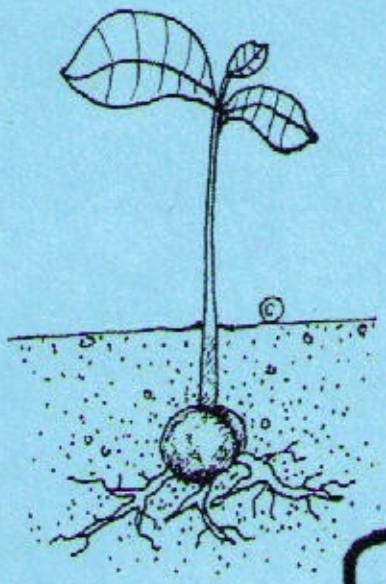
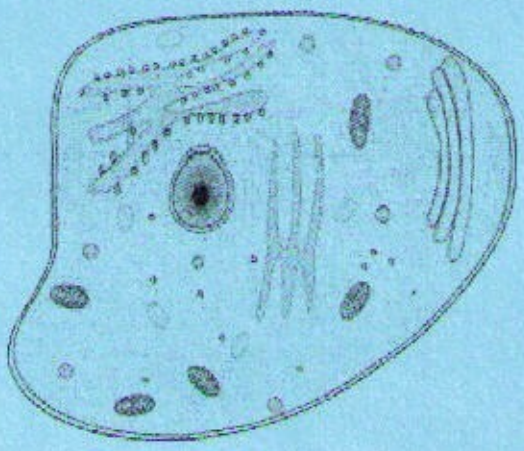




ORGANISMS: FROM MACRO TO MICRO
NOTEBOOK
FRIENDSHIP JR. HIGH SCHOOL

Student Name: _____

Science Teacher: _____

Science Period: _____

2011-2012 School Year

Living Things
&
Classification

12. Circle the letter of each sentence that is true about binomial nomenclature.

a. A genus and a species name together identify one kind of organism.

b. Genus and species names are in Latin because Latin was the language of scientists during Linnaeus's time.

c. The genus name begins with a small letter.

d. Binomial nomenclature makes it easy for scientists to talk about an organism.

▶ Levels of Classification (pages 32–33)

13. List the seven levels of classification used by modern biologists in order from the broadest level to the most specific level. _____

_____

_____

14. Is the following sentence true or false? The more classification levels that two organisms share, the more characteristics they have in common. _____

15. Look carefully at Figure 12 on page 33. What order does the great horned owl belong to? _____

_____

▶ Evolution and Classification (page 34)

16. Is the following sentence true or false? Darwin's theory of evolution did not affect the way in which species were classified. _____

17. What is evolution? _____

_____

_____

9. What is development? _____

_____

_____

10. Circle the letter of a change in an organism's surroundings that causes the organism to react.

a. growth b. response c. stimulus d. development

11. Give one example of a stimulus and one example of a response.

Stimulus: _____

Response: _____

12. All organisms can _____, or produce offspring that are similar to the parents.

▶ Life Comes From Life (pages 19–20)

13. Is the following sentence true or false? Frogs can sprout from mud in ponds. _____

14. The idea that living things can come from nonliving sources is called _____.

15. What did Francesco Redi show in his experiment? _____

_____

16. The factor that a scientist changes in a controlled experiment is the _____.

17. Look carefully at Exploring the *Experiments of Redi and Pasteur* on pages 20–21. Circle the letter of the manipulated variable in Redi's experiment.

a. meat b. jars c. cloth d. flies

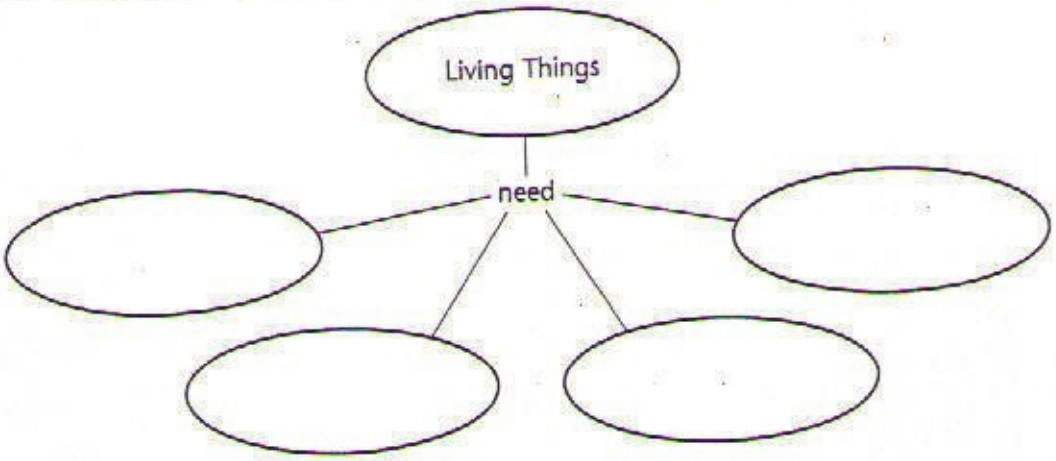
18. Is the following sentence true or false? Louis Pasteur used a controlled experiment to show that bacteria arise from spontaneous generation.

_____

Name _____ Date _____ Class _____

▶ The Needs of Living Things (pages 20–23)

19. Complete this concept map to show what living things need to survive.



20. Is the following sentence true or false? Living things use food as their energy source to carry out their life functions. _____

21. Organisms that make their own food are called _____. Organisms that cannot make their own food are called _____.

22. Is the following sentence true or false? Living things can live without water for long periods of time. _____

23. What property of water makes it vital to living things? _____

24. Is the following sentence true or false? Organisms compete with each other for space to live. _____

25. Why must living things have homeostasis, or stable internal conditions?

Name _____ Date _____ Class _____

SECTION 1-1 **SECTION SUMMARY**

What Is Life?

1

Guide for Reading

- What characteristics do all living things share?
- What do living things need to survive?

Organisms are living things. All living things share six important characteristics. **All living things have a cellular organization, contain similar chemicals, use energy, grow and develop, respond to their surroundings, and reproduce.**

A **cell** is the basic unit of structure and function in an organism. **Unicellular,** or single-celled organisms, include bacteria, the most numerous organisms on Earth. **Multicellular** organisms are composed of many cells. The cells of organisms use energy to grow and repair injured parts.

Cells are composed of chemicals. The most abundant chemical in cells is water. Another chemical called carbohydrate is a cell's energy source. Proteins and lipids are the building materials of cells. Nucleic acids are the genetic materials that direct the cell's activities.

Living things grow and develop. Growth is the process of becoming larger. **Development** is the process of change that occurs during an organism's life to produce a more complex organism.

A change in an organism's surroundings that causes the organism to react is called a **stimulus.** An organism reacts to a stimulus with a **response**—an action or change in behavior.

Another characteristic of organisms is the ability to **reproduce,** or produce offspring that are similar to the parents. People once believed the mistaken idea that living things arise from nonliving sources—an idea called **spontaneous generation.** Controlled experiments helped disprove spontaneous generation. In a **controlled experiment,** a scientist carries out two tests that are identical in every respect except for one factor, called the **variable.**

All organisms need four things to stay alive. **Living things must satisfy their basic needs for energy, water, living space, and stable internal conditions.**

Organisms that make their own food are called **autotrophs.** Organisms that cannot make their own food are called **heterotrophs.** Heterotrophs consume other autotrophs or heterotrophs. All organisms need food, water, and shelter. Because space on Earth in limited, some organisms compete for food and space.

Because conditions in their surroundings can change, organisms must be able to keep the conditions inside their bodies constant. The maintenance of stable internal conditions despite changes in surroundings is called **homeostasis.**

Name _____ Date _____ Class _____

SECTION 1-1 REVIEW AND REINFORCE

What Is Life?

◆ Understanding Main Ideas

Answer the following questions on the back of this page or on a separate sheet of paper.

1. What are six characteristics all living things share?
2. How did Redi's experiment help disprove the idea of spontaneous generation?
3. What are the four basic needs all living things must satisfy?
4. Describe the difference between growth and development.

◆ Building Vocabulary

From the list below, choose the term that best completes each sentence.

autotrophs	heterotrophs	controlled experiment
unicellular	multicellular	organisms
spontaneous generation	homeostasis	stimulus
response	cell	reproduce
manipulated variable		

5. A change in an organism's environment that causes the organism to react is called a(n) _____.
6. Organisms that make their own food are _____.
7. _____ organisms are composed of many cells.
8. _____ is the mistaken idea that living organisms arise from non-living sources.
9. All living things are called _____.
10. The _____ is the basic unit of structure in an organism.
11. Organisms that get energy by consuming other organisms are _____.
12. An organism reacts to a stimulus with a(n) _____.
13. A(n) _____ is conducted by performing two tests that are identical except for one factor called the _____.
14. An organism's ability to maintain stable internal conditions is called _____.
15. To _____ is to produce offspring that are similar to the parents.
16. Bacteria, the most numerous organisms on Earth, are _____ organisms.

What's in an Organism's Name?

Even if you didn't know much about biology, you probably could guess that lions and tigers are close relatives. You also could be pretty sure that bears are animals and that roses are plants. It's easy because these organisms are familiar to us and have such distinctive appearances.

What if you had to find out whether mice, elephants, and bats were related? To answer this question, you would turn to taxonomy.

Taxonomy is the science of classifying living things. Taxonomy is based on the principle that everything in our world is related in some way. It is a science that groups organisms according to their structures and functions.

Taxonomy was introduced in the 18th century by Carolus Linnaeus, a Swedish scientist. Linnaeus's interest in taxonomy started early. His father had a large garden, and he introduced his

These animals look very different, but they've got enough in common to be in the same biological class. Can you identify their common features?

son to the science of plants. Linnaeus enjoyed studying plants, but even as a boy, he recognized that little information was available about how to classify plants. He saw a need for a universal classification system that would allow all scientists to communicate with one another about living things in a meaningful way.

While still in college, Linnaeus began to develop a method of classifying living things. In 1735, he published his first book on the subject, *Systema Naturae*. Over the years, he expanded the science of taxonomy, developing many of the methods still used today.

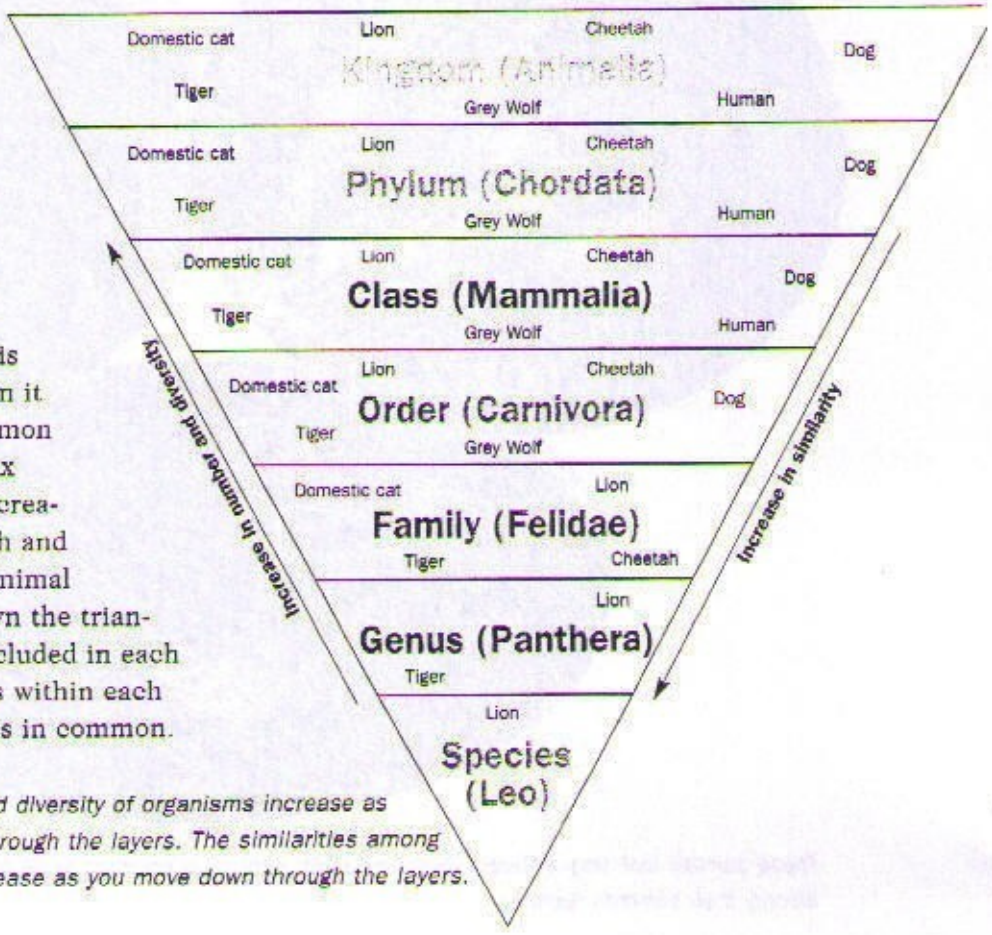
COURTESY OF THE HUNT INSTITUTE FOR BOTANICAL DOCUMENTATION, CARNEGIE MELLON UNIVERSITY, PITTSBURGH, PENNSYLVANIA

Carolus Linnaeus

A Seven-Layer System

Linnaeus developed rules for classifying plants and animals according to their structures. His work resulted in a seven-layer system: kingdom, phylum, class, order, family, genus, and species.

You can think of the system as an upside-down triangle. The top layer of the triangle is the kingdom category. Each kingdom contains the greatest number and diversity of organisms of the entire system. Because this layer is the largest, the organisms in it have fewer features in common than do organisms in the six other layers. For example, creatures as different as jellyfish and lions are both part of the Animal Kingdom. As you move down the triangle, fewer organisms are included in each category, but the organisms within each category have more features in common.



The number and diversity of organisms increase as you move up through the layers. The similarities among organisms increase as you move down through the layers.

Look at Table 1.1. You will see that all of the organisms listed across the top of the table are in the same kingdom, phylum, and class. With the exception of humans, they are also in the same order. The dog and grey wolf are in a different family than the four cats. And, of the four cats, only the tiger and the lion are in the same genus. The lion has the species name *leo*, which makes it unique from all the other animals in the chart.

Using Linnaeus's system, ants and spiders are part of the animal kingdom. They are also both members of the phylum Arthropoda (ar-throp-OH-dah) because they have jointed legs. But each is in a different class. Ants are in the class of animals with three-part bodies and six legs. This class is called Insecta. Spiders are in the class of eight-legged organisms with two-part bodies. This class is known as Arachnida (ah-RAK-nî-dah).

Adding New Kingdoms

Linnaeus grouped all organisms into two main kingdoms—Plants and Animals. Until the second half of the 20th century, most biologists used his system. Then they added a third kingdom, the Protists, because microorganisms did not all clearly fit into the Animal or Plant kingdoms. As scientists discovered more and more information about organisms, they added two more kingdoms—Fungi and Monerans.

One Organism, Two Names

Linnaeus also developed a system for naming organisms, under which a two-part scientific name is assigned to every organism. An organism is named on the basis of its genus and species. The species name is usually an adjective, and the genus name is usually a noun. The first letter of the genus name is always capitalized. When the scientific name is typed, it is always in italics. When written by hand, it is underlined.

Some organisms are named after one of their prominent features. The scientific name for the red maple, for example, is *Acer rubrum*. *Acer* means "maple," and *rubrum* means "red." Some are named after the location in

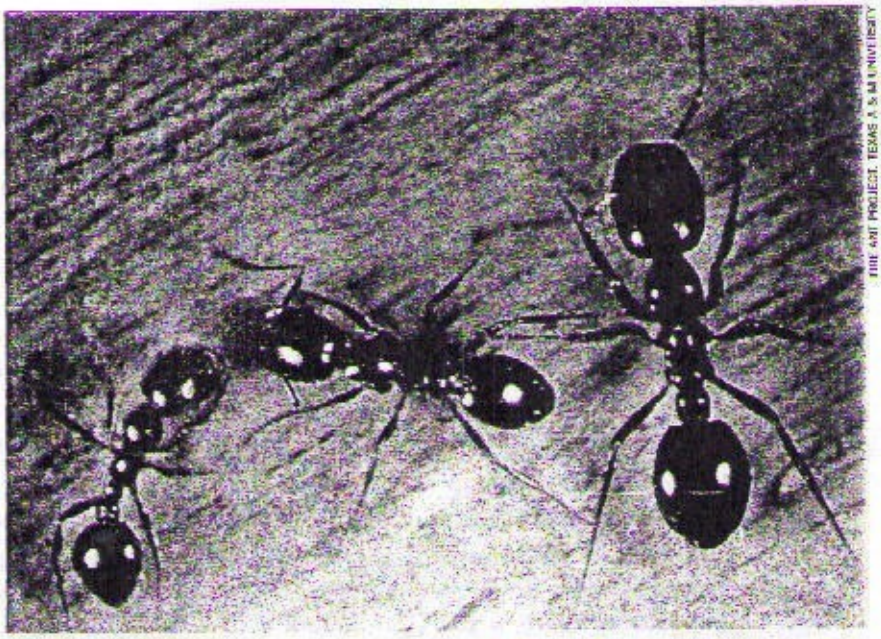
Table 1.1 The Seven-Layer System

	Domestic cat	Lion	Cheetah	Tiger	Dog	Grey Wolf	Human
Kingdom	Animalia	Animalia	Animalia	Animalia	Animalia	Animalia	Animalia
Phylum	Chordata	Chordata	Chordata	Chordata	Chordata	Chordata	Chordata
Class	Mammalia	Mammalia	Mammalia	Mammalia	Mammalia	Mammalia	Mammalia
Order	Carnivora	Carnivora	Carnivora	Carnivora	Carnivora	Carnivora	Primates
Family	Felidae	Felidae	Felidae	Felidae	Canidae	Canidae	Hominidae
Genus	*Felis*	*Panthera*	*Acinonyx*	*Panthera*	*Canis*	*Canis*	*Homo*
Species	*silvestris*	*leo*	*jubatus*	*tigris*	*familiaris*	*lupus*	*sapiens*

which they are found. A species of fly discovered in Humbug Creek, California, was named *Oligodranes humbug*. Others are named after the scientist who discovered them.

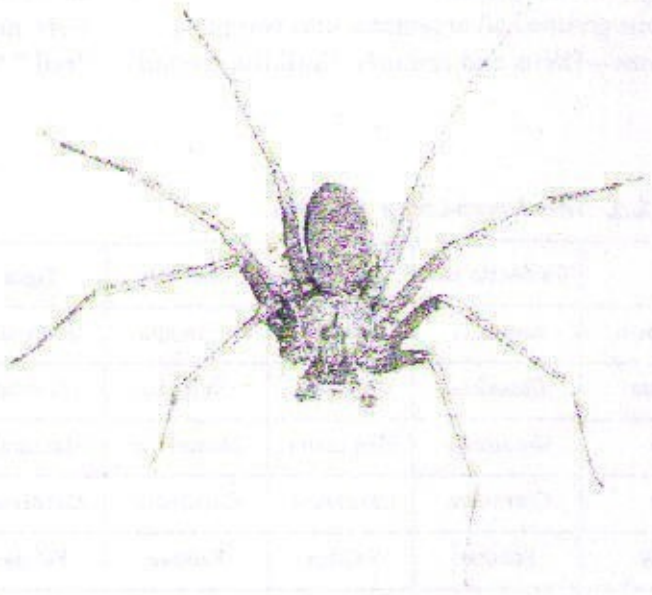
There are other sources of names, too. There is a spider, *Draculoides bramstokeri*, named after the novel, *Dracula*, by Bram Stoker. Perhaps the grandfather of all names belongs to an aphid, a tiny insect. Its scientific name is *Myzocallis kahawaluokalani*. This Hawaiian name supposedly means, "You fish on your side of the lagoon and I'll fish on the other, and no one will fish in the middle."

Linnaeus's groundbreaking work of the 18th century remains the basis of the system we use today. Taxonomy now helps scientists to classify more than 10 million species of organisms on Earth and new kinds are discovered every year. Taxonomy is likely to continue to evolve as scientists debate the most appropriate classification system and the need to change that system to reflect new information and discovery. □



THE ANT PROJECT, TEXAS A & M UNIVERSITY

Their three-part body and six legs put ants in phylum Arthropoda and class Insecta. The two large sections at each end are the head and abdomen. The smaller segments in between comprise a third part, the thorax.



COURTESY ENTOMOLOGY DEPARTMENT, SMITHSONIAN INSTITUTION, WASHINGTON, D.C.

The two-part body and eight legs identify this spider as belonging to phylum Arthropoda, class Arachnida.

3. Circle the letter before each sentence that is true about how life formed on Earth.

   a. Fossils show that bacteria-like living things were on Earth between 3.4 and 3.5 billion years ago.

   b. The first cells probably used the chemicals in their surroundings for energy.

   c. Cells that made their own food produced oxygen as a waste product, which built up in Earth's atmosphere.

   d. Scientists know for certain how life first appeared on Earth.

Reading Skill Practice

A flowchart is useful for organizing the sequence of events in a process. Make a flowchart to show the sequence of events that scientists hypothesize occurred in the origin of life on Earth. For more information about flowcharts, see page 191 in the Skills Handbook of your textbook. Do your work on a separate sheet of paper.

SECTION 1-3 Classifying Organisms (pages 28-37)

This section tells how scientists divide living things into groups. It also describes the first classification systems and how the theory of evolution changed classification systems.

▶ Why Do Scientists Classify? (pages 28-29)

1. The process of grouping things based on their similarities is

   _____.

2. Why do biologists use classification? _____

   _____

   _____

Name _____ Date _____ Class _____

3. The scientific study of how living things are classified is called _____.

4. Is the following sentence true or false? Once an organism is classified, a scientist knows a lot about that organism. _____

5. Is the following sentence true or false? Biologists are the only scientists to classify things. _____

▶ Early Classification Systems (page 29)

6. Into what three groups did Aristotle divide animals? _____

7. Circle the letter of each sentence that is true about classification systems.
   a. Aristotle did not use his observations to group animals.
   b. Aristotle divided each group of animals into subgroups.
   c. Scientists today divide groups of animals into smaller groups based on their similarities.
   d. Scientists today classify animals by how they move and where they live.

▶ The Classification System of Linnaeus (pages 30–31)

8. Is the following sentence true or false? Linnaeus placed organisms into groups based on their features that he could observe. _____

9. In Linnaeus's naming system, called _____, each organism is given a two-part name.

10. Is the following sentence true or false? A species is a classification grouping that contains similar, closely related organisms.

    _____

11. In the scientific name for mountain lions, *Felis concolor*, which is the genus name and which is the species name?

    Genus: _____ Species: _____

12. Circle the letter of each sentence that is true about binomial nomenclature.

a. A genus and a species name together identify one kind of organism.

b. Genus and species names are in Latin because Latin was the language of scientists during Linnaeus's time.

c. The genus name begins with a small letter.

d. Binomial nomenclature makes it easy for scientists to talk about an organism.

▶ Levels of Classification (pages 32–33)

13. List the seven levels of classification used by modern biologists in order from the broadest level to the most specific level. _____

_____

_____

14. Is the following sentence true or false? The more classification levels that two organisms share, the more characteristics they have in common. _____

15. Look carefully at Figure 12 on page 33. What order does the great horned owl belong to? _____

_____

▶ Evolution and Classification (page 34)

16. Is the following sentence true or false? Darwin's theory of evolution did not affect the way in which species were classified. _____

17. What is evolution? _____

_____

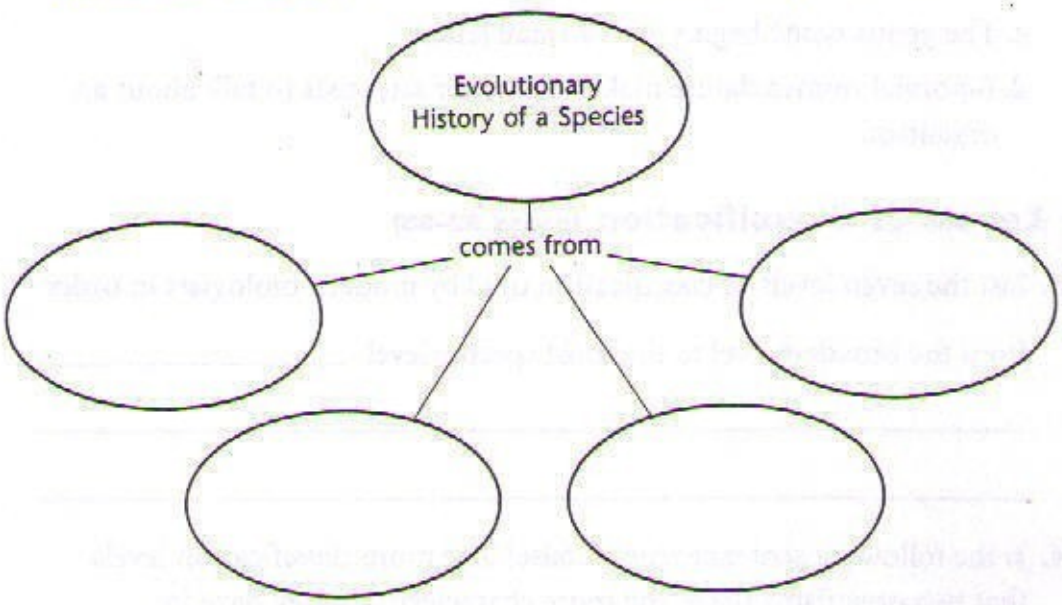
_____

Name _____ Date _____ Class _____

▶ Classification Today (pages 34–36)

18. Is the following sentence true or false? Species with shared ancestors are classified more closely together. _____

19. Complete the concept map below to show four different ways scientists get information about the evolutionary history of a species.



20. What do scientists today rely on primarily to determine evolutionary history? _____

_____

▶ Using the Classification System (pages 36–37)

21. Name two ways to learn the identity of an organism.

a. _____

b. _____

22. Is the following sentence true or false? A taxonomic key is a book with illustrations that highlight the differences between organisms that look similar. _____

23. Look at the taxonomic key in Figure 16 on page 37. How many legs does a tick have? _____

Name _____ Date _____ Class _____

SECTION 1-3 **SECTION SUMMARY**

Classifying Organisms

1

Guide for Reading

- **Why do scientists organize living things into groups?**
- **What is the relationship between classification and evolution?**

Classification is the process of grouping things based on their similarities. **Biologists use classification to organize living things into groups so that the organisms are easier to study.** The scientific study of how living things are classified is called **taxonomy.**

The first scientist to develop a classification system for organisms was the Greek scholar Aristotle. Aristotle observed and divided animals into three groups: those that fly, those that swim, and those that walk, crawl, or run.

The Swedish scientist Carolus Linnaeus created a naming system for organisms called **binomial nomenclature,** where each organism is given a two-part name. The first part of an organism's scientific name is its genus. A **genus** is a classification grouping that contains similar, closely related organisms. The second part of an organism's scientific name is its species name. A **species** is a group of similar organisms that can mate and produce fertile offspring in nature.

Modern biologists classify organisms into seven levels. A kingdom is the broadest level of organization. Within a kingdom, there are phyla, and within each phylum there are classes. Each class is divided into orders. Each order contains families, and each family contains at least one genus. Within a genus there are species. Organisms are grouped by their shared characteristics. The more classification levels that two organisms share, the more characteristics they have in common.

The British scientist Charles Darwin published a theory about how species can change over time. He observed that two groups of the same species can accumulate enough differences over a long time to become two separate species. This process by which species gradually change over time is called **evolution.**

The theory of evolution changed the way biologists think about classification. Scientists understand that certain organisms are similar because they share a common ancestor. **Species with similar evolutionary histories are classified more closely together.** Scientists get information about the evolutionary history of species by studying fossils, comparing the body structures of living organisms, comparing the early development of organisms, and by examining the chemical makeup of cells.

You can identify organisms with field guides and taxonomic keys. Field guides are books with illustrations that highlight differences between similar looking organisms. A **taxonomic key** is a series of paired statements that describe the physical characteristics of different organisms.

Name _____ Date _____ Class _____

SECTION 1-3 REVIEW AND REINFORCE

Classifying Organisms

◆ Understanding Main Ideas

Complete the table below. Then answer the following questions in the space provided.

Scientist	Contributions to Modern Classification
Aristotle	
Carolus Linnaeus	
Charles Darwin	

1. Describe the modern system of classification.

_____

_____

_____

◆ Building Vocabulary

Match each term with its definition by writing the letter of the correct definition in the right column on the line beside the term in the left column.

_____ 2. classification

_____ 3. taxonomic key

_____ 4. binomial nomenclature

_____ 5. evolution

_____ 6. genus

_____ 7. species

_____ 8. taxonomy

a. naming system developed by Carolus Linnaeus

b. process of grouping things based on their similarities

c. first part of an organism's scientific name

d. tool for identifying organisms that is based on a series of paired statements describing physical characteristics

e. theory that species can gradually change over time

f. a group of organisms that can mate and produce fertile offspring

g. the scientific study of how things are classified

SECTION 1-4 The Six Kingdoms (pages 40-42)

This section describes each of the six kingdoms into which all living things are grouped.

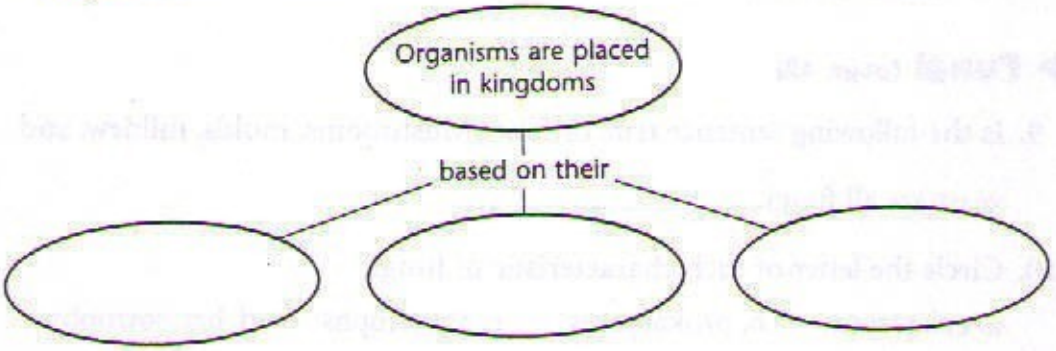
▶ Introduction (page 40)

1. List the six kingdoms of living things.

   a. _____ b. _____ c. _____

   d. _____ e. _____ f. _____

2. Complete the concept map to show how organisms are placed into kingdoms.



▶ Archaebacteria (pages 40–41)

3. Circle the letter of each sentence that is true about archaebacteria.

   a. Archaebacteria can be either autotrophic, or heterotropic.

   b. Archaebacteria are prokaryotes.

   c. Archaebacteria have a cell nucleus.

   d. Archaebacteria do not have nucleic acids.

