About the Consultant

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Dear Science Teacher,

As you begin a new school year, one of the biggest challenges you will probably encounter is getting students to read their textbooks. Informational text can overwhelm students, leaving them less likely to read and more likely to become apathetic about learning. I believe that this Science Notebook will help students use their textbooks more effectively as they learn about Biology.

Note-Taking and Student Success

There is considerable research evidence that addresses how students understand difficult concepts and content in school. Glencoe/McGraw-Hill has developed the Science Notebook for science students based upon that research. Evidence indicates that students need to know how to take notes, use graphic organizers, learn vocabulary, and develop their thinking skills by writing, in order to achieve academic success.

The ability to take and organize notes predicts how well students will do in school. Peverly, Brobst, Graham, and Shaw (2003) showed that when students use background knowledge and take notes, they are likely to perform well on tests. Pauk (1974) observed that note-taking was a critical skill for college success. Notes serve as an external storage function (meaning on the paper) that builds comprehension and content understanding (Ganske, 1981). This Science Notebook is a tool that students can use to achieve this goal. I would like to share some of the features of this Science Notebook with you before you begin teaching.

The Cornell Note-Taking System

First, you will notice that the pages in the Science Notebook are arranged in two columns, which will help students organize their thinking. This two-column design is based on the Cornell Note-Taking System, developed at Cornell University. Faber, Morris, and Lieberman (2000) found that the Cornell Note-Taking System improves comprehension and increases test scores.

The column on the left side of the page highlights the main ideas and vocabulary of the lesson. This column will help students find information and locate the references in their textbooks quickly. Students can also use this column to sketch drawings that help them visually remember the lesson's information. In the column on the right side of the page, students will write detailed notes about the main ideas and vocabulary. The notes they take in this column will help them focus on the important information in the lesson. As students become more comfortable using the Cornell Note-Taking System, they will see that it is an important tool that helps them organize information.

The Importance of Graphic Organizers

Second, there are many graphic organizers in this Science Notebook. Graphic organizers allow students to see the lesson's important information in a visual format. In addition, graphic organizers help students summarize information and remember the content. I hope that you will encourage students to use the graphic organizers because they will help them understand what they are reading.

To the Teacher
Research-Based Vocabulary Development

Third, you will notice that vocabulary is introduced and practiced throughout the Science Notebook. When students know the meaning of the words used to discuss information, they are able to understand that information better. Also, students are more likely to be successful in school when they have vocabulary knowledge. When researchers study successful students, they find that as students acquire vocabulary knowledge, their ability to learn improves (Martino and Hoffman, 2002). The Science Notebook focuses on learning words that are very specific to understanding the content of the textbook. The Science Notebook also highlights general academic words that students need to know so that they can understand any textbook. These vocabulary words are based on the Academic Word List (AWL) developed by Averil Coxhead. The AWL includes the most common 570 words found in academic texts, excluding the 2,000 general English words such as the, in, and that. Research indicates that students who master the words on Coxhead’s list score significantly higher on standardized tests.

Writing Prompts and Note-Taking

Finally, there are a number of writing exercises included in this Science Notebook. Writing is a useful tool that helps students understand the information that is being presented. Writing helps them to assess what they have learned. You will see that many of the writing exercises require students to practice the skills of good readers. Good readers make connections between their lives and the text and predict what will happen next in the reading. They question the information and the author of the text, clarify information and ideas, and visualize what the text is saying. Good readers also summarize the information that is presented and make inferences or draw conclusions about the facts and ideas.

I wish you well as you begin another school year. This Science Notebook is designed to help students understand the information in your Biology class. The guide will be a valuable tool that will also provide students with skills that they can use throughout their lives.

I hope you have a successful school year.

Sincerely,

Douglas Fisher

References


Note-Taking Tips

Your notes are a reminder of what you learned in class. Taking good notes can help you succeed in science. The following tips will help you take better classroom notes.

- Before class, ask what your teacher will be discussing in class. Review mentally what you already know about the concept.
- Be an active listener. Focus on what your teacher is saying. Listen for important concepts. Pay attention to words, examples, and/or diagrams your teacher emphasizes.
- Write your notes as clear and concise as possible. The following symbols and abbreviations may be helpful in your note-taking.

<table>
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<tr>
<th>Word or Phrase</th>
<th>Symbol or Abbreviation</th>
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<tr>
<td>for example</td>
<td>e.g.</td>
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<td>such as</td>
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</tbody>
</table>

- Use a symbol such as a star (★) or an asterisk (*) to emphasize important concepts. Place a question mark (?) next to anything that you do not understand.
- Ask questions and participate in class discussion.
- Draw and label pictures or diagrams to help clarify a concept.
- When working out an example, write what you are doing to solve the problem next to each step. Be sure to use your own words.
- Review your notes as soon as possible after class. During this time, organize and summarize new concepts and clarify misunderstandings.

Note-Taking Don’ts

- Don’t write every word. Concentrate on the main ideas and concepts.
- Don’t use someone else’s notes because they may not make sense.
- Don’t doodle. It distracts you from listening actively.
- Don’t lose focus or you will become lost in your note-taking.
The Study of Life

Before You Read

Use the “What I Know” column to list the things you know about biology. Then list the questions you have about biology in the “What I Want to Find Out” column. Accept all reasonable responses.

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<thead>
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<th>K</th>
<th>W</th>
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</tr>
</thead>
<tbody>
<tr>
<td>What I Know</td>
<td>What I Want to Find Out</td>
<td>What I Learned</td>
</tr>
</tbody>
</table>

Animals, plants, and even bacteria and viruses are considered living things. But what do we mean when we say that an organism is a living thing? In the space below, describe two characteristics that are common to all living things.

Accept all reasonable responses.

____________________________________________________________________
____________________________________________________________________
____________________________________________________________________
____________________________________________________________________
____________________________________________________________________
____________________________________________________________________
The Study of Life
Section 1.1 Introduction to Biology

Main Idea

Skim Section 1 of the chapter. Write three questions that come to mind from reading the headings and illustration captions.

1. Accept all reasonable responses.
2. 
3. 

Details

Review Vocabulary

Use your book or dictionary to define environment.

environment
living and nonliving things that surround an organism and with which the organism interacts

New Vocabulary

Use your book or dictionary to help you write the correct vocabulary term in each blank.

adaptation
biology
development
growth
homeostasis
organism
organization
reproduction
response
species
stimulus

Biology is the science of life. An organism is anything that has all the characteristics of life. All living things are arranged in an orderly way. In other words, living things have organization. Most living things begin as one cell. The addition of mass is called growth. Over an organism’s life, natural changes, called development, take place. The production of offspring, or reproduction, must occur to enable the group of breeding organisms, or species, to continue to exist. A living thing also has the ability to react to a(n) stimulus from its internal or external environment. The reaction is called a response. An organism must be able to maintain its internal conditions. If anything upsets its normal state, processes to restore homeostasis begin. Any inherited characteristic, or adaptation, developed in a species over time can enhance the species’ ability to survive and produce offspring in its environment.
Main Idea

The Science of Life

I found this information on page __________.  
SE, p. 4  
RE, p. 1

Details

Identify four kinds of information you will learn about living things when you study biology.

- the origins and history of life and once-living things
- the structures of living things
- how living things interact with each other
- how living things function

Model one specific question that a biologist might seek to answer for each of the following areas of study. Accept all reasonable responses.

<table>
<thead>
<tr>
<th>Area of Study</th>
<th>Question</th>
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<tbody>
<tr>
<td>Diversity of life</td>
<td>How do chimpanzees in the wild gather food?</td>
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<tr>
<td>Diseases</td>
<td>Why does the flu virus change every year?</td>
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<tr>
<td>New technologies</td>
<td>Can a computer-controlled brace enable paralysis victims to walk?</td>
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<tr>
<td>Agriculture</td>
<td>Can crop rotation increase the output of wheat in Nigeria?</td>
</tr>
<tr>
<td>Environment</td>
<td>Can environmental education in the Amazon slow the loss of rain forest?</td>
</tr>
</tbody>
</table>

Analyze the specific type of work in biology that you might like to do, and explain why. Accept all reasonable responses.

Type of work: Observe the behavior of birds in the wild
Reason: I am fascinated by the beauty of birds and the ability of these fragile-looking creatures to fly.
Main Idea

The Characteristics of Life

I found this information on page __________.
SE, pp. 6–10
RE, pp. 2–3

Details

Identify the eight characteristics that something must have to be alive.

- displays organization
- grows and develops
- adaptations evolve over time
- maintains homeostasis
- reproduces
- responds to stimuli
- requires energy
- made of one or more cells

Sequence the levels of organization listed below in the correct order from least complex to most complex.

- organ system
- organ
- tissue
- cell
- atoms and molecules

CONNECT

A friend argues that a car is alive because its parts form organized systems and it requires energy (gasoline and battery power). How would you respond to your friend?

Accept all reasonable responses. Students should recognize that, to be alive, something must possess all the characteristics of a living thing, not just a few.
The Study of Life
Section 1.2 The Nature of Science

Main Idea

Scan the titles, boldfaced words, pictures, figures, and captions in Section 2. Write two facts you discovered about the nature of science as you scanned the section.

1. Accept all reasonable responses.
2. ____________________________

Details

Review Vocabulary

Use your book or dictionary to define investigation.

investigation: careful search or examination to uncover facts

New Vocabulary

Use your book or dictionary to define each term.

ethics: set of moral principles or values

forensics: field that applies to science fields such as archaeology and botany, as well as to matters of legal interest

metric system: units of measurement with divisions that are powers of ten

peer review: process by which scientists in the same field or who conducted similar research evaluate an experiment’s procedures and results

science: body of knowledge based on the study of nature and its physical setting

SI: International System of Units, which are the unit standards of the metric system

theory: explanation of a natural phenomenon supported by many observations and experiments over time

Academic Vocabulary

Define unbiased to show its scientific meaning.

unbiased: to be objective, impartial, or fair
What is science?

Classify each statement as a characteristic of a science, a pseudoscience, or both.

- makes unbiased observations
- often driven by cultural or commercial goals
- makes claims about the natural world
- physics
- astrology
- involves constant reevaluation of what is known
- research designed to justify existing knowledge
- discards observations that are not consistent with beliefs
- bases claims on a large amount of data
- uses peer review

Science

- makes unbiased observations
- physics
- involves constant reevaluation of what is known
- bases claims on a large amount of data
- uses peer review

Both

- makes claims about the natural world

Pseudoscience

- often driven by cultural or commercial goals
- astrology
- research designed to justify existing knowledge
- discards observations that are not consistent with beliefs

Analyze what is required for a proposed explanation to become accepted as a theory.

The proposed explanation must be supported by enough evidence from many observations and experiments over a period of time.

Identify what each SI unit listed below is used to measure.

gram: mass
meter: length
second: time
liter: volume
Identify an environmental issue, and explain why you think it is an important topic for scientific study. Accept all reasonable responses.

**Issue:** global warming

**Importance:** Research of the causes is needed to guide policy for stopping it. If not stopped, global warming could cause catastrophic climate change that could threaten life on Earth.

Analyze an ethical issue. Choose one issue involving ethics mentioned in the text. Write a statement summarizing each side of the issue, both for and against. Accept all reasonable responses.

**Issue:** euthanasia

**For:** People who are suffering and have no chance of recovery should be allowed to die to relieve their suffering.

**Against:** Life is valuable. No one has the right to decide that someone should die.

Explain why it is important for you to become science literate.

Accept all reasonable responses. Science literacy is needed to evaluate the vast amount of information available in the media, to participate in discussions of important issues, and to support policies that reflect your views.

Summarize Identify clues you would look for to judge whether a claim is based on science or pseudoscience.

Accept all reasonable responses. Check the credibility of the source of the claim. Find out whether extensive supporting research has been conducted. Look for supporting evidence from other reliable sources. Analyze the motives behind the claim; if the claim promotes commercial goals, be suspicious.
The Study of Life
Section 1.3 Methods of Science

Main Idea

Skim Section 3 of the chapter. Write two questions that come to mind from reading the headings and illustration captions.

1. Accept all reasonable responses.

2. _______________________

Details

Review Vocabulary

Use your book or dictionary to define theory.

theory

an explanation of a natural phenomenon supported by many observations and experiments over time

New Vocabulary

Write the correct vocabulary term in the left column for each definition below.

- data
- experimental group
- observation
- control group
- scientific method
- dependent variable
- safety symbol
- constant
- independent variable
- hypothesis
- experiment
- inference
- serendipity

information gained from observations

group in an experiment that is exposed to the factor being tested

direct method of gathering information in an orderly way

group in an experiment that is not exposed to the factor being tested and is used for comparison

organized series of events in scientific inquiry

factor in an experiment that results from or depends on changes to the independent variable

logo that alerts you about a specific danger during lab activities

factor that remains fixed during an experiment while the independent and dependent variables change

tested factor in an experiment that might affect the outcome

testable explanation of a situation

investigation done in a controlled setting that tests a hypothesis

logical conclusion based on gathered information

occurrence of accidental or unexpected, but fortunate, results
Sequence the basic steps in scientific methods by completing the flowchart.

- Observe and identify a problem to solve.
- Form a hypothesis.
- Design and conduct an experiment.
- Compare actual results to expected results.
- Draw a conclusion about whether the hypothesis was supported.
- Repeat the experiment or test an alternative hypothesis.

Form a Hypothesis

- Accept all reasonable responses. A theory is a hypothesis that is supported by enough evidence from many investigations to be considered valid by the scientific community.

Identify the parts of the experiment described in the table below.

- **Experiment:** A biologist gives a new kind of food to a group of dogs and compares the weight gain of these dogs over time to a group of similar dogs that do not receive the new food.

<table>
<thead>
<tr>
<th>Part of the Experiment</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Experimental group:</strong></td>
<td>the dogs that receive the new food</td>
</tr>
<tr>
<td><strong>Control group:</strong></td>
<td>the dogs that do not receive the new food</td>
</tr>
<tr>
<td><strong>Independent variable:</strong></td>
<td>the new kind of food</td>
</tr>
<tr>
<td><strong>Dependent variable:</strong></td>
<td>weight gain</td>
</tr>
</tbody>
</table>
Section 1.3 Methods of Science (continued)

**Main Idea**

**Analyze the Data**

I found this information on page __________.

SE, p. 20
RE, pp. 9–10

**Details**

Model a line graph from the data in the table below. Plot the points, and draw a line connecting the points.

<table>
<thead>
<tr>
<th>Year</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>2001</td>
<td>195</td>
</tr>
<tr>
<td>2002</td>
<td>190</td>
</tr>
<tr>
<td>2003</td>
<td>184</td>
</tr>
<tr>
<td>2004</td>
<td>164</td>
</tr>
<tr>
<td>2005</td>
<td>158</td>
</tr>
</tbody>
</table>

**Report Conclusions**

I found this information on page __________.

SE, p. 20
RE, p. 10

**Student Scientific Inquiry**

I found this information on page __________.

SE, p. 21
RE, p. 10

Connect

Analyze an experiment in which one group of plants receives extra fertilizer and another group receives extra water. Is the experiment controlled or uncontrolled? Support your answer.

Uncontrolled; there are two test factors (independent variables) that change. Both groups are exposed to a test factor, so there is no control group for comparison.

Summarize what the above graph shows about grizzly bears in Park X. Accept all reasonable responses. The number of bears declined each year, with an especially steep drop between 2003 and 2004.

Analyze why it is important for biologists to report their results in scientific journals. Accept all reasonable responses. The results will be available for review by the public and for use by other scientists.

State what you will do when you see a safety symbol in a lab activity. Accept all reasonable responses. I will refer to the safety symbols chart at the front of the book before beginning the activity and will take appropriate safety precautions.
Principles of Ecology

Before You Read

Use the “What I Know” column to list the things you know about ecology. Then list the questions you have about ecology in the “What I Want to Find Out” column. Accept all reasonable responses.

<table>
<thead>
<tr>
<th>K</th>
<th>What I Know</th>
<th>W</th>
<th>What I Want to Find Out</th>
<th>L</th>
<th>What I Learned</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Science Journal

Organisms such as birds get what they need to survive from their environment. Hypothesize why is it important for birds to be able to fly long distances.

Some birds have adaptations that enable them to fly long distances. By flying a long range or distance, the bird is more likely to find the food on which it survives.
Principles of Ecology
Section 2.1 Organisms and Their Relationships

Main Idea

Skim Section 1 of the chapter. Write two questions that come to mind from the headings and illustration captions.
Accept all reasonable responses.

Details

Use the vocabulary words in the left margin to complete the graphic organizer below. List the biological levels from largest to smallest.

<table>
<thead>
<tr>
<th>Levels of Organization</th>
</tr>
</thead>
<tbody>
<tr>
<td>biosphere</td>
</tr>
<tr>
<td>biome</td>
</tr>
<tr>
<td>ecosystem</td>
</tr>
<tr>
<td>biological community</td>
</tr>
<tr>
<td>population</td>
</tr>
</tbody>
</table>

Compare the terms in the tables by defining them side by side.

<table>
<thead>
<tr>
<th>habitat</th>
<th>area where the organism lives out its life</th>
</tr>
</thead>
<tbody>
<tr>
<td>niche</td>
<td>the role or position that an organism has in its environment; how it meets its needs for food, shelter, and reproduction</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>abiotic factor</th>
<th>nonliving part of an organism’s environment, such as soil, wind, moisture, light, temperature, and available nutrients</th>
</tr>
</thead>
<tbody>
<tr>
<td>biotic factor</td>
<td>living organisms that inhabit an environment</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>symbiosis</th>
<th>permanent, close association between two or more organisms of different species</th>
</tr>
</thead>
<tbody>
<tr>
<td>commensalism</td>
<td>one species benefits and the other species is neither harmed nor does it benefit</td>
</tr>
<tr>
<td>mutualism</td>
<td>both species benefit</td>
</tr>
<tr>
<td>parasitism</td>
<td>one species benefits and one is harmed</td>
</tr>
<tr>
<td>predation</td>
<td>the act of one organism consuming another for food</td>
</tr>
</tbody>
</table>
Main Idea

Ecology

Create a journal entry. Imagine that you are an ecologist. Choose one plant or animal in nature and write three relationships of that organism in its environment.

Journal Entry

Organism __________________________ Date __________

1. Encourage students to demonstrate thoughtfulness and list the organism’s relationship with food sources, with predators and prey, and with nonliving parts of the environment.

2. __________________________

3. __________________________

Details

Sequence the abiotic and biotic factors. Write abiotic or biotic in each square.

1. lack of rainfall abiotic

2. dry soil abiotic

3. certain plants die biotic

4. rivers dry up abiotic

5. animals do not reproduce biotic

6. the population of a species diminishes biotic

Levels of Organization

Identify each level of organization that is described.

________ population a group of organisms of all the same species

________ communities interacting populations

________ organism an individual living thing made of cells

________ ecosystem all the different populations in a community

________ biome a large group of organisms that share the same climate and have similar types of communities
Section 2.1 Organisms and Their Relationships (continued)

**Main Idea**

**Ecosystem Interactions**

I found this information on page __________.

SE, p. 38
RE, p. 14

**Details**

Model a community with several organisms. Show two organisms occupying the same niche. Below your sketch, explain why those two organisms cannot usually occupy the same niche for long.

Two organisms cannot occupy the same niche for long because they compete for the same resources. Eventually, one species will out-compete the other.

Rephrase mutualism, commensalism, and parasitism in your own words. Provide an example of each term.

1. mutualism: Certain types of bacteria in our intestines help digest our food.
2. commensalism: Lichen grows on tree branches.
3. parasitism: A lamprey eel feeds on the blood of another fish.

**Summarize**

Bacteria live inside our bodies. Analyze helpful, neutral, and harmful things that bacteria do while living in our bodies. Incorporate the terms parasitism, mutualism, habitat, and niche in your discussion.

Accept all reasonable responses. While helpful bacteria use our body as their habitat, they occupy the niche and keep harmful bacteria out. The helpful bacteria can benefit us by keeping invaders at bay or by eating harmful substances, which is a mutualistic relationship. Harmful bacteria can act as parasites by eating food we need, causing infections, or harming our bodily structures.
Principles of Ecology
Section 2.2 Flow of Energy in an Ecosystem

Main Idea

Scan Section 2 of the chapter. Make a list of the ways in which organisms obtain energy.

Accept all reasonable responses, such as using light energy, eating food, and breaking down dead organisms.

Details

Review Vocabulary

Use your book or dictionary to define energy. Then name the ultimate source of energy for Earth.

energy

the ability to cause change; the Sun

New Vocabulary

Use your book or dictionary to fill in vocabulary terms in this paragraph about food chains.

In a food chain, matter and energy move from autotrophs to heterotrophs to decomposers. A food chain is made of many steps; each organism in the food chain represents a step called a trophic level. An herbivore is a heterotroph that eats only plants, whereas a carnivore preys on other heterotrophs. An omnivore eats both plants and animals. Nutrients are returned to the soil, air, and water by detritivores. A model that shows all the possible feeding relationships at each trophic level is called a food web. If you were a scientist and you wanted to determine the weight of living matter at a certain trophic level, you would measure the biomass.

Academic Vocabulary

Define foundation to show its scientific meaning.

foundation

a basis on which something stands or is supported
Section 2.2 Flow of Energy in an Ecosystem (continued)

**Energy in an Ecosystem**

I found this information on page SE, pp. 41–42

RE, pp. 16–17

**Summarize** three ways that organisms get energy, by completing the table.

<table>
<thead>
<tr>
<th>Type of Organism</th>
<th>Autotrophs</th>
<th>Heterotrophs</th>
<th>Decomposers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Other name(s) for this type</td>
<td>producers</td>
<td>consumers, herbivores, carnivores, scavengers, omnivores</td>
<td>no other name</td>
</tr>
<tr>
<td>Food comes from</td>
<td>soil and the Sun</td>
<td>1. eating plants</td>
<td>dead organisms</td>
</tr>
<tr>
<td>2. eating animals</td>
<td>3. eating plants and animals</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chemical reactions that occur</td>
<td>Light energy and carbon dioxide are stored in energy-rich compounds.</td>
<td>The organisms that are eaten are turned into energy and molecules for the consumer’s body.</td>
<td></td>
</tr>
<tr>
<td>Examples</td>
<td>algae, plants</td>
<td>bears, lions, deer</td>
<td>fungi, bacteria</td>
</tr>
</tbody>
</table>

**Design** your own three-step example of the flow of energy. Accept all reasonable responses.

```
[ ] [ ] [ ]
```

**Classify** each of the following organisms as an autotroph or a heterotroph. Put an A in front of those that are autotrophs and an H in front of those that are heterotrophs.

- H 1. Alligator
- H 2. Squirrel
- A 3. Maple tree
- H 4. Whale
- A 5. Moss
- H 6. Siberian tiger
- A 7. Daffodil
- H 8. Rhinoceros
- A 9. Dandelion
- H 10. Rabbit
- A 11. Tomato
- H 12. Cockroach
Main Idea

Models of Energy Flow

I found this information on page __________.
SE, pp. 42–44
RE, pp. 17–18

Details

Contrast a food chain with a food web.
Food chains show how matter and energy move through an ecosystem. Food webs show all feeding relationships at each trophic level in a community.

State three things that an ecological pyramid shows that food webs and food chains do not show.
An ecological pyramid shows that energy decreases as you go up the trophic levels. There are more organisms in the lower trophic levels. An ecological pyramid also shows biomass consumption.

Create a food web and name the organisms you include. Indicate each organism’s trophic level.

Accept all reasonable drawings. See SE page 43 for an example.

Summarize

Analyze the place in the food chain in which you participate. Use the vocabulary terms from this section that apply to you.

Most students will indicate that they are the top level in their food webs. Strict vegetarians might indicate that they are heterotrophs and herbivores. Others will report that they are heterotrophs and omnivores.
Principles of Ecology
Section 2.3 Cycling of Matter

Main Idea

Scan the titles, boldfaced words, pictures, figures, and captions in Section 3. Write two facts you discovered about animals as you scanned the section.

1. Accept all reasonable responses.

2. 

Details

Review Vocabulary
Use your book or dictionary to define cycle. Then give an example of a cycle.

cycle
a series of events that occur in a regular repeating pattern; examples of cycles will vary

New Vocabulary
Use your book or dictionary to define each vocabulary term.

biogeochemical cycle
the exchange of matter through the biosphere, which involves living organisms, geological processes, and chemical processes

denitrification
a process in which some soil bacteria convert fixed nitrogen compounds back into nitrogen gas, which returns to the atmosphere

matter
anything that takes up space and has mass; provides the nutrients needed for organisms to function

nitrogen fixation
the process of capture and conversion of nitrogen into a form that is usable by plants

nutrient
a chemical substance that an organism must obtain from its environment to sustain life and to undergo life processes

Principles of Ecology
### Main Idea

**Cycles in the Biosphere**

I found this information on page ________.

SE, pp. 45–49
RE, pp. 19–22

### Details

**Create minimodels for each cycle of matter in nature. Use words or pictures to sketch a simple example for each type of cycle to show the movement of matter. Accept all reasonable models.**

<table>
<thead>
<tr>
<th>A. The Water Cycle</th>
<th>B. The Carbon Cycle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Models should show water falling from clouds as precipitation, moving through the earth and water table back into lakes and oceans, and evaporating again. Models may include tree transpiration.</td>
<td>Models should show plants using carbon dioxide to make sugars, animals eating the sugars, respiration, and combustion putting carbon into the air. Models may also show the long-term carbon cycle in which organic matter is buried and converted to fossil fuels. Carbon dioxide is released when fossil fuels are burned.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>C. The Nitrogen Cycle</th>
<th>D. The Phosphorus Cycle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Models should show bacteria fixing nitrogen from the air into the soil, plants using it, animals eating plants and making the nitrogen into proteins. Animals make urine that goes into soil, die, and decay back into soil. They may show bacteria putting nitrogen from soil back into air.</td>
<td>(short-term and long-term) Short-term models should show soil to plants to animals to decay and back to soil. Long-term models should show rocks dissolving into the water table and precipitating back onto the rocks.</td>
</tr>
</tbody>
</table>
Section 2.3 Cycling of Matter (continued)

**Main Idea**
Describe each of the cycles in nature. Identify where each cycle is found, how organisms use them, and what key words relate to them.

<table>
<thead>
<tr>
<th></th>
<th>Water</th>
<th>Carbon/oxygen</th>
<th>Nitrogen</th>
<th>Phosphorus</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Where found</strong></td>
<td>underground, in the atmosphere, and on Earth’s surface</td>
<td>in all living things, in the atmosphere</td>
<td>in the atmosphere; in plants</td>
<td>cell compounds; in Earth’s crust</td>
</tr>
<tr>
<td><strong>How used</strong></td>
<td>basis of life for all living things</td>
<td>to life processes; make up molecules such as carbon dioxide and sugar</td>
<td>to produce proteins; in chemical fertilizers</td>
<td>make up bones and teeth</td>
</tr>
<tr>
<td><strong>Key words in the cycle</strong></td>
<td>evaporating, water vapor, precipitation, transpiration</td>
<td>photosynthesis, cellular respiration, fossil fuel, calcium carbonate</td>
<td>nitrogen fixation, nitrates, decomposers, ammonia, denitrification</td>
<td>decomposers, weathering, erosion, phosphates</td>
</tr>
</tbody>
</table>

**Principles of Ecology**

Analyze current farming practices that are designed to make the best use of energy flow in ecosystems and cycles of matter.

Accept all reasonable responses. Fertilizers replace nitrogen, phosphorus, and other minerals that are lost from the soil when vegetable matter is harvested and removed. Pesticides and herbicides try to stop insects from eating crops, and other plants from stealing the nutrients in the soil from the crop. Greenhouses are used to make the most of the Sun’s energy.
Communities, Biomes, and Ecosystems

Before You Read

Before you read the chapter, respond to these statements. Accept all reasonable responses.

1. Write an A if you agree with the statement.
2. Write a D if you disagree with the statement.

<table>
<thead>
<tr>
<th>Before You Read</th>
<th>Communities, Biomes, and Ecosystems</th>
<th>After You Read</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Once an ecosystem is established, its plant and animal species remain the same.</td>
<td></td>
<td>D</td>
</tr>
<tr>
<td>• Over time, a forest can develop from bare rock.</td>
<td></td>
<td>A</td>
</tr>
<tr>
<td>• Mountains are not a biome because climate, plants, and animals change with elevation.</td>
<td></td>
<td>A</td>
</tr>
<tr>
<td>• Most of Earth’s freshwater is locked in ice.</td>
<td></td>
<td>A</td>
</tr>
</tbody>
</table>

Science Journal

“Organisms in a community reflect the resources and climate of that community.” Give some examples to illustrate this statement.

Accept all reasonable responses.
Communities, Biomes, and Ecosystems
Section 3.1 Community Ecology

Main Idea

Skim Section 1 of the chapter. List three facts you discovered about ecosystems.

1. Accept all reasonable responses.
2. ____________________________
3. ____________________________

Review Vocabulary

Use your book or dictionary to define abiotic factor.

abiotic factor
the nonliving part of an organism’s environment

New Vocabulary

Use the new vocabulary terms to complete the following sentences

Your community includes the people, other animals, plants, bacteria, and fungi in your area. A limiting factor is any abiotic or biotic factor that restricts the numbers, reproduction, or distribution of organisms. The ability of any organism to survive when subjected to abiotic or biotic factors is its tolerance. Changing abiotic or biotic factors can trigger ecological succession—the replacement of one community with another. Primary succession occurs when a community becomes established in an area of exposed rock without topsoil. Eventually, a stable, mature climax community can develop from bare rock. If a disturbance, such as fire, removes the community but not the soil, an orderly and predictable change called secondary succession restores the community over time.
Communities

I found this information on page 60–61.
SE, pp. 60–61
RE, pp. 23–24

Predict how an unusually prolonged drought might affect a biological community.

Accept all reasonable responses. Drought uncharacteristic of the ecosystem might cause some species of plants and animals to decline or become extinct in the area. Other organisms that feed on these plants and animals would also decline. Declining species would be replaced by species that are less sensitive to drought.

Create a tolerance graph similar to the Tolerance of Steelhead Trout figure in your book. Title your graph Tolerance of Plant A. Label the zones. Then label the limits of each zone according to the facts about Plant A listed below.

- can live at an elevation between 1,000 and 2,000 m
- can live at an elevation between 5,000 and 6,000 m
- cannot live above 6,000 m
- grows best between 2,000 and 5,000 m
- cannot live below 1,000 m

Accept all reasonable responses.

Infer other abiotic factors that might limit the survival of Plant A.
Accept all reasonable responses. Abiotic limiting factors might include temperature, amount of sunlight, and nutrients in the soil.
Ecological Succession

I found this information on page ________.
SE, pp. 62–64
RE, pp. 24–25

Contrast primary succession and secondary succession. Give an example of each.

Accept all reasonable responses. Primary succession is the process of establishing a community in an area of exposed rock without topsoil. An example is a hardened lava flow. Secondary succession occurs after a community of organisms has been removed, but the soil remains. An example is a forest fire.

Sequence the following steps in the primary succession of a forest by writing each step in the flowchart.

- perennial herbs and grasses
- lichens
- shade-tolerant trees
- shrubs and shade-intolerant trees
- small annual plants
- bare rock
- perennial herbs and grasses
- shrubs and shade-intolerant trees
- shade-tolerant trees

Suppose that a recent flood devastated a wildlife preserve in your area. Local leaders suggested organizing volunteers to plant trees in the damaged area. Evaluate your plan and support your reasoning.

Accept all reasonable responses. Students may take either position as long as they support their position. Some students might argue that natural succession takes many years, and replanting could hasten the process. Other students might argue that ecosystems will naturally restore the species that thrive in these conditions. Planting trees before their natural succession could upset the balance by preventing other vegetation common to this ecosystem from taking hold.
Communities, Biomes, and Ecosystems
Section 3.2 Terrestrial Biomes

Main Idea

Details

Skim Section 2 of the chapter. Write two questions that come to mind from reading the headings and the illustration captions.

1. Accept all reasonable responses.

2. Use your book or dictionary to define biome. A large group of ecosystems that share the same climate and have similar types of plant communities.

New Vocabulary

Use your book or dictionary to define the following term. Distance of any point on the surface of Earth north or south from the equator.

weather: condition of the atmosphere at a specific place and time
climate: average weather conditions in an area, including temperature and precipitation

Compare the terms in the tables by defining them side by side.

<table>
<thead>
<tr>
<th>weather</th>
<th>climate</th>
</tr>
</thead>
<tbody>
<tr>
<td>tundra: treeless; cold temperatures; permafrost</td>
<td>boreal forest: dense evergreen forest; warmer than tundra; no permafrost</td>
</tr>
<tr>
<td>desert</td>
<td>temperate forest: broad-leaved deciduous trees; well-defined seasons</td>
</tr>
<tr>
<td>grassland</td>
<td>woodlands: woods and mixed shrubs; less annual rainfall than temperate forests</td>
</tr>
<tr>
<td>temperate forest</td>
<td>grassland: thick cover of grasses; fertile soil; underground stems and buds</td>
</tr>
<tr>
<td>tropical rain forest</td>
<td>desert: variety of sparse plants; dry</td>
</tr>
<tr>
<td>tropical savanna</td>
<td>tropical savanna: grasses and scattered trees; less precipitation than other tropical areas</td>
</tr>
<tr>
<td>tropical seasonal forest</td>
<td>tropical seasonal forest: deciduous and evergreen trees; seasonal rainfall</td>
</tr>
<tr>
<td>tundra</td>
<td>tropical rain forest: canopy of tall, broad-leaved trees with mosses and orchids; understory of shorter trees, shrubs, ferns, and creeping plants; warm and rainy year round</td>
</tr>
<tr>
<td>woodland</td>
<td></td>
</tr>
</tbody>
</table>

New Vocabulary

Review Vocabulary
Main Idea

Effects of Latitude and Climate

I found this information on page ___________
SE, pp. 65–66
RE, pp. 26–27

Details

Model the latitude lines, poles, equator, Tropic of Cancer, Tropic of Capricorn, and the Sun below. Labels should resemble those in Fig. 3.5 on text page 65.

Analyze how latitude affects climate and why.
Accept all reasonable responses. Sunlight strikes different areas of Earth at different angles. Direct sunlight provides more warmth than less direct sunlight. As a result, areas in more direct sunlight tend to be warmer than areas in less direct sunlight.

Identify three factors other than latitude that affect climate.
(any three) elevation, continental landmasses, ocean currents, prevailing winds, holes in ozone layer, global warming

Sequence the boreal forest, temperate forest, and tundra in the diagram below.

Major Land Biomes

I found this information on page ___________
SE, pp. 66–72
RE, pp. 27–29

Name ___________________________  Date ________________

Section 3.2 Terrestrial Biomes (continued)
**Main Idea**

Classify the land biome described by each characteristic below.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Biome</th>
</tr>
</thead>
<tbody>
<tr>
<td>most trees drop their leaves during the dry season</td>
<td>tropical seasonal forest</td>
</tr>
<tr>
<td>annual rate of evaporation exceeds rate of precipitation</td>
<td>desert</td>
</tr>
<tr>
<td>open areas of trees and mixed shrubs along the west coasts of North and South America</td>
<td>temperate woodland</td>
</tr>
<tr>
<td>most diverse of all biomes, with a canopy and understory of vegetation</td>
<td>tropical rain forest</td>
</tr>
<tr>
<td>grasses and scattered trees; receives less precipitation than other tropical areas</td>
<td>tropical savanna</td>
</tr>
<tr>
<td>thick cover of grasses with underground stems and buds that can survive fires</td>
<td>temperate grassland</td>
</tr>
<tr>
<td>dense evergreen forest; also called northern coniferous forest or taiga</td>
<td>boreal forest</td>
</tr>
<tr>
<td>composed of broad-leaved deciduous trees; has four well-defined seasons</td>
<td>temperate forest</td>
</tr>
<tr>
<td>treeless; has a layer of permanently frozen soil below the surface called permafrost</td>
<td>tundra</td>
</tr>
</tbody>
</table>

**Details**

Other Terrestrial Areas

I found this information on page ____________
SE, pp. 72–73
RE, p. 29

**Connect**

Compare and contrast a tundra to a desert. Include latitude, climate, and major biomes.

Accept all reasonable responses.

Analyse why the two land areas below are not true biomes.

Mountains: Climate characteristics and plant and animal life vary depending on elevation.

Polar regions: They are ice masses and not true land areas because they lack exposed soil.
**Scan** the titles, boldfaced words, figures, and captions in Section 3. Write three facts you discovered about aquatic ecosystems.

1. Accept all reasonable responses.
2. 
3. 

Use your book or dictionary to define **salinity**.

*salinity*

*a measure of the amount of salt in a body of water*

Write the correct term in the left column for each definition below.

- **profundal zone**: deepest areas of a large lake
- **intertidal zone**: narrow band where the ocean meets land
- **aphotic zone**: area of the open ocean that is too deep for sunlight to penetrate
- **photic zone**: area of the open ocean to a depth of about 200 m that is shallow enough for sunlight to penetrate
- **abyssal zone**: deepest region of the ocean
- **wetlands**: areas of land such as marshes, swamps, and bogs that are saturated with water and that support aquatic plants
- **littoral zone**: area of a lake or pond that is closest to shore
- **estuary**: ecosystem that is formed where a freshwater river or stream merges with the ocean
- **limnetic zone**: open water area of a lake or pond that is well lit and dominated by plankton
- **benthic zone**: area of sand, silt, and dead organisms along the ocean floor
- **sediment**: material that is deposited by water, wind, or glaciers
- **plankton**: free-floating photosynthetic autotrophs that live in freshwater or marine ecosystems
Section 3.3 Aquatic Ecosystems (continued)

**Main Idea**

**The Water on Earth**

I found this information on page 74.

SE, p. 74

RE, p. 30

**Details**

**Complete this paragraph about the distribution of water on the Earth.**

By far, **salt water** is the most common type of water on Earth. Of the 2.5 percent of **freshwater** on Earth, most is locked in the ice of **glaciers**. Most freshwater species live in **lakes**, **ponds**, **rivers**, **streams**, and **wetlands** that make up only **0.3** percent of all freshwater. The remaining freshwater is found in **groundwater**.

**Freshwater Ecosystems**

I found this information on page 74–77.

SE, pp. 74–77

RE, pp. 30–32

**Analyze how the speed of water flow affects life in a river by writing more or less in the appropriate boxes in the figure.**

<table>
<thead>
<tr>
<th>Fast-moving water</th>
<th>Accumulation of sediment and organic material</th>
<th>Species that can live in these waters</th>
</tr>
</thead>
<tbody>
<tr>
<td>less</td>
<td>less</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Slow-moving water</th>
<th>Accumulation of sediment and organic material</th>
<th>Species that can live in these waters</th>
</tr>
</thead>
<tbody>
<tr>
<td>more</td>
<td>more</td>
<td></td>
</tr>
</tbody>
</table>

**Compare the zones of lakes and ponds by completing the table below.**

<table>
<thead>
<tr>
<th>Zone</th>
<th>Location</th>
<th>Example Species</th>
</tr>
</thead>
<tbody>
<tr>
<td>limnetic</td>
<td>well-lit open water area</td>
<td>plankton, many species of fishes</td>
</tr>
<tr>
<td>profundal</td>
<td>deepest areas of a large lake</td>
<td>limited due to cold and reduced light and oxygen</td>
</tr>
<tr>
<td>littoral</td>
<td>closest to shore</td>
<td>algae, rooted and floating plants, snails, insects, clams, crustaceans, fishes, amphibians</td>
</tr>
</tbody>
</table>
Section 3.3 Aquatic Ecosystems (continued)

Main Idea

Transitional Aquatic Ecosystems

I found this information on page ________.
- SE, p. 78
- RE, p. 32

Marine Ecosystems

I found this information on page ________.
- SE, pp. 79–81
- RE, pp. 33–34

Compare transitional aquatic ecosystems. Identify two types in the organizer below and describe the environments each type combines.

<table>
<thead>
<tr>
<th>Wetlands</th>
<th>Estuaries</th>
</tr>
</thead>
<tbody>
<tr>
<td>Combine: land and water</td>
<td>Combine: freshwater and salt water</td>
</tr>
</tbody>
</table>

Identify the marine ecosystems. Write the name of the zone in each box in the figure below.

- Intertidal zone
- Photic zone
- Aphytic zone
- Benthic zone
- Abyssal zone
- Ocean floor
- Extreme depth

Summarize

Analyze several adaptations that would help organisms survive in the intertidal zone.

Accept all reasonable responses. Plants and animals would have to be able to withstand the currents of tides and waves. They would benefit from adaptations that enable them to cling to rocks or sand, such as suction cups, claws, or gluelike secretions. Organisms exposed at low tide would also have to be able to survive out of water for a period of time. The ability to burrow into the sand or breathe air would help organisms survive out of water.
Population Ecology

Before You Read

Use the “What I Know” column to list the things you know about population biology. Then list the questions you have about population biology in the “What I Want to Find Out” column. Accept all reasonable responses.

<table>
<thead>
<tr>
<th>K</th>
<th>What I Know</th>
<th>W</th>
<th>What I Want to Find Out</th>
<th>L</th>
<th>What I Learned</th>
</tr>
</thead>
</table>

Science Journal

White-tailed deer have become so numerous in some areas of the United States that they are a nuisance. Why do you think these deer populations have grown so large?

Accept all reasonable responses. Human land development has removed many deer predators and competitors that would have limited the deer populations naturally. The deer have been able to adapt to the changes in their environments, while many predator and competitor species could not.
Population Ecology
Section 4.1 Population Dynamics

- **Main Idea**

  **Skim** Section 1 of the chapter. Write three questions that come to mind from reading the headings and illustration captions.

  1. Accept all reasonable responses.
  2. 
  3. 

- **Details**

  **Review Vocabulary**
  Use your book or dictionary to define population.

  - **population**
    - the members of a single species that share the same geographic location at the same time

  **New Vocabulary**
  Compare the terms in the tables by defining them side by side.

  - **carrying capacity**
  - **density-dependent factor**
  - **density-independent factor**
  - **dispersion**
  - **emigration**
  - **immigration**
  - **population density**
  - **population growth rate**

<table>
<thead>
<tr>
<th><strong>population density</strong></th>
<th><strong>dispersion</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>the number of organisms per unit area</td>
<td>pattern of spacing of a population within an area</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>density-independent factor</strong></th>
<th><strong>density-independent factor</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>any factor in the environment that does not depend on the number of members in a population per unit area</td>
<td>any factor in the environment that depends on the number of members in a population per unit area</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>population growth rate</strong></th>
<th><strong>speed at which a population grows</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>emigration</strong></th>
<th><strong>immigration</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>the number of individuals moving away from a population</td>
<td>the number of individuals moving into a population</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>carrying capacity</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>the maximum number of individuals in a species that an environment can support for the long term</td>
</tr>
</tbody>
</table>

- **Academic Vocabulary**

  Define fluctuate to show its scientific meaning.

  - **fluctuate**
    - to change from high to low levels or from one thing to another in an unpredictable way
Section 4.1 Population Dynamics (continued)

**Main Idea**

**Population Characteristics**

I found this information on page __________.

SE, pp. 92–94
RE, pp. 35–36

**Details**

**Identify** each pattern of dispersion represented below.

Analysis of patterns:
- **Random**
- **Uniform**
- **Clumped**

**Analyze** why populations are limited in their spatial distribution.

Accept all reasonable responses. A species cannot expand into a new area if it cannot adapt to the biotic and abiotic factors there.

**Classify** each limiting factor below as either density-independent or density-dependent by placing an X in the appropriate column.

<table>
<thead>
<tr>
<th>Factor</th>
<th>Density-Independent</th>
<th>Density-Dependent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lava flow</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Number of predators</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Spread of disease</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Especially cold winter</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Toxic chemical spill into a stream</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Another species competing for the same resources</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Diverting a river for irrigation</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Fungus that attacks elm trees</td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>

**Analyze** how the expansion of housing developments in southern California might limit coyote populations in the area.

Accept all reasonable responses. The developments reduce the land available for coyote habitat. They might also reduce the habitat for the coyotes’ prey animals, which would decrease the coyotes’ food supply. Less space and less food would limit the coyote populations.
Section 4.1 Population Dynamics (continued)

Main Idea  
Population-limiting factors
I found this information on page  __________.
SE, pp. 94–99
RE, pp. 36–39

Details
Identify four main factors in a population’s growth rate.

<table>
<thead>
<tr>
<th>Factors in Population’s Growth Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>• birthrate or natality</td>
</tr>
<tr>
<td>• death rate or mortality</td>
</tr>
<tr>
<td>• emigration</td>
</tr>
<tr>
<td>• immigration</td>
</tr>
</tbody>
</table>

Compare the general shapes of the curves of population growth graphs. Draw the appropriate graph. Label the lag phase, exponential growth phase, and carrying capacity. Below each graph, describe what the graph shows. Accept all reasonable responses.

Exponential Population Growth
Graph should resemble the J-shape of the figure at the top of text page 97. The lag phase and exponential growth phase should be labeled.

Logistic Population Growth
Graph should resemble the S-shape of the figure at the bottom of text page 97. The lag phase, exponential growth phase, and carrying capacity should be labeled.

This graph shows how a population would grow if there were no limits placed on it by the environment. The population would grow slowly at first, and later would grow exponentially.

This graph shows typical population growth. After exponential growth, limiting factors slow the growth until the population stops growing at its carrying capacity.

Summarize
Analyze whether humans are r-strategists or k-strategists.

Humans are k-strategists. Humans produce few offspring compared to other species. Human parents invest energy, resources, and time in caring for their offspring, increasing the chances that the young will survive to reproductive age. Humans also fit the profile of a k-strategist as a larger organism with a long life span.
Section 4.2 Human Population

Main Idea

Skim Section 2 of the chapter. Make a list of the ways in which human populations change.

Accept all reasonable responses.

Details

Review Vocabulary

Use your book or dictionary to define carrying capacity.

carrying capacity
the maximum number of individuals in a species that an environment can support for the long term

New Vocabulary

Use your book or dictionary to define each term.

age structure
in a population, the number of males and females in each of three age groups: pre-reproductive stage, reproductive stage, and post-reproductive stage

demographic transition
a change in a population from high birth and death rates to low birth and death rates

demography
the study of human population size, density, distribution, movement, and birth and death rates

zero population growth (ZPG)
situation in a population in which birthrate equals death rate
Section 4.2 Human Population (continued)

**Main Idea**

**Human Population Growth**

I found this information on page ________
SE, pp. 100–101
RE, p. 40

**Details**

**Summarize** two examples of events that could produce each of the following effects. Accept all reasonable responses.

Effect: decline in world population growth
Events that could produce this effect: **worldwide epidemic;**
**world war**

Effect: increase in world population growth
Events that could produce this effect: **new medicine reduces death rate; new farming method yields more food per acre**

**Examine** the graph below. Then complete the table that follows. Accept all reasonable responses.

![Percent Increase in Human Population graph]

<table>
<thead>
<tr>
<th>Year</th>
<th>1950</th>
<th>1975</th>
<th>2000</th>
<th>2025 (estimated)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percent increase</td>
<td>1.7</td>
<td>1.8</td>
<td>1.3</td>
<td>0.9</td>
</tr>
</tbody>
</table>

What are the main reasons for the expected trend in human population between now and 2050?
**diseases such as AIDS and voluntary population control**
Main Idea  

**Trends in Human Population Growth**

I found this information on page _____

SE, pp. 102–105

RE, pp. 41–42

Details

Calculate the population growth rate for each fictitious country listed in the table below.

<table>
<thead>
<tr>
<th>Country</th>
<th>Births per 1000</th>
<th>Deaths per 1000</th>
<th>Growth rate (percent)</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>25</td>
<td>9</td>
<td>1.6</td>
</tr>
<tr>
<td>Y</td>
<td>14</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>Z</td>
<td>12</td>
<td>15</td>
<td>-0.3</td>
</tr>
</tbody>
</table>

Compare trends in industrialized nations and developing countries in terms of the following factors.

Population growth rate: The population is growing at a faster rate in developing than in developed countries.

Resource use by individuals: Individuals in industrialized nations use far more resources than individuals in developing countries.

Identify three factors that could keep the human population from reaching its carrying capacity.

1. family planning
2. improvements in technology
3. limiting the amount of resources each person uses

SUMMARIZE

Imagine that medical science discovered a cure for all cancers. Analyze how this medical achievement might affect life on Earth.

Accept all reasonable responses. The cure would probably decrease the death rate, resulting in rapid human population growth at first. Then other limiting factors would slow the exponential growth. Overcrowding would increase the spread of other diseases and of parasites. The food supply could not support the increased population, leading to starvation. Competition for resources between humans and other species might decimate animal and plant populations.
Tie It Together

Create a demographic profile for an imaginary country by describing its population characteristics below. List the sources of your data. Accept all reasonable responses.

Name of country: ____________________________

Geographic location: ____________________________

Is it classified as a developing country or as an industrialized nation? ____________________________

Population size: ____________________________

Population density: ____________________________

Description of the population’s spatial distribution across the country’s land area:

__________________________________________________________________________________

__________________________________________________________________________________

Birthrate: ____________________________

Death rate: ____________________________

Current population growth rate: ____________________________

Expected population growth rate in the next 10 to 20 years: ____________________________

General age structure: ____________________________

Major factors promoting population growth: ____________________________

__________________________________________________________________________________

__________________________________________________________________________________

Major factors limiting population growth: ____________________________

__________________________________________________________________________________

Data sources used: ____________________________

__________________________________________________________________________________

__________________________________________________________________________________
Biodiversity and Conservation

Before You Read

Before you read the chapter, respond to these statements. Accept all reasonable responses.

1. Write an A if you agree with the statement.
2. Write a D if you disagree with the statement.

<table>
<thead>
<tr>
<th>Before You Read</th>
<th>Biodiversity and Conservation</th>
<th>After You Read</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Biodiversity is the variety of ecosystems in the biosphere.</td>
<td>D</td>
<td></td>
</tr>
<tr>
<td>• Genetic diversity tends to decrease over time in small pieces of habitat.</td>
<td>A</td>
<td></td>
</tr>
<tr>
<td>• Nonnative species can damage an ecosystem.</td>
<td>A</td>
<td></td>
</tr>
<tr>
<td>• The first national park was established in the United States in 1972.</td>
<td>D</td>
<td></td>
</tr>
</tbody>
</table>

Science Journal

For many years the bald eagle was close to extinction but now lives and reproduces in the wild. Hypothesize how scientists used their knowledge of diversity to save the bald eagle.

Accept all reasonable responses. Scientists studied the effects of the chemical DDT on the eagle; they understood its nesting habits; they cleaned up its feeding sites.
Biodiversity and Conservation
Section 5.1 Biodiversity

Main Idea

Skim Section 1 of the chapter. Read the headings and the illustration captions. Write two questions that come to mind.

1. Accept all reasonable responses.
2. ________________________

Details

Review Vocabulary

Use your book or dictionary to define gene.

Gene
functional unit that controls the expression of inherited traits

New Vocabulary

Use your book or dictionary to define each term.

Biodiversity
the variety of species in a particular area

Ecosystem Diversity
the variety of ecosystems present in the biosphere

Extinction
the complete disappearance of a species when its last member dies

Genetic Diversity
the variety of genes present in a population

Species Diversity
the variety of different species in a biological community

Academic Vocabulary

Define diverse to show its scientific meaning.

Diverse
made of different qualities
What is Biodiversity?

I found this information on page 116–118.
SE, pp. 116–118
RE, pp. 43–44

Compare and contrast the species biodiversity of different areas. Accept all reasonable responses.

<table>
<thead>
<tr>
<th>Type</th>
<th>Rain Forest</th>
<th>Corn Field</th>
<th>Vegetable Garden</th>
<th>Tundra</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plants</td>
<td>hundreds of species of plants</td>
<td>one type of plant</td>
<td>carrots, broccoli, corn, tomatoes, weeds, sunflowers</td>
<td>wild grasses, flowers</td>
</tr>
<tr>
<td>Animals</td>
<td>hundreds of species of birds, thousands of species of insects</td>
<td>hundreds of insects, several birds or animals</td>
<td>insects, moles, toads</td>
<td>polar bears, seals, birds</td>
</tr>
</tbody>
</table>

Describe observable differences among the types of biodiversity using a forest ecosystem. Accept all reasonable responses.

<table>
<thead>
<tr>
<th>Type of Biodiversity</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Genetic diversity</td>
<td>differences in the coat color of rabbits that live in the forest</td>
</tr>
<tr>
<td>Species diversity</td>
<td>the number of tree species growing in the forest</td>
</tr>
<tr>
<td>Ecosystem diversity</td>
<td>the forest ecosystem is one of many types of ecosystems in the biosphere</td>
</tr>
</tbody>
</table>

Analyze how genetic diversity in a population of fishes in a stream can help the fishes resist disease.

Accept all reasonable responses. The variety present in a population of fishes with high genetic diversity increases the chance that some of the fishes will be able to resist disease, survive, and reproduce.

A population with a low level of diversity is less likely to survive and reproduce in the face of disease.
The Importance of Biodiversity

I found this information on page 118–121.

SE, pp. 118–121
RE, pp. 44–45

Summarize why species should be preserved as a possible source of useful genes.

<table>
<thead>
<tr>
<th></th>
<th>Agriculture</th>
<th>Medicine</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organisms that might have value include</td>
<td>wild relatives of crop plants.</td>
<td>unknown plants and other organisms in remote regions.</td>
</tr>
<tr>
<td>These organisms someday might be useful as</td>
<td>a source of genes to give disease resistance to crop plants.</td>
<td>a source of new medicines to treat human diseases.</td>
</tr>
</tbody>
</table>

Identify resources and services that a healthy biosphere provides to people. Accept all reasonable responses.

<table>
<thead>
<tr>
<th>Resources</th>
<th>Services</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. clean water</td>
<td>1. protection from floods</td>
</tr>
<tr>
<td>2. clean air</td>
<td>2. decomposition of wastes</td>
</tr>
<tr>
<td>3. fertile soil</td>
<td>3. protection from droughts</td>
</tr>
<tr>
<td>4. food</td>
<td>4. climate regulation</td>
</tr>
</tbody>
</table>

Organize how humans are dependent on plants and animals by describing two ways that you use products of each. Accept all reasonable responses.

<table>
<thead>
<tr>
<th>Products of Animals</th>
<th>Products of Plants</th>
</tr>
</thead>
<tbody>
<tr>
<td>eating meat</td>
<td>breathing oxygen</td>
</tr>
<tr>
<td>wearing wool clothing</td>
<td>eating a salad, wearing cotton</td>
</tr>
</tbody>
</table>

Summarize Explain how the health of the biosphere impacts the health of people.

Accept all reasonable responses. A healthy biosphere has a high level of biodiversity.

Biodiversity can lead to the possibility of new medicines to treat human diseases. A healthy biosphere is able to provide clean water and clean air that people need. Healthy ecosystems can protect people from extreme weather, floods, and droughts.
Scan the titles, boldfaced words, figures, and captions in Section 2. List three threats you discovered to biodiversity.

1. Accept all reasonable responses.

2. 

3. 

Review Vocabulary

Use your book or dictionary to define food web.

food web

the interconnected food chains and pathways in which matter and energy flow through a group of organisms

New Vocabulary

Use your book or dictionary to define the following terms.

biological magnification

the increased concentration of toxic substances in organisms at a high trophic level in the food chain

different environmental conditions along an ecosystem’s boundaries

eutrophication

water pollution that occurs when substances rich in nitrogen and phosphorous flow into waterways

habitat fragmentation

the separation of an ecosystem into small pieces of land

introduced species

nonnative species that are transported to a new habitat

overexploitation

excessive use of a species, often leading to extinction
Section 5.2 Threats to Biodiversity (continued)

Main Idea

Extinction Rates

Summarize extinction rates by completing the sentences below.

