instruction: Gallery Walk

ELL

1. Divide the class into group and have the groups walk around the room to read and discuss posted questions or topics. All of the questions and topics are on a large sheet

- of paper.
2. Each group, using a different color pen, should answer the questions or write comments about the topics. Students may read and respond to answers and comments written by other groups.
 3. Bring the class together again. Each group should present their questions, along with the written responses they got from other groups.
 4. You should review and reinforce concepts as well as review misunderstandings during this discussion.

Enrichment: Personal Health Journal

1. Ask students to keep a personal health journal.
2. First, they should generate ideas about what optimal health behaviors would include. (These may include eating a well-balanced, healthy diet, getting enough exercise daily, getting enough sleep every night, brushing teeth every day, bathing or showering regularly, keeping their rooms clean, not smoking, avoiding drugs and alcohol, checking to be sure they are up on all vaccinations recommended to prevent disease.)
3. After they agree on what to include, then they write that list in their journal and write down their habits for one week.
4. Students should write a reflection that they will turn in, answering: do you think your habits are healthy? What could you change now? What could you change in the future?
5. NOTE: Students should learn about health in order to enhance their own physical, emotional, mental, and social health. Learning about health may help improve health by teaching prevention and basic health knowledge, as well as helping individuals reconsider lifestyle decisions. Students with an understanding of health basics may be better able to deal with stress, anxiety or emotional disturbance, as well as resulting physical effects of these conditions.

Laboratory Activities

Helpful Bacteria Lab

1. Explain to students that the human body is full of helpful bacteria. Often, we think of getting sick when we think of these organisms. However, without certain bacteria, life on earth would be different, and more difficult.
2. Explain that bacteria are in our food. Humans use bacteria to make fuel, food, and many of our medicines. We use bacteria in milk to make cheese, sour cream, and yogurt. Methane gas is produced by bacteria.
3. Some bacteria decompose. Without decomposers, dead animal and plant materials would build up all over the world.

4. Our digestive track is full of bacteria. These help us digest our food and they may prevent harmful bacteria from growing in our bodies.
5. Let's cultivate the bacteria used to produce yogurt.
6. Cultivation of Bacteria from Commercial Yogurt <http://www.umsl.edu/~microbes/pdf/cultivatingyogurt.pdf>
7. The lab write up includes objective, safety, materials, and procedure. Materials include an MRS agar plate, an inoculating loop, a Bunsen burner, magnifying glass, and Drierite (indicating Drierite).
8. This lab is done one day, followed by a wait of 2-3 days with a second lab day. There is an optional third day of staining the colonies in the lab included. Additional materials are required for that procedure.

Science Inquiry

Ask a Question

1. Ask students to go through the questions they've listed in their notebooks and find the one that most interests them on the immune system.
2. Students go to the ThinkQuest Library, The Immune System. They read general information about immune response, read about the humoral system and the cell-mediated system, immunity as an adaptation, as well as learning about clonal selection.
3. Students take notes and write out their questions and vocabulary. (Needs a Java capable browser.)
 - (a) Overcome infection
 - (b) Read background and instructions, then Launch.
 - (c) <http://library.thinkquest.org/C004367/ia3.shtml>
 - (d) Students work on defeating the infection with different levels of antibodies in the system.
 - (e) When finished, students jot notes about what they learned with the simulator in their notebooks.
 - (f) Now, students should reflect on their questions. Has it been answered?
 - (g) Do they need to go back and formulate an answer, or do further research?
 - (h) If further research is needed, students continue on the project.

Reinforce and Review

Online Quiz

Pair with a Partner

1. Pair students to work on online quizzes.

2. Immune system Quiz <http://biology.about.com/library/quiz/blimmunesysquiz.htm>
3. Cells Alive Immune system Quiz <http://www.cellsalive.com/quiz3.htm>

Review Questions and Answers

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Have students answer the Review Questions that are listed at the end of the lesson in their FlexBook.

Points to Consider

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Lesson Assessment

Provided to teachers upon request at teachers-requests@ck12.org.

Copy and distribute the lesson quiz. Provide class time for the students to complete this assessment.

Diseases and the Body's Defenses: Lesson 21.3 Quiz

Answer Key: Lesson 21.3 Quiz

Provided to teachers upon request at teachers-requests@ck12.org.

29.5 Lesson 21.4: Immune System Defenses

Key Concepts

If pathogens manage to get through the body's first two lines of defense, a third line of defense takes over. This third line of defense involves the immune system. It is called an immune response. The immune system has a special response for each type of pathogen.

Lesson Objectives

- Describe the immune system.
- Explain how lymphocytes respond to pathogens.
- Define immunity and vaccination.

Check Your Understanding

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

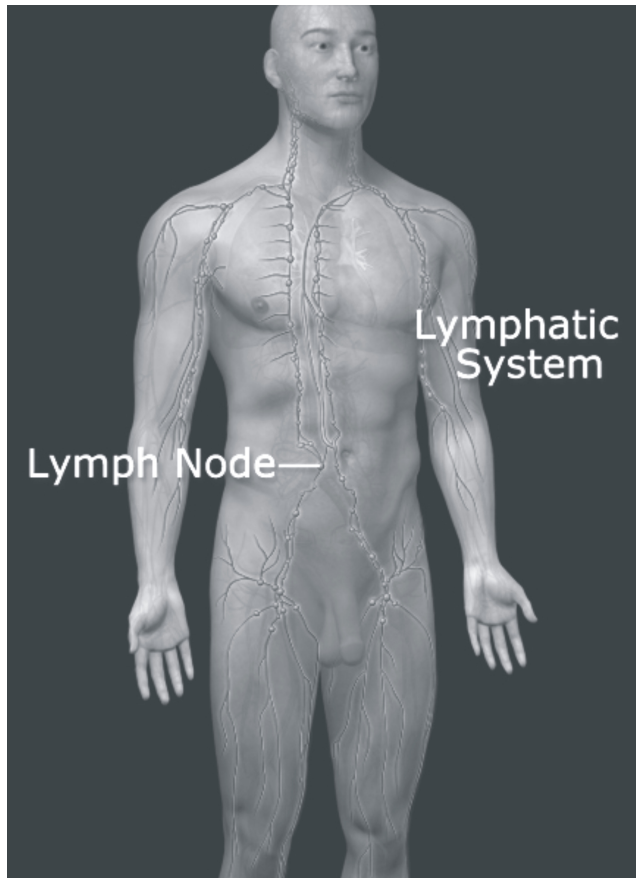
- What are the first two lines of defense?

- Give examples of pathogens.

Teaching Strategies

Use Visuals: Figure 2

1. Students should understand that the immune system and the lymphatic system are one in the same. This is considered the third line of defense for the body. Explain to students that a lymphocyte is a type of white blood cell in the vertebrate immune system. We have briefly discussed these as part of the last FlexBook lesson.
2. Students should understand that the three major types of lymphocytes are T cells, B cells and natural killer cells.
3. Lymph Organs: Refer students to the FlexBook lesson, **Figure 2**, Organs of the Immune System. Go over the organs of the lymph system.
4. Refer students to **Figure 2**. Look at the diagrams, the description, and the names of the organs. Discuss the red bone marrow, the thymus gland, the spleen, and the tonsils.
5. Student pairs read the section of the FlexBook on Lymphocytes so that they understand the function of each major type. They should draw in their notebooks.



Use Visuals, View an Animation

1. Show students the overview of the immune system to review general ideas.
 - (a) Immune System Overview (antigen, cellular immunity, cytokine, humoral immunity) http://www.learner.org/courses/biology/archive/animations/hires/a_hiv1_h.html
2. Ask students what is a lymphocyte (from the above activity), and review with students the three major types.
3. Go to Cells Alive and read together the page on How Lymphocytes Produce Antibodies.
 - (a) Cells Alive Lymphocytes <http://www.cellsalive.com/antibody.htm>
4. Students should analyze the electron micrograph of a human macrophage.
5. Students should view the animation and note the Antigen Processing, the helper T cell stimulating the B cell, and the Antibody Production. Students draw each in notebooks.
6. Enrichment Students may benefit from the following exercise: Review the keywords at the bottom of the page (antigen presenting cell, dendritic cell, macrophage, Helper T

lymphocyte, B lymphocyte, plasma cell, complement, major histocompatibility complex) Students should write the key words and definitions in their notebooks.

Online Video: The First and Second Line of Defense

1. The video explains about macrophages, B cells, T cells, and killer T cells with music and sci-fi attack sequences.
2. <http://www.youtube.com/watch?v=bm4YS293qh4>
3. Discuss the responses seen in the video with the class.

Online Video: The Immune Response

1. Students view the How Stuff Works video on Immune response from ADAM that explains the first and second lines of defense of the body.
2. <http://health.howstuffworks.com/adam-200095.htm>
3. The video explains about macrophages, B cells, T cells, and killer T cells.

Read about the Immune System

1. Student partners should read, discuss and take notes:
2. Immune System
 - (a) KidsHealth Immune System in English http://kidshealth.org/teen/your_body/body_basics/immune.html?tracking=T_RelatedArticle Kids Health Immune System in Spanish http://kidshealth.org/teen/en_espanol/cuerpo/immune_esp.html
3. Class discussion on the immune system.