4. A dense area in a cell that contains nucleic acids is a(n) _____.

▶ Eubacteria (page 41)

5. Is the following sentence true or false? Eubacteria have a similar chemical makeup to archaebacteria. _____

Name _____ Date _____ Class _____

6. What are three helpful things that eubacteria do? _____

_____

_____

_____

▶ Protists (page 41)

7. Is the following sentence true or false? Protists can be either unicellular or multicellular. _____

8. How do protists differ from archaebacteria and eubacteria? _____

_____

_____

▶ Fungi (page 42)

9. Is the following sentence true or false? Mushrooms, molds, mildew, and yeast are all fungi. _____

10. Circle the letter of each characteristic of fungi.

a. eukaryotes b. prokaryotes c. autotrophs d. heterotrophs

▶ Plants (page 42)

11. Plants are _____; they can make their own food.

12. Is the following true or false? Life on Earth could exist without plants.

_____

▶ Animals (page 42)

13. Circle the letter of each characteristic of animals.

a. unicellular b. heterotrophs c. eukaryotes d. autotrophs

14. Is the following sentence true or false? All animals are multicellular.

_____

Name _____ Date _____ Class _____

SECTION 1-4 **SECTION SUMMARY**

The Six Kingdoms

Guide for Reading

- **What are the six kingdoms into which all organisms are grouped?**

Today, the system of classification includes six kingdoms: archaebacteria, eubacteria, protists, fungi, plants, and animals. Organisms are placed into kingdoms based on their type of cells, their ability to make food, and the number of cells in their bodies.

The name archaebacteria means "ancient bacteria." Archaebacteria can be either autotrophic or heterotrophic and live only in places without oxygen. Archaebacteria are **prokaryotes,** organisms whose cells lack a nucleus. A **nucleus** is a dense area in a cell that contains nucleic acids—the chemical instructions that direct the cell's activities. In prokaryotes, nucleic acids are scattered throughout the cell.

Bacteria belong to the kingdom known as Eubacteria. Eubacteria are unicellular prokaryotes. Some eubacteria are autotrophs while others are heterotrophs. Even though they are similar to archaebacteria, eubacteria are classified in their own kingdom because their chemical makeup is different from that of archaebacteria.

Slime molds are protists. The protist kingdom is sometimes called the "odds and ends" kingdom because its members are so different from one another. Protists can be autotrophs or heterotrophs. Although many protists are unicellular, some are multicellular. However, all protists are **eukaryotes**—organisms with cells that contain nuclei.

Mushrooms, molds, mildew, and yeast are all fungi. Most fungi are multicellular eukaryotes. A few, such as yeast, are unicellular eukaryotes. Fungi are found almost everywhere on land, but only a few live in fresh water. All fungi are heterotrophs. Most fungi feed on dead or decaying organisms.

Plants are all multicellular eukaryotes. The plant kingdom includes a variety of organisms. All plants are autotrophs. Plants feed almost all of the heterotrophs on Earth.

All animals are multicellular eukaryotes. All animals are heterotrophs. Animals have different adaptations that allow them to find food, capture it, eat it, and digest it. Members of the animal kingdom are found in diverse environments on earth.

Name _____ Date _____ Class _____

SECTION 1-4 **REVIEW AND REINFORCE**

The Six Kingdoms

◆ Understanding Main Ideas

Fill in the correct characteristics of each kingdom in the table below. More than one answer may fit in each kingdom.

Kingdom	Prokaryote or Eukaryote	Autotrophic or Heterotrophic	Unicellular or Multicellular	Other Characteristics
Archaebacteria				
Eubacteria				
Protists				
Fungi				
Plants				
Animals				

◆ Building Vocabulary

Write a definition for each of the following terms on the lines below or on a separate sheet of paper.

1. nucleus

2. prokaryote

3. eukaryote

6th Grade Science
Chapter 7- The Living World

Group Members' Names: _____

_____ _____

_____ _____

Classification Lab- King Phillip Came Over For Great Spaghetti!

Directions: It is your job as a "group of scientists" to classify the items in the container your group has received. ***It will be extremely important to have good communication within your group since you will have MANY items to classify and a time limit in which to get it done!*** You can do this in any of several ways. Here are some hints to help you get started:

Step 1: ***Take an inventory (count) of your items.*** Write out how many of each item you have below. Do not count the container itself or the lid in your inventory of items.

Step 2: ***Start with simple groupings of your items.*** Have EVERYONE in the group help decide what are the general categories of the items you received. These general categories will be your "kingdoms." Your final classification must have at least **1** kingdom, but can't have any more than **5** kingdoms. **Write your kingdoms below when you have them finalized.**

Step 3: ***Break up your simple groups.*** Have EVERYONE in the group help to go through each of your "kingdoms" to further breakdown the classifications. Follow the procedure you used in step 2 from phylum all the way down to species. You may not have any classifications past a 7th level (species). **Write ALL of your sub-classes below when you have them finalized.**

Step 4: ***Diagram your information.*** Once you have all of the items in your container classified, have EVERYONE in the group help to come up with some type of diagram to show the classification. You may use whatever type of diagram your group feels will best show how your items are classified. **Draw your diagram NEATLY below.**

CLASSIFICATION Name _____

(put an X in the appropriate column as the pictures are shown)

Picture #	Bacteria	Protist	Fungi	Plant	Animal
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
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39					
40					
41					
42					
43					
44					
YOU					

Name: _____
Date: _____
Period: _____

CLASSIFICATION ACTIVITY

First, log into your computer.

Go to the website:

http://www.pbs.org/wgbh/nova/orchid/clas_flash.html

- After the clas there is an underscore. It's hard to tell because the whole website is underlined.

Read the introduction it gives you. You are going to try and classify three living things. You may do them in any order but you must get all three done (bear, orchid, sea cucumber). It is *very* important that you read the information that it gives you about the living things. This will help you get the answers quickly!!!

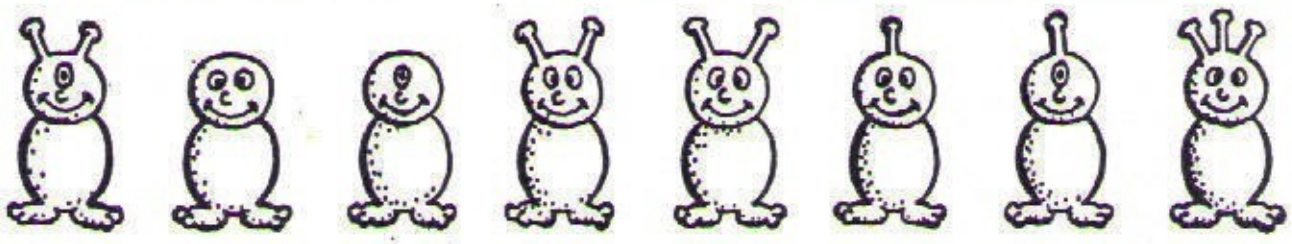
A perfect score is 21 points. Every time you make a choice it gives you a point. Because of this, you don't' want to just guess. Really read the descriptions to choose the best one.

As you keep going, it lists the classification levels on the left for you to see. It also gives you your score on the right so you could see how you are doing.

When you are done, you may pick up a study guide and start filling it out.

Classy Creatures

Name _____



___ ___ ___ ___ ___ ___ ___ ___

Scientists use a special tool to help them find the names of insects, trees, and many other things. It is called a **dichotomist key.**

Each of the creatures above has a name. We will use our own dichotomist key to give each creature its name. To use the key, work with only one creature at a time. First read steps 1a and 1b. Decide which statement is true about the creature. Then follow the directions after that step. The directions will lead you to a new pair of steps. Keep this up until you come to a step that gives you the creature's name. Write the creature's name in the space provided. After you have named all of the creatures, you will be able to complete the following sentence.

A dichotomist key is used to ___ ___ ___ ___ ___ ___ ___ ___.

If this is true,		do this.
1 a.	The creature has two eyes.	Go to step 2.
b.	The creature has one eye.	Go to step 5.
2 a.	The creature has one or more antennae.	Go to step 3.
b.	The creature has no antennae.	Its name is "L."
3 a.	The creature has one antenna.	Its name is "I."
b.	The creature has more than one antenna.	Go to step 4.
4 a.	The creature has two antennae.	Its name is "S."
b.	The creature has three antennae.	Its name is "Y."
5 a.	The creature has one or more antennae.	Go to step 6.
b.	The creature has no antennae.	Its name is "A."
6 a.	The creature has one antenna.	Its name is "F."
b.	The creature has two antennae.	Its name is "C."

Something Special

Draw your own friendly creature from space. Give your creature from zero to three antennae and one or two eyes. Have a friend use the dichotomist key above to find what letter the creature is wearing.

Name: _____

Date: _____ Period: _____

Classify That Animal

Background Information:

- There are 7 levels of classification for living organisms: Kingdom, Phylum, Class, Order, Family, Genus, and Species.
- All living organisms are grouped or classified according to their characteristics.
- As you move from kingdom down to species, the groups become more specific.
- There are 6 main classes of animals.

CLASS	BASIC CHARACTERISTICS OF ORGANISMS
Amphibian *(Amphibia)*	All amphibians are born in the water and breathe with gills. As they grow up, they live on the land and breathe with lungs.
Birds *(Aves)*	All birds have feathers and are born out of a hard-shelled egg.
Fish	All fish live in the water and have gills, scales and fins on their body.
Mammals *(Mammalia)*	All mammals have four chambered hearts, nurse their young, and have hair on their body. Most mammals are born alive.
Reptiles *(Reptilia)*	All reptiles have scaly skin, are cold-blooded, and are born on the land.
Insects *(Insecta)*	All insects have a three-part body consisting of a head, thorax, and abdomen; have an external skeleton, and are invertebrates.

Now that you know some information about each of the 6 main classes, re-group your living organism cards. Complete the following table by listing the names of the living organisms that belong in each of the classes.

Amphibians	Birds
Fish	Mammals
Reptiles	Insects

Conclusion Questions:

1. How did you initially group your living organism cards? Explain your process.

2. After reading the table on the classes and basic characteristics, did your groupings change? If so, how did they change?

3. Why is it helpful to have living organisms classified?

Name: _____
Date: _____ Period: _____ Score: _____

Classify That Animal

Directions:

1. Go to www.sheppardsoftware.com
2. Click on "Kids Corner" (an owl is the icon).
3. Click on the icon that says "What Kind Of Animal Is This"?
4. Choose one of the 5 habitats to begin. At the end of each habitat, record your score.
5. Complete the following tables before you exit the habitat. Keep in mind you may not have 7 or 8 examples of each.
6. Click "exit" to go to another habitat. Continue until you have completed all 5.

African River Score: _____ / 22

Insect	Mammal	Fish	Reptile	Arachnid	Bird
1.	1.	1.	1.	1.	1.
2.	2.	2.	2.	2.	2.
3.	3.	3.	3.	3.	3.
4.	4.	4.	4.	4.	4.
5.	5.	5.	5.	5.	5.
6.	6.	6.	6.	6.	6.
7.	7.	7.	7.	7.	7.

American Forest Score: _____ / 21

Mammal	Reptile	Amphibian	Insect	Bird
1.	1.	1.	1.	1.
2.	2.	2.	2.	2.
3.	3.	3.	3.	3.
4.	4.	4.	4.	4.
5.	5.	5.	5.	5.
6.	6.	6.	6.	6.
7.	7.	7.	7.	7.

Backyard Animals Score: _____ / 19

Mammal	Reptile	Amphibian	Insect	Bird
1.	1.	1.	1.	1.
2.	2.	2.	2.	2.
3.	3.	3.	3.	3.
4.	4.	4.	4.	4.
5.	5.	5.	5.	5.
	6.	6.	6.	6.
7.	7.	7.	7.	7.

Ocean Animals Score: _____ / 26

Mollusk	Mammal	Fish	Reptile	Crustacean	Bird
1.	1.	1.	1.	1.	1.
2.	2.	2.	2.	2.	2.
3.	3.	3.	3.	3.	3.
4.	4.	4.	4.	4.	4.
5.	5.	5.	5.	5.	5.
6.	6.	6.	6.	6.	6.
7.	7.	7.	7.	7.	7.

African Grassland Animals Score: _____ / 20

Mammal	Reptile	Insect	Bird
1.	1.	1.	1.
2.	2.	2.	2.
3.	3.	3.	3.
4.	4.	4.	4.
5.	5.	5.	5.
6.	6.	6.	6.
7.	7.	7.	7.
8.	8.	8.	8.

Name: _____
Date: _____ Period: _____ Score: _____

Animal Classes

Background:

- There are many different classes of animals.
- An animal's class is determined by its characteristics.
- Those animals that are alike in important ways are found to be in the same class.
- The 5 most well known classes are in the phylum chordata (vertebrates). They are: mammals, reptiles, amphibians, birds, and fish.
- Animals without backbones are in the phylum arthropoda. The 2 most common classes in this phylum are: arachnids (spiders) and insects.

Directions:

Use the internet to answer the following true/false questions about the 5 classes for the vertebrates. Write a T if the statement is true or an F if the statement is false. If the statement is false, correct it to make it true.

Mammals

1. _____ Mammals give birth to live young.
2. _____ Mammals do not have lungs to breathe air.
3. _____ Mammals are cold blooded.
4. _____ Mammals nurse their young with water.

Reptiles

5. _____ Reptiles have fur.
6. _____ Reptiles usually lay eggs.
7. _____ Reptiles have ears for hearing.
8. _____ Reptiles are cold blooded.

Birds

9. _____ All birds have feathers and arms.
10. _____ Birds lay eggs.
11. _____ Birds are cold blooded
12. _____ Birds have two legs.

Amphibians

13. _____ Amphibians live only on the land.
14. _____ Amphibians have webbed feet.
15. _____ Amphibians lay only a couple of eggs.
16. _____ Amphibians are cold blooded.

Fish

17. _____ Fish breathe underwater using lungs.
18. _____ Fish live on the land.
19. _____ Fish have no hair or fur.
20. _____ Fish are cold blooded.

Microscopes
&
The Animal Kingdom

THROUGH THE COMPOUND EYE

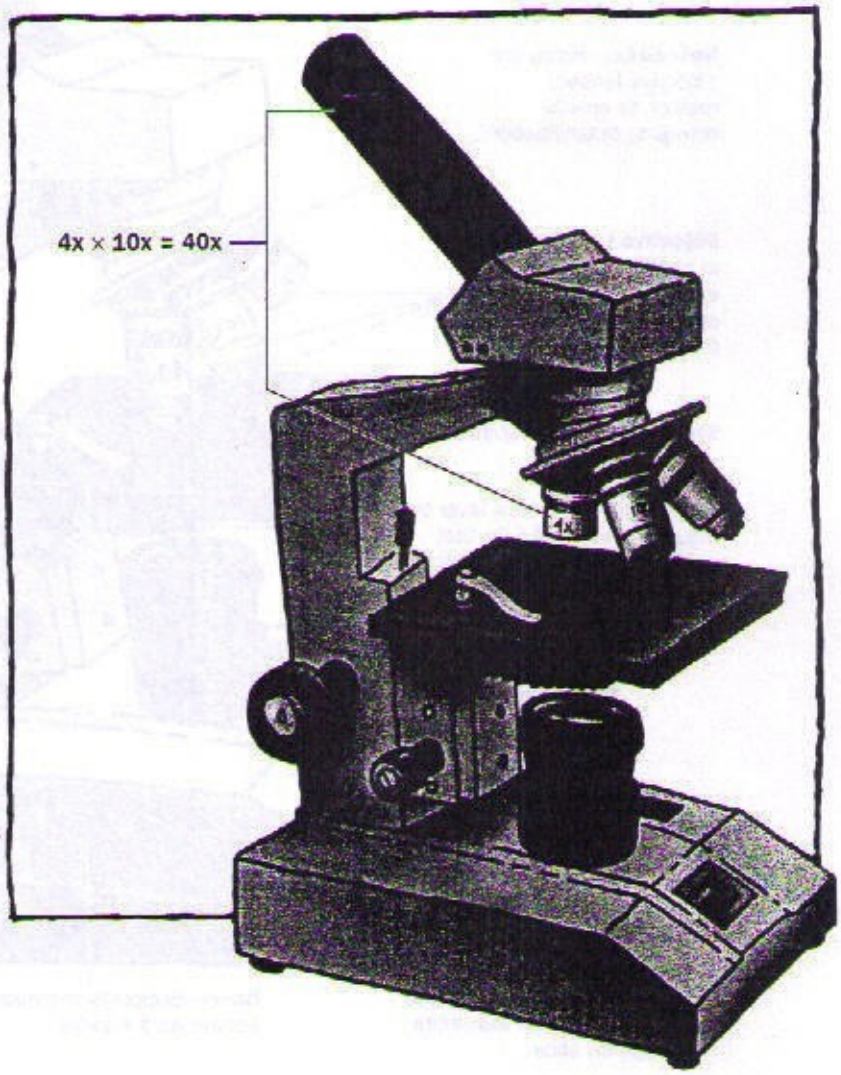
For thousands of years, human beings have used tools. For a biologist, one of the most important tools is the microscope. Since its invention in the early 1600s, the microscope has been transformed into a relatively inexpensive, yet efficient, way for scientists such as yourself to view a world invisible to the naked eye.

You probably will use a compound light microscope during this module. In this type of microscope, light is provided either by a mirror or a small, built-in lightbulb. The word "compound" refers to the two lenses—one in the eyepiece and one in an objective—that together magnify the image. You can calculate the total magnification by multiplying the magnification of the lens of the eyepiece by that of the lens in the objective.

The drawing on page 14 shows the parts of a compound microscope and explains the function of each part.

As you use your microscope during this module, you will gain a working knowledge of its parts and their functions and become much more proficient at using this important tool of science.

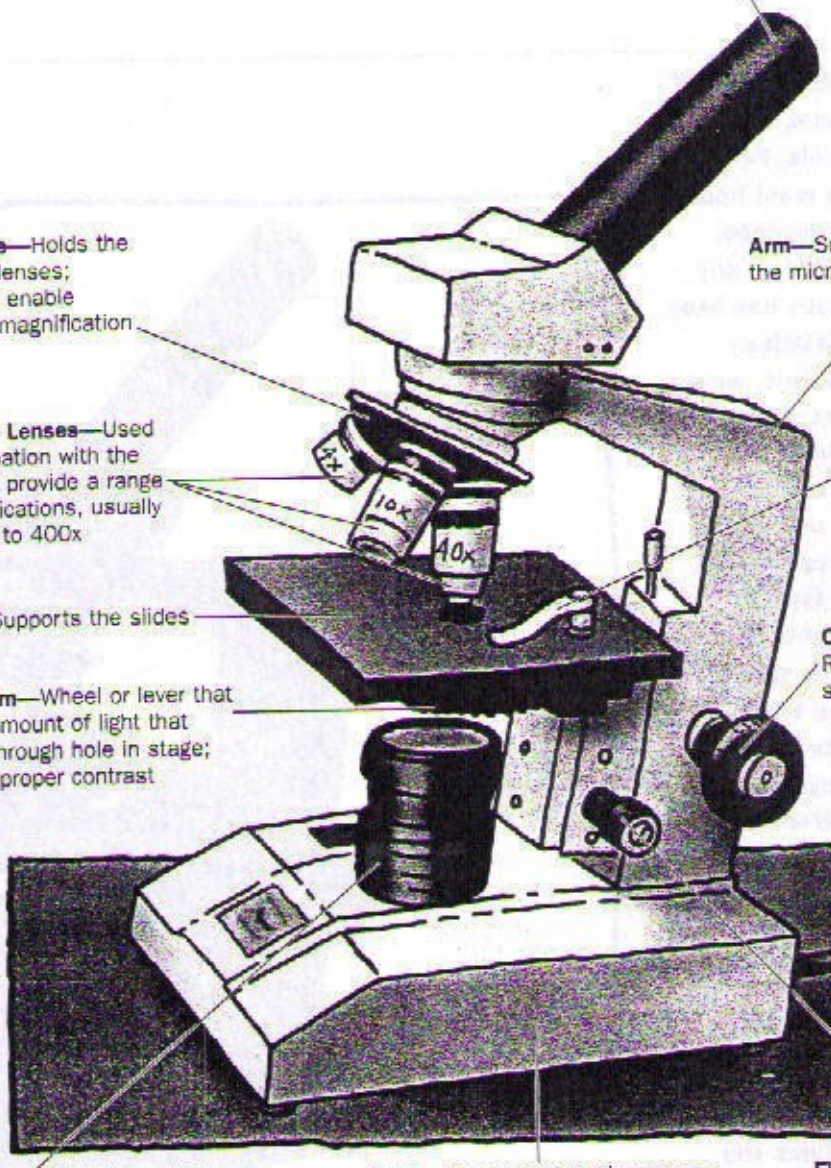
(continued)



Since the eyepiece is 10x and the objective is 4x, the total magnification of these two lenses used together is 40x.

(continued from pg. 13)

The compound light microscope



Name: _____
Date: _____
Period: _____

Lesson 2: Getting Started

What is the name given to the type of lenses being used?

_____

Make a sketch of what you see in your hand lens.

Estimate of the magnification of larger lens: _____

Estimate of the magnification of the smaller lens: _____

A. How does the image of the word "of" change as you raise the lens?

_____

_____

_____

B. What happens to the image of the word "of" in the larger lens as you raise it away from the smaller lens?

_____

_____

_____

USING A COMPOUND MICROSCOPE

Below are 10 sequential steps for using a compound microscope. They should be helpful for your own use and for instructing students.

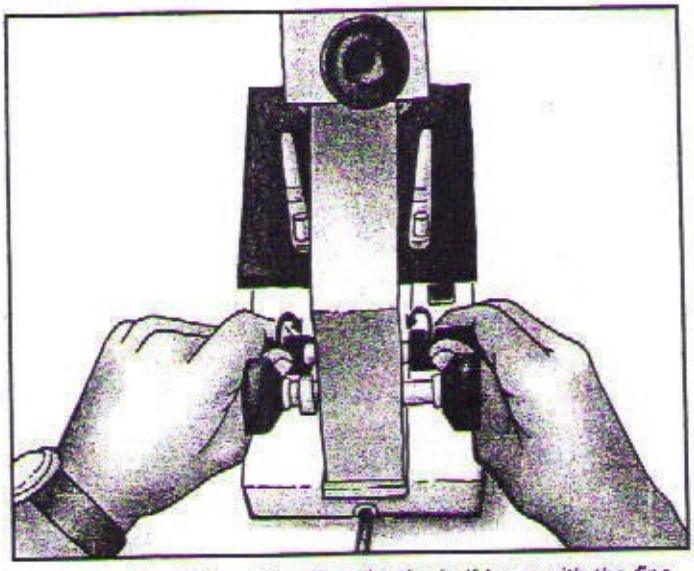


Figure 2.1 *Use this motion to make the half turns with the fine adjustment knobs.*

1. Turn on the light (or adjust the mirror) so that you can see the field of view while looking through the eyepiece.

2. Center the fine adjustment knob in the following manner:

   A. Turn the knobs clockwise with your thumbs, index, and middle fingers until they will not turn any more without considerable force. (Do not force them further.)

   B. Twist the knobs all the way in the opposite direction, as shown in Figure 2.1. Count and remember how many half turns it takes as you do so.

   C. Move the fine adjustment knob to the center of its turning cycle by dividing the number of half turns you made in Step B by two, and then making that number of half turns in the opposite direction. For example, if it took 16 half turns to complete the cycle, move the knobs in the opposite direction 8 half turns. At that point, the fine adjustment will be in the middle of its turning cycle.

3. Open the diaphragm fully. The diaphragm is perhaps the most misused, or unused, feature of the microscope, yet it is one of the most important for optimal viewing. Ensure that students are aware of this feature and have them practice using it consistently.

4. Make sure the lowest power objective lens is clicked into place.

5. Place the center of the slide over the hole in the stage. Carefully move the stage clips over each end of the slide.

6. Center the specimen in the field of view.

7. Use the coarse adjustment knobs to fully raise the stage (or lower the body tube).

8. While looking into the eyepiece, use the coarse adjustment to distance the stage slowly from the objective lens.

9. When you begin to see the object, use the fine adjustment knobs to focus more clearly.

10. If necessary, adjust the diaphragm to get the proper shading.

Name: _____

Date: _____

Period: _____

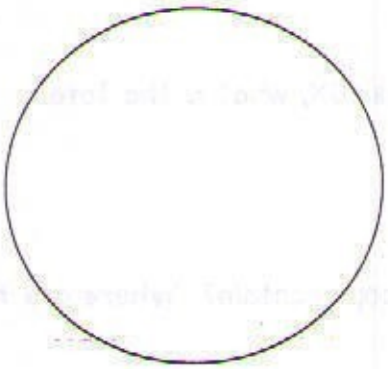
Practice with a Microscope

Specimen Name: _____

Magnification: _____

Specimen Name: _____

Magnification: _____



Specimen Name: _____

Magnification: _____

Specimen Name: _____

Magnification: _____

Wrap-up Questions:

1. Which objective do you always want to begin with? Explain why.

2. Which part of the microscope controls the amount of light that passes through the hole?

3. Which part of the microscope is used for focusing the image?

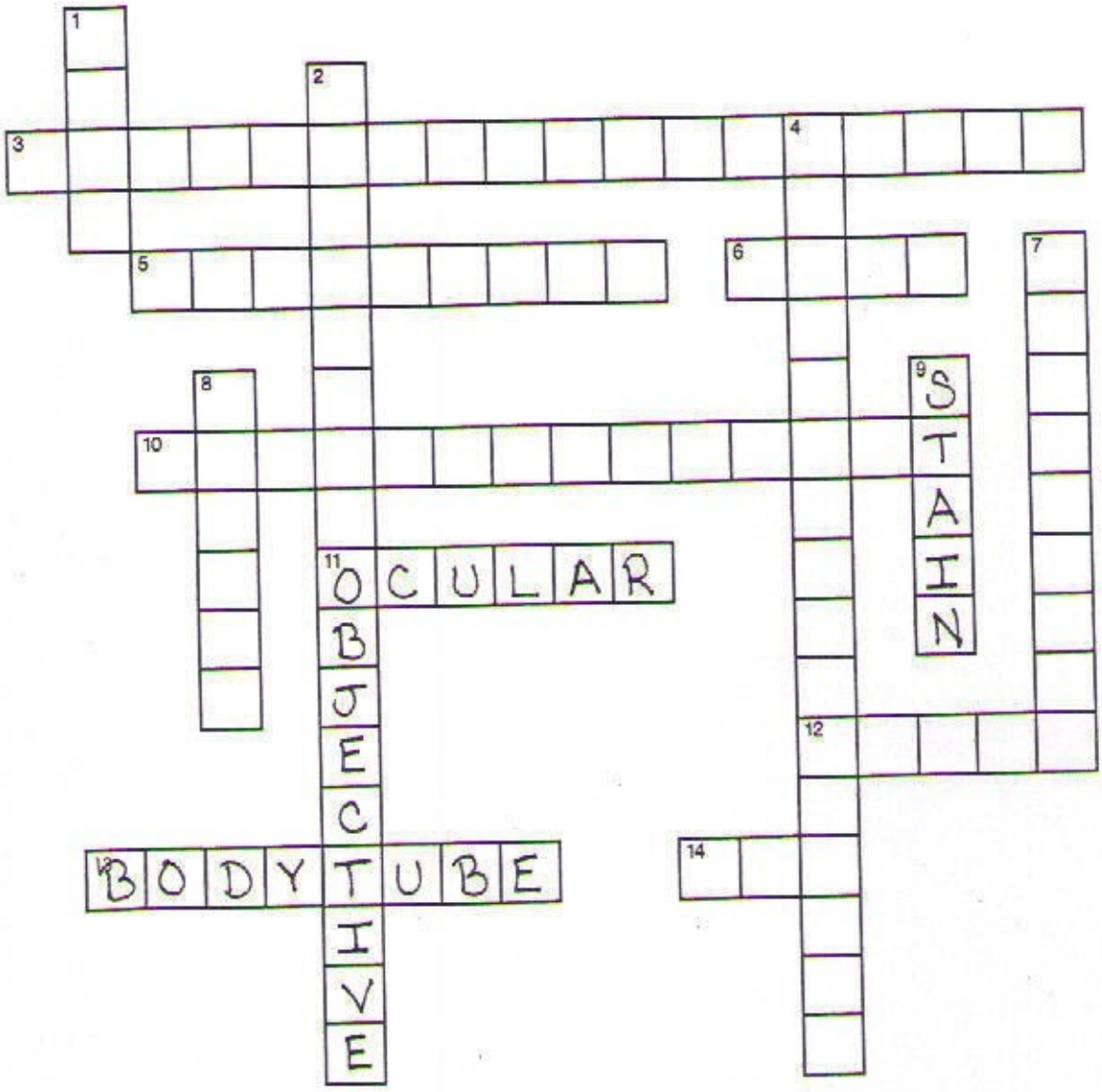
4. Which part of the microscope fully raises the stage?