Background extinction is slow and gradual. It is caused as ecosystems change by natural processes. A mass extinction is an event in which extinctions increase dramatically. Some scientists believe we are in a period of mass extinction today.

Factors That Threaten Biodiversity

Sequence the series of events describing how a habitat can be disrupted. The first one has been done for you.

- Owls that prey on small mammals decline.
- Deer eat most of the young trees in a forest.
- Squirrels and rabbits that live in and around trees decline.
- Deer that are prey for predators increase in number.
- Birds that eat the insects decline.
- Overhunting causes natural predators to disappear.
- Insects that live in the bark of trees decline.

1. Overhunting causes natural predators to disappear.

2. Deer that are prey for predators increase in number.

3. Deer eat most of the young trees in a forest.

4. Ferns, which deer do not eat, grow instead of trees.

5. Insects that live in the bark of trees decline.

6. Squirrels and rabbits that live in and around trees decline.

7. Birds that eat the insects decline.

8. Owls that prey on small mammals decline.
Explain why carnivores are subject to biological magnification of substances like DDT and PCBs.

DDT and PCBs are pollutants that accumulate in bodily tissues.

These substances enter the food chain in low amounts. As one animal eats another, they accumulate in bodily tissues. Because carnivores eat animals that have the substances in their tissues, they accumulate high levels of DDT and PCBs in their own tissues.

Describe the effects of each change in habitat on species of animals.

Accept all reasonable responses.

<table>
<thead>
<tr>
<th>Edge effects</th>
<th>The organisms that live at the edge of a habitat are different from those that live in the middle of a habitat, due to different conditions.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduced species</td>
<td>Introduced species often destroy native species as they feed on them or disturb their habitat.</td>
</tr>
<tr>
<td>Pollution</td>
<td>Pollution in the air, water, and land can destroy soil and vegetation and make animals get sick and/or die.</td>
</tr>
<tr>
<td>Habitat fragmentation</td>
<td>The separation of habitats into small plots of land increases edge effects and causes loss of genetic diversity.</td>
</tr>
<tr>
<td>Habitat loss</td>
<td>Species might become extinct when habitat is destroyed.</td>
</tr>
</tbody>
</table>

Imagine a habitat near you. Hypothesize what would happen to the ecosystem if one species died out. Support your reasoning with information from this section.

Accept all reasonable responses. Students should describe several species of plants and animals and understand that as one species dies out, other species will be affected.
Biodiversity and Conservation
Section 5.3 Conserving Biodiversity

Main Idea

Read the main idea of Section 3 of the chapter and look at the figures and captions in the section. Predict two ways that people are preserving biodiversity.

1. Accept all reasonable responses.

2. __________________________________________________________________________

Details

Review Vocabulary

Use your book or dictionary to define natural resources.

natural resources
organisms and materials found in the biosphere

New Vocabulary

Use your book or dictionary to define the following terms.

biological augmentation
the practice of adding essential materials to restore a degraded ecosystem

bioremediation
a method of using living things, such as bacteria, plants, or fungi, to remove toxins from a polluted area

endemic
native to one specific geographic area

nonrenewable resource
a natural resource that is present in limited amounts or requires a long period of time to be replaced

renewable resource
a natural resource that is replaced by natural processes faster than it is consumed

sustainable use
philosophy that lets people use natural resources in a way that will benefit them and maintain the ecosystem
Section 5.3 Conserving Biodiversity (continued)

**Main Idea**

**Natural Resources**

I found this information on page _______.
SE, pp. 129–130
RE, pp. 51–52

**Details**

**Compare and contrast** renewable and nonrenewable resources by writing characteristics of each in the Venn diagram. Accept all reasonable responses.

- **Nonrenewable**
  - present in limited amounts or are replaced over long periods of time
- **Both**
  - natural resources that come from the biosphere
- **Renewable**
  - replaced by natural processes faster than they are consumed

**Protecting Biodiversity**

Choose the diagram that best represents a habitat corridor. Explain your choice.

- **A.**
- **B.**
- **C.**

Accept all reasonable explanations. Students should note that the habitats must be completely separate, but have a connection between them.

**Summarize** the purpose of a habitat corridor. Provide an example to support your response.

Habitat corridors allow organisms to safely move among habitat fragments. Accept any reasonable example.
Section 5.3 Conserving Biodiversity (continued)

Restoring Ecosystems

Organize the factors that impact how long it takes for an ecosystem to recover after a disaster.

Factors that affect ecosystem recovery rate
- the size of the area affected
- the type of disturbance

Explain the methods ecologists use to restore ecosystems.

Method: bioremediation
How it works: living things used to remove toxins from a polluted area
Example: plants used to remove heavy metals from soil

Method: biological augmentation
How it works: natural predators are added to a degraded ecosystem
Example: ladybugs added to control aphid populations

Legally Protecting Biodiversity

Rephrase a law or treaty designed to protect biodiversity.

Who or what: Endangered Species Act
When: 1973
How: gives legal protection to species that are in danger of becoming extinct

Summarize

Analyze how sustainable use could preserve biodiversity in hot spots.

Hot spots are locations around the world with large numbers of species in danger of extinction. Hot spots comprise only 1.5 percent of Earth’s land but have a high amount of biodiversity. Sustainable use would let people use the resources of these areas in a way that preserves biodiversity and long-term health of the ecosystems.
Before you read the chapter, respond to these statements. Accept all reasonable responses.

1. Write an A if you agree with the statement.
2. Write a D if you disagree with the statement.

<table>
<thead>
<tr>
<th>Before You Read</th>
<th>Chemistry in Biology</th>
<th>After You Read</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Atoms are the smallest particles in matter.</td>
<td></td>
<td>D</td>
</tr>
<tr>
<td>• Chemical reactions occur constantly inside your body.</td>
<td></td>
<td>A</td>
</tr>
<tr>
<td>• About 70 percent of your body is water.</td>
<td></td>
<td>A</td>
</tr>
<tr>
<td>• Almost all molecules in living things contain the element carbon.</td>
<td></td>
<td>A</td>
</tr>
</tbody>
</table>

Consider the characteristics of a living and a nonliving thing. Describe a few ways that the two are alike and a few ways that the two are different.

Accept all reasonable responses.
Scan the headings and boldfaced words in Section 1 of the chapter. Predict two things that you think might be discussed.

1. Accept all reasonable responses.
2. 

Use your book or dictionary to define substance.

form of matter that has a uniform and unchanging composition

Complete the paragraph below using the terms listed to the left.

A substance that cannot be broken down into other substances is a(n) **element**. Carbon-14 is a(n) **isotope**. It has a different number of neutrons than other carbon atoms. A(n) **compound** forms when two or more elements combine. The chemical bond that holds the elements together is a(n) **covalent bond** when electrons are shared. A substance with this kind of bond is called a(n) **molecule**. An atom that has lost or gained one or more electrons becomes a(n) **ion**, which carries an electric charge. Two of these oppositely charged atoms can form an electrical attraction called a(n) **ionic bond**. An attraction between oppositely charged regions of molecules is called a(n) **van der Waals force**.

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>atom</td>
<td>building block of matter</td>
</tr>
<tr>
<td>electron</td>
<td>positively charged particles that are located outside the nucleus</td>
</tr>
<tr>
<td>neutron</td>
<td>negatively charged particles that are located outside the nucleus</td>
</tr>
<tr>
<td>nucleus</td>
<td>center of an atom that contains protons and neutrons</td>
</tr>
<tr>
<td>proton</td>
<td>particles with no charge that are located in the nucleus</td>
</tr>
<tr>
<td>neutron</td>
<td>particles with no charge that are located in the nucleus</td>
</tr>
<tr>
<td>electron</td>
<td>negatively charged particles that are located outside the nucleus</td>
</tr>
<tr>
<td>compound</td>
<td>forms when two or more elements combine</td>
</tr>
<tr>
<td>covalent bond</td>
<td>when electrons are shared</td>
</tr>
<tr>
<td>element</td>
<td></td>
</tr>
<tr>
<td>ion</td>
<td></td>
</tr>
<tr>
<td>isotope</td>
<td></td>
</tr>
<tr>
<td>molecule</td>
<td></td>
</tr>
<tr>
<td>van der Waals force</td>
<td></td>
</tr>
</tbody>
</table>
Section 6.1 Atoms, Elements, and Compounds (continued)

**Main Idea**

**Atoms**

I found this information on page _____.

SE, p. 148
RE, p. 55

**Details**

**Model** an oxygen atom and label the parts. Note the type of electric charge for each part. Then complete the sentence that follows.

Models should resemble the oxygen atom in the book. Accept all reasonable variations. Students should show a negative charge on the electrons, positive charge on the protons, and no charge on the neutrons.

The overall charge of the oxygen atom is _____zero_____, because the atom has an equal number of positively charged protons and negatively charged electrons, and neutrons have no charge _____.

**Elements**

I found this information on page _____.

SE, pp. 149–150
RE, p. 56

**Compare and contrast** the characteristics of carbon-14 by completing the following sentences.

Structurally, carbon-14 differs from other carbon atoms because it has a different number of neutrons than other carbon atoms _____.

Carbon-14 is radioactive because its nucleus decays and breaks apart _____.

Knowing the half-life of carbon-14 enables scientists to calculate the age of an object _____.

**Compounds**

I found this information on page _____.

SE, p. 151
RE, p. 56

**Identify** four unique characteristics of compounds.

- always formed from a specific combination of elements in a fixed ratio
- cannot be broken down into simpler compounds or elements by physical means
- chemically and physically different than the elements that comprise them
- can be broken down by chemical means
Section 6.1 Atoms, Elements, and Compounds (continued)

**Main Idea**

**Chemical Bonds**

I found this information on page 152–154.
SE, pp. 152–154
RE, pp. 57–58

**Details**

Label the following parts of the water molecule illustrated below.

- hydrogen atom(s)  first energy level
- oxygen atom(s)  second energy level
- covalent bonds

The covalent bonds occur where the electron pairs are shared. The first energy level is closest to the nucleus in the H and O atoms. The second level is the outer level on the O atom.

Compare positively and negatively charged ions.

Atom becomes positively charged when it gives away one or more electrons.

Atom becomes negatively charged when it accepts one or more electrons.

Identify the type of substances held together by van der Waals forces. Include indicators of electric charges.

Connect

A chemical compound in your toothpaste helps protect your teeth from decay. The formula for this compound is Na₂PO₃F. Use the periodic table in your book to identify each element in this compound.

sodium, phosphorus, oxygen, fluorine
Chemistry in Biology

Section 6.2 Chemical Reactions

Main Idea

Skim Section 2 of the chapter. Write two facts that you discovered as you read the headings and illustration captions.

1. Accept all reasonable responses.
2. Use your book or dictionary to define process.

Review Vocabulary

Use your book or dictionary to define each term.

process: series of steps or actions that produces an end product

New Vocabulary

activation energy: minimum amount of energy needed for reactants to form products in a chemical reaction

active site: location where a substrate binds on an enzyme

catalyst: substance that lowers the activation energy needed to start a chemical reaction

chemical reaction: process by which atoms or groups of atoms in substances are reorganized into different substances

enzyme: protein that speeds up a chemical reaction in a biological process

product: substance formed during a chemical reaction

reactant: starting substance in a chemical reaction

substrate: reactant that binds to an enzyme

Academic Vocabulary

Define coefficient to show its scientific meaning.

coefficient: number in front of a reactant or a product in a chemical equation
Reactants and Products

I found this information on page ________.
SE, pp. 156–157
RE, pp. 59–60

Label the sides of the following equation as either products or reactants.

\[\text{reactants} \quad \text{products}\]

\[\text{CH}_4 + 2\text{O}_2 \rightarrow \text{CO}_2 + 2\text{H}_2\text{O}\]

Calculate the number of atoms of each element in the chemical equation above. Record the information in the table below.

<table>
<thead>
<tr>
<th>Element Symbol</th>
<th>Element Name</th>
<th>Number of Atoms (reactant side)</th>
<th>Number of Atoms (product side)</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>carbon</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>H</td>
<td>hydrogen</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>O</td>
<td>oxygen</td>
<td>4</td>
<td>4</td>
</tr>
</tbody>
</table>

Analyze the formula to check to see if it is balanced. Support your reasons.

Each element has the same number of atoms on both sides of the equation. No mass has been lost or gained.

Compare what happens to energy in exothermic and endothermic reactions by completing the diagram below.

Exothermic Reaction

During the reaction, energy is released in the form of heat or light.

As a result, the energy of the product is _______ lower than the energy of the reactants.

Endothermic Reaction

During the reaction, energy is absorbed.

As a result, the energy of the product is _______ higher than the energy of the reactants.
**Main Idea**

**Enzymes**

I found this information on page __________.
SE, pp. 159–160
RE, p. 61

**Details**

**Summarize** key characteristics of an enzyme by completing the organizer below.

- **Composed of:** protein
- **Purpose:** speeds up rate of chemical reactions in biological processes
- **Reusable?** yes; does not get used up in a reaction
- **Activity level affected by:** pH, temperature, other substances

**Compounds**

- Participates in how many different types of reactions? one

**Analyze** how an enzyme works by completing the following paragraph.

For a substrate to bind with a particular enzyme, the __________ size _______ and __________ shape _______ of the substrate must match that of the enzyme’s __________ active site _______. In the enzyme-substrate complex, chemical bonds in the __________ reactants _______ are broken and __________ new bonds _______ form. The results of the interaction between an enzyme and its __________ substrates _______ are products, which are released by the __________ enzyme _______.

**Summarize**

Analyze the role of catalysts in chemical reactions.

Accept all reasonable responses. Catalysts begin chemical reactions by lowering the activation energy needed to start the reaction. Some catalysts speed up reactions thousands of times.

Without them, scientists would not have been able to synthesize new elements, conduct nuclear reactions, and so on.
## Main Idea

**Scan** Section 3 of the chapter. Identify two facts you discovered about water.

1. Accept all reasonable responses.

2. ____________________________________________________________________________________

## Details

### Review Vocabulary

- **physical property**
  - characteristic of matter that can be observed or measured without changing the composition of the substance

### New Vocabulary

- **base**
  - substance that releases hydroxide ions when dissolved in water

- **acid**
  - substance that releases hydrogen ions when dissolved in water

- **solvent**
  - substance in which another substance is dissolved

- **buffer**
  - mixture that can react with an acid or a base to keep the pH within a particular range

- **pH**
  - measure of concentration of hydrogen ions in a solution

- **solute**
  - substance that is dissolved in a solvent

- **hydrogen bond**
  - weak interaction involving a hydrogen atom and a fluorine, oxygen, or nitrogen atom

- **polar molecule**
  - molecule that has oppositely charged regions

- **solution**
  - mixture that has a uniform composition throughout

- **mixture**
  - combination of two or more substances in which each substance retains its individual characteristics and properties

### Academic Vocabulary

- **suspend**
  - to keep from falling or sinking

---

56  

*Chemistry in Biology*
Section 6.3 Water and Solutions (continued)

Main Idea

Water’s Polarity

I found this information on page ________.

SE, p. 161
RE, pp. 62–63

Details

Analyze polarity by writing attract or repel to complete the diagram.

\[
\begin{array}{ccc}
+ & - & \text{repel} \\
+ & - & \text{attract} \\
- & + & \text{attract} \\
- & + & - \\
\end{array}
\]

Analyze reasons for water’s polarity and the effect of polarity.

Polarity of Water

<table>
<thead>
<tr>
<th>Reasons for polarity: Electrons are more strongly attracted to the oxygen nucleus than to the hydrogen nuclei, resulting in an unequal distribution of electrons. This, along with the molecule’s bent shape, creates oppositely charged regions.</th>
<th>Effects of polarity: Because oppositely charged regions attract, water molecules tend to form electrostatic bonds with other polar molecules and can readily form solutions.</th>
</tr>
</thead>
</table>

Identify the properties of water that allow it to help an organism maintain homeostasis.

<table>
<thead>
<tr>
<th>Property</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Universal solvent</td>
<td>Water can separate the ions in many compounds.</td>
</tr>
<tr>
<td>Adhesive</td>
<td>Water will form hydrogen bonds with other surfaces. Capillary action is one result.</td>
</tr>
<tr>
<td>Polar</td>
<td>Water has a slight positive charge on one side of the molecule and a slight negative charge on the other side.</td>
</tr>
<tr>
<td>Cohesive</td>
<td>Water molecules are attracted to each other.</td>
</tr>
</tbody>
</table>
Section 6.3 Water and Solutions (continued)

Main Idea

Mixtures with Water

 Identify each of the following mixtures as either homogeneous or heterogeneous.

- Sand and sugar: heterogeneous
- Salt and water: homogeneous
- Blood: heterogeneous

For any homogeneous mixture above, identify the solvent and the solute.

Solvent: water
Solute: salt

Construct a model of acidic solutions and basic solutions by placing each of the items below in the correct sequence on the scale.

- releases some hydrogen ions
- releases many hydrogen ions
- water
- releases some hydroxide ions
- releases many hydroxide ions
- water

Summarize

Analyze how water is important to life.

Accept all reasonable responses. Organisms are composed mostly of water. Humans can survive only a few days without water. Water has the ability to form many solutions in the body, enabling life functions. Water is a good insulator for the body. Water’s ability to form hydrogen bonds enables functions such as capillary action in plants.
**Main Idea**

**Details**

Skim Section 4 of the chapter. Write two facts that you learned from reading the headings and illustration captions.

1. Accept all reasonable responses.

2. Us your book or dictionary to define organic compound.

### Review Vocabulary

**organic compound**

- Carbon-based substance that is the basis of living matter

### New Vocabulary

**amino acid**

- Component of protein that is a compound made of carbon, nitrogen, oxygen, hydrogen, and sometimes sulfur

**carbohydrate**

- Compound composed of carbon, hydrogen, and oxygen in a ratio of one oxygen and two hydrogen atoms for each carbon atom

**lipid**

- Molecule made mostly of carbon and hydrogen that makes up the fats, oils, and waxes

**macromolecule**

- Large molecule that is formed by joining smaller organic molecules

**nucleic acid**

- Complex macromolecule that stores and transmits genetic information

**nucleotide**

- Repeating subunit of a nucleic acid

**polymer**

- Molecule made from repeating units of identical or nearly identical compounds called monomers that are linked together by a series of covalent bonds

**protein**

- Compound made of small carbon compounds called amino acids
Section 6.4 The Building Blocks of Life (continued)

**Main Idea**

**Organic Chemistry**

I found this information on page __________.

SE, p. 166
RE, p. 65

**Details**

**Contrast** an organic compound to an inorganic compound.

Any compound that contains carbon is organic. An inorganic compound is not carbon-based.

**Model** a carbon atom, and label its parts. Then use a label to point out and briefly explain why carbon can form a variety of organic compounds.

Models should resemble the carbon atom in the text, but with labels added for the nucleus, electrons, and first and second energy levels. It contains four electrons instead of the full eight, enabling covalent bonds to form chains of molecules.

**Compare** the composition and functions of the four major groups of biological macromolecules by completing the table below.

<table>
<thead>
<tr>
<th>Group</th>
<th>Composition</th>
<th>Functions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proteins</td>
<td>amino acids made of carbon, nitrogen, oxygen, hydrogen, and sometimes sulfur</td>
<td>transport substances; speed reactions; provide structural support; provide hormones</td>
</tr>
<tr>
<td>Nucleic acids</td>
<td>nucleotides made of carbon, nitrogen, oxygen, phosphorus, and hydrogen</td>
<td>store and communicate genetic information</td>
</tr>
<tr>
<td>Carbohydrates</td>
<td>carbon, hydrogen, and oxygen in ratio of one oxygen and two hydrogen for each carbon</td>
<td>store energy; provide structural support</td>
</tr>
<tr>
<td>Lipids</td>
<td>mostly carbon and hydrogen</td>
<td>store energy; provide steroids; waterproof coatings</td>
</tr>
</tbody>
</table>
Section 6.4 The Building Blocks of Life (continued)

**Main Idea**

Evaluate the number of molecules of each element in the carbohydrate described by the formula below.

\[(\text{CH}_2\text{O})_6\]

Carbon: 6  Hydrogen: 12  Oxygen: 6

Ratio of carbon, hydrogen, and oxygen: 1:2:1

Type of carbohydrate: monosaccharide/simple sugar

**Details**

Model the two general shapes of proteins named below.

- **Pleat**
  - Student drawings should look similar to a folded sheet of paper.

- **Helix**
  - Student drawings should have a spiral appearance.

Describe nucleic acids by filling in the following chart.

<table>
<thead>
<tr>
<th>Units that Make Up Nucleotides</th>
</tr>
</thead>
<tbody>
<tr>
<td>phosphate</td>
</tr>
</tbody>
</table>

Function of DNA: stores all the instructions for organisms to grow, reproduce, and adapt

Function of RNA: uses the information stored in DNA to make proteins

**CONNECT**

Identify two examples of foods that contain high amounts of each of the following macromolecules: carbohydrates, lipids, and proteins. If you need help, read food labels.

Accept all reasonable responses. Carbohydrates are found in pasta, potatoes, and fruit. Lipids are found in animal fat and vegetable oil. Proteins are found in meat and beans.
Tie It Together

You have read about chemical reactions. Now create a simple science review manual explaining how chemical reactions allow living things to grow and develop. Your review manual should be easy to read and contain basic information and specific examples. Include diagrams to illustrate the ideas. Use the space below to create an outline for your review manual.

Accept all reasonable responses.
## Cellular Structure and Function

### Before You Read

*Use the “What I Know” column to list the things you know about cells. Then list the questions you have about cells in the “What I Want to Find Out” column. Accept all reasonable responses.*

<table>
<thead>
<tr>
<th>K</th>
<th>What I Know</th>
<th>W</th>
<th>What I Want to Find Out</th>
<th>L</th>
<th>What I Learned</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Science Journal

*Imagine that you are small enough to fit inside a cell. Describe what you think you might observe while you are there.*

Accept all reasonable responses.

---

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Cellular Structure and Function 63
### Main Idea

**Skim** Section 1 of the chapter. Write three questions that come to mind from reading the headings and the illustration captions.

1. Accept all reasonable responses.
2. 
3. 

### Details

#### Review Vocabulary

*Use your book or dictionary to define organization.*

**organization**

orderly structure of cells in an organism

#### New Vocabulary

*Use your book or dictionary to define each term.*

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>cell</strong></td>
<td>basic unit of all living things</td>
</tr>
<tr>
<td><strong>cell theory</strong></td>
<td>theory that all organisms are made of one or more cells, which are</td>
</tr>
<tr>
<td></td>
<td>the basic units of life, and that all cells come from other cells</td>
</tr>
<tr>
<td><strong>eukaryotic cell</strong></td>
<td>cell with specialized structures, which include the nucleus and</td>
</tr>
<tr>
<td></td>
<td>other organelles</td>
</tr>
<tr>
<td><strong>nucleus</strong></td>
<td>cell organelle that controls the cell’s activities and contains DNA</td>
</tr>
<tr>
<td><strong>organelle</strong></td>
<td>membrane-bound structure with special functions within eukaryotic</td>
</tr>
<tr>
<td></td>
<td>cells</td>
</tr>
<tr>
<td><strong>plasma membrane</strong></td>
<td>boundary that helps control what enters and leaves a cell</td>
</tr>
<tr>
<td><strong>prokaryotic cell</strong></td>
<td>simple cell without specialized structures</td>
</tr>
</tbody>
</table>
History of the Cell Theory

I found this information on page 182–183.
SE, pp. 182–183
RE, pp. 69–70

Identify the three main ideas of the cell theory. Then write a short sentence for each one describing each idea. Accept all reasonable responses.

All living things are made of one or more cells. Sample response: I have seen that an onion is made of cells, and I know an onion was alive because it was a plant.

Cells are the basic units of structure and function in living things. Sample response: I know our muscles are made of muscle cells. I have seen that plants are made of plant cells.

All cells come from other cells. Sample response: We learned that living things only come from other living things. You cannot make a cell in a laboratory.

Microscope Technology

I found this information on page 183–185.
SE, pp. 183–185
RE, pp. 70–71

Summarize information about electron microscopes using five or six bullet points. Accept all reasonable responses. Important points are listed below.

- Microscopes improved in the 1930s–1940s.
- Microscopes allowed scientists to magnify objects up to 500,000 times.
- They use a beam of electrons instead of a beam of light.
- Scanning (SEM) can show a cell’s 3-D shape.
- Transmission (TEM) can help see inside a cell.
- Scanning tunneling electron microscope (STM) can show 3-D images of atoms.
### Basic Cell Types

Compare and contrast eukaryotic and prokaryotic cells by putting the phrases in the Venn diagram.

- **Eukaryotic cells**
  - have membrane-bound organelles
  - multicellular organisms
  - have a nucleus

- **Prokaryotic cells**
  - have membrane-bound organelles
  - unicellular organisms
  - do not have membrane-bound organelles

- **Both**
  - contain organelles
  - unicellular organisms
  - have loose strands of DNA

---

**Model** a eukaryotic cell. Label the parts of the cell.

Accept all reasonable models. Students should include and label the plasma membrane, nucleus, and one or more organelles.

---

### Summarize

Analyze how more sophisticated microscopes have allowed scientists to advance their knowledge of cells.

Accept all reasonable responses. Increased magnification has enabled scientists to study cells in greater detail. Today’s microscopes allow cell structures to be identified and studied.
Scan the illustrations and captions in Section 2 of the chapter. List two facts you discovered about the plasma membrane.

1. Accept all reasonable responses.

2. 

Use your book or dictionary to define ion.

atom or group of atoms with a positive or negative electrical charge

Use your book or dictionary to define each term.

**fluid mosaic model**
structural model of the plasma membrane where phospholipids and proteins float within the surface of the membrane

**phospholipid bilayer**
large molecule with a glycerol backbone, two fatty acid chains, and a phosphate group

**selective permeability**
process in which a membrane allows some molecules to pass through while keeping others out

**transport protein**
protein that moves needed substances or waste materials through the plasma membrane into or out of the cell
Section 7.2 The Plasma Membrane (continued)

Main Idea

Function of the Plasma Membrane
I found this information on page __________.
SE, p. 187
RE, p. 72

Details

Analyze what would happen if the cell membrane were not selectively permeable. Support your response.
Accept all reasonable analyses. Sample response: The cell might be destroyed because wastes could not leave and inappropriate molecules might enter the cell.

Identify five ways that the membrane can deal with materials.

keeping molecules out
allowing molecules in at any time
membrane deals with materials by
allowing molecules in only at certain times
allowing molecules in only in limited amounts
expelling wastes from inside the cell

Model a phospholipid, and label its parts. Describe how the phospholipid functions to make up the fluid membrane.
Accept all reasonable responses. The phosphate group forms the polar head of the molecule. It points outward to interact with the watery environment outside the cell. The nonpolar fatty acid tails point inward toward each other (since two layers make up each membrane) away from the water outside the cell. A barrier is created that is water-soluble on the outside but water-insoluble on the inside.

Diagrams should resemble those on SE p. 188.
Model the plasma membrane. Label each part, and describe the function of that part in detail.

Diagrams should clearly show and explain phospholipids, proteins, and cholesterol.

- **phospholipids**: polar phosphate heads allow membrane to interact with surface water; nonpolar tails are on inside of membrane and make it difficult for water-soluble particles to move through the membrane.
- **transport proteins**: regulate what is allowed to enter and exit the cell through the membrane.
- **cholesterol**: keeps phospholipids fluid, prevents them from sticking together.
- **receptors**: transmit signals to the inside of cells.

Discuss how the terms fluid and mosaic describe the plasma membrane.

**Fluid**: It is fluid because the phospholipids, proteins, and cholesterol float in the membrane.

**Mosaic**: It is a mosaic because it has many parts. The proteins create patterns on the membrane's surface.

Summarize: Analyze the role of the plasma membrane in maintaining homeostasis in the cell.

Accept all reasonable responses. As a selectively permeable barrier between the inside of the cell and the outside environment, the plasma membrane controls the amount of substances entering and leaving the cell and the timing of substance flow.
Main Idea

Skim Section 3 of the chapter. Write two questions that come to mind from reading the headings and the illustration captions.

1. Accept all reasonable responses.

2. ________________________________

Details

Review Vocabulary

Use your book or dictionary to define enzyme.

enzyme

protein that speeds up the rate of a chemical reaction

New Vocabulary

cell wall
centriole
chloroplast
cilium
cytoplasm
cytoskeleton
endoplasmic reticulum
flagellum
Golgi apparatus
lysosome
mitochondrion
nucleolus
ribosome
vacuole

Write each term in the table under the heading that best describes it.

<table>
<thead>
<tr>
<th>Cell Structure (5)</th>
<th>Related to Genetic Material (2)</th>
<th>Food, Storage, and Waste (5)</th>
<th>Energy (2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>cell wall</td>
<td>nucleolus</td>
<td>cytoplasm</td>
<td>chloroplast</td>
</tr>
<tr>
<td>cilium</td>
<td>ribosome</td>
<td>endoplasmic reticulum</td>
<td>mitochondrion</td>
</tr>
<tr>
<td>cytoskeleton</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>flagellum</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>centriole</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Compare and contrast each pair of terms by defining them and noting their differences.

<table>
<thead>
<tr>
<th>Chloroplast</th>
<th>Mitochondrion</th>
</tr>
</thead>
<tbody>
<tr>
<td>plant organelle that captures light and converts it to a chemical</td>
<td>in plants and animals, converts energy to a form cells can use</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Vacuole</th>
<th>Centriole</th>
</tr>
</thead>
<tbody>
<tr>
<td>storage compartment in a cell</td>
<td>organelle that functions during cell division</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cilium</th>
<th>Flagellum</th>
</tr>
</thead>
<tbody>
<tr>
<td>short, hairlike projection that aids in locomotion</td>
<td>long, hairlike projection that aids in locomotion</td>
</tr>
</tbody>
</table>
Section 7.3 Structures and Organelles (continued)

Main Idea

Cytoplasm and Cytoskeleton

I found this information on page _________.
SE, pp. 191–192
RE, p. 75

Compare the cytoplasm and cytoskeleton by defining each in the boxes.

<table>
<thead>
<tr>
<th>Cytoplasm</th>
<th>Cytoskeleton</th>
</tr>
</thead>
<tbody>
<tr>
<td>semifluid material inside the organelles or plasma membrane in which cell processes take place directly</td>
<td>supporting network of long, thin protein fibers forming a framework for the cell and providing an anchor for organelles</td>
</tr>
</tbody>
</table>

Cell Structures

I found this information on page _________.
SE, pp. 193–199
RE, pp. 75–78

Identify the part of the cell that corresponds to each function described.

<table>
<thead>
<tr>
<th>Part of the Cell</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>nucleus</td>
<td>directs cell processes; contains the cell’s DNA; stores information for cell growth, function, and reproduction</td>
</tr>
<tr>
<td>nuclear envelope</td>
<td>double membrane that surrounds the nucleus</td>
</tr>
<tr>
<td>ribosome</td>
<td>helps manufacture proteins</td>
</tr>
<tr>
<td>nucleolus</td>
<td>produces ribosomes inside the nucleus</td>
</tr>
<tr>
<td>endoplasmic reticulum</td>
<td>site of ribosome attachment; can be smooth or rough</td>
</tr>
<tr>
<td>Golgi apparatus</td>
<td>modifies, sorts, and packages proteins for transport outside the cell</td>
</tr>
<tr>
<td>vacuole</td>
<td>membrane-bound storage area within the cell</td>
</tr>
<tr>
<td>lysosome</td>
<td>vesicle that contains substances that digest excess or worn-out organelles</td>
</tr>
<tr>
<td>centriole</td>
<td>structure near the nucleus that functions during cell division</td>
</tr>
<tr>
<td>mitochondrion</td>
<td>converts fuel particles (sugars) into useable energy</td>
</tr>
<tr>
<td>chloroplast</td>
<td>captures light energy and converts it to chemical energy through photosynthesis</td>
</tr>
<tr>
<td>cell wall</td>
<td>gives support to plant cells</td>
</tr>
<tr>
<td>cilia and flagella</td>
<td>projections that allow the cell to move or to move substances along the surface of the cell</td>
</tr>
</tbody>
</table>
Comparing Cells
I found this information on page ________
SE, p. 200
RE, p. 79

Plant Cells Only
- cell wall, chloroplast

Both Plants and Animals
- cytoskeleton, endoplasmic reticulum, Golgi apparatus, mitochondrion, nucleus, plasma membrane, ribosome, vacuole

Animal/Protist Cells Only
- centriole, cilia, flagella, lysosome

Sequence the steps that describe how proteins are made by completing the flowchart.

1. RNA _______ picks up information from DNA.
2. RNA _______ and ribosomes _______ leave the nucleus.
3. RNA _______ and ribosomes work together to make _______ proteins _______ on the surface of the _______ endoplasmic reticulum _______.

CONNECT
Create and describe a unique model for the structure and function of the cell.
Accept all reasonable responses. Responses should mention specific cell parts and their role in the metaphor.
Cellular Structure and Function

Section 7.4 Cellular Transport

Main Idea

Details

**Skim** Section 4 of the chapter. Write two questions that come to mind from reading the headings and the illustration captions.

1. Accept all reasonable responses.

2. ______________

**Review Vocabulary**

*Use your book or dictionary to define homeostasis.*

- homeostasis
  - regulation of the internal environment to maintain conditions suitable for life

**New Vocabulary**

Write the correct vocabulary term in the left column for each definition below.

- **endocytosis**
  - process by which the plasma membrane surrounds a substance outside the cell and moves it inside the cell

- **active transport**
  - movement of substances from a region of lower concentration to a region of higher concentration

- **diffusion**
  - net movement of particles from an area where there are many particles of the substance to an area where there are fewer

- **hypertonic solution**
  - solution that has a higher concentration of solutes in the cell

- **isotonic solution**
  - solution in which the inside of the cell and the solution it is in have the same concentration of water and solutes

- **exocytosis**
  - process by which the plasma membrane surrounds a substance inside the cell and moves it outside the cell

- **osmosis**
  - diffusion of water across a selectively permeable membrane

- **facilitated diffusion**
  - form of transport that uses transport proteins to move other ions and small molecules across the plasma membrane

- **dynamic equilibrium**
  - condition in which there is continuous movement but no overall change in concentration

- **hypotonic solution**
  - solution that has a lower concentration of solutes in the cell
Section 7.4 Cellular Transport (continued)

**Main Idea**

**Diffusion**

I found this information on page __________.

SE, pp. 201–202
RE, pp. 80–81

**Osmosis: Diffusion of Water**

I found this information on page __________.

SE, pp. 203–205
RE, pp. 81–82

**Details**

**Rephrase** the process of diffusion in your own words, and give an example.

Accept all reasonable responses.

**Summarize** the relationship between water and the plasma membrane by completing the concept web below.

Model a cell in a hypertonic, hypotonic, and isotonic solution.

Underneath each model, summarize the effect of each solution on the cell. Accept all reasonable responses.

<table>
<thead>
<tr>
<th>Solutions</th>
<th>Hypertonic</th>
<th>Hypotonic</th>
<th>Isotonic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pressure inside the cell decreases in a hypertonic solution.</td>
<td>A cell swells when placed in a hypotonic solution.</td>
<td>Cell shows no effect when placed in an isotonic solution.</td>
<td></td>
</tr>
</tbody>
</table>
**Main Idea**

**Active Transport** and **Transport of Large Particles**

Classify and summarize the five ways particles move through the membrane. Make notes and sketches in the rectangle for each one. Accept all reasonable responses.

**Details**

**Passive Transport**

- Simple diffusion
  - cell uses no energy to move particles; they just diffuse through membrane

- Facilitated diffusion
  - transport proteins; assist passive transport

**Active Transport**

- Active transport
  - cell uses carrier proteins to help move particles; requires energy

**Transport of Large Particles**

- Exocytosis
  - requires energy, active transport; membrane capsule joins cell membrane and expels material

- Endocytosis
  - requires energy, active transport; cell engulfs materials with a portion of the cell’s plasma membrane and releases the contents within the cell

**CONNECT**

Think of real-life movement between locations, and make analogies of the five different kinds of transport that occurs through the cell membrane. Explain how each type of transport works in your analogy.

- Accept all reasonable responses. Simple diffusion is like walking through an entryway of streamers; facilitated diffusion is like taking an escalator; active transport is like entering through a subway gate using a ticket; endocytosis is like receiving shipping; and exocytosis is like taking out the garbage.
Tie It Together

Make a concept web to show the main ideas and important details in this chapter, and the relationships between the facts you learned. Hint: You might find it easier to list the facts or topics you want to include first, then decide how to connect them in the web.

Accept all reasonable responses.
Cellular Energy

Before You Read

Before you read the chapter, respond to these statements. Accept all reasonable responses.

1. Write an A if you agree with the statement.
2. Write a D if you disagree with the statement.

<table>
<thead>
<tr>
<th>Before You Read</th>
<th>Cellular Energy</th>
<th>After You Read</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy can be transformed, but it cannot be created or destroyed.</td>
<td>A</td>
<td></td>
</tr>
<tr>
<td>ATP is a molecule used by cells to store energy.</td>
<td>A</td>
<td></td>
</tr>
<tr>
<td>Photosynthesis takes place inside the chloroplasts.</td>
<td>A</td>
<td></td>
</tr>
<tr>
<td>Cellular respiration occurs in two stages: glycolysis and the Calvin cycle.</td>
<td>D</td>
<td></td>
</tr>
</tbody>
</table>

Science Journal

How does energy get to cells? How do cells use energy? Write your own ideas.

Accept all reasonable responses.
Main Idea

Scan Section 1 of the chapter and make a list of three general ways in which cells use energy.

1. Accept all reasonable responses.

2. 

3. 

Details

Review Vocabulary

Use your book or dictionary to define metabolism.

metabolism all the chemical reactions that occur within an organism

New Vocabulary

Use your book or dictionary to define each vocabulary term.

adenosine triphosphate energy-storing molecule in cells, made of an adenosine molecule, a ribose sugar, and three phosphate groups

cellular respiration catabolic pathway in which organic molecules are broken down to release energy

domain the ability to do work

metabolism all of the chemical reactions in a cell

photosynthesis anabolic pathway in which light energy from the Sun is harvested as chemical energy for use by living things

thermodynamics the study of how energy flows and is transformed in the universe
Section 8.1 How Organisms Obtain Energy (continued)

**Main Idea**

**Transformation of Energy**

I found this information on page __________.
SE, pp. 218–219
RE, pp. 83–84

**Details**

Organize at least seven of your body’s cell processes that require energy. Accept all reasonable responses.

<table>
<thead>
<tr>
<th>Energy in Cell Processes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
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<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

**Metabolism**

I found this information on page __________.
SE, p. 220
RE, pp. 84–85

**Compare** the laws about how energy flows. Give an example of each.

<table>
<thead>
<tr>
<th>First Law of Thermodynamics</th>
<th>Second Law of Thermodynamics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Defined</td>
<td>Defined</td>
</tr>
<tr>
<td></td>
<td>Energy is neither created nor destroyed, only transformed.</td>
</tr>
<tr>
<td>Example</td>
<td>Example</td>
</tr>
<tr>
<td></td>
<td>The body converts stored energy in food into chemical energy.</td>
</tr>
</tbody>
</table>

**Sequence** the flow of energy from the Sun to heterotrophs.

Plants and other autotrophs capture energy from the Sun. → Plants convert it to chemical energy. → Chemical energy is stored as food. → Heterotrophs obtain this energy by eating other organisms.
Section 8.1 How Organisms Obtain Energy (continued)

**Main Idea**

**Compare and contrast** catabolic and anabolic pathways by writing characteristics of each in the Venn diagram.

- **Catabolic**: break down larger molecules into smaller molecules and release energy
- **Anabolic**: build up larger molecules from smaller ones and use energy
- **Both**: part of the metabolism of cells

**ATP: The Unit of Cellular Energy**

*I found this information on page __________.*

SE, p. 221
RE, p. 85

**Summarize** ATP and ADP.

- **ATP**
  Explain how your body uses ATP, and list the three parts of the molecule. Adenosine triphosphate provides quick energy for cells when they need it. It is made of an adenosine molecule, a ribose sugar, and three phosphate groups.

- **ADP**
  Explain how ADP is made from ATP. Adenosine diphosphate is made when ATP loses a phosphate group.

**SUMMARIZE**

Design a concept map to show the three most important ideas from this section.

Encourage students to choose concise but meaningful phrases for their maps.
Scan Section 2 of the chapter. Write two questions that come to mind from reading the headings and the illustration captions.

1. Accept all reasonable responses.

2. ______

**Review Vocabulary**  
Use your book or dictionary to define carbohydrate.

**carbohydrate**  
an organic compound containing carbon, hydrogen, and oxygen

**New Vocabulary**  
Use your book or dictionary to define each vocabulary term.

**Calvin cycle**  
series of reactions during the light-independent phase of photosynthesis in which energy is stored in simple sugars

**granum**  
a stack of thylakoid membranes on the inside of chloroplasts

**NADP+**  
final electron-carrying molecule in light-dependent reactions; combines with electrons to form the energy-storage molecule NADPH

**pigments**  
molecules that absorb specific wavelengths of light

**rubisco**  
an enzyme in the Calvin cycle that converts inorganic carbon molecules into organic molecules that can be used by the cell

**stroma**  
the fluid-filled space outside the grana; location of the light-independent reactions of photosynthesis

**thylakoid**  
flattened saclike membranes inside chloroplasts; location of the light-dependent reactions of photosynthesis

**Academic Vocabulary**  
Define transport to show its scientific meaning.

transport  
to carry something from one place to another
Overview of Photosynthesis

I found this information on page 222.
SE, p. 222
RE, p. 86

Phase One: Light Reactions

I found this information on page 223–224.
SE, pp. 223–224
RE, pp. 87–88

Summarize the functions of the light-dependent and light-independent reactions by completing the sentences.

Plants and other green organisms trap light energy from the Sun. The light-dependent reactions change light energy into the molecules ATP and NADPH. The light-dependent reactions use ATP and NADPH to make glucose.

The light-independent reactions produce simple sugars, which are then made into complex carbohydrates, such as starch, which stores energy in plants.

Create a concept web to summarize what you know about chloroplasts and chlorophyll. Accept all reasonable responses.

Analyze how leaves change color in the fall.

Leaves break down chlorophyll, so other pigment colors become visible.

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Section 8.2 Photosynthesis (continued)

**Main Idea**

**Phase Two: The Calvin Cycle**

I found this information on page ________.

SE, p. 226
RE, p. 89

**Details**

Model *light-dependent reactions in a flow chart.*

Accept all reasonable responses.

Compare *light-dependent and light-independent reactions by putting each phrase into the correct part of the Venn diagram.*

- forms stored energy
- makes NADPH
- makes sugar
- needs sunlight
- occurs in the chloroplast
- occurs in the dark
- uses Calvin cycle
- uses electron transport chain

Alternative Pathways

I found this information on page ________.

SE, p. 227
RE, p. 89

Compare *two alternative photosynthesis pathways. Identify plants that use each pathway.*

<table>
<thead>
<tr>
<th>Pathway: $C_4$ pathway</th>
<th>Pathway: CAM pathway</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description: carbon dioxide fixed in 4-carbon instead of 3-carbon compounds</td>
<td>Description: carbon dioxide enters leaves only at night</td>
</tr>
<tr>
<td>Plants that use this pathway: sugar cane and corn</td>
<td>Plants that use this pathway: cacti, orchids, and pineapple</td>
</tr>
</tbody>
</table>

**Summarize**

Explain the results of light-dependent and light-independent reactions. Accept all reasonable responses.

Sunlight triggers light-dependent reactions, which produce ATP and NADPH molecules to produce sugars out of carbon dioxide and water.
Scan the headings, illustrations, and captions in Section 3 of the chapter. Write three facts that you discover about cellular respiration.

1. Accept all reasonable responses.
2. 
3. 

Use your book or dictionary to define cyanobacterium.

cyanobacterium

a type of eubacterium that is a photosynthetic autotroph

Read the definitions below and write the correct vocabulary term in the blank.

**anaerobic process**

metabolic process that does not require oxygen

**glycolysis**
in cellular respiration, a series of anaerobic chemical reactions in the cytoplasm that break down glucose into pyruvic acid; forms a net profit of two ATP molecules

**aerobic**

metabolic processes that require oxygen

**Krebs cycle**
in cellular respiration, a cycle of chemical reactions that break down glucose and produce ATP; energizes electron carriers that pass the energized electrons on to the electron transport chain

**fermentation**
a series of anaerobic reactions in the cytoplasm that regenerate NAD$^+$ for glycolysis and produce ATP; supplies energy for aerobic organisms when oxygen is low

**aerobic respiration**
in cellular respiration, the processes that take place in the mitochondrion and require oxygen; includes the Krebs cycle and electron transport
Section 8.3 Cellular Respiration (continued)

Main Idea

Overview of Cellular Respiration
I found this information on page 228
SE, p. 228
RE, p. 90

Glycolysis, Krebs Cycle, and Electron Transport
I found this information on page 229–231
SE, pp. 229–231
RE, pp. 90–91

Details

Rephrase the function of cellular respiration in your own words. Write the equation that describes it.

**Function:** harvest electrons from carbon compounds and use that energy to make ATP

**Equation:**
\[ \text{C}_6\text{H}_{12}\text{O}_6 + 6 \text{O}_2 \rightarrow 6 \text{CO}_2 + 6 \text{H}_2\text{O} + \text{energy} \]

Compare and summarize the three stages of cellular respiration. Accept all reasonable responses.

<table>
<thead>
<tr>
<th>Glycolysis</th>
<th>Krebs Cycle</th>
<th>Electron Transport</th>
</tr>
</thead>
<tbody>
<tr>
<td>a series of chemical reactions that break down glucose</td>
<td>a series of chemical reactions that break down pyruvate from glycolysis</td>
<td>ATP made from high-energy electrons and protons.</td>
</tr>
<tr>
<td>takes place in the cytoplasm of the cell</td>
<td>takes place in the mitochondria</td>
<td>takes place in mitochondrial membrane</td>
</tr>
<tr>
<td>produces two ATP molecules for every glucose molecule that is broken down</td>
<td>produces one ATP and two CO2</td>
<td>provides energy for ATP production final electron acceptor is electron oxygen</td>
</tr>
</tbody>
</table>

Anaerobic Respiration
I found this information on page 231–232
SE, pp. 231–232
RE, p. 92

Sequence events that lead to fermentation in aerobic organisms.

Cause: Cells can't get enough oxygen.

Fermentation follows glycolysis.

It replaces the Krebs cycle and electronic transport.

Fermentation is needed to replenish the supply of NAD+ for glycolysis.
Section 8.3 Cellular Respiration (continued)

**Main Idea**

Summarize a process of fermentation that is useful to humans.

Alcoholic fermentation is a process used by some types of bacteria and yeast to make CO₂ and ethyl alcohol from pyruvic acid (which is made during glycolysis from glucose). This process is used to produce alcoholic beverages.

**Details**

Photosynthesis and Cellular Respiration

I found this information on page ____________

SE, p. 233
RE, p. 98

**Compare** photosynthesis and respiration in a Venn diagram.

Encourage students to make detailed notes. Accept all reasonable responses.

Photosynthesis

- food is made;
- energy from the Sun is stored as sugar;
- CO₂ is used;
- O₂ is produced;
- needs light;
- occurs in chloroplasts

Both

- use electron carriers and a cycle of chemical reactions to form ATP; electron transport takes place in membranes

Respiration

- food is broken down;
- sugar energy is used;
- CO₂ and H₂O are produced;
- O₂ is used;
- does not need light; occurs in all cells, both plant and animal

**Summarize**

Create a graphic organizer to compare aerobic and anaerobic processes. Accept all reasonable responses.
Cellular Reproduction

Before You Read

Use the "What I Know" column to list the things you know about how cells work. Then list the questions you have about how cells work in the "What I Want to Find Out" column. Accept all reasonable responses.

<table>
<thead>
<tr>
<th>K</th>
<th>What I Know</th>
<th>W</th>
<th>What I Want to Find Out</th>
<th>L</th>
<th>What I Learned</th>
</tr>
</thead>
</table>

New cells are created in your body every day. Write about the reasons your body might need new cells.

Accept all reasonable responses.
Scan the titles, boldfaced words, pictures, figures, and captions in Section 1. Write three facts you discovered about cellular growth as you scanned the section.

1. Accept all reasonable responses.
2. ____________________________
3. ____________________________

Use your book or dictionary to define carbohydrate.

Carbohydrate: an organic compound containing carbon, hydrogen, and oxygen, usually in a 1:2:1 ratio

Use your book or dictionary to define each term.

- Cell cycle: the sequence of events by which cells grow and divide
- Chromatin: the relaxed form of DNA in the cell’s nucleus
- Chromosome: structure in the nucleus that contains the genetic material
- Cytokinesis: the stage of the cell cycle in which the cytoplasm divides and a new cell is created
- Interphase: the stage of the cell cycle during which the cell grows, carries out normal functions, and copies its DNA
- Mitosis: the stage of the cell cycle during which the nucleus and nuclear material divide
Section 9.1 Cellular Growth (continued)

Cell Size Limitations

I found this information on page 244–246.
SE, pp. 244–246
RE, pp. 93–94

Analyze movement of nutrients and wastes as cell size increases. Accept all reasonable responses.

If a cell gets too large, transport of nutrients and wastes by diffusion slows down. Therefore, cells divide before they become too large.

Describe how surface area-to-volume ratio relates to cell size by completing the sentence.

As a cell grows larger, its volume increases more rapidly than its surface area, thus surface area-to-volume ratio decreases.

Complete the diagram of the cell cycle. Describe the main events in each stage.

Chromosomes to opposite poles of the cell. Nucleus divides.

Cell makes microtubules in preparation for cell division.

mitosis

Cytoplasm divides. Two daughter cells are formed.

The Cell Cycle

G2

mitosis

cytokinesis

S

Cell replicates its DNA.

G1

Cell is growing and performing normal functions.
Organize information about chromosomes in the concept web. Accept all reasonable responses.

Chromosomes are the carriers of the genetic material that is copied and passed from generation to generation.

For most of the cell’s lifetime, they exist as chromatin.

Just before cells divide, they appear as several short, stringy structures in the nucleus.

Without the proper amount of DNA the cell cannot survive. Therefore, chromosomes must be accurately passed on to new cells.

Identify four events that occur in a cell during interphase.

1. cell grows
2. cell carries on metabolism
3. cell duplicates chromosomes
4. cell prepares for division

Cells must stay small to function properly. Cells use the cell cycle to stay small. Actively growing cells are in interphase. When a growing cell reaches its maximum size, it keeps itself small by entering mitosis and cytokinesis and dividing into two smaller daughter cells.
Section 2 of the chapter. From the headings and illustrations list the four stages of mitosis.

1. **prophase**
2. **metaphase**
3. **anaphase**
4. **telophase**

**life cycle**

Use your book or dictionary to define life cycle.

*life cycle*

the sequence growth and development stages that an organism goes through during its life

**anaphase**

Use your book or dictionary to define the following terms.

*anaphase*

the third stage of mitosis, during which the centromeres separate and the chromatids are pulled apart

*centromere*

structure at the center of the chromosome to which the sister chromatids attach

*metaphase*

the second stage of mitosis, during which the sister chromatids line up along the equator of the cell

*prophase*

the first stage of mitosis, during which the chromatid condenses into chromosomes

*sister chromatid*

structures in a chromosome containing identical copies of the DNA

*spindle apparatus*

structure that helps move and organize the chromosomes during mitosis; made of spindle fibers, centrioles, and aster fibers

*telophase*

the final stage of mitosis, during which the chromosomes migrate to the poles of the cell and then decondense
Mitosis

I found this information on page ____.
SE, p. 248
RE, p. 96

The Stages of Mitosis

I found this information on page ____.
SE, pp. 248–251
RE, pp. 96–98

Identify two functions of mitosis in animals.

Function of mitosis in animals
- wound repair
- growth of organism to adult size

Model the stages of mitosis and the process of cytokinesis. Draw and label a cell in each stage, name each stage, and describe what is happening. Accept all reasonable responses.

<table>
<thead>
<tr>
<th>Name of Phase</th>
<th>Sketch of Cell</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>prophase</td>
<td></td>
<td>chromatin coils to form chromosomes</td>
</tr>
<tr>
<td>metaphase</td>
<td></td>
<td>chromosomes move to the center of the cell</td>
</tr>
<tr>
<td>anaphase</td>
<td></td>
<td>centromeres split and sister chromatids are pulled to the opposite sides of the cell</td>
</tr>
<tr>
<td>telophase</td>
<td></td>
<td>two new nuclei are formed and a double membrane begins to form between them</td>
</tr>
<tr>
<td>cytokinesis</td>
<td></td>
<td>cell’s cytoplasm divides and separates into two new identical cells</td>
</tr>
</tbody>
</table>

Summarize the similarities and differences of any two phases of mitosis.

Accept all reasonable responses.

Section 9.2 Mitosis and Cytokinesis (continued)
Section 9.2 Mitosis and Cytokinesis (continued)

**Main Idea**

I found this information on page __________.
SE, pp. 248–251
RE, pp. 96–98

**Details**

**Summarize** the function of each structure in mitosis.

- **centromeres**: part of chromosome to which spindle apparatus attaches
- **microtubules**: tube-like structures that shorten and pull the chromosomes to opposite poles of the cell
- **motor proteins**: help microtubules pull chromosomes to poles of the cell
- **spindle apparatus**: attaches to and moves the chromosomes

**Cytokinesis**

I found this information on page __________.
SE, p. 252
RE, p. 99

**Compare and contrast** cytokinesis in plant and animal cells.

<table>
<thead>
<tr>
<th>Cytokinesis in Plant Cells</th>
<th>Both</th>
<th>Cytokinesis in Animal Cells</th>
</tr>
</thead>
<tbody>
<tr>
<td>cell plate and new cell walls form between the daughter cells</td>
<td>results in genetically identical daughter cells</td>
<td>occurs by microfilaments constricting the dividing cell and pinching it into two daughter cells</td>
</tr>
</tbody>
</table>

**SUMMARIZE**

Create a concept map describing the stages of the cell cycle.
Accept all reasonable responses.

- **cell cycle**
  - **interphase**
    - 1. prophase
    - 2. metaphase
    - 3. anaphase
    - 4. telophase
  - **mitosis**
  - **cytokinesis**
### New Vocabulary

**nucleotide**
- subunit that makes up RNA and DNA

**apoptosis**
- process of programmed cell death

**cancer**
- uncontrolled growth and division of cells; results from a failure of cell cycle regulation

**carcinogen**
- substance known to cause cancer

**cyclin**
- protein that binds to cyclin-dependent kinases to regulate the activities of the cell cycle

**cyclin-dependent kinase**
- enzymes that are activated by cyclins and serve to regulate the activities of the cell cycle

**stem cell**
- unspecialized cells that have the potential to develop into specialized cells
Section 9.3 Cell Cycle Regulation (continued)

**Main Idea**

**Normal Cell Cycle**

I found this information on page ____________.
SE, pp. 253–254
RE, pp. 100–101

**Details**

**Summarize** how cells regulate the cell cycle. Choose from the list of words to complete the paragraph.

- checkpoints
- cyclin-dependent kinases
- G2 stage
- cyclin/CDK
- cytokinesis
- mitosis
- cyclins
- G1 stage
- S stage

Cells use ___cyclins___ and ___cyclin-dependent kinases___ to control the cell cycle. Different combinations of ___cyclin/CDK___ start the cell cycle at different ___checkpoints___. The cell also uses ___cyclin/CDK___ to monitor the cycle for quality control. In ___G1 stage___, the cell checks the DNA for damage. If there is any damage, the cycle won’t proceed to ___S stage___.