Discussion

1. Ask students what they know about vaccination. Are they vaccinated? Do they know what vaccinations they've had and why? Do they know if they are up to date on all of the recommended vaccinations for their age group and or gender?
2. Explain to students that vaccination is the administration of antigenic material (the vaccine) to produce immunity to a disease.
3. There are four kinds of vaccinations: an inactivated vaccine that has virus particles that are killed before injection, live virus particles with low virulence, virus like particle vaccines that have viral proteins from the proteins of the virus, and a subunit vaccine that has an antigen without introducing viral particles.
4. Show students the CDC website for Vaccines and Immunizations.

- (a) Persons Aged 7-18 years B&W http://www.cdc.gov/vaccines/recs/schedules/downloads/child/2009/09_7-18yrs_schedule_bw.pdf
 - (b) Persons Aged 7-18 years color http://www.cdc.gov/vaccines/recs/schedules/downloads/child/2009/09_7-18yrs_schedule_pr.pdf
 - (c) Persons Aged 7-18 years Spanish http://www.cdc.gov/vaccines/recs/schedules/downloads/child/2009/09_7-18yrs_schedule_sp.pdf
 - (d) Make a copy for each student from the links above, B&W, color, and or Spanish.
5. Go to the CDC page Vaccines and Preventable Diseases. Discuss the idea that all of these diseases are preventable with vaccinations; however, they spread in populations that are not vaccinated.
- (a) Vaccine preventable diseases <http://www.cdc.gov/vaccines/vpd-vac/default.htm>
6. Students should take home the page on vaccines and check with their parents and their medical records to see whether their vaccinations are up to date. Families should discuss.

Online Museum Exhibit

Whatever Happened to Polio?

1. Explain to students that before AIDS, polio was the dreaded epidemic around the world. In 1955 Jonas Salk developed a vaccine.
2. Student pairs go to the American History Museum site, Whatever Happened to Polio? <http://americanhistory.si.edu/polio/>
3. First, they should briefly review the timeline, figuring out periods of their grandparents and parents youths.
4. Next, they should visit the history of vaccines to find out more about the concept of vaccination, and smallpox.
5. This website has much more to offer. It is optional to have your students further investigate this wonderful resource on polio.

Online Animation

1. Student pairs should view the Life Cycle of the Poliovirus Animation at the American History Museum <http://americanhistory.si.edu/polio/activities/index.htm>
2. They should discuss similarities and differences in transmission of other diseases that they have studied.
3. Write reflections in notebooks.

Differentiated Instruction: Gallery Walk

ELL

1. Divide the class into group and have the groups walk around the room to read and discuss posted questions or topics. All of the questions and topics are on a large sheet of paper.
2. Each group, using a different color pen, should answer the questions or write comments about the topics. Students may read and respond to answers and comments written by other groups.
3. Bring the class together again. Each group should present their questions, along with the written responses they got from other groups.
4. You should review and reinforce concepts as well as review misunderstandings during this discussion.

Enrichment: Find Out More

1. Students investigate the immune systems and the arms race in nature.
2. Go to Immunity and the Arms Race and read about our adaptation, immunity.
3. <http://library.thinkquest.org/C004367/be8.shtml>
4. Continue learning about antibiotics. Remind students about the antibiotic resistance activity done earlier. Then read and ask questions: <http://library.thinkquest.org/C004367/be8a.shtml>
5. Go to the Viruses and Antibodies simulation again:
6. <http://library.thinkquest.org/C004367/ia3.shtml>
7. Students should reflect on their learning about antibiotics, antibodies, and viruses. Students should present what they have learned to the class in either a poster, oral presentation, or skit.

Laboratory Activities

HHMI Virtual Immunology Lab

Students should use this laboratory for both lessons on the First and Second Line of Defense of the Immune System.

1. HHMI Virtual Immunology Lab (Shockwave required) <http://www.hhmi.org/biointeractive/vlabs/immunology/>
2. Go over the directions on the first page with students.
3. Pairs go through the lab as the manager of a clinical laboratory. They must test different vials for specific disease. There are directions on what to do, beginning with

centrifuging whole blood samples. They should always click on the why to understand the reason for each step.

4. At the end of the lab, students should write reflections on what it is like to work in a virtual lab. Did they like the work? Why or why not? What did they learn?

Science Inquiry

Analyze Data, Develop a Research Plan

1. Explain to students that when the immune system is healthy the white blood cells can tell the difference between it's own cells and pathogens entering the system. The body only attacks the outside cells. In some diseases, the immune system goes awry and begins to attack the body's own cells. These are called autoimmune diseases.
2. Ask students to investigate autoimmune diseases.
3. Then, choose one most relevant to out more about.
4. Look at what populations are affected, are there environmental factors, age factors, and what is the latest research on that particular disease.
5. Report to the class.

Reinforce and Review

Activity Type: Online Quiz

Pair with a Partner

1. Pair students to work on online quizzes.
2. Immune system Quiz http://www.softschools.com/quizzes/biology/immune_system/quiz890.html
3. Biology4Kids Quiz: Immune System http://www.biology4kids.com/extras/quiz_systemimmune/index.html

Review Questions and Answers

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Have students answer the Review Questions that are listed at the end of the lesson in their FlexBook.

Points to Consider

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Lesson Assessment

Provided to teachers upon request at teachers-requests@ck12.org.

Copy and distribute the lesson quiz. Provide class time for the students to complete this assessment.

Diseases and the Body's Defenses: Lesson 21.4 Quiz

Answer Key: Lesson 21.4 Quiz

Provided to teachers upon request at teachers-requests@ck12.org.

Chapter 30

TE Reproductive Systems and Life Stages

30.1 Chapter 22: Reproductive Systems and Life Stages

Outline

The chapter *Reproductive Systems and Life Stages* consists of four lessons that introduce students to

- Lesson 22.1: Male Reproductive System
- Lesson 22.2: Female Reproductive System
- Lesson 22.3: Reproduction and Life Stages
- Lesson 22.4: Reproductive System Health

Overview

Teaching Strategies

Pacing the Lessons

Use the **Class Periods per Lesson** table below as a guide for the time required to teach the lessons of this chapter.

Table 30.1:

Lesson	Number of Class Periods*
Lesson 22.1: Male Reproductive System	1.0

Table 30.1: (continued)

Lesson	Number of Class Periods*
Lesson 22.2: Female Reproductive System	2.0
Lesson 22.3: Reproduction and Life Stages	1.0
Lesson 22.4: Reproductive System Health	1.0

- Class periods are assumed to be 60 minutes long.

Lab Links

Managing Materials

The materials listed in the **Materials List** table below are needed to teach the strategies and activities described in the Teachers Edition of the FlexBook for this chapter.

Table 30.2:

Lesson	Strategy or Activity	Materials Needed
22.1	1) 2)	1) 2)
22.2	1)	1)
22.3	1)	1)
22.4	1)	1)

Additional Web-Based Resources

Making the FlexBook Flexible

An important advantage of the FlexBook is the ability it gives you, the teacher, to choose the chapters and lessons that you think are most important for your own classes. The following information is provided to help you decide whether to include this chapter or certain lessons in this chapter in your students' FlexBook. You should also consult the standards correlation table that follows when selecting chapters and lessons to include in the FlexBook.

- To understand the content of this chapter, students should have read the _____ chapter.

- Students should read this entire chapter before reading the remaining chapters of the FlexBook.
- It is recommended that you include all the lessons of this chapter in the FlexBook.

Common Misconceptions

Here are some common student misconceptions, related to this chapter:

- Prostrate cancer is rare in men. There is no way to test for it. Radiation therapy is harmful for the men with prostate cancer.
- A woman will get breast cancer only if she has a family history of it. Breast cancer is always fatal. Only women over 50 years old get breast cancer. There is no good way to test for it. Men never get breast cancer.
- Most normal people don't have to go through an identity crisis. In fact, you have to go through any crisis in life, if you're normal.
- Sexually-transmitted diseases (STDs) can be prevented by birth control pills. Condoms prevent STDs 100%. Douching and/or taking over-the-counter yeast infection medications can cure STDs.
- HIV is the same as AIDS. You can get AIDS through casual contact with someone who has the disease. AIDS is transmitted through mosquitoes. Only homosexual men and drug users get AIDS.