5. If the eyepiece is 10X and the objective is 10X, what is the total magnification of the object in view?

6. How many lenses does a compound microscope contain? Where are these lenses located?

MICROSCOPE CROSSWORD

Name _____



Across

3. Lens that allows greater magnification
5. Regulates the amount of light
6. The microscope rests on this.
10. Used for final focusing
11. Eyepiece
12. Platform upon which to mount the slide
13. Holds eyepiece lens at top and objective lens at bottom
14. Holds the tube and stage, and attaches them to the base

Down

1. Holds the slide in place
2. Lens used to locate the specimen
4. Used for first focusing
7. Rotating piece that holds objective lens
8. Reflects light to the specimen
9. Chemical sometimes used to make the specimen visible

MICROSCOPE PIONEERS

You can't study organisms thoroughly without a good microscope. This tool, which today's scientists take for granted, has played a major role in helping scientists understand more about living things.

Robert Hooke and Antony van Leeuwenhoek (Lay-ven-HOKE) were important pioneers in the development of this important scientific instrument. Hooke was born in England in 1635. A member of the Royal Society of England, he was one of the most famous scientists of his time. Leeuwenhoek was born in the Dutch town of Delft in 1632.

COURTESY OF THE LIBRARY OF CONGRESS

Cork cells as seen by Robert Hooke

Hooke: Discovering the Mysteries of Cork

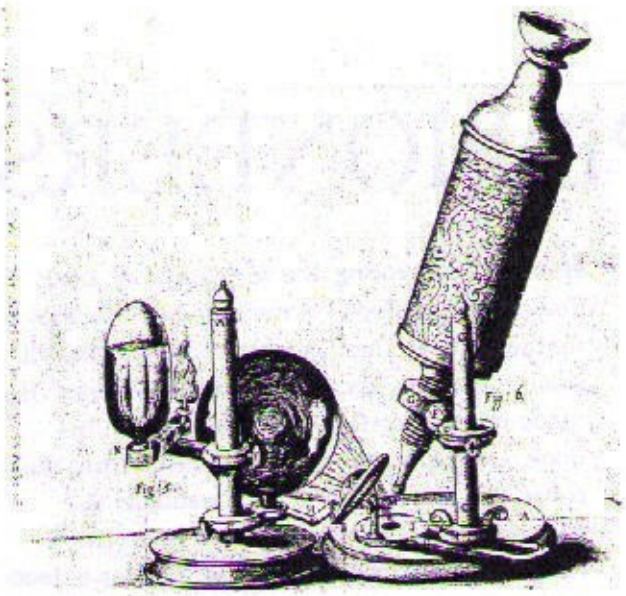
Today, Robert Hooke is remembered more as a mathematician than as a biologist. But like all scientists of his day, he had broad interests. He made many contributions to biology. In his book, *Micrographia*, Hooke described and illustrated the discoveries he had made using a compound microscope that he'd built. Hooke used the microscope to observe familiar objects such as insects, sponges, and feathers. When he put a thin slice of cork under the lens of his microscope, Hooke made a very important discovery. He saw the cell walls in the cork tissue. Hooke had discovered plant cells.

Even though his discoveries were amazing in his day, Hooke's microscope was quite crude. It didn't look that different from today's microscopes, but it had poorly ground lenses, which caused Hooke's view of the objects to be blurred or distorted. What's more, early microscopes could not magnify objects more than 20 or 30 times their actual size. By contrast, most microscopes found in middle schools today can magnify objects up to 430 times.

Leeuwenhoek Perfects the Lens

Leeuwenhoek's major contribution to the development of the microscope was to make lenses that were much more finely ground than those used by Hooke and others. He never went to college, and he earned a living by selling fabric in a small shop. For him, making microscopes was a hobby that became a lifelong obsession.

Leeuwenhoek learned to grind lenses by observing the craftsmen who made eyeglasses in Delft. Leeuwenhoek's lenses, often no more than 0.3 centimeters across, were so even and perfect they provided clear images that were free of distortion. They could magnify objects to between 50 and 300 times their actual size. He mounted the tiny lenses in frames of gold and silver that he also crafted himself.



Hooke's microscope was called a "compound microscope" because it had two lenses.

HISTORICAL COLLECTIONS, NATIONAL MUSEUM OF HEALTH & MEDICINE, ARMED FORCES INSTITUTE OF PATHOLOGY, WASHINGTON, D.C.

Leeuwenhoek's microscope

Unlike Hooke's compound microscope, Leeuwenhoek's device had only one lens. It was mounted in a tiny hole in a brass plate. Leeuwenhoek placed the object he wanted to examine on a sharp point in front of the lens. He adjusted the position with the screws. The entire device was less than 10 centimeters long.

For a scientist, good tools are just the start. Scientists also need the ability to observe carefully and to record their findings accurately. They need patience. Leeuwenhoek had all these qualities; in addition, he was very curious. He wrote about everything he saw, from algae on pond water to mineral crystals and fossils. He discovered microscopic organisms in rainwater. He discovered blood cells and was the first to see living sperm in an insect. He is credited with publishing the first drawing of bacteria.

Leeuwenhoek stuck just about everything under his lens—including plaque from his own teeth! What did he see? Something that wouldn't surprise your dentist at all. "I saw . . . many very little living animalcules," he wrote. "Very prettily a-moving. The biggest . . . had a very strong and swift motion . . . and shot through the water. The second . . . spun around like a top."

Hooke passed away in 1703, and Leeuwenhoek died in 1723, at the age of 91. Both had become world famous. Leeuwenhoek was so famous that Peter the Great, czar of Russia, once came to Delft to visit him at his home.

The science of microscopy has made great progress since the time of Hooke and Leeuwenhoek. To get an idea of how much progress, take a look at the image of a mite. It was taken through a scanning electron microscope that has a magnification range of from 15 to 200,000 times! □

ERIC ERDE, AGRICULTURAL RESEARCH SERVICE/UNITED STATES DEPARTMENT OF AGRICULTURE

This mite, which measures 150–200 microns in length (1/1000 mm), is magnified 850 times its actual size.

Name: _____
Date: _____
Period: _____

LESSON 3: INVESTIGATING BLACKWORMS LAB

Getting Started: step 5 questions

A. What familiar organism does the blackworm resemble?

_____

_____

B. In what way(s) does the blackworm resemble this organism?

_____

_____

C. In what way(s) is it different from this organism?

_____

_____

D. Explain how you can identify the anterior and posterior ends of your blackworm.

_____

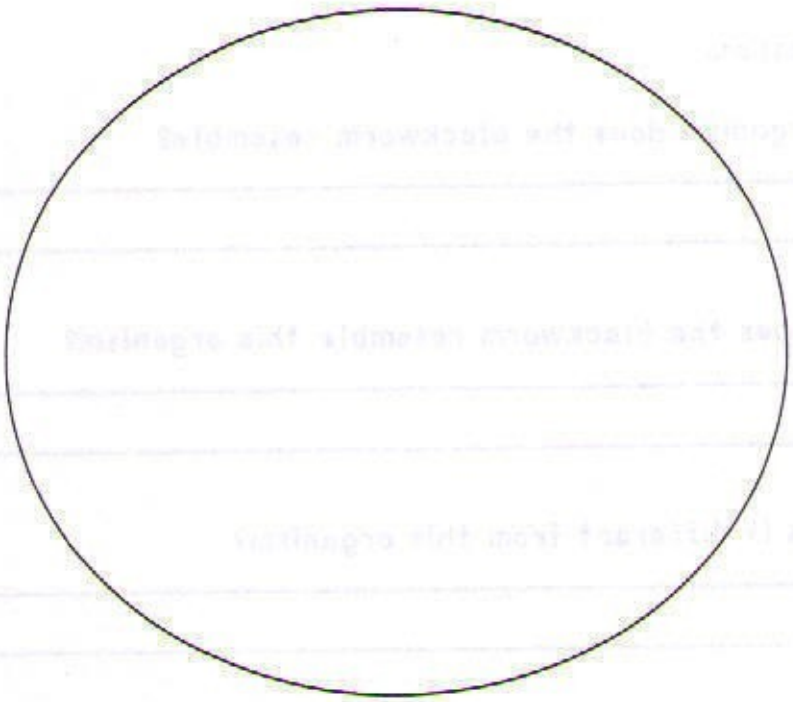
_____

_____

_____

Inquiry 3.1: Drawing the Blackworm

Label at least 4 of the following:
A blood vessel, the chaetae, the digestive tract, a body segment, the anterior end, the posterior end.



Magnification: _____

Name of Specimen:

_____

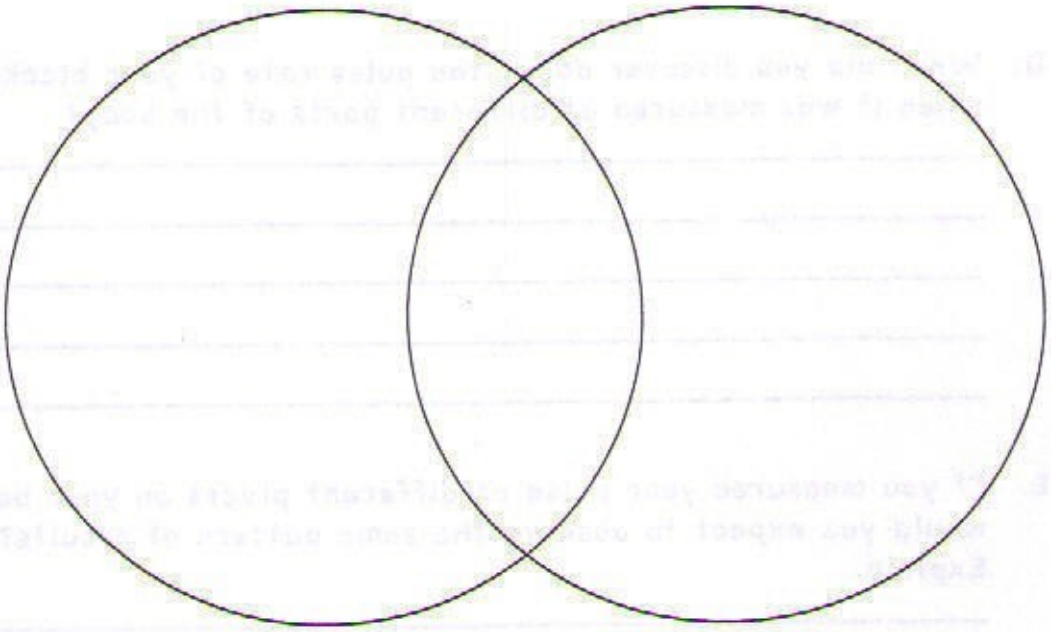
Inquiry 3.2: Determining the Pulse Rate of a Blackworm

Pulse Rate Data Table

Trial Number	Pulse Rate (pulsations/minute)	Average Pulse Rate (pulsations/minute)
1		
2		
3		
4		

Reflections:

A. Use a Venn diagram to summarize the similarities and differences between the blackworm and the common earthworm.



B. You may have noticed that one or both ends of some of the blackworms are lighter in color than the rest of their bodies. What is the probable reason for this?

C. Why do blackworms make some of their unusual movements?

D. What did you discover about the pulse rate of your blackworm when it was measured at different parts of the body?

E. If you measured your pulse at different places on your body, would you expect to observe the same pattern of results? Explain.

F. Lisa says that, in addition to being fairly active, blackworms are much larger than organisms usually studied through the microscope. Because of this, she believes blackworms have a more complex way of moving food and oxygen through their bodies. What evidence have you observed to support Lisa's statement?

G. What evidence did you observe that regeneration might have occurred in your blackworm(s)?

_____

_____

_____

_____

_____

H. What is the genus and species of the blackworm?

Genus: _____

Species: _____

More Than Just Bait

What do you get when you cut a blackworm in half?

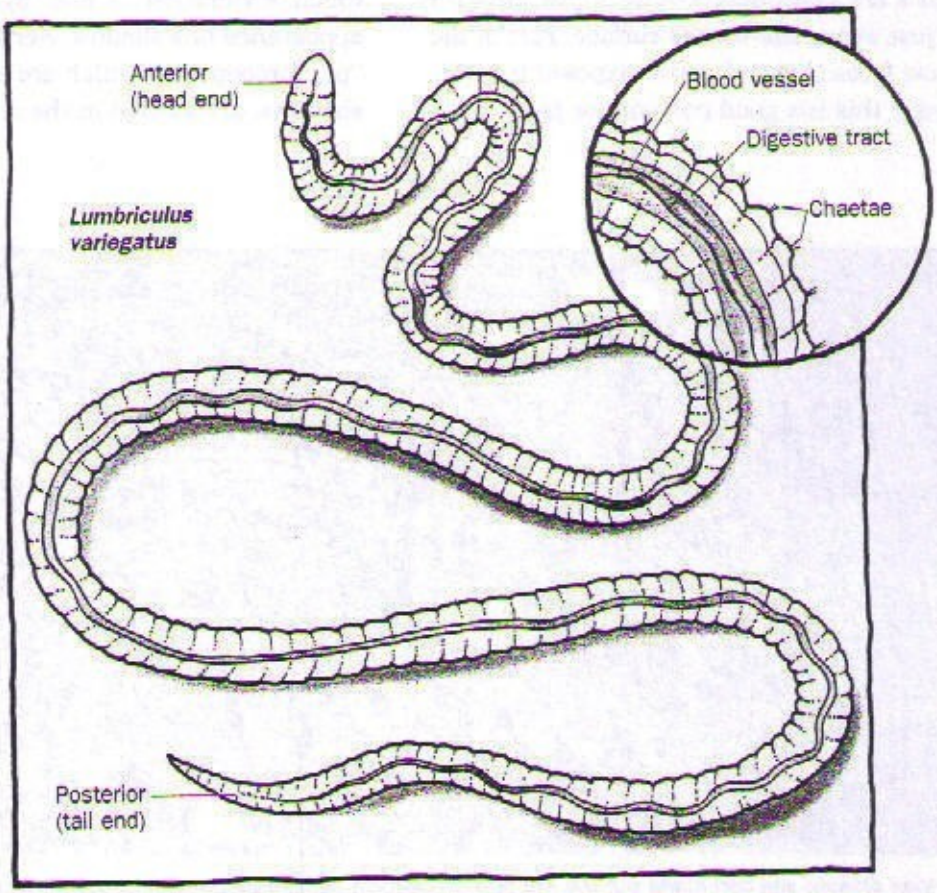
A. One dead worm
B. Two live worms
C. A bloody mess

Strangely, the answer is B. This amazing worm, whose scientific name is *Lumbriculus variegatus*, can be cut into several fragments—and it won't die or even bleed. Instead, it regenerates a new head or tail, or both, from the various pieces.

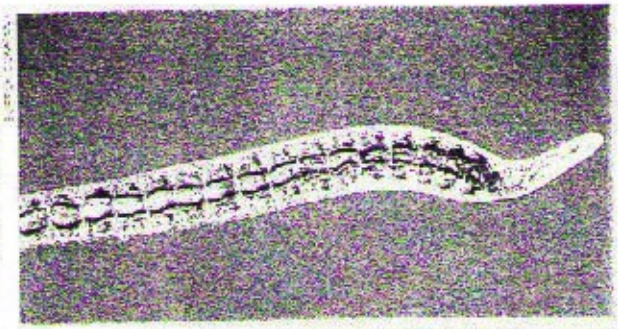
What's more amazing is that the blackworm is not a rare animal living in some faraway place. Usually no more than 10 centimeters long, this worm lives in the shallow edges of ponds, marshes, and lakes throughout North America and Europe.

Despite its short length, a mature blackworm has between 150 and 250 body segments. Even a fragment of blackworm only a few segments long can regenerate lost body parts—fast. In fact, fragmentation, followed by regeneration, is much more common than sexual reproduction in blackworms.

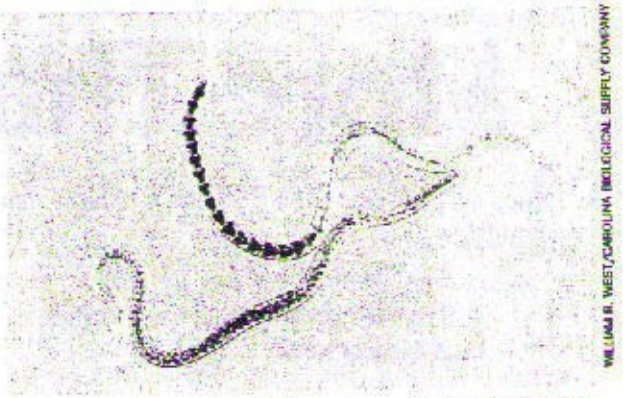
"The segments regenerate quickly," says Dr. Charles Drewes, a zoologist who has studied blackworms for many years. "For example, a new head or tail usually develops within 2 to 3 weeks. The new segments—usually eight for a head and between 20 and 100 for a tail—are smaller and paler than the original ones."



Basic anatomy of an adult blackworm



You can tell that the anterior end of this blackworm has undergone regeneration because of its pale color.



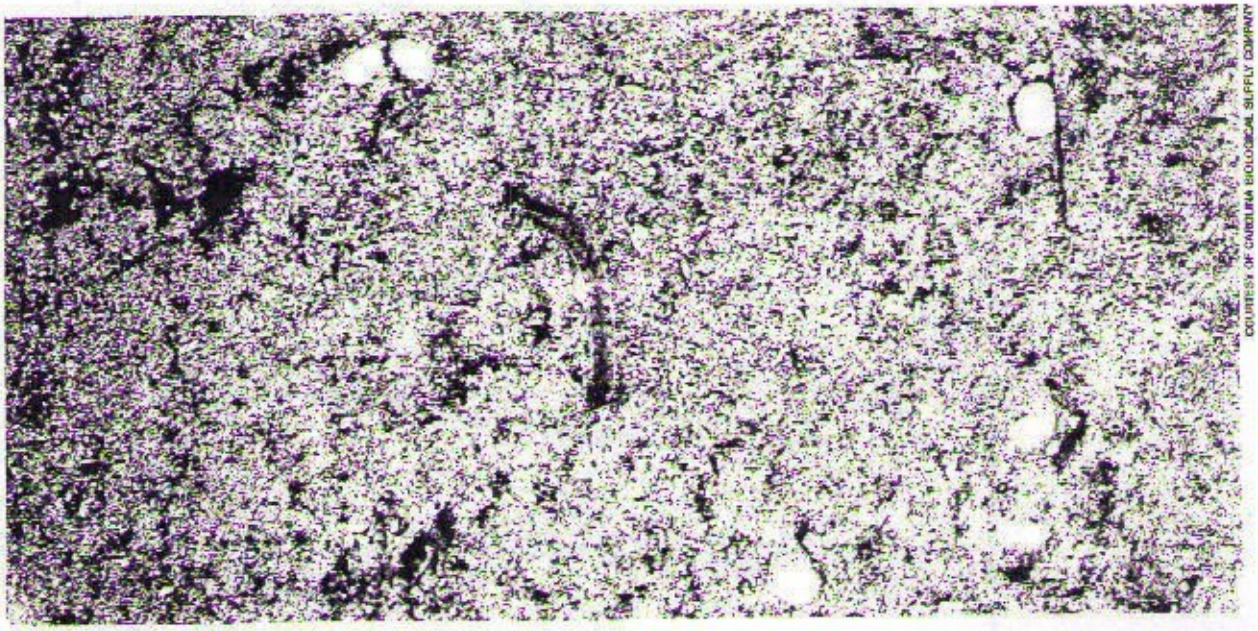
WILLIAM B. WEST/CAROLINA BIOLOGICAL SUPPLY COMPANY

Note the lighter color of the regenerated head and tail ends of these blackworms.

A Worm With a Rapid Reflex

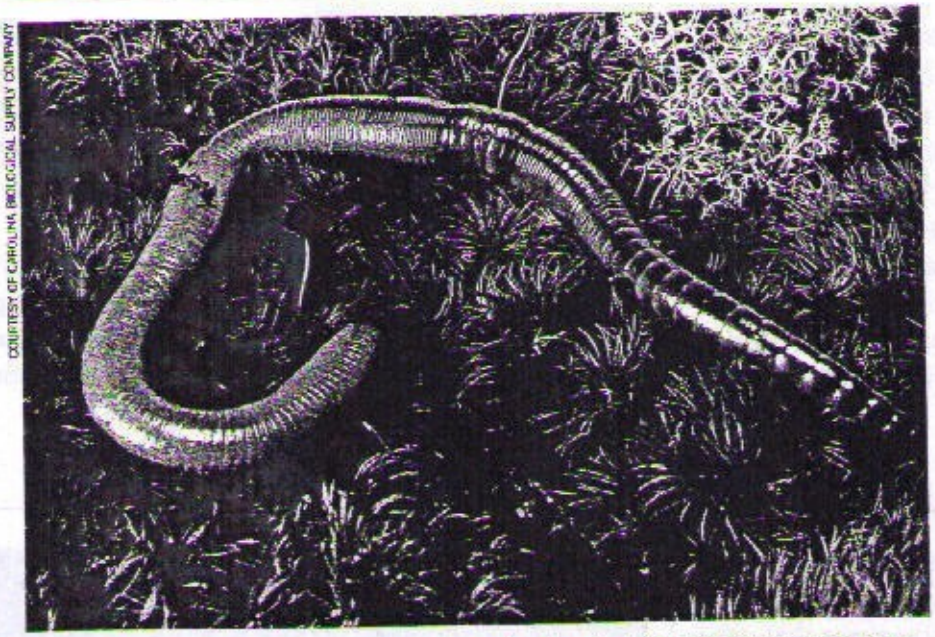
The blackworm "swims" by twisting its body through the water in a corkscrew fashion. If the water in which it lives is shallow enough, a blackworm will stretch its tail to the surface of the water. It then bends its tail at a right angle so that a few centimeters of its dorsal surface is lying just above the water's surface. Part of the tail now faces skyward and is exposed to air. Although this is a good position for gas exchange of oxygen and carbon dioxide, it exposes the blackworm's tail to its enemies.

To offset the problem of the tail's exposure, the worm uses a special rapid escape reflex. The tail end rapidly shortens in response to a threatening enemy. This reflex can be triggered by touch, a vibration, or even by the sudden appearance of a shadow. Nerve cells, called "photoreceptors," which are able to detect these shadows, are located in the blackworm's tail.



COURTESY OF CAROLINA BIOLOGICAL SUPPLY COMPANY

If you look closely, you can make out the tail of a blackworm bent to be parallel to the surface of this pond.



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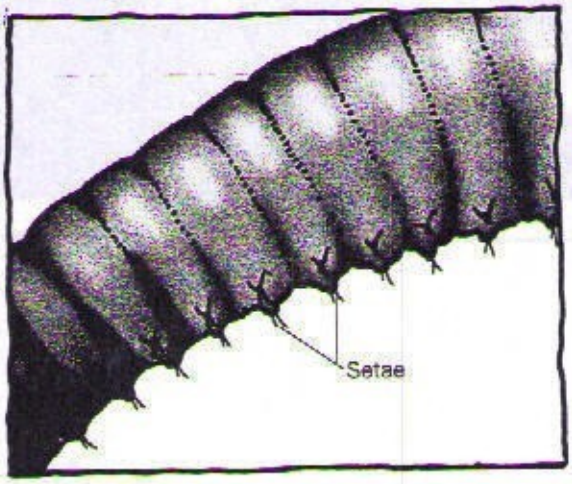
The bulge around the earthworm near its center is called the clitellum. It produces mucus that forms a cocoon for the worm's eggs.

It's All in the Family

If you haven't seen a blackworm in the wild, you've likely seen its relative, *Lumbricus terrestris*, the common earthworm. It, too, lives throughout North America and Europe—but in the soil. It can grow up to 25 centimeters long, and like the blackworm, it has the gift of regeneration.

A mature earthworm has about 150 segments. It also has a light-colored bulge on its body, called the clitellum. If an earthworm is cut in two, only the part with the clitellum can regenerate. The part without the clitellum will die.

The next time you see an earthworm, look for its clitellum. Look even more carefully and you'll also see tiny hairs on each segment of its body. These hairs, called setae (SEE-tee), help earthworms move by giving them many tiny grips on the soil. In blackworms, similar hairs are referred to as chaetae.



These tiny hairs help the earthworm cling to the soil as it moves.

COURTESY OF CAROLINA BIOLOGICAL SUPPLY COMPANY

This magnified photo of an earthworm's seta allows you to see its actual structure.

Earth Movers

Earthworms have remarkable regeneration powers, and they are also terrific diggers. These mini-bulldozers actually plow and fertilize soil!

Here's how: First, they eat bits of soil, decaying leaves, and bacteria and other microorganisms. (Each bite enlarges their network of underground tunnels.) With digestive systems the length of their bodies, they next grind and mix their food. Then they expel their waste, called castings, which is actually first-rate, nutrient-rich soil. Throughout this process, these tiny farmers till the earth by bringing subsoil to the surface. That's not all! Their tunnels give air and water easy access to the roots of plants, helping them to grow.

Both blackworms and earthworms are amazing animals that deserve our respect. So while we may have to look down to find them, we should never look down on them. □

Are blackworms and earthworms the only two organisms that can undergo regeneration? Hardly! Another amazing regeneration story belongs to the starfish. A starfish can grow a new arm, or ray, if it loses one. A few starfish species can even regenerate an entire body from a single ray. In some cases, several starfish can result from one starfish that gets cut into pieces.

The shape of this starfish will become more typical as its parts regenerate fully.

The Plant Kingdom

Name _____ Date _____ Class _____

CHAPTER 4

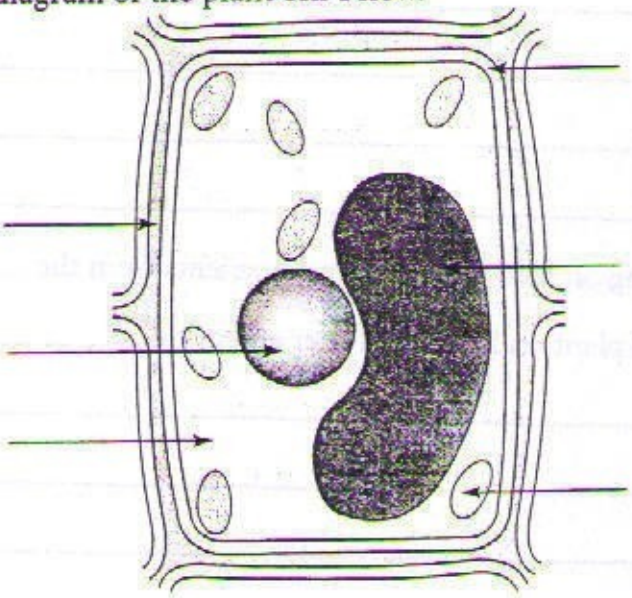
INTRODUCTION TO PLANTS

SECTION 4–1 The Plant Kingdom (pages 110-117)

This section explains the features that all plants have. It also describes what plants need to survive and how they reproduce.

▶ What Is a Plant? (pages 111–112)

1. Circle the letter of each characteristic that all plants share.
   a. heterotroph b. autotroph c. prokaryote d. eukaryote
2. Is the following sentence true or false? Plants make their own food in the process of photosynthesis. _____
3. Plant cells have a(n) _____, a boundary that surrounds the cell membrane and separates the cell from the environment.
4. Cell walls are made mostly of _____, a chemical that makes the walls rigid.
5. Label the diagram of the plant cell below.



Name _____ Date _____ Class _____

6. Is the following sentence true or false? Only some plants are multicellular. _____

7. A group of similar cells that perform a specific function in an organism is a(n) _____.

▶ Origin of Plants (page 112)

8. How do biologists learn which organisms were the ancestors of today's plants? _____

9. A green pigment found in the chloroplasts of plants is called _____.

10. Why do biologists think that ancient green algae were the ancestors of today's plants? _____

▶ Living on Land (pages 113–116)

11. List five things that plants must do to survive on land.

a. _____

b. _____

c. _____

d. _____

e. _____

12. Plants living on land get water and nutrients from the _____.

13. Why can a plant on land lose water and dry out? _____

Name _____ Date _____ Class _____

14. Circle the letter of one adaptation that land plants have to keep from drying out.

a. chlorophyll b. cell wall

c. cuticle d. vascular tissue

15. Some plants move water, minerals, and food with an internal system of tubelike structures called _____.

16. Is the following sentence true or false? Some land plants are supported by vascular tissue. _____

17. What occurs during fertilization? _____

_____

18. Circle the letter of the name of a fertilized egg.

a. sporophyte b. gamete

c. gametophyte d. zygote

▶ Complex Life Cycles (page 117)

19. Plants produce spores during the _____ stage and produce gametes during the _____ stage.

20. Is the following sentence true or false? The sporophyte of a plant looks the same as the gametophyte. _____

21. What are two kinds of gametes that a gametophyte produces?

a. _____ b. _____

Reading Skill Practice

A concept map is a useful tool for organizing information. Make a concept map that shows the characteristics shared by all plants described in *What Is a Plant?* on pages 111–112. For more information about concept maps, see page 190 in the Skills Handbook of your textbook. Do your work on a separate sheet of paper.

Name _____ Date _____ Class _____

SECTION 4-1 **SECTION SUMMARY**

The Plant Kingdom

Guide for Reading

- What characteristics do all plants share?
- What do plants need to live successfully on land?

Plants are autotrophs that produce their own food. In addition, all plants are eukaryotes that contain many cells.

The process by which plants make food is called **photosynthesis.** During photosynthesis, a plant uses carbon dioxide gas and water to make food and oxygen.

Plant cells are enclosed by a **cell wall,** a boundary that surrounds the cell membrane and separates the cell from the environment. Plant cell walls are made mostly of **cellulose,** a chemical that makes the walls rigid. Plant cells contain **chloroplasts,** structures in which food is made. Plant cells also contain **vacuoles.** A **vacuole** is a large sacklike storage area. The vacuole stores many things including water, wastes, and food. Plant cells are organized into **tissues,** groups of similar cells that perform a specific function.

Fossils that biologists study show that early plants looked like green algae. Another clue that ancient green algae were the ancestors of today's plants is that both green algae and plants contain **chlorophyll. Chlorophyll** is a green pigment found in the chloroplasts of plant cells.

Most plants live on land. **For plants to survive on land, they must have ways to obtain water and other materials from their surroundings, retain water, transport materials throughout the plant, support their bodies, and reproduce successfully.**

Most plants have a waxy, waterproof layer covering their leaves called a **cuticle.** The cuticle helps keep water inside a plant cell rather than let it evaporate into the air.