In ___mitosis___, if the spindle apparatus is malfunctioning, the cycle won’t proceed to ___cytokinesis___.

**Abnormal Cell Cycle**

I found this information on page ____________.
SE, pp. 254–255
RE, pp. 101–102

**Sequence** the causes and effects of cancer by completing the flow chart below.

Cancer is the uncontrolled growth and division of cells.

Cancer is the result of a failure in regulation of the cell cycle.

Cells lose control when genes that regulate the cell cycle are damaged.

Cancer cells cause damage by crowding out normal cells, leading to organ failure.

**Identify** four environmental factors that cause cancer.

1. cigarette smoke  3. X rays
2. asbestos  4. ultraviolet radiation
Section 9.3 Cell Cycle Regulation (continued)

**Main Idea**

**Apoptosis**

I found this information on page __________.

Apoptosis is a process of programmed cell death.

Organisms use apoptosis to destroy cells that are no longer needed.

Two processes that use apoptosis:

1. trees losing their leaves in autumn
2. development of hands and feet

**Details**

Summarize information about apoptosis.

**Stem Cells**

I found this information on page __________.

Compare and contrast adult and embryonic stem cells by writing characteristics in the Venn diagram.

<table>
<thead>
<tr>
<th>Adult</th>
<th>Both</th>
<th>Embryonic</th>
</tr>
</thead>
<tbody>
<tr>
<td>come from various tissues in the body; present from infancy through adulthood</td>
<td>unspecialized cells that have the potential to become specialized</td>
<td>100–150 cells formed after fertilization; will become specialized as embryo grows</td>
</tr>
</tbody>
</table>

| Connect |

A classmate thinks that cancer and apoptosis are both harmful to organisms. Do you agree or disagree? Explain your reasoning.

Accept all reasonable responses. Only cancer is harmful to an organism. Apoptosis is a normal process in which cells that are not needed by an organism die in a controlled process.

---

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Sexual Reproduction and Genetics

Before You Read

Use the “What I Know” column to list the things you know about genetics. Then list the questions you have about genetics in the “What I Want to Find Out” column. Accept all reasonable responses.

<table>
<thead>
<tr>
<th>K</th>
<th>What I Know</th>
</tr>
</thead>
<tbody>
<tr>
<td>W</td>
<td>What I Want to Find Out</td>
</tr>
<tr>
<td>L</td>
<td>What I Learned</td>
</tr>
</tbody>
</table>

Genetics explains why you have inherited certain characteristics from your parents. Write about some characteristics that you have inherited from your own parents, or similarities in other families, animals, or plants that you think might have been inherited.

Accept all reasonable responses.

---

Sexual Reproduction and Genetics 97
Skim the headings and illustration captions in Section 1 of the chapter. Write three facts you discovered about meiosis as you scanned the section.

1. Accept all reasonable responses.

2. __________________________________________________________________________

3. __________________________________________________________________________

Use your book or dictionary to define chromosome.

A segment of DNA on a chromosome that controls the production of a protein is called a ____________. A ___________ cell contains two copies of each chromosome. A sex cell, or ____________, is ____________, meaning it contains one copy of each chromosome. ___________ are pairs of chromosomes, one from each parent.

Describe three processes that occur during sexual reproduction. Accept all reasonable responses.

<table>
<thead>
<tr>
<th>What happens?</th>
<th>Meiosis</th>
<th>Fertilization</th>
<th>Crossing Over</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>cell division reduces chromosome number</td>
<td>two haploid sex cells, one from each parent combine</td>
<td>segments of homologous chromosomes break and change places</td>
</tr>
<tr>
<td>What is the product?</td>
<td>four haploid cells</td>
<td>a diploid fertilized egg</td>
<td>new combinations of genetic material on chromosomes</td>
</tr>
</tbody>
</table>
Section 10.1 Meiosis (continued)

Main Idea

Chromosomes and Chromosome Numbers
I found this information on page __________.
SE, pp. 270–271
RE, pp. 103–104

Meiosis I, Meiosis II, and The Importance of Meiosis
I found this information on page __________.
SE, pp. 271–276
RE, pp. 105–108

Details

Identify three characteristics that are the same in each member of a pair of homologous chromosomes. Name one thing that is different.

<table>
<thead>
<tr>
<th>Same</th>
<th>Different</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. length</td>
<td>1. exact version of each gene</td>
</tr>
<tr>
<td>2. centromere position</td>
<td></td>
</tr>
<tr>
<td>3. position of genes</td>
<td></td>
</tr>
</tbody>
</table>

Compare and contrast the phases of Meiosis I and Meiosis II.
Sketch each phase. Accept all reasonable responses. Sketches should be similar to those in the text.

Meiosis I

<table>
<thead>
<tr>
<th>Description</th>
<th>Prophase I</th>
<th>Metaphase I</th>
<th>Anaphase I</th>
<th>Telophase I</th>
</tr>
</thead>
<tbody>
<tr>
<td>chromosomes condense and pair up</td>
<td>spindle fiber attaches to</td>
<td>metaphase, pulls</td>
<td>chromosomes move from each</td>
<td>each pole contains one</td>
</tr>
<tr>
<td>and spindle forms</td>
<td>centromere, pulls chromosomes</td>
<td>center of cell</td>
<td>other toward poles of cell</td>
<td>member of a pair of homologous</td>
</tr>
<tr>
<td></td>
<td>to center of cell</td>
<td></td>
<td>cell divides</td>
<td>chromosomes, cell divides</td>
</tr>
</tbody>
</table>

Sketch

Meiosis II

<table>
<thead>
<tr>
<th>Description</th>
<th>Prophase II</th>
<th>Metaphase II</th>
<th>Anaphase II</th>
<th>Telophase II</th>
</tr>
</thead>
<tbody>
<tr>
<td>chromosomes condense and spindle</td>
<td>haploid number of chromosomes</td>
<td>sister chromatids are pulled</td>
<td>nuclear membrane and nucleus</td>
<td></td>
</tr>
<tr>
<td>forms</td>
<td>line up at center of cell</td>
<td>apart</td>
<td>reforms, cell divides into 4</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>haploid cells</td>
<td></td>
</tr>
</tbody>
</table>

Sketch

Analyze the chart above to determine the phase of meiosis when crossing over can occur. Mark a star on the correct phase. Students should place a star by Prophase I.
Sexual Reproduction v. Asexual Reproduction
I found this information on page ________
SE, p. 276
RE, p. 108

Compare meiosis and mitosis by filling in the chart below.

<table>
<thead>
<tr>
<th></th>
<th>Mitosis</th>
<th>Meiosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of DNA replications</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Number of cell divisions</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Number of daughter cells</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Chromosome number of daughter cells</td>
<td>2n</td>
<td>n</td>
</tr>
</tbody>
</table>

Organize information on how meiosis produces genetic variation.

Meiosis produces random arrangement of chromosomes at equator

Meiosis produces crossing over

Compare sexual reproduction and asexual reproduction by completing the paragraph with the terms below.

- sexual reproduction
- protists
- animals
- genes
- asexual reproduction
- mammals
- plants
- genetic diversity

In ______ asexual reproduction, an organism inherits its genetic material from a single parent. The new organism has the same ______ genes as its parent. In ______ sexual reproduction, an organism inherits genetic material from two different parents. Sexual reproduction increases ______ genetic diversity, whereas asexual reproduction does not. ______ Protists, simple ______ animals, and most ______ plants can reproduce sexually or asexually. ______ Mammals only reproduce sexually.

SUMMARIZE

Explain how meiosis and fertilization produce genetic variation during sexual reproduction.

Crossing over and random sorting of chromosomes during meiosis increase genetic variation.

Fertilization increases genetic variation further by combining genetic material from two different individuals.
Sexual Reproduction and Genetics

Section 10.2 Mendelian Genetics

**Main Idea**

**Details**

**Skim** Section 1 of the chapter, and then write two questions that come to mind from reading the headings and illustration captions.

1. Accept all reasonable responses.

2. __________

**Review Vocabulary**

Use your book or dictionary to define **segregation**.

**segregation**

the separation of alleles that occurs during meiosis

**New Vocabulary**

*Use terms in the left margin to complete the paragraph below.*

**Genetics** is the branch of biology that studies how traits are inherited. **Hybrid** offspring result from parents that have different forms of **alleles** for certain traits. Mendel’s **law of segregation** states that every individual has two alleles of each gene and when gametes are produced, each gamete receives one of these alleles. Mendel’s **law of independent assortment** states that genes for different traits are inherited independently of each other.

**Compare and contrast each pair of terms by defining them and/or noting their differences. Accept all reasonable responses.**

<table>
<thead>
<tr>
<th>dominant trait</th>
<th>recessive trait</th>
</tr>
</thead>
<tbody>
<tr>
<td>dominant</td>
<td>recessive form of a trait</td>
</tr>
<tr>
<td>genotype</td>
<td>trait that can be observed if the dominant trait is not present</td>
</tr>
<tr>
<td>heterozygous</td>
<td>the allele combination an organism contains</td>
</tr>
<tr>
<td>homozygous</td>
<td>the way an organism looks and behaves</td>
</tr>
<tr>
<td>phenotype</td>
<td>phenotype</td>
</tr>
<tr>
<td>homozygous</td>
<td>heterozygous</td>
</tr>
<tr>
<td>recessive</td>
<td>an organism’s genotype when two alleles for a trait are the same</td>
</tr>
<tr>
<td></td>
<td>an organism’s genotype when two alleles for a trait are different</td>
</tr>
</tbody>
</table>
Describe how a plant self-pollinates.
A plant self-pollinates when its male and female gametes come from the same plant.

Infer why Mendel used cross-pollination to study inheritance.
Mendel cross-pollinated plants to create offspring that have traits of both plants.

Analyze Mendel’s experiment with green-seed and yellow-seed pea plants by completing this summary paragraph.
Mendel used only true breeding lines, which consistently produced the same trait in the offspring. He controlled variables by studying one trait at a time. When he crossed a green-seed plant with a yellow-seed plant, the F1 offspring were 100 percent yellow and 0 percent green. He allowed the F1 plants to self-fertilize to produce F2 plants. The F2 plants were 75 percent yellow and 25 percent green. Mendel concluded that each trait has two forms, called alleles. Mendel called yellow seed color the dominant form and green seed color the recessive form of the trait.

Compare genotypes and phenotypes for pea plants.

<table>
<thead>
<tr>
<th>Genotype</th>
<th>Homozygous or Heterozygous</th>
<th>Phenotype</th>
</tr>
</thead>
<tbody>
<tr>
<td>YY</td>
<td>homozygous</td>
<td>yellow seeds</td>
</tr>
<tr>
<td>Yy</td>
<td>heterozygous</td>
<td>yellow seeds</td>
</tr>
<tr>
<td>yy</td>
<td>homozygous</td>
<td>green seeds</td>
</tr>
</tbody>
</table>
Section 10.2  Mendelian Genetics (continued)

**Main Idea**

I found this information on page __________.
SE, pp. 277–280
RE, pp. 109–111

**Details**

**Demonstrate** the law of independent assortment by listing the 4 alleles that are produced when a pea plant with the genotype RrYy produces gametes.

1. YR
2. Yr
3. yr
4. yR

**Complete** the Punnett squares for height in the \(F_1\) and \(F_2\) generations. Tall plants (T) are dominant over short plants (t). Write the expected genotypes and the probability for each.

<table>
<thead>
<tr>
<th>YR</th>
<th>yR</th>
<th>Yr</th>
<th>yr</th>
</tr>
</thead>
<tbody>
<tr>
<td>TT</td>
<td>Tt</td>
<td>Tt</td>
<td>Tt</td>
</tr>
<tr>
<td>Tt</td>
<td>Tt</td>
<td>Tt</td>
<td>Tt</td>
</tr>
</tbody>
</table>

Phenotypic ratio: 9 yellow round : 3 green round : 3 yellow wrinkled : 1 green wrinkled

**Identify** the genotypes within the Punnett square showing the dihybrid cross of seed color and seed texture. The first row has been done for you. Write the expected phenotypic ratio.

<table>
<thead>
<tr>
<th>YR</th>
<th>yR</th>
<th>Yr</th>
<th>yr</th>
</tr>
</thead>
<tbody>
<tr>
<td>YR</td>
<td>YyRR</td>
<td>YyRR</td>
<td>YyRR</td>
</tr>
<tr>
<td>yR</td>
<td>YyRR</td>
<td>yyRR</td>
<td>YyRR</td>
</tr>
<tr>
<td>Yr</td>
<td>YYRr</td>
<td>YyRr</td>
<td>Yyrr</td>
</tr>
<tr>
<td>yr</td>
<td>YyRr</td>
<td>yyRr</td>
<td>Yyrr</td>
</tr>
</tbody>
</table>

Phenotypic ratio: 9 yellow round : 3 green round : 3 yellow wrinkled : 1 green wrinkled

**Summarize**

Discuss the effects of Mendel’s two laws (segregation and independent assortment). Give an example. Accept all reasonable responses.

The law of segregation states that every individual has two alleles of each gene and each gamete receives one of these alleles. The law of independent assortment states that genes for different traits are inherited independently. For example, when a pea plant with the genotype RrYy produces gametes, the alleles R and r will separate from each other and from the alleles Y and y.
Scan the headings, boldfaced words, pictures, figures, and captions in Section 3.

Read all section titles.

Read all boldfaced words.

Look at all pictures and read the captions.

Look at all figures.

Read all captions.

Predict three things that you think will be discussed.

1. Accept all reasonable responses.

2. 

3. 

Review Vocabulary

protein

Use your book or dictionary to define protein.

the total nitrogenous material in plant and animal tissues

New Vocabulary

genetic recombination

Use your book or dictionary to define each term.

new combinations of genes that result from crossing over and independent assortment

polyplody

the occurrence of one or more extra sets of all chromosomes in an organism
Section 10.3 Gene Linkage and Polyploidy (continued)

Main Idea

Genetic Recombination

I found this information on page ____________.

SE, p. 283
RE, p. 113

Gene Linkage and Chromosome Maps

I found this information on page ____________.

SE, pp. 283–285
RE, p. 114

Details

Calculate the number of chromosome combinations due to independent assortment by filling in the chart. Use the formula $2^n$. The first one has been done for you.

<table>
<thead>
<tr>
<th>Species</th>
<th>Chromosome Number ($n$)</th>
<th>Possible Combinations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pea</td>
<td>7</td>
<td>$2^7 = 128$</td>
</tr>
<tr>
<td>Housefly</td>
<td>6</td>
<td>$2^6 = 64$</td>
</tr>
<tr>
<td>Cabbage</td>
<td>9</td>
<td>$2^9 = 512$</td>
</tr>
<tr>
<td>Fruit fly</td>
<td>4</td>
<td>$2^4 = 16$</td>
</tr>
<tr>
<td>Frog</td>
<td>13</td>
<td>$2^{13} = 8192$</td>
</tr>
</tbody>
</table>

Summarize at least five pieces of information about genetic recombination by creating a concept map below. Accept all reasonable responses.
Complete the paragraph about gene linkage.

- chromosomes    • farther    • inherited    • sequence
- crossing over  • individual genes • linked

Genes close together on the same chromosome are **linked**.

Linked genes are usually **inherited** together. **Chromosomes**, not **individual genes**, follow Mendel's law of independent assortment. Linked genes might become separated, as a result of **crossing over**. Crossing over is more likely to happen if genes are **farther** apart on a chromosome.

Analyze whether the gene linkage is an exception to, or an example of, Mendel's law of independent assortment. Use an example from your book.

Gene linkage is an exception because genes that are located close to each other on the same chromosome usually travel together.

Scientists studied the fruit fly to confirm this exception.

Identify four species that show polyploidy.

1. earthworms
2. goldfish
3. wheat
4. sugar cane

Summarize

Compare and contrast gene linkage to polyploidy and how they do not follow all of Mendel’s laws of inheritance.

<table>
<thead>
<tr>
<th>Gene Linkage</th>
<th>Polyploidy</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Genes close together on the chromosome do not sort independently.</td>
<td>• Polyploid organisms have more than two sets of chromosomes.</td>
</tr>
<tr>
<td>• Each trait is controlled by two alleles.</td>
<td>• They have more than two alleles for each trait.</td>
</tr>
</tbody>
</table>
Complex Inheritance and Human Heredity

Before You Read

Use the “What I Know” column to list the things you know about human heredity and genetics. Then list the questions you have about these topics in the “What I Want to Find Out” column. Accept all reasonable responses.

<table>
<thead>
<tr>
<th>K</th>
<th>What I Know</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>W</th>
<th>What I Want to Find Out</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>L</th>
<th>What I Learned</th>
</tr>
</thead>
</table>

Describe how you think a child’s DNA is different from his or her mother’s DNA and father’s DNA.

Accept all reasonable responses.

---

Complex Inheritance and Human Heredity 107
Complex Inheritance and Human Heredity
Section 11.1 Basic Patterns of Human Inheritance

Main Idea

Skim and Scan Section 1 of the chapter. Use the checklist as a guide.

- Read all section titles.
- Read all boldfaced words.
- Read all tables and graphs.
- Look at all pictures and read the captions.
- Think about what you already know about patterns of heredity and human genetics.

Write three facts you discovered about patterns of heredity and human genetics as you scanned the section.

1. Accept all reasonable responses.
2. ________________________________
3. ________________________________

Review Vocabulary

Use your book or dictionary to define genes.

genesis: segments of DNA that control the production of proteins

New Vocabulary

Use your book or dictionary to define each vocabulary term.

carrier: an individual heterozygous for a recessive genetic disorder

pedigree: a diagram of genetic inheritance used by geneticists to trace genetic traits

Explain why pedigrees are needed to identify the carriers of a recessive trait in a family.

Pedigrees are necessary to find carriers because the recessive traits are not readily apparent by looking at the phenotype.

Define decline to show its scientific meaning.

decline: to gradually waste away; a downward slope
Section 11.1 Basic Patterns of Human Inheritance (continued)

Main Idea

Recessive Genetic Disorders

I found this information on page _______________.
SE, pp. 296–298
RE, pp. 115–116

Details

Write three facts about recessive heredity in the concept map. Accept all reasonable responses.

Simple Recessive Heredity

Who: Dr. Garrod identified that alkaptonuria was a recessive genetic disorder.

What: Diseases caused by recessive mutations include cystic fibrosis, Tay-Sachs disease, and albinism.

How: For an offspring to inherit a recessive trait, both parents must have the allele.

Identify two examples of dominant genetic disorders in humans. Accept all reasonable responses.

Huntington’s disease

dominant genetic disorders

achondroplasia

Summarize the facts about Huntington’s disease by completing the concept map below.

There is no effective treatment.

A pedigree analysis could help people better understand their own risks and the risks to their offspring.

The disease is caused by a rare dominant allele.

The disease causes a breakdown in certain parts of the brain.

The symptoms don’t appear until a person is between the ages of 30 and 50.

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Complex Inheritance and Human Heredity 109
Pedigrees

I found this information on page 299.

Summarize pedigree symbols by naming them and then drawing them in the right-hand column of the table. Sketches should resemble those in the book.

<table>
<thead>
<tr>
<th>Description of Symbol</th>
<th>Sketch of Symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>male</td>
<td>square</td>
</tr>
<tr>
<td>female</td>
<td>circle</td>
</tr>
<tr>
<td>affected male</td>
<td>shaded square</td>
</tr>
<tr>
<td>affected female</td>
<td>shaded circle</td>
</tr>
<tr>
<td>known heterozygotes</td>
<td>half–shaded symbol</td>
</tr>
<tr>
<td>parents and offspring siblings</td>
<td>line down, from parent circles or squares on second row</td>
</tr>
<tr>
<td>parents</td>
<td>circle joined to square</td>
</tr>
</tbody>
</table>

Evaluate the inheritance of achondroplasia shown in the pedigree.

Parent with achondroplasia: the father

Number of children with achondroplasia: one

Genotype of the younger son: homozygous recessive

Connect

Create a pedigree diagram for an imaginary family. Pick a trait and designate it as dominant, then shade the boxes to show who has recessive genes, who has dominant genes, and who is likely heterozygous. Accept all reasonable responses.
### Complex Inheritance and Human Heredity
#### Section 11.2 Complex Patterns of Inheritance

**Main Idea**

**Details**

**Skim** Section 2 of the chapter. Write two questions that come to mind from reading the headings and illustration captions.

1. 
2. 

**New Vocabulary**

- **gamete**
  - a mature sex cell with a haploid number of chromosomes

- **autosomes**
  - any chromosomes that are not sex chromosomes

- **codominance**
  - inheritance pattern where phenotypes of both homozygote parents are produced in heterozygous offspring; both alleles are expressed

- **epistasis**
  - interaction of alleles with one allele masking the effects of the other

- **incomplete dominance**
  - inheritance pattern where the phenotype of a heterozygote is intermediate between those of the two homozygotes; neither allele of the pair is dominant but combine and display a new trait

- **multiple alleles**
  - presence of more than two alleles for a genetic trait

- **polygenic trait**
  - inheritance pattern of a trait controlled by two or more genes; genes may be on the same or different chromosomes

- **sex chromosomes**
  - the chromosomes that determine the sex of an individual and carry sex-linked characteristics

- **sex-linked traits**
  - traits controlled by genes located on sex chromosomes
Section 11.2 Complex Patterns of Inheritance (continued)

Main Idea

Incomplete Dominance
I found this information on page 302.
SE, p. 302
RE, p. 119

Codominance
I found this information on page 302–303.
SE, pp. 302–303
RE, pp. 119–120

Multiple Alleles
I found this information on page 304.
SE, p. 304
RE, pp. 120–121

Details

Analyze the ratios of offspring of the following snapdragon pairs. Hint: To write the genotypes, designate the dominant red allele as R and the recessive white allele as r.

<table>
<thead>
<tr>
<th>Parent Flowers</th>
<th>Genotypes of Parent Flowers</th>
<th>Punnett Square</th>
<th>Ratio of Offspring</th>
</tr>
</thead>
<tbody>
<tr>
<td>red and white</td>
<td>RR × rr</td>
<td></td>
<td>4 pink</td>
</tr>
<tr>
<td>pink and white</td>
<td>Rr × rr</td>
<td></td>
<td>2 pink: 2 white</td>
</tr>
<tr>
<td>red and pink</td>
<td>RR × rr</td>
<td></td>
<td>2 red: 2 pink</td>
</tr>
<tr>
<td>pink and pink</td>
<td>Rr × Rr</td>
<td></td>
<td>1 red: 2 pink: 1 white</td>
</tr>
</tbody>
</table>

Predict the results if two people who are heterozygous for sickle-cell anemia but lead normal lives have a child.
The child might have no alleles for the disease, might be heterozygous, or might be homozygous for the disease.

Identify the blood group that results from each combination of genotypes. The first one has been done for you.

<table>
<thead>
<tr>
<th>Possible Genotype Combinations</th>
<th>Phenotypes</th>
</tr>
</thead>
<tbody>
<tr>
<td>A and A</td>
<td>A</td>
</tr>
<tr>
<td>A and B</td>
<td>AB</td>
</tr>
<tr>
<td>A and O</td>
<td>A</td>
</tr>
<tr>
<td>B and B</td>
<td>B</td>
</tr>
<tr>
<td>B and O</td>
<td>B</td>
</tr>
<tr>
<td>O and O</td>
<td>O</td>
</tr>
</tbody>
</table>

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Section 11.2 Complex Patterns of Inheritance (continued)

Main Idea

Epistasis, Sex Determination, Dosage Compensation, Sex-Linked Traits, and Polygenic Traits

I found this information on page ______.
SE, pp. 305–309
RE, pp. 121–123

Analyze the role of each item in inheritance. Give an example of a trait governed by each process.

<table>
<thead>
<tr>
<th>Role in Inheritance</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Epistasis</td>
<td>interaction where one allele masks another</td>
</tr>
<tr>
<td>Polygenic traits</td>
<td>traits that arise from the interaction of multiple genes</td>
</tr>
<tr>
<td>X-chromosome inactivation</td>
<td>X chromosome stops working in female to balance gene dosage</td>
</tr>
<tr>
<td>X-linked traits</td>
<td>traits controlled by genes on the X chromosome</td>
</tr>
</tbody>
</table>

Environmental Influences

I found this information on page ______.
SE, p. 309
RE, p. 123

Identify environmental influences that can affect phenotype.

<table>
<thead>
<tr>
<th>External factors</th>
<th>Behaviors</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. heat</td>
<td>1. diet</td>
</tr>
<tr>
<td>2. sunlight</td>
<td>2. exercise</td>
</tr>
</tbody>
</table>

Twin Studies

I found this information on page ______.
SE, p. 310
RE, p. 123

Describe the use of twin studies in the study of genetics by completing the paragraph.

Scientists use twin studies to distinguish between ________ genetic and ________ environmental influences on a trait. If a high percentage of ________ identical twins but not ________ fraternal twins express a trait, there is a strong chance that the trait is ________ genetic.

CONNECT

Think of some traits in people, plants, or animals. Describe one trait and tell whether you think the trait is a dominant/recessive, multiple allele, codominant, incompletely dominant, sex-linked, or polygenic trait. Explain your reasoning.

Accept all reasonable responses. Eye color; some people have blue eyes, some have green, and some have brown. I think this is a multiple allele situation because there are many possible colors, and some colors seem dominant over others.
Complex Inheritance and Human Heredity

Section 11.3 Chromosomes and Human Heredity

Organize Information Make a list of some physical characteristics that appear in your family members or friends. Try to determine how each trait is inherited by examining its inheritance pattern.

Accept all reasonable responses.

Review Vocabulary Use your book or dictionary to define mitosis.

mitosis a process in the nucleus of a dividing cell; made of prophase, metaphase, anaphase, and telophase

New Vocabulary Use your book or dictionary to define the following terms.

nondisjunction cell division during which sister chromatids fail to separate properly

telomere protective caps made of DNA and protein found at the end of chromosomes

Define karyotype and describe its use. Then make a sketch of a human karyotype in the space below.

karyotype chart of homologous chromosome pairs arranged according to size;

used to pinpoint unusual chromosome numbers in cells

Accept all reasonable responses.
**Main Idea**

**Karyotype Studies**

*I found this information on page __________.*

- SE, p. 311
- RE, p. 124

**Details**

**Sequence** *how a scientist makes a karyotype.*

1. Chromosomes are removed from a cell in metaphase.
2. The chromosomes are stained, revealing the banding patterns that mark each pair of homologous chromosomes.
3. The chromosomes are arranged in pairs by size.
4. A microscopic picture is taken.

**Compare** *and contrast karyotype studies and pedigrees by writing characteristics in the Venn diagram. Accept all reasonable responses.*

- **Karyotypes**
  - a method for visualizing chromosomes;
  - used to detect abnormalities in chromosome number
- **Both**
  - used by geneticists to study genetic disorders
- **Pedigrees**
  - a method for studying inheritance by following traits in a family

**Describe** *telomeres by completing the paragraph. Accept all reasonable sketches.*

Telomeres are made of ____ DNA ____ and ____ protein ____. They are located at ____ the ends of chromosomes ____. Their function is ____ to protect the chromosomes ____.
Main Idea

**Nondisjunction**

I found this information on page 313–314.

SE, pp. 313–314

RE, pp. 125–126

---

Details

**Model** a picture showing the ways that nondisjunction during meiosis can produce a sex cell with an extra copy of a chromosome.

Sketches should be similar to parts of Figure 11.20 and should show nondisjunction during meiosis I and meiosis II.

**Model** a karyotype of a boy with Down’s syndrome.

The karyotype should show 22 pairs of autosomes and XY sex chromosomes. There should be 3 copies of chromosome 21.

---

**Fetal Testing**

I found this information on page 314–315.

SE, pp. 314–315

RE, p. 126

---

**Summarize** the following facts about fetal testing.

- how an abnormal number of chromosomes is identified
  
  A sample of cells is taken from an individual or fetus.
  
- four possible results of abnormal chromosome numbers
  
  embryo death, Down syndrome, Turner’s syndrome, and Klinefelter’s syndrome

---

**SUMMARIZE**

Analyze how nondisjunction during meiosis could lead to Klinefelter’s syndrome.

A person with Klinefelter’s syndrome has two X chromosomes and one Y chromosome.

Nondisjunction in meiosis I or meiosis II could produce an egg with two sex chromosomes (either XX or XY). Klinefelter’s syndrome would result when an XX egg is fertilized with a sperm carrying a Y chromosome.

---

116 Complex Inheritance and Human Heredity
# Molecular Genetics

## Before You Read

*Before you read the chapter, respond to these statements. Accept all reasonable responses.*

1. Write an **A** if you agree with the statement.
2. Write a **D** if you disagree with the statement.

<table>
<thead>
<tr>
<th>Before You Read</th>
<th>Molecular Genetics</th>
<th>After You Read</th>
</tr>
</thead>
<tbody>
<tr>
<td>• James Watson and Francis Crick discovered that DNA was the genetic material.</td>
<td><strong>D</strong></td>
<td></td>
</tr>
<tr>
<td>• DNA replication is the same in prokaryotes and eukaryotes.</td>
<td><strong>D</strong></td>
<td></td>
</tr>
<tr>
<td>• Information in a cell flows from DNA to RNA to protein.</td>
<td><strong>A</strong></td>
<td></td>
</tr>
<tr>
<td>• A mutation is a permanent change in a cell’s DNA.</td>
<td><strong>A</strong></td>
<td></td>
</tr>
</tbody>
</table>

---

**Science Journal**

*Ponies on the Shetland Islands in Scotland have short stature, thick hair, strength, and hardiness so they can thrive in their harsh environment. How do you think the DNA of their population has changed over time?*

Accept all reasonable responses.

---

*Name __________________________  Date __________________________*
Scan Section 1 of the chapter. Identify the results of three DNA experiments.

1. Accept all reasonable responses.

2. ____________________________

3. ____________________________

Use your book or dictionary to define nucleic acid.

**nucleic acid**

*a biomolecule that stores cellular information in the form of a code*

**double helix**

*shape of a DNA molecule*

*consisting of two strands of nucleotides that are twisted into a coil and held together by the nitrogenous bases*

**nucleosome**

*a structure found in chromosomes in which DNA is coiled around histone proteins*

**transform**

*Define transform to show its scientific meaning.*

*to cause a change in type or kind*
Complete the table below about geneticists and their discoveries.

<table>
<thead>
<tr>
<th>Scientist</th>
<th>Discovery</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fredrick Griffith</td>
<td>discovered a transforming factor that could change rough bacteria into smooth bacteria</td>
<td>1928</td>
</tr>
<tr>
<td>Oswald Avery</td>
<td>identified DNA as the transforming factor</td>
<td>1931</td>
</tr>
<tr>
<td>Alfred Hershey and Martha Chase</td>
<td>proved that DNA was the genetic material in a virus</td>
<td>1952</td>
</tr>
<tr>
<td>James Watson and Francis Crick</td>
<td>discovered that the structure of DNA is a double helix</td>
<td>1953</td>
</tr>
</tbody>
</table>

Organize the characteristics of nucleotides by filling in the graphic organizer below.

All nucleotides have:
- a five-carbon sugar
- a negative phosphate group
- one of four nitrogenous bases

In DNA it is:
- deoxyribose
- cytosine, guanine, adenine, and thymine

And in RNA it is:
- ribose
- cytosine, guanine, adenine, and uracil

Main Idea

Discovery of the Genetic Material

I found this information on page 326–328.

DNA Structure

I found this information on page 329–331.
Main Idea

I found this information on page ________________.
SE, pp. 329–331
RE, pp. 130–131

Create a memory device to help you remember how the nitrogenous bases are always paired.

Accept all reasonable responses that pair adenine with thymine and cytosine with guanine. Sample response: Aunt Tillie and Cousin Gus

Analyze the DNA molecule by explaining how each word applies to the molecule. Use a sketch to back up your explanation in each case.

<table>
<thead>
<tr>
<th>Word and What It Means</th>
<th>Sketch of Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>complementary: Nitrogenous bases are paired on the inside of the molecule.</td>
<td>Accept all reasonable responses.</td>
</tr>
<tr>
<td>helix: A helix is something twisted into a coil.</td>
<td></td>
</tr>
<tr>
<td>double (as in “double helix”): DNA is made of two strands that are twisted into a coil.</td>
<td></td>
</tr>
</tbody>
</table>

Synthesize and rephrase how a DNA strand that is 200 million bases long can fit inside a cell.

A long strand of DNA is coiled around a beadlike group of histone proteins to form a nucleosome. The nucleosomes group together in fibers, then supercoil into a chromosome.

Chromosome Structure

I found this information on page ________________.
SE, p. 332
RE, p. 131

Chargaff’s rules.

Chargaff’s data showed that for any organism, the number of purine bases in DNA (A and G) always equals the number of pyrimidine bases (T and C). Watson and Crick’s structure showed that A pairs with T and G pairs with C, therefore A = T and G = C.
Scan Section 2 of the chapter. Write three questions that come to mind from reading the headings and the illustration captions.

1. Accept all reasonable responses.
2. _______________________
3. _______________________

Use your book or dictionary to define template.

*a molecule of DNA that is a pattern for synthesis or a new DNA molecule*

Use your book or dictionary to define the following terms. Then look through the section to find a sentence with each term. Write the sentence. Sentences will vary.

**DNA polymerase**

*enzyme that creates chemical bonds between nucleotides using a DNA strand as a template*

**Okazaki fragment**

*small segments of DNA made as DNA polymerase copies DNA 3' to 5' on the lagging strand*

**semiconservative replication**

*method of DNA replication in which strands separate, serve as templates, and produce DNA molecules each containing one original strand and one new strand*
Section 12.2 Replication of DNA (continued)

Semiconservative Replication

Describe semiconservative DNA replication.

<table>
<thead>
<tr>
<th>Model</th>
<th>During replication, the parental strands</th>
<th>The new DNA molecule is composed of</th>
</tr>
</thead>
<tbody>
<tr>
<td>Semiconservative replication</td>
<td>separate and serve as templates</td>
<td>one parental strand and one new strand</td>
</tr>
</tbody>
</table>

Sequence and model each step in the replication of a DNA molecule. Write about what happens, and draw a DNA molecule going through each step. In the last box, describe and draw the products of replication. Accept all reasonable responses.

A. The DNA unzips.

B. Nucleotides in the cell attach to the unzipped chains (A to T and C to G).

C. The molecule continues to unzip, and nucleotides continue to match and join.

D. Two new DNA molecules will be formed, each containing one parental and one new strand.

Analyze how a DNA molecule acts like a template.

Complementary bases match up to the bases on the original strand, so the two new molecules are identical to the parent molecule.
Complete the table below on the role of each protein in DNA replication. The first one has been done for you.

<table>
<thead>
<tr>
<th>Protein</th>
<th>Stage of DNA Replication</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>DNA helicase</td>
<td>unwinding</td>
<td>unwinds and unzips the DNA</td>
</tr>
<tr>
<td>DNA ligase</td>
<td>joining</td>
<td>links DNA sections after RNA primer is removed</td>
</tr>
<tr>
<td>DNA polymerase</td>
<td>base pairing, joining</td>
<td>forms new strand by base pairing; removes RNA primer and fills in with DNA</td>
</tr>
<tr>
<td>RNA primase</td>
<td>unwinding</td>
<td>adds on RNA primer to each DNA strand</td>
</tr>
<tr>
<td>Single-stranded binding protein</td>
<td>unwinding, base pairing</td>
<td>keeps the strands separate during replication</td>
</tr>
</tbody>
</table>

Comparing DNA Replication in Eukaryotes and Prokaryotes

Contrast the differences between prokaryotic and eukaryotic DNA replication.

<table>
<thead>
<tr>
<th></th>
<th>Eukaryotes</th>
<th>Prokaryotes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of origins for DNA replication</td>
<td>many</td>
<td>one</td>
</tr>
<tr>
<td>Where replication takes place in the cell</td>
<td>nucleus</td>
<td>cytoplasm</td>
</tr>
</tbody>
</table>

Summarize

Analyze how the activity of DNA polymerase is consistent with Watson and Crick’s model of semiconservative replication.

Watson and Crick predicted that DNA replication is semiconservative, meaning the parental strand serves as template for the daughter strand. DNA polymerase is the enzyme that creates the daughter strand using the parental DNA as a template.
Scan the headings and boldfaced words for the section. Predict two things that you think might be discussed.

1. Accept all reasonable responses.

2. 

Use your book or dictionary to define synthesis.

**synthesis**

the composition or combination of parts to form a whole

Write the correct term in the left column for each definition below.

- **transcription**
  process in which RNA is synthesized from DNA

- **codon**
  a group of three nitrogenous bases in DNA or mRNA that code for one amino acid

- **RNA**
  nucleic acid made of ribose, phosphate, and one of four nitrogenous bases—adenine, cytosine, guanine, or uracil

- **intron**
  intervening DNA sequences that are transcribed and then removed from the final mRNA

- **translation**
  process by which mRNA directs the synthesis of a protein

- **messenger RNA**
  long strands of RNA that are complementary to one strand of DNA

- **exon**
  protein coding sequences in DNA that are transcribed into mRNA and translated into protein

- **transfer RNA**
  small RNA molecules that transport amino acids to the ribosome

- **RNA polymerase**
  an enzyme that catalyzes the synthesis of mRNA using DNA as a template

- **ribosomal RNA**
  RNA molecules that make up part of the ribosome
Section 12.3 DNA, RNA, and Protein (continued)

**Main Idea**

**Central Dogma**

I found this information on page 336–337 of SE, pp. 134–135 of RE.

**Details**

**Compare and contrast** RNA and DNA by writing at least five characteristics of their structure and composition in the Venn diagram. Accept all reasonable responses.

<table>
<thead>
<tr>
<th>RNA</th>
<th>Both</th>
<th>DNA</th>
</tr>
</thead>
<tbody>
<tr>
<td>single strand; has ACUG for bases; uracil binds with adenine</td>
<td>are nucleic acids; have sugars, but different ones</td>
<td>double strand; has ACTG for bases; thymine binds with adenine</td>
</tr>
</tbody>
</table>

**State** the central dogma of biology.

DNA codes for RNA, which directs the synthesis of proteins.

**Compare** the function of each type of RNA molecule by completing the table.

<table>
<thead>
<tr>
<th>Type of RNA</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>mRNA</td>
<td>carry genetic information from the nucleus to the cytoplasm to direct protein synthesis</td>
</tr>
<tr>
<td>rRNA</td>
<td>form part of the ribosome</td>
</tr>
<tr>
<td>tRNA</td>
<td>carry amino acids to the ribosome</td>
</tr>
</tbody>
</table>

**Sequence** the steps in transcription of RNA.

- A portion of the DNA molecule unzips.
- RNA polymerase joins RNA nucleotides using the DNA strand as a template.
- The mRNA strand is released and the DNA strands rejoin.
- The mRNA leaves the nucleus and enters the cytoplasm.
Section 12.3 DNA, RNA, and Protein (continued)

**Main Idea**

**The Code, One Gene—One Enzyme**

I found this information on page ______.

SE, pp. 338–341
RE, pp. 135–138

**Details**

Identify four examples of codons and state the instructions they encode.

1. (GCU) alanine
2. (AAA) lysine
3. (AUG) methionine, tells the ribosome that this is the start of the amino acid chain
4. (UAA) stop, tells ribosome that this is the end of the amino acid chain

Model the movement of tRNA molecules showing the translation process.

Diagrams should show tRNA molecules moving to a ribosome while carrying amino acids. As each amino acid bonds, the tRNA moves away to bring another amino acid.

State the updated version of Beadle and Tatum’s hypothesis.

One gene ______ codes for ______ one polypeptide ______.

Summarize

Create a flow chart to describe the formation of a protein.

DNA issues instructions

messenger RNA brings instructions from DNA to the cytoplasm

ribosomal RNA binds to the mRNA

transfer RNA delivers amino acids to the ribosome to be made into a protein

the rRNA uses the instructions to assemble the amino acids in the right order

Describe the activities of DNA and the three types of RNA. Accept all reasonable responses.
**Main Idea**

Scan the illustrations and tables in Section 3. Predict the effect of mutations on organisms.
Accept all reasonable responses.

**Details**

<table>
<thead>
<tr>
<th><strong>Review Vocabulary</strong></th>
<th>Use your book or dictionary to define prokaryote.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>prokaryote</strong></td>
<td>simple organism that lacks membrane-bound organelles and DNA organized in chromosomes</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>New Vocabulary</strong></th>
<th>Use your book or dictionary to define the following terms.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>gene regulation</strong></td>
<td>the ability of an organism to control the expression of genes in response to the environment</td>
</tr>
<tr>
<td><strong>mutagen</strong></td>
<td>a substance, such as chemicals or radiation, that causes mutations</td>
</tr>
<tr>
<td><strong>mutation</strong></td>
<td>a permanent change in the DNA sequence</td>
</tr>
<tr>
<td><strong>operon</strong></td>
<td>a section of prokaryotic DNA that contains the genes for the proteins in a metabolic pathway</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Academic Vocabulary</strong></th>
<th>Define substitution and write a sentence to show its scientific meaning.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>substitution</strong></td>
<td>the act of replacing one thing with another</td>
</tr>
</tbody>
</table>
**Prokaryote Gene Regulation**

*Describe gene regulation in prokaryotes by using the terms below to complete the paragraph.*

- **E. coli**
- environment
- genes
- proteins
- metabolic pathway
- operator
- promoter
- repressor
- RNA polymerase

An operon is a cluster of genes in ________ **E. coli**. These genes make ________ proteins that work together in one ________ metabolic pathway. An operon is able to respond to changes in the ________ environment. The ________ operator is a segment of DNA that acts as a switch for transcription, turning the operon on or off. When the operon is on, [RNA polymerase] binds to the ________ promoter and transcribes the DNA. When the operon is off, a ________ repressor blocks transcription.

**Compare and contrast the trp operon and the lac operon.**

<table>
<thead>
<tr>
<th></th>
<th>Trp Operon</th>
<th>Lac Operon</th>
</tr>
</thead>
<tbody>
<tr>
<td>Responds to the presence of</td>
<td>tryptophan</td>
<td>allolactose</td>
</tr>
<tr>
<td>Transcription is turned on when</td>
<td>no tryptophan is present</td>
<td>allolactose is present</td>
</tr>
<tr>
<td>The repressor is active when</td>
<td>tryptophan binds to it</td>
<td>no allolactose is bound to it</td>
</tr>
<tr>
<td>When the operon is turned on, the cell can</td>
<td>synthesize tryptophan</td>
<td>digest lactose</td>
</tr>
</tbody>
</table>

**Analyze the ways eukaryotes control gene expression.**

<table>
<thead>
<tr>
<th>Molecule</th>
<th>Effect on Gene Expression</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hox genes</td>
<td>determine the body plan of an organism by controlling gene expression during embryo development</td>
</tr>
<tr>
<td>Nucleosomes</td>
<td>control gene expression by inhibiting transcription of DNA in chromosomes</td>
</tr>
<tr>
<td>Small interfering RNA</td>
<td>inhibit gene expression by binding to a protein that degrades specific mRNA molecules in the cytoplasm</td>
</tr>
<tr>
<td>Transcription factors</td>
<td>regulate genes so that a gene is turned on at the right time and in the right amounts</td>
</tr>
</tbody>
</table>
Section 12.4 Gene Regulation and Mutation (continued)

(Main Idea) Mutations

I found this information on page __________.
SE, pp. 345–349
RE, pp. 141–142

Details

Compare and contrast a point mutation and a frameshift mutation by defining each mutation and stating its consequence.

<table>
<thead>
<tr>
<th>Mutation</th>
<th>Result</th>
<th>Sketch</th>
</tr>
</thead>
<tbody>
<tr>
<td>Missense mutation</td>
<td>DNA codes for wrong amino acid</td>
<td></td>
</tr>
<tr>
<td>Nonsense mutation</td>
<td>stop codon replaces amino acid codon</td>
<td></td>
</tr>
<tr>
<td>Chromosome rearrangement</td>
<td>piece of chromosome is moved to different location</td>
<td></td>
</tr>
<tr>
<td>Chromosome deletion</td>
<td>piece of chromosome is lost</td>
<td></td>
</tr>
</tbody>
</table>

Analyze each type of DNA mutation and its result. Sketch what each change might look like. Accept all reasonable responses.

Summarize

Discuss why a mutagen can have longer-lasting effects in a sex cell than in a body cell.

Mutagens cause mutations, or changes in the DNA sequence. In a body cell, the mutation might kill the cell, or it might be passed to daughter cells in the body. A mutation in a sex cell can be passed on to the organism’s offspring, and all subsequent generations will carry the mutation.
Create a concept web to tie together what you learned in this chapter about molecular genetics. Hint: You might find it easier to first list the facts or topics you want to include, then decide how to connect them in the web. Accept all reasonable responses.
Genetics and Biotechnology

Before You Read

*Before you read the chapter, respond to these statements. Accept all reasonable responses.*

1. Write an A if you agree with the statement.
2. Write an D if you disagree with the statement.

<table>
<thead>
<tr>
<th>Before You Read</th>
<th>Genetics and Biotechnology</th>
<th>After You Read</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Hybridization is a type of selective breeding.</em></td>
<td>A</td>
<td></td>
</tr>
<tr>
<td><em>Genetic engineering is the process of breeding animals for desired traits.</em></td>
<td>D</td>
<td></td>
</tr>
<tr>
<td><em>Polymerase chain reaction is a way to make millions of copies of a fragment of DNA.</em></td>
<td>A</td>
<td></td>
</tr>
<tr>
<td><em>Scientists have determined the sequence of all human DNA.</em></td>
<td>A</td>
<td></td>
</tr>
</tbody>
</table>

Science Journal

Describe two examples of genetic technology that have affected your life or that you have read about in the news.

Accept all reasonable responses.
Main Idea

Scan Section 1 of the chapter. Use the checklist as a guide.

- Read all section titles.
- Read all boldfaced words.
- Read all tables and graphs.
- Look at all pictures and read the captions.

Write three facts you discovered about genetic technology.

1. Accept all reasonable responses.
2. 
3. 

New Vocabulary

Use your book or dictionary to define each term. Then look through the section to find a sentence with each term and write the sentence. Sentences will vary; important points are listed.

**hybrid**
- an organism whose parents have different forms of a trait

**inbreeding**
- mating between closely related individuals; ensures that offspring are homozygous for most traits, but also brings out harmful, recessive traits

**selective breeding**
- the process of breeding plants and animals for desired traits

**test cross**
- mating of an individual of unknown genotype with an individual of known genotype; can help determine the unknown genotype of the parent
Summarize selective breeding by completing the prompts. Accept all reasonable responses.

**Goal:** increase the frequency of desired traits or alleles in a population

**Example:** breeds of dogs such as German shepherds and huskies

The offspring of parents that have different forms of a trait: **hybrids**

Two different types of selective breeding: **hybridization** and **inbreeding**

**Analyze** inbreeding and hybridization by identifying the effect, an advantage, and a disadvantage of each.

**Inbreeding**

- **advantage:** helps eliminate undesired traits, and ensure desired traits
- **effect:** creates individuals who are homozygous for most traits
- **disadvantage:** harmful recessive traits can be passed on

**Hybridization**

- **advantage:** organisms can be bred to have a certain combination of traits
- **effect:** hybrid organism created by crossing parents with different traits
- **disadvantage:** time-consuming and expensive
**Main Idea**

**Test Cross**

I found this information on page [SE, p. 362] [RE, pp. 144–145].

**Details**

*Analyze* the use of a test cross to determine the genotype of a yellow flower by completing the prompts. The first one has been done for you.

The genotype of the white flower: \( YY \)

Possible genotypes of the yellow flower: \( YY \) or \( Yy \)

<table>
<thead>
<tr>
<th></th>
<th>Possible Phenotypes</th>
<th>Possible Genotypes</th>
</tr>
</thead>
<tbody>
<tr>
<td>offspring if the yellow flower is heterozygous</td>
<td>50% white 50% yellow</td>
<td>white: ( yy ) yellow: ( YY ) or ( Yy )</td>
</tr>
<tr>
<td>offspring if the yellow flower is homozygous</td>
<td>100% yellow</td>
<td>( YY ) or ( Yy )</td>
</tr>
</tbody>
</table>

*Create* a Punnett Square that shows the result of each test cross.

Heterozygous:

\[
\begin{array}{ccc}
Y & y & y \\
Y & Yy & Yy \\
y & yy & yy \\
\end{array}
\]

Homozygous:

\[
\begin{array}{ccc}
Y & y & y \\
Y & Yy & Yy \\
y & yy & yy \\
\end{array}
\]

*Summarize* how test crosses work by using the words *genotype* and *phenotype* to complete the sentence.

In a test cross, the **phenotype** of the offspring can reveal the **genotype** of the parents.

**Connect**

Selective breeding practices have been used since ancient times. Provide specific examples where selective breeding has resulted in plants or animals that are familiar to us today.

Accept all reasonable responses. Clydesdale horses, Angus cattle, German shepherds, Saint Bernards, huskies, corn, beans, flowers
Scan Section 2 of the chapter. Write two questions that come to mind from reading the headings and illustration captions.

1. Accept all reasonable responses.

2. ______________________________

New Vocabulary

Use your book or dictionary to define each term.

- genetic engineering: method of manipulating DNA from one organism and inserting the DNA fragment into a host organism of the same or different species
- genome: the total DNA present in the nucleus of each cell
- restriction enzyme: bacterial enzyme that can cut foreign DNA at a specific nucleotide sequence
- gel electrophoresis: a method of separating DNA fragments by size with the use of an electric current
- recombinant DNA: DNA made by recombining fragments of DNA from different sources
- plasmid: small, circular, double-stranded DNA found in bacterial cells and used as a vector
- DNA ligase: an enzyme that is used to join DNA fragments; used by the cell for DNA repair and replication
- transformation: a method for getting plasmid DNA into bacterial cells
- cloning: the process of creating a genetically identical copy of an organism or gene
- polymerase chain reaction: a technique for making millions of copies of a specific region of DNA
- transgenic organism: organism that contains functional recombinant DNA from a different organism
Identify one transgenic organism from this chapter. Describe how it was created. Then use your imagination to think of another possible transgenic organism that could be made and identify the original organisms that could be used to make it.

A glowing mosquito was created by putting GFP from a jellyfish into a mosquito. Accept all imagined transgenic organisms, for example, horses with wings (a horse and an eagle).

Complete the paragraph about DNA tools by using the words below.

- blunt ends
- restriction enzymes
- sticky ends
- Eco RI
- gel electrophoresis

Scientists use restriction enzymes to cut DNA at specific sequences, and gel electrophoresis to separate fragments based on size. Some restriction enzymes create DNA with single-stranded, sticky ends. Eco RI is an example of this type of enzyme. The resulting DNA fragments can be joined with other DNA fragments that have complementary sticky ends. Other restriction enzymes create blunt ends, which can be joined to another DNA fragment that has blunt ends.

Compare the DNA tools and techniques used in genetic engineering.

<table>
<thead>
<tr>
<th>Genetic Engineering Application</th>
<th>Tool or Technique Used</th>
</tr>
</thead>
<tbody>
<tr>
<td>Make millions of copies of a region of DNA</td>
<td>polymerase chain reaction</td>
</tr>
<tr>
<td>Determine the order of nucleotides</td>
<td>DNA sequencing</td>
</tr>
<tr>
<td>Chemically join together two fragments of DNA</td>
<td>DNA ligase</td>
</tr>
<tr>
<td>Carry recombinant DNA into bacteria</td>
<td>plasmid</td>
</tr>
<tr>
<td>Produce large amounts of recombinant DNA</td>
<td>DNA cloning</td>
</tr>
</tbody>
</table>
Describe the functions of the components of PCR.

- **Thermocycler:** cycles through hot and cool temperatures
- **Primers:** starting points for DNA synthesis
- **Nucleotides:** building blocks for new DNA strand
- **DNA polymerase:** copies the DNA; can withstand high heat

Organize advances that have been made in transgenic organisms. Accept all reasonable responses.

<table>
<thead>
<tr>
<th>Area</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Transgenic animals</strong></td>
<td>goats that have been engineered to secrete antithrombin III, which is used to prevent blood clotting during surgery</td>
</tr>
<tr>
<td><strong>Transgenic plants</strong></td>
<td>herbicide- and insecticide-resistant soybeans, corn and cotton</td>
</tr>
<tr>
<td><strong>Transgenic bacteria</strong></td>
<td>bacteria engineered to clean up oil spills or to protect crops from frost damage</td>
</tr>
</tbody>
</table>

Summarize the uses of genetic technology. Accept all reasonable responses.

PCR is used to establish paternity, to identify victims and suspects in a crime, and to detect infectious diseases. Genetic technology has been used to create transgenic organisms for medicinal and agricultural uses.
Genetics and Biotechnology
Section 13.3 The Human Genome

Scan Section 3 of the chapter. Use the checklist as a guide.

Read all section titles.
Read all boldfaced words.
Look at all illustrations and read the captions.

Write three facts you discovered as you scanned the section.

1. Accept all reasonable responses.
2. 
3. 

Use your book or dictionary to define each term.

bioinformatics: the creation and maintenance of databases to handle large amounts of biological data

DNA microarray: tiny microscope slides or silicon chips dotted with DNA fragments

haplotype: regions of the human genome containing linked variations

pharmacogenomics: the study of the effect of genetics on the body’s response to drugs

single nucleotide polymorphism: single nucleotide variations in human genomes; present in at least 1 percent of the human population

Define sequence to show its scientific meaning. Write a sentence using sequence.

sequence: a continuous series
Main Idea

The Human Genome Project

I found this information on page ________.
SE, pp. 372–374
RE, pp. 152–153

Details

Sequence the steps in gene sequencing by writing the steps in order.

1. DNA is cut with restriction enzymes to produce overlapping sequences.
2. Fragments are cloned.
3. Fragments are sequenced.
4. Fragments are put into order by matching overlapping sequences.

Organize three applications of DNA fingerprinting.

- identify suspects or victims in a crime
- determine paternity
- identify soldiers killed in war

Identify different ways to find genes in DNA sequences. Name the organisms for which each method is used.

<table>
<thead>
<tr>
<th>Method for identifying genes</th>
<th>Organism</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scientists look for open reading frames, stretches of DNA that begin with a start codon, are followed by at least 100 codons, and end with a stop codon.</td>
<td>bacteria, yeast</td>
</tr>
<tr>
<td>Sophisticated computer algorithms are used to compare the DNA sequence under study to the genomes of other organisms.</td>
<td>humans, other complex organisms</td>
</tr>
</tbody>
</table>
### Main Idea

**Bioinformatics, DNA Microarrays, The Genome and Genetic Disorders, Genomics and Proteomics**

*I found this information on page 375–379.*

**Details**

Organize the techniques that have arisen in the age of genomics. Give one benefit or application for each technique. The first one has been done for you.

<table>
<thead>
<tr>
<th>Description</th>
<th>Technique</th>
<th>Application or Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>inserting recombinant DNA into human cells to treat diseases</td>
<td>gene therapy</td>
<td>might someday be used to cure genetic diseases</td>
</tr>
<tr>
<td>slides or chips used to analyze complex changes in gene expression</td>
<td>DNA microarrays</td>
<td>large amount of information can be stored in a small space</td>
</tr>
<tr>
<td>an international effort to describe regions of linked variations in the human genome</td>
<td>HapMap</td>
<td>identify genes that cause disease in humans</td>
</tr>
<tr>
<td>the study of how to manage large amounts of biological information</td>
<td>bioinformatics</td>
<td>allows the study of gene evolution by comparing proteins from different organisms</td>
</tr>
<tr>
<td>the study of all of the DNA in the genome of an organism</td>
<td>genomics</td>
<td>powerful method for determining the function of human genes</td>
</tr>
<tr>
<td>the study and cataloging of an organism’s proteins</td>
<td>proteomics</td>
<td>development of new drugs to treat diabetes, obesity, atherosclerosis</td>
</tr>
<tr>
<td>the study of how to match a person’s genetics to the drugs they are prescribed</td>
<td>pharmacogenomics</td>
<td>genetically-tailored drugs</td>
</tr>
</tbody>
</table>

### Summarize

Discuss the applications of genetic technology that you think might affect your life in the future and the limitations you think there will be on DNA technology.