Regarding Prostate Cancer

Prostrate cancer is not rare: the lifetime risk for men is 1 in 6 (in comparison, the lifetime risk for women for breast cancer is 1 in 8). The PSA (Prostate Specific Antigen) test can detect prostate cancer. Research evidence is strong that radiation therapy for prostate cancer is completely safe for men. Since the treatment is non-invasive, it helps men preserve their urinary as well as sexual function. (Reference 1)

Regarding Breast Cancer

About 80% to 85% of women with breast cancer have no family history of the disease. Breast cancer is not a death warrant: currently the 10-year survival rates are from 85 percent to 90 percent. When caught early, up to 98 percent of women survive at least five years. Breast cancer can affect women at any age. The best way to check for breast cancer is for young women to have annual doctor's exams and for women over 40 years old to have annual mammography exams. Men account for about 1% of all breast cancers. (Reference 2)

Regarding Life-cycle Issues

Psychologists agree that normal human development is accompanied by regular and predictable challenges. Erik Erikson (who is this?) spoke of “the identity crisis” as a “normative crisis” for adolescents. In fact, Erikson identified 8 psycho-social life cycle stages; each stage has its own age-related conflict or “normative crisis,” which must be resolved by the individual. So it is quite normal for people to struggle with an identity crisis (and other normal conflicts), during the life cycle. (Reference 3)

Regarding STDs

Birth control pills do not prevent the spread of STDs; they only prevent pregnancy (about 97% of the time), if taken precisely as prescribed. Condoms do not always prevent STDs, since they protect only the area covered; skin-to-skin contact can also transmit STDs. Douching and/or taking over-the-counter yeast infection medications do not cure STDs. Students often do not have adequate access to reliable information about these diseases. Study of this chapter can give them the opportunity to ask questions and gain such information. (Reference 4)

Regarding AIDS

HIV (Human Immunodeficiency Virus) and AIDS (Acquired Immune Deficiency Syndrome) are not the same. HIV is the underlying cause of the disease, while AIDS is the disease itself. Also, not all HIV-positive individuals have AIDS, since the HIV virus can remain in a latent state for many years. Regarding the process of infection, a person cannot become infected with HIV through casual contact with someone with the disease; the virus is not transmitted through shaking hands, hugging, kissing or even being exposed to coughing or sneezing by someone infected by the HIV virus. This virus is transmitted via sexual contact and/or through contact with the blood of someone with AIDS. Mosquitoes do not transmit AIDS; since they do not inject the blood of a previous victim into the person they bite next (Mosquitoes inject their saliva into their victims, which may carry other diseases such as malaria or West Nile virus, so they can infect a bitten person with these diseases.) Finally, the HIV virus can infect anyone, regardless of sex, ethnicity or sexual orientation. (Reference 5)

- Reference 1: Bowman, L. (2006), “Misconceptions about Prostate Cancer Persist,” Scripps Howard News Service. http://docs.google.com/gview?a=v&q=cache:_a8tE24_9YYJ:www.prostatecancerfoundation.org/atf/cf/%257B705B3273-F2EF-4EF6-A653-E257D/scripps061606.pdf+Misconceptions+about+prostate+cancer&hl=en&gl=il

- Reference 2: Fawcett, N., “16 Common Myths about Breast Cancer. University of Michigan Comprehensive Cancer Center. http://www.cancer.med.umich.edu/news/brcancer_myths06.shtml
- Reference 3: Harder, A. (2002). “The Developmental Stages of Erik Erikson,” <http://www.learningplaceonline.com/stages/organize/Erikson.htm>
- Reference 4: Mac Kay, G., “Myths and Misconceptions about STDs.” <http://www.helium.com/items/313409-myths-and-misconceptions-about-stds>
- Reference 5: “About AIDS: Myths and Misconceptions.” Health Promotion Board, Singapore. <http://www.hpb.gov.sg/aids/page5.htm>

30.2 Review Answers Repository

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Have students answer the Review Questions that are listed at the end of the lesson in their FlexBook.

Chapter 31

Introduction to Life Science (TE)

31.1 Unit 7: Ecology

Outline

This unit, *Ecology*, includes three chapters that ...

Chapter 23: From Populations to the Biosphere

Lesson 1: Introduction to Ecology

Lesson 2: Populations

Lesson 3: Communities

Lesson 4: Ecosystems

Lesson 5: Biomes and the Biosphere

Chapter 24: Ecosystem Dynamics

Lesson 1: Flow of Energy

Lesson 2: Cycles of Matter

Lesson 3: Ecosystem Change

Chapter 25: Environmental Problems

Lesson 1: Air Pollution

Lesson 2: Water Pollution and Waste

Lesson 3: Natural Resources

Lesson 4: Habitat Destruction and Extinction

Overview

Chapter 32

TE From Populations to the Biosphere

32.1 Chapter 23: From Populations to the Biosphere

Outline

The chapter *From Populations to the Biosphere* consists of five lessons that introduce students to ecology:

- Lesson 23.1: Introduction to Ecology
- Lesson 23.2: Populations
- Lesson 23.3: Communities
- Lesson 23.4: Ecosystems
- Lesson 23.5: Biomes and the Biosphere

Overview

Teaching Strategies

Pacing the Lessons

Use the **Class Periods per Lesson** table below as a guide for the time required to teach the lessons of this chapter.

Table 32.1:

Lesson	Number of Class Periods*
Lesson 23.1: Introduction to Ecology	1.0

Table 32.1: (continued)

Lesson	Number of Class Periods*
Lesson 23.2: Populations	2.0
Lesson 23.3: Communities	1.0
Lesson 23.4: Ecosystems	1.0
Lesson 23.5: Biomes and the Biosphere	1.0

- Class periods are assumed to be 60 minutes long.

Lab Links

Managing Materials

The materials listed in the **Materials List** table below are needed to teach the strategies and activities described in the Teachers Edition of the FlexBook for this chapter.

Table 32.2:

Lesson	Strategy or Activity	Materials Needed
23.1	1) 2)	1) 2)
23.2	1)	1)
23.3	1)	1)
23.4	1)	1)
23.5	1)	1)

Additional Web-Based Resources

Making the FlexBook Flexible

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- To understand the content of this chapter, students should have read the _____ chapter.

- Students should read this entire chapter before reading the remaining chapters of the FlexBook.
- It is recommended that you include all the lessons of this chapter in the FlexBook.

Common Misconceptions

Here are some common student misconceptions, related to this chapter:

- A new species arises because it has created new adaptations to survive in a given environment. These adaptations are developed by individuals in response to the needs of the individual. Traits are passed on by the bigger, stronger organisms that replace the smaller, weaker ones.
- Our knowledge about ecology is based on common-sense principles.
- When a population's growth rate "levels off," this means that no new individuals are being born or dying.
- From a population growth point of view, it's better for a species to produce lots of offspring than investing its energy into only a few offspring.
- Because predators eat their prey, they have a negative effect on the populations they prey upon.
- Scientists today are able to create a self-contained working copy of our biosphere. So if things get "really bad" on Earth, people will be able to live in this type of artificial biosphere in space. This is good news, because people are going to ruin the Earth.

Understanding species and their adaptations

Many students have naïve conceptions about how species and adaptations arise. A species can be understood as "a taxonomic division that generally refers to a group of animals which are similar in structure and descent and are able to breed among themselves" (Reference 2). Different species can arise when different segments of a parent population are separated over time and/or geographical location. This process of "speciation" involves the evolution of different adaptations that lead to different species that are not able to breed among themselves. However, these adaptations do not arise because individuals "want" to do so, nor as a response of individuals to different needs, as many students believe. Rather, random mutations can give rise to different adaptations, which may or may not contribute to the overall reproductive fitness of a given population; for this reason, physical strength is not necessarily a criteria for the survival of a given species. While the students may have been exposed to the concepts of "speciation" and "adaptation" earlier – as discussed earlier in the *Evolution* chapter – it is important to review them as the basis for developing a good understanding of basic ecological principles.

The origin of ecological knowledge

Students believe that ecology is closer to literature than science (i.e., there are “moral” principles behind this body of knowledge that are not based on empirical evidence). This misconception may be due to the fact that ecological principles are abstract and because the scientific evidence supporting these principles is rarely presented in the popular press and media. Discuss with your students the methodology that scientists use to generate valid and reliable data that give rise to and support these ecological principles. Ecological methodology includes field studies, laboratory work (experimentation), computer modeling and statistical analysis. Present students with specific ecological studies and their respective data which support basic ecological principles.

Population growth graphs

Students often have difficulty understanding population growth graphs, in particular, the phenomenon of “population equilibrium,” in which the growth rate “flattens out” and appears as a horizontal line on the graph. Some students will naively believe that this pattern suggests that, during this time, no individuals are being born or dying. Point out to your students that “growth rate” is a dynamic concept, i.e., it relates to the relationship between population increase (birth rate and immigration) and population decrease (death rate and emigration); if population increase is identical to population decrease, the growth rate becomes zero and “flattens out” on the graph. Use specific examples to emphasize this point.

Different population strategies

While it may “make sense” for a species to increase its chance of survival by creating a large number of offspring, this strategy usually occurs in unstable environments. Another strategy, which occurs in more stable environments, involves producing a relatively small number of offspring while investing resources to increase the fitness of these few individuals. In fact, this latter strategy has been adopted by many mammals, including humans. These two types of population strategies – called r-selection for the former and K-selection for the latter – were first proposed by the ecologist Eric Pianka. Review these two types of population strategies with your students.

Predator-prey relations

Many students hold a “common-sense” view of predators which presents them as “bad,” since they kill other animals. However, from an ecological perspective, predators are essential in order to curb the excessive population growth of prey populations; to emphasize this point, discuss the example of the Kaibab deer population, as presented in the chapter.

The Earth’s biosphere and sustainability

Biology textbooks can give the mistaken impression that scientists can replicate the Earth’s biosphere without difficulty. However, based on our current understanding of ecology, creating such a replication is pure science fiction. As an example, the chapter makes mention of Biosphere 2 in Arizona. What the chapter does not mention is that in a heavily-publicized experiment, scientists failed to create a long-term self-sustaining biosphere in this facility. However, while we can send people into space for extended periods of time, so far we do not have enough knowledge to create large-scale replicas of the Earth’s biosphere. On the other hand, this does not mean that the Earth is doomed to be ruined by humankind. Scientists have been much more successful at researching the conditions necessary for “sustainability,” i.e., the condition in which the ecological needs of people as well as the ecological needs of the Earth are both taken into account. Discuss with your students both the Biosphere 2 experiment as well as current research work dealing with sustainable living on Earth. How might this work influence their own day-to-day behavior?