Some plants have **vascular tissue,** an internal system of tubelike structures through which food and water move inside the plant. The vascular tissue also strengthens and supports the large bodies of plants.

All plants undergo sexual reproduction that involves **fertilization. Fertilization** occurs when a sperm cell unites with an egg cell. The fertilized egg is called a **zygote.**

Plants have complex life cycles that are made up of two different stages. In one stage, called the **sporophyte,** the plant produces spores. Spores are tiny cells that can grow into new organisms. A spore develops into the second stage, called the **gametophyte.** In this stage, the plant produces **gametes,** which are sperm cells and egg cells.

Name _____ Date _____ Class _____

SECTION 4-1 REVIEW AND REINFORCE

The Plant Kingdom

◆ Understanding Main Ideas

Answer the following on a separate sheet of paper.

1. What characteristics do all plants share?
2. What do plants need to live successfully on land?

◆ Building Vocabulary

From the list below, choose the term that best completes each sentence and write it in the blank.

photosynthesis	cell wall	cellulose	chlorophyll	gametophyte
chloroplast	vacuole	tissue	cuticle	gamete
vascular tissue	fertilization	zygote	sporophyte	

3. A group of similar cells that perform a similar function is called a(n) _____.
4. Internal transporting system through which water and food move inside the plant is called _____.
5. In the _____ stage, the plant produces two kinds of sex cells.
6. The _____ is a structure inside a plant's cell in which food is made.
7. The process by which plants make food is called _____.
8. Plant cell walls are made mostly of _____.
9. When a sperm cell unites with an egg cell, _____ occurs.
10. A(n) _____ is a waxy, waterproof layer that covers the leaves of most plants.
11. A storage area in a plant is called a(n) _____.
12. The green pigment called _____ reflects most of the green light in the visible spectrum.
13. In the _____ stage, the plant produces spores.
14. The _____ is a boundary that surrounds the cell membrane.
15. A(n) _____ is either a sperm cell or an egg cell.
16. A fertilized egg is called a(n) _____.

SECTION 4-2 Photosynthesis and Light (pages 120-124)

This section explains how plants get energy from sunlight and describes what occurs during photosynthesis.

▶ The Nature of Light (pages 120–121)

1. Circle the letter of each sentence that is true about light.
   a. The sun is the source of energy on Earth.
   b. The light you can see is called a prism.
   c. White light is made up of red, orange, yellow, green, blue, and violet light.
   d. Shiny surfaces absorb light and dark surfaces reflect light.
2. The colors of light that make up white light are referred to as the _____.
3. A shirt looks red because it _____ red light.

▶ Plants and Light (pages 121–122)

4. Circle the color of light that is reflected by plant leaves.
   a. green b. red c. yellow d. blue
5. Light is absorbed by _____ found in the chloroplasts of plant cells.
6. Circle the letter of each color of light that is absorbed by chlorophyll.
   a. green b. blue c. yellow d. red
7. Circle the letter of each sentence that is true about plant pigments.
   a. Accessory pigments absorb the same colors of light that chlorophyll does.
   b. Accessory pigments are always visible in plants.
   c. Chlorophyll masks the color of most accessory pigments during most of the year.
   d. In cool temperatures, chlorophyll breaks down and the colors of accessory pigments can be seen.

Name _____ Date _____ Class _____

8. How is the light energy absorbed by plants important to photosynthesis?

_____

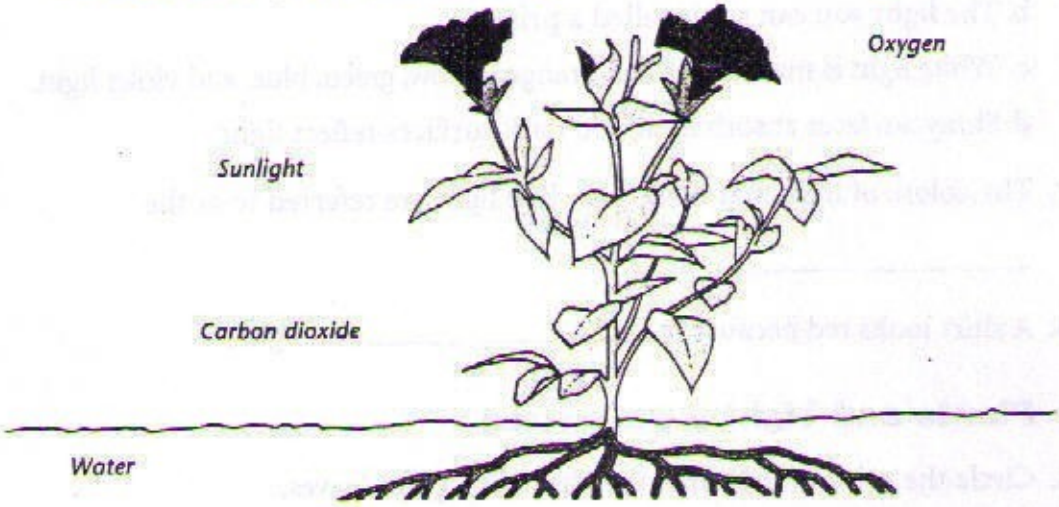
_____

▶ The Chemistry of Photosynthesis (pages 123–124)

9. In addition to light, what do plants need for photosynthesis?

_____

10. In the diagram below, draw arrows to show which materials the plant is taking up and which materials the plant is giving off or using.



11. Write the chemical equation for the process of photosynthesis.

_____

12. What happens to excess food made by plants? _____

_____

Reading Skill Practice

A summary helps you to review the main ideas of something you have read. Write a summary of the subsections *Plants and Light* and *The Chemistry of Photosynthesis*. The summary should be much shorter in length than the actual text. However, the summary should include all the main ideas. Do your work on a separate sheet of paper.

Name _____ Date _____ Class _____

SECTION 2-1 **SECTION SUMMARY**

Photosynthesis

Guide for Reading

- What happens during the process of photosynthesis?
- How does the sun supply living things with the energy they need?

2

The sun provides almost all the energy used by living things on Earth. All cells need energy to carry out their functions. The process by which a cell captures the energy in sunlight and uses it to make food is called **photosynthesis.**

During photosynthesis, plants and some other organisms use energy from the sun to convert carbon dioxide and water into oxygen and sugars, including glucose. You can think of photosynthesis as taking place in two stages. The first stage of photosynthesis involves capturing the energy in sunlight. In plants, this energy-capturing process occurs in the leaves and other green parts of the plant. The chloroplasts in plant cells give plants their green color. The green color comes from **pigments,** colored chemical compounds that absorb light. The main pigment found in the chloroplasts of plants is **chlorophyll.** The pigments capture light energy and use it to power the second stage of photosynthesis. In the second stage of photosynthesis, the cell uses the captured energy to produce sugars. The cell needs two raw materials for this stage: water (H_2O) and carbon dioxide (CO_2). In plants, the roots absorb water from the soil. Carbon dioxide enters the plant through small openings on the undersides of the leaves called **stomata.**

The events of photosynthesis can be summed up in a chemical equation. The raw materials—six molecules of carbon dioxide and six molecules of water—are on the left side of the equation. The products—one molecule of glucose and six molecules of oxygen—are on the right side of the equation. An arrow connects the raw materials to the products. Light energy, which is necessary for the chemical reaction to occur, is written above the arrow.

A plant is an **autotroph,** an organism that makes its own food. The plant's leaves contain sugars made during photosynthesis. A caterpillar is a **heterotroph,** an organism that cannot make its own food. To live, grow, and perform other functions, the caterpillar needs the energy in plant sugars. By eating plants, heterotrophs get energy from the sun in an indirect way. **Nearly all living things obtain energy either directly or indirectly from the energy of sunlight captured during photosynthesis.** Photosynthesis also is essential for the air you breathe. Almost all the oxygen in Earth's atmosphere was produced by living things through the process of photosynthesis.

Name _____ Date _____ Class _____

SECTION 2-1 REVIEW AND REINFORCE

Photosynthesis

◆ Understanding Main Ideas

Fill in the blanks in the photosynthesis equation below with the names of the missing compounds. Then answer the questions that follow in the spaces provided.

1. _____ + 2. _____ $\xrightarrow{\text{sunlight}}$ 3. _____ + 4. _____

5. What are the raw materials of photosynthesis?

_____

6. What are the products of photosynthesis?

_____

7. Why is *sunlight* written above the arrow in the equation, rather than on either side of it?

_____

_____

_____

8. Where does photosynthesis occur?

_____

_____

◆ Building Vocabulary

Fill in the blank to complete each statement.

9. The process by which a cell captures the energy in sunlight and uses it to make food is called _____.

10. _____ are colored chemical compounds that absorb light.

11. The main pigment found in the chloroplasts of plants is _____.

12. _____ are small openings on the undersides of leaves through which carbon dioxide enters a plant.

13. An organism that makes its own food is a(n) _____.

14. A(n) _____ is an organism that cannot make its own food.

Name _____ Date _____ Class _____

SECTION 2-2 **SECTION SUMMARY**

Respiration

Guide for Reading

- What events occur during respiration?
- How are photosynthesis and respiration related?
- What is fermentation?

2

Cells store and use energy in a way that is similar to the way you deposit and withdraw money from a savings account. When you eat a meal, you add to your body's energy savings account. When your cells need energy, they make a withdrawal and break down the glucose in food to release energy.

The process by which cells "withdraw" energy from glucose is called **respiration. During respiration, cells break down simple food molecules such as glucose and release the energy they contain.** Because living things need a continuous supply of energy, the cells of all living things carry out respiration continuously. The term *respiration* also is used to mean breathing, that is, moving air in and out of your lungs. To avoid confusion, the respiration process that takes place inside cells sometimes is called cellular respiration. The two kinds of respiration are related. Breathing brings oxygen into your lungs, and oxygen is necessary for cellular respiration to occur in most cells.

The overall process of respiration can be summarized in a simple chemical equation. However, respiration is a complex, two-stage process. The first stage takes place in the cytoplasm of the organism's cells. There, glucose molecules are broken down into smaller molecules. Oxygen is not involved in this stage of respiration, and only a small amount of energy is released. The second stage of respiration takes place in the mitochondria. There, the small molecules are broken down into even smaller molecules. These chemical reactions require oxygen, and a great deal of energy is released. Two other products of respiration are carbon dioxide and water.

Photosynthesis and respiration can be thought of as opposite processes. Together, these two processes form a cycle that keeps the levels of oxygen and carbon dioxide fairly constant in the atmosphere.

Some cells obtain their energy through **fermentation,** an energy-releasing process that does not require oxygen. **Fermentation provides energy for cells without using oxygen.** One type of fermentation occurs in yeast and some other single-celled organisms. This process is sometimes called alcoholic fermentation because alcohol is one of the products made when these organisms break down sugars. Another type of fermentation takes place at times in your body, for example, when you've run as fast as you could for as long as you could. One product of this type of fermentation is an acid known as lactic acid. When lactic acid builds up, your muscles feel weak and sore.

Name _____ Date _____ Class _____

SECTION 2-2 **REVIEW AND REINFORCE**

Respiration

◆ Understanding Main Ideas

Fill in the blanks in the table below. Then answer the questions that follow in the spaces provided.

Respiration

Raw Materials	Products
1.	3.
2.	4.
	5.

6. Where in the cell does the first stage of respiration take place?

_____

7. Where in the cell does the second stage of respiration take place?

_____

8. How does fermentation differ from respiration?

_____

_____

9. Which type of fermentation occurs in yeast?

_____

10. Which type of fermentation sometimes occurs in people?

_____

◆ Building Vocabulary

If the statement is true, write true. If it is false, change the underlined word to make it true.

_____ 11. The process by which cells "withdraw" energy from glucose is called photosynthesis.

_____ 12. Respiration is an energy-releasing process that does not require oxygen.

Name _____ Date _____ Class _____

SECTION 4-2 **SECTION SUMMARY**

Photosynthesis and Light

Guide for Reading

- What happens when light strikes a green leaf?
- How do scientists describe the overall process of photosynthesis?

The light that you see is called white light. White light is made up of the colors of the rainbow—red, orange, yellow, green, blue, and violet. These colors are called the visible spectrum. Some objects reflect some colors of the visible spectrum and absorb others. When light strikes a red shirt, the shirt absorbs most colors and reflects red. The shirt looks red because your eyes see the reflected color.

Like most other objects, plants absorb some colors and reflect others. **When light strikes the leaves of a plant, most of the green part of the spectrum is reflected while most of the other colors of light are absorbed.** The light is absorbed by chlorophyll, the green pigment in the plant. Most of the pigments reflect green light. Other pigments, called **accessory pigments,** include yellow, orange, and red. These pigments absorb the other colors. The colors of the accessory pigments are only visible during the fall season, when the cool temperatures break down the chlorophyll.

4

Plants use energy from light to power the process of photosynthesis. Carbon dioxide gas from the air and water from the soil are the raw materials for photosynthesis. Sugar and oxygen are the products. **The many chemical reactions of photosynthesis can be summarized by the following equation.**

$$\textit{carbon dioxide} + \textit{water} \xrightarrow{\textit{light energy}} \textit{sugar} + \textit{oxygen}$$

Carbon dioxide and water combine in the presence of light to produce sugar and oxygen.

Name _____ Date _____ Class _____

SECTION 4-2 REVIEW AND REINFORCE

Photosynthesis and Light

◆ Understanding Main Ideas

If the statement is true, write true. If it is false, change the underlined word or words to make the statement true.

_____ 1. White light is made of all the colors of the rainbow, referred to as the visible spectrum

_____ 2. When light strikes a green leaf, all the colors except green are reflected.

_____ 3. Chlorophyll absorbs mostly red and blue light.

_____ 4. Accessory pigments include green, yellow, red, blue, and orange pigments.

_____ 5. A red object looks red because it absorbs red light.

Use the equation below to answer the following questions. Write your answers on the line provided.

$$\text{carbon dioxide} + \text{water} \xrightarrow{\text{light energy}} \text{sugar} + \text{oxygen}$$

6. What process is illustrated by the equation shown above?

_____

7. What provides the energy to power this process?

_____

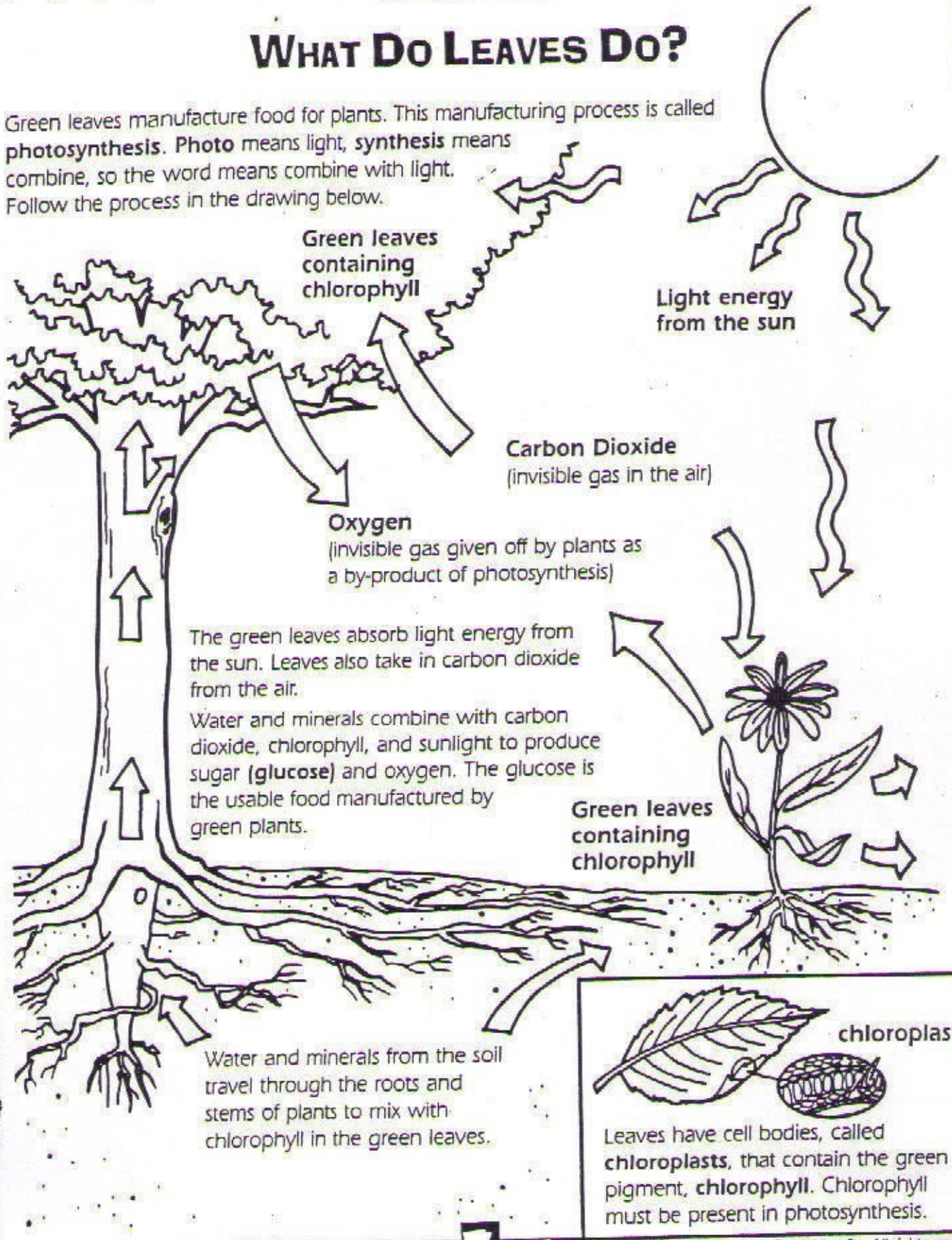
8. What are the products of the process illustrated above?

_____

Name _____ Date _____

What Do Leaves Do?

Green leaves manufacture food for plants. This manufacturing process is called **photosynthesis**. **Photo** means light, **synthesis** means combine, so the word means combine with light. Follow the process in the drawing below.



Leaves have cell bodies, called **chloroplasts**, that contain the green pigment, **chlorophyll**. Chlorophyll must be present in photosynthesis.

Plant Parts

By Cindy Grigg

1 What are plants? Plants are living things that are made of many cells. They are **autotrophs** which means they can make their own food. They do this by a chemical reaction called photosynthesis.

2 Different kinds of plant structures move water and nutrients from one part of a plant to other parts. Some plants, such as lettuce, have tiny tubes that move water and nutrients inside the plant. Other plants, such as mosses, do not have these tubes. Plants that have the tubes can move water and nutrients farther, faster, and easier than plants without tubes. If a plant needs water, all you have to do is water the roots.

3 Plants have their own way of moving water from the ground to the stems and leaves where it's needed. Plants that move water from the roots to the stems and leaves with tube-like structures are called **vascular plants**. Vascular plants include flowering plants, other seed-producing plants, and ferns. Vascular tubes, or veins, carry water and nutrients from the soil to the parts of a plant where they are needed.

4 Each part of a plant has certain jobs or functions. Leaves, stems, and roots work together as a system to help the plant perform its life functions. Leaves capture sunlight and perform photosynthesis to make food for the plant. Tiny openings in the leaves allow plants to take in carbon dioxide and to give off oxygen and water. Nearly all plant leaves are green because they contain the chemical called chlorophyll.

5 Chlorophyll is used in photosynthesis, the process by which green plants make food. In photosynthesis, light energy and certain chemicals are used to change water and carbon dioxide into sugar and oxygen. The roots absorb water and the leaves absorb carbon dioxide. The chlorophyll inside the leaf absorbs light energy. The oxygen is given off into the air through openings in the leaf and the sugar is used as food. Respiration is the process by which a plant uses oxygen to change food into the energy it needs for life functions.

6 The structures that hold the plant in the ground are called roots. Besides this important job, roots absorb water and nutrients from the soil. Without these the plant could not survive. Plants have different types of roots. Roots can be thick like carrots or have many branches like the roots of trees and grasses. But roots perform the same function for all plants and work with other plant parts to keep the plant alive.

Getting water and nutrients from the roots to the rest of the plant is the job of the

stems. Stems also hold plants up so that the leaves can get sunlight. Some stems store nutrients and water for the plant.

8 Flowers of plants help the plant to reproduce. The flower is the part of the plant in which seeds form. Like stems, leaves, and roots, the flowers of plants come in all shapes, sizes, and colors. The colors, sizes, and shapes are not just for show. They are important to the survival of the plant.

9 Flower parts are the petals, the pistil, the sepals, the stamen, and the ovary.

10 The petals are the parts of the flower that surround the inside parts of the flower. They are usually brightly colored to attract the insects that pollinate the plant.

11 The sepals are the outer parts of the flower that surround and protect the bud before it opens. The stamen is the male part of the flower. It produces a powdery material called pollen. Pollen grains contain male sex cells. The pistil is the female part of the flower. It contains the ovary. The ovary is at the bottom of the pistil. Inside the ovary are female sex cells which can be fertilized and develop into embryos inside seeds. Wind or insects such as bees are two things that can move pollen to the pistil.

12 Pollination takes place when pollen grains are moved from the stamen onto the sticky part of the pistil of a flower. Once the pollen is on the pistil, a tube begins to grow from each pollen grain. The tubes grow downward through the narrow part of the pistil until they reach the ovary. When male sex cells from the pollen join with female sex cells inside the ovule, which is inside the ovary, fertilization occurs. Fertilization is the joining of a female sex cell and a male sex cell from flowers of the same species. The fertilized eggs develop into embryos inside seeds. Both pollination and fertilization must take place to produce seeds that will grow into new plants.

13 As you can see, plants have complex systems that work together to keep the plant alive and help it reproduce.

Name _____ Date _____ Class _____

SECTION 5-3 **SECTION SUMMARY**

Angiosperms

Guide for Reading

- What characteristics do angiosperms share?
- How do angiosperms reproduce?

An **angiosperm** is a plant that produces seeds that are enclosed in a fruit. Seeds develop in a protective structure called an **ovary.** The ovary is located within an angiosperm's **flower**—the reproductive structure of an angiosperm. **Two characteristics of angiosperms are that they all produce flowers and fruits.**

Although all flowers have the same function—reproduction—not all flowers appear the same. Some flowers lack **petals**—the colorful structures that you see when flowers open. A flower bud is enclosed by leaflike structures called **sepals** that protect the developing flower. Within the petals are the flower's male and female reproductive parts. Thin stalks topped by small knobs inside the flower are **stamens,** the male reproductive parts. The thin stalk is called the filament. Pollen is produced in the knob, or anther, at the top of the stalk. The female parts, or **pistils,** are usually found in the center of the flower. The sticky tip of the pistil is called the stigma. A slender tube, called a style, connects the stigma to the ovary, a hollow structure at the base of the flower. The ovary contains one or more ovules.

For angiosperms to reproduce, **first, pollen falls on a stigma. In time, the sperm cell and egg cell join together in the flower's ovule. The zygote develops into the embryo part of the seed.** As the seed develops, the ovary changes and eventually becomes a **fruit**—a ripened ovary and other structures that enclose one or more seeds.

Angiosperms are divided into monocots and dicots. **Monocots** are angiosperms that have only one seed leaf. Grasses, including corn, wheat, and rice, and plants such as lilies and tulips, are monocots. Dicots produce seeds with two seed leaves. **Dicots** include plants such as roses, violets, and dandelions.

Angiosperms have many uses. People and many animals depend on various kinds of angiosperms for food. Fibers such as cotton and flax are used to make clothing. Angiosperms are used to make many medicines. These include digitalis, which is a heart medication, and cortisone, which is used to treat arthritis and other joint problems.

5

Name _____ Date _____ Class _____

SECTION 5-3 **REVIEW AND REINFORCE**

Angiosperms

◆ Understanding Main Ideas

Answer the following in the space provided.

1. Name two characteristics of angiosperms.

2. What do the male parts of the flower produce?

3. What do the female parts of the flower produce?

4. Briefly describe the process of embryo formation in an angiosperm.

5. What is the difference between a monocot and a dicot?

◆ Building Vocabulary

Fill in the blank with the term that matches the numbered part of the flower in the figure.

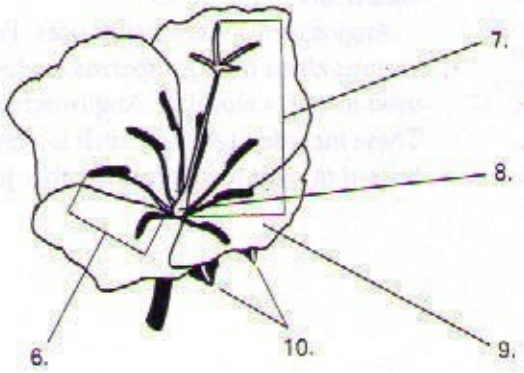
6. _____

7. _____

8. _____

9. _____

10. _____



Name _____ Date _____

Flowers and Parts of Flowers

Complete the puzzle.

down 1. A part of some flowers that forms around a seed.	down 3. The part of the stamen that holds pollen grains.	down 4. A narrow stalk that supports the stigma and is a part of the pistil.	down 5. Small, leaf-like structures that protect a flower when it is still a bud. These are usually green.
down 7. The flower is the ____ organ of a flowering plant.	down 8. The stamen is the ___ part of a flower.	down 10. The part of a flower where the seed develops and grows.	down 11. Bees use the nectar from flowers to make this.
down 13. The pistil is the ____ part of a flower.	across 2. The part of a plant that will eventually grow into a flower and is protected by sepals.	across 5. The sticky top of the pistil where pollination occurs when pollen from another flower gets stuck on this.	across 6. A sticky and sweet liquid inside of some flowers.
across 9. The colored part of a flower that attracts birds and insects.	across 10. A dusty powder that is produced in the stamen.	across 12. The seeds and fruits that flowers produce are ____ sources for animals.	across 13. The part of plants that produce seeds, nectar, and sometimes beautiful colors.
across 14. The part of a flower that makes pollen.	across 15. The part of the pistil that will develop into seeds if it receives pollen.		

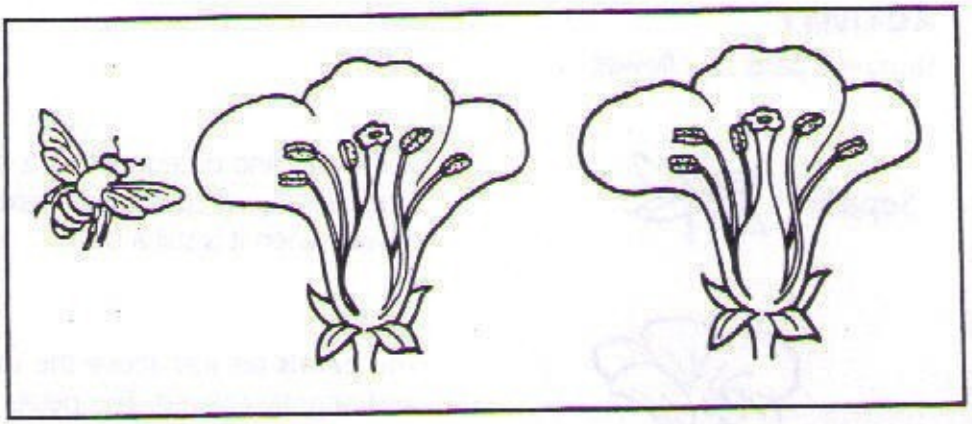
Name _____ Date _____

POLLINATION AND FERTILIZATION

For seeds to form, pollination and fertilization must occur. A pollen grain must be transferred to a flower's stigma for pollination to occur. Wind, insects, birds, or people can cause pollination. Wind and insects, mostly bees, cause most of the pollination of flowers.

ACTIVITY

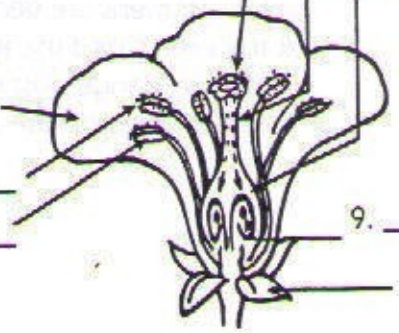
Circle the pollen in the drawing. Draw a dotted line to show the transfer of the pollen to the stigma.



Fertilization occurs when the sperm from the pollen grains joins with eggs in the ovary. Then seeds develop. The ovary grows to protect the seeds inside.

ACTIVITY

Label the parts of the flower.



1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____

ACTIVITY

Label the processes shown below.

1. _____ 2. _____ 3. _____

Name _____ Date _____

PLANTS

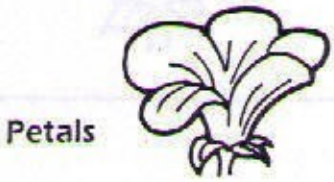
LOOKING AT FLOWERS

If someone asked you to tell them about flowers, you could say that many flowers are pretty. Some flowers smell good. They come in beautiful shapes and colors. But flowers don't just look pretty. They have a job to do. Their job is to make seeds so that new plants can grow.

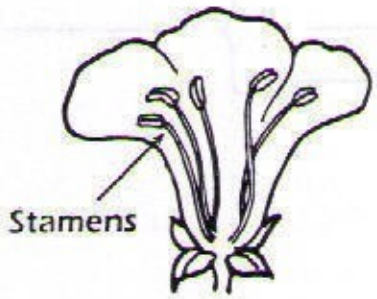
ACTIVITY

Study the parts of a flower.

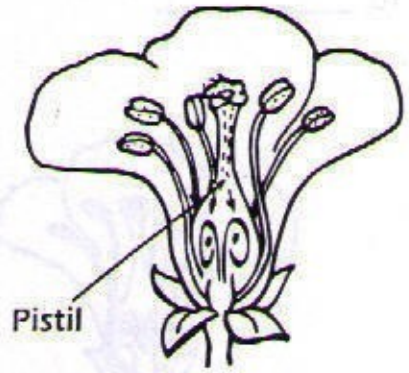
The lower and outermost parts of the flower are the **sepals**. They are usually green and make a protective cover for the flower when it is still a bud.