Accept all reasonable responses.
The History of Life

Before You Read

Use the “What I Know” column to list the things you know about the history of life. Then list the questions you have about the history of life in the “What I Want to Find Out” column. Accept all reasonable responses.

<table>
<thead>
<tr>
<th>K</th>
<th>What I Know</th>
<th>W</th>
<th>What I Want to Find Out</th>
<th>L</th>
<th>What I Learned</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Science Journal

Think about early life on Earth. Describe the physical conditions that needed to be present in order for life to begin to form.

Accept all reasonable responses.

________________________
________________________
________________________
________________________
________________________
________________________
________________________
________________________
The History of Life
Section 14.1 Fossil Evidence of Change

Main Idea

Details

Skim Section 1 of the chapter. Write two questions that come to mind from reading the headings and the illustration captions.

1. Accept all reasonable responses.
2. 

Review Vocabulary

Use your book or dictionary to define extinction.

extinction

the death of all individuals of a species

New Vocabulary

Use the terms in the left column to complete the paragraph below.

Scientists measure Earth’s geological and biological events using the geologic time scale, which is divided into eras and periods. The Cambrian explosion is the name of a period of rapid change during which the ancestors of most animal groups emerged. A layer of soot found between rock layers worldwide, known as the K-T boundary, might indicate that a large meteorite collided with Earth.

The theory of plate tectonics describes Earth’s surface as large plates that move over Earth’s thick, liquid interior. These plates are made up of various types of rocks. Paleontologists are scientists who study fossils. They determine the relative age of rocks using relative dating, which compares the sequence of rock layers. The law of superposition states that younger rock layers are deposited on top of older rock layers. Another method of determining the age of rocks is radiometric dating, which measures the decay of radioactive isotopes. The rate of decay can be measured using half-lives, the amount of time required for half of a radioactive isotope to decay.
Section 14.1 Fossil Evidence of Change (continued)

Main Idea

Earth’s Early History

I found this information on page __________.
SE, pp. 392–393
RE, pp. 157–158

Details

Sequence the organizer below by listing the order of events that led to the formation of life in the oceans. The last step has been done for you.

4.5 billion years ago, Earth formed as a molten planet.

More than 4 billion years ago, Earth cooled and formed a solid crust with a molten interior.

Volcanoes erupted, giving off gases and forming the early atmosphere.

Clues in Rocks

I found this information on page __________.
SE, pp. 393–396
RE, pp. 158–160

Identify three types of materials in which fossils are found.

1. sedimentary rock
2. ice
3. amber

Compare relative and radiometric dating using the table below.
Provide three facts for each type of dating.
Accept all reasonable responses.

<table>
<thead>
<tr>
<th>Relative Dating</th>
<th>Radiometric Dating</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. used with sedimentary rocks</td>
<td>1. measures rate of decay of radioactive isotopes</td>
</tr>
<tr>
<td>2. youngest rock on top of older rocks</td>
<td>2. gives accurate age of fossil</td>
</tr>
<tr>
<td>3. does not give exact age</td>
<td>3. cannot be used with fossil sedimentary rocks; must date other rocks near sedimentary fossils</td>
</tr>
</tbody>
</table>
The Geologic Time Scale

I found this information on page ______.  
SE, pp. 396–400  
RE, pp. 160–163

Main Idea

Details

Summarize the four eras of the geologic time scale using the table below.

<table>
<thead>
<tr>
<th>Geologic Era</th>
<th>Major Biological Events</th>
<th>Organisms that Appeared</th>
<th>Other Facts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Precambrian</td>
<td>life began, eukaryotic cells evolved</td>
<td>unicellular life, eukaryotic cells, small marine animals</td>
<td>includes Earth’s formation, almost 90% of Earth’s entire history</td>
</tr>
<tr>
<td>Paleozoic</td>
<td>Cambrian explosion at beginning of Paleozoic, mass extinction at end</td>
<td>fish, amphibians, early land plants, reptiles</td>
<td>drastic changes in animal life occur</td>
</tr>
<tr>
<td>Mesozoic</td>
<td>mass extinction of dinosaurs, possibly caused by meteorite impact</td>
<td>dinosaurs, small mammals, flowering plants, birds</td>
<td>continents shift dramatically</td>
</tr>
<tr>
<td>Cenozoic</td>
<td>following extinction of dinosaurs, mammals diversify</td>
<td>large mammals, humans</td>
<td>most recent era</td>
</tr>
</tbody>
</table>

Rephrase the current theory on the cause of the mass extinction at the end of the Mesozoic era. Accept all reasonable responses.

Scientists propose that Earth was struck by a giant meteor, which caused a tremendous amount of dust to enter the atmosphere. This led to climate change. Species that could not adjust to the new climate disappeared.

Discuss how palentologists use relative and radiometric dating to support the geologic timescale.

Accept all reasonable responses. Paleontologists use relative dating to identify the age of rock layers. They use radiometric dating to accurately date fossils. Findings from both tools were helpful in structuring the geologic time scale and in determining the exact dates on the scale.
The History of Life
Section 14.2 The Origin of Life

Main Idea

Scan Section 2 of the chapter. Use the checklist as a guide.

- Read all section titles.
- Read all boldfaced words.
- Look at all pictures and read the captions.
- Think about what you already know about the history of life.

Write three facts you discovered about the origin of life.

1. Accept all reasonable responses.
2. ________________________________
3. ________________________________

Review Vocabulary

Use your book or dictionary to define amino acid. Use the term in a sentence to show its scientific meaning.

amino acid [building block of proteins]

New Vocabulary

Use your book or dictionary to define each term.

dendosymbiont theory [the idea that eukaryotic cells evolved from prokaryotes living symbiotically with other prokaryotes]

spontaneous generation [mistaken idea that life arises from nonlife]

theory of biogenesis [idea that living things arise from other living things]

Academic Vocabulary

Define mechanism to show its scientific meaning.

mechanism [an instrument or process by which something is done or comes into being]
Create a cartoon that illustrates how Redi’s experiment was used to disprove spontaneous generation.

Cartoons will vary but should include at least two different jars. One jar should be open with a piece of meat on the bottom, and a second jar should be covered with a piece of meat on the bottom. Students should show that there are flies and, later, maggots on the meat that is uncovered. The flies can be shown circling around the covered jar of meat but no maggots or flies should be shown inside the covered jar.

Compare spontaneous generation and biogenesis.
Accept all reasonable responses.

Model Oparin’s primordial soup hypothesis for the formation of simple organic molecules by filling in the graphic organizer below.

Identify four requirements for life using the concept map below.
Section 14.2 The Origin of Life (continued)

Main Idea

Cellular Evolution

I found this information on page _______.
SE, pp. 405–407
RE, pp. 167–168

Details

Sequence how oxygen accumulated in the atmosphere and the effect it had on life by completing the flowchart below.

- little oxygen in atmosphere; all living things are anaerobic
- photo-synthetic organisms evolve and produce oxygen
- oxygen accumulates in atmosphere
- ozone layer forms
- first eukaryotic cells evolve

Identify three properties that mitochondria and chloroplasts share with prokaryotes.

1. circular DNA
2. similar ribosomes
3. reproduce by fission

Analyze the endosymbiont theory of the evolution of plant cells by completing the sequence chart.

- prokaryote ingested aerobic bacteria
- bacteria evolved into mitochondria
- prokaryotes ingested photosynthesizing bacteria
- cyanobacteria became chloroplasts

Summarize

Analyze how the four requirements for life were identified by scientists.

Accept all reasonable responses. Orapin’s hypothesis identified a way in which simple organic molecules may have formed. Clay is assumed by scientists to provide a framework for protein assembly. RNA might have been life’s first coding system. Researchers are still working to identify the pathways that led to cell formation.
Tie It Together

Write an analogy to explain the difference between radiometric and relative dating. Develop a second analogy to explain the endosymbiont theory. Accept all reasonable responses.

Analogy of dating methods used by palentologists:

Analogy of endosymbiont theory:
Before You Read

*Use the “What I Know” column to list the things you know about evolution. Then list the questions you have about evolution in the “What I Want to Find Out” column. Accept all reasonable responses.*

<table>
<thead>
<tr>
<th>K</th>
<th>W</th>
<th>L</th>
</tr>
</thead>
<tbody>
<tr>
<td>What I Know</td>
<td>What I Want to Find Out</td>
<td>What I Learned</td>
</tr>
</tbody>
</table>

---

**Science Journal**

*Life has evolved slowly on Earth. Certain organisms evolved in response to changes in their environment. Describe an adaptation of an organism that you see around you. How has the organism become better suited to its environment as a result of this adaptation?*

Accept all reasonable responses.
Skim Section 1 of the chapter. Write three questions that come to mind from reading the headings and illustration captions.

1. Accept all reasonable responses.
2. ____________________________
3. ____________________________

Use your book or dictionary to define selective breeding.

process by which a breeder develops a plant or animal to have certain traits

Use your book or dictionary to define each term.

artificial selection

process of breeding organisms with specific traits to produce offspring with the same traits; selective breeding

evolution

change in a species over time

natural selection

occurs in nature when organisms with favorable variations survive, reproduce, and pass their variations to the next generation

Write a short paragraph that uses at least two of the terms above.

Accept all reasonable responses.

_____________________________________________________________________

_____________________________________________________________________

_____________________________________________________________________

_____________________________________________________________________

_____________________________________________________________________

_____________________________________________________________________
Summarize three observations Darwin made in his research on the South American mainland.

1. marine fossils present in Andes mountains
2. giant fossil versions of small, present-day animals
3. earthquakes can move rocks great distances

Identify three organisms from the Galápagos Islands and their distinguishing characteristics.

<table>
<thead>
<tr>
<th>Organism</th>
<th>Variation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mockingbirds</td>
<td>different mockingbirds present on each island</td>
</tr>
<tr>
<td>Tortoises</td>
<td>tortoises on each island have different shells</td>
</tr>
<tr>
<td>Finches</td>
<td>new species different from mainland species</td>
</tr>
</tbody>
</table>

Analyze Darwin’s hypothesis on the origin of Galápagos finches by filling in the flow chart. The first step has been done for you.

Finches migrate from South America to the Galápagos islands. The finches adapt to the different conditions on the islands. Over time, the finches change into new species.

Summarize three observations that Darwin made in his research with pigeons.

1. small variations in traits of individual pigeons
2. traits inherited by offspring
3. traits promoted in offspring by selection and breeding
Identify the four principles of natural selection.

1. Organisms have more offspring than can survive.
2. Individuals in a population show variations.
3. These variations are inherited.
4. Variations that increase survival or reproductive success will be more common in the next generation.

Summarize natural selection by completing the sentences below.

Organisms with favorable traits are able to reproduce and pass their traits on to their offspring, who then reproduce.

Those without such favorable traits are more likely to die out before reproducing.

Sequence the events that led to the publication of Darwin’s ideas.

Darwin begins work on a book describing how new species evolve by natural selection.

In 1858, Darwin and Wallace present their findings on natural selection to the scientific community.

In 1859, Darwin publishes a book titled On the Origin of Species by Means of Natural Selection.

Discuss Darwin’s different observations that led him to propose the theory of natural selection.

Accept all reasonable responses. Darwin observed that fossils he collected were distinct from present-day organisms. He observed patterns among similar species living on the Galápagos islands. He observed the process of selective breeding in pigeons.
Evolution

Section 15.2 Evidence of Evolution

**Main Idea**

Scan Section 2 of the chapter. List the lines of evidence that support Darwin’s theory of evolution by natural selection.

Accept all reasonable responses. Answers may include fossils, anatomy, embryology, biochemistry.

**Details**

Use your book or dictionary to define fossil.

fossil
remains of an organism or its activities

Use your book or dictionary to define the following terms.

- **analogous structures**
  structures with a similar function but different form and not arising from a common ancestor

- **ancestral trait**
  trait shared by species and common ancestors

- **biogeography**
  study of the distribution of plants and animals on Earth

- **camouflage**
  adaptation in which a species blends in with its environment

- **derived trait**
  newly evolved traits not found in common ancestors

- **embryo**
  early stage of development of a plant or animal

- **fitness**
  count of offspring born to an individual with a trait compared to an individual without that trait

- **homologous structures**
  anatomically similar structures with a common evolutionary origin

- **mimicry**
  adaptation in which one species resembles another species

- **vestigial structure**
  reduced form of a structure that is functional in other organisms
Section 15.2 Evidence of Evolution (continued)

Support for Evolution

I found this information on page ____.
SE, pp. 423–428
RE, pp. 172–174

Summarize the role that anatomy plays in teaching us about evolution by completing the table below.

<table>
<thead>
<tr>
<th>Structure</th>
<th>What is it?</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Homologous structure</td>
<td>structural features with common evolutionary origin</td>
<td>forelimbs of humans, cats, and bats are similar</td>
</tr>
<tr>
<td>Analogous structure</td>
<td>body parts that are similar in function but evolved from a different ancestor</td>
<td>birds and insects both have wings</td>
</tr>
<tr>
<td>Vestigial structure</td>
<td>body structure no longer serving a purpose</td>
<td>wings of kiwis</td>
</tr>
<tr>
<td>Embryo</td>
<td>earliest stage of growth and development of a plant or animal</td>
<td>embryos of fishes, birds, reptiles, and mammals have structures that suggest they had common ancestors</td>
</tr>
</tbody>
</table>

Identify ways scientists interpret relationships among species by completing the organizer below.

Scientists combine data from
fossils
anatomy
embryology
biochemistry
geographic distribution
to interpret relationships among species.
Section 15.2 Evidence of Evolution (continued)

**Main Idea**

**Adaptation**

I found this information on page ______.  
SE, pp. 428–430  
RE, p. 175

**Details**

**Compare** similarity and differences between adaptations and non-adaptations by writing yes or no in the table. Then give an example of an adaptation and a non-adaptation.

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Adaptations</th>
<th>Non-Adaptations</th>
</tr>
</thead>
<tbody>
<tr>
<td>inherited traits</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>increase survival or reproduction</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>by-product arising from other evolutionary changes</td>
<td>no</td>
<td>yes</td>
</tr>
<tr>
<td>Example:</td>
<td>Accept all reasonable responses.</td>
<td>Accept all reasonable responses.</td>
</tr>
</tbody>
</table>

**Apply** Give examples of how animals use camouflage and mimicry in order to protect themselves. Use examples that are not given in your book. Accept all reasonable responses.

**Summarize**

Explain why fossils are important tools in understanding evolution.

Accept all reasonable responses. Fossils teach us about the structure of organisms from the past. Fossils show species that are intermediate between other species. Fossils clarify the evolutionary relationships between species.
Main Idea

Evolution

Section 15.3 Shaping Evolutionary Theory

Details

Scan Section 3 of the chapter. Write two facts that you discover.

1. Accept all reasonable responses.

2. __________________________________________________________________________

Review Vocabulary

Use your book or dictionary to define allele.

allele: alternate forms of a gene

New Vocabulary

Write the correct vocabulary term in the left column for each definition below.

Hardy-Weinberg Principle
founder effect
bottleneck
prezygotic isolating mechanism
genetic drift
stabilizing selection
postzygotic isolating mechanism
directional selection
disruptive selection
sexual selection
allopatric speciation
sympatric speciation

allele frequencies remain the same unless acted upon by a factor
random evolution that occurs in a small, separate subpopulation
process of a large population declining in number then rebounding to a large number again
mechanism that operates before fertilization occurs
change in the allele frequencies in a population by chance
selection which removes organisms with extreme expressions of a trait
mechanism that operates after fertilization occurs to ensure that resulting hybrid remains infertile
selection which shifts a population toward an extreme trait
selection which removes individuals with average traits
change in a trait based on competition for mates
speciation in the presence of a barrier
speciation without any barriers
Section 15.3  Shaping Evolutionary Theory (continued)

**Main Idea**  
Mechanisms of Evolution

I found this information on page ____________.
SE, pp. 431–436
RE, pp. 176–180

**Details**  
Sequence the steps associated with genetic equilibrium by completing the graphic organizer below.

| Alleles | make up a gene pool at a certain allelic frequency which, over time, results in genetic equilibrium. |

Identify three ways that genetic equilibrium can be disrupted.

1. genetic mutation
2. genetic drift
3. gene flow

Contrast geographic isolation and reproductive isolation.
Geographic isolation is when a new species develops after members of a population are separated by a physical boundary. Reproductive isolation occurs when organisms that used to mate and produce fertile offspring no longer can do so.

Compare natural selection and sexual selection by completing the table.

<table>
<thead>
<tr>
<th>Species Changes Based on</th>
<th>Increases Fitness?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural selection</td>
<td>the environment</td>
</tr>
<tr>
<td>Sexual selection</td>
<td>competition for a mate</td>
</tr>
</tbody>
</table>

Sequence
Section 15.3 Shaping Evolutionary Theory (continued)

**Main Idea**

**Speciation**
I found this information on page ______.
SE, p. 438
RE, p. 158

**Details**

**Compare** allopatric speciation and sympatric speciation by writing one fact in each segment of the Venn diagram below. Accept all reasonable responses.

<table>
<thead>
<tr>
<th>Allopatric Speciation</th>
<th>Both</th>
<th>Sympatric Speciation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical barrier divides populations.</td>
<td>Populations diverge into different species.</td>
<td>Ancestor and new species live side by side during speciation.</td>
</tr>
</tbody>
</table>

**Speciation and Patterns of Evolution**
I found this information on page ______.
SE, pp. 439–441
RE, pp. 181–182

**Label** each model as representing divergent evolution or convergent evolution.

- Divergent evolution
- Convergent evolution

- **Species A**
- **Species B**
- **Species C**
- **Species X**
- **Species Y**

- share similar traits

**Summarize** the current thoughts about the rate of speciation by completing the table below.

<table>
<thead>
<tr>
<th>Gradualism</th>
<th>Punctuated Equilibrium</th>
</tr>
</thead>
<tbody>
<tr>
<td>species originate through a gradual change of adaptations</td>
<td>speciation occurs rapidly, in bursts, followed by periods of stability</td>
</tr>
</tbody>
</table>

**SUMMARIZE**
List three possible patterns of evolution and an example of each.

Accept all reasonable responses.

- adaptive radiation: more than 300 species of cichlid fishes that once lived in Lake Victoria;
- coevolution: a species of moth and a comet orchid;
- convergent evolution: mouse and marsupial mouse
Primate Evolution

Before You Read

Use the “What I Know” column to list the things you know about the way primates evolved. Then list the questions you have about primate evolution in the “What I Want to Find Out” column. Accept all reasonable responses.

<table>
<thead>
<tr>
<th>K</th>
<th>What I Know</th>
<th>W</th>
<th>What I Want to Find Out</th>
<th>L</th>
<th>What I Learned</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Science Journal

The ability of an organism to adapt to its surroundings is needed for survival. Describe the adaptations you think were most important to the survival of primates in a variety of climates.

Accept all reasonable responses.

_____________________________________________________
_____________________________________________________
_____________________________________________________
_____________________________________________________
_____________________________________________________
_____________________________________________________
_____________________________________________________
_____________________________________________________
Primate Evolution

Section 16.1 Primates

**Main Idea**

Scan the title and main idea of Section 1. List two things that might be discussed in this section.

1. Accept all reasonable responses.
2. ________________

**Details**

Review Vocabulary

Use your book or dictionary to define extinction.

extinction

the condition of no longer existing

New Vocabulary

Use your book or dictionary to define each term.

anthropoid

humanlike primate that appears to be more closely related to present-day humans than it is to present-day chimpanzees and bonobos

arboreal

tree-dwelling

binocular vision

overlapping fields of vision

diurnal

active during the day

hominin

humanlike primate

nocturnal

active at night

opposable first digit

either a toe or a thumb that is set apart from other digits and can be brought across the palm or foot so that it touches or nearly touches the other digits

prehensile tail

tail that functions like a fifth limb

Define diverge to show its scientific meaning.

diverge

to become different in character or form
Identify the benefits of the following primate characteristics.
Accept all reasonable responses.

<table>
<thead>
<tr>
<th>Primate Characteristic</th>
<th>Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Opposable first digit</td>
<td>can grasp objects with a powerful grip</td>
</tr>
<tr>
<td>Binocular vision</td>
<td>enables greater depth perception</td>
</tr>
<tr>
<td>Unspecialized teeth</td>
<td>suitable for diverse diets</td>
</tr>
<tr>
<td>Flexible shoulders and hips</td>
<td>enable easy movement through trees, walking on four limbs and some upright walking</td>
</tr>
<tr>
<td>Large, complex brain</td>
<td>enhanced memory and coordination; problem-solving abilities; well-developed social skills; complex communication</td>
</tr>
<tr>
<td>Low reproductive rate</td>
<td>extended dependency period allows time to learn complex social interaction</td>
</tr>
</tbody>
</table>

Identify the primate groups in the diagram below.

Primate Groups

“Wet-nosed”:
- strepsirrhines

“Dry-nosed”:
- haplorhines

- anthropoids
- tarsiers

Summarize a theory on why lemurs are found only on Madagascar and nearby islands.
Accept all reasonable responses. During the time lemurs evolved, Madagascar drifted away from the African mainland. Lemurs might have migrated there on rafts of leaves. There they evolved in reproductive isolation.
Primate Evolution

I found this information on page _____________
SE, pp. 458–460
RE, p. 188

Classify the subgroups of anthropoids by completing the diagram.

Anthropoids

- New World Monkeys
  
  Example: tamarins

- Apes
  
  Lesser Apes
  
  Great Apes

- Old World Monkeys
  
  Example: baboons

- Hominins
  
  Example: humans

Summarize primate evolution by completing the time line below.

85 mya: First primates appeared.

50 mya: Anthropoids diverged from tarsiers.

60 mya: Earliest primate fossils appeared; Altiatlasius.

35–25 mya: New World monkeys diverged from Old World monkey line.

Summarize

Analyze the theory that the rise of flowering trees had a great impact on primate evolution. Explain why.

Accept all reasonable responses. Flowering trees provided new food sources, such as flowers and fruits, as well as new living environments. To take advantage of these new niche opportunities, primates evolved adaptations for an arboreal life. Adaptations included prehensile tails, long limbs, brachiation, and opposable digits. These adaptations facilitated movement and food gathering in the trees.
## Primate Evolution
### Section 16.2 Hominoids to Hominins

### Main Idea

**Scan** the time line and other illustrations in Section 2 of the chapter. Write two questions that come to mind.

1. Accept all reasonable responses.
2. ______________________

### Details

**Review Vocabulary**

*Use your book or dictionary to define savanna.*

| savanna                        | flat grassland of tropical or subtropical regions |

**New Vocabulary**

*Use your book or dictionary to define each term.*

<table>
<thead>
<tr>
<th>australopithecine</th>
<th>hominin group that lived in the east-central and southern part of Africa between 4.2 and 1 million years ago; first truly bipedal</th>
</tr>
</thead>
<tbody>
<tr>
<td>hominin</td>
<td></td>
</tr>
<tr>
<td>bipedal</td>
<td>ability to walk upright on two legs</td>
</tr>
<tr>
<td>hominoid</td>
<td>any nonmonkey anthropoid, including a human</td>
</tr>
</tbody>
</table>

*Place the first australopithecines and first hominoids in the general time line below.*

<table>
<thead>
<tr>
<th>hominoids</th>
<th>australopithecines</th>
</tr>
</thead>
<tbody>
<tr>
<td>about 25 mya</td>
<td>about 4.2 mya</td>
</tr>
</tbody>
</table>
Section 16.2 Hominoids to Hominins (continued)

**Main Idea**

**Hominoids**

I found this information on page 461–462.

**Details**

Sequence hominoid divergence by placing the primates listed below in the proper location on the flowchart.

- gorillas
- gibbons
- chimpanzees and bonobos
- humans
- orangutans

Describe why the Proconsul species was an important find for scientists. Accept all reasonable responses.

Some of the oldest hominoid fossils are members of the genus **Proconsul**. Some scientists believe that **Proconsul** is a human ancestor.

Label five adaptations for bipedalism on the skeleton.

Labels should include descriptions such as the following: spine attaches at base of skull; S-shaped spine; arms shorter than legs; bowl-shaped pelvis; femur angled inward.
Describe some potential advantages and disadvantages of bipedalism compared to quadrupedalism. Accept all reasonable responses.

Disadvantages of bipedalism:
- Individuals easier for predators to see;
- Slower running speed;
- Greater strain on hips and back;
- Might require more energy.

Advantages of bipedalism:
- Could travel longer distances to search for food;
- Could spot food sources more easily;
- Might reduce total area of body exposed to sunlight and increase area exposed to cooling winds;
- Hands free to carry objects or for other purposes;
- Could reach fruit on low branches.

Identify a key discovery by each of the following scientists. Then analyze how the discovery contributed to the debate about which adaptation evolved first: larger brain or bipedalism.

<table>
<thead>
<tr>
<th>Raymond Dart</th>
<th>Donald Johanson</th>
<th>Mary Leakey</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discovery: Taung baby</td>
<td>Discovery: Lucy</td>
<td>Discovery: fossilized australopithecine footprints</td>
</tr>
<tr>
<td>Analysis: placement of the foramen magnum in the skull suggested that this small-brained australopithecine was bipedal</td>
<td>Analysis: helped resolve the debate; Lucy’s hip and knee joints showed that she was clearly bipedal</td>
<td>Analysis: supplied further evidence that australopithecines were bipedal</td>
</tr>
</tbody>
</table>

CONNECT

Analyze why scientists have difficulty classifying many hominin fossils.

Accept all reasonable responses. Hominins followed mosaic evolution—different body parts and behaviors evolved at different rates. As a result, early hominin fossils showed a patchwork of human and apelike traits. A variety of hominin species lived alongside human ancestors but were not direct human ancestors themselves.
Primate Evolution
Section 16.3 Human Ancestry

Main Idea

Scan Section 3 of the chapter. Use the checklist as a guide.

☐ Read all section titles.

☐ Read all boldfaced words.

☐ Read all tables, figures, and graphs.

☐ Look at all pictures and read the captions.

Write two facts you discovered as you scanned the section.

1. Accept all reasonable responses.

2. ______________________________________________________________________

Review Vocabulary

Use your book or dictionary to define mitochondrion.

mitochondrion
organelle found in eukaryotic cells containing genetic material and responsible for cellular energy

New Vocabulary

Use your book or dictionary to define each term.

Cro-Magnon
first fully modern human group; expressed itself symbolically and artistically, developed sophisticated tools and weapons, was the first to fish, tailor clothing, and domesticate animals

Homo
genus that includes living and extinct humans

Neanderthal
distinct human species that evolved exclusively in Europe and Asia about 200,000 years ago, likely from H. erectus or a Homo intermediary; larger and more heavily muscled than modern humans
Section 16.3 Human Ancestry (continued)

Main Idea

The *Homo* Genus

I found this information on page 467–470, SE, pp. 193–195

Details

Identify the correct species from the list below for each of the following characteristics.

- *H. habilis*
- *H. erectus*
- *H. heidelbergensis*
- *H. ergaster*
- *H. floresiensis*
- *H. neanderthalensis*

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Homo Species</th>
</tr>
</thead>
<tbody>
<tr>
<td>Evidence suggests they cared for their sick and buried their dead</td>
<td><em>H. neanderthalensis</em></td>
</tr>
<tr>
<td>More versatile than predecessors; adapted successfully to a variety of environments</td>
<td><em>H. erectus</em></td>
</tr>
<tr>
<td>First undisputed member of the <em>Homo</em> genus</td>
<td><em>H. habilis</em></td>
</tr>
<tr>
<td>Nicknamed “The Hobbit” because of its small size</td>
<td><em>H. floresiensis</em></td>
</tr>
<tr>
<td>Larger and more heavily muscled than modern humans</td>
<td><em>H. neanderthalensis</em></td>
</tr>
<tr>
<td>Believed to have had the first human nose (nostrils facing downward)</td>
<td><em>H. ergaster</em></td>
</tr>
<tr>
<td>Classification for various transitional fossils that display a mosaic of <em>H. ergaster</em> and <em>H. sapiens</em> traits</td>
<td><em>H. heidelbergensis</em></td>
</tr>
<tr>
<td>Name means “handy man” because of association with primitive stone tools</td>
<td><em>H. habilis</em></td>
</tr>
<tr>
<td>Probably evolved from <em>H. erectus</em> or a <em>Homo</em> intermediary</td>
<td><em>H. neanderthalensis</em></td>
</tr>
<tr>
<td>First African <em>Homo</em> species to migrate in large numbers to Asia and Europe</td>
<td><em>H. ergaster</em></td>
</tr>
<tr>
<td>Serves as evidence that <em>H. erectus</em> or some other ancient hominin species remained on Earth until 12,000 years ago</td>
<td><em>H. floresiensis</em></td>
</tr>
</tbody>
</table>

Identify a Homo species that scientists hypothesize to be a human ancestor, based on features shared with modern humans.

*Homo ergaster*

Identify a Homo species that scientists believe was not a human ancestor, based on DNA tests on fossil bones.

*Homo neanderthalensis*
Section 16.3 Human Ancestry (continued)

**Main Idea**

Emergence of Modern Humans

I found this information on page ______.
SE, pp. 471–473
RE, pp. 195–196

**Details**

Rephrase two hypotheses proposed to explain the global dominance of modern humans.

Multiregional evolution model: Modern humans evolved from several dispersed populations of early Homo species at the same time in different areas of the world. Modern races of humans arose in isolated populations by convergent evolution.

“Out of Africa” hypothesis: Modern humans evolved only once, in Africa, and then migrated to all parts of the world, eventually displacing other hominins.

Summarize a scientific study that supported the “Out of Africa” hypothesis by completing the paragraph.

- Africans have the most variation in mitochondrial DNA
- mitochondrial DNA changes very little over time
- mitochondrial DNA is inherited only from the mother
- the population with the most variation had the longest existence

Because mitochondrial DNA changes very little over time, scientists reasoned that the population with the most variation had the longest existence. In studying the DNA of contemporary humans, scientists found that Africans have the most variation in mitochondrial DNA. Because mitochondrial DNA is inherited only from the mother, scientists concluded that *H. sapiens* emerged in Africa from a hypothetical “Mitochondrial Eve.”

**Summarize**

Contrast *Homo sapiens* to all other *Homo* species. Accept all reasonable responses.

*H. sapiens* are more gracile with thinner skeletons, rounder skulls, smaller faces, and more prominent chins than all other *Homo* species. Their brains are larger than all except Neanderthals. They have developed complex language and culture.
Organizing Life’s Diversity

Before You Read

Use the “What I Know” column to list the things you know about life’s diversity. Then list the questions you have about diversity in the “What I Want to Find Out” column. Accept all reasonable responses.

<table>
<thead>
<tr>
<th>K What I Know</th>
<th>W What I Want to Find Out</th>
<th>L What I Learned</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Science Journal

Consider several living organisms that you see around you. Describe some characteristics that biologists might use when trying to classify, or organize, them into similar species.

Accept all reasonable responses.


Scan Section 1 of the chapter. Write three questions that come to mind from reading the headings and the illustration captions.

1. Accept all reasonable responses.
2. 
3. 

Use your book or dictionary to define morphology.

the structure and form of an organism or one of its parts

Classify each term at the left as being part of Linnaeus’ two-word naming system or a taxonomic group.

<table>
<thead>
<tr>
<th>Linnaeus’ System</th>
<th>Taxonomic Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>binominal nomenclature</td>
<td>class</td>
</tr>
<tr>
<td>genus</td>
<td>division</td>
</tr>
</tbody>
</table>

Use your book to define each term.

classification: grouping of objects or information based on a set of criteria

taxon: a named group of organisms

taxonomy: a discipline of biology primarily concerned with identifying, naming, and classifying species based on natural relationships
Main Idea

Early Systems of Classification

I found this information on page 484–486.
SE, pp. 484–486
RE, pp. 197–200

Details

Identify the parts of Linnaeus’ two-word naming system by completing the graphic organizer below.

Binomial Nomenclature:

- first word identifies a genus
- which is a group of similar species

- second word is called the specific epithet
- which often describes a characteristic of an organism

Distinguish the genus and specific name, or epithet, for the species name of modern humans.

Homo sapiens

- genus
- specific epithet

1. Compare data in the table below to determine which two animals are most closely related. Support your reasoning.

   Coyote and wolf; their classifications are identical down to the species level

   Classification of Selected Mammals

<table>
<thead>
<tr>
<th>Kingdom</th>
<th>Animalia</th>
<th>Animalia</th>
<th>Animalia</th>
<th>Animalia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phylum</td>
<td>Chordata</td>
<td>Chordata</td>
<td>Chordata</td>
<td>Chordata</td>
</tr>
<tr>
<td>Class</td>
<td>Mammalia</td>
<td>Mammalia</td>
<td>Mammalia</td>
<td>Mammalia</td>
</tr>
<tr>
<td>Order</td>
<td>Cetacea</td>
<td>Carnivora</td>
<td>Carnivora</td>
<td>Carnivora</td>
</tr>
<tr>
<td>Family</td>
<td>Mysticeti</td>
<td>Felidae</td>
<td>Canidae</td>
<td>Canidae</td>
</tr>
<tr>
<td>Genus</td>
<td>Balenopora</td>
<td>Felis</td>
<td>Canis</td>
<td>Canis</td>
</tr>
<tr>
<td>Species</td>
<td>B. physalis</td>
<td>F. catus</td>
<td>C. latrans</td>
<td>C. lupus</td>
</tr>
<tr>
<td>Common name</td>
<td>Blue whale</td>
<td>Domestic cat</td>
<td>Coyote</td>
<td>Wolf</td>
</tr>
</tbody>
</table>

2. Analyze at which level the blue whale diverges from the other animals on the table.

   At the order level
Section 17.1 The History of Classification (continued)

Organize the following taxa from most specific to least specific: family, genus, order, species. The first one has been done for you.

- family
- genus
- order
- species

Analyze the figure of the taxonomic groups in your book. Then identify the domain, kingdom, phylum, and class for humans.

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

Summarize how a dichotomous key works.

A dichotomous key is based on a series of choices between alternate characteristics. At each choice in the key, you identify a characteristic, such as color of stem—red or green. If the answer is red, you follow the key to the next choice. At the end, you will know the scientific name of the organism.

Summarize why a name such as catfish is not a good scientific name. Accept all reasonable responses. Common names may describe a characteristic of an organism but be misleading. Catfish are not related to cats. Scientific names provide a specific way of classifying organisms that all biologists understand.
**Main Idea**

Scan the illustrations in Section 2 of the chapter and read the captions. Select one illustration and state why you think it will be important.

Illustration: **Accept all reasonable responses.**

Why it will be important: ____________________________________________

---

**Details**

**Review Vocabulary**

*evolution*

Use your book or dictionary to define evolution.

*the historical development of a regulated group of organisms*

**New Vocabulary**

*characters*

inherited features that vary among species; can be morphological or biochemical

*a method of analysis that reconstructs phylogenies*

*a branching diagram that represents the proposed phylogeny or evolution of a species or group*

*a model that uses comparisons of DNA sequences to estimate how long species have been evolving independently*

*the evolutionary history of a species*

**Academic Vocabulary**

*corresponding*

Define corresponding to show its scientific meaning.

*being similar or equivalent in character, quantity, origin, structure, or function*
**Main Idea**

**Determining Species**

*I found this information on page __________.  
SE, pp. 490–491  
RE, pp. 202–204*

--

**Details**

*Compare the four concepts that biologists have used or are using to classify organisms.*

<table>
<thead>
<tr>
<th>Concept</th>
<th>Basis of Classification</th>
<th>Limitations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Typological species concept</td>
<td>physical characteristics</td>
<td>does not account for variations in species or the fact that species change over time</td>
</tr>
<tr>
<td>Biological species concept</td>
<td>group of organisms that can interbreed and produce fertile offspring in a natural setting</td>
<td>does not account for extinct species or species that reproduce asexually</td>
</tr>
<tr>
<td>Evolutionary species concept</td>
<td>groups that evolve independently from their ancestral population</td>
<td>unknown evolutionary histories for some species</td>
</tr>
<tr>
<td>Phylogenetic species concept</td>
<td>clusters of organisms that are distinct from other clusters and share a pattern of ancestry</td>
<td>unknown evolutionary histories for some species</td>
</tr>
</tbody>
</table>
Section 17.2 Modern Classification (continued)

Main Idea

Characters

I found this information on page 492–495.
SE, pp. 492–495
RE, pp. 204–205

Details

Identify and give examples of the two types of characters in the concept map.

Characters:
Inherited features that vary among species

Morphological Characters: Similar or analogous structures

Example: hollow spaces in leg bones of oviraptors and birds

Example: feathers in oviraptors and birds

Biochemical Characters: Similarities in genetic material (DNA and RNA)

Example: similar genetic makeup of broccoli, kale, and cauliflower

Example: chromosome similarities among chimps, gorillas, and orangutangs

Phylogenetic Reconstruction

I found this information on page 495–498.
SE, pp. 495–498
RE, pp. 206–207

Describe cladograms by completing the paragraph.

A __cladogram__ is a branching diagram that represents the proposed __phylogeny__ or evolution of a __species__ or group.

The groups used in cladograms are called __clades__. To __develop__ a cladogram, __derived__ characters are identified.

Then the __ancestry__ of various species is identified based on the __presence__ or __absence__ of the derived characters in the __species__. In making a cladogram, __taxonomists__ assume that groups that __share__ more derived characters have a more __recent__ common ancestor.

Summarize

Describe a process scientists use to construct a cladogram that includes a new species of vascular plant that was recently discovered in the rainforest.

Accept all reasonable responses. Scientists would identify derived characters and ancestral characters. They would place the new species close to other species that share the most derived characters.
Organizing Life’s Diversity
Section 17.3 Domains and Kingdoms

Main Idea

Scan Section 3 of the chapter. Use the checklist as a guide.

- Read all section titles.
- Read all boldfaced words.
- Read all tables and graphs.
- Look at all pictures and read the captions.
- Think about what you already know about groups of organisms.

Write three facts you discovered as you scanned the section.

1. Accept all reasonable responses.

2. __________________________________________________________________________

3. __________________________________________________________________________

Review Vocabulary

Use your book or dictionary to define eukaryote.

eukaryote
an organism composed of one or more cells containing a nucleus and membrane-bound organelles

New Vocabulary

Use your book or dictionary to define each term.

Archaea
a kingdom of prokaryotes whose cell walls do not contain peptidoglycan; sometimes called extremophiles

eubacteria
a kingdom of prokaryotes whose cell walls contain peptidoglycan

fungus
eukaryotic organisms that can be unicellular or multicellular and absorbs nutrients from organic materials in its environment; have cell walls that contain chitin

protists
eukaryotic organisms that can be unicellular, colonial, or multicellular; subclassified as algae, protozoans, and fungus-like

176 Organizing Life’s Diversity
Section 17.3 Domains and Kingdoms (continued)

Main Idea

Grouping Species
I found this information on page _____________.
SE, p. 499
RE, p. 208

Domain Bacteria
I found this information on page ______________.
SE, pp. 499–500
RE, pp. 208–209

Domain Archaea
I found this information on page _____________.
SE, p. 500
RE, p. 209

Domain Eukarya
I found this information on page _____________.
SE, pp. 501–503
RE, pp. 209–212

Details

Rephrase why the members formerly in the Kingdom Monera were separated into the two new domains Bacteria and Archaea.
Biochemical studies showed that there were two different types of bacteria, so they were divided into two domains.

Model the cell walls of eubacteria. Label the features of eubacteria.
Accept all reasonable drawings.

Analyze why archaeobacteria are sometimes called extremophiles.
Archaeobacteria are called extremophiles because they live in some of the most extreme environments on Earth, including boiling hot springs, salty lakes, thermal vents, and mud.

Organize the kingdoms in the Domain Eukarya and describe their cell structure. List each kingdom’s sources of energy and other important characteristics.

<table>
<thead>
<tr>
<th>Kingdom</th>
<th>Cell Structure</th>
<th>Energy Sources</th>
<th>Other Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eubacteria</td>
<td>strong cell walls</td>
<td>heterotrophs, autotrophs, and chemo-synthetic</td>
<td>live in most habitats</td>
</tr>
<tr>
<td>Archaebacteria</td>
<td>have cell walls that are different from eubacteria</td>
<td>autotrophs, chemo-synthetic, and photosynthetic</td>
<td>live in extreme environments</td>
</tr>
</tbody>
</table>
## Section 17.3 Domains and Kingdoms (continued)

### Main Idea

I found this information on page 501–503.

### Details

<table>
<thead>
<tr>
<th>Kingdom</th>
<th>Cell Structure</th>
<th>Energy Sources</th>
<th>Other Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protists</td>
<td>unicellular or multicellular</td>
<td>autotrophs, heterotrophs</td>
<td>simple organ systems</td>
</tr>
<tr>
<td>Fungi</td>
<td>unicellular or multicellular</td>
<td>heterotrophs</td>
<td>stationary</td>
</tr>
<tr>
<td>Plants</td>
<td>have cell walls</td>
<td>autotrophs</td>
<td>stationary</td>
</tr>
<tr>
<td>Animals</td>
<td>no cell walls</td>
<td>heterotrophs</td>
<td>most able to move</td>
</tr>
</tbody>
</table>

**SUMMARIZE**

Model a diagram of the relationship between domains and kingdoms. Accept all reasonable responses.
Bacteria and Viruses

Before You Read

Before you read the chapter, respond to these statements. Accept all reasonable responses.

1. Write an A if you agree with the statement.
2. Write a D if you disagree with the statement.

<table>
<thead>
<tr>
<th>Before You Read</th>
<th>Bacteria and Viruses</th>
<th>After You Read</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Bacteria can live in a thermal vent on the ocean floor, where temperatures top 80°C.</td>
<td>A</td>
<td></td>
</tr>
<tr>
<td>• If you have bacteria in your intestines, you will get sick.</td>
<td>D</td>
<td></td>
</tr>
<tr>
<td>• Some viruses remain inactive for years inside human cells.</td>
<td>A</td>
<td></td>
</tr>
<tr>
<td>• <em>Mad cow</em> disease is caused by a protein.</td>
<td>A</td>
<td></td>
</tr>
</tbody>
</table>

Many viruses and bacteria can cause diseases in animals and plants. Write about a disease that you know of that is caused by a virus or a bacteria. Be sure to discuss how the disease is treated.

Accept all reasonable responses.
# Bacteria and Viruses

## Section 18.1 Bacteria

**Main Idea**

**Details**

Scan (Lesson 1 of the chapter) Write two facts that you discovered as you scanned the section.

1. Accept all reasonable responses.

2. ____________________________

Review Vocabulary

Use your book or dictionary to define **prokaryotic cell**.

- **prokaryotic cell**: cell that does not contain any membrane-bound organelles

New Vocabulary

Use your book or dictionary to define each term.

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>bacteria</strong></td>
<td>unicellular prokaryotic microorganisms</td>
</tr>
<tr>
<td><strong>binary fission</strong></td>
<td>division of a cell into two genetically identical cells</td>
</tr>
<tr>
<td><strong>capsule</strong></td>
<td>layer of secreted polysaccharides around a prokaryotic cell wall</td>
</tr>
<tr>
<td><strong>conjugation</strong></td>
<td>method of reproduction in which two prokaryotes attach to each other and exchange genetic information</td>
</tr>
<tr>
<td><strong>endospore</strong></td>
<td>structure produced by some bacteria during harsh environmental conditions that contains genetic information and can germinate into a new bacterial cell when conditions improve</td>
</tr>
<tr>
<td><strong>nucleoid</strong></td>
<td>area of a prokaryotic cell that holds the chromosome</td>
</tr>
<tr>
<td><strong>pilus</strong></td>
<td>submicroscopic, hairlike structure made of protein that is found on the outer surface of some bacteria</td>
</tr>
</tbody>
</table>
Main Idea

Diversity of Prokaryotes

I found this information on page __________.
SE, pp. 516–517
RE, pp. 213–214

Details

Summarize three general environments where archaebacteria live, and give one example of each environment.

1. hot, acidic: sulfur hot springs, thermal vents, volcanoes
2. high concentrations of salt: Great Salt Lake, Dead Sea
3. oxygen-free: swamps, bogs, volcanic vents

Prokaryote Structure

I found this information on page __________.
SE, p. 518
RE, pp. 214–215

Model a prokaryotic cell and label its structures.

Identify each bacterial shape below with its scientific name.

Identifying Prokaryotes

I found this information on page __________.
SE, p. 519
RE, p. 215

Reproduction of Prokaryotes

I found this information on page __________.
SE, p. 520
RE, pp. 215–216

Compare prokaryote reproduction by completing the table below.

<table>
<thead>
<tr>
<th>Reproduction Method</th>
<th>Binary Fission</th>
<th>Conjugation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Process</td>
<td>chromosome replicates, cell elongates, new plasma membrane and cell wall form and separate cell</td>
<td>two individuals use pili to attach to each other and exchange genetic material</td>
</tr>
<tr>
<td>Result</td>
<td>two genetically identical cells</td>
<td>new gene combination</td>
</tr>
</tbody>
</table>
Section 18.1 Bacteria (continued)

**Main Idea**

**Metabolism of Prokaryotes**

*I found this information on page ________.*  
SE, pp. 520–521  
RE, pp. 216–217

**Details**

*Compare prokaryotes by describing how each group below obtains energy for cellular respiration.*

- **Saprotrophs:** decompose dead organisms or organic waste
- **Photoautotrophs:** use light for photosynthesis
- **Chemoautotrophs:** use chemosynthesis to break down inorganic matter that contains nitrogen and sulfur

**Survival of Bacteria**

*I found this information on page ________.*  
SE, pp. 521–522  
RE, p. 217

**Ecology of Bacteria**

*I found this information on page ________.*  
SE, pp. 522–524  
RE, p. 218

**Details**

*Identify two bacterial survival mechanisms and describe the advantages of each mechanism.*

<table>
<thead>
<tr>
<th>Mechanism</th>
<th>Survival Advantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Endospores</td>
<td>can survive extreme conditions that kill the bacteria; germinate when conditions improve</td>
</tr>
<tr>
<td>Mutations</td>
<td>produce new gene forms and combinations; increase chances that some can survive environmental changes and repopulate</td>
</tr>
</tbody>
</table>

*List five ways that bacteria are helpful to humans.*

- decompose dead organisms and recycle nutrients
- nitrogen fixation
- normal flora protect against disease and produce vitamin K
- used in producing foods and vitamin pills
- used in producing antibiotics

**Summarize**

Assess whether bacteria are more harmful than helpful to humans. Defend your answer.

*Accept all reasonable responses. Bacteria are more helpful than harmful. Life would be impossible without bacteria because they produce the oxygen that is necessary for life.*
Bacteria and Viruses

Section 18.2 Viruses and Prions

Scan the table and time line in Section 2 of the chapter. Write three facts you discovered about viruses from these elements.

1. Accept all reasonable responses.
2. 
3. 

Use your book or dictionary to define protein.

protein

large, complex polymer composed of carbon, hydrogen, oxygen, nitrogen, and sometimes sulfur

Use the new vocabulary terms in the left column to complete the following paragraph.

A ____ virus ____ is genetic material within a protein coat, but it has no organelles or other characteristics of life. The genetic material lies inside its ____ capsid ____, or outer layer of protein. In the ____ lytic cycle ____, viral genes instruct the host cell to make many copies of the viral RNA or DNA. Some viruses replicate in a ____ lysogenic cycle ____ , in which the viral DNA integrates into a host chromosome and lies dormant for some time. A ____ retrovirus ____ , such as the HIV virus, contains RNA instead of DNA. Mutation in the genes of a normal protein called a ____ prion ____ is responsible for diseases such as “mad cow.”

Define widespread to show its scientific meaning.

widespread

widely diffused or prevalent
**Main Idea**

**Viruses**

*I found this information on page ____________.*

SE, pp. 525–527
RE, pp. 219–220

**Viral Infection**

*I found this information on page ____________.*

SE, pp. 527–529
RE, pp. 220–221

**Details**

**Model of one type of virus. Label its parts.**

Drawings should resemble one of the virus diagrams in Figure 18.1.

**Synthesize why many viruses cannot pass from one species to another.**

The virus attaches to the host cell using specific receptors on the plasma membrane of the host. Different types of organisms have receptors for different types of viruses, limiting transmission between species.

**Label steps A, B, C, D, and E of a lytic cycle in the figure below. Use the following terms.**

- Assembly
- Attachment
- Entry
- Lysis and Release
- Replication

- **Attachment**
- **Entry**
- **Lysis and Release**
- **Assembly**
- **Replication**
Main Idea

Sequence the steps of a lysogenic cycle.

1. Viral DNA integrates into a chromosome of a host cell.
2. There the viral genes remain dormant for months or years.
3. Activation triggers the lytic cycle to begin.
4. New viruses leave the cell by exocytosis or by bursting the cell.

Details

Retroviruses

I found this information on page _________.
SE, p. 530
RE, pp. 221–222

Prions

I found this information on page _________.
SE, p. 531
RE, p. 222

Evaluate and discuss the role of reverse transcriptase in the replication cycle of HIV.

After HIV attaches to a cell and releases its RNA, the reverse transcriptase enzyme synthesizes DNA using the viral RNA as a template.

Summarize information about prions by completing the table.

<table>
<thead>
<tr>
<th>What is a prion?</th>
<th>What causes a prion to become harmful?</th>
</tr>
</thead>
<tbody>
<tr>
<td>a protein that normally exists in cells but can cause infection or disease</td>
<td>It mutates.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>How might humans contract a prion-caused disease?</th>
<th>What is the result of prion infection?</th>
</tr>
</thead>
<tbody>
<tr>
<td>by eating beef from an infected cow</td>
<td>Prions infect nerve cells in the brain, causing them to burst.</td>
</tr>
</tbody>
</table>

Conclude whether viruses that replicate by the lytic cycle or the lysogenic cycle are more dangerous. Explain your reasoning. Accept all reasonable responses.
Create a quiz to help you review key topics in this chapter. Write one question with its answer for each major topic listed below. Accept all reasonable responses. Make sure all answers are correct.

<table>
<thead>
<tr>
<th>Topic: Diversity of Prokaryotes</th>
<th>Topic: Metabolism of Prokaryotes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Question: ______________________</td>
<td>Question: ______________________</td>
</tr>
<tr>
<td>Answer: _________________________</td>
<td>Answer: _________________________</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Topic: Prokaryote Structure</th>
<th>Topic: Ecology of Bacteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Question: ____________________</td>
<td>Question: __________________</td>
</tr>
<tr>
<td>Answer: _____________________</td>
<td>Answer: ____________________</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Topic: Identifying Prokaryotes</th>
<th>Topic: Viruses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Question: ____________________</td>
<td>Question: ______</td>
</tr>
<tr>
<td>Answer: _____________________</td>
<td>Answer: _______</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Topic: Reproduction of Prokaryotes</th>
<th>Topic: Retroviruses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Question: ______________________</td>
<td>Question: ______</td>
</tr>
<tr>
<td>Answer: _________________________</td>
<td>Answer: ________</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Topic: Survival of Bacteria</th>
<th>Topic: Prions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Question: __________________</td>
<td>Question: ______</td>
</tr>
<tr>
<td>Answer: ____________________</td>
<td>Answer: ________</td>
</tr>
</tbody>
</table>
Protists

Before You Read

Before you read the chapter, respond to these statements. Accept all reasonable responses.

1. Write an A if you agree with the statement.
2. Write a D if you disagree with the statement.

<table>
<thead>
<tr>
<th>Before You Read</th>
<th>Protists</th>
<th>After You Read</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Protists are not animals, plants, or fungi.</td>
<td>Protists</td>
<td>A</td>
</tr>
<tr>
<td>• Some amoebas have a hard covering like a shell.</td>
<td>Protists</td>
<td>D</td>
</tr>
<tr>
<td>• Protists cannot make their own food.</td>
<td>Protists</td>
<td>D</td>
</tr>
<tr>
<td>• A type of downy mildew was responsible for widespread starvation in 19th century Ireland.</td>
<td>Protists</td>
<td>A</td>
</tr>
</tbody>
</table>

Science Journal

Protists are the base for most food chains in aquatic environments. Describe how protists might contribute to an important food source—fish and other seafood.

Accept all reasonable responses.
Scan the table and pictures in Section 1 of the chapter. Read all captions. List three facts that you discovered about protists.

1. Accept all reasonable responses.

2. 

3. 

Use your book or dictionary to define heterotroph. Then use the term in a sentence to show its scientific meaning.

**heterotroph**

organism that cannot make its own food and must get its energy and nutrients from other organisms

Use your book or dictionary to define each vocabulary term. Then use each term in a sentence.

**microsporidium**

microscopic protozoan that lives in the guts of termites and produces enzymes that digest wood

**protozoan**

unicellular, heterotrophic, animal-like protist
Protists can be classified as:

- Animal-like
- Plantlike
- Funguslike

**Type of Protist** | **Characteristic** | **Example**
--- | --- | ---
Animal-like | heterotrophic | protozoans
Plantlike | photosynthetic | algae
Funguslike | absorb nutrients from other organisms | water mold

**List** two characteristics that distinguish funguslike protists from fungi.

- Centrioles
- Composition of cell wall
**Main Idea**

I found this information on page 542–544.

SE, pp. 542–544
RE, pp. 223–224

**Details**

Summarize the common habitats of protists by completing the graphic organizer. Accept all reasonable responses.

![Diagram of Common Protist Habitats]

- decaying leaves
- damp soil
- streams
- guts of termites
- oceans

Identify two examples of mutualistic relationships between protists and other organisms.

1. protozoans produce enzymes that help termites digest wood
2. green algae living in the hair of sloths provides camouflage

Summarize information about the origin of protists by completing the following paragraph.

The theory of _______endosymbiosis_______ suggests that _______mitochondria_______ became part of protist cells early in the evolutionary process. Later in the evolutionary process, _______chloroplasts_______ appeared in cells, and _______algae_______ evolved as the only protists that could photosynthesize.

**Origin of Protists**

I found this information on page 545.

SE, p. 545
RE, p. 224

**Summarize**

Analyze why protists are difficult to classify and why the classification system is likely to change.

Accept all reasonable responses. Protists are difficult to classify because they have characteristics of animals, plants, and fungi, yet they have key differences as well. Classifying by method of obtaining nutrition is convenient, but it ignores an organism’s evolutionary history. As a result, the classification system will likely change as scientists learn more about the evolutionary history of protists.
Protists
Section 19.2 Protozoans—Animal-like Protists

Main Idea

Scan Section 2 of the chapter. Use the checklist as a guide.

- Read all section titles.
- Read all boldfaced words.
- Look at all illustrations and read the captions.
- Think about what you already know about protists.