- Reference 1: “Overcoming Ecology Misconceptions: Using the Power of the Story” Center for Learning and Teaching, Binghamton University <http://ecomisconceptions.binghamton.edu/intro.htm>
- Reference 2: “Animal Diversity Web” Glossary University of Michigan Museum of Zoology <http://animaldiversity.ummz.umich.edu/site/glossary/page/s.html>

32.2 Review Answers Repository

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Chapter 33

TE Ecosystem Dynamics

33.1 Chapter 24: Ecosystem Dynamics

Outline

The chapter *Ecosystem Dynamics* consists of three lessons that introduce students to

- Lesson 24.1: Flow of Energy
- Lesson 24.2: Cycles of Matter
- Lesson 24.3: Ecosystem Change

Overview

Teaching Strategies

Pacing the Lessons

Use the **Class Periods per Lesson** table below as a guide for the time required to teach the lessons of this chapter.

Table 33.1:

Lesson	Number of Class Periods*
Lesson 24.1: Flow of Energy	1.5
Lesson 24.2: Cycles of Matter	1.0
Lesson 24.3: Ecosystem Change	1.0

- Class periods are assumed to be 60 minutes long.

Lab Links

Managing Materials

The materials listed in the **Materials List** table below are needed to teach the strategies and activities described in the Teachers Edition of the FlexBook for this chapter.

Table 33.2:

Lesson	Strategy or Activity	Materials Needed
24.1	1) 2)	1) 2)
24.2	1)	1)
24.3	1)	1)

Additional Web-Based Resources

Making the FlexBook Flexible

An important advantage of the FlexBook is the ability it gives you, the teacher, to choose the chapters and lessons that you think are most important for your own classes. The following information is provided to help you decide whether to include this chapter or certain lessons in this chapter in your students' FlexBook. You should also consult the standards correlation table that follows when selecting chapters and lessons to include in the FlexBook.

- To understand the content of this chapter, students should have read the _____ chapter.
- Students should read this entire chapter before reading the remaining chapters of the FlexBook.
- It is recommended that you include all the lessons of this chapter in the FlexBook.

Common Misconceptions

Here are some common student misconceptions, related to this chapter:

- It is important to recycle energy. All of the energy from the Sun is used by green plants, which use the energy to produce food. When animals eat green plants, they use all of the energy in those plants.

- The term “balance of nature” refers to having equal number predator and prey animals in an ecosystem. The top of the food chain has the most energy because it accumulates up the food chain. Food chains involve predator and prey, but not producers.
- The water cycle can be summarized as the evaporation of water into the atmospheric and its precipitation back to earth. Underground water is not a significant part of this cycle.
- Humans are adding carbon dioxide into the environment, which may throw off the balance of nature. The carbon cycle and the water cycle are linked; water carries carbon around the cycle.
- The nitrogen cycle is used to provide energy for the carbon cycle. Since nitrogen constitutes a large part of the atmosphere (about 78%), it is easily assimilated into plants from the air. This is similar to the way that carbon dioxide is assimilated into plants.
- Global warming is caused by the ozone hole because the hole lets in more radiation. Carbon dioxide makes up such a small percentage of the atmosphere that what the carbon dioxide we add doesn't make a difference.

Energy Flow in Ecosystems

Students often fail to understand that energy cannot be recycled. It moves from the Sun and through ecosystems. First, the solar energy is captured by green plants in the process of photosynthesis. Next, when consumers eat the plants, the chemical energy (food) is transferred to the consumers. The process continues down each food chain. But in each of these “transformations,” energy is dissipated and lost. For this reason, only a fraction of the solar energy that reaches a plant is converted into chemical energy in the resulting sugars (about 1%). Likewise, when herbivores eat green plants, only a fraction of the energy in the sugars (about 10%) is transformed into chemical energy in the herbivores. The same process occurs at successive links, up the food chain (e.g., when primary carnivores eat herbivores or when secondary carnivores eat primary carnivores).

Food Chains

As noted above (see “Energy Flow in Ecosystems”), students often fail to appreciate that there is a loss of total energy in each successive transformation down each food chain. For this reason, there are fewer predator animals than prey animals, in each progressive link in the food chain. Also for this reason, most of the energy in an ecosystem is actually located at the bottom of the food chain, not at the top. Students also fail to take into account that food chains involve more than predators and prey; they actually start with the producers, which start each food chain by capturing solar energy and converting it into chemical energy.

The Water Cycle

Most students have an incomplete and fragmented perception of the water cycle. While they are aware of the atmospheric component of the water cycle (i.e. evaporation, condensation, and rainfall) they are usually unaware of the groundwater component. When they consider this factor, they have a static perception of the underground water and they make no connection between the underground and upper ground subsystems of the water cycle. Very few students include aspects of the biosphere such as humans, animals, and plants. Few students include aspects of human consumption, i.e. water consumption, housing, wells, sewage, and water pollution. Discuss the water cycle as a dynamic, cyclic system, which includes underground water and aspects of the biosphere. (Reference 1)

The Carbon Cycle

The carbon cycle follows the law of the conservation of matter. In other words, no extra carbon is added into the environment. Human activities have the effect of transferring carbon from plants and fossil fuels to the atmosphere; nonetheless, the amount of carbon on the Earth is staying the same. The cycling of each element (carbon, water) functions independently from the other; the former is driven by such factors as photosynthesis and respiration while the latter is driven by the Sun.

The Nitrogen Cycle

The nitrogen cycle is not used to provide energy for the carbon cycle; as mentioned above (“The Carbon Cycle”) the cycling of each element (in this case, nitrogen) functions independently from the other. Unlike carbon dioxide, which is easily taken into plants from the air during photosynthesis and then released during respiration, the nitrogen cycle is more complicated and involves several different types of bacteria: nitrogen-fixing bacteria (which convert atmospheric nitrogen gas into water-soluble forms of nitrogen, which can be used by plants), nitrifying bacteria (which convert ammonium into nitrites and nitrates) and denitrifying bacteria (which convert nitrates back into nitrogen gas). One strategy to help students “make sense” of ecosystem dynamics – the energy flow and 3 “biogeochemical cycles” (water, carbon and nitrogen) – is to have them represent these dynamics graphically. Have students use arrows to represent energy flow goes through a given ecosystem, dissipating (with the arrows becoming narrower) with each successive link in a food chain. Each of the three cycles can be represented by arrows, cycling from the biosphere (animals) and geosphere (earth and rocks) into the atmosphere and back again. (Have them refer to Figures 1, 2 and 4 in the Chapter for useful guidelines.) Make sure that students contrast the differences between these three cycles of matter, especially regarding the processes which accompany them (e.g., temperature-driven evaporation and condensation for the water cycle, photosynthesis and respiration for the carbon cycle, and bacteria-related processes for the nitrogen cycle).

Global Warming

Global warming is caused by increased amounts of greenhouse gases in the atmosphere. Ozone is not a greenhouse gas and the depletion of ozone does not affect the Earth's temperature. Most gases in the atmosphere do not trap heat. But greenhouse gases – including carbon dioxide – do trap heat. Even though carbon dioxide makes up a relatively small percentage of the atmosphere (about 0.03%), the way it traps heat adds up to having a relatively large effect on the Earth's temperature. A powerful film which describes the effects of global warming is Al Gore's prize-winning documentary film, "An Inconvenient Truth." (Reference 2)

- Reference 1: Ben-Zvi-Assarf, O. and Orion, N. (2005). A Study of Junior High Students' Perceptions of the Water Cycle. The Journal of Geoscience Education. http://findarticles.com/p/articles/mi_qa4089/is_200509/ai_n15668035/?tag=content;col1
- Reference 2: "Common Misconceptions about Climate Change." CIRES Education and Outreach http://docs.google.com/gview?a=v&q=cache:e79Ujq0H_50J:cires.colorado.edu/education/k12/makingclimatehot/CC%2520Misconceptions%2520Handout.pdf+Common+misconceptions+about+climate+change&hl=iw

33.2 Review Answer

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

Chapter 34

TE Environmental Problems

34.1 Chapter 25: Environmental Problems

Outline

The chapter *Environmental Problems* consists of xxxxx lessons that introduce students to living organisms:

- Lesson 25.1: Air Pollution
- Lesson 25.2: Water Pollution and Waste
- Lesson 25.3: Natural Resources
- Lesson 25.4: Habitat Destruction and Extinction

Overview

Pacing the Lessons

Use the **Class Periods per Lesson** table below as a guide for the time required to teach the lessons of this chapter.

Table 34.1:

Lesson	Number of Class Periods*
Lesson 25.1: Air Pollution	1.0
Lesson 25.2: Water Pollution and Waste	1.0
Lesson 25.3: Natural Resources	1.0

Table 34.1: (continued)

Lesson	Number of Class Periods*
Lesson 25.4: Habitat Destruction and Extinction	1.0

- Class periods are assumed to be 60 minutes long.

Managing Materials

The materials listed in the **Materials List** table below are needed to teach the strategies and activities described in the Teachers Edition of the FlexBook for this chapter.

Table 34.2:

Lesson	Strategy or Activity	Materials Needed
25.1	1) 2)	1) 2)
25.2	1)	1)
25.3	1)	1)
25.4	1)	1)

Making the Flex Book Flexible

An important advantage of the Flex Book is the ability it gives you, the teacher, to choose the chapters and lessons that you think are most important for your own classes. The following information is provided to help you decide whether to include this chapter or certain lessons in this chapter in your students' Flex Book. You should also consult the standards correlation table that follows when selecting chapters and lessons to include in the Flex Book.