The **petals** are just above the sepals, They are often large and brightly colored. The petals may be separate, or they may be joined in a cup or trumpet shape.



(male parts) **Stamens** are found within the circle of the petals. Stamens are slender and stem-like with a thicker part at the end, called the **anther**. If you have ever discovered yellow or orange dust in a flower, you were seeing **pollen**. Pollen is found on the anthers.



(female parts) The **pistil** is in the very center of the flower. At the top of the pistil, there is a sticky enlarged part called the **stigma**. The bottom of the pistil contains a cavity called the **ovary**, Seeds develop in the ovary. The stigma and the ovary are connected by a thin stalk called the **style**.

Flowers are the reproductive parts of a plant. For plants to make seeds and to reproduce, the flowers must have both male and female parts.

Puzzling Plants

Name _____

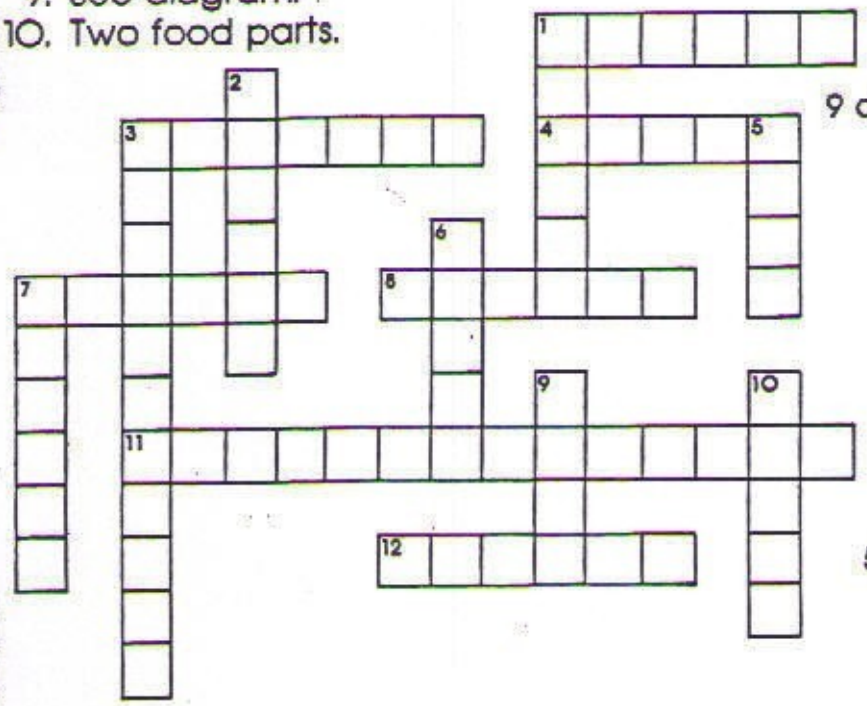
Complete the puzzle using the words from the word bank.

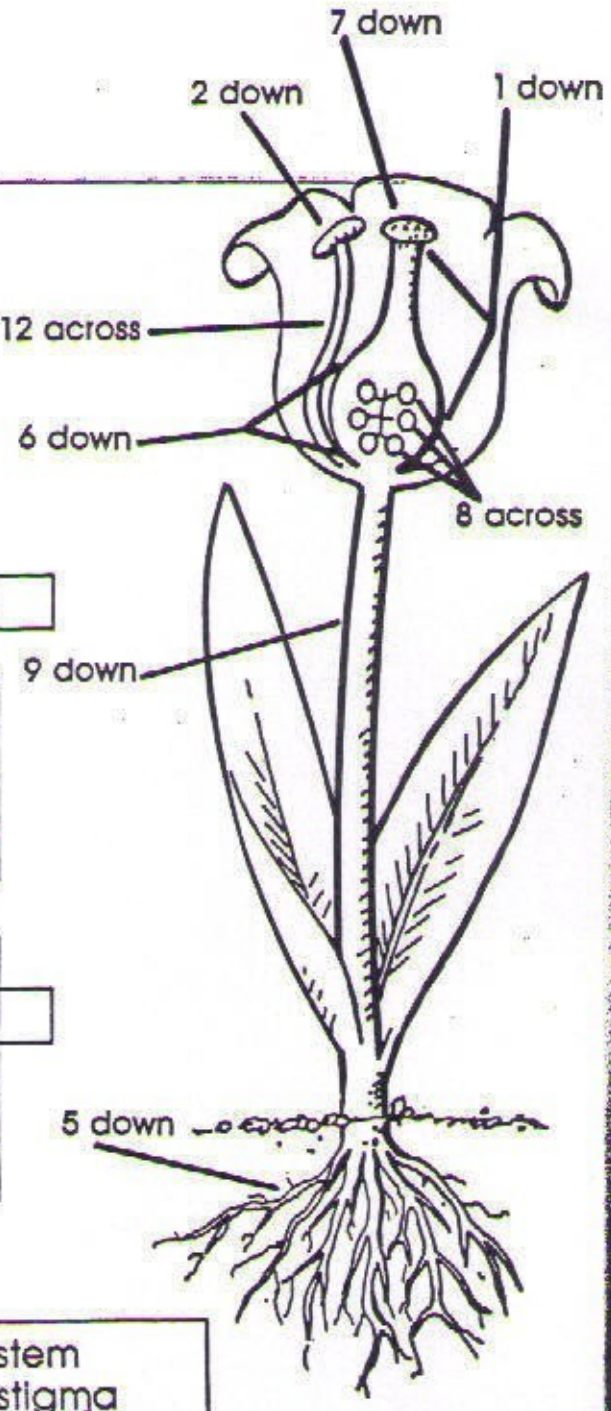
Across

1. Gold dust found in the stamen
3. Makes seeds in a cone
4. Product of photosynthesis
7. Means of reproduction for ferns, molds, and yeast
8. See diagram.
11. Plant's food-making process
12. See diagram.

Down

1. See diagram.
2. See diagram.
3. Green coloring in leaves
5. See diagram.
6. See diagram.
7. See diagram.
9. See diagram.
10. Two food parts.



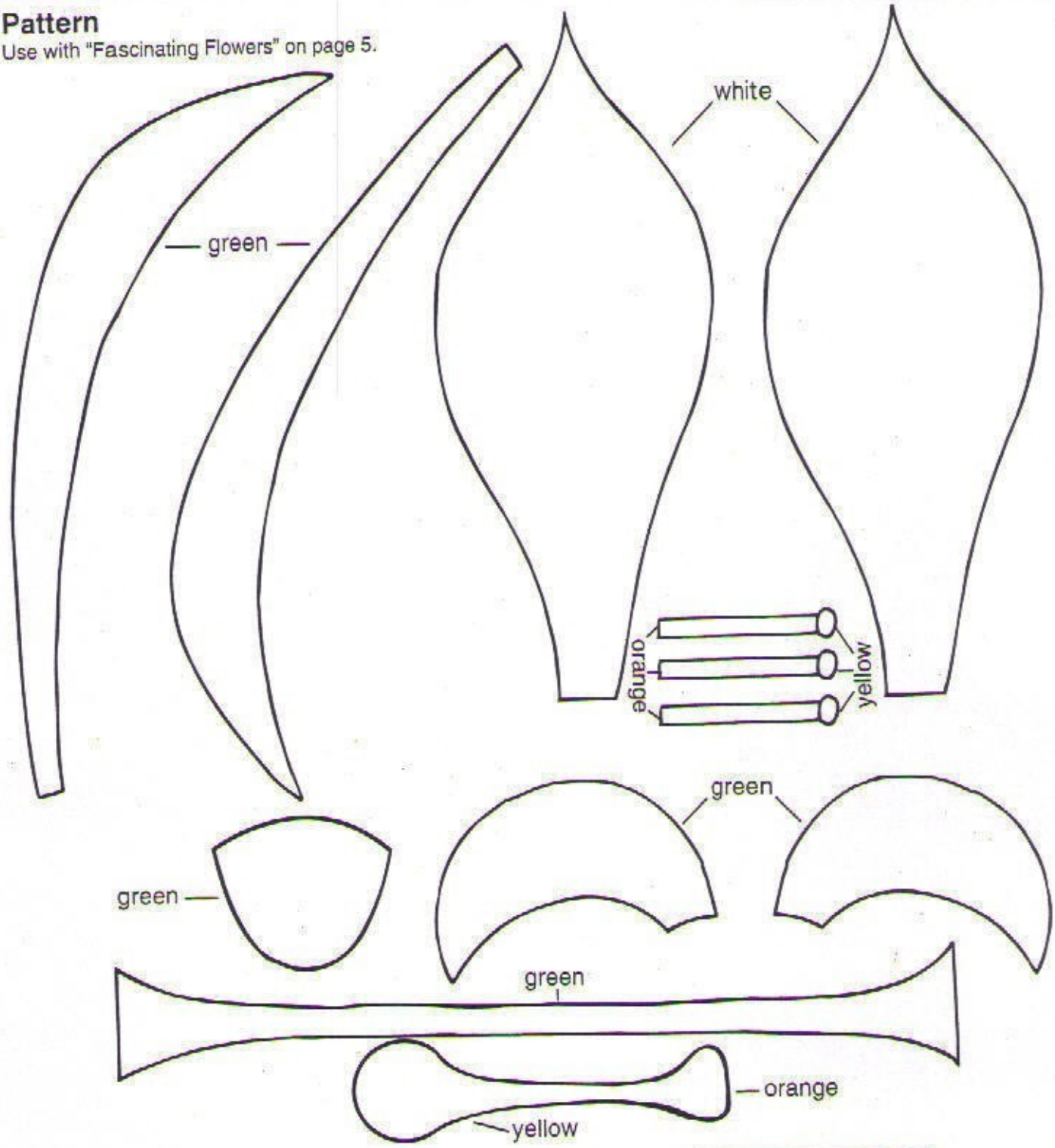


Word Bank

anther	ovary	pollen	stem
chlorophyll	ovules	root	stigma
conifer	photosynthesis	spores	sugar
dicot	pistil	stamen	

Pattern

Use with "Fascinating Flowers" on page 5.



stem	sepal	petal	receptacle
stamen	anther	filament	stigma
style	pistil	ovary	leaf

Monocots & Dicots

Lesson 5

NUTRITIONAL NEEDS OF PLANTS

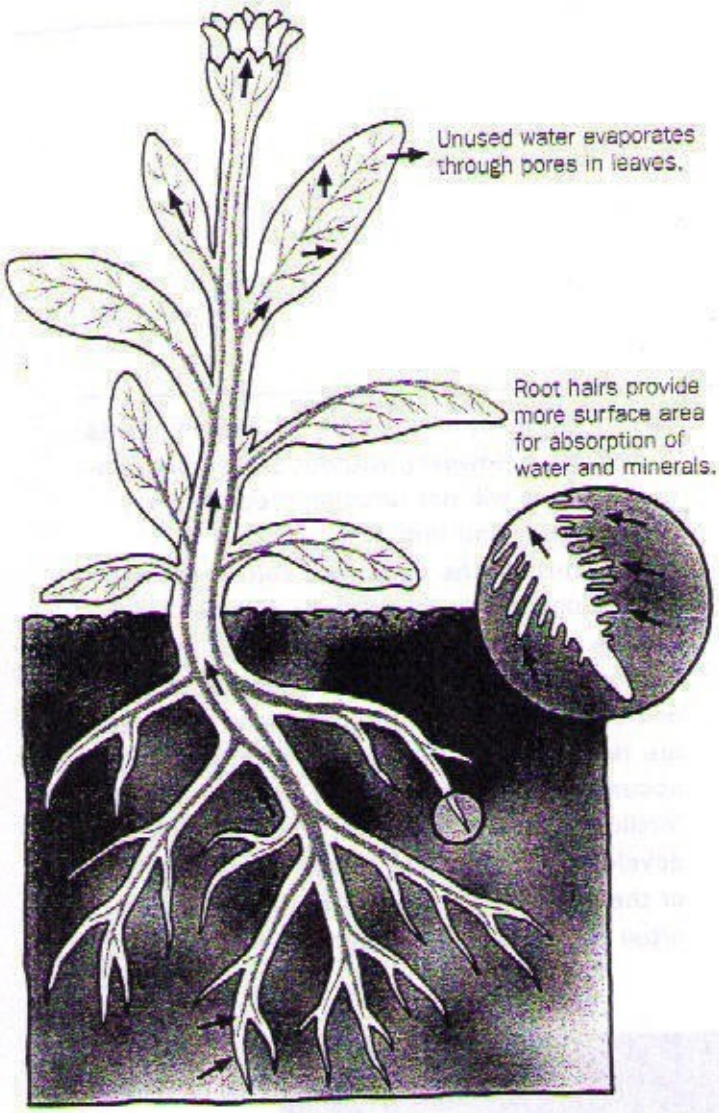
If you've ever seen a commercial for plant food, you might have the impression that plants depend on humans to supply their food. Actually, plants don't need us to feed them because they manufacture their own food called glucose. This "real" plant food is a simple form of sugar from which plants obtain energy. To be considered food, a substance must provide energy.

In addition to glucose, light, water, air, and a suitable temperature, plants need minerals to grow and develop. The Fast Plants that you will grow in class, as well as the African violet on your kitchen windowsill or the tomato plants in your garden, need a variety of minerals. Unlike food, minerals do not supply plants with energy. However, without the proper minerals, plants will not function properly; they will not grow and thrive.

The truth is, the plant food sold in stores isn't really food at all because it doesn't contain an energy source. It's a mixture of substances that plants need for proper growth and development. Sometimes these mixtures are referred to as fertilizers, which is a more accurate term, because their purpose is to fertilize plants, or to enable them to grow and develop properly. When plants cannot get all of the minerals they need naturally, humans often step in to lend a hand.

(continued)

This beautiful African violet most likely receives the proper concentration of fertilizer and water.



Do you think this lawn fertilizer would work effectively for houseplants, too?

Any of these minerals in the [illegible] plants absorb them from the soil through their root systems.

Fertilizers to the Rescue

Some soil is rich and fertile. It can actually all the minerals that most plants need. But using soil over and over again can deplete the soil's natural mineral supply. Recycling organic materials such as grass and leaves is a good way to revitalize outdoor soil. Sometimes, however, even recycling isn't enough. In these cases, farmers and gardeners must add fertilizer that contains essential minerals. Eventually, a potted plant also will need fertilizer because its soil supply is limited.

There are many different types of fertilizer—for lawns, houseplants, and outdoor plants, for example. Each type contains the same basic nutrients, but in proportions that meet the specific needs of certain plants. Some mixtures help plants grow strong roots; others promote beautiful blossoms or huge fruit.

You can find much of the information you need about the minerals that a fertilizer supplies by reading its label, as you can see on the example to the left. For further details about these minerals, read on!

Macro and Micronutrients

Plants need a total of 18 different minerals. Of these, three are especially important because plants need them in greater quantities than they need the others. These "macronutrients" are nitrogen, phosphorus, and potassium. Notice that there is a line on the fertilizer label that says "29-3-4." This refers to the proportions, in order, of each of these three nutrients in the fertilizer. This lawn fertilizer, for example, contains 29 percent nitrogen.

Nitrogen promotes the growth of healthy leaves. It also contributes to overall plant health. A plant that does not get enough nitrogen will have light green leaves and thin stems. Its lower leaves will turn yellow and [illegible] Lawns need a great deal of nitrogen.

Which characteristics of a nitrogen-deprived plant appear in this photo?

COURTESY POTASH & PHOSPHATE INSTITUTE, NORCROSS, GEORGIA

How can you tell this plant needs phosphorus?

COURTESY POTASH & PHOSPHATE INSTITUTE, NORCROSS, GEORGIA

What are the signs that this plant needs potassium?

If a flowering plant gets too much nitrogen, its leaves will grow too much and flowering will slow.

The second macronutrient is phosphorus (called "phosphate" on the label). As the label indicates, this lawn fertilizer contains 3 percent phosphorus. Phosphorous promotes strong, healthy roots. It also helps flowers bloom. Bulb plants such as tulips need high amounts of phosphorus. So do newly transplanted trees and shrubs, which must establish a root system before they can start to grow again. Plants that do not get enough phosphorus do not grow well. Their leaves become too dark. The whole plant may turn purple-blue and leaves may drop off.

Potassium (called "potash" on the label) helps plants withstand dramatic temperature changes and protects them from disease. A plant that does not get enough potassium may have brown leaves that curve downward and droop. The lawn fertilizer has 4 percent potassium. Both potassium and phosphorus can be harmful in their most concentrated form. That's why they are placed in fertilizer in less-concentrated, less-harmful forms—potash and phosphate.

If the three most important minerals are known as macronutrients, what do you think the other 10 are called? Micronutrients! Of these 10 micronutrients, calcium, magnesium, and sulfur are usually the most important. For lawns, however, iron is an important mineral. The other micronutrients are boron, copper, chlorine, manganese, molybdenum, and zinc. Because plants need only very small amounts of these minerals, they also are called "trace elements."

Too Much of a Good Thing?

The proportions on the lawn fertilizer label are 29-3-4. The fertilizer you will use in this module is 20-20-20. It has equal proportions of the three macronutrients. That makes it a good all-purpose fertilizer.

When it comes to fertilizing, too little is sometimes better than too much. Too much fertilizer may cause poisonous mineral salts to build up in the soil and damage the roots. This can be fatal for plants. The actual strength of the fertilizer is determined by how much water is mixed with a given amount of fertilizer.

In this module, you will use a 12.5 percent concentration of 20-20-20 fertilizer, one that is most suitable for the growth and development of your Fast Plants.

Name: _____

Date: _____

Period: _____

The Nutritional Needs of Plants

Answer all of the following questions while reading "Nutritional Needs of Plants" pages 47-49.

1. In order to fully grow and develop, a plant's needs need to be met. List all of the needs of a plant.

2. Where do plants get their energy?

3. What is glucose?

4. What happens to a plant if it does not receive a proper amount of minerals?

5. How do minerals enter a plant?

6. Describe two ways in which a soil's mineral supply can be replenished.

7. How many minerals are necessary for plant growth and development?

8. What is a macronutrient?

9. Name the macronutrients.

10. What does nitrogen do for a plant? What happens if a plant does not get enough nitrogen? What happens if a plant gets too much nitrogen?

11. What does phosphorus do for a plant? What happens to a plant that does not get enough phosphorus?

12. What does potassium do for a plant? What happens to a plant that does not get enough potassium?

13. What do we call the other 10 essential nutrients? List these nutrients.

14. The fertilizer we are using for our plants is 20-20-20. Explain what this means.

15. What happens if a plant is given too much fertilizer?

Name _____ Date _____ Class _____

SECTION 5-1 **SECTION SUMMARY**

The Characteristics of Seed Plants

Guide for Reading

- What characteristics do seed plants share?
- What are the main parts of a seed?
- What are the functions of leaves, stems, and roots?

All seed plants share two characteristics. They have vascular tissue and use seeds to reproduce. They all have body plans that include leaves, stems, and roots.

Water, food, and nutrients are transported throughout plants in vascular tissue. There are two types of vascular tissue. **Phloem** is the vascular tissue through which food moves. When food is made in the plant's leaves, it enters the phloem and travels to the plant's stems and roots.

Water and nutrients travel in the vascular tissue called **xylem.** The plant's roots absorb water and nutrients from the soil. These materials enter the root's xylem and move upward into the stems and leaves.

Seeds are structures that contain a young plant inside a protective covering. **A seed has three important parts—an embryo, stored food, and a seed coat.**

The young plant that develops from the zygote, or fertilized egg, is called the **embryo** and has the beginnings of roots, stems, and leaves. In some plants, food is stored inside one or two seed leaves, or **cotyledons.** The outer covering of a seed is called the seed coat.

Germination is the early growth stage of the embryo. Germination begins when the seed absorbs water from the environment and uses its stored food to begin to grow.

Leaves capture the sun's energy and carry out the food-making process of photosynthesis. The underside of the leaf has small openings, or pores, called **stomata.** These open and close to control when gases enter and leave the leaf. The process by which water evaporates from the stomata in a plant's leaves is called **transpiration.**

The stem carries substances between the plant's roots and leaves. The stem also provides support for the plant and holds up the leaves so they are exposed to the sun. Inside the stem is a layer of cells called the **cambium.** The cells of the cambium divide to produce new phloem and xylem and to increase the stem's width.

Roots anchor a plant in the ground and absorb water and nutrients from the soil. The tip of the root is rounded and is covered by a **root cap.** The root cap protects the root from injury from rocks as the root grows through the soil.

5

Name _____ Date _____ Class _____

SECTION 5-1 **REVIEW AND REINFORCE**

The Characteristics of Seed Plants

◆ Understanding Main Ideas

Answer the following questions in the space provided.

1. Name four characteristics of seed plants.

_____

_____

_____

_____

2. What are three important parts of a seed?

_____

_____

_____

_____

◆ Building Vocabulary

Fill in the spaces in the table below.

Part of Plant	Function
leaf	3. _____
cambium	4. _____
5. _____	anchors plants and absorbs water and minerals
seed	6. _____
7. _____	the vascular tissue through which water and nutrients travel
8. _____	the vascular tissue through which food moves
root cap	9. _____
10. _____	small openings or pores on the underside of leaves
stem	11. _____
cotyledon	12. _____

Name: _____

Date: _____ Period: ____

Comparing Monocots and Dicots

Both monocot and dicot seeds develop in similar ways and have the same parts. There are a few minor differences: monocots start out with one seed leaf, while dicots have two. The technical word for seed leaf is cotyledon: you can find it on the coloring sheet; it is the first leaf to emerge from a developing seed. **Color all the cotyledons (A) on the seeds dark green.** As a seed, both monocots and dicots are covered by a seed coat. **Color the seed coat (B) yellow.**

The seed consists of the outside seed coat and a large area called the endosperm which functions as a source of reserve materials and food for the developing embryo. As germination occurs, the endosperm will be broken down and used by the plant. **Color the endosperm blue (C).**

Germination occurs when the seed begins to sprout, usually in the spring and under appropriate conditions the radicle, the part of the seed that will become the root, begins to elongate and grow downward. **Color the root brown (D).** Meanwhile, the coleoptile begins to grow upward. The coleoptile is a sheath that encloses the shoot of the embryo. The primary function of the coleoptile is to provide protection to the developing shoot as it is passing through the soil. **Color the coleoptile orange (E).** Extending out from the coleoptile is the shoot. **Color the shoot purple (F).**

Eventually adult leaves grow on the plant. **Color these leaves light green. (G)**

Comparing Adult Monocots and Dicots

Angiosperms are divided into two classes, the monocots and the dicots. The majority of flowering plants are dicots. Dicots include maples, oaks, and magnolias. Monocots are grasses, wheat, corn, and rice. Most of our food supply comes from monocots. The diagram compares the differences between the two.

First of all look at the roots. The root of a monocot is called a **fibrous root** and the root of a dicot is a **taproot.** Notice how taproots have one main part - called the **primary root.** In a taproot the primary root grows very large and small roots spread out from it. Fibrous roots, on the other hand, do not have very large primary roots, and many small roots develop and remain near the surface. **Color the taproot dark brown and the fibrous root light brown.**

Monocots and dicots also differ in their leaf structure. Adult monocots usually have parallel venation, whereas dicots have net-like venation. For monocots and dicots, **color the leaves green and outline the veins in a darker green.** The flowers of monocots and dicots differ in the number of petals they have. Monocots tend to have flower parts that occur in 3's (3, 6, 9, 12...). Dicot flowers usually have 4 to 5 petals. **Color the monocot flower purple, and the dicot flower pink** (make sure all petals are colored). Stems hold the flowers up and attach the leaves, **color the stems blue.**

Monocot and dicots also differ in the way their vascular systems are arranged. In monocots, the vascular bundles are scattered throughout the stem. In dicots, the vascular bundles are arranged in a ring. **Color the vascular bundles in both types of plants purple (V), color the stems green.**

Questions:

1. Give two examples of plants that are monocots. _____
2. Give two examples of plants that are dicots. _____
3. What is a cotyledon? _____
4. What is the function of the endosperm? _____
5. Are the majority of flowering plants monocots or dicots? _____

6. What is the difference between a fibrous root and a taproot?

_____

_____

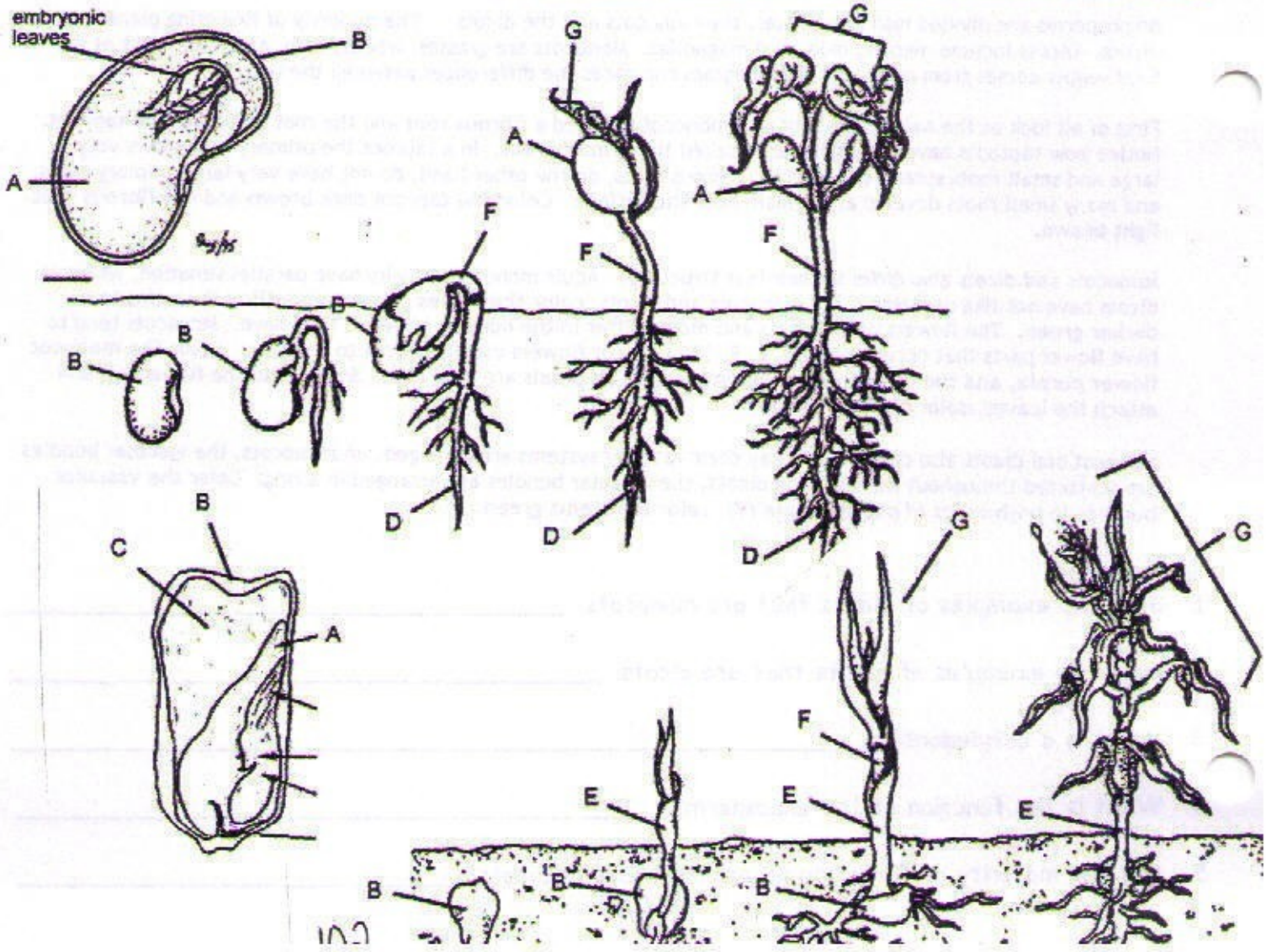
_____

7. Fill out the table below.

	Number of Leaves	Type of Leaf Venation	Number of Flower Parts	Type of Roots	Examples
Monocot					
Dicot					

8. An unknown plant is brought to you and your job is to determine whether it is a monocot or dicot. You observe that the plant has 6 petals and its leaves have parallel veins. Is it a monocot or dicot?

_____



Name: _____

Date: _____

Period: _____

Lesson 5: Inquiry 5.4
Observing the Bean and Corn Seeds

1. Why are we observing a bean and corn seed? What are we looking for?

_____

_____

_____

_____

READ "FROM SEED TO ADULT PLANT – AND BACK". This will help you to answer the questions that follow the lab.

Record your drawings of the bean and corn plants below. Be sure you are detailed and that you color each of your drawings.

Observations:

Type of Seed: Bean **Date Observed: _____**	**Type of Seed: Corn** **Date Observed: _____**

Type of Seed: Bean Date Observed: _____	Type of Seed: Corn Date Observed: _____
Type of Seed: Bean Date Observed: _____	Type of Seed: Corn Date Observed: _____
Type of Seed: Bean Date Observed: _____	Type of Seed: Corn Date Observed: _____

Conclusion Questions:

1. Where does the seed fit into the life cycle of the plant? Explain.

2. What is germination? What enables this process to begin?

3. Which part protects a seed?

4. Describe and explain the inside of a "dormant" seed.

5. What is the difference between a monocot and dicot?

6. Is the corn plant a monocot or dicot? Explain how you know.

7. Is the bean plant a monocot or dicot? Explain how you know.

8. What is the difference between the cotyledons and the true leaves of flowering plants. Be specific.

9. What structures develop to protect the seeds in flowering plants?

10. List 3 items, common to our diet, that are actually fruits. (there are many to choose from, just list 3).

1. _____
2. _____
3. _____

Name _____ Date _____

A Beginning Look at Plants (Monocots)

Look closely at a corn seed that has been soaked in water. Does the seed coat slip off easily like the bean covering did? Does this seed split naturally into two pieces like the bean did?