Write two facts you discovered as you scanned the section.
1. Accept all reasonable responses.
2. ____________________________

Review Vocabulary

Use your book or dictionary to define hypotonic.

hypotonic
concentration of dissolved substances is lower in the solution outside the cell than the concentration inside the cell

New Vocabulary

Use your book or dictionary to define each vocabulary term.

contractile vacuole
structure that collects the excess water from the cytoplasm and expels it from the cell

pellicle
membrane that covers a paramecium

pseudopod
temporary extensions of cytoplasm, used for feeding and locomotion

test
hard, porous covering similar to a shell that surrounds the plasma membrane of some types of amoebas

trichocyst
elongated, cylindrical body that can discharge a spinelike structure
Main Idea

Protozoans—Animal-like Protists

Ciliophora

Model and label a paramecium and its parts in the space below. Label the following parts with a brief description of each part.

- anal pore
- cilia
- contractile vacuole
- ectoplasm
- gullet
- micronucleus
- macronucleus
- oral groove

Student drawings may resemble Figure 19.6 on SE, p. 548. Accept all reasonable responses.

Sarcodina

Organize facts about amoebas in the table below. Accept all reasonable responses.

<table>
<thead>
<tr>
<th>Phylum: Sarcodina</th>
<th>Excretion method: through outer membranes by diffusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Habitats: salt water, freshwater streams, muddy bottoms of ponds, damp moss and leaves, inside animal host</td>
<td>Feeding method: extend pseudopodia to envelop small organism, form a food vacuole where enzymes break down food</td>
</tr>
<tr>
<td>Body structures: outer plasma membrane, inner ectoplasm membrane, cytoplasm, nucleus, food vacuoles, contractile vacuole</td>
<td>Reproduction method: asexually by cell division; some form cysts during harsh environmental conditions</td>
</tr>
</tbody>
</table>
Section 19.2 Protozoans—Animal-like Protists (continued)

**Main Idea**

**Apicomplexa**

I found this information on page ___________.

SE, p. 551
RE, p. 228

**Details**

Organize information about the members of the phylum Apicomplexa.

Members of phylum Apicomplexa

also called

- sporozoans

because they produce

- spores

are

- parasites

obtaining nutrients from

- host organisms

**Zoomastigina**

I found this information on page ___________.

SE, p. 552
RE, p. 228

Compare American and African sleeping sickness.

**Compare**

American

- Host insect: rediviud bug

- Passes to human from insect’s: feces

- Can damage host’s: heart, liver, spleen

African

- Host insect: tsetse fly

- Passes to human from insect’s: saliva

- Can damage host’s: nervous system

**Summarize**

Compare the habitats and methods of movement among the three phyla of protozoans.

Accept all reasonable responses. Ciliates and sarcodines are found in aquatic environments.

Some sarcodines and all sporozoans are parasites that live inside animal hosts. Ciliates move using cilia; and sarcodines move using pseudopods. Sporozoans have no method of movement.
Protists
Section 19.3 Algae—Plantlike Protists

Main Idea

Skim Section 3 of the chapter. Write three questions that come to mind from reading the headings and illustration captions.

1. Accept all reasonable responses.
2. __________________________

Details

Review Vocabulary

Use your book or dictionary to define chloroplasts.

chloroplasts
chlorophyll-containing organelles found in the cells of green plants and some protists that capture light energy and convert it to chemical energy.

New Vocabulary

Use your book or dictionary to define each vocabulary term. Then write a sentence for each term to show its scientific meaning.

alternation of generations
life cycle of algae that takes two generations—one that reproduces sexually and one that reproduces asexually—to complete a life cycle.

bioluminescent
emit light

colony
group of cells that join together to form a close association

Academic Vocabulary

Define suspension, then write a sentence to show its scientific meaning.

suspension
mixture whose particles settle out over time and whose particles can be separated from the mixture by filtration.
Section 19.3 Algae—Plantlike Protists (continued)

Main Idea

Characteristics of Algae

I found this information on page ___________.
SE, p. 553
RE, p. 229

Organize information about algae by completing the chart.

<table>
<thead>
<tr>
<th>Algae</th>
<th>Algae</th>
</tr>
</thead>
<tbody>
<tr>
<td>Like plants: contain photosynthetic pigments that enable algae to produce food using energy from the Sun</td>
<td>Unlike plants: lack roots, leaves, and other structures typical of plants</td>
</tr>
<tr>
<td>Function of secondary pigments: allow algae to absorb light energy in deep water</td>
<td>Found in many colors because: secondary pigments reflect light at different wavelengths</td>
</tr>
</tbody>
</table>

Diversity of Algae

I found this information on page ___________.
SE, pp. 554–559
RE, pp. 229–232

Sequence the asexual and sexual reproductive cycles of diatoms by writing the letter for each step in the correct box.

a. fusion of gametes  
   d. gametes released  
   b. meiosis  
   e. wall formation around cell  
   c. mitosis  
   f. zygote

Asexual Reproduction:

Sexual Reproduction:

e → c → b  
d → a → f

Compare the ways that euglenoids are like plants and like animals.

Like plants
1. contain chlorophyll
2. photosynthesize

Euglenoids

Like animals
1. lack cell wall
2. can be heterotrophs
Section 19.3 Algae—Plantlike Protists (continued)

**Main Idea**

**Uses for Algae**

*I found this information on page ______.*

SE, pp. 554–559
RE, pp. 229–232

**Details**

**Summarize the common uses for algae. Algae types may be used more than once.**

<table>
<thead>
<tr>
<th>Common Uses</th>
<th>Type of Algae</th>
</tr>
</thead>
<tbody>
<tr>
<td>Used for filtering water supplies</td>
<td>diatoms</td>
</tr>
<tr>
<td>Used to stabilize syrups</td>
<td>red and brown algae</td>
</tr>
<tr>
<td>Used in the preparation of scientific gels</td>
<td>red algae</td>
</tr>
<tr>
<td>Used as abrasives</td>
<td>diatoms</td>
</tr>
<tr>
<td>Used in salads</td>
<td>green algae</td>
</tr>
<tr>
<td>Used to thicken puddings and shampoos</td>
<td>red algae</td>
</tr>
<tr>
<td>Used to preserve canned meat and fish</td>
<td>red algae</td>
</tr>
</tbody>
</table>

**Life Cycle of Algae**

*I found this information on page ______.*

SE, p. 560
RE, p. 233

**Summarize the alternation of generations.**

The haploid form of the algae, __________ gametophyte __________, produces __________ gametes __________. The gametes join to form a __________ zygote __________. From the zygote, the __________ diploid __________ form of the algae will develop. The diploid form is called a __________ sporophyte __________. Certain cells in the sporophyte undergo __________ meiosis __________. These spores are __________ haploid __________ that develop into new __________ gametophytes __________.

**SUMMARIZE**

Use the terms *meiosis, fertilization, diploid, and haploid* in a sentence that demonstrates your understanding of alternation of generations in green algae.

Accept all reasonable responses. In *meiosis* haploid spores of green algae develop, and in *fertilization* they are combined to produce the diploid form.
## Protists
### Section 19.4 Funguslike Protists

### Main Idea

Scan Section 4 of the chapter. Write three facts that you discovered about cellular and acellular slime molds.

1. Accept all reasonable responses.

2. 

3. 

### Details

#### Review Vocabulary

Use your book or dictionary to define cellulose.

<table>
<thead>
<tr>
<th>Cellulose</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glucose polymer that forms the cell walls of plants and some funguslike protists</td>
<td></td>
</tr>
</tbody>
</table>

#### New Vocabulary

Use your book or dictionary to define each vocabulary term.

<table>
<thead>
<tr>
<th>Acrasin</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemical given off by a starving cellular slime mold, signaling slime molds to congregate into a colony that functions like a single organism and eventually reproduces asexually</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Plasmodium</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mobile mass of cytoplasm that contains many diploid nuclei but no separate cells</td>
<td></td>
</tr>
</tbody>
</table>

#### Academic Vocabulary

Define phase to show its scientific meaning. Then use the word in a sentence.

<table>
<thead>
<tr>
<th>Phase</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Particular state in a regular cycle of changes</td>
<td></td>
</tr>
</tbody>
</table>
Main Idea

Slime Molds

I found this information on page __________

SE, pp. 561–563
RE, pp. 234–236

Details

Compare slime molds to fungi by completing the table below.

<table>
<thead>
<tr>
<th>Similarities in Slime Molds and Fungi</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reproduce using: <strong>spores</strong></td>
</tr>
<tr>
<td>Feed on: <strong>decaying organic matter</strong></td>
</tr>
<tr>
<td>Absorb nutrients through: <strong>cell walls</strong></td>
</tr>
</tbody>
</table>

Contrast slime molds and fungi by completing the following sentence.

The cell walls of fungi are composed of **chitin**, and cell walls in slime molds contain **cellulose or celluloselike compounds**.

Compare and contrast acellular and cellular slime molds by using the following phrases to complete the Venn diagram.

- move and surround food like amoebas
- flagellated during part of life cycle
- most of life cycle spent as single, amoeba-like cells
- form colonies when food is scarce
- mobile mass of cytoplasm with no separate cells
- make spores to reproduce
- **Acellular Slime Molds**
- **Cellular Slime Molds**
- **Both**
Section 19.4 Funguslike Protists (continued)

**Main Idea**

I found this information on page __________.
SE, pp. 561–563
RE, pp. 234–236

**Details**

**Analyze** two ways in which the life cycles of acellular and cellular slime molds are similar and two ways in which they are different.

<table>
<thead>
<tr>
<th>Similarities in Life Cycle</th>
<th>Differences in Life Cycle</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Both form masses during parts of their life cycles.</td>
<td>1. Cellular slime forms amoeba-like cells that feed and grow before they colonize.</td>
</tr>
<tr>
<td>2. Both make spores to reproduce.</td>
<td>2. Acellular slime produces flagellated cells before becoming amoeba-like.</td>
</tr>
</tbody>
</table>

**Water Molds and Downy Mildew**

I found this information on page __________.
SE, pp. 564–565
RE, p. 236

**Organize** information about water molds and downy mildews by completing the table below.

<table>
<thead>
<tr>
<th>Water Molds and Downy Mildews</th>
</tr>
</thead>
<tbody>
<tr>
<td>Habitat</td>
</tr>
<tr>
<td>Source of nutrition</td>
</tr>
<tr>
<td>Similarities to fungi</td>
</tr>
<tr>
<td>Differences from fungi</td>
</tr>
</tbody>
</table>
Malaria is a disease caused by sporozoans. It is spread by mosquitoes. Consider which would have a greater benefit—developing a drug that would cure malaria or developing an insecticide that would kill all mosquitoes. List the possible advantages and disadvantages of each approach. Then make a conclusion about which choice would be better.

Accept all reasonable responses.

<table>
<thead>
<tr>
<th>Malaria Drug</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Advantages</td>
<td>Disadvantages</td>
<td></td>
</tr>
<tr>
<td>Insecticide</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Advantages</td>
<td>Disadvantages</td>
<td></td>
</tr>
</tbody>
</table>

**Conclusions**
Fungi

Before You Read

Use the “What I Know” column to list the things you know about fungi. Then list the questions you have about fungi in the “What I Want to Find Out” column. Accept all reasonable responses.

<table>
<thead>
<tr>
<th>K</th>
<th>W</th>
<th>L</th>
</tr>
</thead>
<tbody>
<tr>
<td>What I Know</td>
<td>What I Want to Find Out</td>
<td>What I Learned</td>
</tr>
</tbody>
</table>

Fungi can be both helpful and harmful to humans. On the lines below, write two things that you already know about fungi.

Accept all reasonable responses.
Fungi
Section 20.1 Introduction to Fungi

**Main Idea**

Scan the figures and read the figure captions in Section 1 of the chapter. Write two facts that you discovered about fungi.

1. Accept all reasonable responses.
2. ________________________________________________________________________

**Details**

Review Vocabulary

Use your book or dictionary to define saprobe.

**Vocabulary**

- **saprobe**
  - organism that feeds on dead organisms or organic wastes

New Vocabulary

Use your book or dictionary to define each term.

- **chitin**
  - strong, flexible polysaccharide found in the cell walls of all fungi and in the exoskeletons of insects and crustaceans

- **fruiting body**
  - in fungi, the reproductive structure that grows above the ground

- **haustoria**
  - in fungi, specialized hyphae that grow into a host’s tissues and absorb their nutrients

- **hyphae**
  - tubular filaments that are the basic structural units of multicellular fungi

- **mycelium**
  - in fungi, netlike mass created by the hyphae as they grow at their tips and branch repeatedly

- **septa**
  - cross-walls that divide the hyphae of a fungus into cells

- **sporangium**
  - a sac or case in which spores are produced

- **spore**
  - a reproductive haploid cell with a hard outer coat that develops into a new organism without the fusion of gametes
Section 20.1 Introduction to Fungi (continued)

Main Idea

Characteristics of Fungi/Major Features of Fungi

I found this information on page ________.
SE, pp. 576–578
RE, pp. 237–238

Details

Describe the kingdom Fungi.

Most are _______ multicellular _______.

Unicellular fungi are known as _______ yeasts _______.

List three features of fungi that distinguish them from plants.

Features that distinguish fungi from plants:
- cell walls made of chitin
- body structure made of tubular filaments
- cross-walls

Organize information about the structure of multicellular fungi by completing the graphic organizer.

Nutrition in Fungi

I found this information on page ________.
SE, p. 578
RE, pp. 238–239

Describe how fungi digest their food outside the body.

Hyphae produce digestive enzymes that break down large organic molecules into smaller molecules. These small molecules are absorbed into the hyphae through their cell walls.
### Main Idea

**Classify** types of fungi by writing how each obtains food.

- **Saprophytes**
  - feed on dead organic material
- **Mutualists**
  - have cooperative relationship with another organism
- **Parasites**
  - absorb nutrients from host cells

**Reproduction in Fungi**

*I found this information on page [580–581 SE, pp. 239 RE].*

**Distinguish** the 3 forms of asexual reproduction in fungi in the boxes below.

- **Forms of asexual reproduction**
  - **fragmentation**
  - **spore production**
  - **budding**

**Analyze** three ways that reproduction by spores gives fungi an adaptive advantage.

- **Adaptive advantage of reproduction by spores**
  - The sporangia protect the spores until they are ready to be released.
  - Spores are small, lightweight, and can be carried long distances by wind, water, and animals.
  - A large number of spores are produced at one time.

**Summarize**

Discuss why hyphae are an adaptive advantage in fungi.

Accept all reasonable responses. Hyphae help fungi obtain sufficient nutrients by providing a large surface area for nutrients to be absorbed.
Fungi
Section 20.2 Diversity of Fungi

Main Idea

Details

Skim Section 2 of the chapter. Write two questions that come to mind from reading the headings and the illustration captions.

1. Accept all reasonable responses.

2. ________________

Review Vocabulary

Use your book or dictionary to define flagellated.

flagellated

having long projections that propel organisms with a whiplike motion

New Vocabulary

Write the correct vocabulary term in the left column for each definition below.

- stolons
- rhizoids
- gametangium
- conidiophores
- ascocarp
- ascus
- ascospores
- basidiocarp
- basidia
- basidiospores

in molds, hyphae that spread across the surface of food
in molds, hyphae that penetrate food and absorb nutrients
a mold reproductive structure that contains a haploid nucleus
in sac fungi, hyphae that produce spores on their tips for asexual reproduction
in sac fungi, a reproductive structure where a zygote forms during sexual reproduction
in sac fungi, a saclike structure where spores develop during sexual reproduction
spores produced by the ascus in sac fungi
fruiting body of club fungi
club-shaped hyphae that produce spores in club fungi
spores produced in basidia during sexual reproduction of club fungi
Main Idea

Classification of Fungi
I found this information on page 582
SE, p. 582
RE, p. 240

Details

Model a phylogenetic tree for fungi and label the major phyla.

Drawings should resemble Figure 20.8, with all major phyla labeled.

Chytrids
I found this information on page 582
SE, p. 582
RE, p. 240

Summarize the evidence supporting the initial classification of chytrids as protists and later reclassification as fungi.

Chytrids are like protists.
flagellated spores

Chytrids are like fungi.
similar protein and DNA sequences, chitin-containing cell walls

Common Molds
I found this information on page 583
SE, p. 583
RE, pp. 241–242

Sequence how zygomycetes reproduce sexually, by completing the graphic organizer.

One plus and one minus hyphae grow together and fuse.

Each hyphae produces a gametangium, which contains a haploid nucleus.
The haploid nuclei from each gametangium fuse to form a diploid zygote.

The resulting sporangium produces haploid spores that can grow into new mycelium.

In favorable conditions, the zygospore germinates and undergoes meiosis.
The zygote develops a thick wall and becomes a dormant zygospore.
Sac Fungi

I found this information on page __________.
SE, pp. 584–585
RE, pp. 242–243

Club Fungi

I found this information on page __________.
SE, pp. 585–586
RE, p. 243

Other Fungi

I found this information on page __________.
SE, p. 586
RE, p. 243

**Main Idea**

**Details**

Organize information about where the spores of sac fungi form during reproduction.

Where Spores Form

- Asexual Reproduction
  - externally, at the tips of the conidiophores
- Sexual Reproduction
  - in the ascus

Model a club fungi. Label the basidiocarp and the basidia.

Accept all reasonable responses.

Predict what might happen to the phylum Deuteromycota as scientists continue to study its species. Explain your reasoning.

Accept all reasonable responses. Students might predict that the phylum might eventually be discontinued. As scientists learn more about how the species in this group reproduce, they might be able to reclassify the species into other phyla.

**Summarize**

Explain the adaptive advantages of zygospores that help ensure the survival of the species.

Accept all reasonable responses. Zygospores have a thick wall that helps protect them. Their ability to remain dormant for months enables the next generation to germinate when growing conditions are favorable. Sexual reproduction through zygospores provides genetic diversity, helping zygomycetes survive in changing environments.
Fungi
Section 20.3 Ecology of Fungi

Main Idea

Scan Section 3 of the chapter. Use the checklist as a guide.

- Read all section titles.
- Read all boldfaced words.
- Read all tables.
- Look at all pictures and read the captions.

Write two facts you discovered about the ecology of fungi.

1. Accept all reasonable responses.

2. ________________________________

Review Vocabulary

Use your book or dictionary to define cyanobacterium.

cyanobacterium

- a bacterium that is a photosynthetic autotroph

New Vocabulary

Use your book or dictionary to define each term.

- bioindicator

  - a living organism that is sensitive to changes in environmental conditions and is one of the first organisms to respond to changing conditions

- lichen

  - a symbiotic relationship between a fungus and a photosynthetic partner

- mycorrhiza

  - a symbiotic relationship between a specialized fungus and plant roots

Academic Vocabulary

Define cooperate to show its scientific meaning.

cooperate

to work or act together toward a common end or purpose
Section 20.3 Ecology of Fungi (continued)

**Main Idea**

**Fungi and Photosynthesizers**

*I found this information on page __________.*

SE, pp. 587–589
RE, pp. 244–246

**Details**

Identify the symbiotic relationships formed by the partners in the graphic organizer.

![Graphic Organizer]

Complete the paragraph below to describe mycorrhizal relationships.

Infection by a fungal partner helps orchid seeds to **germinate**. The fungal partner of a *Eucalyptus* tree absorbs **minerals** for the tree. The tree can absorb more water because the **hyphae** of the fungus increase the **surface area** of the tree’s roots. In return, the fungus receives **carbohydrates and amino acids** from the tree.

Analyze the benefits of lichens as . . .

- **food for animals**
  - Lichens are the main ground cover on the tundra, providing food for grazing animals. Caribou have a special enzyme for digesting lichens.

- **pioneers**
  - Lichens help plants return to a devastated area by breaking down rocks to form soil and trapping soil and fixing nitrogen that plants need.

- **bioindicators**
  - Lichens are sensitive to air pollutants. Dying lichens are a warning sign that air pollution is rising in the area.
### Fungi and Humans

I found this information on page __________.

SE, pp. 589–591
RE, p. 246

---

**Organize** the beneficial effects of fungi in the table below.

<table>
<thead>
<tr>
<th>Role of Fungi</th>
<th>Benefits to Humans</th>
</tr>
</thead>
<tbody>
<tr>
<td>as decomposers</td>
<td>recycle nutrients; prevent dead organisms from littering the surface of Earth</td>
</tr>
<tr>
<td>in medicine</td>
<td>penicillin; treat high blood pressure, bleeding, migraine headaches; promote contractions during childbirth; help bodies of transplant patients avoid rejecting new organ</td>
</tr>
<tr>
<td>in foods</td>
<td>humans eat mushrooms and truffles; yeast used to make bread, beer, and wine; flavor cheeses and colas; used to make soy sauce</td>
</tr>
<tr>
<td>in bioremediation</td>
<td>used in environmental clean-up projects; decompose organic materials in pollutants, breaking them down into harmless substances</td>
</tr>
</tbody>
</table>

**Describe** the harmful effects of fungi on each of the following.

<table>
<thead>
<tr>
<th>Plants</th>
<th>Humans</th>
</tr>
</thead>
<tbody>
<tr>
<td>kill American elm and American chestnut trees; spread quickly from tree to tree; damage some crops</td>
<td>cause athlete’s foot, ringworm, yeast infections, and oral thrush</td>
</tr>
</tbody>
</table>

---

**SUMMARIZE**

Compare and contrast mycorrhizae and lichens.

Accept all reasonable responses. Both involve symbiotic relationships between a fungus and another organism. A mycorrhizae is made up of a fungus and a plant, while a lichen is made up of a fungus and an algae or cyanobacteria.
Introduction to Plants

Before You Read

Use the “What I Know” column to list the things you know about plants. Then list the questions you have about plants in the “What I Want to Find Out” column. Accept all reasonable responses.

<table>
<thead>
<tr>
<th>K</th>
<th>What I Know</th>
<th>W</th>
<th>What I Want to Find Out</th>
<th>L</th>
<th>What I Learned</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Plants are found in many different environments. Describe some of the plants with which you are familiar. Identify the environment in which each lives.

Accept all reasonable responses.

________________________

________________________

________________________

________________________

________________________

________________________
Introduction to Plants
Section 21.1 Plant Evolution and Adaptations

Main Idea

Scan Section 1 of the chapter. Write two questions that come to mind from reading the headings and the illustration captions.

1. Accept all reasonable responses.

2. _______________________________________________________________________

Details

Review Vocabulary

Use your book or dictionary to define limiting factor.

limiting factor
any abiotic or biotic factor that restricts the existence, numbers, reproduction, or distribution of organisms

New Vocabulary

Use your book or dictionary to define each term.

nonvascular plant
plants that do not have vascular tissues

seed
a plant organ of seed plants consisting of an embryo, a food supply, and a protective coat; protects the embryo from drying out

stomata
openings in the outer cell layers of leaves that enable the exchange of gases even with the presence of a waxy cuticle

vascular plant
plants that have vascular tissues; enables taller growth and survival on land

vascular tissue
tissues found in vascular plants composed of tubelike, elongated cells through which food, water, and other materials are transported throughout the plant; include xylem and phloem

Academic Vocabulary

Define dominant to show its scientific meaning.

dominant
most immediately noticeable
**Main Idea**

**Plant Evolution**

I found this information on page __________.
SE, p. 604
RE, pp. 247–248

**Details**

**Sequence** the evolution of plants by placing the following information in the correct boxes below:

- algae at edges of seas adapted to life on land
- algae in oceans
- no plants
- simple plants appear

<table>
<thead>
<tr>
<th>no plants</th>
<th>algae in oceans</th>
<th>algae at edges of seas adapted to life on land</th>
<th>simple plants appear</th>
</tr>
</thead>
</table>

1 billion years ago 400 million years ago

**Identify** the 6 characteristics of the present-day members of the algae and plant groups.

- cell walls with cellulose
- chlorophyll in photosynthesis
- a cell plate during cell division
- similar genes for ribosomal DNA
- same types of enzymes in vesicle
- store food in the form of starch

**Organize** the plant organs by completing the table below. The first row has been filled in for you.

<table>
<thead>
<tr>
<th>Location</th>
<th>Purpose</th>
<th>Plant organ?</th>
</tr>
</thead>
<tbody>
<tr>
<td>cuticle</td>
<td>on stems and leaves</td>
<td>reduce water loss</td>
</tr>
<tr>
<td>leaf</td>
<td>grows from stem</td>
<td>photosynthesis, gas exchange</td>
</tr>
<tr>
<td>root</td>
<td>bottom of stem</td>
<td>absorbs water and nutrients</td>
</tr>
<tr>
<td>stem</td>
<td>middle of plant</td>
<td>provides support for growth</td>
</tr>
<tr>
<td>seed</td>
<td>on plant</td>
<td>protects embryo from drying</td>
</tr>
</tbody>
</table>
Main Idea

Alternation of Generations

I found this information on page 607.

SE, p. 607
RE, pp. 249–250

Details

Compare the gametophyte generation and the sporophyte generation of plants. Accept all reasonable responses.

<table>
<thead>
<tr>
<th>Gametophyte Generation</th>
<th>Sporophyte Generation</th>
</tr>
</thead>
<tbody>
<tr>
<td>haploid</td>
<td>diploid</td>
</tr>
<tr>
<td>produces sperm and eggs</td>
<td>produced from the diploid zygote</td>
</tr>
<tr>
<td>sperm and eggs form a diploid zygote</td>
<td>multicellular</td>
</tr>
<tr>
<td>microscopic in size</td>
<td>produces spores</td>
</tr>
<tr>
<td></td>
<td>usually dominant over the gametophyte generation</td>
</tr>
</tbody>
</table>

Plant Classification

I found this information on page 609.

SE, p. 609
RE, p. 250

Classify the following plant categories by writing an NV in front of nonvascular plants, an NS in front of seedless vascular plants, and a VS in front of vascular plants with seeds.

VS cycadophytes      NV anthocerophytes
VS anthophytes       NV bryophytes
VS coniferophytes    VS ginkgophytes
NS pterophytes       VS gnetophytes
NV hepaticophytes    NS lycophytes

SUMMARIZE

Contrast how the sperm reaches the egg differently in seed plants than in non-seed plants.

Accept all reasonable responses. Seed plant’s sperm can reach the egg without needing water.

In non-seed plants the sperm need a film of water in order to reach the egg, and require a wetter environment.
Introduction to Plants
Section 21.2 Nonvascular Plants

Scan Section 2 of the chapter. Use the checklist as a guide.

☐ Read all section titles.
☐ Read all boldfaced words.
☐ Read all tables and graphs.
☐ Look at all pictures and read the captions.
☐ Think about what you already know about the diversity of plants.

Write three facts you discovered about the diversity of plants as you scanned the section.

1. Accept all reasonable responses.

2.

3.

Use your book or dictionary to define symbiosis.

symbiosis

a relationship in which two organisms live together in a close association

Use your book or dictionary to define the following term.

thallose

a liverwort with a body resembling a fleshy, lobed structure
Diversity of Nonvascular Plants

I found this information on page ______.
SE, pp. 610–612
RE, pp. 251–252

Analyze why nonvascular plants need to be near water.

Nonvascular plants need water for life functions such as reproduction and photosynthesis. A steady supply of water is not available everywhere, so nonvascular plants need to be in moist habitats.

Model and label an example of a sporophyte attached to a gametophyte.

Sketches should resemble Figure 21.9 in the book, with sporophyte and gametophyte properly labeled.

Compare characteristics of bryophytes, hepaticophytes, and anthocerophytes by completing the table below.

Accept all reasonable responses.

<table>
<thead>
<tr>
<th>Description</th>
<th>Environment</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bryophyta</td>
<td>small plants with leafy stems</td>
<td>variety of habitats</td>
</tr>
<tr>
<td>Hepaticophyta</td>
<td>thallose body, shape of liverwort gametophyte looks like an animal’s liver</td>
<td>grown on damp soil, tropical jungles, and places with dense fog</td>
</tr>
<tr>
<td>Anthocerophyta</td>
<td>thallose body, shape of hornwort sporophyte looks like an animal’s horn</td>
<td>moist environments</td>
</tr>
</tbody>
</table>
Organize the following terms with the correct definition below:
sporophyte, gametophyte, thallus, and rhizoid.

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>rhizoid</td>
<td>colorless, multicellular structures found in nonvascular plants; used to help anchor the plants to the soil</td>
</tr>
<tr>
<td>thallus</td>
<td>broad shape resembling a fleshy lobed leaf</td>
</tr>
<tr>
<td>sporophyte</td>
<td>diploid generation; grow attached to gametophytes</td>
</tr>
<tr>
<td>gametophyte</td>
<td>haploid generation; dominant generation</td>
</tr>
</tbody>
</table>

Conclude how anthocerophytes became known as hornworts.
The sporophyte of an anthocerophyte resembles the horn of an animal.

Create a graphic organizer that models the possible common ancestry of nonvascular and vascular plants. Accept all reasonable responses.

Classify each group of nonvascular plants by naming one species of the group and one identifiable structure on that species. Accept all reasonable responses.
## Introduction to Plants

### Section 21.3 Seedless Vascular Plants

**Main Idea**

**Predict** the primary difference between the plants you read about in Section 2 of the chapter and the seedless vascular plants that you will read about in Section 3.

Accept all reasonable responses. Students should recognize that vascular tissue is the main difference between the two plant groups.

### Details

**Review Vocabulary**

Use your book or dictionary to define *spore*.

| **spore** | a reproductive haploid cell with a hard outer coat that can develop into a new organism without the fusion of gametes |

**New Vocabulary**

Use your book or dictionary to define each term.

| **epiphyte** | a plant that lives anchored to an object or another plant |
| **rhizome** | thick, underground stem of a fern and other vascular plants; often functions as an organ for food storage |
| **sorus** | clusters of sporangia usually found on the surface of fern fronds |
| **sporangium** | a structure in ferns that forms spores; a cluster of sporangia form a sorus |
| **strobilus** | compact cluster of spore-bearing leaves produced by some non-seed vascular plants |
Section 21.3 Seedless Vascular Plants (continued)

**Main Idea**

**Diversity of Seedless Vascular Plants**

I found this information on page ____________

SE, pp. 613–616
RE, pp. 253–254

**Details**

**Compare** present-day club mosses with their ancestors and describe the structures found in present-day plants.

- **Fossil Evidence**
  - were once tree-sized plants
  - formed a large part of Paleozoic forests

- **Present-day Plants**
  - usually less than 30 cm tall
  - dominant sporophyte generation

**Club Mosses**

**Structures**

- roots that grow from base of stem
- branched or unbranched stems
- small, scaly leaflike structures with vascular tissue

**Describe** the structures and common locations of ferns and horsetails.

<table>
<thead>
<tr>
<th></th>
<th>Ferns</th>
<th>Horsetails</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Structures</strong></td>
<td>roots produced from sporophyte; rhizome used to store food; photosynthetic fronds; sporangium where spores form</td>
<td>ribbed, hollow stems with strobili at tips, scalelike leaves, roots</td>
</tr>
<tr>
<td><strong>Locations</strong></td>
<td>moist or dry environments</td>
<td>wet environments</td>
</tr>
</tbody>
</table>
Section 21.3 Seedless Vascular Plants (continued)

**Main Idea**

Compare the 2 divisions of non-seed vascular plants by completing the table below:

<table>
<thead>
<tr>
<th>Lycophyta</th>
<th>Pterophyta</th>
</tr>
</thead>
<tbody>
<tr>
<td>club moss or spike moss; sporophyte generation is dominant; sporophyte has roots, stems, and leaflike structures; a single vein of vascular tissue runs through each leaflike structure</td>
<td>ferns and horsetails; become dormant when water is scarce; sporophyte generation has roots, stems, leaves, and rhizomes; the main stem is underground; first of vascular plants to have evolved leaves with veins of branching vascular tissue</td>
</tr>
</tbody>
</table>

**Details**

Identify each of the following plants or plant structures as lycophyte or pterophyte. Write L for lycophyte and P for pterophyte.

- **L** club moss
- **L** spike moss
- **L** tropical tree fern
- **P** sorus
- **L** epiphyte
- **L and P** strobilus
- **P** rhizome
- **P** frond
- **P** scouring rushes

**Summarize**

Model the two main groups of non-seed vascular plants. Label the important features of each group and give an example of each one.

Accept all reasonable responses.
Introduction to Plants
Section 21.4 Vascular Seed Plants

Scan the illustrations and read the captions. List two conclusions that you can draw about seeds and cones.

1. Accept all reasonable responses.

2. 

Review Vocabulary
Use your book or dictionary to define parasite.
parasite
an organism that benefits at the expense of another organism

New Vocabulary
Use your book or dictionary to define each term.
annual
anthophyte that lives for one year or less

biennial
anthophyte that has a life span of two years

cone
reproductive structures of cycads and other gymnosperm plants; may be male or female

cotyledon
structure of seed plant embryo that stores or absorbs food for the developing embryo

perennial
able to live for several years and produce flowers and seed annually

Introduction to Plants 221
Diversity of Seed Plants

I found this information on page __________.
SE, pp. 617–621
RE, pp. 255–257

Summarize the information about the divisions of seed plants by writing one or two sentences about division. Accept all reasonable responses.

Division Cycadophyta: Plants with cones evolved before plants with flowers. Cycads have soft stems consisting mostly of storage tissue. They live in the tropics or in subtropical zones.

Division Gnetophyta: Long-lived plants with unusual structural adaptations. Only one lives in the United States. *Welwitschia* takes moisture directly from fog, dew, or rain.

Division Ginkgophyta: One living species, *Ginkgo biloba*, has fern-shaped leaves with male and female structures on separate plants.

Division Coniferophyta: Cone-bearing plants with a wide range of sizes. Male and female cones grow on different branches. Leaves are adapted as waxy needles to survive cold, dry climates.

Division Anthophyta: Flowering plants, also known as angiosperms, widely distributed, anthophytes make up 75 percent of the plant kingdom. They are adapted to a wide variety of environments.

Identify the life span of each of the following types of plants and list one example of each.

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual</td>
<td>one growing season</td>
<td>tomatoes</td>
</tr>
<tr>
<td>Biennial</td>
<td>two years</td>
<td>carrots</td>
</tr>
<tr>
<td>Perennial</td>
<td>several years</td>
<td>roses</td>
</tr>
</tbody>
</table>
Section 21.4 Vascular Seed Plants (continued)

**Compare** the characteristics of the different divisions of seed plants by completing the table below. The first one has been done for you.

<table>
<thead>
<tr>
<th></th>
<th>Reproduction</th>
<th>Environment</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cycadophyta</td>
<td>males produce pollen grains from cones, pollen produce motile sperm</td>
<td>tropics and subtropics</td>
<td>there are about 100 species today</td>
</tr>
<tr>
<td>Ginkgophyta</td>
<td>males produce pollen grains from cones, pollen produce motile sperm</td>
<td>male ginkgoes planted in cities—they tolerate smog and pollution</td>
<td><em>Ginkgo biloba</em></td>
</tr>
<tr>
<td>Gnetophyta</td>
<td>none given</td>
<td>found in deserts or mountains of Asia, Africa, North America, Central or South America</td>
<td>tropical climbing plants and shrub-like plants</td>
</tr>
<tr>
<td>Coniferophyta</td>
<td>reproductive structures produced in cones</td>
<td>found in many forest environments</td>
<td>pine, fir, spruce, juniper, cedar, redwood, yew, larch</td>
</tr>
<tr>
<td>Anthophyta</td>
<td>enclose seeds in a fruit</td>
<td>found in a variety of environments</td>
<td>fruit trees</td>
</tr>
</tbody>
</table>

**Connect**

Suppose you want to plant a vegetable garden. Research the soil conditions and overall climate in your area. Then describe a plant that should be successful, and explain your reasoning.

Accept all reasonable responses.
Tie It Together

You have read about the three types of plants: nonvascular plants, non-seed vascular plants, and seed plants. Now create a quick identification guide to common plants in your area. Your plant guide should be easy to read, yet contain basic information about the reproduction, environment, general structure, and significant characteristics of each plant. Include one plant from each type. Remember that a good plant guide has well-labeled diagrams. When you are finished, share your plant guide with your class. Accept all reasonable responses.
Plant Structure and Function

Before You Read

Use the “What I Know” column to list the things you know about plant structure and function. Then list the questions you have about plant structure and function in the “What I Want to Find Out” column. Accept all reasonable responses.

<table>
<thead>
<tr>
<th>K</th>
<th>W</th>
<th>L</th>
</tr>
</thead>
<tbody>
<tr>
<td>What I Know</td>
<td>What I Want to Find Out</td>
<td>What I Learned</td>
</tr>
</tbody>
</table>

Describe some plants that you eat. Then describe some products that you use that come from plants.

Accept all reasonable responses.
# Plant Structure and Function

## Section 22.1 Plant Cells and Tissues

### Main Idea

**Scan** Section 1 of the chapter. Write two questions that come to mind from reading the headings and illustration captions.

1. Accept all reasonable responses.

2. ________________________________

### Vocabulary

*New Vocabulary*  
**Classification** each vocabulary word in the list to the left as being a plant cell or a plant tissue. Then give a short description.

<table>
<thead>
<tr>
<th>Cells (8 terms)</th>
<th>Tissues (7 terms)</th>
</tr>
</thead>
<tbody>
<tr>
<td>collenchyma cell</td>
<td>cork cambium: lateral meristem that produces a tough protective covering for the surface of stems and roots</td>
</tr>
<tr>
<td>companion cell</td>
<td>epidermis: in plants, the outermost layer of flattened cells that covers and protects all parts of the plant</td>
</tr>
<tr>
<td>cork cambium</td>
<td>ground tissue: plant tissue that is not meristemic, dermal, or vascular; has diverse functions, including photosynthesis, storage, and support</td>
</tr>
<tr>
<td>epidermis</td>
<td>meristem: region of actively dividing cells</td>
</tr>
<tr>
<td>ground tissue</td>
<td>phloem: vascular plant tissue made of tubular cells joined end to end</td>
</tr>
<tr>
<td>guard cell</td>
<td>vascular cambium: lateral meristem that produces new xylem and phloem cells in the stems and roots</td>
</tr>
<tr>
<td>meristem</td>
<td>xylem: vascular plant tissue composed of tubular cells</td>
</tr>
<tr>
<td>parenchyma cell</td>
<td></td>
</tr>
<tr>
<td>phloem</td>
<td></td>
</tr>
<tr>
<td>sclerenchyma cell</td>
<td></td>
</tr>
<tr>
<td>sieve-tube member</td>
<td></td>
</tr>
<tr>
<td>tracheid</td>
<td></td>
</tr>
<tr>
<td>vascular cambium</td>
<td></td>
</tr>
<tr>
<td>vessel element</td>
<td></td>
</tr>
<tr>
<td>xylem</td>
<td></td>
</tr>
</tbody>
</table>

*Review Vocabulary*

Use your book or dictionary to define **adaptation**.

**adaptation**  
*inherited characteristic that results from response to an environmental factor*
**Main Idea**

**Plant Cells**

I found this information on page _____.
SE, pp. 632–633
RE, pp. 259–260

**Details**

**Point out** three ways that plant cells differ from animal cells.

Plant cells have a cell wall, a central vacuole, and can contain chloroplasts.

**Model** a plant cell. Label the cell wall, central vacuole, and chloroplast.

Accept all reasonable responses. The cell wall, central vacuole, and chloroplast should be accurately labeled.

**Compare** the three types of plant cells by completing the table below.

Describe one characteristic and one function for each type of cell.

<table>
<thead>
<tr>
<th></th>
<th>Parenchyma</th>
<th>Collenchyma</th>
<th>Sclerenchyma</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Characteristic</strong></td>
<td>sphere-shaped cells that have thin, flexible walls</td>
<td>long cells with unevenly thickened cell walls</td>
<td>thick and rigid cells that often die when they mature</td>
</tr>
<tr>
<td><strong>Function</strong></td>
<td>used for storage and food production</td>
<td>provide strength and support for surrounding tissue</td>
<td>provide support for plant</td>
</tr>
</tbody>
</table>

**Summarize** the function of each of the following.

epidermis: covers and protects the body of a plant
stomata: control the exchange of gases
guard cells: control the opening and closing of stomata
trichomes: reduce the evaporation of water from the plant
Model a sketch of phloem tissue. Label the following parts.
- companion cell
- sieve plate
- sieve tube member

Sketches should resemble SE Figure 22.7, and the three parts should be accurately labeled.

Analyze ground tissue by completing the organizer below.

<table>
<thead>
<tr>
<th>Made up of:</th>
<th>Functions include:</th>
</tr>
</thead>
<tbody>
<tr>
<td>sclerenchyma cells</td>
<td>photosynthesis</td>
</tr>
<tr>
<td>parenchyma cells</td>
<td>storage</td>
</tr>
<tr>
<td>collenchyma cells</td>
<td>support</td>
</tr>
</tbody>
</table>

Summarize
Model a plant. Include captions that explain the three types of cells as well as the four types of tissues. Accept all reasonable responses.
Plant Structure and Function
Section 22.2 Roots, Stems, and Leaves

Skim Section 2 of the chapter. For each structure below, list two functions. Accept all reasonable responses.

Roots: __________________________________________

___________________________________________

Stems: _________________________________________

___________________________________________

Leaves: _________________________________________

___________________________________________

Review Vocabulary
Use your book or dictionary to define apical meristem.

apical meristem
tissue at the tips of roots and stems that produce cells

New Vocabulary
Write the correct term in the left column for each definition below.

pericycle
layer of cells just within the endodermis that gives rise to lateral roots

endodermis
single layer of cells that forms a waterproof seal around a root’s vascular tissue

palisade mesophyll
column-shaped cells that contain many chloroplasts; most photosynthesis takes place here

transpiration
loss of water through stomata

root cap
tough, protective layer of parenchyma cells that covers the tip of a root

cortex
layer of ground tissue in the root that is involved in the transport of water

petiole
stalk that joins the leaf blade to the stem

spongy mesophyll
layer of irregularly shaped, loosely packed cells through which oxygen, carbon dioxide, and water vapor move

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Section 22.2 Roots, Stems, and Leaves (continued)

**Main Idea**

**Roots**

I found this information on page ________.

SE, pp. 639–641
RE, pp. 263–264

**Stems**

I found this information on page ________.

SE, pp. 642–643
RE, pp. 264–265

**Details**

**Compare** the two main types of root systems. Describe taproots and fibrous roots, then make a sketch of each type.

<table>
<thead>
<tr>
<th>Taproots</th>
<th>Fibrous Roots</th>
</tr>
</thead>
<tbody>
<tr>
<td>Definition: single, thick structures with smaller branching roots</td>
<td>Definition: have many small branching roots that grow from a central point</td>
</tr>
<tr>
<td>Sketch: Accept all reasonable responses.</td>
<td>Sketch: Accept all reasonable responses.</td>
</tr>
</tbody>
</table>

**Sequence** the layers of cells of roots beginning with the outermost layer.

3 endodermis 1 epidermis 4 pericycle 2 cortex

**Distinguish** among the three stems that store food.

A tuber is a swollen stem that has buds from which new plants grow.

A corm is a short thickened stem surrounded by leaf scales. Rhizomes also store food.

**Summarize** the information on stems in the blanks in the paragraph below.

Stems vary in their size and ________ strength _________. The main function of a plant’s stem is ________ support ________ of the ________ leaves ________ and ________ reproductive ________ structures. They also ________ transport ________ water and dissolved substances throughout the plant. The annual growth of bundles of ________ xylem ________ and ________ phloem ________ in the stem can lead to the formation of ________ growth rings ________ that reveal the ________ age ________ of the plant. Some stems, such as ________ tubers ________, bulbs, and ________ corms ________, store ________ food ________.
Section 22.2 Roots, Stems, and Leaves (continued)

**Main Idea**

**Leaves**

I found this information on page ____________
SE, pp. 644–647
RE, pp. 265–266

**Details**

**Compare** the shapes of leaves. Give a brief description of a simple and a compound leaf, and provide one example of each.

- **simple leaf**: blade that is not divided; maple leaf
- **compound leaf**: blade that is divided into leaflets; walnut leaf

**Summarize** the role of mesophyll by completing the organizer below.

- **palisade mesophyll**: most photosynthesis takes place; cells receive maximum exposure to sunlight and have many chloroplasts
- **spongy mesophyll**: surrounded by air spaces that allow carbon dioxide, oxygen, and water vapor to flow freely

**Mesophyll**

- two types of parenchyma cells

**Analyze** two plants with leaves that have functions besides photosynthesis. Briefly describe these functions.

1. **Cacti spines** help reduce water loss and provide protection from plant-eaters.

2. **Carnivorous plants** have leaves that can trap insects or small animals.

**Summarize**

Use an analogy to explain how plant structures are adapted to their functions.

Accept all reasonable responses.
Plant Structure and Function
Section 22.3 Plant Hormones and Responses

Scan Section 3 of the chapter. Use the checklist as a guide.

☐ Read all section titles.
☐ Read all boldfaced words.
☐ Read all tables.
☐ Look at all pictures and read the captions.

Write two facts you discovered about plant hormones.

1. Accept all reasonable responses.
2. ____________________________

Review Vocabulary

Use your book or dictionary to define active transport.
active transport
the movement of materials across the plasma membrane against a concentration gradient; requires energy

New Vocabulary

Use your book or dictionary to define each term.

auxins
the group of plant hormones that promote cell elongation

cytokinins
the group of hormones that stimulate mitosis and cell division

ethylene
the plant hormone that promotes the ripening of fruit

gibberellins
the group of plant hormones that cause plants to grow taller by stimulating cell elongation

nastic response
the responsive movement of a plant not dependent on the direction of the stimulus

tropism
the growth response of a plant to an external stimulus
**Main Idea**

**Plant Hormones**

I found this information on page __________.  
SE, pp. 648–650  
RE, pp. 267–268

---

**Details**

**Compare** four plant hormones by completing the table below.

<table>
<thead>
<tr>
<th>Hormone</th>
<th>How This Hormone Regulates Growth</th>
<th>Characteristic of This Hormone</th>
<th>Another Benefit of This Hormone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Auxin</td>
<td>causes cells to lengthen or elongate</td>
<td>produced in apical meristems</td>
<td>delays fruit formation and keeps side branches from growing</td>
</tr>
<tr>
<td>Gibberellin</td>
<td>helps cells elongate</td>
<td>some dwarf plants do not produce these</td>
<td>increases the rate at which seeds begin to grow and buds develop</td>
</tr>
<tr>
<td>Cytokinin</td>
<td>stimulates the production of proteins needed for mitosis</td>
<td>effects are enhanced by other hormones</td>
<td>plant cells would never divide without it</td>
</tr>
<tr>
<td>Ethylene</td>
<td>causes cell walls to weaken and soften</td>
<td>is a gas made of carbon and hydrogen</td>
<td>speeds ripening of fruits</td>
</tr>
</tbody>
</table>

**Plant Responses**

I found this information on page __________.  
SE, pp. 650–651  
RE, p. 268

---

**Summarize** the two types of tropisms in the organizer below.

Tropism is a change in a plant’s __________ growth due to an __________ external __________ stimulus __________.

The tropism is __________ positive __________ if the plant grows __________ toward __________ the stimulus.

The tropism is __________ negative __________ if the plant grows __________ away __________ from the stimulus.

Plants respond to __________ phototropism __________ as they grow toward the __________ light __________.

Stems respond to __________ gravitropism __________ as they grow against __________ gravity __________ away from the __________ ground __________.
Compare tropism and nastic movement. Place each characteristic in the correct location in the Venn diagram below.

- involves growth
- involves plant response
- response can be positive or negative
- does not involve growth
- is not reversible
- is reversible

Classify each of the following as an example of tropism or nastic movement.

- **nastic movement**
  - Venus flytrap closes on an insect.

- **tropism**
  - Sweet pea tendrils climb a fence.
  - Plant grows toward a lamp.
  - Mimosa pudica leaflets become limp when touched.
  - Plant roots grow into the soil.

Connect

Farmers often use hormones to improve their crop yield. Describe a hormone that a farmer might use and how the hormone can help increase crop output.

Accept all reasonable responses. Farmers use gibberellins to increase the formation of fruit.

Farmers might pick unripe fruit and use ethylene to ripen it later. Farmers can use auxins to control the ripening of their fruits.
Reproduction in Plants

Before You Read

Use the “What I Know” column to list the things you know about plant reproduction. Then list the questions you have about reproduction in plants in the “What I Want to Find Out” column. Accept all reasonable responses.

<table>
<thead>
<tr>
<th>K</th>
<th>W</th>
<th>L</th>
</tr>
</thead>
<tbody>
<tr>
<td>What I Know</td>
<td>What I Want to Find Out</td>
<td>What I Learned</td>
</tr>
</tbody>
</table>

Science Journal

Explain how you think life on Earth would be affected if plants were to stop reproducing.

Accept all reasonable responses.
Reproduction in Plants
Section 23.1 Introduction to Plant Reproduction

**Main Idea**

**Details**

**Skim** Section 1 of the chapter. Write two questions that come to mind from reading the headings and the illustration captions.

1. Accept all reasonable responses.
2. 

**Review Vocabulary**

Use your book or dictionary to define flagellated.

flagellated
having one or more flagella that propel a cell by whiplike motion

**New Vocabulary**

Use your book or dictionary to define each term.

- chemotaxis
  movement of moss sperm through a film of water to the archegonia in response to chemicals produced by archegonia

- heterosporous
  in conifers, the production of two types of spores that develop into male or female gametophytes

- megaspore
  female spore formed by some plants; develops into a female gametophyte

- micropyle
  opening in the ovule through which the pollen tube enters

- microspore
  male spore formed by some plants; develops into a male gametophyte

- prothallus
  tiny heart-shaped fern gametophyte that grows from spores; contains chloroplasts

- protonema
  in mosses, a small green filament of haploid cells that develops from a spore; develops into the gametophyte

- vegetative reproduction
  type of asexual reproduction in plants where a new plant is produced from existing plant organs or parts of organs
List three examples of vegetative reproduction.

1. Accept reasonable responses; the text refers to moss plants growing from fragments; liverworts reproducing from gemmae cups;
2. strawberries from stolons; potatoes from eyes; and various plants from tissue culture technique.
3. __________

Summarize the alternation of generations in the flowchart below. Use the words eggs, diploid zygote, and haploid gametophyte.

Model the life cycle of mosses by completing the flowchart below.

A haploid cell can germinate to form a _______________.

If the spores land in a _______________ environment, they can _______________ and develop into a new _______________.
Section 23.1 Introduction to Plant Reproduction (continued)

**Main Idea**

**Fern Reproduction and Life Cycle**

I found this information on page 665.

**Conifer Reproduction and Life Cycle**

I found this information on page 665–667.

**Details**

**Sequence** the life cycle of ferns by numbering the following steps in the order that they occur. The first and last steps have been done for you.

1. A spore develops to form a prothallus.
2. The prothallus produces archegonia and antheridia on its surface.
3. Sperm released by antheridia swim to eggs in archegonia.
4. If fertilization occurs, the resulting diploid zygote develops into a sporophyte.
5. As soon as the sporophyte produces green fronds, it can carry on photosynthesis and live on its own.
6. The prothallus dies and decomposes as the sporophyte matures.
7. The mature fern consists of rhizomes from which roots and fronds grow.
8. If pieces of the rhizome break off, new fern plants can develop from the pieces by vegetative reproduction.
9. The cycle continues when sporangia develop on the fronds, and spores are released.

**Compare** female and male conifer cones in the table below. List two facts about each type of cone. Accept all reasonable responses.

<table>
<thead>
<tr>
<th>Female Cones</th>
<th>Male Cones</th>
</tr>
</thead>
<tbody>
<tr>
<td>larger than male cones; two ovules form on each scale; megaspores eventually become female gametophyte; depend on sporophyte for protection and nutrition</td>
<td>sporangia undergo meiosis to microspores; pollen grains transported on air currents</td>
</tr>
</tbody>
</table>

**Summarize** 
Create a graphic organizer to compare the reproductive structure of mosses, ferns, and conifers. Accept all reasonable responses.
Reproduction in Plants
Section 23.2 Flowers

Main Idea

Details

Skim Section 2 of the chapter. Write two facts you discover about flower organs or adaptations.

1. Accept all reasonable responses.
2. ____________________________

Review Vocabulary

Use your book or dictionary to define nocturnal.

nocturnal
active only at night

New Vocabulary

photoperiodism
flowering plant response to differences in the length of night and day

Classify each term as being a type of plant or a part of a plant. Write a brief definition of each term.

<table>
<thead>
<tr>
<th>Type of Flowering Plant (4 terms)</th>
<th>Part of Flowering Plant (4 terms)</th>
</tr>
</thead>
<tbody>
<tr>
<td>day-neutral plant: plant that flowers over a range in the number of daylight hours</td>
<td>petal: leaflike flower organ, usually brightly colored structure at the top of a stem</td>
</tr>
<tr>
<td>intermediate-day plant: plant that flowers as long as the number of hours of darkness is neither too great nor too few</td>
<td>pistil: female reproductive organ of a flower</td>
</tr>
<tr>
<td>long-day plant: plant that flowers when the number of daylight hours is longer than its critical period</td>
<td>sepal: leaflike, usually green structure that encircles the top of a flower stem below the petals and protects the bud</td>
</tr>
<tr>
<td>short-day plant: plant that flowers when the number of daylight hours is shorter than its critical period</td>
<td>stamen: male reproductive organ of a flower consisting of an anther and a filament</td>
</tr>
</tbody>
</table>
**Details**

**Main Idea**

**Flower Organs**

I found this information on page [SE, pp. 668–669](#) [RE, pp. 274–275](#).

*Compare the organs of a flower in the table below. Give the location and function for each organ.*

<table>
<thead>
<tr>
<th>Organ</th>
<th>Location</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Petal</td>
<td>top of stem</td>
<td>attracts pollinators; provides surface for insect pollinators to rest on</td>
</tr>
<tr>
<td>Stamen</td>
<td>inside flower; anther at top of filament</td>
<td>male reproductive organ</td>
</tr>
<tr>
<td>Sepal</td>
<td>outermost part of flower</td>
<td>protective covering for flower bud</td>
</tr>
<tr>
<td>Pistil</td>
<td>attached to stem inside flower</td>
<td>female reproductive organ</td>
</tr>
</tbody>
</table>

*Model a complete flower and label the petals, sepals, stamen, and pistil.*

Sketches should resemble the one on SE p. 668. The four organs should be labeled appropriately.
Section 23.2 Flowers (continued)

Main Idea

Flower Adaptations

I found this information on page __________.
SE, pp. 669–673
RE, pp. 275–277

Details

Identify the three types of pollination.

animal pollination

Types of pollination

wind pollination

self-pollination

Compare the four types of plants based on their critical periods.

<table>
<thead>
<tr>
<th>Plant Type</th>
<th>Flowering Season</th>
<th>Characteristic</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Short-day plant</td>
<td>winter, spring, or fall</td>
<td>flower when the number of hours of darkness is greater than the critical period</td>
<td>poinsettias, pansies, tulips, chrysanthemums</td>
</tr>
<tr>
<td>Long-day plant</td>
<td>summer</td>
<td>flower when the number of hours darkness is less than the critical period</td>
<td>lettuce, spinach, aster, coneflowers, potatoes</td>
</tr>
<tr>
<td>Day-neutral plant</td>
<td>any season</td>
<td>flower over a range in the number of hours of darkness</td>
<td>roses, corn, cotton, buckwheat, tomatoes</td>
</tr>
<tr>
<td>Intermediate-day plant</td>
<td>any season</td>
<td>will flower if the number of hours of darkness is neither too great or too few</td>
<td>sugarcane, some grasses</td>
</tr>
</tbody>
</table>

Summarize

Collect a flower from your home or neighborhood. On a separate sheet of paper, draw a diagram of the plant and label the major parts. List its critical period, flower adaptations, and methods of pollination. Accept all reasonable responses.
Reproduction in Plants
Section 23.3 Flowering Plants

Main Idea

Scan the illustrations, and read the captions in Section 3 of the chapter. List two facts you learn about seeds.