- To understand the content of this chapter, students should have read the _____ chapter.
- Students should read this entire chapter before reading the remaining chapters of the Flex Book.
- It is recommended that you include all the lessons of this chapter in the Flex Book.

Common Misconceptions

Here are some common student misconceptions, related to this chapter:

- There is a lot of air on Earth. If I move away from the inner city I won't have to worry about air pollution. If I'm a healthy person, don't smoke and don't have asthma, then air pollution won't affect me. I don't have to worry about air pollution if I'm inside a building.
- Global warming is caused by the ozone hole because the hole lets in more radiation. Carbon dioxide makes up such a small percentage of the atmosphere that what the carbon dioxide we add doesn't make a difference.
- Water pollution occurs only when water in a particular lake or stream is polluted. The water from storm drains runs into the local waste water treatment plant, so it's OK to place pollutants there for disposal.
- Biodiversity is important to plants and animals, but not to humans. Not all species are important, so some have to be sacrificed. If there is a lot of one species, then the ecosystem must be healthy; for example, if there are a lot of pigeons in the park, then the ecosystem is healthy. Large empty spaces that are unmanaged, such as desert land and open space in a city, are wastelands.

Regarding Air Pollution

Compared to the size of the Earth, air is only a very thin skin of gas. For this reason, air can easily be filled with pollutants. Research shows that air pollution can exist outside the inner city. Even a healthy person can be affected by air pollution. Indoor air pollution exists; possible sources of this type of pollution include computers, formaldehyde, air fresheners and burning candles.

Regarding Global Warming

Global warming is caused by increased amounts of greenhouse gases in the atmosphere. Ozone is not a greenhouse gas and the depletion of ozone does not affect the Earth's temperature. Most gases in the atmosphere do not trap heat. But greenhouse gases – including carbon dioxide – do trap heat. Even though carbon dioxide makes up a relatively small percentage of the atmosphere (about 0.03%), the way it traps heat adds up to having a relatively large effect on the Earth's temperature. A powerful film which describes the effects of global warming is Al Gore's prize-winning documentary film, "An Inconvenient Truth." (Reference 1)

Regarding Water Pollution

Most students perceive underground water as a lake without any connection to the water on the surface of the Earth, e.g., in lakes and rivers. This misconception prevents students from seeing how pollution of the aquifers can affect water located far away from where the aquifers are located. Also, most of the water from storm drains ends up in the local groundwater,

streams, ponds, and/or lakes. So it is very important to keep polluting materials out of them.

Regarding Biodiversity

A common student misconception is that humans are not part of ecosystems; we are an important part of ecosystems, so biodiversity is important for us. Another misconception is that some species can be “sacrificed.” However, since complex interactions between species are often unknown, the loss of one species can have profound effects all the way up through the food chain. Also, a healthy ecosystem needs biodiversity, i.e., different populations and not more individuals of the same species. Finally, research shows that deserts and open spaces are necessary to provide habitat for many species, thus maintaining biodiversity.

- Reference 1: “Common Misconceptions about Climate Change.” CIRES Education and Outreach http://docs.google.com/gview?a=v&q=cache:e79Ujq0H_50J:cires.colorado.edu/education/k12/makingclimatehot/CC%2520Misconceptions%2520Handout.pdf+Common+misconceptions+about+climate+change&hl=iw

Additional Web-Based Resources

The Air We Breathe

Students learn about air pollution.

- http://teachengineering.org/view_lesson.php?url=http://www.teachengineering.org/collection/cub_/lessons/cub_enveng/cub_enveng_lesson07.xml

Cleaning the Air activity

- http://teachengineering.org/view_activity.php?url=http://teachengineering.org/collection/cub_/activities/cub_enveng/cub_enveng_lesson07_activity2.xml

Energy Sources PowerPoint presentation and worksheets

- http://teachengineering.org/collection/cla_/lessons/cla_lesson5_energy_sources_systems/energy_sources_photos.ppt
- http://teachengineering.org/collection/cla_/lessons/cla_lesson5_energy_sources_systems/

The Nature Conservancy

- <http://change.nature.org/?src=l13>

34.2 Lesson 25.1: Air Pollution

Key Concepts

This lesson introduces the concepts of pollution, including the pollution of outdoor air, the environmental effects of outdoor air pollution, the pollution of indoor air, the health hazards of air pollution, and protecting you from air pollution.

Lesson Objectives

- Discuss the types of outdoor pollution and what causes them.
- Describe the effects of outdoor pollution on the environment.
- Discuss where indoor air pollutants come from and what they are.
- Describe the health hazards of both indoor and outdoor pollutants.
- Discuss how you can protect yourself from air pollution.

Check Your Understanding

Review these concepts with the class:

The five layers of the earth's atmosphere

Exosphere: from 300 – 600 mi up to 6,000 mi.

Thermosphere: from 265,000 – 285,000 ft to 400 + mi.

Mesosphere: from about 160,000 ft to the range of 265,000 – 285,000 ft.

Stratosphere: from 23,000 – 60,000 ft range to about 160,000 ft; contains most of the ozone layer. Has relatively high [a few parts per million] concentration of ozone. The ozone layer is mainly located from approximately 50,000 to 115,000 ft above Earth's surface.)

Troposphere: from the Earth's surface to between 23,000 ft at the poles and 60,000 ft at the equator.

The chemical composition of the atmosphere

Dry air contains roughly (by volume) 78% nitrogen, 21 oxygen, 0.9 argon, 0.04% carbon dioxide, and trace amounts of other gases.

The significance of the atmosphere

Encourage students to think about how the atmosphere shields us from some of the sun's rays. Ask students if they have heard of the ozone layer, or ozone layer depletion. The ozone layer is a necessity for human life. It can absorb the harmful ultraviolet radiation so that it doesn't affect the earth's surface or the humans living on earth. Without the ozone layer, human life on earth, as well as other forms of life would be vulnerable to UV radiation.

Teaching Strategies

Partner Activity

- Ask students to think about what causes air pollution and discuss their answers with a partner. Teams should write down one thing that causes air pollution.
- Follow with a class discussion, grouping answers into categories. Have students copy all answers into their notebooks.

Online Simulation: Smog City

Student pairs should go to **Smog City** to see how their actions affect the ozone levels, find out how weather controls ozone, and learn how ozone affects their health. Let students know that they will be using smog city several times in this unit with different goals each time.

- Smog City <http://www.smogcity.com/>

Discussion: Healthy Air

1. Student pairs should read and discuss **Healthy Air**. On the American Lung Association web site is information about Healthy Air, at home, at school and outdoors. Have students explore this site, keeping the following in mind:
2. Ask students to reflect upon their lives and environments in terms of air quality. Are they at risk in any way? What can they do to minimize the risk?
3. Students should write up a brief, personal reflection about their own air quality environments.

- <http://www.lungusa.org/healthy-air/>

Activity: Air Pollution Baseball

1. Break students up into teams of four to eight.

2. Use a poster board as the baseball diamond.
 3. Use the questions included on the web site to make stacks of cards containing questions on air pollution. These are listed as first base, second base, third base, and home run in terms of difficulty.
 4. Rules are similar to real baseball. When a student is up, they answer the question and either are out or make it to a base.
 5. Keep track of the runs of each team.
- http://www.tceq.state.tx.us/assets/public/assistance/education/air/air_pollution_baseball.pdf.

Activities: Discussion/Jigsaw/Quiz/Writing a Paper: Why Study Air Pollution

1. Explain to students that in this lesson they should learn to identify some of the major causes of air pollution, technologies developed to reduce air pollution, resources to reduce air pollution, and a bit of history that happened because of air pollution.
2. Students will examine air pollution, solutions, and the government agencies that are involved.
3. Students will participate in four activities: Cornering Air Quality, Air Pollution IQ Quiz, a Jigsaw Activity, and a Culminating Activity in which students are asked to write a Student Position Paper on an Air Quality issue.
4. <http://www.dnrec.state.de.us/DNREC2000/Divisions/AWM/aqm/education/airqualityLesson.pdf>
5. The directions for each activity, objectives, student worksheets, and all teacher background are all included on the web site.

Differentiated Instruction

1. Pair ELL and English native speakers and give them a copy of the **Clean Air Act Information sheet**.
 2. Ask students to read each section and make a concept map about the clean air act.
 3. Place the concept maps around the room and ask students to take a walk around and review each other's maps.
 4. Follow with a class discussion. **ELL**
- http://teachengineering.org/collection/cub_/lessons/cub_air/cub_air_lesson10_cleanair.pdf

Science Inquiry

Indoor Air Quality Project

Take a Field Trip to Your School

1. Ask students what they know about the air quality at school. What questions might they have about this and how would they investigate?
2. This Indoor Air Quality Project teaches students about indoor air quality, the effects of building materials and furnishings, as well as ventilation systems, temperature and humidity settings.
3. This project also offers the opportunity to work with experts, have scientist mentors to help during the project.
4. Download the Word doc description of the project, which includes all relevant information.

- http://www.shellyjери.net/My_Homepage_Files/Page1.html

Reinforce and Review

Cleaning the Air worksheet

1. Students should complete the Cleaning the Air worksheet in the lab experience described above.
2. After students finish their worksheet, they should compare theirs with partners and discuss and make changes.
3. Share out to a class discussion.

Review Questions

Have students answer the Lesson 25.1 Review Questions that are listed at the end of the lesson in their Flex Book.