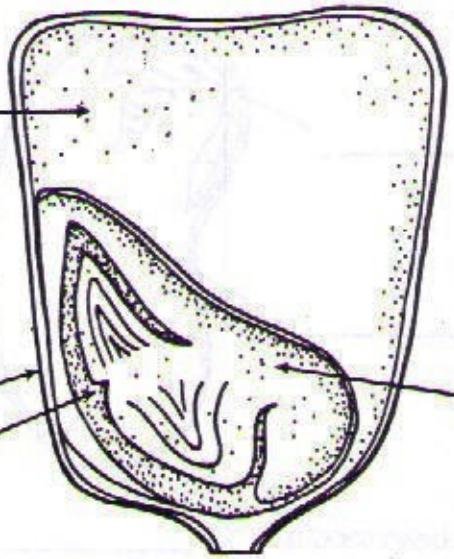
The corn seed does have an outside covering or **seed coat**, but it doesn't slip off and it may be difficult for you to tell it is there. The corn seed does not split naturally at all. In fact, you will need to cut it in half.

Even when the seed is cut, it is often difficult to see the tiny embryo. Use a hand lens to try to see the part that will become the leaves. One **cotyledon** will surround the **embryo**. It is a lighter color than the rest of the seed. The remainder of the seed is called the **endosperm**. It provides food for the developing plant.

The corn seed is a **monocotyledon** or **monocot**. **Mono** comes from the Greek word **monos** meaning one.

Activity

Use the underlined words to label the picture below.



1. _____
2. _____
3. _____
4. _____

5. A corn seed is a _____.

Note

Monocots are also flowering plants. Their leaves usually have parallel veins. Their flowers usually have three petals or multiples of three. There are more than 50,000 species of monocotyledons.

Name _____ Date _____

A Beginning Look at Plants (Dicots)

Green plants are probably the most important living organisms on Earth. Plants are the basis for all food. Life could go on without people, or dogs, or butterflies, or sharks, but if all the green plants were gone, life on Earth would soon cease to exist.

On the other hand, as long as plants have enough sunlight, water, air, and some minerals, they could get along nicely without animals.

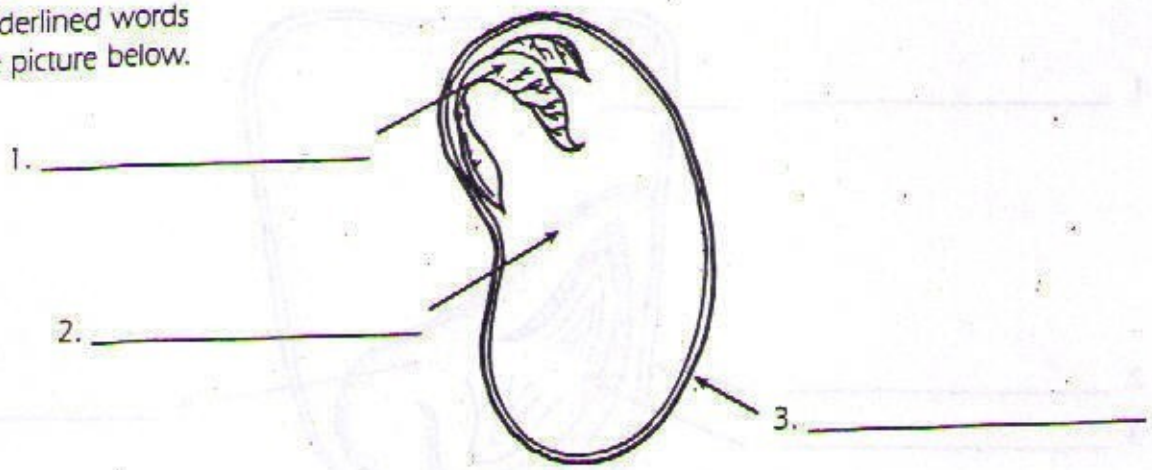
Begin the study of plants by looking closely at a bean seed that has been soaked in water. Does it have an outside skin or covering?

This is the **seed coat**. This coat will probably slip easily off the seed. Do you see a slit running around the seed? Carefully slide your fingernail into this slit, and the seed will split into two parts. Look for the tiny plant inside the seed. This is the **embryo**, or baby plant. Use a hand lens if you have one. Can you see the two small leaves?

The large part of the seed is called the **cotyledon**. It supplies food to the young plant when it starts growing. The bean seed has two cotyledons. Therefore, it is called a **dicotyledon** or **dicot**, for short. **Di** comes from the Greek word **dis** meaning two.

Activity

Use the underlined words to label the picture below.



4. A bean seed is a _____.

Activity

Find other seeds to examine. If they split naturally into two parts, they are dicots.

Note

Dicots are flowering plants. Their leaves have branching veins. Their flowers usually have four or five petals or multiples of those numbers. There are about 200,000 species of dicotyledons.

Monocot or Dicot?

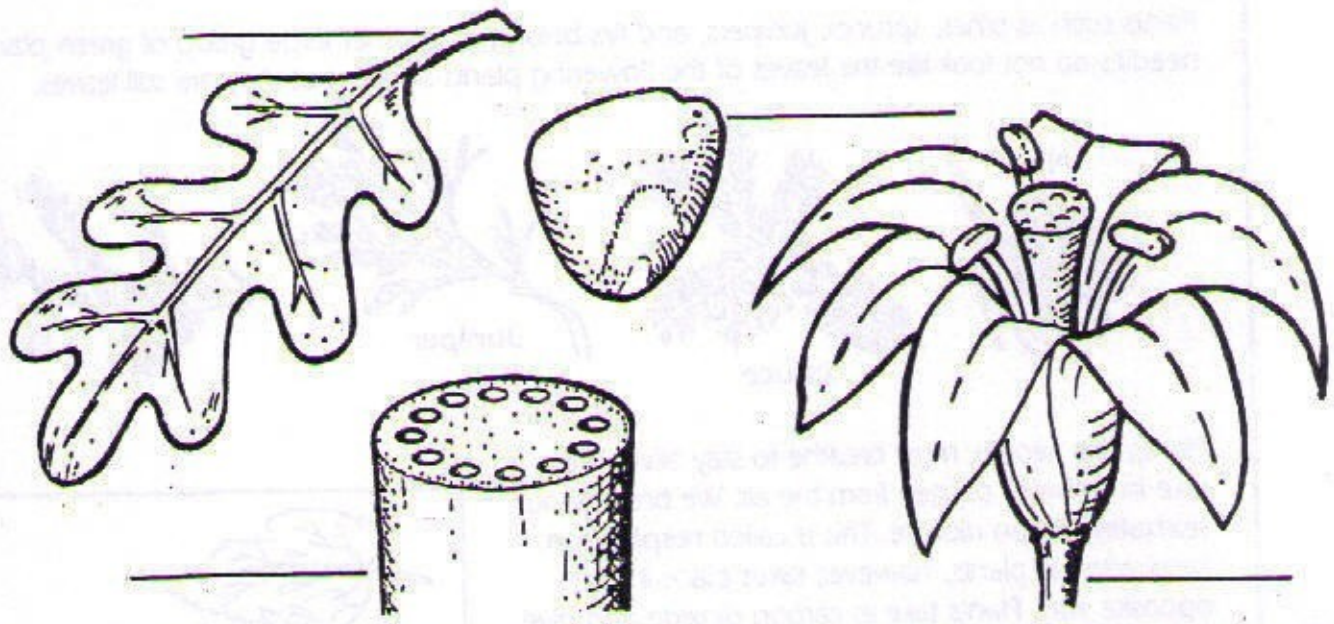
Name _____

Flowering plants are divided into two main groups–the dicots, or dicotyledons, and the monocots, or monocotyledons. The basic differences can be found by looking at their seeds. The dicots have two cotyledons, or food parts, and the monocots have one cotyledon, or food part.

There are other differences in their leaves, stems, and flowers. The differences are noted in the chart below.

Plant Part	Monocot	Dicot
leaves	The veins are parallel.	The veins form a net-like structure.
stem	The bundles of tubes are scattered throughout the stem.	The bundles of tubes form a ring around the outside of the stem.
flower	The petals and stamen are in groups of three, six, and nine.	The petal and stamen are in groups of four and five.
seeds	The seeds have one cotyledon or food part.	The seeds have two cotyledons or food parts.

Identify each of the plant parts below as a dicot or monocot.



Something Special

Find some common plants around your home or school and classify them as monocot or dicot.

Name _____ Date _____

PLANTS

LOOKING AT LEAVES

Look at the plants around you. Leaves come in many sizes, shapes, textures, and smells! During some seasons they even come in different colors. Flowering green plants are placed in two large groups: monocots and dicots. One of the easiest ways to recognize them is by looking at their leaves. Monocot leaves have parallel veins. Dicot leaves have branching or net-like veins. Many leaves are in one part. They are called simple leaves. Some leaves are divided into separate parts or leaflets. They are called compound leaves.

Label these leaves simple or compound.

Monocots

Barley

Palmetto Palm

Dicots

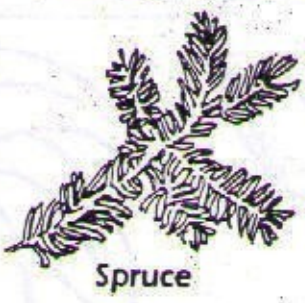
American Elm

Sumac

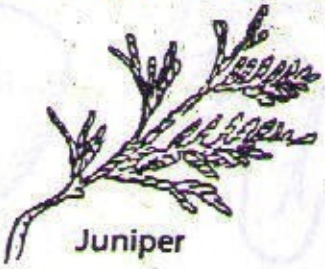
1. _____ 2. _____ 3. _____ 4. _____

Plants such as pines, spruces, junipers, and firs belong to another large group of green plants. Pine needles do not look like the leaves of the flowering plants above, but they are still leaves.

Pine



Spruce



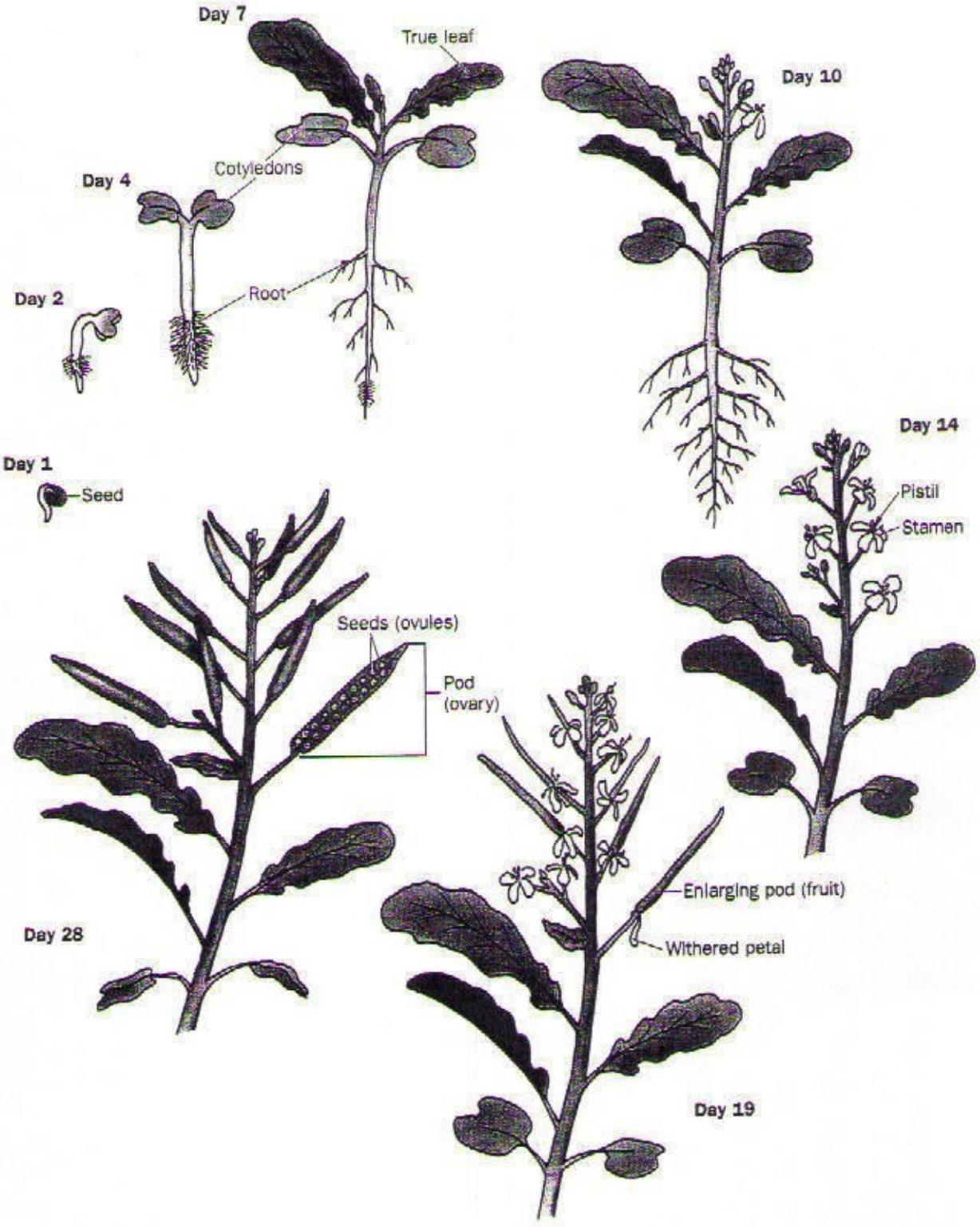
Juniper

Fir

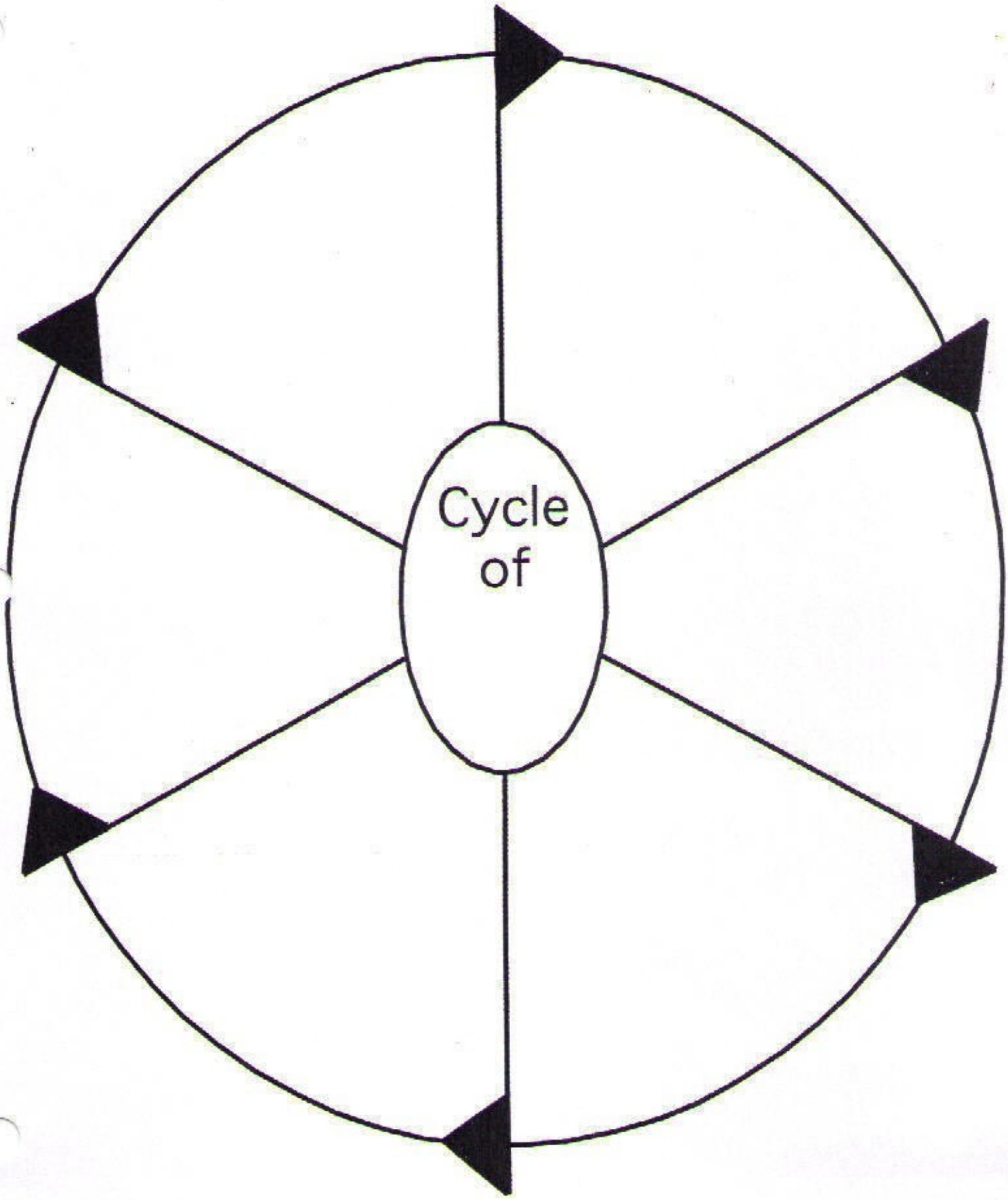
Plants, like people, must breathe to stay alive. We take in **(inhale)** oxygen from the air. We breathe out **(exhale)** carbon dioxide. This is called **respiration**. Respiration in plants, however, takes place in the opposite way. Plants take in carbon dioxide and give off oxygen. At night, transpiration in plants occurs. **Transpiration** is the evaporation of water, mostly from the **stomata** (pores in the leaves) of plants.

Stomata

Transparency 5.0: Life Cycle of Wisconsin Fast Plants



Name _____ Date _____



Name _____ Date _____ Class _____

SECTION 5-2 **SECTION SUMMARY**

Gymnosperms

Guide for Reading

- What are the characteristics of gymnosperms?
- How do gymnosperms reproduce?

A **gymnosperm** is a seed plant that produces naked seeds—seeds that have no protective covering. **All gymnosperms produce naked seeds. In addition, many gymnosperms also have needlelike or scalelike leaves and deep-growing root systems.** Most gymnosperms are trees, although a few are shrubs and vines. Gymnosperms are classified into four groups—the cycads, the ginkgo, the gnetophytes, and the conifers. The conifers are the largest group of gymnosperms on Earth today.

Most gymnosperms have reproductive structures called **cones.** Most gymnosperms produce two types of cones: male cones and female cones. Male cones produce tiny grains of **pollen,** which contain the microscopic cells that will later become sperm cells. Female cones contain at least one ovule at the base of each scale. An **ovule** is a structure that contains an egg cell. After being fertilized, the ovule develops into a seed.

To reproduce, **first, pollen falls from a male cone onto a female cone. In time, a sperm cell and an egg cell join together in an ovule on the female cone.** The transfer of pollen from a male reproductive structure to a female reproductive structure is called **pollination.**

Many useful products come from conifers. Some of these products include paper and the lumber to build homes. Conifers are also used to make the rayon fibers in clothes.

Conifers are grown in large forests. Clear cutting is one method to obtain lumber. In clear cutting, all the trees in a large area of forest are cut down. This practice can destroy animals' homes and cause the soil to be washed away by rains.

5

Name _____ Date _____ Class _____

SECTION 5-2 **REVIEW AND REINFORCE**

Gymnosperms

◆ Understanding Main Ideas

Study the diagram and read the following statements. Fill in the blank to complete each statement.

1. All gymnosperms produce naked seeds. Many have _____ or scalelike leaves, and deep root systems.
2. Cycads, ginkgo, gnetophytes, and conifers are all gymnosperms. The plant shown is a _____.
3. The _____ shown on the plant are the reproductive structures.
4. The tree shown produces _____ in male cones.
5. The tree shown produces _____ in female cones.

◆ Building Vocabulary

Answer the following item in the space provided.

pollen ovule pollination

6. Briefly describe reproduction in gymnosperms. Be sure to include the above terms in your description.

_____

_____

_____

_____

_____

5

Protists, Fungi, Viruses, & Bacteria

Name _____ Date _____ Class _____

CHAPTER 3

PROTISTS AND FUNGI

SECTION 3-1 Protists (pages 80-89)

This section describes the characteristics of protists.

▶ What Is a Protist? (pages 80–81)

1. Circle the letter of each sentence that is true about protists.
   a. All protists are eukaryotes, organisms that have cells with nuclei.
   b. All protists live in dry surroundings.
   c. All protists are unicellular.
   d. Some protists are heterotrophs, some are autotrophs, and some are both.
2. List the three categories into which scientists group protists.
   a. _____
   b. _____
   c. _____

▶ Animal-like Protists (pages 81–85)

3. Circle the letter of each characteristic that animal-like protists share with animals.
   a. autotroph b. heterotroph c. movement d. unicellular
4. Another name for an animal-like protist is _____.
5. Describe how a sarcodine, such as an ameba, gets food. _____

6. Circle the letter of the cell part in an ameba that removes excess water.

a. pseudopod
b. cilia
c. contractile vacuole
d. cell membrane

7. Is the following sentence true or false? Paramecia have two nuclei.

_____

Match the animal-like protist with the cell part it uses for movement.

Protist	Cell Part
_____ 8. ameba	a. cilia
_____ 9. paramecium	b. flagella
_____ 10. zooflagellate	c. pseudopods

11. Is the following sentence true or false? Zooflagellates living in symbiosis always harm the animal in which they live. _____

12. Animal-like protists called _____ are parasites that feed on the cells and body fluids of their hosts.

13. Is the following sentence true or false? Sporozoans never have more than one host. _____

▶ Funguslike Protists (pages 85–86)

14. Circle the letter of each sentence that is true about funguslike protists.

a. Like fungi, funguslike protists are heterotrophs.
b. Funguslike protists do not have cell walls.
c. Funguslike protists use spores to reproduce.
d. Funguslike protists never move during their lives.

15. List the three types of funguslike protists.

a. _____
b. _____
c. _____

Name _____ Date _____ Class _____

16. Where do most water molds and downy mildews live? _____

_____

17. Circle the letter of each place where slime molds live.

a. dry soil b. moist soil c. decaying plants d. in animals

▶ Plantlike Protists (pages 86–89)

18. Plantlike protists are commonly called _____.

19. Like plants, plantlike protists are _____; they make their own food.

20. Complete this table about the different types of plantlike protists.

Characteristics of Plantlike Protists		
Type	**Unicellular or Multicellular**	**Characteristics**
Euglenoids		
Dinoflagellates		
Diatoms		
Green Algae		
Red Algae		
Brown Algae		

Reading Skill Practice

Concept maps are useful in organizing information. Make a concept map to show the characteristics of the four different types of animal-like protists. For more information about concept maps, see page 190 in the Skills Handbook of your textbook. Do your work on a separate sheet of paper.

Name _____ Date _____ Class _____

SECTION 3-1 **SECTION SUMMARY**

Protists

Guide for Reading

- What are the characteristics of animal-like, funguslike, and plantlike protists?

3

The protist kingdom is very diverse. However, all protists are eukaryotes, or organisms that have cells with nuclei. All live in moist surroundings. Most are unicellular, but some are multicellular. Some are heterotrophs, some are autotrophs, and some are both. Protists can be divided into three categories: animal-like, funguslike, and plantlike protists.

Animal-like protists are also called **protozoans. Like animals, animal-like protists are heterotrophs.** Most can move from place to place to get food. Many protozoans that live in fresh water have **contractile vacuoles.** A contractile vacuole is a structure that expels water that has entered a cell through its cell membrane. There are four types of protozoans: sarcodines, ciliates, zooflagellates, and sporozoans. Sarcodines move and feed by using **pseudopods.** Pseudopods are temporary bulges of the cell membrane that fill with cytoplasm. Ciliates are covered with hairlike projections called **cilia.** They use cilia to move, obtain food, and sense the environment. Zooflagellates move using whiplike flagella. Often, zooflagellates live inside the bodies of other organisms in a state of **symbiosis.** Symbiosis is a close relationship between two species where at least one of the species benefits. Sometimes, zooflagellates harm their hosts. In other cases, their relationship is one of **mutualism,** in which both the host and the zooflagellate benefit. Sporozoans are parasites that feed on their hosts' cells and body fluids.

Like fungi, funguslike protists are heterotrophs, have cell walls, and use spores to reproduce. Unlike fungi, however, all funguslike protists are able to move at some point in their lives. The three types of funguslike protists are water molds, downy mildews, and slime molds. Water molds and downy mildews grow as tiny threads in water or moist places. Slime molds live in moist soil and on decaying plants.

Plantlike protists are called **algae. The one characteristic that all algae share is that, like plants, they are autotrophs.** Algae can exist in a variety of colors because they contain many types of **pigments**—chemicals that produce color. There are six types of plantlike protists: euglenoids, dinoflagellates, diatoms, green algae, red algae, and brown algae. Euglenoids can be heterotrophs when sunlight is not available. Dinoflagellates are covered by stiff plates and move using two flagella. Diatoms have beautiful, glasslike cell walls. Green algae live in fresh water, salt water, and moist places on land. Red algae and brown algae live in the oceans.

Name _____ Date _____ Class _____

Protists

◆ Understanding the Main Ideas

Fill in the blanks in the table below.

Type of Protist	Shared Characteristics	Examples
animal-like	heterotrophs; most move by using pseudopods, cilia, or 1. _____	sarcodines, ciliates, zooflagellates, and 2. _____
3. _____	heterotrophs, cells walls, reproduce with spores	water molds, downy mildews, and 4. _____
5. _____	autotrophs	euglenoids, dinoflagellates, red algae, brown algae, 6. _____, and 7. _____

◆ Building Vocabulary Skills

Match each term with its definition by writing the letter of the correct definition in the right column on the line beside the term in the left column.

_____ **8.** protozoan

_____ **9.** pseudopod

_____ **10.** spore

_____ **11.** contractile vacuole

_____ **12.** cilia

_____ **13.** algae

_____ **14.** symbiosis

_____ **15.** mutualism

_____ **16.** pigment

a. a form of symbiosis that benefits both species

b. an animal-like protist

c. a tiny cell that is able to grow into a new organism

d. a chemical that produces color

e. temporary bulge of a cell membrane that fills with cytoplasm

f. hairlike projections of ciliates that are used to capture food, move, and sense the environment

g. plantlike protists

h. structure that collects excess water and expels it from a cell

i. close relationship between two species where at least one of the species benefits

EXCUSE ME,
But Your Habitat Is in My Ecosystem!

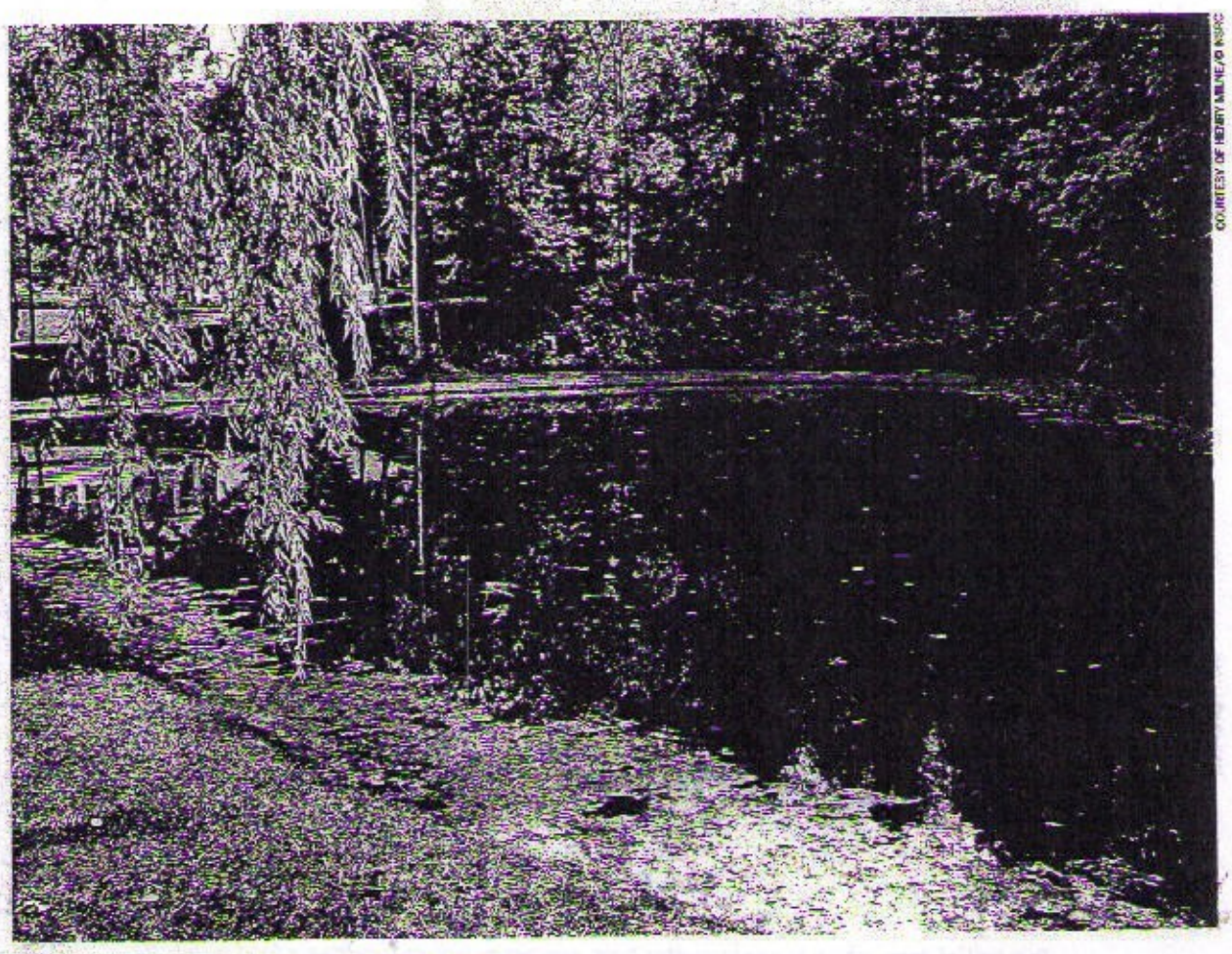
There are countless ecosystems in the world. An ecosystem can be as small as a puddle or as large as an ocean. An ecosystem can simply be a stretch of grassland or a rotten tree trunk. You'll find an ecosystem wherever groups of living and nonliving things interact.