1. Accept all reasonable responses.
2. ____________________________

Details

Review Vocabulary

Use your book or dictionary to define cytoskeleton.

cytoskeleton
the long, thin protein fibers that form a cell's framework

New Vocabulary

Use your book or dictionary to define each term.

dormancy
period of inactivity in a mature seed prior to germination

endosperm
food storage tissue in an anthophyte seed that supports development of the growing embryo

germination
beginning of the development of an embryo into a new plant

hypocotyl
portion of the stem nearest the seed in a young plant

polar nuclei
two nuclei in the sac of a flowering plant that become the triploid endosperm when joined with a sperm during double fertilization

radicle
embryonic root of an anthophyte embryo; the first part of the young sporophyte to emerge during germination

seed coat
protective tissue around a seed, formed from outer layers of the ovule

Academic Vocabulary

Define compatible to show its scientific meaning.

compatible
capable of functioning together
Summarize the development of the female gametophyte by completing the flowchart below.

- Ovary
- Ovule

**Produces four haploid megaspores**

- One haploid nucleus
- Other haploid nucleus

- Undergoes mitosis three times, producing **eight** haploid nuclei.
  - Six of the nuclei develop cell walls.
  - One of the six becomes the **egg** cell.
  - The two remaining nuclei become the **central** cell of the female gametophyte.

- One haploid nucleus
- Other haploid nucleus

**Compare** how the two haploid nuclei are involved in fertilization.

<table>
<thead>
<tr>
<th>Tube Nucleus</th>
<th>Generative Nucleus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Directs the growth of the pollen</td>
<td>Divides by mitosis, producing two sperm</td>
</tr>
<tr>
<td>tube down through the pistil to</td>
<td>nuclei, which move down the pollen tube to</td>
</tr>
<tr>
<td>the ovary</td>
<td>the microphyte</td>
</tr>
</tbody>
</table>
Main Idea

**Results of Reproduction**

*I found this information on page 676–679.*

SE, pp. 676–679

RE, pp. 280–282

---

**Details**

Compare the characteristics of seeds and fruits in the table below.

<table>
<thead>
<tr>
<th></th>
<th>Structure</th>
<th>Formation</th>
<th>Benefit to Plant</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Seed</strong></td>
<td>contains an embryo and a food supply covered by a protective coat</td>
<td>begins when fertilization occurs; zygote divides and develops into embryo plant; triploid central cell develops into endosperm; wall of ovule becomes seed coat</td>
<td>ensures future generation</td>
</tr>
<tr>
<td><strong>Fruit</strong></td>
<td>includes the ripened ovary of a flower</td>
<td>as seed forms, the ovary becomes the fruit</td>
<td>protection of seeds, dispersal of seeds, ensures future generation</td>
</tr>
</tbody>
</table>

---

**Analyze** the specific conditions that the following seeds need to germinate.

- Some conifer and wildflower seeds: *must be exposed to fire*
- Apple seeds: *need a period of freezing temperatures*
- Coconut seeds: *have to soak in salt water*

---

**Summarize**

Create a flowchart to describe the life cycle of flowering plants.

Accept all reasonable responses.
Introduction to Animals

Before You Read

Use the “What I Know” column to list the things you know about animals. Then list the questions you have about animals in the “What I Want to Find Out” column. Accept all reasonable responses.

<table>
<thead>
<tr>
<th>K</th>
<th>W</th>
<th>L</th>
</tr>
</thead>
<tbody>
<tr>
<td>What I Know</td>
<td>What I Want to Find Out</td>
<td>What I Learned</td>
</tr>
</tbody>
</table>

Science Journal

Describe at least three characteristics that distinguish animals from plants.

Accept all reasonable responses.

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
Scan the titles, boldfaced words, pictures, figures, and captions in Section 1 of the chapter. Write two facts you discovered about animals as you scanned the section.

1. Accept all reasonable responses.
2. Use your book or dictionary to define protist.
   diverse group of unicellular or multicellular eukaryotes that lack complex organ systems and live in moist environments

Compare the terms in the table by defining them side by side.

<table>
<thead>
<tr>
<th>Vocabularies</th>
<th>Definitions</th>
</tr>
</thead>
<tbody>
<tr>
<td>blastula</td>
<td>fluid-filled ball of cells formed during early embryo development</td>
</tr>
<tr>
<td>endoskeleton</td>
<td>internal skeleton</td>
</tr>
<tr>
<td>exoskeleton</td>
<td>hard or tough outer covering that provides a framework of support</td>
</tr>
<tr>
<td>internal fertilization</td>
<td>sperm and egg combine inside the animal’s body</td>
</tr>
<tr>
<td>external fertilization</td>
<td>sperm and egg combine outside the animal’s body</td>
</tr>
<tr>
<td>gastrula</td>
<td>two-cell-layer sac with an opening at one end, formed when blastula cells move inward during embryo development</td>
</tr>
<tr>
<td>hermaphrodite</td>
<td>produces both eggs and sperm in the same body</td>
</tr>
<tr>
<td>zygote</td>
<td>fertilized egg cell</td>
</tr>
</tbody>
</table>

List the cell layers from the most interior to the most exterior. Identify the tissues that develop from each layer.

**Layers of Cells in the Gastrula**
- ectoderm: nervous tissue and skin
- endoderm: digestive organs and lining of the digestive tract
- mesoderm: muscle tissue, circulatory system, excretory system, and, in some animals, respiratory system
**Main Idea**

**General Animal Features and Feeding and Digestion**

*I found this information on page _________.*

- SE, p. 692
- RE, p. 283

**Details**

Identify the following facts about animals.

- earliest true animals from which all others likely evolved
- choanoflagellates
- features that mark the branching points of the evolutionary tree
- adaptations in form
- way that animals differ from plants in obtaining food

Plants make their own food from sunlight; animals get their food by eating organisms.

Classify each animal below as having an endoskeleton or an exoskeleton.

- beetle: **exoskeleton**
- shark: **endoskeleton**
- horse: **endoskeleton**
- cicada: **exoskeleton**

**Habitats**

*I found this information on page _________.*

- SE, p. 693
- RE, p. 283

Analyze each habitat below. Give an example of an adaptation that enables an animal to live in that habitat.

<table>
<thead>
<tr>
<th>Habitat</th>
<th>Adaptation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polar region</td>
<td>Accept all reasonable responses.</td>
</tr>
<tr>
<td>Ocean</td>
<td></td>
</tr>
<tr>
<td>Rain forest</td>
<td></td>
</tr>
</tbody>
</table>

**Animal Cell Structure and Movement**

*I found this information on page _________.*

- SE, p. 694
- RE, p. 284

**Support**

*I found this information on page _________.*

- SE, p. 693
- RE, p. 283

**Summarize** the important differences between animals and plants.

- Accept all reasonable responses.

- 

- 

- 

- 

---

*Introduction to Animals* 247
Reproduction

I found this information on page _________.
SE, pp. 695–697
RE, pp. 284–285

Sequence the development of an animal from fertilization to birth by completing the following paragraph.

During ______ sexual reproduction, fertilization occurs when an ______ egg cell is penetrated by a ______ sperm cell, forming a ______ zygote. After ______ mitosis and cell division begin, the egg is called an embryo. The cells form a fluid-filled ball called a ______ blastula. Some cells migrate inside, forming a cup-shaped structure called the ______ gastrula, which has two cell layers. The layer on the outside is the ______ ectoderm and will form the ______ nerve tissue and skin. The inner layer is called the ______ endoderm, which will form ______ the animal’s digestive tract lining and digestive organs.

All animals retain the two embryonic cell layers throughout their lives, but others develop a third cell layer, the ______ mesoderm, between the other layers. This layer forms ______ the muscles and other systems of the body ______.

Identify the tissue types into which each layer develops.

<table>
<thead>
<tr>
<th>Cell Layer</th>
<th>Forms These Tissues</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mesoderm</td>
<td>muscle, circulatory, excretory, sometimes respiratory</td>
</tr>
<tr>
<td>Ectoderm</td>
<td>skin, nerve</td>
</tr>
<tr>
<td>Endoderm</td>
<td>digestive tract lining and organs</td>
</tr>
</tbody>
</table>

Summarize

Next to each prefix, write a vocabulary word from this section that uses this prefix. Then write what you think the prefix means.

endo- ______ endoskeleton or endoderm; inside
exo- ______ exoskeleton; outside
meso- ______ mesoderm; middle
Introduction to Animals
Section 24.2 Animal Body Plans

Main Idea

Scan the figures and read the captions in Section 2 of the chapter. Write two facts that you discovered about animal body plans.

1. Accept all reasonable responses.
2. ________________________

Review Vocabulary

Use your book or dictionary to define phylogeny.

phylogeny

evolutionary history of a species based on comparative relationships of structures and comparisons of modern life-forms with fossils

New Vocabulary

Compare the terms within each table by writing their definitions.

<table>
<thead>
<tr>
<th>acoelomate</th>
<th>anterior</th>
<th>head</th>
<th>end of bilateral animals where sensory organs are often located</th>
</tr>
</thead>
<tbody>
<tr>
<td>anterior</td>
<td>posterior</td>
<td>tail</td>
<td>end of tail</td>
</tr>
<tr>
<td>dorsal</td>
<td>ventral</td>
<td>lower surface of bilaterally symmetrical animals</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>symmetry</th>
<th>term describing the arrangement of an animal's body structures</th>
</tr>
</thead>
<tbody>
<tr>
<td>bilateral</td>
<td>can be divided down the body's length into two similar right and left halves</td>
</tr>
<tr>
<td>radial</td>
<td>can be divided along any plane, through a central axis, into roughly equal halves</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>protostome</th>
<th>animal with a mouth that develops from the opening in the gastrula</th>
</tr>
</thead>
<tbody>
<tr>
<td>deuterostome</td>
<td>animal whose mouth develops from cells other than those at the opening of the gastrula</td>
</tr>
</tbody>
</table>

| coelom    | fluid-filled body cavity completely surrounded by mesoderm |
| acoelomate | an animal without a coelom |
| pseudocoelom | fluid-filled body fluid-filled body with mesoderm |
Evolution of Animal Body Plans and Development of Tissues

I found this information on page 698–699.
SE, pp. 698–699
RE, pp. 286–287

Symmetry

I found this information on page 700.
SE, p. 700
RE, pp. 287–288

Model an evolutionary tree, and show what the trunk, branches, and branching points represent. Accept all reasonable responses.

Analyse the evolutionary sequence by completing the sentences.

The earliest animals had __________ body plans, as do their modern descendants, such as __________.

Later, sea stars, hydras, and other animals appeared with ________ radial symmetry ________. They were able to detect and capture ________ coming from any direction.

The last body plan to develop was ________ bilateral symmetry ________ with a head at the ________ end of the body and a tail at the ________ end of the body.

Model a bilaterally symmetrical being. Then create characters showing asymmetry and radial symmetry. Use your imagination. List the number of arms, legs, eyes, etc., that each character has. Accept all reasonable responses.

<table>
<thead>
<tr>
<th>Bilateral Symmetry</th>
<th>Radial Symmetry</th>
<th>Asymmetry</th>
</tr>
</thead>
<tbody>
<tr>
<td>body parts: 2 eyes, 2 legs, 2 arms, 1 nose in center</td>
<td>body parts:</td>
<td>body parts:</td>
</tr>
</tbody>
</table>
Section 24.2 Animal Body Plans (continued)

**Main Idea**

Body Cavities

*I found this information on page ____________.*

SE, p. 701
RE, p. 288

Model each type of body cavity labeled below. Diagrams should resemble SE p. 701. Accept reasonable variations.

<table>
<thead>
<tr>
<th>Acoelomate</th>
<th>Pseudocoelomate</th>
<th>Coelomate</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Development in Coelomate Animals

*I found this information on page ____________.*

SE, p. 703
RE, p. 289

Compare mouth development in the two major lines of coelomates.

<table>
<thead>
<tr>
<th>Coelomates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protostomes</td>
</tr>
<tr>
<td>Mouth develops from opening in gastrula.</td>
</tr>
</tbody>
</table>

Segmentation

*I found this information on page ____________.*

SE, p. 703
RE, p. 289

Analyze two advantages of segmentation.

1. animal can survive damage to one segment; other segments might be able to take over functions of damaged segment
2. movement more effective because segments can move independently

**SUMMARIZE**

Describe the general evolutionary trend of animal body parts.

The general trend is from simple to complex. Early animals lacked true tissues. As animals evolved, tissues developed. Tissues evolved into specialized tissues and organ systems.

### Main Idea

**Skim** Section 3 of the chapter. Write two questions that come to mind from reading the headings and the illustration captions.

1. Accept all reasonable responses.
2. __________

### Details

#### Review Vocabulary

*Use your book or dictionary to define diploid.*

- **diploid**
  - cell with two of each kind of chromosome

#### New Vocabulary

*Use your book or dictionary to define each term.*

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>cnidocyte</td>
<td>stinging cell</td>
</tr>
<tr>
<td>filter feeder</td>
<td>organism that gets its food by filtering small particles from water</td>
</tr>
<tr>
<td>gastrovascular cavity</td>
<td>in cnidarians, large cavity where digestion takes place</td>
</tr>
<tr>
<td>medusa</td>
<td>cnidarian body form in which the body is umbrella-shaped with tentacles that hang down</td>
</tr>
<tr>
<td>nematocyst</td>
<td>capsule holding a coiled, threadlike tube containing poison and barbs</td>
</tr>
<tr>
<td>nerve net</td>
<td>nervous system of cnidarians that conducts impulses to and from all parts of the body</td>
</tr>
<tr>
<td>polyp</td>
<td>cnidarian body form in which the body is tube-shaped with a mouth surrounded by tentacles</td>
</tr>
<tr>
<td>sessile</td>
<td>organism that attaches to one place and stays there</td>
</tr>
</tbody>
</table>

#### Academic Vocabulary

*Define survive to show its scientific meaning.*

- **survive**
  - to remain alive
Section 24.3 Sponges and Cnidarians (continued)

**Sponges**

* I found this information on page ________, SE, pp. 705–709
  RE, pp. 290–292

**Model** a sponge. Use the figure in your book to help you. Label the six parts that are listed in the table below on your diagram. Then describe the function of each part in the table below.

Diagrams should resemble the illustration on SE p. 706. Accept all reasonable responses.

<table>
<thead>
<tr>
<th>Body Part</th>
<th>Function of Body Part</th>
</tr>
</thead>
<tbody>
<tr>
<td>Osculum</td>
<td>water and wastes expelled through this mouthlike opening at the top of the sponge</td>
</tr>
<tr>
<td>Epithelial-like cells</td>
<td>thin, flat cells that contract (and close pores) in response to touch or an irritating chemical</td>
</tr>
<tr>
<td>Collar cells</td>
<td>cells that line the interior of the sponge; their agella whip back and forth to draw in water</td>
</tr>
<tr>
<td>Pores</td>
<td>cells that surround pores and allow water (with food and oxygen) into the sponge’s body</td>
</tr>
<tr>
<td>Archaeocytes</td>
<td>carry nutrients to other cells, aid in reproduction, and produce spicule chemicals</td>
</tr>
<tr>
<td>Spicules</td>
<td>small, needlelike structures between cell layers that form the support structure</td>
</tr>
</tbody>
</table>
Section 24.3 Sponges and Cnidarians (continued)

Main Idea

Cnidarians

I found this information on page __________.

SE, pp. 710–715
RE, pp. 292–294

Details

Compare a polyp with a medusa by filling in the table.

<table>
<thead>
<tr>
<th></th>
<th>Polyp</th>
<th>Medusa</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body shape</td>
<td>tubelike</td>
<td>umbrella (bell)</td>
</tr>
<tr>
<td>Position of mouth</td>
<td>top side</td>
<td>underside</td>
</tr>
<tr>
<td>Position of tentacles</td>
<td>top side</td>
<td>underside</td>
</tr>
</tbody>
</table>

Model the complete life cycle of a jellyfish.

Diagrams should resemble SE p. 712. Accept all reasonable responses.

Summarize

Compare cnidarians and sponges.

Accept all reasonable responses. Both groups have one body opening and two cell layers, although cnidarian cell layers are organized into tissues. Cnidarians have radial symmetry, but sponges are asymmetrical. Most cnidarians have polyp and medusa stages in their life cycle. Most sponges have the same form throughout their life cycle.
Worms and Mollusks

Before You Read

Use the “What I Know” column to list the things you know about worms and mollusks. Then list the questions you have about these organisms in the “What I Want to Find Out” column. Accept all reasonable responses.

<table>
<thead>
<tr>
<th>K</th>
<th>W</th>
<th>L</th>
</tr>
</thead>
<tbody>
<tr>
<td>What I Know</td>
<td>What I Want to Find Out</td>
<td>What I Learned</td>
</tr>
</tbody>
</table>

Even the simplest organism has a role in the ecological community. Hypothesize the role of mollusks in their ecosystems. Why would people need to know about worms?

Accept all reasonable responses.
Scan the illustrations and read the captions in Section 1 of the chapter. List three characteristics of flatworms that you discovered.

1. Accept all reasonable responses.
2. ____________________________
3. ____________________________

Use your book or dictionary to define acoelomate.
acoelomate
an animal that has no body cavity

Use your book or dictionary to define each term.

flame cells
in flatworms, bubblelike cells lined with cilia that help move water and excretory substances out of the body

ganglion
group of nerve cell bodies that coordinates incoming and outgoing nerve signals in flatworms

pharynx
in planarians, the tubelike, muscular organ that extends from the mouth; aids in feeding and digestion

proglottid
a section of a tapeworm that contains muscles, nerves, flame cells, and male and female reproductive organs

regeneration
replacement or regrowth of missing body parts

scolex
knob-shaped head of a tapeworm, with hooks and suckers that attach to the intestinal lining of a host
## Body Structure

*I found this information on page __________.

SE, pp. 726–728
RE, pp. 295–297

---

### Main Idea

**Body Structure**

---

### Details

#### Summarize facts about flatworms in the table.

Accept all reasonable responses.

<table>
<thead>
<tr>
<th>Size Range</th>
<th>Number of Species</th>
</tr>
</thead>
<tbody>
<tr>
<td>1mm to several meters</td>
<td>about 20,000</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Preferred Environments</th>
<th>Adaptations for Movement of Free-living Flatworm</th>
</tr>
</thead>
<tbody>
<tr>
<td>freshwater, marine, moist land and inside living bodies</td>
<td>cilia on undersides, mucous production</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Diet of a Free-living Flatworm</th>
<th>Symmetry</th>
</tr>
</thead>
<tbody>
<tr>
<td>dead or slow-moving organisms</td>
<td>bilaterally symmetrical</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>What Happens When Free-living Flatworms Are Damaged</th>
<th>Adaptations for Parasitic Lifestyle</th>
</tr>
</thead>
<tbody>
<tr>
<td>can regenerate, or grow new body parts</td>
<td>hooks and suckers, reduced or no digestive system</td>
</tr>
</tbody>
</table>

#### Model a flatworm. Label at least nine body parts.

Diagrams should resemble SE p. 727. Accept all reasonable responses.
Identify the correct flatworm class for each characteristic below and write it in the appropriate box. Some characteristics may belong in more than one class.

- parasitic
- free-living
- scolex
- eyespots
- flukes
- auricles
- proglottids
- planaria

**Classes of Flatworms**

<table>
<thead>
<tr>
<th>Trematodes</th>
<th>Cestodes</th>
<th>Turbellarians</th>
</tr>
</thead>
<tbody>
<tr>
<td>parasitic flukes</td>
<td>parasitic scolex proglottids</td>
<td>free-living eyespots auricles planaria</td>
</tr>
</tbody>
</table>

**Model** the life cycle of a fluke.

Diagrams should resemble SE p. 729.

**Identify and describe a human disorder that tapeworms and flukes can cause.**

<table>
<thead>
<tr>
<th>Group</th>
<th>Human Disorder Caused</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tapeworms</td>
<td>infestation of intestines, can burrow through intestinal walls, entering blood and eventually muscle</td>
</tr>
<tr>
<td>Flukes</td>
<td>Schistosomiasis, fluke eggs clog blood vessels, causing swelling and eventual tissue damage</td>
</tr>
</tbody>
</table>
Scan Section 2 of the chapter. Use the checklist as a guide.

- Read all the section titles.
- Read all boldfaced words.
- Look at all illustrations and read the captions.
- Think about what you already know about worms.

Write three facts that you discovered about roundworms and rotifers.

1. Accept all reasonable responses.
2. 
3. 

Use your book or dictionary to define cilia.

- short, numerous projections that look like hairs

Use your book or dictionary to define each term. Then write a sentence using the word to show its scientific meaning.

- hydrostatic skeleton
  - fluid within a closed space that provides rigid support for muscles to work against

- trichinosis
  - a disease caused by the roundworm Trichinella that can be ingested in raw or undercooked pork, pork products, or wild game
Body Structure of Roundworms

Organize information about roundworms by filling in the chart below. Accept all reasonable responses.

<table>
<thead>
<tr>
<th>Phylum:</th>
<th>Nematoda</th>
<th>Symmetry: bilateral</th>
</tr>
</thead>
<tbody>
<tr>
<td>Habitats: everywhere from marine and freshwater habitats to land; some are parasites on plants and animals</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Body shape: cylindrical, unsegmented, tapered at both ends</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Food: some are predators on tiny invertebrates, others feed on decaying plant and animal matter, some feed on living hosts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Digestive tract of free-living forms: one way, with food entering the mouth and wastes exiting through the anus at the other end</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Circulatory and respiratory organs: none, they depend on diffusion for moving nutrients and gases throughout the body</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stimuli they can detect: touch and chemicals, some can detect differences between light and dark</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reproduction method: sexual</td>
<td>Type of fertilization: internal</td>
<td></td>
</tr>
</tbody>
</table>

Analyze the movement of roundworms.

<table>
<thead>
<tr>
<th>Roundworm Movement</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thrashing Movement</td>
<td>They have muscles that run the length of their bodies. As one muscle contracts, another relaxes, causing a thrashing movement.</td>
</tr>
<tr>
<td>Role of Pseudocoelom</td>
<td>It acts as a hydrostatic skeleton. The fluid within the pseudocoelom provides rigid support for the muscles to work against.</td>
</tr>
</tbody>
</table>
Section 25.2 Roundworms and Rotifers (continued)

Diversity of Roundworms

I found this information on page ________.
SE, pp. 733–735
RE, pp. 299–300

Identify the roundworm that matches each description.

<table>
<thead>
<tr>
<th>Animal</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>pinworm</td>
<td>most common roundworm parasite in the U.S.</td>
</tr>
<tr>
<td>hookworm</td>
<td>enters the human body through bare feet</td>
</tr>
<tr>
<td>Ascaris</td>
<td>world’s most common roundworm infection</td>
</tr>
<tr>
<td>Trichinella</td>
<td>carried by infected, undercooked pork</td>
</tr>
<tr>
<td>nematode</td>
<td>causes plant diseases</td>
</tr>
<tr>
<td>filarial worm</td>
<td>mosquito acts as intermediate host</td>
</tr>
</tbody>
</table>

Rotifers

I found this information on page ________.
SE. p. 736
RE, p. 300

Identify a negative and a positive effect of nematodes on plants.

Negative: By attaching themselves to plant roots, nematodes can cause the plants to sicken.
Positive: If added to soil infected with crop pests, nematodes can control the spread of the pest insects.

Analyze the cilia of rotifers by completing the graphic organizer below.

Locations:
1. mouth
2. anterior end

Uses:
1. movement
2. gather food

Connect

Compare the digestive tracts of roundworms with those in free-living flatworms. What does the comparison suggest about the probable evolutionary history of roundworms?

Accept all reasonable responses. Free-living flatworms have a digestive tract with only one opening; wastes are ejected through the mouth. Roundworms have digestive tracts with two openings; wastes are ejected through the anus. The digestive tract of roundworms is more advanced, so roundworms probably appeared later than flatworms.
Worms and Mollusks
Section 25.3 Mollusks

Main Idea

Skim Section 3 of the chapter. Write two questions that come to mind from reading the headings and illustration captions.

1. Accept all reasonable responses.
2. ____________________________

Details

Review Vocabulary

Use your book or dictionary to define herbivore.

herbivore

an organism that eats only plants

New Vocabulary

Use your book or dictionary to define each term.

closed circulatory system

system in which blood moves through the body enclosed entirely in blood vessels

gills

respiratory structures on the mantle that consist of a system of filamentous projections; used to move water into and through mantle

mantle

a membrane that surrounds the internal organs of a mollusk;
in mollusks with shells, it secretes the shell

nephridia

organs that remove metabolic wastes from an animal’s body

open circulatory system

system in which blood moves through vessels into open spaces around the body organs

radula

in the mouth of many mollusks, the rasping, tonguelike organ with rows of teeth; used to drill, scrape, or tear up food

siphon

a tube in octopuses and squids used to expel water taken into the mantle cavity
Body Structure

I found this information on page __________.
SE, pp. 737–741
RE, pp. 301–303

Model a snail and a squid. Label the body parts of each.

Diagrams should resemble SE p. 738. Accept all reasonable responses.

List the snail and squid structures that differ.
the snail’s foot, the squid’s tentacles, and the squid’s reduced internal shell

Distinguish two ways mollusks feed.
Radula: a tonguelike organ with rows of teeth used to scrape, drill, and tear up food
Filter feeders: draw in food from the water and strain it

Compare the way mollusks reproduce in water and on land.
in water: eggs and sperm are released at the same time and fertilization is external
on land: many land mollusks are hermaphrodites and produce both sperm and eggs, and fertilization takes place within the animal
**Main Idea**

Diversity of Mollusks, Ecology of Mollusks

I found this information on page ________.
SE, pp. 742–743
RE, p. 304

**Details**

Analyze the three classes of mollusks and the meaning of each class name. Provide at least three examples of each class.

![Diagram of mollusk classes](image)

**Classify** each mollusk in the left column of the table. Place it in the proper class.

<table>
<thead>
<tr>
<th>Class</th>
<th>Mollusk Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gastropoda</td>
<td>has a single shell and a large foot under the body</td>
</tr>
<tr>
<td>Bivalvia</td>
<td>has no radula; has two shells connected with a ligament, and a large, muscular foot for digging in the sand</td>
</tr>
<tr>
<td>Gastropoda</td>
<td>is brightly colored and has a layer of mucus covering its body; has a large foot under the body and no shell</td>
</tr>
<tr>
<td>Cephalopoda</td>
<td>has a radula and tentacles; has no shell; squirts ink at predators</td>
</tr>
</tbody>
</table>

**CONNECT**

Compare mollusks’ excretory structures with those of two or more groups that evolved earlier.

Accept all reasonable responses. Mollusks have nephridia, excretory structures that filter metabolic wastes from the coelom and remove the wastes from the body. Planarians have simpler structures called flame cells that move fluid along and eliminate water. A jellyfish has no excretory structures; water and salts move in and out of the body by osmosis.
Worms and Mollusks
Section 25.4 Segmented Worms

Main Idea

Details

Skim Section 4 of the chapter. Write three facts that you discovered about segmented worms.

1. Accept all reasonable responses.
2. 
3. 

Review Vocabulary

Use your book or dictionary to define protostome.
protostome
an animal with a mouth that develops from the opening in the gastrula

New Vocabulary

Use your book or dictionary to define each term.
clitellum
a thickened band of segments that produces a cocoon from which young earthworms hatch
crop
part of the worm’s digestive tract where food and soil taken in by the mouth are stored before passing on to the gizzard
gizzard
muscular sac containing hard particles that help grind soil and food before they pass into the intestine
setae
tiny bristles on each segment that push into the soil and anchor the worm during movement

Academic Vocabulary

Define convert to show its scientific meaning.
convert
to change from one form to another
Section 25.4 Segmented Worms (continued)

Body Structure

I found this information on page 745–748.

Summarize the characteristics of segmentation. Accept all reasonable responses.

Segments separated by septa.

Segments contain structures for digestion, excretion, and locomotion.

Segmentation

A segment’s rigidity is created by fluid within the coelom.

Sequence the process of digestion in an earthworm.

1. Food and soil enter through the mouth.
2. They pass through the pharynx into the crop, where they are stored.
3. The soil and food pass to the gizzard, where they are ground.
4. The ground materials pass into the intestine, where nutrients are absorbed.
5. Undigested material passes out of the body through the anus.
**Main Idea**

Diversity of Annelids/Ecology of Annelids/ Evolution of Mollusks and Annelids

I found this information on page ________.
SE, pp. 748–751
RE, pp. 307–308

**Details**

Organize information about annelids. Identify two characteristics of each annelid. Then write the class to which they belong. Accept all reasonable responses.

<table>
<thead>
<tr>
<th>Fanworms</th>
<th>Leeches</th>
<th>Earthworms</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Class:</strong> Polychaeta</td>
<td><strong>Class:</strong> Hirudinea</td>
<td><strong>Class:</strong> Oligochaeta</td>
</tr>
<tr>
<td>well-developed sense organs, including eyes; many setae; parapodia</td>
<td>flattened bodies; no setae; front and rear suckers; saliva contains chemical anesthetic</td>
<td>ingest soil to extract nutrients; aerate the soil</td>
</tr>
</tbody>
</table>

Analyze two ways that each of these annelids benefit their ecosystem. Accept all reasonable responses.

Earthworms
- food for many animals
- aerate the soil
- convert organic debris on the ocean floor into carbon dioxide
- food for marine predators

Marine Polychaetes

Sequence these developments in the evolution of annelids: body suckers, parapodia, clitella.

From earliest to latest: parapodia, clitella, body suckers

Summarize

Compare the type of circulatory system found in annelids with that found in some mollusks. State the advantage of the annelid type.

Accept all reasonable responses. Annelids have closed circulatory systems, with the blood entirely enclosed in blood vessels. Some mollusks also have open circulatory systems, in which the blood flows through vessels and in open spaces. A closed system provides a more efficient means for gas exchanges (oxygen and carbon dioxide) in the animal.
Tie It Together

Create a mini poster that highlights the diversity of worms.
Accept all reasonable responses.
Arthropods

Before You Read

Before you read the chapter, respond to these statements. Accept all reasonable responses.

1. Write an A if you agree with the statement.
2. Write a D if you disagree with the statement.

<table>
<thead>
<tr>
<th>Before You Read</th>
<th>Arthropods</th>
<th>After You Read</th>
</tr>
</thead>
<tbody>
<tr>
<td>A lobster’s hard covering cannot grow as the animal grows.</td>
<td></td>
<td>A</td>
</tr>
<tr>
<td>A spider begins digesting its food while the food is outside its body.</td>
<td></td>
<td>A</td>
</tr>
<tr>
<td>When you try to swat a fly, it often escapes because it can sense changes in airflow.</td>
<td></td>
<td>A</td>
</tr>
<tr>
<td>A newly hatched butterfly looks like an adult butterfly only smaller.</td>
<td></td>
<td>D</td>
</tr>
</tbody>
</table>

Science Journal

Speculate about what would happen if cockroaches and other insects were to disappear.

Accept all reasonable responses. Because of their importance in food webs, the impact of extinguishing insect species might be disastrous.
Arthropods
Section 26.1 Arthropod Characteristics

Main Idea

Skim Section 1 of the chapter. Write two questions that come to mind from reading the headings and the illustration captions.

1. Accept all reasonable responses.
2. ________________________________

Details

Use your book or dictionary to define ganglion.

ganglion

a group of nerve cell bodies that coordinates messages

Write the correct term in the left column for each definition below.

body structure consisting of fused thorax and head regions

cephalothorax

opening from the tracheae or book lungs to the outside of an arthropod's body

spiracle

tube that branches into smaller and smaller tubules to carry oxygen throughout the body

tracheal tube

body region of fused segments at the posterior end of an arthropod that contains digestive structures and reproductive organs

abdomen

in most arthropods, structure that removes cellular wastes from the blood and empties into the gut

Malpighian tubule

saclike pocket with highly folded walls for respiration

book lung

in arthropods, process of shedding an exoskeleton

molting

middle body region, consisting of three fused main segments to which, in many arthropods, legs and wings are attached

thorax

structure that grows and extends from an animal's body

appendage

mouthpart in arthropods that can be adapted for biting and chewing

mandible

chemical secreted by many animal species that influences the behavior of other animals of the same species

pheromone

Define transport to show its scientific meaning.

transport
to transfer from one place to another
Section 26.1 Arthropod Characteristics (continued)

**Main Idea**

**Arthropod Features**

I found this information on page __________.

SE, pp. 762–764
RE, pp. 309–310

**Details**

**Compare** arthropods to annelids by listing characteristics below.

<table>
<thead>
<tr>
<th>Arthropods</th>
<th>Like annelids: segmented invertebrates, bilateral symmetry, coelomate body cavities, protostome development</th>
<th>Unlike annelids: exoskeletons, jointed appendages</th>
</tr>
</thead>
</table>

**Identify** the structures attached to or contained in the main body regions of arthropods.

- **Anterior:** head mouthparts, eyes, antennae
- **Middle:** thorax legs, wings
- **Posterior:** abdomen additional legs, digestive and reproductive structures

What regions are fused in a cephalothorax? head and thorax

**Analyze** the advantages and disadvantages of an exoskeleton.

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>framework for support, protects soft body tissues, slows water loss in terrestrial animals, provides place for muscle attachment</td>
<td>adds weight, limits body size, made of nonliving material so must be shed to allow room to grow</td>
</tr>
</tbody>
</table>

**Evaluate** the role of the body functions below in the molting process.

- Fluid secreted by skin glands: softens and eventually cracks the old exoskeleton
- Increased blood circulation: puffs up the animal to make the new hardening exoskeleton larger for growing room
Model three types of arthropod respiratory structures. Identify the habitat—aquatic or terrestrial—of the arthropods with that type of respiratory system. Label the spiracles.

<table>
<thead>
<tr>
<th>Structure</th>
<th>Habitat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gills</td>
<td>Aquatic</td>
</tr>
<tr>
<td>Tracheal tubes</td>
<td>Terrestrial</td>
</tr>
<tr>
<td>Book lungs</td>
<td>Terrestrial</td>
</tr>
</tbody>
</table>

Rephrase one key fact about arthropods for each function below.

Excretion: Malpighian tubules remove cellular wastes from the blood and help terrestrial arthropods preserve water balance.

Chemical communication: Pheromones signal behaviors such as mating and feeding, and ants use them to create scent trails.

Movement: Muscles attach to inner surface of exoskeleton and strength of contraction depends on nerve impulse rate.

Summarize Identify three structures that arthropods use to respond to their environments. Explain how each structure is helpful to the arthropods.

Accept all reasonable responses. Compound eyes enable arthropods to analyze landscape changes as they fly. Tympanums or the forelegs of crickets allow for quick responses to sound waves. Limbs attached to the inside of exoskeletons facilitate rapid movement.
Main Idea

Scan Section 2 of the chapter. Use the checklist as a guide.

- Read all section titles.
- Read all boldfaced words.
- Read all tables, figures, graphs, and captions.

Write two facts you discovered as you scanned the section.

1. Accept all reasonable responses.
2. 

New Vocabulary

Use your book or dictionary to define each term.

- **chelicera**: arachnid mouthpart that is adapted to function as a fang or pincer and often is connected to a poison gland
- **cheliped**: front leg of a crustacean that has a large claw adapted to catch and crush food
- **pedipalp**: arachnid appendage used to sense and hold prey; also used for reproduction in male spiders and as large pincers in scorpions
- **spinneret**: structure located at the end of a spider’s abdomen that spins secreted fluid protein into silk for web-building
- **swimmeret**: crustacean appendage located behind the walking legs that is used as a flipper during swimming
Section 26.2 Arthropod Diversity (continued)

**Main Idea**

**Arthropod Groups**

I found this information on page ________.
SE, p. 770
RE, p. 313

**Details**

Compare the common characteristics of the major arthropod groups.

**Arthropod Groups**

<table>
<thead>
<tr>
<th>Example: crab</th>
<th>Example: fly</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group: crustaceans</td>
<td>Group: insects and relatives</td>
</tr>
<tr>
<td>Antennae: two pairs</td>
<td>Antennae: yes</td>
</tr>
<tr>
<td>Eyes: two compound</td>
<td>Eyes: compound and simple</td>
</tr>
<tr>
<td>Body sections: two—abdomen</td>
<td>Body sections: three—head, thorax, abdomen</td>
</tr>
<tr>
<td>and cephalothorax</td>
<td></td>
</tr>
<tr>
<td>Appendages: mandibles, five</td>
<td>Appendages: three pairs of</td>
</tr>
<tr>
<td>pairs of legs, swimmerets</td>
<td>legs; two pairs of wings</td>
</tr>
</tbody>
</table>

Example: wolf spider

Group: spiders and relatives
Antennae: none
Body sections: two—cephalothorax and abdomen
Appendages: six pairs, jointed (chelicerae, pedipalps, four pairs of walking legs)

**Crustaceans**

I found this information on page ________.
SE, p. 771
RE, p. 314

**Model** a lobster and label its appendages.

Sketches should resemble the figure on SE p. 771. Accept all reasonable variations. Students should include: antennae, eye, chelipeds, walking legs, and swimmerets.
Main Idea

Spiders and Their Relatives

I found this information on pages 771–774. SE, pp. 314–315

Details

Distinguish the arachnid appendage for each description below. Names will be used more than once.

<table>
<thead>
<tr>
<th>Appendage</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>spinnerets</td>
<td>create silk from fluid protein</td>
</tr>
<tr>
<td>chelicerae</td>
<td>function as fangs or pincers</td>
</tr>
<tr>
<td>pedipalps</td>
<td>used for sensing and holding prey</td>
</tr>
<tr>
<td>chelicerae</td>
<td>often connected to a poison gland</td>
</tr>
<tr>
<td>spinnerets</td>
<td>located at the end of a spider’s abdomen</td>
</tr>
<tr>
<td>pedipalps</td>
<td>large pincers on scorpions</td>
</tr>
</tbody>
</table>

Analyze ways in which a spider uses the web it constructs.

- to capture prey
- to wrap prey until the spider is ready to feed
- Male spider deposits sperm.
- Female spider lays her eggs in a cocoon of spun silk.

Conclude why the leaflike plates on the posterior appendages are important to a female horseshoe crab during reproduction.

The posterior appendages are modified for digging. The female uses these appendages to dig a burrow into the sand to deposit her eggs. After sperm is added, she uses them again to cover the eggs with sand.

Summarize Create a concept web that you can use to identify arthropods. Accept all reasonable responses.
Arthropods
Section 26.3 Insects and their Relatives

Main Idea

Skim Section 3 of the chapter. Examine each illustration and read the caption. Write three facts that you learn about the structures of insects.

1. Accept all reasonable responses.

2. 

3. 

Details

Use your book or dictionary to define each term.

subphylum  
A category in biological classification that is below a phylum and above a class.

caste  
A group of individuals within a society that performs specific tasks.

metamorphosis  
A series of major changes from a larval form to an adult form.

nymph  
An immature form of an insect that looks like a small adult without fully developed wings.

pupa  
A nonfeeding stage of metamorphosis in which the animal changes from the larval form into the adult form.

New Vocabulary

Review Vocabulary
Section 26.3 Insects and their Relatives (continued)

**Main Idea**

**Diversity of Insects**

I found this information on page __________.

SE, p. 775
RE, p. 316

**Details**

**Conclude** how insects can live in many habitats.

- ability to fly and adapt
- small size for easy movement
- exoskeleton for protection and for keeping them from drying out
- capacity to produce large numbers of offspring

**External Features**

I found this information on page __________.

SE, p. 775
RE, p. 317

**Model** a cricket and label its external features.

Drawings should resemble the figure on SE p. 775. Accept all reasonable variations. Body parts should be labeled.

**Insect Adaptations**

I found this information on page __________.

SE, pp. 776–780
RE, pp. 317–320

**Sequence** the stages in two types of metamorphosis by completing the flowcharts below. Identify each type of metamorphosis.

![Flowchart for Complete Metamorphosis](image)

![Flowchart for Incomplete Metamorphosis](image)
Section 26.3 Insects and their Relatives (continued)

Main Idea

I found this information on page ________.
SE, pp. 776–780
RE, pp. 317–320

Details

**Model** the honeybee’s waggle dance in the space below. Use labels to explain how the dance communicates where the food is.

Sketched should resemble the figure on SE p. 779. Labels should indicate that the length of the straight line gives the distance to the food source. Also, the direction of the line relative to the vertical indicates the direction of the food relative to the Sun.

**Compare** centipedes and millipedes by listing their characteristics in the Venn diagram.

<table>
<thead>
<tr>
<th>Centipedes</th>
<th>Millipedes</th>
</tr>
</thead>
<tbody>
<tr>
<td>move quickly</td>
<td>walk slowly</td>
</tr>
<tr>
<td>one pair of jointed legs per segment</td>
<td>two pairs of appendages per abdominal segment</td>
</tr>
<tr>
<td>poison claws</td>
<td>one pair on thorax</td>
</tr>
<tr>
<td>predators</td>
<td>herbivorous</td>
</tr>
<tr>
<td>Both live in moist places</td>
<td></td>
</tr>
</tbody>
</table>

**Conclude** in general how segmentation has evolved from ancestral arthropods to present-day arthropods.

Ancestral arthropods tended to have a large number of identical segments. This segmentation evolved into more specialized appendages and fewer segments in present-day arthropods.

**Summarize** Compare and contrast insect features to other arthropod groups.

Accept all reasonable responses.
# Echinoderms and Invertebrate Chordates

## Before You Read

*Before you read the chapter, respond to these statements. Accept all reasonable responses.*

1. Write an A if you agree with the statement.
2. Write a D if you disagree with the statement.

<table>
<thead>
<tr>
<th>Before You Read</th>
<th>Echinoderms and Invertebrate Chordates</th>
<th>After You Read</th>
</tr>
</thead>
<tbody>
<tr>
<td>A sea star can make its stomach come out of its mouth.</td>
<td>A</td>
<td></td>
</tr>
<tr>
<td>Many echinoderms can regrow lost body parts.</td>
<td>A</td>
<td></td>
</tr>
<tr>
<td>A lancelet's body organs are visible through its skin.</td>
<td>A</td>
<td></td>
</tr>
<tr>
<td>A tunicate is called a sea squirt because it is the smallest creature in the sea.</td>
<td>D</td>
<td></td>
</tr>
</tbody>
</table>

## Science Journal

*Write what you know or stories you have heard about sea stars, sea urchins, and other spiny sea creatures.*

Accept all reasonable responses.
Main Idea

Details

**Skim** Section 1 of the chapter. Write three questions that come to mind from reading the headings and illustration captions.

1. Accept all reasonable responses.
2. ____________________________________________
3. ____________________________________________

**Review Vocabulary**

*Use your book or dictionary to define endoskeleton.*

**endoskeleton**

an internal skeleton that provides support and protection and can act as a brace for muscles to pull against

**New Vocabulary**

*Use your book or dictionary to define each term.*

**ampulla**

muscular sac on a tube foot that contracts, forcing water into the tube foot

**madreporite**

strainerlike opening to the water-vascular system in echinoderms

**pedicellaria**

small pincer on the skin of echinoderms that aids in catching food and in removing foreign materials from the skin

**tube foot**

small, muscular, fluid-filled tube that ends in a suction-cuplike structure and is used in movement, food collection, and respiration

**water-vascular system**

system of fluid-filled, closed tubes that work together to enable echinoderms to move and get food

**Academic Vocabulary**

*Define aid to show its scientific meaning.*

**aid**

to give assistance or to help
Echinoderms Are Deuterostomes

I found this information on page 792.
SE, p. 792
RE, p. 321

Body Structure

I found this information on page 793–796.
SE, pp. 793–796
RE, pp. 321–323

Main Idea:
Echinoderms Are Deuterostomes

Details:

Analyze the importance of deuterostome development.
Accept all reasonable responses. The evolutionary tree branches at deuterostomes, marking this development as a major transition in animal phylogeny. Only echinoderms and the chordates that evolved after echinoderms have this type of development.

Sequence the steps that occur in the water-vascular system to enable an echinoderm to move. Complete the flowchart by writing the letters of the scrambled steps in the proper boxes.

A. Water is forced into the tube foot.
B. Water moves through the stone canal to the ring canal.
C. Water is drawn into the madreporite.
D. The muscles of the ampulla contract.
E. With hydraulic suction, the tube foot attaches to a surface.
F. Water moves to the radial canals.

The echinoderm moves.

Identify the echinoderm that moves in the described way.

<table>
<thead>
<tr>
<th>Echinoderm</th>
<th>Movement</th>
</tr>
</thead>
<tbody>
<tr>
<td>sea urchin</td>
<td>burrows into rocky areas using movable spines</td>
</tr>
<tr>
<td>brittle star</td>
<td>makes snakelike movements using tube feet and arms</td>
</tr>
<tr>
<td>feather star</td>
<td>uses cirri to grasp soft sediments on the seafloor</td>
</tr>
<tr>
<td>sea cucumber</td>
<td>crawls using tube feet and body wall muscles</td>
</tr>
</tbody>
</table>
**Main Idea**

**Echinoderm Diversity**

I found this information on page 797–800.
SE, pp. 797–800
RE, pp. 324–325

**Details**

**Name** the class of each echinoderm described below.

<table>
<thead>
<tr>
<th>Echinoderm Class</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Holothuroidea</td>
<td>cucumber shape; leathery covering; tentacles near mouth</td>
</tr>
<tr>
<td>Echinoidea</td>
<td>body encased in a test; burrows</td>
</tr>
<tr>
<td>Ophiuroidea</td>
<td>often five arms; arms regenerate; no suction cups on tube feet</td>
</tr>
<tr>
<td>Asteroidea</td>
<td>often five arms; tube feet used for feeding and movement</td>
</tr>
<tr>
<td>Concentricycloidea</td>
<td>no arms; tube feet located around a central disk</td>
</tr>
<tr>
<td>Crinoidea</td>
<td>sessile for some part of life</td>
</tr>
</tbody>
</table>

**Ecology of Echinoderms**

I found this information on page 801.
SE, p. 801
RE, p. 325

**List** echinoderm strategies for coping with potential predators.

- sea stars: protected by spiny skin
- brittle stars: release an arm and regenerate it later
- sea urchins: protected by venomous spines and pedicellariae
- sea cucumbers: cast out some internal organs and regenerate them

**Analyze** the effect of echinoderms on other organisms in the following situations.

- Activity as bioturbators: make nutrients available to other organisms by stirring up sediment on ocean floor
- Unexplained population explosions of crown-of-thorns sea stars: consume so many coral polyps that they destroy reefs

**CONNECT**

Give an example of regeneration in humans. Then give an example of regeneration in echinoderms that is beyond the capability of humans.

Accept all reasonable responses. Humans regenerate tissues to replace shed skin cells and repair broken bones. Humans cannot regenerate whole body parts like echinoderms can.
Echinoderms and Invertebrate Chordates

Section 27.2 Invertebrate Chordates

Scan the illustrations and read the captions in Section 2. Write two facts you discovered about invertebrate chordates.

1. Accept all reasonable responses.
2. ____________________________

New Vocabulary

Use your book or dictionary to define each term.

**chordate**
animal belonging to phylum Chordata that has four distinctive features—a dorsal tubular nerve cord, a notochord, pharyngeal pouches, and a postanal tail—at some point during development

dorsal tubular nerve cord
tube-shaped nerve cord located dorsal to the digestive organs

invertebrate chordate
member of phylum Chordata that has a dorsal tubular nerve cord, a notochord, pharyngeal pouches, a postanal tail, and possibly an ancestral thyroid gland but no backbone

notochord
flexible, rodlike structure that extends the length of the body and is located just below the dorsal tubular nerve cord

pharyngeal pouch
structure that occurs in pairs in all chordate embryos; connects the muscular tube that links the mouth cavity and the esophagus

postanal tail
structure used primarily for locomotion and is located behind the digestive system and anus

Review Vocabulary

Use your book or dictionary to define deuterostome.

deoerostome
animal whose mouth develops from cells other than those at the opening of the gastrula
Invertebrate Chordate Features

Identify the four distinctive features of chordates and their location on the animal. Describe how each feature benefits the animal.

<table>
<thead>
<tr>
<th>Feature</th>
<th>Location</th>
<th>Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>notochord</td>
<td>just below the dorsal tubular nerve cord and runs the length of the body</td>
<td>enables body to bend, rather than shorten, during contraction of muscle segments; for first time enabled side-to-side, fishlike swimming motion</td>
</tr>
<tr>
<td>postanal tail</td>
<td>behind the digestive system and anus</td>
<td>can propel an animal with more powerful movements than the body structure of invertebrates without a postanal tail</td>
</tr>
<tr>
<td>dorsal tubular nerve cord</td>
<td>above the digestive organs</td>
<td>during development, anterior end becomes the brain and posterior end becomes the spinal cord</td>
</tr>
<tr>
<td>pharyngeal pouches</td>
<td>connect the muscular tube that links the mouth cavity and esophagus</td>
<td>evolved into gills in aquatic chordates; develop into structures such as tonsils and thymus gland in terrestrial chordates</td>
</tr>
</tbody>
</table>

Analyze the importance of an endostyle.

An endostyle represents an early form of thyroid gland.

Describe the following features of lancelets.

<table>
<thead>
<tr>
<th>Phylum: Chordata</th>
<th>Subphylum: Cephalochordata</th>
</tr>
</thead>
<tbody>
<tr>
<td>Skin:</td>
<td>lacks color and scales; body structures visible through skin</td>
</tr>
<tr>
<td>Feeding method:</td>
<td>filter feeders; digestion in stomach-like structure</td>
</tr>
<tr>
<td>Movement:</td>
<td>segmented muscle blocks enable fishlike swimming</td>
</tr>
<tr>
<td>Sensory structures:</td>
<td>light receptors and small sensory tentacles near mouth</td>
</tr>
<tr>
<td>Blood circulation:</td>
<td>pumping action of blood vessels; no heart</td>
</tr>
</tbody>
</table>
Section 27.2 Invertebrate Chordates (continued)

Main Idea

I found this information on page ________.
SE, pp. 804–805
RE, pp. 327–328

Details

Model a tunicate. Label its parts. Identify its subphylum.

Subphylum: Urochordata

Drawings should resemble SE p. 805.

Analyze why tunicates are called sea squirts.

When threatened, tunicates can eject a stream of water through the excurrent siphon, possibly distracting the potential predator.

Identify key developments in the evolution of echinoderms and invertebrate chordates by completing the following paragraph.

Probably echinoderms evolved from ancestors with ______bilateral______ symmetry because echinoderms have this kind of symmetry in the ______larval______ stage. Echinoderms develop ______radial______ symmetry in the adult stage. ______Deuterostome______ development links echinoderms to chordates. The key features of ______chordates______ shared by lancelets and tunicates show their close relationship, though ______tunicates______ have these features only as larvae. A key development in the evolution of chordates was the ______notochord______, which provided support and a place for ______muscles______ to attach, leading to the first large animals.

Summarize

Why do lancelets excite the scientific community?

Accept all reasonable responses. Fossil evidence and recent molecular data show that

lancelets are one of the closest living relatives of vertebrates. Humans are more closely related to lancelets than to any other invertebrate.
You plan to visit a large aquarium. You want to be able to identify specific echinoderms and invertebrate chordates among the many sea creatures on display. Create an identification guide by listing two observable features that distinguish each animal below. Features can be physical or behavioral.

Accept all reasonable responses. Listed features must be observable.

<table>
<thead>
<tr>
<th>Animal</th>
<th>Feature 1</th>
<th>Feature 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sea Star</td>
<td>generally five arms; clings to rocks with suckers on tube feet</td>
<td>spiny skin</td>
</tr>
<tr>
<td>Brittle Star</td>
<td>moves by rowing with snakelike movements of thin, flexible arms</td>
<td>no suckers on tube feet</td>
</tr>
<tr>
<td>Sea Urchin</td>
<td>body encased in test with spines</td>
<td>burrows in rocky crevices</td>
</tr>
<tr>
<td>Sand Dollar</td>
<td>body encased in test that reflects five-part pattern of arms in sea stars</td>
<td>burrows in sand</td>
</tr>
<tr>
<td>Sea Lily</td>
<td>sessile</td>
<td>flower-shaped body at top of long stalk</td>
</tr>
<tr>
<td>Feather Star</td>
<td>long-branched arms radiating upward from central area</td>
<td>sessile</td>
</tr>
<tr>
<td>Sea Cucumber</td>
<td>shaped like a cucumber</td>
<td>outer body appears leathery</td>
</tr>
<tr>
<td>Lancelet</td>
<td>translucent, scaleless skin—can see internal body structures through skin</td>
<td>eel-like body about 5 cm long</td>
</tr>
<tr>
<td>Tunicate</td>
<td>small, saclike body with siphons</td>
<td>sessile; might live in masses</td>
</tr>
</tbody>
</table>
# Fishes and Amphibians

## Before You Read

Use the “What I Know” column to list the things you know about fishes and amphibians. Then list the questions you have about them in the “What I Want to Find Out” column. Accept all reasonable responses.

<table>
<thead>
<tr>
<th>K What I Know</th>
<th>W What I Want to Find Out</th>
<th>L What I Learned</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## Science Journal

Hypothesize what factors might be responsible for amphibian species becoming extinct.

Accept all reasonable responses. Most biologists think amphibians are disappearing because the habitats of amphibians are becoming smaller or unusable; but pollution, temperature variations, and other factors have also been suspected.

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Skim Section 1 of the chapter. Write two questions that come to mind from reading the headings and the illustration captions.

1. Accept all reasonable responses.
2. __________________________________________________________________________

Use your book or dictionary to define notochord.

**notochord**  
a flexible rodlike structure that extends the length of the body

Write the correct term in the left column for each definition below.

- **lateral line system**  
  receptors that enable fishes to detect movement in the water and help keep them upright and balanced

- **spawning**  
  external fertilization in which male and female fishes release their gametes near each other in the water

- **ventricle**  
  chamber of the heart that pumps blood to the gills

- **neural crest**  
  in vertebrates, group of cells that develop from the nerve cord and contribute to the development of other important features

- **atrium**  
  chamber of the heart that receives blood from the body

- **scale**  
  small, flat, platelike structure near the skin surface of most fishes

- **swim bladder**  
  gas-filled space in bony fishes that allows a fish to control its depth

- **cartilage**  
  tough, flexible material making up the skeletons or parts of skeletons of vertebrates

- **operculum**  
  movable flap that covers the gills and protects them

- **nephron**  
  filtering unit within the kidney that helps maintain the salt and water balance of the body and remove cellular waste

Define these terms to show their scientific meaning.

- **precision**  
  act of moving forward by means of a force that causes motion

- **propulsion**  
  characterized by accurate action
Summarize information about two major characteristics of vertebrates.

<table>
<thead>
<tr>
<th>Characteristics of Fishes</th>
</tr>
</thead>
<tbody>
<tr>
<td>I found this information on page __________.</td>
</tr>
<tr>
<td>SE, pp. 821–827</td>
</tr>
<tr>
<td>RE, pp. 330–335</td>
</tr>
</tbody>
</table>

Summarize the reproduction method of most fishes.

Most fishes use an external fertilization process called spawning.

Male and female fishes release gametes near each other in the water.