- Sample answers to these questions will be provided upon request. **Please send an email to teachers-requests@ck12.org to request sample answers.**

Points to Consider

- One of the effects of outdoor air pollution is to cause global warming. Global warming, in turn, has an effect on both land and sea. Think about how the effects of global

warming on the amount and pattern of precipitation will have an effect on water pollution.

(Rain and snowfall have increased around the globe. We can already note changes and impacts from global warming. Ask students to discuss in depth and consider what can be done now and how long will it take to make changes.)

- Environmental effects of global dimming include less energy to drive evaporation and the hydrologic cycle, and cooler ocean temperatures, which may lead to changes in rainfall and drought. Will such changes affect water pollution?

(Encourage students to remember the water cycle and the processes. If evaporation is affected and cooler temperatures in the ocean slow evaporation, then what happens to the water that does cycle through the system?)

- Some outdoor air pollutants have a direct effect on aquatic habitats. For example, acid rain can adversely affect freshwater habitats.

(Encourage students to think about acid rain. The problem occurs due to emissions into the atmosphere, but then can be carried through the atmosphere far from the site of emission. Ask students to think how this affects each country and geographic area in the world? Does this make us more of a global society? Do we need global laws that regulate this to protect all of us?)

Lesson Assessment

- Have students complete the Lesson 25.1 Quiz.

The lesson quiz and answer key are available upon request. Please send an email to teachers-requests@ck12.org to request material.

34.3 Lesson 25.2: Water Pollution and Waste

Key Concepts

In this lesson, students will learn about the Sources of Water Pollution, the Effects of Water Pollution on Living Things, Preventing Water Pollution, and Ways to Save Water.

Lesson Objectives

- Describe water pollution sources.
- Explain how water pollution affects living organisms.
- Discuss how to prevent water pollution.
- Discuss ways you can save water.

Check Your Understanding

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

- What are water resources?
- What is the demand for water?
- What are the sources of fresh water?

Teaching Strategies

Discussion: Preventing Water Pollution

1. Explain to students that in the U.S., concern over water pollution resulted in the enactment of state anti-pollution laws in the latter half of the 1800s, and federal legislation in 1899, which prohibited the disposal of any refuse matter into the nation's navigable rivers, lakes, streams, and other bodies of water, unless a person first had a permit. In 1948, the Water Pollution Control Act was passed and gave authority to the Surgeon General to reduce water pollution.
2. Growing public awareness and concern for controlling water pollutants led to enactment of the Federal Water Pollution Control Act Amendments of 1972, later amended in 1977, to become commonly known as the Clean Water Act. This Act established the basics for regulating discharge of contaminants and established the authority for the U.S. Environmental Protection Agency (EPA) to implement standards for wastewater discharge by industry. The Clean Water Act also continued requirements to set water quality standards for all surface water contaminants.
3. **Ask** students if they are aware of clean water attempts. Discuss as a class.
4. Explain that cleanup measures have been somewhat successful. For example, Finnish removal of phosphorus started in the mid-1970s has targeted rivers and lakes polluted by industrial and municipal discharges. These efforts have had 90% efficiency in removal. And with nonpoint sources, some efforts, like intercepting pollutants between

the source and water, are successful. Also, creating buffer zones near farms and roads is another possible way to prevent nutrients from traveling into waterways.

5. **Ask** students to think about the fact that most of the water pollution comes from human activities that travel to our seas.
6. Lead a class discussion of what students do with waste and how they can help this issue.

(Remind them that toxic paints and car oil need to be disposed of properly, trash should be disposed of, but as much as possible should be recycled, not to flush sanitary napkins or diapers down the toilet, use environmentally friendly cleaners, use natural pesticides, and conserve water.)

Virtual Wastewater Treatment: Flow Chart

1. Student pairs should tour the virtual sewage treatment plant, **Adventures in Wastewater**, from the City of San Diego.
2. Ask students to make a Flow chart of where things go and how they are treated in the plant.

- <http://www.sandiego.gov/mwwd/kids/learnit/virtualewage.shtml>

Video: Read Online: Flow Chart

1. Student pairs watch the video and read the commentary on the Point Loma Wastewater Treatment Plant in San Diego.
2. Click on Take a Video tour (Windows Media Player required)
3. Read the commentary and watch the video.
4. Students make a Flow chart of the plant and the treatment cycle.

- <http://www.sandiego.gov/mwwd/facilities/ptloma.shtml>

Activity: Calculate Your Water Footprint

1. Student pairs go the H²O Conserve web page and use the calculator to figure out their water footprint.
2. Each student uses the calculator and writes down their numbers and the detailed summary.
3. After both have completed the summary, they should click on water saving tips at the end of the calculator session.

4. After students complete the session, they should get a copy of the **Save Water!** handout.

- Water Calculator http://www.h2oconserve.org/wc_disclaimer.php
- http://www.h2oconserve.org/uploads/water_footprint_handout.pdf

Activity: Read and Discuss Conservation Handouts

1. You may print a copy of each handout and divide the handouts between groups of three to four students.
2. Each group should read and discuss the handout.
3. Groups present their handouts to the class.
4. Make sure all groups present. Nine handouts are suggested below.

- Safe Water http://www.h2oconserve.org/uploads/water_footprint_handout.pdf
- Water Use in the USA <http://www.h2oconserve.org/uploads/usa.pdf>
- Indoor Water Use <http://www.h2oconserve.org/uploads/indoor.pdf>
- Outdoor Water Use <http://www.h2oconserve.org/uploads/outdoor.pdf>
- The Energy We Use <http://www.h2oconserve.org/uploads/energy.pdf>
- The Food We Eat <http://www.h2oconserve.org/uploads/food.pdf>
- Global Warming http://www.h2oconserve.org/uploads/global_warming.pdf
- Water Privatization <http://www.h2oconserve.org/uploads/privatization.pdf>
- Conservation <http://www.h2oconserve.org/uploads/conservation.pdf>

Differentiated Instruction: Cluster Diagram

1. ELL should be placed in teams with other students. Each team should have a large piece of butcher paper.
2. Have each team make a cluster diagram that organizes the lesson concepts.
3. Refer students to the “Lesson Summary” section of the lesson to be sure they have covered all-important concepts.
4. Post diagrams in the room and have teams walk and view other teamwork. **ELL**

Enrichment

1. Students should read the Clean Water Act of 1972 and the Enforcement section from the EPA.
2. Students should discuss and reflect on what else could be done to make the clean air act more effective and what additional enforcement measures might be required.
3. Have students present their findings to the class and follow with a class discussion.

- Clean Air Act Summary <http://www.epa.gov/regulations/laws/cwa.html>
- Enforcement <http://www.epa.gov/compliance/index-e.html>

Laboratory Activity: Dilution and Pollution Lab

1. Students will compare pollution amounts in water, explain how even small amounts of pollution can be harmful, and outline alternative waste removal techniques.
2. This is a one period lab.
3. The objectives, background information for teachers, materials, advance preparation, procedure, follow-up, extensions, and student lab sheets are all included on the web site.

- <http://www.epa.gov/safewater/kids/wsb/pdfs/685.pdf>

Reinforce and Review

Online “Quiz:” Wastewater 101

Student pairs the interactive quiz on wastewater from the City of San Diego.

- <http://www.sandiego.gov/mwwd/kids/learnit/quiz1.shtml>

Review Questions

Have students answer the Lesson 25.2 Review Questions that are listed at the end of the lesson in their Flex Book.

- Sample answers to these questions will be provided upon request. **Please send an email to teachers-requests@ck12.org to request sample answers.**

Points to Consider

- Even though water is a renewable resource, there is not always availability of clean water. Control of water pollution, such as removal of phosphorus or creating buffer zones near farms, helps to preserve this renewable resource for the future.

(Encourage students to think about water pollution and its effect on the environment and the world population.)

- Methods such as wastewater reuse, atmospheric water generation, reclaiming water, catchments management, and protection of aquatic systems can all contribute towards the dual goals of keeping water clean and also available for future generations.

(Encourage students to begin to think about water as a resource and how well we can preserve the health of our water for future generations and ourselves.)

Lesson Assessment

- Have students complete the Lesson 25.2 Quiz.

The lesson quiz and answer key are available upon request. Please send an email to teachers-requests@ck12.org to request material.

34.4 Lesson 25.3: Natural Resources

Key Concepts

This lesson will help students understand what natural resources are, and what are considered renewable and nonrenewable resources. The lesson will also venture to discuss fossil fuels, alternative energy sources and the recycle mantra, reduce, reuse, and recycle.

Lesson Objectives

- Explain what natural resources are.
- Describe renewable resources.
- Explain what nonrenewable resources are.
- Discuss the use of fossil fuels as an energy source and what energy sources are available as alternatives.
- Discuss how reducing, reusing, and recycling can help conserve resources.

Check Your Understanding

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

- What are our natural resources?
- What is the difference between a renewable and nonrenewable resource?