In the ocean, which is a saltwater environment, bottle-nosed dolphins interact with squid—by eating them. Sea lions eat squid, too, so they compete with the dolphins. Since they all interact, bottle-nosed dolphins, squid, and sea lions all share the same ecosystem.

Rainbow trout, which live in cool, freshwater streams, share their ecosystem with plants and other organisms, including those they prey on, such as snails and dragonflies. Both the freshwater stream and the saltwater ocean are known as aquatic—or water-based—ecosystems.

Inside a Typical Ecosystem—A Pond

Plants, animals, and other organisms live within every ecosystem. The living component of an ecosystem is referred to as a "community." A pond, for example, is an ecosystem in which a



COURTESY OF HENRY MILNE/JO INSKC

This pond is home to a great diversity of organisms.

community of organisms, including blackworms, dragonflies, and *Lemna*, all interact among themselves and with their nonliving environment. (The members of each species in a community are called a "population.")

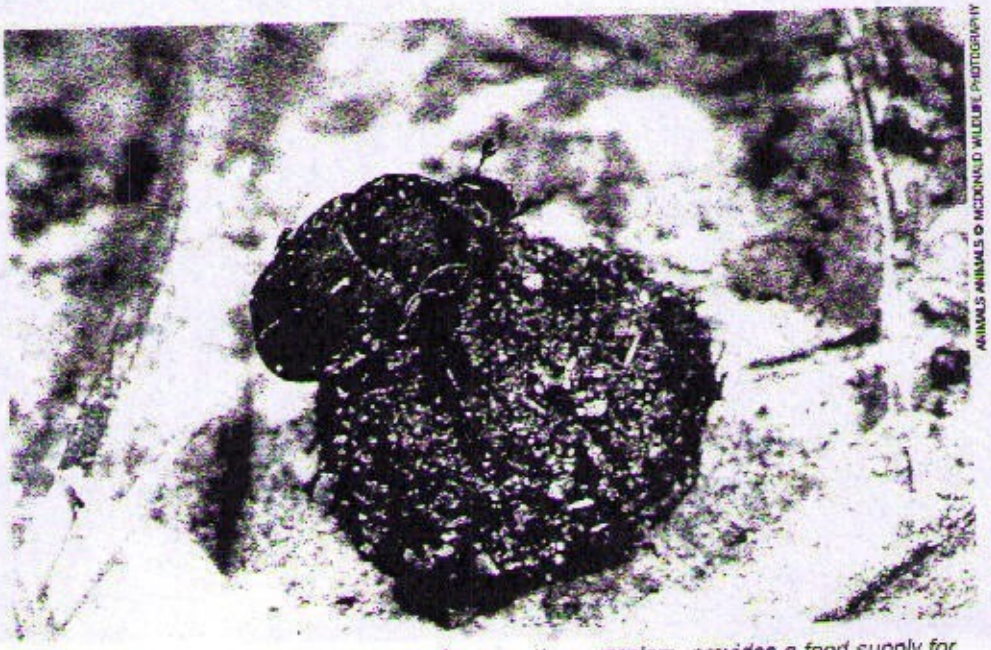
Within this pond ecosystem—and others—are many different habitats, or homes. Blackworms may live in the muddy fringes of the pond. This is where they find shelter. This is also where they find food. This is their habitat—the place where their needs are met.

COURTESY OF CAROLINA BIOLOGICAL SUPPLY COMPANY

These damselfly nymphs eventually move out of the water, unless they become fish food first!

Dragonflies and damselflies live the first part of their lives in their pond water habitat as nymphs. They eventually climb up plant stems, where they change into their adult form. Then the area above and around the pond becomes their habitat.

Other organisms that share this pond ecosystem may have different habitats. For example, *Lemna*, or duckweed, live on the water's surface, closer to the light from the sun. Crayfish, on the other hand, live at the bottom of the pond, scavenging for food that falls from upper layers.



ANIMALS ANIMALS © MCDONALD WILDLIFE PHOTOGRAPHY

This ball of dung, which is waste matter from another organism, provides a food supply for this beetle, appropriately named the "dung beetle."

The destruction of these trees greatly changes the nature of the ecosystems and habitats in this area.

Finding an Organism's Niche

Organisms within an ecosystem perform certain jobs that keep the ecosystem functioning. In a pond, for example, birds and frogs keep the number of insects in check by eating them. In a grassy pasture habitat, dung beetles may eat the waste matter from cows and other animals, which helps to recycle nutrients. These are their functions, their jobs—their niches.

Everything Changes

Don't think for a minute that ecosystems, habitats, communities, and populations don't change. They do. Ponds dry up. Forests are ravaged by fires. Hurricanes blow down trees. Organisms become extinct. These are all natural processes. However, change also occurs because of human intervention. A river gets dammed, creating a lake in the process. Grasslands get mowed and turned into soybean fields. Or trees get cut down and replaced by parking lots or housing developments.

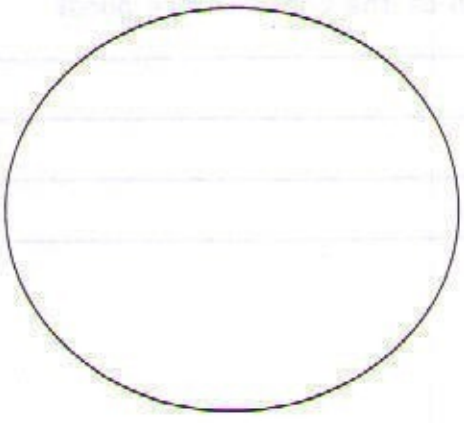
All over the world, animals, plants, and other species come and go—and habitats and ecosystems shift and change over time. Change, in fact, is one thing we can always rely on. □

Name: _____
Date: _____
Period: _____

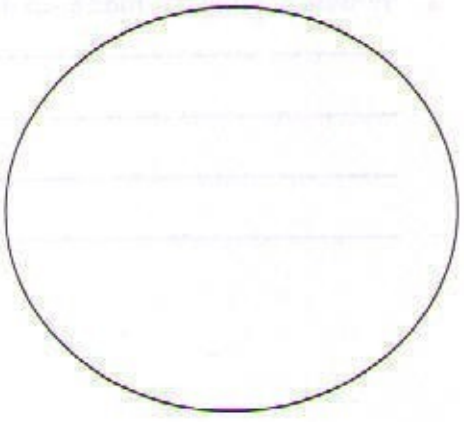
Lesson 4 Lab: The Pond

Pond Drawing
Make a drawing of your pond. List the materials located at each of the pond's layers.

Microscope Drawings
Use the circles that follow to sketch any organisms you find in your pond water samples.



Specimen Name: _____
Magnification: _____



Specimen Name: _____
Magnification: _____

Reflection Questions:

1. List 7 organisms that you observed living at or near the Conservatory pond.

   - _____
   - _____
   - _____
   - _____
   - _____
   - _____
   - _____

2. What is an ecosystem? Describe the ecosystem at the Conservatory pond.

   _____
   _____
   _____
   _____
   _____
   _____

3. Which organisms made up the population at the Conservatory pond?

   _____
   _____
   _____
   _____

4. List 4 organisms from the pond and describe each of their habitats.

- _____
- _____
- _____
- _____

5. Describe a niche from within this pond environment.

_____

_____

_____

6. Can an organisms' habitat change? Explain.

_____

_____

_____

_____

_____

7. Can the population within an ecosystem change? Explain.

_____

_____

_____

_____

_____

Name _____ Date _____ Class _____

SECTION 3-3 **SECTION SUMMARY**

Fungi

Focus Questions

- What characteristics do fungi share?
- How do fungi obtain food?
- What roles do fungi play in the living world?

3

Most fungi share three important characteristics: They are eukaryotes, use spores to reproduce, and are heterotrophs that feed in a similar way. Fungi also need moist, warm places in which to grow. They vary in size from unicellular yeasts to multicellular mushrooms. There are four groups of fungi: the threadlike fungi, the sac fungi, the club fungi, and the imperfect fungi.

Hyphae (singular *hypha*) are branching, threadlike tubes that make up the bodies of multicellular fungi. How a fungus looks depends on the arrangement of its hyphae.

Fungi are heterotrophs, but they do not take food into their bodies like animals do. **First, the fungus grows hyphae into a food source. Then digestive chemicals ooze from the tips of the hyphae into the food. The digestive chemicals break down the food into small substances that can be absorbed by the hyphae.** Some fungi feed on the remains of dead organisms. Others are parasites that break down the chemicals in living organisms.

When there is adequate moisture and food, most fungi reproduce asexually. To do this, they grow structures called **fruiting bodies.** Fruiting bodies are reproductive hyphae that release thousands of spores. Wind or water easily carries the spores to new sites. Unicellular yeasts use a form of asexual reproduction called **budding.** In budding, a small cell grows from the body of a large, well-fed cell. When growing conditions are less favorable, fungi may reproduce sexually. This occurs when the hyphae of two fungi grow together and new genetic material is exchanged. Its spores can develop into fungi different from either parent.

Fungi play an important role as decomposers on Earth. In addition, many fungi provide foods for people. Some cause disease and some fight disease. Still other fungi live in symbiosis with other organisms. Fungi break down the chemicals in dead organisms. This returns nutrients to the soil. Yeasts are important in the preparation of foods such as bread. People also eat some types of fungi, such as mushrooms. Many fungi cause disease in crops and in humans. Others, such as *Penicillium*, make useful substances that kill bacteria. The hyphae of some fungi grow among the roots of plants. The hyphae help the plant absorb more water and nutrients from the soil. In return, the fungus feeds on extra food the plant makes. A **lichen** consists of a fungus living in a mutualistic relationship with either algae or autotrophic bacteria.

Name _____ Date _____ Class _____

SECTION 3-3 REVIEW AND REINFORCE

Fungi

◆ Understanding the Main Ideas

Figures 1 and 2 show two possible life cycles of fungi. Use these figures to answer questions 1–5. Write the answers on the back of this page or on a separate sheet of paper.

Figure 1

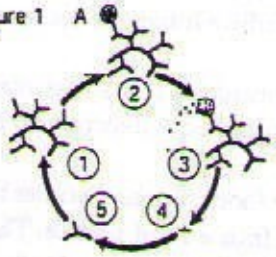
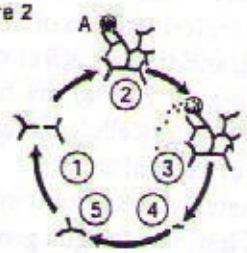


Figure 2



1. What is structure A in Figure 1 called?
2. Step 5 in Figure 1 shows a new fungus. Is it identical to its parent?
3. Step 5 in Figure 2 also shows a new fungus. Is it identical to its parents?
4. What kind of reproduction does Figure 1 show?
5. What kind of reproduction does Figure 2 show?

Answer the following questions on the back of this page or on a separate sheet of paper.

6. What is a fungus?
7. Does a fungus get its food the same way you do? Explain.
8. Describe what would happen if fungi did not exist.

◆ Building Vocabulary Skills

Fill in the space to complete each sentence.

9. A(n) _____ consists of the mutualistic relationship of a fungus and either algae or autotrophic bacteria.
10. A(n) _____ is one of the branching, threadlike tubes that make up the bodies of multicellular fungi.
11. _____ is a form of asexual reproduction in yeast that does not require the production of spores.
12. A(n) _____ is a structure that produces the spores of a fungus.

Name _____ Date _____ Class _____

SECTION 2-1 **SECTION SUMMARY**

Viruses

Guide for Reading

- Why are viruses considered to be nonliving?
- What is the basic structure of a virus?
- How do viruses multiply?

2

A **virus** is a small, nonliving particle that invades and then reproduces inside a living cell. **Biologists consider viruses to be nonliving because viruses are not cells. Viruses do not use energy to grow or to respond to their surroundings.**

Viruses can only multiply when they are in a living cell. The organism that a virus enters and multiplies inside is called a host. A **host** is a living organism that provides a source of energy for a virus or an organism. Organisms that live on or in a host and cause harm to the host are called **parasites.** Most viruses are like parasites because they destroy the cells in which they multiply.

Scientists may name a virus after the disease it causes, the organisms they infect, the place where it was first found, or the scientists who first identified it.

Viruses vary in shape and size. Viruses can be round, rod-shaped, bricklike, threadlike, or bulletlike shapes. Some viruses, including bacteriophages, have complex, robot-like shapes. A **bacteriophage** is a virus that infects bacteria. Viruses are much smaller than cells.

All viruses have two basic parts: an outer coat that protects the virus and an inner core made of genetic material. Each virus contains unique proteins in its coat. The shape of the proteins allows the virus's coat to attach to, or lock onto, only certain cells in the host.

After a virus attaches to a cell, it enters the cell. **Once inside, a virus's genetic material takes over the cell's functions. The genetic material directs the cell to produce the virus's proteins and genetic material. These proteins and genetic material are then assembled into new viruses.**

An active virus immediately takes over the cell's functions, and the cell quickly begins to produce the virus's proteins and genetic material. These parts are assembled into new viruses. When it is full of new viruses, the host cell bursts open and releases the new viruses.

When a hidden virus enters a host cell, the virus's genetic material becomes part of the cell's genetic material. The virus's genetic material may stay inactive for a long time. Then, the virus's genetic material suddenly becomes active and takes over the cell's functions and replicates. Once the host cell is full of new viruses, it bursts open to release them.

Name _____ Date _____ Class _____

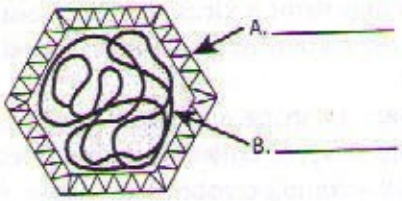
SECTION 2-1 **REVIEW AND REINFORCE**

Viruses

◆ Understanding Main Ideas

Answer the following questions on the back of this page or on a separate sheet of paper.

1. Viruses are considered to be nonliving. How are viruses similar to living organisms? How are they different?
2. How are viruses similar to parasites?
3. How do hidden viruses differ from active viruses?
4. In the diagram below, identify the two structural parts of the virus. Explain the function of each part.



◆ Building Vocabulary

Write a definition for each of the following terms on the lines below.

5. virus

6. bacteriophage

7. parasite

8. host

Name _____ Date _____ Class _____

SECTION 2-2 **SECTION SUMMARY**

Bacteria

Guide for Reading

- How are the cells of bacteria different from those of all other organisms?
- What positive roles do bacteria play in people's lives?

2

Bacteria are prokaryotes. The genetic material in their cells is not contained in a nucleus. Bacterial cells have one of three basic shapes: spherical, rodlike, or spiral.

Most bacterial cells are surrounded by a rigid cell wall that helps to protect the cell. Inside the cell wall is the cell membrane that controls what materials pass into and out of the cell. **Cytoplasm** is the gel-like material inside the cell membrane. Inside the cytoplasm are tiny structures called **ribosomes** that are the chemical factories where proteins are produced. The cell's genetic material is also located in the cytoplasm, and contains the instructions for all the cell's functions. Some bacteria have flagella. A **flagellum** is a long, whiplike structure that extends out through the cell membrane and cell wall. A flagellum helps a cell to move.

Because of chemical differences, scientists classify bacteria into two separate kingdoms—Archaebacteria and Eubacteria. Archaebacteria have existed on Earth for billions of years. Scientists think they closely resemble Earth's first life forms.

Bacteria reproduce by **binary fission,** a process in which one cell divides to form two identical cells. Binary fission is a form of asexual reproduction. **Asexual reproduction** is a reproductive process that involves only one parent and produces offspring that are identical to the parent. Some bacteria perform a simple form of sexual reproduction called conjugation. **Sexual reproduction** involves two parents who combine their genetic material to produce a new organism that differs from both parents. During **conjugation,** one bacterium transfers some of its genetic material into another. After the transfer the cells separate.

Some bacteria are autotrophs and make their own food. Others are heterotrophs that obtain food by consuming autotrophs or other heterotrophs. Bacteria get energy to carry out their functions from food. The process of breaking down food to release its energy is called **respiration.**

Many bacteria can survive harsh conditions by forming endospores. An **endospore** is a small, rounded, thick-walled, resting cell that forms inside a bacterial cell.

Some bacteria cause diseases and other harmful conditions. However, most bacteria are either harmless or helpful to people. **Bacteria are involved in fuel and food production, environmental recycling and cleanup, and the production of medicines.** Heterotrophic eubacteria break down materials for reuse. These bacteria, which live in the soil, are **decomposers**—organisms that break down large chemicals in dead organisms into small chemicals.

Name _____ Date _____ Class _____

SECTION 2-2 REVIEW AND REINFORCE

Bacteria

◆ Understanding Main Ideas

Answer the following questions on the back of this page or on a separate sheet of paper.

1. How are bacterial cells different from the cells of other types of organisms?
2. Name the two kingdoms of bacteria and explain why scientists classify them separately.
3. List four ways that bacteria are helpful to people.

◆ Building Vocabulary

Match each term with its definition by writing the letter of the correct definition on the line beside the term.

_____ 4. cytoplasm

_____ 5. endospore

_____ 6. binary fission

_____ 7. decomposer

_____ 8. sexual reproduction

_____ 9. flagellum

_____ 10. asexual reproduction

_____ 11. conjugation

_____ 12. respiration

_____ 13. ribosome

a. where two parents combine their genetic material to produce a new organism that differs from both parents

b. where one bacterium divides to form two identical bacteria cells

c. a small, thick-walled resting cell that forms inside a bacterial cell

d. the region inside the cell membrane

e. organism that breaks down the large chemicals in dead organisms into small chemicals

f. where one bacterium transfers genetic material into another bacterial cell

g. the cell's chemical factories where proteins are produced

h. the process of breaking down food to release energy

i. whiplike structure that helps a cell to move

j. where one parent reproduces offspring identical to that parent

Animal & Plant Cells

Name _____ Date _____ Class _____

SECTION 1-1 **SECTION SUMMARY**

Discovering Cells

1

Guide for Reading

- How did the invention of the microscope contribute to scientists' understanding of living things?
- What is the cell theory?
- How does a lens magnify an object?

Cells are the basic units of structure and function in living things. Most cells are too small to be seen with the naked eye. **The invention of the microscope made it possible for people to discover and learn about cells.**

A **microscope** is an instrument that makes small objects look larger. Some microscopes do this by using lenses to focus light. A simple light microscope contains only one lens. A light microscope that has more than one lens is called a **compound microscope.**

One of the first people to observe cells was Robert Hooke. In 1663, Hooke observed the structure of a thin slice of cork using a compound microscope he had built himself. At about the same time, Anton van Leeuwenhoek began to construct microscopes and use them to observe tiny objects. Leeuwenhoek was the first person to see the single-celled organisms that are now called bacteria.

In 1838 Matthais Schleiden concluded that all plants are made up of cells. The next year, Theodor Schwann concluded that all animals are also made up of cells. In 1855 Rudolf Virchow proposed that new cells are formed only from existing cells. The observations and conclusions of Hooke, Leeuwenhoek, Schleiden, Schwann, Virchow, and others led to the development of the **cell theory. The cell theory states: all living things are composed of cells; cells are the basic unit of structure and function in living things; all cells are produced from other cells.**

For a microscope to be useful, it must combine two important properties—magnification and resolution. **Magnification** is the ability to make things look larger than they are. **The lens or lenses in a light microscope magnify an object by bending the light that passes through them.** A lens that magnifies is thicker in the center than at the edges and is called a **convex lens.** Because a compound microscope uses more than one lens, it can magnify an object more than a simple microscope. The total magnification of a compound microscope is equal to the magnifications of the two lenses multiplied together. The ability to clearly distinguish the individual parts of an object is called **resolution.** Resolution is another term for the sharpness of an image.

Since the 1930s, scientists have developed different types of electron microscopes, which use a beam of electrons instead of light to examine a specimen. Because they use tiny electrons to produce images, the resolution of electron microscopes is much better than the resolution of light microscopes.

Name _____ Date _____ Class _____

SECTION 1-1 **REVIEW AND REINFORCE**

Discovering Cells

1

◆ Understanding Main Ideas

Fill in the blanks in the table below.

Discovering Cells

Scientist	Contribution
1. _____	One of the first people to observe cells
Leeuwenhoek	2. _____
3. _____	Concluded that all plants are made up of cells
Schwann	4. _____
5. _____	Proposed that all cells come from other cells

Answer the following questions on a separate sheet of paper.

6. Compare and contrast magnification and resolution.
7. State how an electron microscope differs from a light microscope.
8. Explain how cells are related to living things.

◆ Building Vocabulary

Match each term with its definition by writing the letter of the correct definition in the blank beside the term.

_____ 9. cell

_____ 10. microscope

_____ 11. compound microscope

_____ 12. cell theory

_____ 13. magnification

_____ 14. convex lens

_____ 15. resolution

a. the ability to make things look larger than they are

b. the basic unit of structure and function in living things

c. a widely accepted explanation of the relationship between cells and living things

d. a light microscope that has more than one lens

e. any instrument that makes small objects look larger

f. the ability to distinguish the individual parts of an object

g. a curved lens that is thicker in the middle than at the edges

Name _____ Date _____ Class _____

SECTION 1-2 **SECTION SUMMARY**

Looking Inside Cells

1

Guide for Reading

- What role do the cell membrane and nucleus play in the cell?
- What functions do other organelles in the cell perform?
- How do bacterial cells differ from plant and animal cells?

Inside a cell are tiny structures called **organelles,** which carry out specific functions in the cell. Organelles include the cell wall, cell membrane, and nucleus.

The **cell wall** is a rigid layer of nonliving material that surrounds the cells of plants and some other organisms. It helps protect and support a cell. Although the cell wall is stiff, many materials can pass through it.

In cells that do not have cell walls, the **cell membrane** is the outside boundary that separates the cell from its environment. There are tiny openings, or pores, in the cell membrane through which materials can enter or leave the cell. **One of the cell membrane's main functions is to control what substances come into and out of a cell.**

The **nucleus** is a large, oval structure that acts as the "brain" of the cell. **You can think of the nucleus as the cell's control center, directing all of the cell's activities.** The nucleus is surrounded by a nuclear membrane. Materials pass in and out of the nucleus through small openings, or pores, in the nuclear membrane. Floating in the nucleus are thin strands called **chromatin,** which contains the genetic material, or the instructions for cell functions. The nucleus also contains the nucleolus, a structure where ribosomes are made.

The **cytoplasm** is the region between the cell membrane and the nucleus. Many cell organelles are found in the cytoplasm. **The organelles function to produce energy, build and transport needed materials, and store and recycle wastes.** Rod-shaped organelles called **mitochondria** produce energy. A maze of passageways called the **endoplasmic reticulum** carries proteins and other materials from one part of the cell to another. Small, grainlike bodies called **ribosomes** produce proteins. Collections of sacs and tubes called **Golgi bodies** distribute proteins and other materials throughout the cell. The Golgi bodies aslo release materials outside the cell. In plants and some other organisms, large, green structures called **chloroplasts** capture energy from sunlight and use it to produce food for the cell. A large sac called a **vacuole** stores food and other materials in the cell. Small, round structures called **lysosomes** break down food and recycle old cell parts.

A bacterial cell is smaller than a plant or animal cell. **While a bacterial cell does have a cell wall and a cell membrane, it does not contain a nucleus.** A bacterial cell also contains ribosomes but none of the other organelles found in plant or animal cells.

In many-celled organisms, the cells are often quite different from each other. The structure of each kind of cell is suited to the function it carries out in the organism.

Name _____ Date _____ Class _____

SECTION 1-2 **REVIEW AND REINFORCE**

Looking Inside Cells

◆ Understanding Main Ideas

Identify each of the cell structures in the figure.

1. _____ 2. _____

3. _____ 4. _____

5. _____

Simplified Animal Cell

◆ Building Vocabulary

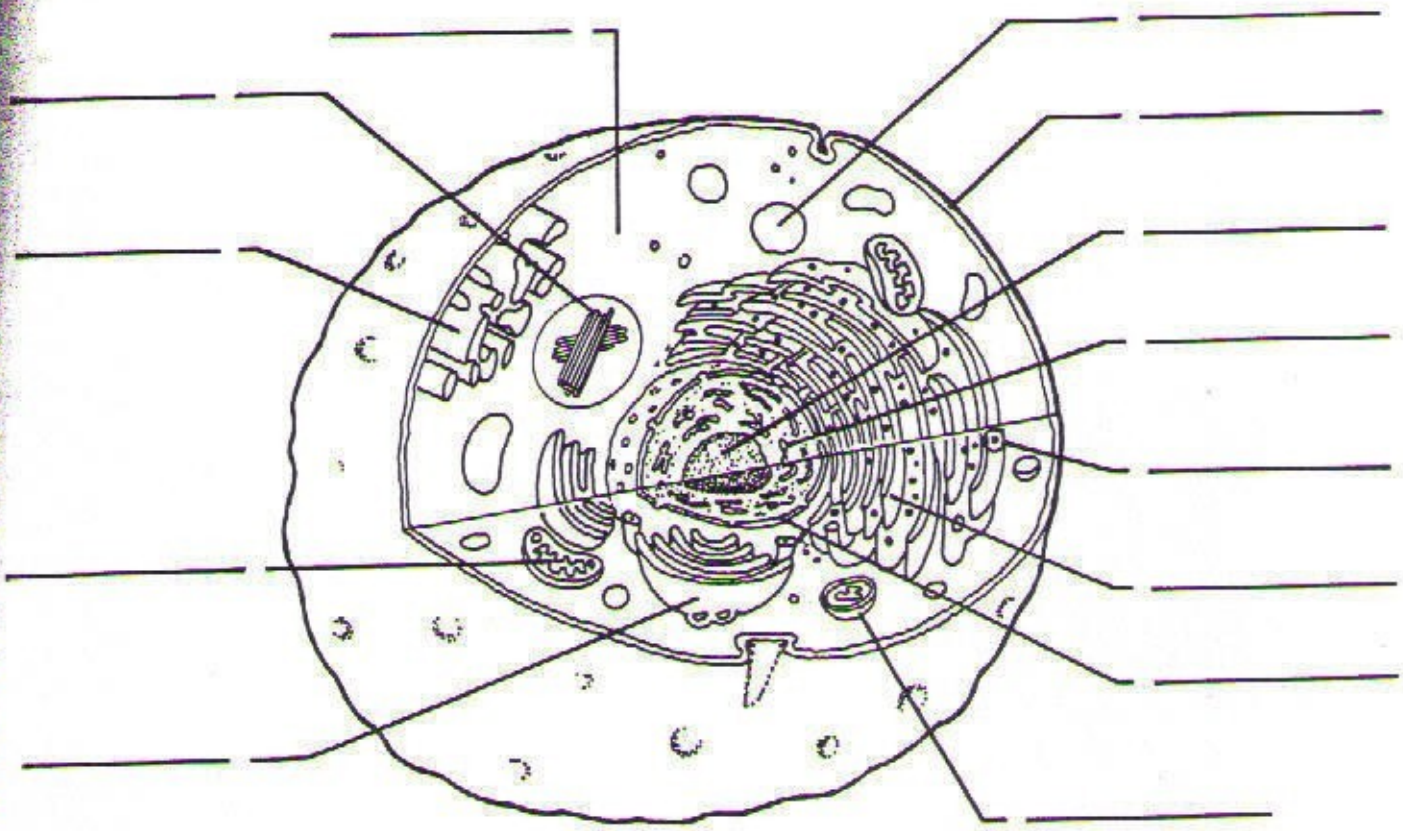
Fill in the blank to complete each statement.

6. _____ are tiny cell structures that carry out specific functions within the cell.
7. The rigid layer of nonliving material that surrounds the cells of plants and other organisms is called the _____.
8. In cells without cell walls, the _____ forms the outside boundary that separates the cell from its environment.
9. The _____ is a large, oval structure that directs all of the cell's activities.
10. Strands of genetic material floating in the nucleus are referred to as _____.
11. The region between the cell membrane and the nucleus is called the _____.
12. _____ produce most of the energy the cell needs to carry out its functions.
13. A maze of passageways called the _____ carries proteins and other materials from one part of the cell to another.
14. _____ function as factories to produce proteins.
15. _____ receive proteins and other newly formed materials and distribute them to other parts of the cell.
16. Organelles called _____ capture energy from sunlight and use it to produce food for the cell.
17. The storage area of a cell is called a(n) _____.
18. _____ are small, round structures in cells that break down large food particles into smaller ones.