Embryos feed on the yolk of the egg.
Organize facts about characteristics of fishes. Accept all reasonable responses.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Facts</th>
</tr>
</thead>
<tbody>
<tr>
<td>habitats</td>
<td>most aquatic environments, including the ocean floor and freezing waters of polar regions</td>
</tr>
<tr>
<td>adaptive advantages of jaws</td>
<td>enable fishes to prey on a larger range of animals, including fishes that are larger and more active; enable a biting defense</td>
</tr>
<tr>
<td>benefits of paired fins</td>
<td>reduce chance of rolling to the side; allow for better steering during swimming</td>
</tr>
<tr>
<td>four types of scales and their composition</td>
<td>ctenoid and cycloid: bone; placoid: toothlike materials; ganoid: enamel and bone</td>
</tr>
<tr>
<td>functions of gills</td>
<td>take in oxygen from water and give off carbon dioxide</td>
</tr>
<tr>
<td>functions of pyloric ceca</td>
<td>secrete enzymes for digestion and absorb nutrients into the bloodstream</td>
</tr>
<tr>
<td>functions of nephrons</td>
<td>maintain salt and water balance in body and remove cellular waste from blood</td>
</tr>
<tr>
<td>sensory abilities</td>
<td>sense of smell can detect chemicals in the water; color vision; lateral line system to detect movement in the water</td>
</tr>
<tr>
<td>process for controlling depth in water</td>
<td>fish sinks when gases diffuse out of swim bladder; fish rises when gases from the blood diffuse into the swim bladder</td>
</tr>
</tbody>
</table>

Connect

Design a graphic organizer to summarize the adaptations and functions of fish. Accept all reasonable responses.
Fishes and Amphibians
Section 28.2 Diversity of Today's Fishes

Main Idea

Scan Section 2 of the chapter. Use the checklist as a guide.

- Read all headings.
- Read all boldfaced words.
- Read all diagrams.
- Look at all pictures and read the captions.

Write three facts that you discovered about fishes.

1. Accept all reasonable responses.
2. 
3. 

Details

Use your book or dictionary to define adaptive radiation.

the process of evolution that produces many species from an ancestral species

Use your book or dictionary to define the following term.

tetrapod

four-footed animal with legs that have feet and toes that have joints; thought to have evolved from lobe-finned fishes

Use tetrapod in a sentence describing its possible place in the evolution of fishes.

Accept all reasonable responses.
Classes of Fishes

Classify fishes and provide an example in the organizer below.

- **Class:** Myxini
- **Examples:** hagfishes
- **Class:** Cephalaspidomorphi
- **Examples:** lampreys
- **Class:** Chondrichthyes
- **Examples:** rays, sharks, skates
- **Subclass:** ray-finned fishes
- **Examples:** trout, salmon
- **Subclass:** lobe-finned fishes
- **Examples:** lungfishes

Compare and contrast how each pair of fishes are alike and how they differ. Accept all reasonable responses.

**Hagfish and lamprey**
- Alike: both lack jaws, scales, paired fins, and bony skeletons
- Different: lamprey is parasite; hagfish is not

**Great white shark and whale shark**
- Alike: both have cartilaginous skeletons
- Different: great white is predator; whale shark is filter feeder

**Trout and lungfish**
- Alike: both have bony skeleton
- Different: trout has ray fins; lungfish has lobes and joints
Section 28.2 Diversity of Today’s Fishes

### Main Idea

#### Evolution of Fishes

**I found this information on page 832.**

- **SE, p. 832**
- **RE, pp. 338–339**

Sequence the evolution of fishes by writing the letter of the following features on the cladogram in the order in which they appeared.

- a. jaws, bony skeleton, primitive lung
- b. jaws, paired fins, bony plates covering body
- c. jaws, placoid scales, cartilaginous skeleton

### Details

#### Ecology of Fishes

**I found this information on page 833.**

- **SE, p. 833**
- **RE, p. 339**

Analyze the effects of human activities on fishes.

- Damming rivers in Pacific Northwest: interfere with migration of salmon to spawning areas; decline of salmon
- Polluting waterways: decline in number and diversity of fishes

### Connect

Describe ways in which humans can use water resources with less impact on aquatic ecosystems. Identify how an individual could support this effort.

- Accept all reasonable responses. The government can enforce standards that require businesses to reduce water pollutants.
- Dam builders can find ways to reduce the impact of a dam on fish ecology, such as providing a way for migrating salmon to get around the dam.
- Individuals can support these efforts by staying informed, voting for politicians who support conservation, and expressing disapproval to companies that pollute.
**Main Idea**

**Details**

**Skim** Section 3 of the chapter. Name two characteristics of amphibians.

1. Accept all reasonable responses.

2. 

**Review Vocabulary**

Use your book or dictionary to define metamorphosis.

**metamorphosis**

a series of developmental changes in the form or structure of an organism

**New Vocabulary**

Use your book or dictionary to define each term.

**cloaca**

chamber that receives the digestive wastes, urinary waste, and eggs or sperm before they leave the body

**ectotherm**

animal that cannot regulate its body temperature

**nictitating membrane**

transparent eyelid that can move across the eye to protect it underwater and keep it from drying out on land

**tympanic membrane**

eardrum of an amphibian; in frogs, a thin external membrane on each side of the head that hears high-pitched sounds

**Academic Vocabulary**

Define and use diversify in a sentence to show its scientific meaning.

to produce variety
Section 28.3 Amphibians (continued)

### Main Idea

**Evolution of Tetrapods**

*I found this information on page __________.*

SE, pp. 834–835
RE, pp. 340–341

### Details

**Identify three adaptations that helped amphibians leave water for life on land.** Accept all reasonable responses.

1. skeletal and muscular systems, including limbs
2. lungs for obtaining oxygen from air
3. ears to sense sound waves traveling through air

**Summarize the characteristics of amphibians.** Accept all reasonable responses.

**Characteristics of Amphibians**

<table>
<thead>
<tr>
<th>Feeding and digestion:</th>
<th>adults predatory; digest in stomach and intestine; wastes collect in cloaca before exiting body</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excretion:</td>
<td>kidneys filter wastes from blood; aquatic amphibians excrete ammonia; land amphibians excrete urea</td>
</tr>
<tr>
<td>Respiration:</td>
<td>larvae exchange gases through gills and skin; adults breathe through lungs and skin</td>
</tr>
<tr>
<td>Circulation:</td>
<td>double-loop circulation; three chambered heart including two atria and one ventricle</td>
</tr>
<tr>
<td>Brain and senses:</td>
<td>forebrain detects odors; vision important; nictitating membrane protects eyes; tympanic membrane for hearing; ectotherms, so cannot regulate body temperature</td>
</tr>
<tr>
<td>Reproduction:</td>
<td>eggs laid and fertilized in water; embryo feeds on yolk; tadpoles change to adults through metamorphosis</td>
</tr>
</tbody>
</table>

**Amphibian Diversity**

*I found this information on page __________.*

SE, pp. 838–839
RE, p. 343

**Create a concept map to show characteristics and examples of each order of amphibians.** Accept all reasonable responses.

[Amphibians concept map]

**Order Anura**
- frogs, toads
  - lack tails; long legs for jumping; need water for reproduction; toads have poison-secreting gland for protection

**Order Caudata**
- salamanders, newts
  - long, slim bodies with necks and tails; four legs; salamanders live near water; newts aquatic throughout life

**Order Gymnophiona**
- caecilians
  - legless; wormlike; burrow in soil; feed on worms; skin covers eyes; internal fertilization; lay eggs near water
Evolution of Amphibians

Identify the evolutionary adaptations that make the branching points for each amphibian group.

<table>
<thead>
<tr>
<th>Amphibian Group</th>
<th>Evolutionary Branching Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rhipidistians</td>
<td>lobe-finned, nostril-like structures on top of mouth</td>
</tr>
<tr>
<td>Ichthyostegans</td>
<td>heavier leg bones, ankle and wrist joints, stronger muscles</td>
</tr>
<tr>
<td>Tetrapods</td>
<td>five toes on front and hind limbs</td>
</tr>
<tr>
<td>Caecilians</td>
<td>legless</td>
</tr>
<tr>
<td>Salamanders</td>
<td>most have four legs</td>
</tr>
<tr>
<td>Frogs and toads</td>
<td>four legs, no tail</td>
</tr>
</tbody>
</table>

Ecology of Amphibians

Describe factors in the worldwide decline of amphibians and explain how each factor affects the ability of amphibians to survive.

Local factors: habitat destruction, such as draining wetlands to build buildings; introduction of exotic species

Effects: less water available for amphibian reproduction; exotic species compete with amphibians for food and space or might be predators of amphibians

Global factors: global climate change, such as changes in temperature, length of dry season, soil moisture, and rainfall

Effects: can kill amphibians or stress their bodies, making them more susceptible to disease

SUMMARIZE

Compare amphibians with fishes. List some important evolutionary advances seen in amphibians.

Accept all reasonable responses. Amphibians have a double-loop circulatory system and a three-chambered heart. Fishes have a single loop and two chambers. Amphibians have lungs during part of their life cycle; fish breathe by using gills. Most amphibians have limbs.
Before you read the chapter, respond to these statements. Accept all reasonable responses.

1. Write an A if you agree with the statement.
2. Write a D if you disagree with the statement.

<table>
<thead>
<tr>
<th>Before You Read</th>
<th>Reptiles and Birds</th>
<th>After You Read</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Snakes flick their tongue to smell odors.</td>
<td>A</td>
<td></td>
</tr>
<tr>
<td>• Some scientists hypothesize that a meteorite crashed to Earth, causing extinction of the dinosaurs.</td>
<td>A</td>
<td></td>
</tr>
<tr>
<td>• All birds have feathers.</td>
<td>A</td>
<td></td>
</tr>
<tr>
<td>• All birds can fly.</td>
<td>D</td>
<td></td>
</tr>
</tbody>
</table>

Science Journal

Think about the lives of fishes compared to the lives of reptiles and the lives of birds. What adaptations do birds and reptiles have to suit them to life on land and in the air?

Accept all reasonable responses.

[Blank lines for student response]
Reptiles and Birds
Section 29.1 Reptiles

Main Idea

Details

Skim Section 1 of the chapter. Read the headings and illustration captions. Write three questions that come to mind.

1. Accept all reasonable responses.
2. ____________________________
3. ____________________________

Review Vocabulary

Use your book or dictionary to define embryo.

embryo
the earliest stage of development of plants and animals after an egg has been fertilized

New Vocabulary

Use your book or dictionary to define each term.

amnion
fluid-filled membrane that surrounds a developing embryo inside an amniotic egg

amniotic egg
egg that is covered with a protective shell and has several internal membranes with fluids contained between the membranes

carapace
dorsal part of a turtle's shell

Jacobson's organ
saclike structure on the roof of a snake's mouth that senses odors

plastron
ventral part of a turtle's shell

Academic Vocabulary

Define interpretation to show its scientific meaning.

interpretation
a particular adaptation or version of a work, method, or style
Section 29.1 Reptiles (continued)

Main Idea

Characteristics of Reptiles

I found this information on page 852–856.
SE, pp. 852–856
RE, pp. 345–348

Details

Identify the adaptations reptiles made to survive on land.

<table>
<thead>
<tr>
<th>Needed for Life on Land</th>
<th>Adaptation</th>
</tr>
</thead>
<tbody>
<tr>
<td>protect embryo from drying out</td>
<td>amniotic egg</td>
</tr>
<tr>
<td>prevent excessive loss of water and minerals from the body</td>
<td>dry, scaly skin; cloaca that reabsorbs water from urine before excretion</td>
</tr>
<tr>
<td>exchange gases other than through skin</td>
<td>lungs with larger surface area and ability to inhale and exhale through muscular contraction</td>
</tr>
<tr>
<td>crocodile’s need for more oxygen delivered to cells to help move its large body</td>
<td>four-chambered heart</td>
</tr>
<tr>
<td>snake’s need to swallow prey larger than itself</td>
<td>loosely joined bones of the skull and jaw that can spread apart</td>
</tr>
<tr>
<td>complex vision and muscle function</td>
<td>larger optic lobes and cerebellum</td>
</tr>
<tr>
<td>move faster and bear more body weight</td>
<td>limbs rotated farther under the body; claws on toes</td>
</tr>
</tbody>
</table>

Model a reptilian egg. Label the amnion, embryo, allantois, yolk sac, chorion, and shell.

Diagrams should resemble SE p. 853. Accept all reasonable responses.
Section 29.1 Reptiles (continued)

Main Idea

Diversity of Modern Reptiles

I found this information on page 856–857.
SE, pp. 856–857
RE, pp. 348–349

Evolution of Reptiles

I found this information on page 858–859.
SE, pp. 858–859
RE, p. 349

Ecology of Reptiles

I found this information on page 860.
SE, p. 860
RE, p. 349

Details

Contrast characteristics of each order in class Reptilia.
Accept all reasonable responses.

<table>
<thead>
<tr>
<th>Order</th>
<th>Examples</th>
<th>Key Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>Squamata</td>
<td>snakes, lizards</td>
<td>lizards: long legs, claws, movable eyelids, and hinge joint on lower jaw, tympanic membranes; snakes: legless, shorter tails, movable lower jaw, lack movable eyelids and tympanic membranes</td>
</tr>
<tr>
<td>Crocodilia</td>
<td>crocodiles, alligators</td>
<td>four-chambered heart, long snout, sharp teeth, powerful jaws; alligators: broad snout, upper jaw wider than lower jaw; crocodiles: jaws about same width, teeth visible when mouth closed</td>
</tr>
<tr>
<td>Testudinata</td>
<td>turtles, tortoises</td>
<td>shell; vertebrae and ribs fused to inside of carapace; pull in heads and legs for protection; turtles aquatic; tortoises live on land</td>
</tr>
<tr>
<td>Sphenodonta</td>
<td>tuataras</td>
<td>on islands near New Zealand; spiny crest down back; scaly third eye senses sunlight; two rows of teeth in upper jaw, one row in lower jaw</td>
</tr>
</tbody>
</table>

Identify each animal’s ancestors as diapsids, anapsids, or synapsids.

- diapsids ➔ birds ➔ diapsids ➔ lizards
- synapsids ➔ mammals ➔ anapsids ➔ turtles

Analyze how loss of a reptile species could upset the balance of an ecosystem.

Accept all reasonable responses. Reptiles are both predator and prey. Removing a species could cause its prey to increase out of control. Also, predators that feed on the species would decline.

Summarize

Evaluate whether a meteorite crashing to Earth could have doomed the dinosaurs. Discuss the catastrophic effects of such a crash and adaptations needed to survive the event.

Accept all reasonable responses. The dust cloud caused by the crash could have blocked the Sun, killing plants on which dinosaurs and their prey fed. Earth would have cooled rapidly.

Dinosaurs might not have been able to adapt quickly enough to the colder climate to survive.
Skim Section 2 of the chapter. Identify characteristics of birds that make them different from reptiles.

Accept all reasonable responses. Present-day birds have feathers, bones with cavities of air, and beaks. Most species can fly. Birds are endotherms with a high metabolic rate. They lay hard-shelled eggs.

**Review Vocabulary**

*terrestrial*
living on or in land

**New Vocabulary**

*air sac*
saclike structure located at the anterior and posterior of a bird’s respiratory system

*contour feather*
type of feather that covers the body, wings, and tail of a bird

*down feather*
soft feather located beneath contour feathers

*endotherm*
organism that generates its body heat internally by its own metabolism

*feather*
specialized outgrowth of the skin of birds that provides insulation and enables flight

*incubate*
maintain favorable conditions for hatching

*preen gland*
gland located near the base of a bird’s tail that secretes oil for waterproofing feathers

*sternum*
breastbone
Main Idea

Characteristics of Birds

I found this information on page 861–866. SE, pp. 861–866; RE, pp. 350–353.

Details

Model a contour feather and a down feather. Label the structures. Write brief captions describing the characteristics or functions of each feather. Accept all reasonable responses. For each feather, students should label the shaft and barbs.

<table>
<thead>
<tr>
<th>Down feathers</th>
<th>Contour feathers</th>
</tr>
</thead>
<tbody>
<tr>
<td>The caption for the down feather should note that the loose structure can trap air for insulation.</td>
<td></td>
</tr>
<tr>
<td>The caption for the contour feather should note that the barbs are joined with hooks, and that preening rejoins separated barbs.</td>
<td></td>
</tr>
</tbody>
</table>

Sequence the respiratory organs of a bird. Place the organs from the list below in the proper sequence. One organ appears more than once.

- lungs
- posterior air sacs
- anterior air sacs
- trachea

Air enters and exits the trachea.

Anterior air sacs → trachea → lungs → posterior air sacs

Analyze how eye position reflects a bird’s life habits.

Accept all reasonable responses. Predatory birds need to focus both eyes on distant prey, so their eyes are in the front of their head. The eyes of grain-feeding birds are on the sides of their head, enabling them to detect predators in any direction.
Diversity of Modern Birds

Identify the order and one member of the order for each distinguishing characteristic listed below.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Order/Member</th>
</tr>
</thead>
<tbody>
<tr>
<td>builds nests in cavities</td>
<td>Piciformes/woodpecker</td>
</tr>
<tr>
<td>flipper-like wings; solid bones</td>
<td>Sphenisciformes/penguin</td>
</tr>
<tr>
<td>flightless; includes largest living birds</td>
<td>Struthioniformes/ostrich</td>
</tr>
<tr>
<td>sing; feet adapted for perching</td>
<td>Passeriformes/blue jay</td>
</tr>
<tr>
<td>marine; tube-shaped nostrils</td>
<td>Procellariiformes/albatross</td>
</tr>
<tr>
<td>long legs for wading</td>
<td>Ciconiiformes/heron</td>
</tr>
<tr>
<td>nocturnal; large eyes; talons</td>
<td>Strigiformes/owl</td>
</tr>
<tr>
<td>aquatic; round beak</td>
<td>Anseriformes/duck</td>
</tr>
</tbody>
</table>

Evolution of Birds

Compare features of dinosaurs found in fossil records that are similar to features of present-day birds.

One species of dinosaur had a coat of downy, featherlike fibers. 

Two others had feathers on their front appendages and tails. 

Archaeopteryx had asymmetrical feathers and a brain much like present-day birds. Another species had features for hovering flight.

Ecology of Birds

Analyze how birds are key to the survival of many plants.

Birds disperse seeds. Seeds eaten or caught in feathers move with birds to new locations, where the seeds are eliminated after digestion or drop off feathers. Hummingbirds pollinate plants as they feed on nectar.

SUMMARIZE

Compare and contrast ectothermy and endothermy.

Accept all reasonable responses. Endotherms can alter their metabolism to regulate their body temperature and produce a large amount of ATP to power complex movement. Ectotherms must regulate body temperature through behavior. Endotherms must eat large amounts of food to maintain their high metabolic rate. Ectotherms need less food energy.
Create a profile of one bird and one reptile common to your area. Identify the animal’s order and species. Sketch each animal and label characteristics that distinguish it from other birds or reptiles. Write a brief summary of its life habits from your research. Point out characteristics on the sketches that are adapted for the animal’s life habits.

Accept all reasonable responses.

Reptile species:
Order:

Bird species:
Order:
Mammals

Before You Read

Before you read the chapter, respond to these statements. Accept all reasonable responses.

1. Write an A if you agree with the statement.
2. Write a D if you disagree with the statement.

<table>
<thead>
<tr>
<th>Before You Read</th>
<th>Mammals</th>
<th>After You Read</th>
</tr>
</thead>
<tbody>
<tr>
<td>• If an animal has hair, it is a mammal.</td>
<td></td>
<td>A</td>
</tr>
<tr>
<td>• Mammals produce their body heat internally.</td>
<td></td>
<td>A</td>
</tr>
<tr>
<td>• A duck-billed platypus is not a true mammal because it lays eggs.</td>
<td></td>
<td>D</td>
</tr>
<tr>
<td>• The first mammals probably evolved from reptiles.</td>
<td></td>
<td>A</td>
</tr>
</tbody>
</table>

Science Journal

Mammals are one of the most successful groups of animals on Earth. Think about a specific mammal and some of its characteristics. Write about how you think some of these characteristics help the mammal to survive and be successful.

Accept all reasonable responses.
Mammals

Section 30.1 Mammalian Characteristics

**Main Idea**

**Details**

*Skim* Section 1 of the chapter. Write two questions that come to mind from reading the headings and the illustration captions.

1. Accept all reasonable responses.

2. ________________________________

**Review Vocabulary**

Use your book or dictionary to define metabolic rate.

*metabolic rate*

the rate at which all the chemical reactions that occur within an organism take place

**New Vocabulary**

Write the correct vocabulary term in the left column for each definition below.

- _mammary gland_ produces and secretes milk that nourishes developing young
- _diaphragm_ sheet of muscle located beneath the lungs that separates the chest cavity from the abdominal cavity; its contraction and relaxation allows air to move into and out of the lungs
- _cerebral cortex_ highly folded outer layer of the cerebrum; responsible for coordinating conscious activities, memory, and ability to learn
- _cerebellum_ part of the brain responsible for balance and coordinating movement
- _gland_ group of cells that secretes fluid to be used elsewhere in the body
- _uterus_ saclike muscular organ in which embryos develop
- _placenta_ organ that provides food and oxygen to and removes waste from the developing young
- _gestation_ amount of time the young stay in the uterus until they are born

**Academic Vocabulary**

*Define retain to show its scientific meaning.*

*retain* to keep in possession or use
### Main Idea

**Hair and Mammary Glands**

*I found this information on page*.  
**SE, pp. 880–881**  
**RE, pp. 355–356**

#### Details

**Analyze** the importance of hair by identifying the six functions of hair and giving an example of each function.  
Accept all reasonable responses.

<table>
<thead>
<tr>
<th>Functions</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>insulation</td>
<td>a fox’s fur traps body heat</td>
</tr>
<tr>
<td>camouflage</td>
<td>a tiger’s stripes help it blend into its habitat</td>
</tr>
<tr>
<td>sensory devices</td>
<td>a seal uses its sensitive whiskers to track prey</td>
</tr>
<tr>
<td>waterproofing</td>
<td>a sea otter’s hair keeps water from reaching the skin</td>
</tr>
<tr>
<td>signaling</td>
<td>a white-tailed deer raises its tail to show the white underside for others to follow</td>
</tr>
<tr>
<td>defense</td>
<td>a porcupine’s quills stab predators that touch it</td>
</tr>
</tbody>
</table>

**Other Characteristics**

*I found this information on page*.  
**SE, pp. 881–888**  
**RE, pp. 356–361**

**Organize** mammalian characteristics by completing the concept map.

![Concept Map](image-url)
Classify each description below as a characteristic of insectivores, herbivores, carnivores, or omnivores.

<table>
<thead>
<tr>
<th>Classification</th>
<th>Characteristic</th>
</tr>
</thead>
<tbody>
<tr>
<td>herbivores</td>
<td>have longest digestive tract</td>
</tr>
<tr>
<td>omnivores</td>
<td>feed on both plants and animals</td>
</tr>
<tr>
<td>insectivores</td>
<td>have long, curved incisors to seize prey</td>
</tr>
<tr>
<td>carnivores</td>
<td>have long, sharp canines to pierce prey</td>
</tr>
</tbody>
</table>

Sequence how the diaphragm works in respiration.

1. Diaphragm flattens as it contracts.
2. Chest cavity enlarges.
3. Air flows into the lungs.
4. Diaphragm relaxes, making the chest cavity smaller.
5. Air is expelled from the lungs.

Describe the functions of each type of gland listed below.

<table>
<thead>
<tr>
<th>Gland</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sweat glands</td>
<td>help maintain body temperature</td>
</tr>
<tr>
<td>Scent glands</td>
<td>mark territory and attract a mate</td>
</tr>
<tr>
<td>Mammary glands</td>
<td>produce and secrete milk to nourish developing young</td>
</tr>
<tr>
<td>Oil glands</td>
<td>maintain quality of hair and skin</td>
</tr>
</tbody>
</table>

Summarize

Create a graphic organizer showing characteristics of mammals. The organizer should distinguish characteristics common to all mammals from characteristics common to only certain species. Accept all reasonable responses.
Mammals

Section 30.2 Diversity of Mammals

Scan Section 2 of the chapter. Use the checklist as a guide.

- Read all section titles.
- Read all boldfaced words.
- Read all tables and graphs.
- Look at all illustrations and read the captions.
- Think about what you already know about mammals.

Write two facts that you discovered about the subgroups of mammals.

1. Accept all reasonable responses.
2. ____________________________

Review Vocabulary

Use your book or dictionary to define chromosome.

chromosome: cell structure that carries genetic material that is copied and passed from generation to generation of cells

New Vocabulary

Use your book or dictionary to define the following terms.

marsupial: pouched mammal that has a short period of development in the uterus

monotreme: mammal that reproduces by laying eggs

placental mammal: mammal that has a placenta and gives birth to young that do not need further development within a pouch

therapsid: extinct vertebrate with both mammalian and reptilian features, from which the first mammals probably arose

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**Main Idea**

Mammal Classification

*I found this information on page ________.*  
SE, pp. 889–895  
RE, pp. 362–365

**Organize** information about the three subclasses of mammals by completing the concept map below.

![Concept map of Mammal Subclasses](image)

**Analyze** characteristics of monotremes by identifying their mammal-like and reptilelike features.

- **Mammalian features:** hair; mammary glands
- **Reptilian features:** lay eggs; bone structure of shoulder area; lower body temperature than most mammals; a mix of mammal-sized and reptile-sized chromosomes

**Compare and contrast** the development of young in a placental mammal with the development of young in a marsupial.

Accept all reasonable responses.

<table>
<thead>
<tr>
<th>Marsupial</th>
<th>Placental Mammal</th>
</tr>
</thead>
<tbody>
<tr>
<td>The young develop for a short time in the uterus. Immediately after birth, the young crawl into the mother’s pouch, where they continue to develop while receiving nourishment from the milk of the mother’s mammary glands.</td>
<td>The young receive food and oxygen from the placenta as they develop in the uterus. After birth, the young do not need further development within a pouch, but continue to nurse from their mother.</td>
</tr>
</tbody>
</table>
Section 30.2 Diversity of Mammals (continued)

**Main Idea**

*I found this information on page 889–895.*

**Details**

**Contrast** orders of placental mammals. List characteristics that distinguish each order.

<table>
<thead>
<tr>
<th>Order</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chiroptera</td>
<td>the only mammals that truly fly</td>
</tr>
<tr>
<td>Xenarthra</td>
<td>have no teeth or simple, peglike teeth</td>
</tr>
<tr>
<td>Carnivora</td>
<td>predators; teeth adapted for tearing flesh</td>
</tr>
<tr>
<td>Primates</td>
<td>most developed brains of all mammals</td>
</tr>
<tr>
<td>Artiodactyla</td>
<td>hoofed mammals with even number of toes</td>
</tr>
<tr>
<td>Perissodactyla</td>
<td>hoofed mammals with odd number of toes</td>
</tr>
<tr>
<td>Cetacea</td>
<td>front flippers and tail of fleshy flukes</td>
</tr>
</tbody>
</table>

**Evolution of Mammals**

*I found this information on page 886–897.*

**Sequence** the environmental developments that led to the expansion of mammalian diversity during the Cenozoic era.

1. Dinosaurs disappeared at the end of the Mesozoic era.
2. Flowering plants flourished, providing new sources of nutrition and new habitats.
3. Mammals evolved to fill the new niches that became available.

**SUMMARIZE**

Describe what the mammals of Australia might be like today if the movement of Earth’s plates had not separated Australia from other continents. Explain your reasoning.

Accept all reasonable responses. Had the separation not occurred, marsupials might be rare or even extinct in Australia today, because placental mammals had adaptive advantages, such as limbs with greater functionality and a more complex cerebral cortex. In the protective isolation of Australia, marsupials could fill the niches occupied by placental mammals elsewhere in the world.
Describe the ideal adaptations that would be needed by a mammal who lived in a high desert with broad temperature ranges, limited food and water, and predatory birds and reptiles. Identify the likely distinguishing characteristics in the areas of hair functions, teeth, senses, limb types, movement, and metabolic rate.

Accept all reasonable responses.
# Animal Behavior

## Before You Read

*Use the “What I Know” column to list the things you know about animal behavior. Then list the questions you have about animal behavior in the “What I Want to Find Out” column. Accept all reasonable responses.*

<table>
<thead>
<tr>
<th>K</th>
<th>What I Know</th>
</tr>
</thead>
<tbody>
<tr>
<td>W</td>
<td>What I Want to Find Out</td>
</tr>
<tr>
<td>L</td>
<td>What I Learned</td>
</tr>
</tbody>
</table>

---

## Science Journal

*Describe two behavior patterns in humans.*

Accept all reasonable responses.

---

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Scan the titles, boldfaced words, illustrations, and captions in Section 1. Write two facts you discovered about animal behavior.

1. Accept all reasonable responses.
2. Use your book or dictionary to define natural selection.

Use the new vocabulary words to complete the paragraph below.

Any way that an animal responds to a stimulus is behavior. Some behaviors, such as innate behavior, are genetically based. An animal that carries out a specific set of actions, in the same order, in response to a stimulus is exhibiting a fixed action pattern. Behavior that results from an interaction between genetically based behaviors and past experiences is learned behavior. An example is habituation, in which the response decreases after repeated exposure to a stimulus that has no positive or negative effects. An animal can learn to associate two different kinds of stimuli through classical conditioning. Learning through operant conditioning involves rewards and punishments. One type of permanent learning, called imprinting, occurs only within a specific time period. When an animal solves a problem, it is exhibiting cognitive behavior.

Define inanimate to show its scientific meaning.

not having life; not alive
Section 31.1 Basic Behaviors (continued)

**Main Idea**

**Behavior**

I found this information on page SE, pp. 908–909
RE, pp. 367–368

**Innate Behavior**

I found this information on page SE, p. 910
RE, p. 368

**Learned Behavior**

I found this information on page SE, pp. 911–915
RE, pp. 369–370

**Details**

**Analyze the relationship of behavior and natural selection by completing the graphic organizer.**

Animals with **traits**
giving them a **competitive advantage**
over other animals without these

are more likely to **reproduce**, passing on their **genes** to future generations.

**Complete the fixed action pattern by completing the diagram.**

Defined as **specific set of actions carried out in the same sequence each time**

**Effect of removal of stimulus**

None; an animal would complete behavior without stimulus.

**Contrast learned behavior to innate behavior. Give an example of a behavior in response to a particular stimulus.**

Accept all reasonable responses. Innate behavior is influenced by **genes alone. Learned behavior results from an interaction between genes and past experiences. An example of a learned behavior is studying in response to an upcoming test.**
### Main Idea

I found this information on page SE, pp. 911–915.

**Details**

Organize information about the different kinds of learned behavior in the chart. Accept all reasonable responses.

<table>
<thead>
<tr>
<th>Learned Behavior</th>
<th>Description</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Habituation</td>
<td>lack of response after repeated exposure to a stimulus with no positive or negative effects</td>
<td>a horse ignoring noisy cars that pass by its pasture</td>
</tr>
<tr>
<td>Classical conditioning</td>
<td>learning to associate two different kinds of stimuli</td>
<td>a cat rushing to its food bowl at the sound of a can opener because its food is opened with a can opener</td>
</tr>
<tr>
<td>Operant conditioning</td>
<td>learning to associate a response to a stimulus with a reward or punishment</td>
<td>learning to follow the rules when playing a sport to avoid a penalty</td>
</tr>
<tr>
<td>Imprinting</td>
<td>learning that can occur only within a specific time period in an animal’s life and is permanent</td>
<td>a duck following its mother because the mother was the first thing the duck saw after birth</td>
</tr>
<tr>
<td>Cognitive behavior</td>
<td>thinking, reasoning, and processing information to understand complex concepts and solve problems</td>
<td>a chimpanzee using a stone to crack open nuts</td>
</tr>
</tbody>
</table>

### Summarize

Animals respond to both internal and external stimuli. Give an example of a response to an internal stimulus and a response to an external stimulus.

Accept all reasonable responses. Students might note that feelings of hunger are an internal stimulus that prompts them to go to the refrigerator to find something to eat. They might suggest that the external stimulus of a parent who promises a reward might motivate them to clean up their room.
Skim Section 2 of the chapter. Write three questions that come to mind from reading the headings and illustration captions.

1. Accept all reasonable responses.
2. 
3. 

Use your book or dictionary to define colony.

colony
group of unicellular or multicellular organisms that live together in close association

Write the correct vocabulary term in the left column for each definition below.

Agonistic behavior
threatening or combative interaction between two individuals of the same species

dominance hierarchy
ranking within a group, in which a top-ranked animal gets access to resources without conflict from others in the group

territorial behavior
attempt to adopt and control a physical area over other animals of the same species

Foraging behavior
finding and eating food

Migratory behavior
moving long distances seasonally to new locations

Circadian rhythm
cycle that occurs daily

Language
auditory communication in which animals use vocal organs to produce groups of sounds that have shared meanings

courting behavior
behavior designed to attract a mate

Nurturing behavior
parental care of offspring in early stages of development

Altruistic behavior
action that benefits another individual at a cost to the actor
Section 31.2 Ecological Behaviors (continued)

**Main Idea**

Types of Behaviors

I found this information on page ________.
SE, pp. 916–919
RE, pp. 371–372

**Details**

**Analyze** competitive behaviors by describing the survival benefits of each behavior.

**Competitive Behaviors**

**Behavior:** agonistic behavior  
**Survival benefit:** gains control over resources, such as food or potential mates

**Behavior:** dominance hierarchy  
**Survival benefit:** reduces hostile behaviors within group, which would take time and energy away from survival activities such as finding food

**Behavior:** territorial behavior  
**Survival benefit:** increases chances of obtaining adequate food, mates, and places to rear offspring

**Communication Behaviors**

I found this information on page ________.
SE, p. 920
RE, p. 373

**Contrast** language with communication. Give an example of communication and an example of language.

Accept all reasonable responses. Animals can communicate simple information, such as their location, with sounds, such as chirps, and with odors, such as through pheromones. Language, however, is the use of sounds to communicate complex information. For example, humans can communicate ideas through language.

**Courting and Nurturing Behaviors**

I found this information on page ________.
SE, p. 921
RE, p. 373

**Infer** why a peacock fans and shakes his large, colorful tail in the presence of a pea hen during mating season.

Accept all reasonable responses. Often a female animal chooses to mate with a male that appears relatively larger and healthier than his rivals. Probably the peacock fans his tail to appear large, and the brightness of the colors and vigor of the shaking might attract attention and indicate his state of health.
Cooperative Behaviors

I found this information on page 922.
SE, p. 922
RE, p. 374

Advantages and Disadvantages

I found this information on page 923.
SE, p. 923
RE, p. 374

Analyze why an animal might engage in altruistic behavior, even though the behavior does not promote its own reproductive success.

Accept all reasonable responses. The theory of kin selection holds that altruistic behavior evolves because it increases the number of copies of a gene that is common to a population. As nonreproductive members work to feed and protect the reproductive members of the colony, they ensure that genes similar to their own will pass to future generations.

Organize the costs and benefits for survival and reproductive success of the behaviors listed below. Accept all reasonable responses.

<table>
<thead>
<tr>
<th>Behavior</th>
<th>Benefit</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geese fly south before winter in North America.</td>
<td>increases chances for survival by moving to an area where food and climate conditions are favorable</td>
<td>moving long distances consumes energy and increases chances of predation</td>
</tr>
<tr>
<td>Male lions fight to establish a territory.</td>
<td>promotes survival and reproductive success by controlling an area containing resources, such as food and mates</td>
<td>fights to gain and defend a territory cost energy and can result in injury</td>
</tr>
<tr>
<td>Hawk parents fly many kilometers daily to find food for their young.</td>
<td>offspring have increased chance of survival, ensuring the continuation of the parents’ genes</td>
<td>energy spent in caring for offspring can endanger the parents’ health and safety</td>
</tr>
</tbody>
</table>

CONNECT

You have dominance hierarchies in your life similar to some animals. Although they function differently, some of the benefits are the same. Describe one of these hierarchies and its advantages.

Accept all reasonable responses. There is a dominance hierarchy in my classroom. My teacher is dominant. He or she makes the classroom rules and leads the class in discussions.

This makes the class flow more smoothly and be more organized so we can learn more.
Observe animal behaviors and take notes. Select two behaviors you observe, and analyze them, using the forms below. Conduct further research, as needed, to complete your behavior report thoroughly. Accept all reasonable responses.

<table>
<thead>
<tr>
<th>Animal:</th>
<th>Description of behavior:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Innate or learned?</td>
<td>Type of behavior:</td>
</tr>
<tr>
<td>Description of stimulus:</td>
<td></td>
</tr>
<tr>
<td>Internal or external?</td>
<td></td>
</tr>
<tr>
<td>Advantages of behavior for survival or reproductive success:</td>
<td></td>
</tr>
<tr>
<td>Costs of behavior in terms of survival or reproductive success:</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Animal:</th>
<th>Description of behavior:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Innate or learned?</td>
<td>Type of behavior:</td>
</tr>
<tr>
<td>Description of stimulus:</td>
<td></td>
</tr>
<tr>
<td>Internal or external?</td>
<td></td>
</tr>
<tr>
<td>Advantages of behavior for survival or reproductive success:</td>
<td></td>
</tr>
<tr>
<td>Costs of behavior in terms of survival or reproductive success:</td>
<td></td>
</tr>
</tbody>
</table>
Integumentary, Skeletal, and Muscular Systems

Before You Read

Before you read the chapter, respond to these statements. Accept all reasonable responses.

1. Write an A if you agree with the statement.
2. Write a D if you disagree with the statement.

<table>
<thead>
<tr>
<th>Before You Read</th>
<th>Integumentary, Skeletal, and Muscular Systems</th>
<th>After You Read</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Skin is an organ.</td>
<td></td>
<td>A</td>
</tr>
<tr>
<td>• Use of a tanning bed will not put you at risk for skin cancer.</td>
<td></td>
<td>D</td>
</tr>
<tr>
<td>• All joints of the skeleton allow the bones to move.</td>
<td></td>
<td>D</td>
</tr>
<tr>
<td>• Some muscles in your body are not under your conscious control.</td>
<td></td>
<td>A</td>
</tr>
</tbody>
</table>

Science Journal

Think about a sport you or someone you know plays. Describe how your skin, skeleton, and muscles help you play that sport.

Accept all reasonable responses.

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________
Scan Use the checklist below to preview Section 1 of the chapter.

☐ Read all section titles.
☐ Read all boldfaced words.
☐ Look at all pictures and read the captions.
☐ Think about what you already know about skin.

Write two facts you discovered about skin as you scanned the section.

1. Accept all reasonable responses.
2. ________________________________

Review Vocabulary

Use your book or dictionary to define integument.

integument

an enveloping layer of an organism

New Vocabulary

Write the correct vocabulary term in the left column for each definition below.

melanin

a pigment manufactured by cells in the inner layer of epidermis that protects from ultraviolet radiation

sebaceous gland

structure that produces oil that lubricates skin and hair

keratin

protein found in the outer layers of epidermal cells that waterproofs and protects the cells and tissues underneath

hair follicle

narrow cavity in the dermis from which hair cells grow

epidermis

the outer superficial layer of skin

dermis

the inner, thicker layer of skin

Academic Vocabulary

Define function, then write a sentence to show its scientific meaning.

function

action, purpose

______________________________
The Structure of Skin

I found this information on page ___________.
SE, pp. 936–938
RE, pp. 375–376

Analyze the four types of body tissues in the integumentary system, and give the function of each one.

1. epithelial tissue; covers surfaces of the body
2. connective tissue; provides support and protection
3. muscle tissue; involved in body movement
4. nerve tissue; body’s communication network

Classify each phrase as describing the dermis or epidermis. Write each phrase under the correct skin layer.

- consists of connective tissue
- has inner and outer portions
- contains dead cells that shed
- contains keratin
- contains melanin
- contains muscle fibers, nerve cells, sweat glands, and oil glands
- outer layer of skin
- inner, thicker portion of skin

Main Layers of Skin

<table>
<thead>
<tr>
<th>Dermis</th>
<th>Epidermis</th>
</tr>
</thead>
<tbody>
<tr>
<td>consists of connective tissue; contains muscle fibers, nerve cells, sweat glands, and oil glands; inner, thicker portion of skin</td>
<td>has inner and outer portions; contains dead cells that shed; contains keratin; contains melanin; outer layer of skin</td>
</tr>
</tbody>
</table>

Summarize the diagram of the integumentary system in your book. Accept all reasonable responses. Encourage students to describe how each part looks and the arrangement of the parts around each other.
Section 32.1 The Integumentary System (continued)

**Main Idea**

**Functions of the Integumentary System**

*I found this information on page ________.*

SE, pp. 938–939
RE, pp. 376–377

**Damage to the Skin**

*I found this information on page ________.*

SE, pp. 939–940
RE, p. 377

**Details**

Organize information about the four functions of skin.

<table>
<thead>
<tr>
<th>Functions of Skin</th>
</tr>
</thead>
<tbody>
<tr>
<td>senses pain, pressure, and temperature changes</td>
</tr>
<tr>
<td>produces vitamin D</td>
</tr>
<tr>
<td>protects against microorganisms and ultraviolet rays</td>
</tr>
<tr>
<td>regulates body temperature</td>
</tr>
</tbody>
</table>

Sequence the steps that occur during skin healing.

- A scab forms on the skin to close the wound.
- The skin receives a cut that bleeds.
- White blood cells move in to fight infection.
- Cells beneath the scab multiply and fill the wound.
- Blood flows out of the wound and a clot forms.

**CONNECT**

Your skin changes as you age. Describe some things you can do to protect your skin so that it can better protect your body.

Accept all reasonable responses. I can wear sunscreen when I am out in sunlight or just not stay out in sunlight too long. I can avoid tanning beds. I can also use lotion to help my skin stay moisturized. I can eat a healthy diet and exercise.
Integumentary, Skeletal, and Muscular Systems
Section 32.2 The Skeletal System

Main Idea

Details

Skim Section 2 of the chapter. Write two questions that come to mind from reading the headings and the illustration captions.

1. Accept all reasonable responses.
2. ____________

Review Vocabulary

Use your book or dictionary to define cartilage.

cartilage
tough, flexible connective tissue that forms the skeleton of embryos and later covers the surface of bones that move against each other in joints

New Vocabulary

Use your book or dictionary to define each term.

compact bone
dense and strong outer layer of all bones

osteocyte
living bone cell

spongy bone
less dense bone with cavities containing bone marrow

red bone marrow
substance in bone that produces red and white blood cells and platelets

yellow bone marrow
substance in bone that consists of stored fat

osteoblast
bone-forming cell

ossification
formation of bone from osteoblasts

osteoclast
cell that breaks down bone cells

ligament
tough band of connective tissue that attaches one bone to another
Main Idea

structure of the skeletal system

identify the two main divisions of the human skeleton and the bones each includes.

Axial skeleton
includes
the skull, the vertebral column, the ribs, and the sternum.

appendicular skeleton
includes
the bones of the arms, hands, legs, feet, shoulders, and hips.

create a sketch of a bone. show and label compact bone, spongy bone, and the location of osteons. use the figure in your book to help you.

students should sketch a simple bone showing compact bone, spongy bone, and osteons in the area along the length of compact bone. sketches may resemble those in the book. accept all reasonable responses.

sequence the steps in the repair of fractured bone. the first step has been completed for you. accept all reasonable responses.

1. endorphins flood the area of injury.

2. the injured area swells.

3. blood clot forms between broken ends.

4. cartilage forms at the break.

5. osteoblasts form spongy bone around the fracture.

6. compact bone replaces spongy bone.
Section 32.2 The Skeletal System (continued)

Main Idea

Joints
I found this information on page 944–945
SE, pp. 944–945
RE, pp. 380–381

Function of the Skeletal System
I found this information on page 946
SE, p. 946
RE, p. 381

Details

Classify each bone joint listed below as one or more of the following types:
- gliding
- hinge
- suture
- pivot
- ball-and-socket

knee joint hinge
skull bone joint suture
elbow joint pivot, hinge
shoulder joint ball-and-socket
hip joint ball-and-socket
wrist joint gliding
ankle joint gliding
vertebral joint gliding

Complete the concept map about the skeletal system functions.
Accept all reasonable responses.

Supports the body

Provides a place for muscle attachment

Stores minerals

Protects vital organs

Manufactures blood cells and platelets

Skeletal System Functions

Summarize

Compare yellow bone marrow and red bone marrow.

Red bone marrow is found in the femur, humerus, sternum, ribs, vertebrae, and pelvis. This marrow makes red blood cells, white blood cells, and platelets needed for clotting. Yellow bone marrow does not produce any blood cells. It is stored fat that can be used at times when the body needs it.
Integumentary, Skeletal, and Muscular Systems

Section 32.3  The Muscular System

Main Idea

Skim Section 3 of the chapter. Write two facts you discovered about muscles.

1. Accept all reasonable responses.

2. ____________________________________________________________________________

Details

Review Vocabulary

Use your book or dictionary to define anaerobic.

anaerobic

chemical reactions that do not require the presence of oxygen

New Vocabulary

Use your book or dictionary to define each term.

actin

protein filament that, along with myosin, makes up a myofibril

cardiac muscle

involuntary muscle present only in the heart

involuntary muscle

muscle that cannot be controlled consciously

myofibril

small unit of muscle fiber, made up of myosin and actin

myosin

protein filament that, along with actin, makes up a myofibril

sarcomere

the functional unit of a muscle and the part that contracts

skeletal muscle

muscle attached to bone by tendons and when contracted, causes movement

smooth muscle

involuntary muscle that lines many hollow internal organs

tendon

tough band of connective tissue that connects muscle to bone

voluntary muscle

muscle under conscious control
Identify the three types of muscles. Classify each as voluntary or involuntary.

1. smooth muscle—involuntary
2. cardiac muscle—involuntary
3. skeletal muscle—voluntary

Distinguish between voluntary muscles and involuntary muscles.

Voluntary muscles are muscles you have to think about moving. They contract under conscious control. Involuntary muscles are muscles that contract by themselves. You do not consciously control involuntary muscles.

Model the structure and appearance of each type of muscle. Label the nucleus and striation if the muscle is striated. Next to each muscle, describe its function.

<table>
<thead>
<tr>
<th>Muscle Model</th>
<th>Muscle Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smooth Muscle</td>
<td>for example, moves food through the digestive tract</td>
</tr>
<tr>
<td>Sketches</td>
<td></td>
</tr>
<tr>
<td>Cardiac Muscle</td>
<td>allows heart to contract efficiently and rhythmically</td>
</tr>
<tr>
<td>Skeletal Muscle</td>
<td>contraction causes movement</td>
</tr>
</tbody>
</table>
Skeletal Muscle Contraction

I found this information on page __________.
SE, pp. 948–950
RE, pp. 383–384

Analyze muscle tissue by completing the graphic organizer.

- Skeletal muscle is arranged in fibers made up of sarcomeres containing protein filaments myofibrils.
- Myosin and actin are arranged in sections called sarcomeres.

Summarize the sliding filament theory.
Accept all reasonable responses. When a nerve impulse reaches the muscle to be moved, calcium is released into the myofibrils. Calcium causes myosin and actin to attach to each other, pulling the actin filaments toward the center of the sarcomere. This causes the muscle to shorten or contract. ATP is needed for this step. When the muscle relaxes, the filaments slide back.

Contrast the abilities of slow-twitch and fast-twitch muscles.

<table>
<thead>
<tr>
<th>Slow-twitch</th>
<th>Fast-twitch</th>
</tr>
</thead>
<tbody>
<tr>
<td>contract more slowly than fast-twitch muscles, but have more endurance</td>
<td>fatigue easily, but provide great strength for rapid, short movements</td>
</tr>
</tbody>
</table>

Contract your biceps muscle. Describe what you did to contract the muscle and which muscle is relaxed. Try the opposite and contract the muscle that was relaxed and describe what happens.
Accept all reasonable responses. I contracted my biceps by bending my arm. The triceps was relaxed. Then I contracted my triceps by straightening my arm and the biceps muscle was relaxed.
Nervous System

Before You Read

Use the “What I Know” column to list the things you know about the nervous system. Then list the questions you have about this system in the “What I Want to Find Out” column. Accept all reasonable responses.

<table>
<thead>
<tr>
<th>K</th>
<th>What I Know</th>
<th>W</th>
<th>What I Want to Find Out</th>
<th>L</th>
<th>What I Learned</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

Think about a time you have been frightened. Describe how you felt and how your body responded.

Accept all reasonable responses.

---
Nervous System
Section 33.1 Structure of the Nervous System

Main Idea

Skim Section 1 of the chapter. Focus on the headings, subheadings, boldfaced words, and main ideas. Write two facts you discovered about the structure of the nervous system.

1. Accept all reasonable responses.

2. ____________________________

Details

Review Vocabulary

Use your book or dictionary to define diffusion.

random movement of particles from an area of higher concentration to an area of lower concentration resulting in even distribution

New Vocabulary

Write the correct vocabulary term in the left column for each definition below.

dendrite
region of a neuron that receives impulses from other neurons and conducts them to the cell body

node
gap in the myelin sheath along the length of an axon

action potential
nerve impulse

reflex arc
nerve pathway that consists of a sensory neuron, an interneuron, and a motor neuron; the basic structure of the nervous system

threshold
minimum stimulus to cause an action potential to be produced

cell body
contains the nucleus of a neuron and many of the cell organelles

neurotransmitter
chemical that diffuses across a synapse and binds to receptors on the dendrite of a neighboring cell

axon
region of a neuron that carries the nerve impulse from the cell body to other neurons and muscles

synapse
small gap between the axon of one neuron and the dendrite of another neuron

neuron
specialized cell that helps you gather, interpret, and react to information about your environment
**Neurons**

I found this information on page 962–963.

SE, pp. 962–963
RE, pp. 385–386

**A Nerve Impulse**

I found this information on page 963–967.

SE, pp. 963–967
RE, pp. 386–388

---

**Label** the neuron. Include the axon, axon endings, cell body, dendrites, nucleus, and myelin sheath. Draw arrows to show the direction that impulses move through the neuron.

Arrows should point from the dendrite to the cell body and away from the cell body through the axon.

**Analyze** how the myelin sheath increases the speed at which impulses move.

The myelin sheath keeps the ions from diffusing across the plasma membrane of the axon. This makes the ions move quickly down the axon until they find a gap in the sheath through which they can pass.

This makes the impulses jump from gap to gap so they move faster.

**Evaluate** how neurotransmitters move across synapses. Write one question and answer about the diagram above.

Question: Accept all reasonable responses.

Answer: ________________________________

______________________________
Section 33.1 Structure of the Nervous System (continued)

Main Idea

I found this information on page __________.
SE, pp. 963–967
RE, pp. 386–388

Details

Sequence the steps in how a nerve impulse moves from one neuron to another neuron, by writing the numbers 1 to 5 in the squares to the left of the steps.

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>The neurotransmitter drifts across the synapse and binds to receptors on the dendrite of a neighboring neuron.</td>
</tr>
<tr>
<td>3</td>
<td>An electrical impulse is sent along an axon, jumping from node to node in axons covered with myelin.</td>
</tr>
<tr>
<td>1</td>
<td>The neuron is at rest, with more sodium ions outside the cell and more potassium ions inside the cell.</td>
</tr>
<tr>
<td>4</td>
<td>The impulse reaches the synapse, where channels again open. Vesicles fuse with the plasma membrane and release a neurotransmitter by exocytosis.</td>
</tr>
<tr>
<td>2</td>
<td>The threshold for an action potential is reached at a dendrite, opening channels in the plasma membrane and causing a reversal in electrical charge.</td>
</tr>
</tbody>
</table>

SUMMARIZE

Give an example of an impulse that would be carried by a neuron with myelin and by a neuron without myelin.

Accept all reasonable responses. A sharp pain would be carried by a neuron with myelin.

A dull, throbbing pain would be carried by a neuron without myelin.
Nervous System
Section 33.2 Organization of the Nervous System

Main Idea

Details

Skim Section 2 of the chapter, taking note of headings, illustrations, photos, and captions. Then identify two facts that drew your interest.

Fact 1: Accept all reasonable responses.

Fact 2: __________________________

Review Vocabulary

Use your book or dictionary to define sensory.

sensory
conveying nerve impulses from the sense organs to the nerve centers

New Vocabulary

Classify each term in the left column as being part of the nervous system or part of the brain. Write a brief definition of each term.

<table>
<thead>
<tr>
<th>Part of Nervous System</th>
<th>Part of Brain</th>
</tr>
</thead>
<tbody>
<tr>
<td>autonomic nervous system: part of the peripheral nervous system that carries impulses from the central nervous system to the heart and other organs; involuntary</td>
<td>cerebrum: largest part of the brain, responsible for thought processes involved with learning, memory, language, speech, voluntary body movement, and sensory perception</td>
</tr>
<tr>
<td>cerebrum</td>
<td>hypothalamus: brain structure that regulates body temperature, thirst, appetite, water balance, blood pressure, sleep, aggression, fear, and sexual behavior</td>
</tr>
<tr>
<td>hypothalamus</td>
<td>medulla oblongata: part of the brain stem that helps control breathing rate, heart rate, and blood pressure</td>
</tr>
<tr>
<td>medulla oblongata</td>
<td>pons: part of the brain stem that helps control breathing rate</td>
</tr>
<tr>
<td>parasympathetic nervous system: branch of the autonomic nervous system most active when the body is relaxed</td>
<td>somatic nervous system: part of the peripheral nervous system that relays information from sensory receptors to the central nervous system and from the central nervous system to the skeletal muscles</td>
</tr>
<tr>
<td>pons</td>
<td>sympathetic nervous system: branch of the autonomic nervous system most active in times of emergency and stress</td>
</tr>
<tr>
<td>somatic nervous system</td>
<td>sympathetic nervous system: branch of the autonomic nervous system most active in times of emergency and stress</td>
</tr>
</tbody>
</table>
Identify two body parts that make up the central nervous system.

1. **brain**
2. **spinal cord**

Compare and contrast the central nervous system and the peripheral nervous system.

The central nervous system coordinates all of the body’s activities.

The peripheral nervous system carries messages to and from the central nervous system.

Organize the information about three main sections of the brain in the table below.

<table>
<thead>
<tr>
<th>Description</th>
<th>Cerebrum</th>
<th>Cerebellum</th>
<th>Medulla Oblongata</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description</strong></td>
<td>divided into two halves that are connected by bundles of nerves; halves are called hemispheres</td>
<td>located at the back of the brain</td>
<td>part of the brain stem</td>
</tr>
<tr>
<td><strong>Function</strong></td>
<td>controls all conscious activity, intelligence, memory, language, skeletal muscle, and senses</td>
<td>controls balance, posture, and coordination</td>
<td>controls involuntary activities such as breathing and heart rate</td>
</tr>
</tbody>
</table>
The Peripheral Nervous System

Organize and summarize each division of the nervous system and its function.

- autonomic
- peripheral
- somatic
- sympathetic
- parasympathetic
- central

Nervous System

Central: coordinates all the body's activities

Peripheral: carries messages to and from the CNS

Somatic: voluntary system that relays information between the skin, CNS, and skeletal muscles

Autonomic: involuntary system that carries impulses from the CNS to internal organs

Sympathetic: controls internal functions during times of stress

Parasympathetic: controls body's internal functions when the body is at rest

Summarize

Compare and contrast a voluntary response of the somatic nervous system and a reflex.

Accept all reasonable responses. A voluntary response would be deciding to take a drink of hot cocoa. I would voluntarily control the muscles that moved my hand and arm to grasp and lift the cup and bring it to my mouth. If the cup of hot cocoa were too hot to grasp, I would pull my hand away as a reflex. It would happen without my brain even thinking about it.
Skim Section 3 of the chapter. Write two questions that come to mind from reading the headings and illustration captions.

1. Accept all reasonable responses.

2. ____________________________

### New Vocabulary

Use your book or dictionary to define each term.

- **cochlea**: snail-shaped structure in the inner ear containing fluid and hairs; produces electrical impulses that the brain interprets as sound
- **lens**: structure of the eye that inverts an image, focuses it, and projects it onto the retina
- **retina**: thin layer of tissue found at the back of the eye made up of light receptors and sensory neurons
- **rod**: receptor cell in the retina that is adapted for vision in dim light; also helps detect shape and movement
- **semicircular canal**: structure in the inner ear containing fluid and hairs that help the body maintain balance
- **taste bud**: sensory receptor located on the tongue; involved in taste perception

### Academic Vocabulary

Define interpret to show its scientific meaning.