Teaching Strategies

Discussion: What are Natural Resources

1. Explain to students that natural resources are the land or raw materials that occur in environments.
2. Natural resources are derived from the environment. Many of them are essential for our survival while others are used for satisfying our wants.
3. Natural resources may be further classified in different ways.
4. On the basis of origin, resources may be divided into:
 - (a) **Biotic** - Biotic resources are the ones which are obtained from the biosphere. Forests and their products, animals, birds and their products, fish and other marine organisms are important examples. Minerals such as coal and petroleum are also included in this category because they were formed from decayed organic matter.
 - (b) **Abiotic** - Abiotic resources comprise of non-living things. Examples include land, water, air and minerals such as gold, iron, copper, silver etc.
5. Considering their stage of development, natural resources may be referred to in the following ways:
 - (a) **Potential Resources** - Potential resources are those, which exist in a region and may be used in the future. For example, mineral oil may exist in many parts of India having sedimentary rocks but till the time it is actually drilled out and put into use, it remains a potential resource.
 - (b) **Actual Resources** - Actual Resources are those, which have been surveyed, their quantity and quality determined and are being used in present times. For example, the petroleum and the natural gas, which is obtained from the Bombay High Fields. The development of an actual resource, such as wood processing depends upon the technology available and the cost involved. That part of the actual resource, which can be developed profitably with available technology, is called a reserve.
6. With respect to renewability, natural resources can be categorized as follows:
 - (a) **Renewable Resources** - Renewable resources are the ones, which can be replenished or reproduced easily. Some of them, like sunlight, air, wind, etc., are continuously available and their quantity is not affected by human consumption. Many renewable resources can be depleted by human use, but may also be replenished, thus maintaining a flow. Some of these, like agricultural crops, take a short time for renewal; others, like water, take a comparatively longer time, while still others, like forests, take even longer.
 - (b) **Non-renewable Resources** - Non-renewable resources are formed over very long geological periods. Minerals and fossils are included in this category. Since their rate of formation is extremely slow, they cannot be replenished once they get

depleted. Out of these, the metallic minerals can be re-used by recycling them. But coal and petroleum cannot be recycled.

Activity: Gumdrops-Ozone Activity

1. Explain to students that after this activity they should be able to explain the different processes that destroy ozone in the Earth's atmosphere, understand an interactive model of ozone destruction, and understand the global trend towards ozone depletion and recovery.
2. Students will collect data and create a graph of global ozone amounts over a 50-year period from 1950-2000.
3. Graph of Global CFC Production 1950-2000
 - (a) http://www.teachengineering.org/collection/cub_/activities/cub_air/cub_air_lesson08_activity1_graph.pdf
4. Using gumdrops and toothpicks, students will conduct an interactive ozone depletion model.
5. Battling for Oxygen Activity Lesson Summary, including objectives, materials, introduction, procedure, and troubleshooting tips. Conduct the basic depletion model with students.
 - (a) http://www.teachengineering.org/view_activity.php?url=http://www.teachengineering.org/collection/cub_/activities/cub_air/cub_air_lesson08_activity1.xml&rights=true#fig1.jpg

Online Simulation: Smog City

1. Explain to students that this session of smog city has specific goals other than understanding the importance of gases in the atmosphere.
 2. Students will need to classify the gases as renewable, nonrenewable, or inexhaustible resources.
- Smog City <http://www.smogcity.com/>

Alternative Energy Resources

1. Explain to students that solar cells are an alternative energy source.
2. Student pairs should explore **How Solar Cells Work** at **How Stuff Works**
3. Students should study the module that includes the introduction, photovoltaic cells, how silicon makes a solar cell, energy loss in a solar cell, solar-powering a house, and solving solar power issues.

4. Have students read, discuss, take notes and draw diagrams to understand the concepts of photovoltaic cells, batteries, energy storage, utility grid, is landing, and deep cycle batteries.
5. Have students present one aspect from the site to the class and follow with a brief class discussion of solar cells and solar power.

- <http://science.howstuffworks.com/solar-cell.htm>

Reduce, Reuse, And Recycle

Plastic Waste

1. Students will describe the effects of plastic waste on aquatic wildlife and identify specific actions they can take to remedy the problem.
2. This is one period activity.
3. The objectives, background information, materials, procedures, terms, advanced preparation, follow up, extensions, and student sheets are all included on the web site.

- Plastic Waste <http://www.epa.gov/safewater/kids/wsb/pdfs/685.pdf>

Click on the Plastic Waste item on the menu bar on the left.

Sing a Song

1. Students sing three recycling songs to have fun and think about recycling as part of their lives.
2. Reduce, Recycle, and Reuse, to the tune of Twinkle, Twinkle,
3. Recycle Boogie, to the tune of Hokey Pokey.
4. Recycle and Reuse, to the tune of Bingo.

- <http://www.ci.tacoma.wa.us/envirokids/Activities/songs.htm#Recycle%20boogey>
Click on the names of the songs to be taken to the words.

Ecological Footprint and Carbon Footprint

1. Ask students if they know what an ecological footprint is.
2. Make sure that they all understand that the ecological footprint is a measure of human demand on the Earth's ecosystems. It compares human demand with planet Earth's ecological capacity to regenerate. It represents the amount of biologically productive land and sea area needed to regenerate the resources a human population consumes and to absorb and render harmless the corresponding waste.

3. Ask if students have heard of carbon footprint. **How is a carbon footprint different from ecological footprint?**
4. Make sure students understand that a carbon footprint is the “total set of GHG (greenhouse gas) emissions caused directly and indirectly by an individual, organization, event or product.” An individual, nation, or organization’s carbon footprint is measured by undertaking a GHG emissions assessment. Once the size of a carbon footprint is known, a strategy can be devised to reduce it. The carbon footprint is a subset of the ecological footprint.
5. Use a display system to show students the Carbon Footprint Calculator online: <http://www.nature.org/initiatives/climatechange/calculator/>
6. Explore the carbon footprint calculator with the class, using average numbers from different students for different questions.
7. On the results page, discuss the result of the estimated greenhouse gas emissions per year of carbon dioxide. Explain to students that even if this is below the United States national average, it is most probably still greater than the worldwide average.
8. Next, look at the ecological footprint with the class.
9. Go to: http://www.footprintnetwork.org/en/index.php/GFN/page/footprint_basics_overview/ and look at the figure titled **The Ecological Footprint**.
10. Using the Ecological Footprint, it is possible to estimate how much of the Earth (or how many planet Earths) it would take to support humanity if everybody lived a given lifestyle.
11. Analyze the diagram with students. Point out that the carbon footprint is a part of the total of the ecological footprint.
12. Have students go to the **Climate Change: What Can You Do?** Page: <http://www.nature.org/initiatives/climatechange/activities/art19630.html>
13. On this page are things you can do to reduce your footprint.
14. Ask students to read these items and make a list of things they can change this week in their lives to reduce their ecological footprint.
15. Develop class posters of student responses and post around the room.
16. Leave the posters up for at least a few weeks in the classroom and routinely take two to three minutes to have students report on things they are doing, or things they have convinced their families to do, to reduce their footprints.

Differentiated Instruction: Videos and Discussion

1. Pair ELL students with native English speakers and ask them to watch two videos on solar power.
2. **Solar Farm** at **How Stuff Works**
3. **Solar Power Comeback** at **How Stuff Works**
4. Students should watch the video, discuss, and watch again, taking notes about solar power. **ELL**

- <http://videos.howstuffworks.com/howstuffworks/3910-solar-farm-video.htm>
- <http://videos.howstuffworks.com/energy-conversion-devices-ecd-ovonics-/660-solar-power-comeback-video.htm>

Science Inquiry

Ecology Issues Project

1. Student teams will create a lesson that teaches the class about an environmental issue.
2. The following topics are available. Assign one team per topic:
 - (a) Endangered species
 - (b) Saving the rainforests
 - (c) Wildlife conservation
 - (d) Global Climate Change
 - (e) Waste Management
 - (f) Human Overpopulation
3. Students research their topic and create a PowerPoint presentation and present it to the class, fielding questions about their topic.

- <http://www.biologycorner.com/quests/ecoproject/index.html>

Reinforce and Review

Quiz: Personal Footprints

1. Student pairs should go to following site, choose an avatar and calculate how many earths it takes to support each of their lifestyles.
2. Students take the quiz separately, if possible printing the page that shows **Your Ecological Footprint**, and then discuss each other's results. If students cannot print out their results, they should write their results in their notebooks.
3. There are three choices at the end of the quiz, to edit your footprint, explore scenarios to change your footprint, and continue without exploring.
4. Encourage students to try editing the footprint and explore scenarios. Then, students may use their email and a password to save their footprints. Write this information in notebooks.
5. Ask students to revisit this site and try the quiz again in a few weeks to again raise awareness in the opportunity to change one's ecological footprint.

- <http://www.footprintnetwork.org/en/index.php/GFN/page/calculators/>

Review Questions

Have students answer the Lesson 25.3 Review Questions that are listed at the end of the lesson in their Flex Book.

- Sample answers to these questions will be provided upon request. **Please send an email to teachers-requests@ck12.org to request sample answers.**

Points to Consider

- Minimizing use of some resources helps to preserve habitats; for example, conservation of human water use helps to preserve freshwater habitats for local wildlife and migrating waterfowl.

(Encourage students to consider their use of resources in their life. Are there any ways that they could minimize use?)

- Habitats are another resource for both humans and other organisms. Now that we have considered conservation of natural resources, we will move on in the next lesson to examining the effects of habitat destruction and how to protect habitats. Why do you think this is an important topic?

(Encourage students to think about when habitats are destroyed, animals and plants lose their own ecosystem and then are in danger of extinction.)

- Discuss how the protection of natural resources may be important for biodiversity.

(Encourage students to think about what ecosystems provide: water resources and their protection, soils, new formation and protection, nutrient recycling, pollution breakdown, and recovery from events such as fire or other natural disasters. Different species also depend on each other in a balanced ecosystem where the cooperation assures mutual survival.)

- Protection of natural resources, including habitats, is also important to avoid dire consequences, such as extinction of species. Discuss why.

(Species continued existence is based on the existence of the resources that the species needs to survive. When these are threatened, so is the species. Many modern problems are causing declines in populations of organisms around the world, including disease, environmental pollution, farming practices, or clearing woodland or rainforest in order to build houses or industries.)

Lesson Assessment

- Have students complete the Lesson 25.3 Quiz.

The lesson quiz and answer key are available upon request. Please send an email to teachers-requests@ck12.org to request material.

34.5 Lesson 25.4: Habitat Destruction and Extinction

Key Concepts

This lesson will introduce student to the Causes of Habitat Destruction, reasons Why Habitat Destruction Threatens Species, Other Causes of Extinction, the Importance of Biodiversity, and about Protecting Habitats.

Lesson Objectives

- Discuss what causes destruction of habitats.
- Explain why habitat destruction threatens species.
- Describe causes of extinction other than habitat destruction.
- Explain why biodiversity is important.
- Explain why habitat protection is important, including for maintaining biodiversity.

Check Your Understanding

Sample answers will be provided upon request. Please send an email to teachers-requests@ck12.org.

- What is a habitat?
- What is habitat destruction?
- What is the effect of habitat destruction?
- What is biodiversity?

Teaching Strategies

Discussion: Causes of Habitat Destruction: Species Threatened

1. Ask students if they understand that habitat destruction and biodiversity are related. How do they think these concepts might be intertwined? Begin discussion and accept all answers, writing some notes on the board.
2. Explain to students that clearing some habitats of vegetation for purposes of agriculture and development is a major cause of habitat destruction or loss.
3. Habitats can be destroyed by natural causes—ask students for input. (lightning, earthquakes, fires, hurricanes, ice storms)
4. Habitats can be destroyed by humans—ask students for examples.
5. Write down all the ideas students have and help guide them to brainstorm as many of the following causes of destruction as possible: building urban areas, building freeways, building factories, building schools, houses, housing developments, any human construction projects, clearing fields for agriculture, clearing fields for pastures for livestock, clearing for fences, lumber development, some forestry, mining, pollution, chemical pollution, landfills, trash, or storing human waste.
6. Ask students which causes more destruction, natural causes or those caused by humans. Briefly discuss.
7. Explain that within the past 100 years, the area of cultivated land worldwide has increased significantly.
 - (a) Land for the grazing of cattle has increased.
 - (b) Agriculture, alone, has cost the United States 50% of its wetlands and most of its prairies.
 - (c) What cost does all of this destruction have on species living in the habitat? Write down student answers.
8. Explain that native prairie ecosystems, with their thick fertile soils, deep-rooted grasses, diversity of colorful flowers, burrowing prairie dogs and burrowing owls, herds of bison and pronghorn antelope, and other animals, are virtually extinct.

Animations: Biodiversity

Student pairs visit the following web page and click on four assigned animations, take notes, and turn in their notes. Annenberg Learner Animations: Biodiversity Decline

- http://www.learner.org/courses/envsci/unit/unit_vis.php?unit=9

1. Changes in Forest Biomass
2. Encroaching Edges
3. Forest Fragments
4. The rise of Slime

Activity: What will decompose

1. Explain to students that one of the problems with landfills and throwing away trash is that much of trash will just remain.
2. Ask if they know what biodegrade means. Discuss the differences in biogradability between organic and inorganic materials.
3. Find an outside earthy area that can be left undisturbed for two to three months. Dig up the area and mark it off with stakes and string in about ten different sections.
4. Ask students to classify trash according to organic materials and inorganic materials.
5. The class should create a key for what will be buried in each of the ten areas. Use about five of the squares for organic, and about five for inorganic. (Guide students to choose materials such as leftover lettuce, apple cores, cooked meat, plastic bags, aluminum cans, paper, and so forth.)
6. Conduct a class burial of the area. Ask students to copy the plan of what was buried where and to write predictions about what they think they will find when the class uncovers the materials again in several months.
7. Come back two to three months later and uncover the materials.
8. Ask students if their predictions were correct.
9. In class, direct a discussion of your own local landfill information and discuss biodegradable, organic material, landfill pros and cons, and any alternative solutions that they might come up with.

Video: Biodiversity Decline

1. Student pairs should watch the video from Annenberg/Harvard/Smithsonian, Biodiversity Decline.
2. Biodiversity Decline Text <http://www.learner.org/courses/envsci/unit/pdfs/unit9.pdf>
3. Biodiversity Decline Video <http://www.learner.org/courses/envsci/video/index.php> Scroll down to number 9, Biodiversity Decline and click on the name.

Activity: Role Playing Game: Protecting Habitats

1. Students will learn ways that development can impact wetlands and its habitats. They will learn to present the interests of townspeople affected by development, and present the reasons for the state, county, or town to purchase land or change zoning laws to preserve the wetlands.
2. This is a two period activity.
3. The objectives, background, terms, materials, copies of farm and proposed development, copies of character descriptions, procedure, follow up, extensions, and student sheets are all included.

4. Role-Playing Game <http://www.epa.gov/safewater/kids/wsb/pdfs/685.pdf> then click on the Role-Playing Game item in the left hand menu.

Differentiated Instruction: Frayer Model

1. Have the lesson vocabulary list at hand.
2. Students should fold one piece of paper in fourths.
3. Students label each of the four parts as Definition, Drawing, Example, and Non-example.
4. Assign each student a vocabulary word for the lesson vocabulary list.
5. Students should fill in the parts of the box for that word.
6. Have students exchange papers with a partner and discuss their work.
7. When students get their own sheet back, allow them time to make any changes before turning the papers in.

Enrichment

- Bagheera: Classroom Studies http://www.bagheera.com/inthewild/class_classroom.htm
1. Students should study three or four of the sections at this site on diversity.
 2. Students should take notes on the 3-4 sections, and go to the questions for thought and choose one question to write about.
 3. Students write up a brief report to turn in.
 4. Sections include:
 - (a) The Extinction Crisis
 - (b) Why It Matters
 - (c) Threatened and Endangered Species
 - (d) Causes: Habitat Loss
 - (e) Causes: Overexploitation
 - (f) Causes: Introduced Species
 - (g) Causes: Pollution
 - (h) Other Factors
 - (i) Conservation Biology
 - (j) Conservation Actions
 - (k) Questions for Thought

Laboratory Activity

Biodiversity Decline Lab from The Habitable Planet, Annenberg Learner Media

1. Students have learned that ecosystems are complex systems. The addition or removal of any species affects many other species that might compete for or provide food. In this lab you will get a chance to “build your own” ecosystem, and explore the effects of these interrelationships.
2. Student pairs should go to the Interactive Labs, Ecology Lab. <http://www.learner.org/courses/envsci/interactives/ecology/>
3. First, students should download the data table here or clicking the icon on the front page of the above link. http://www.learner.org/courses/envsci/interactives/ecology/data_table_ecology.doc
4. Next, go over the Producers and the Challenge sections with the class.
5. Students complete Step 1 and Step 2.
6. Ask students to read the For Your Consideration section under the Producers, and then discuss their work in the Producers.
7. Next, go over the Food Web and Challenge sections with the class.
8. Students complete Step 1 and Step 2.
9. Ask students to read the For Your Consideration section under the Food Web, and then discuss their work in the Food Web.

Science Inquiry

Analyze Data, Develop a Research Plan

1. Print out this list of inquiry activities that include solve problems and take action, inquire, analyze, and compare, or use your imagination.
2. Ask students or student teams to use these to develop their own individual or team inquiry.
3. Students should write up what they want to do, who they will contact, how they will do it, and get teacher approval.
4. Students research independently and report on their project to the class.
5. Bagheera: Classroom Activities http://www.bagheera.com/inthewild/class_activities.htm#solve

Reinforce and Review

Online Quiz, Pair with a Partner

Student pairs take the following online quizzes with their partner, discussing their answers and their mistakes.

- Natural Connections Quiz http://your.kingcounty.gov/solidwaste/secondaryschool/documents/quiz_with_answer_sheet.pdf

- Biodiversity to Our Environment <http://www.quibblo.com/quiz/7FUzEvP/Biodiversity-to-our->
- What's Your Biodiversity IQ? At WWF <http://www.worldwildlife.org/fun/quizzes/bioiq/>

Review Questions

Have students answer the Lesson 25.4 Review Questions that are listed at the end of the lesson in their Flex Book.

- Sample answers to these questions will be provided upon request. **Please send an email to teachers-requests@ck12.org to request sample answers.**

Points to Consider

- Global warming and climate change are frequently in the news these days, with reports of glaciers melting, and possible effects on species, such as the polar bear. Keep aware of these news trends and learn what you can about what species are becoming threatened.

(Encourage students to think about these issues and discuss what they can do now and in the future about this problem.)

- Our purchasing decisions may affect biodiversity: be more aware of the natural resources used to make and transport any product you buy; Buy recycled products whenever possible; when you buy fish for food, check to be sure that commercial species are not from over-harvested areas.

(Encourage students to think about these issues and discuss their what they can do now and in the future about all of these problems in the world.)

Lesson Assessment

- Have students complete the Lesson 25.4 Quiz.

The lesson quiz and answer key are available upon request. Please send an email to teachers-requests@ck12.org to request material.