- **interpret**: to explain or tell the meaning of
Main Idea

**Taste and Smell**

I found this information on page ____.

SE, p. 973
RE, p. 392

---

**Details**

**Identify** the sensory receptors in the mouth and nasal cavity.

<table>
<thead>
<tr>
<th>Sensory receptors</th>
<th>smell</th>
<th>taste</th>
</tr>
</thead>
</table>

**Compare** the steps in smelling and tasting. Write the steps for smelling on the left. Write the steps for tasting on the right. Some steps have been completed for you.

1. Chemical molecules touch receptors in your nose.
2. Chemicals acting on the receptors initiate impulses in the olfactory nerve.
3. The olfactory nerve sends the impulses to the brain.
4. Your brain interprets the signal as a particular taste or odor.
5. Chemicals dissolved in saliva contact your taste buds.
6. The cells of taste buds are depolarized.
7. Signals from your taste buds are sent to the cerebrum.

---

**Sight**

I found this information on page ____.

SE, p. 974
RE, p. 392–393

---

**Sight**

I found this information on page ____.

SE, p. 974
RE, p. 392–393

---

**Compare** how rods and cones in your eyes help you to sense light.

<table>
<thead>
<tr>
<th>Rods</th>
<th>Both</th>
<th>Cones</th>
</tr>
</thead>
<tbody>
<tr>
<td>• adapted for vision in dim light</td>
<td>• receptor cells in the eye</td>
<td>• adapted for sharp vision in bright light</td>
</tr>
<tr>
<td>• help you detect shape and movement</td>
<td></td>
<td>• help you detect color</td>
</tr>
</tbody>
</table>
Sequence the steps in how your sense of hearing works, by writing the numbers 1 to 5 in the squares to the left of the steps.

1. Sound waves enter your ear and travel down to the end of the ear canal.
2. Sound waves strike the eardrum and cause it to vibrate. The vibrations pass to the bones in the middle ear.
3. The stapes causes the membrane of the oval window to move back and forth.
4. Fluid in the cochlea moves, causing the hair cells to bend.
5. The hairs produce electric impulses that travel to the cerebrum, where they are interpreted as sound.

Identify three stimuli to which receptors in the dermis of the skin respond.
1. temperature
2. pressure
3. pain

Predict how damage to the semicircular canals in the ears would affect balance. Support your reasoning.

Accept all reasonable responses. If the semicircular canals were damaged, you would not be able to balance as well. The hairs in the semicircular canals are responsible for telling the brain if you are balanced.
Scan Section 3 of the chapter and identify two legal and two illegal drugs. Accept all reasonable responses.

<table>
<thead>
<tr>
<th>Legal Drugs</th>
<th>Illegal Drugs</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>1.</td>
</tr>
<tr>
<td>2.</td>
<td>2.</td>
</tr>
</tbody>
</table>

**Review Vocabulary**

Use your book or dictionary to define threshold.

threshold

the certain strength of a stimulus that causes an action potential to be generated

**New Vocabulary**

Use your book or dictionary to define the following terms.

**addiction**

psychological and/or physiological drug dependence

**depressant**

type of drug that lowers or depresses the activity of the nervous system

**dopamine**

neurotransmitter found in the brain that is involved with the control of body movement and feelings of pleasure or reward

**drug**

chemical substance that affects body function

**stimulant**

drug that increases the activity of the central and sympathetic nervous systems

**tolerance**

the body becomes less responsive to a drug and an individual needs larger or more frequent doses of the drug to achieve the same effect
Section 33.4 Effects of Drugs (continued)

Main Idea

How Drugs Work
I found this information on page 977–978.
SE, pp. 977–978
RE, p. 395

Classes of Commonly Abused Drugs
I found this information on page 978–980.
SE, pp. 978–980
RE, pp. 396–398

Details

Summarize four ways drugs can act on the body.

Ways Drugs Act on the Body

- increase the amount of neurotransmitter that is released into a synapse
- imitate a neurotransmitter
- prevent a neurotransmitter from binding
- prevent a neurotransmitter from leaving a synapse

Compare the three main classes of commonly abused drugs. Identify each class, how it works in the body, and common examples.

CLASSES OF COMMONLY ABUSED DRUGS

- STIMULANTS
  - HOW THEY WORK: increase alertness and physical activity
  - EXAMPLES: nicotine, caffeine

- DEPRESSANTS
  - HOW THEY WORK: slow down the central nervous system
  - EXAMPLES: alcohol, inhalants

- ILLEGAL DRUGS
  - HOW THEY WORK: prevent dopamine reabsorption; bind to pleasure receptors
  - EXAMPLES: cocaine, marijuana
Section 33.4 Effects of Drugs (continued)

**Main Idea**

I found this information on page 978–980.

**Details**

**Analyze** the short-term and long-term risks of smoking marijuana.

Short-term risks: problems with memory and learning, loss of coordination, increased heart rate, anxiety, paranoia, panic attacks

Long-term risks: lung cancer, emphysema

**Tolerance and Addiction**

I found this information on page 981.

**Identify** the following scenarios as tolerance, physiological dependence, or psychological dependence.

- **psychological dependence**
  “I just can’t go to that party without having some alcohol. I need it to feel like I fit in.”

- **tolerance**
  “I used to take two painkillers a day, but lately I have to take three or four pills to get the same effect as before.”

- **physiological dependence**
  “When I try to go for a day without my caffeine, I get a terrible headache and nausea.”

**CONNECT**

Analyze why some stimulants are illegal and others are not.

Accept all reasonable responses. Stimulants like amphetamines have a much greater effect on the nervous system than stimulants like caffeine. For example, amphetamines cause irregular heartbeat, chest pain, and paranoia. Caffeine causes increased alertness and mood swings. Its adverse effects are much less severe than amphetamines.
Tie It Together

You have read about the structures and functions of the human nervous system, as well as the effects of drugs on it. Create a mini poster that informs readers of the importance of the nervous system to the body's health.

Accept all reasonable responses.
Circulatory, Respiratory, and Excretory Systems

Before You Read

*Before you read the chapter, respond to these statements. Accept all reasonable responses.*

1. Write an A if you agree with the statement.
2. Write a D if you disagree with the statement.

<table>
<thead>
<tr>
<th>Before You Read</th>
<th>Circulatory, Respiratory, and Excretory Systems</th>
<th>After You Read</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Your pulse rate is the number of times your heart beats each minute.</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td>• If you need a blood transfusion, the donated blood must be the same type as yours.</td>
<td>D</td>
</tr>
<tr>
<td></td>
<td>• Breathing and respiration are two names for the same process.</td>
<td>D</td>
</tr>
<tr>
<td></td>
<td>• The components of the excretory system are the lungs, skin, and kidneys.</td>
<td>A</td>
</tr>
</tbody>
</table>

Science Journal

When you breathe in, oxygen enters your lungs. Describe what you understand about how oxygen from the air reaches the cells in your body.

Accept all reasonable responses.
Scan Section 1 of the chapter. Identify and list the functions of blood.
Accept all reasonable responses.
- carrying oxygen and nutrients to cells
- removing cellular wastes
- carrying disease-fighting materials
- transporting chemical messengers
- forming clots
- regulating body temperature

Use your book or dictionary to define muscle contraction.

muscle contraction

muscle cells or fibers shorten in response to stimuli

Use the new vocabulary terms to complete the paragraph below.

Large blood vessels called _____ arteries ____ carry oxygenated blood away from the heart. The blood flows into microscopic ____ capillaries ____, where the blood exchanges oxygen and wastes with body cells. Then _____veins____ carry deoxygenated blood back to the heart. In these large vessels, flaps of tissue called ____ valves ____ prevent blood from flowing backward. The hollow, muscular _____ heart ___ pumps blood throughout the body. A ____ pacemaker ____ in the right atrium sends out signals that tell the heart muscle to contract. Over half of blood is made up of a clear, yellowish fluid called ____ plasma ____. The function of ____ red blood cells ____ is to carry oxygen to all body cells. The ____ white blood cells ____ are the body’s disease fighters. Cell fragments called ____ platelets ____ help to form blood clots at a wound site. Blood clots, fat deposits, or other materials can block the flow of blood through the arteries, resulting in a condition called ____ atherosclerosis ____. 
Functions of the Circulatory System

I found this information on page 992.

SE, p. 992
 RE, p. 399

Blood Vessels and The Heart

I found this information on page 993–996.

SE, pp. 993–996
 RE, pp. 399–403

Main Idea

Analyze how the circulatory system functions as the body’s transport system.

Accept all reasonable responses. The main job of the circulatory system is to carry oxygen and nutrients to the cells and remove waste products from the cells. In addition, the circulatory system transports disease-fighting materials and blood-clotting fragments and distributes heat through the body.

Details

Sequence the path blood takes through the human body by completing the flowchart below.

Enters

veins

venule

capillaries

veins

venule

capillaries

vena cavae

right atrium

right ventricle

pulmonary artery

lungs

left atrium

left ventricle

arterioles

arteries

tissue

aorta

Circulatory, Respiratory, and Excretory Systems 347
Section 34.1 Circulatory System (continued)

**Blood Components**

*I found this information on page* ____________  
SE, pp. 997–998  
RE, p. 403

**Identify** the components of blood, and list the characteristics of each.

<table>
<thead>
<tr>
<th>Blood Component</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>White blood cells</td>
<td>surround and kill invaders</td>
</tr>
<tr>
<td>Red blood cells</td>
<td>mostly made up of the protein hemoglobin; resemble pinched-in discs with no nuclei</td>
</tr>
<tr>
<td>Plasma</td>
<td>carries most of the carbon dioxide waste; transports glucose, fats, and chemical messengers</td>
</tr>
<tr>
<td>Platelets</td>
<td>releases chemicals that produce the protein fibrin</td>
</tr>
</tbody>
</table>

**Blood Types**

*I found this information on page* ____________  
SE, pp. 998–999  
RE, p. 404

**Distinguish** between blood type, by putting checks in the boxes to show which marker molecules and antibodies it contains.

<table>
<thead>
<tr>
<th>Blood Type</th>
<th>Marker A</th>
<th>Marker B</th>
<th>Anti-A Antibody</th>
<th>Anti-B Antibody</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>√</td>
<td></td>
<td></td>
<td>√</td>
</tr>
<tr>
<td>B</td>
<td></td>
<td>√</td>
<td></td>
<td>√</td>
</tr>
<tr>
<td>AB</td>
<td>√</td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>O</td>
<td>√</td>
<td>√</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Circulatory System Disorders**

*I found this information on page* ____________  
SE, p. 999  
RE, p. 404

**Compare** heart attacks to strokes.

<table>
<thead>
<tr>
<th></th>
<th>Heart Attack</th>
<th>Stroke</th>
</tr>
</thead>
<tbody>
<tr>
<td>Causes</td>
<td>blood does not reach heart muscle</td>
<td>blood clots in vessels supplying oxygen to brain</td>
</tr>
<tr>
<td>Effects</td>
<td>damage to heart or death</td>
<td>ruptured blood vessels; internal bleeding; parts of brain die</td>
</tr>
</tbody>
</table>

**SUMMARIZE**

Create an analogy that explains the one way flow of blood through the circulatory system.

Accept all reasonable responses. Students might suggest a racetrack analogy with the heart and lungs functioning as pitstops.
**Main Idea**

**Details**

*Skim* Section 2 of the chapter. Read the headings and illustration captions. Write three questions that come to mind.

1. Accept all reasonable responses.

2. 

3. 

*Review Vocabulary*

*New Vocabulary*

Use your book or dictionary to define each term.

**ATP**

*biological molecule that provides the body’s cells with chemical energy*

**alveolus**

*individual air sac at the end of a bronchiole where oxygen and carbon dioxide exchange occurs*

**breathing**

*mechanical movement of air in and out of the lungs*

**bronchus**

*large tube that branches from the trachea and leads to the lungs*

**external respiration**

*exchange of gases between the atmosphere and the blood*

**internal respiration**

*exchange of gases between the blood and the body’s cells*

**lung**

*largest organ in the respiratory system and the location of gas exchange*

**trachea**

*long tube in the chest cavity; also called the windpipe*
The Importance of Respiration

I found this information on page _______

SE, p. 1000
RE, p. 405

The Path of Air

I found this information on page _______

SE, p. 1001
RE, p. 406

Contrast breathing and respiration.

Accept all reasonable responses. Breathing is a mechanical process of moving air in and out of the lungs and helps external respiration to occur. Respiration is an exchange of gases, which occurs with both external respiration and internal respiration.

Identify three structures that filter air as it enters through the nose on its way to the lungs.

1. hairs in the nose
2. cilia that line the nasal passages and other respiratory tubes
3. mucous membranes beneath the cilia in the nasal passages

Sequence the process of gas exchange by completing the sentences in the flow chart below.

Air enters the lungs from the atmosphere through the process of breathing.

Oxygen diffuses into capillaries through the alveoli and then into red blood cells.

The blood transports the carbon dioxide waste to the lungs to be returned to the atmosphere.

Meanwhile, carbon dioxide moves in the opposite direction, crossing capillary walls and diffusing into the alveoli.

The blood carries the oxygen for release to the body’s tissue cells.
Section 34.2 Respiratory System (continued)

**Main Idea**

Breathing

*I found this information on page ___.*

SE, pp. 1002–1003

RE, p. 407

**Details**

Model the lungs during inhalation and exhalation. Label and describe the position of the diaphragm during each process.

<table>
<thead>
<tr>
<th>Inhalation</th>
<th>Exhalation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diagrams may resemble Figure 34.13 in the text. Accept all reasonable responses. Labels should clearly indicate that the diaphragm contracts during inhalation and relaxes during exhalation.</td>
<td></td>
</tr>
</tbody>
</table>

**Respiratory Disorders**

*I found this information on page ___.*

SE, p. 1004

RE, p. 407

Summarize each of the following common respiratory disorders.

<table>
<thead>
<tr>
<th>Respiratory Disorder</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pneumonia</td>
<td>lung infection causing mucus buildup in alveoli</td>
</tr>
<tr>
<td>Emphysema</td>
<td>breakdown of alveoli</td>
</tr>
<tr>
<td>Lung cancer</td>
<td>uncontrolled cell growth in lung tissue</td>
</tr>
<tr>
<td>Asthma</td>
<td>constriction of bronchioles</td>
</tr>
<tr>
<td>Bronchitis</td>
<td>infection of respiratory pathways</td>
</tr>
<tr>
<td>Pulmonary tuberculosis</td>
<td>infection of lungs by a specific bacterium</td>
</tr>
</tbody>
</table>

**SUMMARIZE**

Discuss the importance of respiration to the body.

Accept all reasonable responses. Respiration allows the body’s cells to receive oxygen and get rid of carbon dioxide.
Circulatory, Respiratory, and Excretory Systems

Section 34.3 Excretory System

Scan Section 3 of the chapter. Use the checklist as a guide.

- Read all section titles.
- Read all boldfaced words.
- Read all tables, figures, and graphs.
- Look at all pictures and read the captions.
- Think about what you already know about the excretory system.

Write three facts you discovered as you scanned the section.

1. Accept all reasonable responses.
2. ______________________________________________________________________
3. ______________________________________________________________________

Use your book or dictionary to define pH.

pH: measure of acidity and alkalinity of a solution

Use your book or dictionary to define each term.

- kidney: bean-shaped organ that filters out wastes, water, and salts from the blood
- urea: nitrogenous waste product that is a component of urine

Define inhibit to show its scientific meaning.

inhibit: to hold back, restrain, or block the action or function of something
Main Idea

Parts of the Excretory System

I found this information on page

SE, p. 1005
RE, p. 408

Details

Describe three functions of the excretory system that help maintain homeostasis of the body.

1. removes metabolic wastes from the body
2. regulates the amount of fluid and salts in the body
3. maintains the pH of the blood

Identify the main waste products secreted by the following components of the excretory system.

lungs: carbon dioxide

skin: water and salts

Model the structure of a kidney, including a diagram of a nephron. Label each major component.

Drawings should resemble the figure on SE p. 1006. Accept all reasonable responses. Labels should include the glomerulus, Bowman's capsule, renal vein, renal artery, and collecting tubule.
Kidney Disorders
I found this information on page ____________.
SE, p. 1008
RE, p. 410

Kidney Treatments
I found this information on page ____________.
SE, p. 1009
RE, p. 410

Summarize information about kidney disorders in the table below.

<table>
<thead>
<tr>
<th>Disorder</th>
<th>Symptoms</th>
<th>Common Causes</th>
<th>Treatments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kidney infection</td>
<td>fever, chills, and mid- to low-back pain</td>
<td>bladder infection that spreads; obstructions in kidney</td>
<td>antibiotics</td>
</tr>
<tr>
<td>Nephritis</td>
<td>blood in urine; swelling of body tissues; protein in urine</td>
<td>large particles in bloodstream lodge in glomeruli, causing inflammation</td>
<td>special diet; prescription drugs</td>
</tr>
<tr>
<td>Kidney stones</td>
<td>pain</td>
<td>crystallized solids, such as calcium, form in kidney</td>
<td>ultrasonic sound waves; surgery</td>
</tr>
</tbody>
</table>

Contrast the two types of dialysis by explaining how they differ in the following areas.

Filtering device: One method uses a machine to filter, and the other uses the membrane lining of the patient’s abdomen.

Frequency and duration of treatment: The machine method requires three sessions of three to four hours each week. The other method requires 30 to 40 minutes daily.

Summarize
Analyze the path wastes take from the kidney out of the body by making a list of the order of the structures through which wastes flow.

1. kidneys
2. renal artery
3. glomerulus
4. Bowman’s capsule
5. renal tubule
6. urethra
7. urinary bladder
8. ureter
# Digestive and Endocrine Systems

## Before You Read

Use the “What I Know” column to list the things you know about the digestive and endocrine systems. Then list the questions you have about these systems in the “What I Want to Find Out” column. Accept all reasonable responses.

<table>
<thead>
<tr>
<th>K</th>
<th>What I Know</th>
<th>W</th>
<th>What I Want to Find Out</th>
<th>L</th>
<th>What I Learned</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## Science Journal

What can go wrong with your digestive and endocrine systems? Describe your own experience, that of someone you know, or items you have heard about in the media.

Accept all reasonable responses.

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Digestive and Endocrine Systems

Section 35.1 The Digestive System

**Main Idea**

**Details**

*Skim Section 1 of the chapter. Write two questions that come to mind from reading the headings and the illustration captions.*

1. Accept all reasonable responses.
2. ____________________________

**Review Vocabulary**

*Use your book or dictionary to define nutrients.*

**New Vocabulary**

*Write the correct vocabulary term in the left column for each definition below.*

**Vocabulary**

- **mechanical digestion**
  - process that breaks food into smaller pieces by chewing and by the churning action of smooth muscles in the stomach and small intestine

- **small intestine**
  - longest part of the digestive tract, which connects the stomach and the large intestine and where digestion is completed

- **esophagus**
  - muscular tube that connects the pharynx to the stomach

- **amylase**
  - enzyme found in saliva that begins chemical digestion by breaking down starches into sugars

- **villi**
  - fingerlike structures in the small intestine through which chemical digestion is completed and most nutrients from food are absorbed

- **pepsin**
  - enzyme in the stomach that helps digest proteins

- **liver**
  - largest internal organ of the body; produces bile, which helps to break down fats

- **chemical digestion**
  - action of digestive enzymes in breaking down large molecules of food into smaller molecules that can be absorbed by cells

- **peristalsis**
  - rhythmic contraction of smooth muscles that moves food through the digestive tract

- **large intestine**
  - end portion of the digestive tract, which includes the colon, rectum, and appendix
Functions of the Digestive System

Label the parts of the digestive system in the figure below.

Summarize how each organ below mechanically and chemically digests food.

<table>
<thead>
<tr>
<th>Organ</th>
<th>Mechanical Digestion</th>
<th>Chemical Digestion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mouth</td>
<td>chewing breaks food into smaller pieces</td>
<td>amylase breaks down starches into sugars</td>
</tr>
<tr>
<td>Stomach</td>
<td>churning of the smooth muscles breaks food into smaller pieces</td>
<td>gastric glands secrete acid that aids the action of pepsin, which breaks down proteins</td>
</tr>
<tr>
<td>Small intestine</td>
<td>smooth muscle contractions continue to break food into smaller pieces</td>
<td>concludes chemical digestion with help of pancreas, liver, and gallbladder</td>
</tr>
<tr>
<td>Pancreas</td>
<td>does not apply</td>
<td>produces enzymes that digest carbohydrates, proteins, and fats; secretes alkaline fluid that aids enzyme action</td>
</tr>
<tr>
<td>Liver</td>
<td>does not apply</td>
<td>produces bile, which helps break down fats</td>
</tr>
</tbody>
</table>
Section 35.1 The Digestive System (continued)

I found this information on page 1020–1024. SE, pp. 1020–1024 RE, pp. 411–413

Sequence the path of food through the digestive tract by placing the terms from the following list in the proper order on the flowchart.

mouth → rectum → small intestine
   ↓                          ↓
esophagus → stomach → small intestine
   ↓                          ↓
anus → rectum → colon

Analyze why a sandwich would progress through your digestive tract, even if you ate it while standing on your head.

Accept all reasonable responses. Peristalsis, or the rhythmic contraction of smooth muscles that line the digestive tract, moves food through the system. Gravity is not required.

Contrast the digestive functions of the small intestine with those of the large intestine. Accept all reasonable responses.

<table>
<thead>
<tr>
<th>Small Intestine</th>
<th>Large Intestine</th>
</tr>
</thead>
<tbody>
<tr>
<td>• digestion completed</td>
<td>• eliminating indigestible wastes</td>
</tr>
<tr>
<td>• most nutrients absorbed</td>
<td>• colon absorbs water from chyme</td>
</tr>
<tr>
<td></td>
<td>• converts it to feces for passage through the rectum</td>
</tr>
<tr>
<td></td>
<td>• elimination from the anus</td>
</tr>
</tbody>
</table>

Describe how your body’s ability to benefit from food would change if your small intestine did not have villi. Explain why.

Accept all reasonable responses. Without villi, the body would obtain less benefit from the food ingested. Without villi, a person would have to consume more food because digestion would be less efficient.
Digestive and Endocrine Systems
Section 35.2 Nutrition

Scan Section 2 of the chapter. Use the checklist as a guide.

☐ Read all section titles.
☐ Read all boldfaced words.
☐ Read all tables, figures, and graphs.
☐ Look at all pictures and read the captions.
☐ Think about what you already know about nutrition.

Write three facts you discovered as you scanned the section.

1. Accept all reasonable responses.
2. 
3. 

Review Vocabulary

Use your book or dictionary to define amino acids.

amino acids

basic building blocks of proteins

New Vocabulary

Use your book or dictionary to define each term.

Calorie

unit used to measure the energy content of foods

mineral

inorganic compound that is used by the body as building material

and is involved with metabolic functions

nutrition

process by which a person takes in and uses food

vitamin

organic compound that is needed in small amounts for metabolic activities
**Main Idea**

**Carbohydrates**  
and **Fats**  
and **Proteins**

**Details**

**Evaluate** Assume that playing soccer requires 540 Calories per hour. On a particular day, you ate 2,000 Calories in food. You played soccer for 2.5 hours. Your body used 800 Calories in other activities. Did you use more energy than you consumed on this day? Show your work.

Yes; you used 800 + (540 X 2.5 hours) = 2,150 Calories. You took in 2,000 Calories. You took in 150 fewer Calories than you used.

**Summarize** information about carbohydrates, fats, and proteins by completing the table below.

<table>
<thead>
<tr>
<th>Carbohydrates</th>
<th>Break Down Into</th>
<th>Importance to the Body</th>
</tr>
</thead>
<tbody>
<tr>
<td>simple sugars</td>
<td>provide energy for cells; cellulose helps food move through digestive tract</td>
<td></td>
</tr>
<tr>
<td>Fats</td>
<td>fatty acids and glycerol</td>
<td>provide energy; building blocks for body; protect some internal organs; store and transport some vitamins</td>
</tr>
<tr>
<td>Proteins</td>
<td>amino acids</td>
<td>cells assemble amino acids into proteins needed for body structures and functions</td>
</tr>
</tbody>
</table>

**Classify** all the foods you ate yesterday in the appropriate food groups. Accept all reasonable responses.

<table>
<thead>
<tr>
<th>Grains</th>
<th>Fruits</th>
<th>Milk</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Main Idea

Vitamins and Minerals and Nutrition Labels

Typically men need more Calories per day than women, and teenagers need more Calories than adults. Analyze why Calorie needs differ between these groups.

Accept all reasonable responses. Usually men are larger and have higher metabolic rates than women and would need more Calories to support their body mass and higher metabolic rate.

Teenagers are still growing and need more Calories to support their growth. Also, teenagers tend to be more physically active than adults, and physical activity uses Calories.

Details

Examine the food label below, and complete the table below assuming you ate the contents of the entire container.

<table>
<thead>
<tr>
<th>NUTRITION FACTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serving Size: 1 cup (237 g)</td>
</tr>
<tr>
<td>Servings Per Container: 2</td>
</tr>
<tr>
<td>Amount Per Serving</td>
</tr>
<tr>
<td>Calories 100</td>
</tr>
<tr>
<td>Calories from Fat 20</td>
</tr>
<tr>
<td>% Daily Value</td>
</tr>
<tr>
<td>Total Fat 2 g</td>
</tr>
<tr>
<td>Saturated Fat 0.5 g</td>
</tr>
<tr>
<td>Cholesterol 20 mg</td>
</tr>
<tr>
<td>Sodium 960 mg</td>
</tr>
<tr>
<td>Total Carbohydrate 13 g</td>
</tr>
<tr>
<td>Dietary Fiber 1 g</td>
</tr>
<tr>
<td>Sugars 1 g</td>
</tr>
<tr>
<td>Protein 9 g</td>
</tr>
<tr>
<td>Vitamin A 30%</td>
</tr>
<tr>
<td>Calcium 2%</td>
</tr>
<tr>
<td>Iron 4%</td>
</tr>
<tr>
<td>Vitamin C 0%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Calories Consumed</th>
<th>Grams of Saturated Fat</th>
<th>Grams of Protein</th>
<th>Percent of Daily Value of Calcium</th>
</tr>
</thead>
<tbody>
<tr>
<td>200</td>
<td>1 g</td>
<td>18 g</td>
<td>4%</td>
</tr>
</tbody>
</table>

SUMMARIZE

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Digestive and Endocrine Systems
Section 35.3 The Endocrine System

Main Idea

Scan the titles, boldfaced words, figures, and captions in Section 3. Write two facts you discovered as you scanned the section.

1. Accept all reasonable responses.
2. ____________________________________________________________________________

Details

Review Vocabulary

Use your book or dictionary to define homeostasis.

homeostasis
regulation of an organism’s internal environment to maintain life

New Vocabulary

Write the correct term in the left column for each definition below.

- hormone
- thyroxine
- endocrine gland
- calcitonin
- parathyroid hormone
- aldosterone
- cortisol
- pituitary gland
- glucagon
- insulin
- antidiuretic hormone

acts on target cells and tissues to produce a specific response
hormone that causes cells to have a higher rate of metabolism
any gland that produces hormones, which are released into the bloodstream and distributed to body cells
thyroid hormone that is partly responsible for the regulation of calcium, blood clotting, nerve function, and muscle contraction
increases blood calcium by stimulating the bones to release calcium
steroid hormone secreted by the adrenal glands that primarily affects the kidneys and is important for reabsorbing sodium
steroid hormone secreted by the adrenal glands that raises blood glucose levels and also reduces inflammation
secretes hormones that regulate many body functions as well as other endocrine glands
pancreatic hormone that signals liver cells to convert glycogen to glucose and release the glucose into the blood
pancreatic hormone that signals liver and muscle cells to accelerate the conversion of glucose to glycogen, which is stored in the liver
hormone produced by the hypothalamus, regulates water balance
Section 35.3 The Endocrine System (continued)

Main Idea

Action of Hormones

I found this information on page 1031–1032.
SE, pp. 1031–1032
RE, p. 417

Contrast the action of steroid hormones and amino acid hormones.
Accept all reasonable responses.

<table>
<thead>
<tr>
<th>Steroid Hormones</th>
<th>Amino Acid Hormones</th>
</tr>
</thead>
<tbody>
<tr>
<td>cause target cells to initiate protein synthesis; soluble in lipids so can diffuse through plasma membrane of target cell; bind with receptors in cytoplasm; move together into nucleus; bind with DNA, activating specific genes</td>
<td>cannot diffuse through plasma membrane, so bind with receptors on membrane of target cell; receptors activate enzyme inside, which initiates a biochemical pathway, resulting in desired response</td>
</tr>
</tbody>
</table>

Negative Feedback

I found this information on page 1032.
SE, p. 1032
RE, p. 418

Sequence the steps in a portion of the negative feedback system. Steps in the regulation of calcium are written in scrambled order at right. Write the steps in the correct order in the boxes.

Blood calcium drops too low.

Parathyroid glands detect calcium deficiency.

Parathyroid glands release more parathyroid hormone.

Bones release more calcium.

Kidneys excrete less calcium.

Parathyroid glands detect calcium deficiency.

Bones release more calcium.

Blood calcium drops too low.

Parathyroid glands release more parathyroid hormone.

Bones release more calcium.

Endocrine Glands and Their Hormones

I found this information on page 1032–1035.
SE, pp. 1032–1035
RE, pp. 418–419

Explain how the endocrine system functions as a communication system.

<table>
<thead>
<tr>
<th>Serves as messengers</th>
<th>hormones</th>
</tr>
</thead>
<tbody>
<tr>
<td>Produces messengers</td>
<td>endocrine glands</td>
</tr>
<tr>
<td>Receives the messages</td>
<td>target cells and tissues</td>
</tr>
</tbody>
</table>
Section 35.3 The Endocrine System (continued)

**Main Idea**

Links to the Endocrine/Nervous System

I found this information on page ________.

SE, p. 1037
RE, p. 420

**Details**

Compare the hormone functions of the glands listed below.

<table>
<thead>
<tr>
<th>Gland/Location</th>
<th>Hormones Produced</th>
<th>Body Functions Regulated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pituitary: base of brain</td>
<td>human growth hormone (hGH), among others</td>
<td>hGH regulates physical growth; others regulate many body functions and other endocrine glands</td>
</tr>
<tr>
<td>Thyroid: throat</td>
<td>thyroxine</td>
<td>causes cells to have a higher metabolic rate</td>
</tr>
<tr>
<td></td>
<td>calcitonin</td>
<td>calcium levels in blood, blood clotting, nerve function, muscle contraction</td>
</tr>
<tr>
<td>Parathyroid: throat</td>
<td>parathyroid hormone</td>
<td>calcium levels</td>
</tr>
<tr>
<td>Pancreas: below stomach</td>
<td>insulin</td>
<td>lowers blood glucose levels</td>
</tr>
<tr>
<td></td>
<td>glucagon</td>
<td>raises blood glucose levels</td>
</tr>
<tr>
<td>Adrenal: just above kidneys</td>
<td>aldosterone</td>
<td>reabsorption of sodium</td>
</tr>
<tr>
<td></td>
<td>cortisol</td>
<td>raises blood glucose and reduces inflammation</td>
</tr>
</tbody>
</table>

Identify the key link in the diagram below.

Nervous System → hypothalamus → Endocrine System

**Summarize**

Create a concept map showing two pairs of hormones that work together and the effect of their cooperation on homeostasis. Accept all reasonable responses.

- parathyroid hormone → calcitonin → blood calcium balance
- blood glucose balance → insulin → glucagon
Human Reproduction and Development

Before You Read

Use the “What I Know” column to list the things you know about reproduction and development. Then list the questions you have about these topics in the “What I Want to Find Out” column. Accept all reasonable responses.

<table>
<thead>
<tr>
<th>K</th>
<th>What I Know</th>
<th>W</th>
<th>What I Want to Find Out</th>
<th>L</th>
<th>What I Learned</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Science Journal

As you have grown and developed since birth, you have gone through many changes. Write about some of the physical changes you have experienced since you were born.

Accept all reasonable responses.
Main Idea

Skim Section 1 of the chapter. Read the headings and illustration captions. Write three questions that come to mind.

1. Accept all reasonable responses.
2. _____________________________
3. _____________________________

Review Vocabulary

Use your book or dictionary to define hypothalamus.

hypothalamus: portion of the brain that connects the endocrine and nervous systems and which controls the pituitary gland.

New Vocabulary

Classify each vocabulary term. Give a brief description of each. One term fits in both categories.

<table>
<thead>
<tr>
<th>Male Reproductive System</th>
<th>Female Reproductive System</th>
</tr>
</thead>
<tbody>
<tr>
<td>epididymis: single coiled tube where sperm mature</td>
<td>menstrual cycle: changes in the female reproductive cycle each month</td>
</tr>
<tr>
<td>puberty: time when secondary sex characteristics develop</td>
<td>oocyte: immature egg that develops into an ovum</td>
</tr>
<tr>
<td>semen: combination of sperm and fluids</td>
<td>oviduct: tube that carries an egg from ovary to uterus</td>
</tr>
<tr>
<td>seminiferous tubule: tubule in each testis in which sperm develops</td>
<td>polar body: is formed at the first and second meiotic divisions</td>
</tr>
<tr>
<td>urethra: tube that carries both semen and urine out of the body through the penis</td>
<td>puberty: time when secondary sex characteristics develop</td>
</tr>
<tr>
<td>vas deferens: duct that carries sperm from the epididymis toward the ducts that will force the sperm out of the body</td>
<td></td>
</tr>
</tbody>
</table>

366  Human Reproduction and Development
Section 36.1 Reproductive Systems (continued)

**Main Idea**

**Human Male Reproductive System**

I found this information on page __________.

SE, pp. 1048–1049
RE, pp. 421–422

**Details**

Model the structures of the male reproductive system below. Label the testes, epididymus, vas deferens, and urethra. Describe the function of each.

Sketches should resemble SE p. 1048
- testes—where sperm are produced; epididymus—tube where sperm mature; vas deferens—duct that carries sperm toward the ducts that will push them out of the body; urethra—carries sperm out of body

Create a diagram to show how the negative feedback system works to control FSH and LH in the male body.

Accept all reasonable diagrams that show that as the levels of testosterone in the blood increase, the body decreases the production of FSH and LH. Increased sperm production also decreases the production of these. When the levels of testosterone drop, the body increases production of FSH and LH.

Identify the three main functions of the female reproductive system.

- to produce eggs, to receive sperm, and to provide an environment in which a fertilized egg can develop

Model the structures of the human female reproductive system below. Label the oviduct, cervix, ovary, and uterus. Describe the function of each.

Sketches should resemble SE p. 1050.
- ovary—produces eggs; oviduct—moves eggs to the uterus; uterus—where a fetus develops; cervix—lower end of the uterus that leads to the vagina; vagina—leads to outside the female body
**Main Idea**

**Sex Cell Production**

I found this information on page ____.

SE, p. 1051  
RE, p. 424

**The Menstrual Cycle**

I found this information on page ____.

SE, pp. 1051–1053  
RE, pp. 424–425

---

**Details**

**Summarize** the results of each meiotic division in the production of eggs.

<table>
<thead>
<tr>
<th>First Meiotic Division</th>
<th>Second Meiotic Division</th>
</tr>
</thead>
<tbody>
<tr>
<td>a polar body, which eventually disintegrates, and a cell that contains most of the cytoplasm and eventually becomes an egg</td>
<td>completed only if the egg is fertilized; polar body, which disintegrates, and the zygote</td>
</tr>
</tbody>
</table>

**Sequence** the steps in the menstrual cycle. Describe the changes in hormones, the uterus, and the ovary at each stage.

1. **The Flow Phase**
   - **Hormone Changes**
     - Level of FSH in blood begins to rise.
   - **Uterine Changes**
     - Endometrium is shed; uterine muscle contracts to help expel endometrium.
   - **Ovary Changes**
     - A follicle in one ovary begins to mature; meiosis of the prophase I cells goes on.

2. **The Follicular Phase**
   - **Hormone Changes**
     - Estrogen stimulates the repair of the endometrial lining; production of FSH and LH slows. Estrogen peaks causing sharp increase in release of LH.
   - **Uterine Changes**
     - Endometrial cells undergo mitosis and uterine lining thickens.
   - **Ovary Changes**
     - Follicle ruptures and egg is released into oviduct.

3. **The Luteal Phase**
   - **Hormone Changes**
     - Progesterone and estrogen are produced. If egg not fertilized, release of FSH and LH blocked, hormone levels drop.
   - **Uterine Changes**
     - If egg is not fertilized, lining sheds. If egg is fertilized, endometrium secretes fluid rich in nutrients.
   - **Ovary Changes**
     - Corpus luteum develops from ruptured follicle. If egg is not fertilized, corpus luteum breaks up.

---

**SUMMARIZE**

Draw a concept web that shows sex cell production in males and females. Accept all reasonable responses.
Human Reproduction and Development

Section 36.2 Human Development Before Birth

Main Idea

Details

Skim Section 2 of the chapter. Write two questions that come to mind from reading the heading and illustration captions.

1. Accept all reasonable responses.

2. ________________________________

Review Vocabulary

*lysosome*

organelle that contains digestive enzymes

New Vocabulary

*amniotic fluid*

liquid that protects, cushions, and insulates the embryo

*blastocyst*

hollow ball of cells formed by the fifth day of pregnancy; attaches to the endometrium

*morula*

solid ball of cells at the point at which the zygote leaves the oviduct and enters the uterus

Academic Vocabulary

*enable*

define to show its scientific meaning. Write a sentence using the term.

to make able or feasible
Fertilization and Early Development

I found this information on page 1054–1058
SE, pp. 1054–1058
RE, pp. 426–429

Sequence the steps of fertilization of an egg and implantation of a blastocyst. The steps are written in scrambled order at right. Write the steps in the correct order in the boxes.

1. 300 million to 500 million sperm are released in the female’s vagina.

2. The sperm that survive the acidic vagina swim through the vagina into the uterus.

3. A few hundred sperm make it into the two oviducts.

4. One sperm penetrates the egg, which changes the electrical charge of the egg’s membrane so other sperm cannot enter.

5. The nucleus of the sperm and the nucleus of the egg unite, forming a zygote.

6. The zygote moves down the oviduct and begins to divide by mitosis.

7. The zygote moves into the uterus and becomes a blastocyst.

8. The blastocyst attaches to the uterine lining.

The zygote moves into the uterus and becomes a blastocyst.

300 million to 500 million sperm are released in the female’s vagina.

The nucleus of the sperm and the nucleus of the egg unite, forming a zygote.

A few hundred sperm make it into the two oviducts.

The zygote moves down the oviduct and begins to divide by mitosis.

The blastocyst attaches to the uterine lining.
Model a placenta and umbilical cord attached to an embryo. Draw arrows to show the route oxygen and nutrients take from the mother’s blood to the embryo and how wastes are removed.

Accept all reasonable diagrams. See SE p. 1056.

Three Trimesters of Development

Compare development of an embryo into a fetus during each trimester. Describe the changes that occur.

<table>
<thead>
<tr>
<th>First Trimester</th>
<th>Second Trimester</th>
<th>Third Trimester</th>
</tr>
</thead>
<tbody>
<tr>
<td>organ systems form; fetus can move arms, legs, fingers, and toes, and make facial expressions</td>
<td>period of marked growth; hair forms; eyes can open; fetus cannot maintain a constant body temperature and lungs not fully developed</td>
<td>rapid growth; fat accumulates under the skin; rapid development of nerve cells in the brain</td>
</tr>
</tbody>
</table>

Analyze one of the methods of diagnosis in the fetus and describe its benefits and risks.

Accept all reasonable responses. The three methods discussed in the text are ultrasound, amniocentesis, and chorionic villi sampling.

Use the analogy of plant growth to compare to the growth and development of a fetus over nine months.

Accept all reasonable responses. A developing plant is similar to a fetus growing. The seed sprouts and the young plant begins to grow. This is similar to the first trimester growth of a fetus. The plant is developing new parts. In the second trimester, the plant makes its way above the surface of the soil. In the third trimester, the plant continues to grow and grow.
Scan the illustrations and read the captions in Section 3 of the chapter. Predict two things you will read about birth and growth.

1. Accept all reasonable responses.

2. ____________________________

Use your book or dictionary to define growth.

- **growth**: increase in the amount of living material and formation of new structures in an organism

Use your book or dictionary to define the following terms.

- **adolescence**: major phase of development that begins with puberty and ends at adulthood
- **adulthood**: phase of development that begins when physical development is complete
- **dilation**: opening of the cervix prior to giving birth
- **expulsion stage**: phase of labor in which strong uterine contractions push the fetus out through the vagina
- **infancy**: first two years of life
- **labor**: birthing process
- **placental stage**: phase of labor after birth, during which the placenta detaches from the uterus and leaves the mother’s body through the vagina
**Main Idea**

**Birth**

I found this information on page 1062–1063.

SE, pp. 1062–1063
RE, p. 431

**Details**

Identify and describe the three stages of birth in the graphic organizer below.

- **Birth**
  - **dilation:** cervix expands due to uterine contractions
  - **placental stage:** placenta and remains of embryonic membranes are pushed out of the mother’s body
  - **expulsion:** baby is pushed out of the mother’s body

**Growth and Aging**

I found this information on page 1063–1065.

SE, pp. 1063–1065
RE, p. 432

**Analyze** the primary way the following hormones affect human growth.

<table>
<thead>
<tr>
<th>Hormone</th>
<th>Effect on Growth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Human growth hormone</td>
<td>increases the rates of protein synthesis and breakdown of fats</td>
</tr>
<tr>
<td>Thyroxine</td>
<td>increases the overall metabolic rate</td>
</tr>
<tr>
<td>Steroids</td>
<td>activate certain genes that promote the formation of proteins, causing cell sizes to increase</td>
</tr>
</tbody>
</table>
Section 36.3 Birth, Growth, and Aging (continued)

**Main Idea**

Describe the changes that occur at each stage of growth and development.

1. Infancy
   Infancy describes the first two years of life. The child grows tremendously, increasing physical coordination and mental development. The infant’s birth weight triples in the first year. Infants learn to control their legs and arms, roll over, sit, crawl, and walk. The child may begin to talk toward the end of this stage.

2. Childhood
   Childhood lasts from the end of infancy to adolescence. The child develops ability to reason and solve problems.

3. Adolescence
   Adolescence follows childhood and begins at puberty. Teenagers have growth spurts that can be surprisingly large. Adolescents gain their maximum height. By the time adulthood is reached, physical growth is complete.

4. Adulthood
   During adulthood, metabolism slows down, the skin begins to lose its elasticity, wrinkles appear, and hair begins to turn white. Disks between vertebrae compress, so people become shorter. Vision and hearing might diminish.

**Details**

Create a flowchart of the stages of human development from newborn to adulthood. Write the approximate age when an individual moves from one stage to the next. Accept all reasonable responses.
The Immune System

Before You Read

*Use the “What I Know” column to list the things you know about disease and immunity. Then list the questions you have about disease and immunity in the “What I Want to Find Out” column. Accept all reasonable responses.*

<table>
<thead>
<tr>
<th>K</th>
<th>What I Know</th>
<th>W</th>
<th>What I Want to Find Out</th>
<th>L</th>
<th>What I Learned</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

When you get a cold, your immune system fights it and you eventually feel better. Hypothesize how people with weakened immune systems might need to live their lives differently to stay healthy.

Accept all reasonable responses.

---

The Immune System

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The Immune System
Section 37.1 Infectious Diseases

Main Idea

Skim Section 1 of the chapter and list three ways that diseases spread from person to person.

1. Accept all reasonable responses.
2. 
3. 

Details

Review Vocabulary

Use your book or dictionary to define protozoan.
protozoan
unicellular, heterotrophic, animal-like protist

New Vocabulary

Use your book or dictionary to define each term.

antibiotic
prescription drug containing a substance that can kill or inhibit the growth of other microorganisms

disease continually found in small amounts within the population
endemic disease

large outbreak in an area that affects many people with the same disease
epidemic

rules for demonstrating that an organism causes a disease
Koch’s postulates

epidemic that is widespread throughout a large region, such as a country, continent, or the entire globe
pandemic

cause of infectious disease
pathogen

for diseases, a source of the pathogen in the environment
reservoir
Section 37.1 Infectious Diseases (continued)

**Main Idea**

**Pathogens Cause Infectious Disease**

*Identify facts about harmful and helpful microorganisms.*

- **Details**
  - **Five types of pathogens:**
    1. bacteria
    2. viruses
    3. protozoans
    4. fungi
    5. parasites
  - **Four places that helpful microorganisms live in your body:**
    1. intestinal tract
    2. reproductive tract
    3. skin
    4. hair follicles

**Germ Theory and Koch’s Experiments**

*Design the experimental steps you would use to identify the virus that caused bird flu in a flock of chickens using Koch’s postulates.*

1. Isolate the suspected pathogen in each diseased chicken.
2. Grow the suspected pathogen in pure culture in artificial media in the laboratory.
3. Inject the suspected pathogen into a healthy chicken.
4. Isolate suspected pathogen from new host, grow it again, and see if characteristics are the same as original pathogen.

**Spread of Disease**

*Analyze how diseases spread.*

- **Details**
  - **Three disease reservoirs:**
    1. animals
    2. people
    3. inanimate objects, such as contaminated soil, water, or food
  - **Four main ways diseases are transmitted to humans:**
    1. direct contact
    2. indirectly through the air
    3. through vectors
    4. indirectly through touching contaminated object
Symptoms of Disease

Contrast how viruses and bacteria cause symptoms of disease.

**Viruses:** multiply in cells; damage or kill the cells when they leave by exocytosis or by bursting the cells

**Bacteria:** produce toxins that can be carried throughout the body in the bloodstream, damaging various parts of the body

Disease Patterns

Compare endemic, epidemic, and pandemic disease by using different colors or patterns to represent each disease pattern. Add a key to explain your map. Accept all reasonable responses.

Treating and Fighting Diseases

Analyze the relationship between natural selection and the increase in antibiotic-resistant bacteria.

Accept all reasonable responses. Natural selection occurs when organisms with favorable variations survive, reproduce, and pass their variations to the next generation. Bacteria with a trait that enables them to survive a particular antibiotic will pass on this favorable trait. Bacteria reproduce quickly, resulting in increased numbers with resistance.

Critique what people can do to help keep antibiotics effective in disease fighting.

Accept all reasonable responses. People should use antibiotics only when necessary.

This will keep them from being overused, which can lead to bacteria becoming resistant.
The Immune System

Section 37.2 The Immune System

Main Idea

Skim Section 2 of the chapter. Identify the system responsible for the body’s specific immunity.

the lymphatic system

Details

Review Vocabulary

Use your book or dictionary to define white blood cells.

white blood cells

large, nucleated blood cells that play a major role in protecting the body from foreign substances and microorganisms

New Vocabulary

Write the correct vocabulary term in the left column for each definition below.

cytotoxic T cell

lymphocyte that destroys pathogens and releases cytokines

memory cell

long-living cell that is exposed to an antigen during the primary immune response and will respond rapidly if the body encounters the same pathogen later

antibody

protein produced by B lymphocytes that specifically reacts to a foreign pathogen

immunization

deliberate exposure of the body to an antigen so that a primary response and immune memory will develop

interferon

protein secreted by virus-infected cells that binds to neighboring cells and stimulates these cells to produce antiviral proteins

complement protein

protein that enhances phagocytosis by helping the phagocytic cells bind better to pathogens, activating the phagocytes, and enhancing the destruction of the pathogen’s membrane

helper T cell

lymphocyte that activates antibody secretion in B cells and another type of T cell that aids in killing microorganisms

lymphocyte

type of white blood cell that is produced in red bone marrow and plays a role in specific immunity

B cell

antibody-producing cell that is present in all lymphatic tissues
### Section 37.2 The Immune System (continued)

#### Main Idea

**Nonspecific Immunity**

I found this information on page _______.

SE, pp. 1084–1085

RE, p. 438–439

#### Details

**Summarize** nonspecific immune defenses by completing the table.

<table>
<thead>
<tr>
<th>Defense</th>
<th>How it Works</th>
</tr>
</thead>
<tbody>
<tr>
<td>Skin</td>
<td>layer of dead skin cells forms barrier against invasion; bacteria living symbiotically on the skin produce acids that inhibit pathogens</td>
</tr>
<tr>
<td>Saliva, tears, and nasal secretions</td>
<td>contain enzyme lysozyme that breaks down bacterial cell walls, killing these pathogens</td>
</tr>
<tr>
<td>Mucus</td>
<td>blocks bacteria from sticking to inner epithelial cells; inner surfaces secrete extra mucus when infected, triggering coughing that helps move infected mucus out of the body</td>
</tr>
<tr>
<td>Stomach acid</td>
<td>hydrochloric acid in the stomach kills many microorganisms found in food</td>
</tr>
<tr>
<td>Phagocytosis</td>
<td>phagocytes surround and internalize foreign microorganisms, and then release digestive enzymes that destroy the microorganisms</td>
</tr>
<tr>
<td>Interferon</td>
<td>virus-infected cells secrete interferon, which binds to neighboring cells and stimulates these cells to produce antiviral proteins</td>
</tr>
<tr>
<td>Inflammatory response</td>
<td>chemicals released by invaders and body cells attract phagocytes, increase blood flow to area, and make blood vessels more permeable to allow white blood cells to escape; result is more white blood cells in the area</td>
</tr>
</tbody>
</table>

#### Compare the functions of these organs of the lymphatic system.

<table>
<thead>
<tr>
<th>Lymph Nodes</th>
<th>Tonsils</th>
<th>Spleen</th>
<th>Thymus Gland</th>
</tr>
</thead>
<tbody>
<tr>
<td>filter the lymph and remove foreign materials from the lymph</td>
<td>form protective ring between nasal and oral cavities, protecting against pathogens in nose and mouth</td>
<td>stores blood and destroys damaged red blood cells; contains lymphatic tissue that responds to foreign substances in blood</td>
<td>helps activate T cells, which are produced in bone marrow but mature in the thymus gland</td>
</tr>
</tbody>
</table>
Sequence B cell and T cell responses. Write the numbers 1–5 next to the activities below to show the order in which they occur.

2. A processed antigen is displayed on the membrane of the macrophage.
4. The activated helper T cell reproduces and attaches to a B cell or cytotoxic T cell.
1. A macrophage digests a pathogen.
5. The B cell begins to make antibodies and the cytotoxic T cell releases cytokines.
3. The macrophage binds with a helper T cell.

Contrast passive immunity and active immunity.

Passive Immunity
- Both antibodies made by other people or animals are transferred into the body, such as by injection or through a mother’s placenta or breast milk to her child.

Active Immunity
- Both reduction of the likelihood of developing a disease
- Exposure of immune system to disease antigens either through having an infectious disease or immunization

Analyze why AIDS patients often die from a secondary infection caused by a different pathogen.

Accept all reasonable responses. The HIV virus infects helper T cells, which produce viruses that infect other helper T cells. Eventually, loss of helper T cells makes AIDS patients susceptible to diseases.

Summarize: Classify AIDS as an endemic, an epidemic, or a pandemic disease. Explain your reasoning.

Accept all reasonable responses. Students should recognize from Section 1 that AIDS is at least an epidemic and probably a pandemic. Infection is widespread over many nations and continents. An estimated 40 million people globally were living with HIV infection in 2004.
The Immune System
Section 37.3 Noninfectious Disorders

Main Idea

Scan Section 3 of the chapter. Use the checklist as a guide.

- Read all section titles.
- Read all boldfaced words.
- Read all tables, figures, and graphs.
- Look at all pictures and read the captions.
- Think about what you already know about noninfectious disorders.

Write three facts you discovered as you scanned the section.

1. Accept all reasonable responses.
2. ________________________________
3. ________________________________

Review Vocabulary

Use your book or dictionary to define cancer.

- cancer: uncontrolled cell division that might be caused by environmental factors and/or changes in enzyme production in the cell cycle

New Vocabulary

Write the correct vocabulary term in the left column for each definition below.

- anaphylactic shock: severe allergic reaction to particular allergens, which causes a massive release of histamine; smooth muscles in the bronchioles contract, restricting air flow into and out of the lungs
- metabolic disease: disease that results from an error in a biochemical pathway
- degenerative diseases: diseases that result when a part of the body wears out
- allergy: a response to environmental antigens
Section 37.3 Noninfectious Disorders (continued)

**Main Idea**

Genetic Disorders, Degenerative Diseases, Metabolic Diseases, Cancer

I found this information on page 1092–1093. SE, pp. 1092–1093

**Details**

Classify each noninfectious disorder according to whether it is caused strictly by a person’s genes, or by genes combined with environmental factors.

- arteriosclerosis
- Down syndrome
- coronary artery disease
- hemophilia
- sickle cell anemia
- Type 1 diabetes
- leukemia
- albinism

### Causes of Noninfectious Disorders

<table>
<thead>
<tr>
<th>Genes Only</th>
<th>Genes and Environmental Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Down syndrome</td>
<td>arteriosclerosis</td>
</tr>
<tr>
<td>hemophilia</td>
<td>coronary artery disease</td>
</tr>
<tr>
<td>sickle cell anemia</td>
<td>Type 1 diabetes</td>
</tr>
<tr>
<td>albinism</td>
<td></td>
</tr>
</tbody>
</table>

Evaluate ways that an individual can increase his or her chance of surviving one of the noninfectious diseases that are partly caused by environmental factors.

Accept all reasonable responses.

Identify the causes of noninfectious disorders.

<table>
<thead>
<tr>
<th>Noninfectious Disorders</th>
<th>Causes</th>
</tr>
</thead>
<tbody>
<tr>
<td>genetic disorders</td>
<td>inheritance of genes that do not function properly; also abnormal number of chromosomes</td>
</tr>
<tr>
<td>degenerative diseases</td>
<td>a part of the body wears out, sometimes due to aging and sometimes sooner than expected in a lifetime</td>
</tr>
<tr>
<td>metabolic diseases</td>
<td>error in a biochemical pathway</td>
</tr>
<tr>
<td>cancer</td>
<td>abnormal cell growth due to loss of the body’s normal control over cell division</td>
</tr>
</tbody>
</table>
Inflammatory Diseases

Compare and contrast the pairs of disorders in the table below. Accept all reasonable responses.

| | Inflammatory response to infectious disease and inflammatory disease: | Inflammatory response to infectious disease enhances the overall immune response to infection. In inflammatory disease, the body produces an inflammatory response to a common substance. This response is not helpful to the body. |
|---|---|
| Simple allergic reaction and anaphylactic shock: | Both react to particular allergens by releasing histamine from white blood cells. In anaphylactic shock, however, the release is massive and the result is life threatening. Smooth muscles in the bronchioles contract, restricting air flow. In a simple allergic reaction, symptoms are less severe. |
| Degenerative arthritis and rheumatoid arthritis: | Rheumatoid arthritis is an autoimmune disorder. The body makes antibodies that attack its own proteins. Degenerative arthritis results from part of the body wearing out rather than from autoimmunity. |

Identify the parts of the body attacked by antibodies in each of the following autoimmune disorders.

<table>
<thead>
<tr>
<th>Rheumatic fever</th>
<th>Lupus</th>
<th>Rheumatoid arthritis</th>
</tr>
</thead>
<tbody>
<tr>
<td>valves of the heart</td>
<td>cell nuclei</td>
<td>joints</td>
</tr>
</tbody>
</table>

Summarize

Make a table of the types of noninfectous disorders, listing one cause and one example of each disorder.