ANIMAL CELLS

Name _____

Label the organelles in the diagram below of a typical animal cell. Describe the function/purpose of each organelle in the cell.



a. vacuole _____

b. lysosome _____

c. ribosomes _____

d. Golgi complex _____

e. cytoplasm _____

f. nucleus _____

g. nucleolus _____

h. nuclear membrane _____

i. cell (plasma) membrane _____

j. mitochondria _____

k. smooth endoplasmic reticulum _____

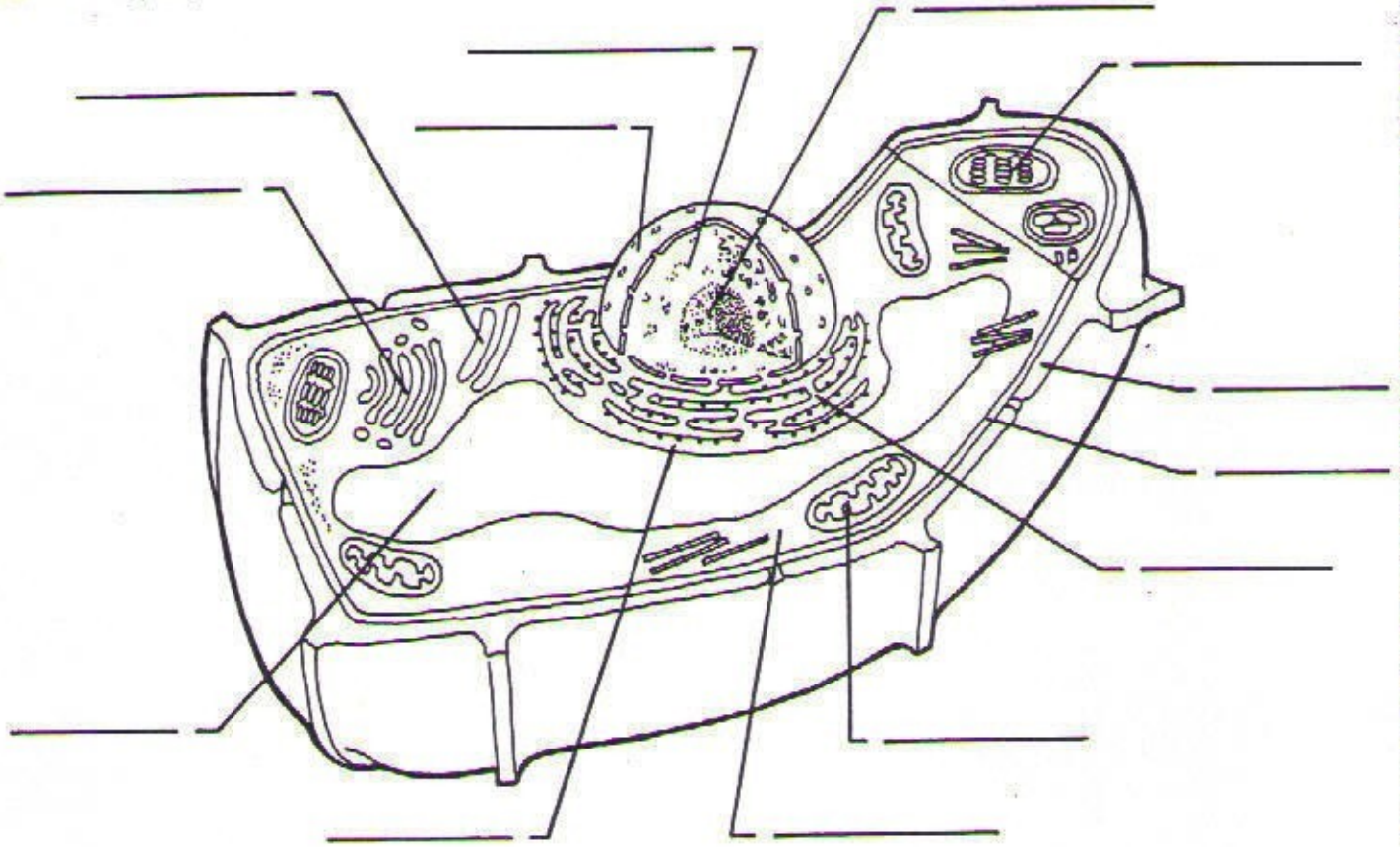
l. rough endoplasmic reticulum _____

m. centriole _____

PLANT CELLS

Name _____

Label the organelles in the diagram below of a typical plant cell. Describe the function/purpose of each organelle in the cell.



a. ribosomes _____

b. Golgi complex _____

c. cytoplasm _____

d. nucleus _____

e. nucleolus _____

f. nuclear membrane _____

g. cell (plasma) membrane _____

h. mitochondria _____

i. rough endoplasmic reticulum _____

j. vacuole _____

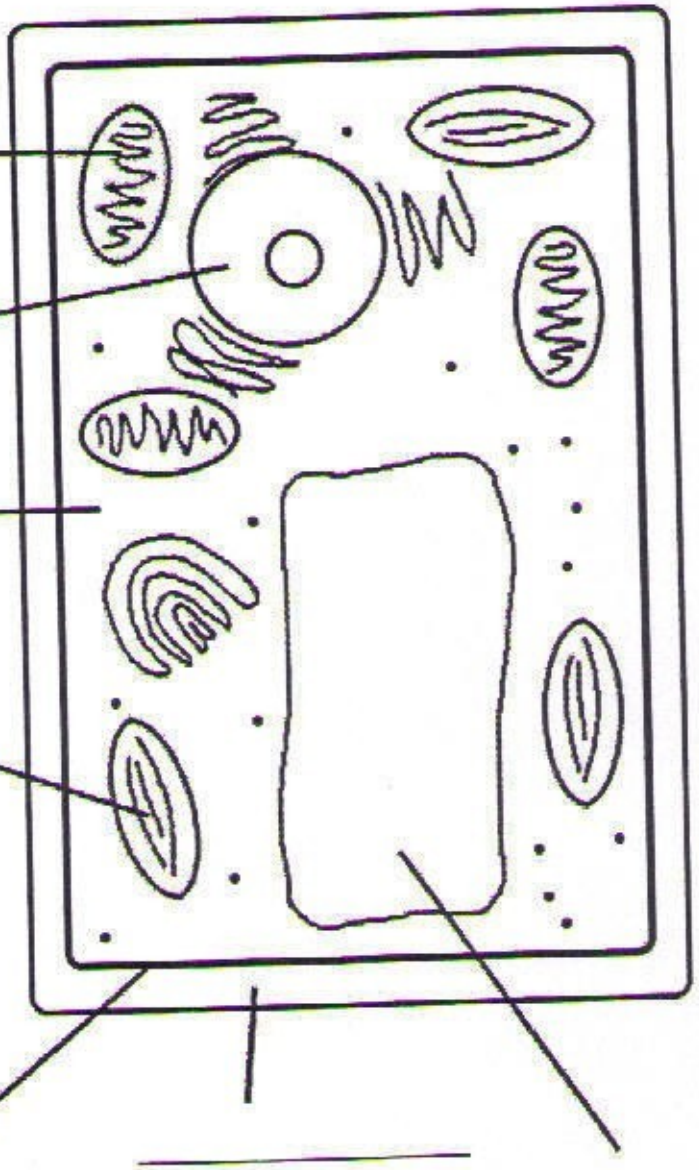
k. cell wall _____

l. chloroplast _____

m. smooth endoplasmic reticulum _____

Name _____ Date _____

Basic Parts of a Plant Cell



_____

_____

_____

_____ (contains chlorophyll)

_____ _____

_____ _____

cell wall
chloroplast
cytoplasm
membrane
mitochondria
nucleus
vacuole

PLANT & ANIMAL CELLS (ORGANELLES)

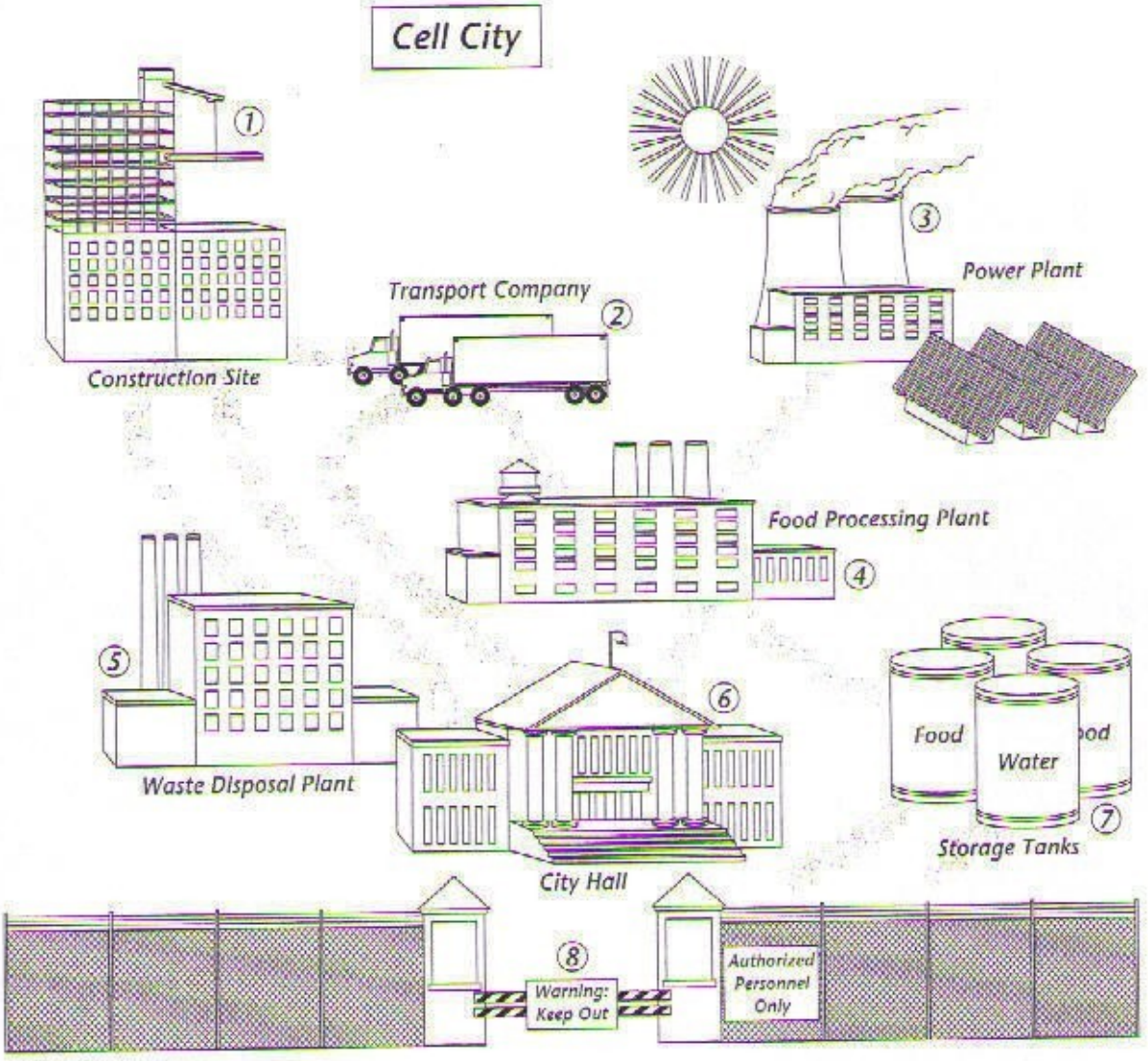
Cell Structure/ Cell Part	Function	Plant Cell	Animal Cell
Cell Wall	- the rigid, non-living outer layer of a plant cell - protects the cell - made primarily of cellulose	X	
Cell Membrane	- the outermost, living layer in cells - gives cells shape and support - it's selectively permeable (determines what enters or leaves the cell)	X	X
Cytoplasm	- "jelly-like" substance found between the nuclear and cell membranes - provides support for the cells - contains most of the organelles	X	X
Nucleus	- "control center" - controls the cell's activities - contains the DNA of the cell	X	X
Nuclear Membrane	- encloses the nucleus - assists in the exchanges between the nucleus and the cytoplasm	X	X
Nucleolus	- small "spherical" structure found in the nucleus - produces ribosomes	X	X
Endoplasmic Reticulum (ER)	- "maze of passageways" - assists in the communication between the nucleus and cytoplasm - Rough ER contains ribosomes, Smooth ER does not	X	X
Ribosomes	- tiny "knob-like" particles in a cell - manufacture proteins - attached to the membranes of the ER	X	X
Golgi Bodies	- "mailroom" of the cell - package, sort, and deliver proteins to the proper locations in and out of the cell	X	X
Mitochondria	- "powerhouses" of the cell - breaks down nutrients for energy - cells that need more energy contain more mitochondria (i.e.: muscle cells)	X	X
Vacuoles	- "storage areas" for cells - store what is necessary for the cell - plant cells have a larger vacuole (need to store more)	X	X
Lysosomes	- "garbage disposal" of the cell - contain digestive enzymes that break down food		X
Chloroplasts	- special plastid in plant cells that contain chlorophyll (green pigment) - captures energy from the sunlight for photosynthesis	X	

Name _____ Date _____ Class _____

SECTION 1-2 **ENRICH**

Modeling Cell Structures

1 The figure below shows a city that is a model for a cell. Study the figure, and use it to respond to the items that follow.



Answer the following questions on a separate sheet of paper.

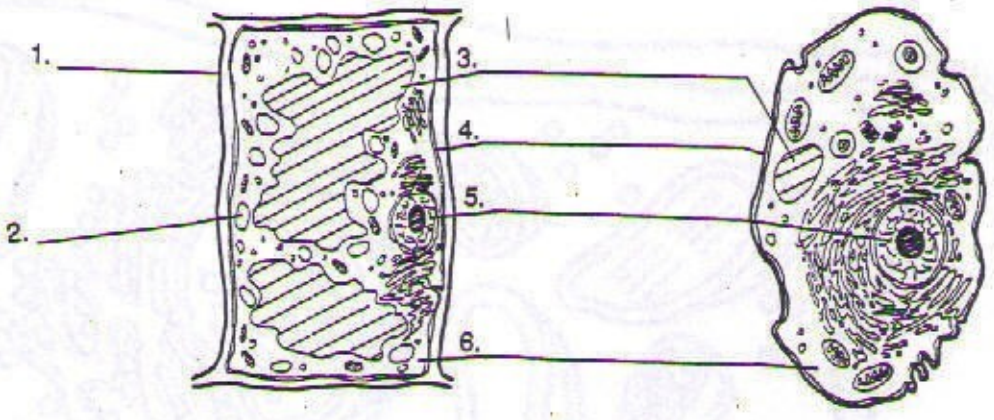
1. State the function performed by each numbered structure in the figure.
2. Now name a cell structure that performs each of these same functions.
3. Does "Cell City" represent a plant cell or an animal cell? Explain your answer.

How Plant and Animal Cells Differ

The diagrams below show some basic parts of typical plant and animal cells. Label the diagrams, using the words in the box. Then answer the questions.

Cell wall
Cell membrane
Chloroplast
Cytoplasm
Nucleus
Vacuole

Plant Cell **Animal Cell**



7. How do plant cells differ from animal cells? _____

_____

8. What is the function of each of the following cell parts?

Cell wall _____

_____

Cell membrane _____

_____

Chloroplasts _____

_____

Cytoplasm _____

_____

Nucleus _____

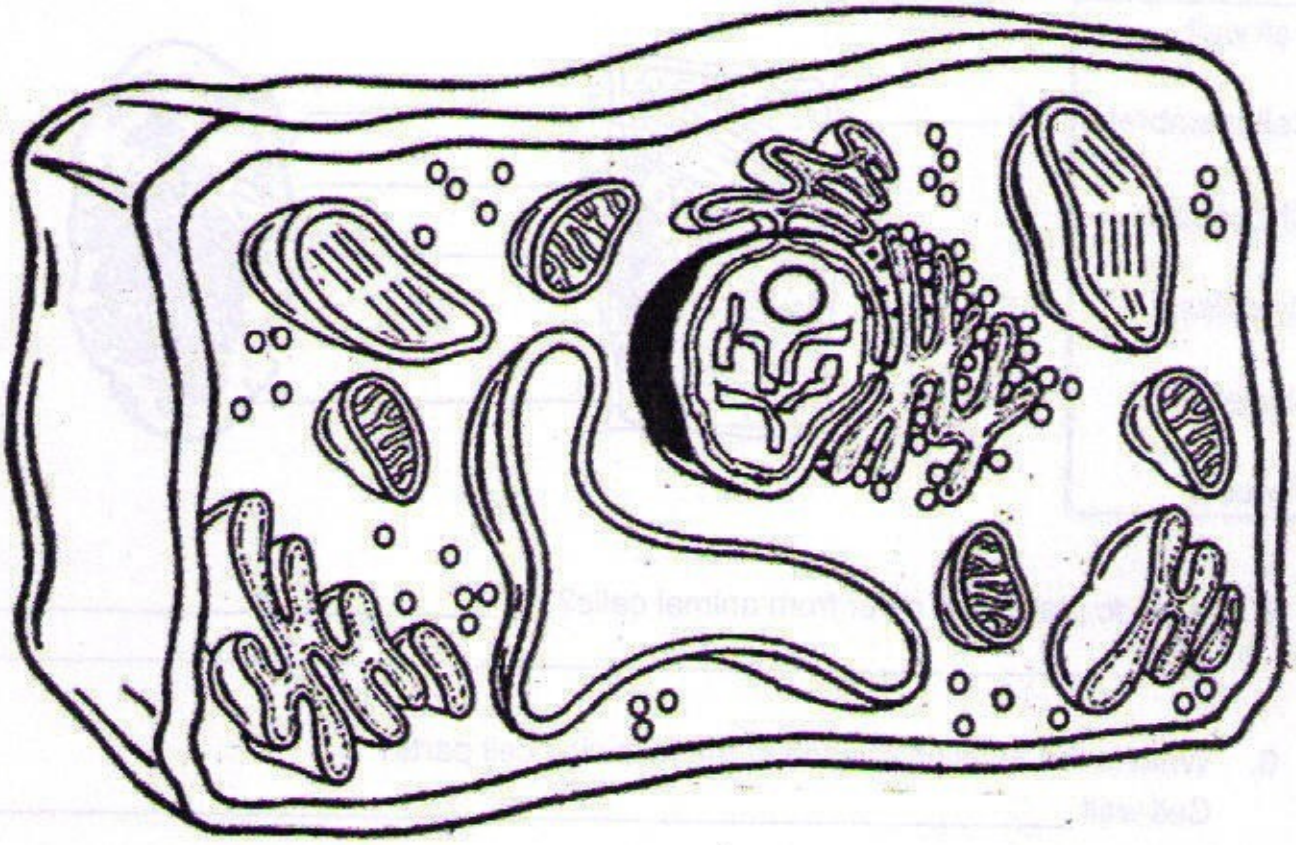
_____

Vacuoles _____

_____

Plant Cell Coloring ..... Name _____

- ☐ Cell Membrane (orange)
- ☐ Nucleoplasm (yellow)
- ☐ Mitochondria (red)
- ☐ Vacuole (lt. Blue)
- ☐ Chromatin (gray)
- ☐ Cell Wall (dark green)
- ☐ Nucleolus (brown)
- ☐ Chloroplasts (light green)
- ☐ Ribosome (purple)
- ☐ Cytoplasm (white)
- ☐ Golgi Apparatus (dk blue)
- ☐ Smooth Endoplasmic Reticulum (pink)
- ☐ Rough Endoplasmic Reticulum (pink)



Analysis

1. Name two things found in a plant cell that are not found in an animal cell:
2. How does the shape of a plant cell differ from that of an animal cell?
3. What is the function of the chloroplasts?
4. What is the function of the vacuole?

FUNCTION OF THE ORGANELLES

Name _____

Which organelle performs each of the following functions within the cell?

Function	Organelle
1. Controls the movement into and out of the cell	1. _____
2. Watery material which contains many of the materials involved in cell metabolism	2. _____
3. Serves as a pathway for the transport of materials throughout the cell; also associated with synthesis and storage	3. _____
4. Serves as the control center for cell metabolism and reproduction	4. _____
5. Sites of protein synthesis	5. _____
6. Involved in the digestion of food within the cell	6. _____
7. The "powerhouse" of the cell	7. _____
8. Packages and secretes the products of the cell	8. _____
9. Involved in cell division in animal cells	(*)9. _____
10. Fluid filled organelles enclosed by a membrane; contains stored food or wastes	10. _____
11. Site of the production of ribosomes	11. _____
12. Controls movement into and out of the nucleus	12. _____
13. Gives the cell its shape and provides protection; not found in animal cells	13. _____
14. Hairlike structures with the capacity for movement	(*)14. _____
15. A long, hairlike structure used for movement	(*)15. _____
16. Site of photosynthesis	16. _____
17. During cytokinesis, the new cell wall that begins to form in the middle, dividing the two sides	(*)17. _____
18. rod-shaped bodies that carry genetic information	18. _____

(*) = Extra Credit 157

Name _____ Date _____

Get Set to Read

What do you know about cells? In Before Reading, write *true* if you think the statement is true. Write *false* if you think the statement is not true. Then read KIDS DISCOVER *Cells*. Check back to find out if you were correct. Write the correct answer and its page number.

CHALLENGE: Rewrite each false sentence in a way that makes it true.

Before Reading		After Reading	Page Number
_____	1. All living and nonliving things are made up of cells.	_____	_____
_____	2. Every bacterium is a living creature made up of one cell.	_____	_____
_____	3. After seeing them through a microscope, Robert Hooke named cells after small rooms.	_____	_____
_____	4. Cells are mostly fats and proteins.	_____	_____
_____	5. The most basic unit of heredity is DNA.	_____	_____
_____	6. Groups of muscle cells form muscle tissue, which is responsible for movement.	_____	_____
_____	7. Through meiosis, a parent cell divides into two cells identical to the parent.	_____	_____
_____	8. Louis Pasteur proved that cells could not spontaneously generate.	_____	_____
_____	9. About 50 percent of your genetic makeup is different from that of other humans.	_____	_____
_____	10. Stem cells from embryos can produce over 200 kinds of human cells.	_____	_____

Name: _____
Date: _____ Period: ____

Kids Discover Magazine
Pages 2-5

Directions: Answer each of the following questions after reading pages 2-5 in the Kid Discover magazine.

CELLS ARE THE BASIC UNIT OF LIFE.

1. What is the relationship between atoms, molecules, and cells? Be specific.

2. How are unicellular creatures and multicellular creatures alike? How are they different?

3. What are the six categories of human cells?

CELLS HAVE SIMILAR STRUCTURES

4. What structures do all cells have in common? List each of the structures with their function.

5. How do plants produce food for energy?

6. Which organelles are found only in plant cells? What are their functions?

7. What five major ingredients make up cells? What percentage of each of these is found in a cell?

Name _____ Date _____

Everything Visual

In *Cells*, a time line shows the progression of the story of cells. Use the time line on pages 12–13 to answer these questions.

1. Who was the first person to see a cell? About when did this happen? Why was it possible for the person to see cells at this time?

2. In the 1860s, the Civil War raged in the United States. What was Walther Flemming doing at the time? Why was this important?

3. In the summer of 2005, a news report announced that a dog had been cloned. Would you add this information to the time line? Explain.

4. When did Louis Pasteur disprove the idea of spontaneous generation? Whose work did this support?

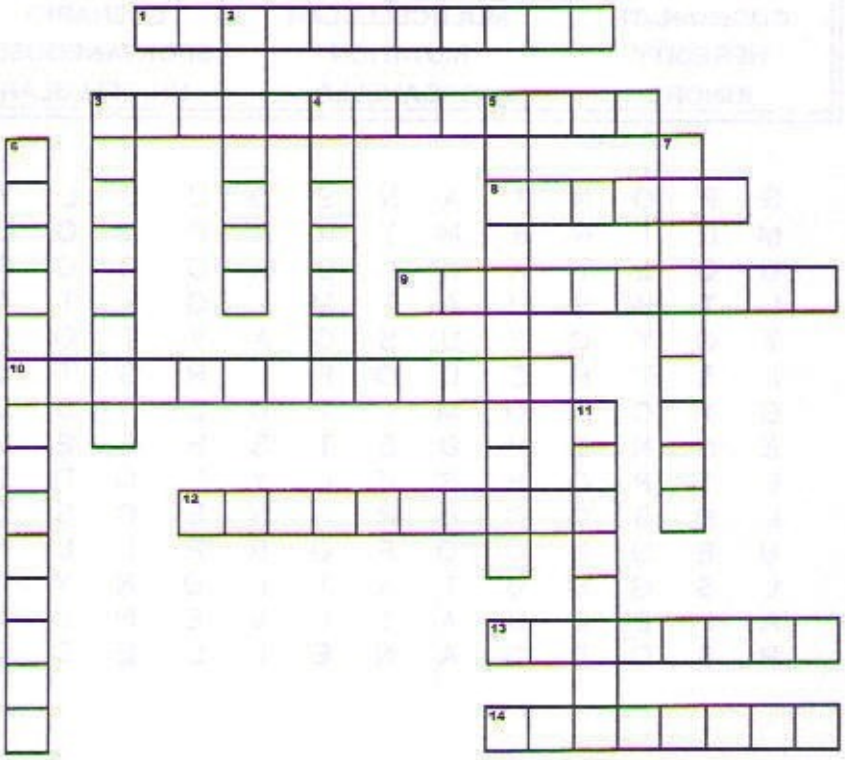
5. In what two years were two different kinds of microscopes invented?

6. For how many years has the map of the entire human genome been finished?

Name _____ Date _____

Crossword

compartment	heredity	mitosis	organelle	scenario
compose	ignore	multicellular	photosynthesis	spontaneously
coordinate	inevitable	mutation	profound	unicellular



Across

1. a section of an enclosed place set off by a divider
3. having many cells
8. to pay no attention to
9. sure to take place; impossible to avoid
10. happening without an outside cause
12. to put in proper relation or order; to adjust to another
13. the passing of characteristics by genes from parents to offspring
14. very deep; very great

Down

2. process by which a cell divides to make two cells exactly like itself
3. an alteration; a change
4. to make up
5. having only one cell
6. process by which plants make their own food
7. tiny cell structure with a specific job
11. sequence of events; account of a possible course of action

Name _____ Date _____

Word Find

Circle each word from the box in the letter grid below. The words are up and down, across, backwards, and diagonal. Then, going across each row starting at the top left, place each unused letter on a blank until you reveal the hidden message.

COMPARTMENT	INEVITABLE	PHOTOSYNTHESIS
COMPOSE	MITOSIS	PROFOUND
COORDINATE	MULTICELLULAR	SCENARIO
HEREDITY	MUTATION	SPONTANEOUSLY
IGNORE	ORGANELLE	UNICELLULAR

S	P	O	N	T	A	N	E	O	U	S	L	Y
M	H	T	N	E	M	T	R	A	P	M	O	C
U	O	E	T	A	N	I	D	R	O	O	C	R
L	T	W	R	H	A	T	M	I	G	H	T	A
T	O	Y	O	E	U	S	C	A	Y	T	O	L
I	S	T	H	E	D	O	F	I	R	S	T	U
C	Y	C	L	O	M	I	T	O	S	I	S	L
E	N	N	E	P	D	E	T	S	H	E	E	L
L	T	P	O	H	R	E	L	Y	L	O	D	E
L	H	S	O	O	I	R	A	N	E	C	S	C
U	E	D	N	U	O	F	O	R	P	L	L	I
L	S	G	M	U	T	A	T	I	O	N	Y	N
A	I	E	L	B	A	T	I	V	E	N	I	U
R	S	O	R	G	A	N	E	L	L	E	D	L

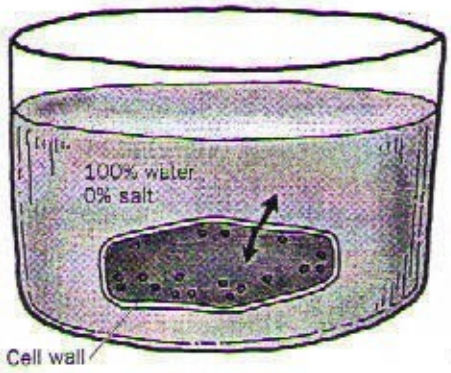
_____ _____ _____ _____ _____ _____ _____

_____ _____?

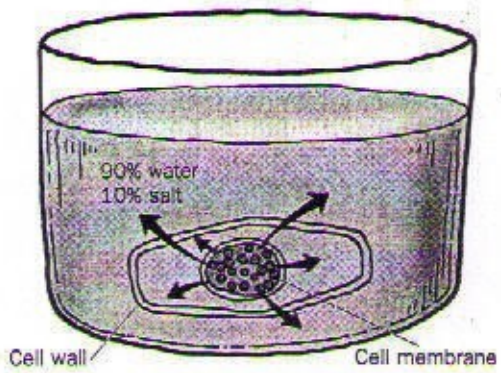
_____, _____

Inquiry Master 7.3
Plasmolysis in *Elodea* Cells

Elodea cell in fresh water



Elodea cell in salt water



Assume that the concentration of water inside both cells was orginally around 97%.

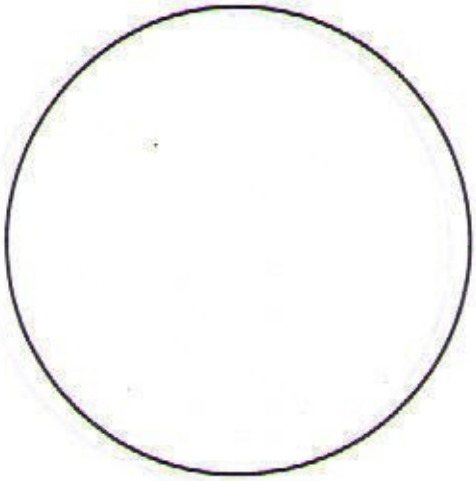
Because the concentration of water outside the cell is slightly greater, some water moves into the cell. The slight imbalance of water enables the cell to maintain its shape.

Because the concentration of water inside the cell is greater, water moves out of the cell. As the cell loses water, the cell membrane shrinks away from the cell wall, confining cytoplasm and organelles to a small, bubble-shaped space.

Name:_____

Class:_____ Date:_____

Student Sheet 7.1
Template for *Spirogyra* Cell Drawing

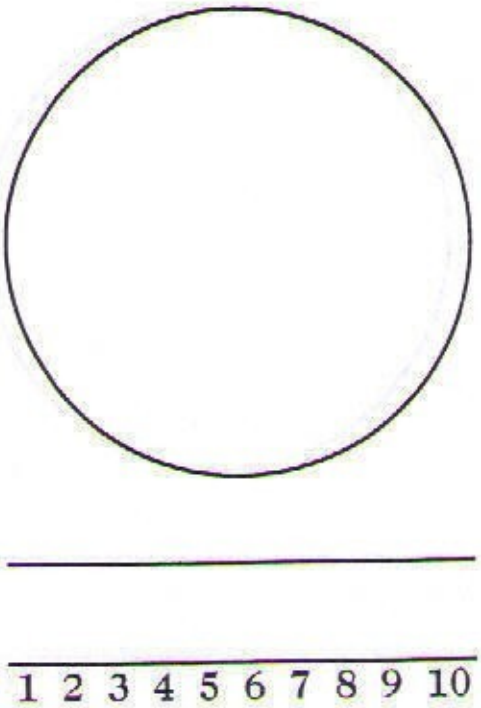


1 2 3 4 5 6 7 8 9 10

Reflecting on What You've Done

A. Based on the alga *Spirogyra* that you observed, would you consider *Spirogyra* to be more plant-like or animal-like? Defend your answer.

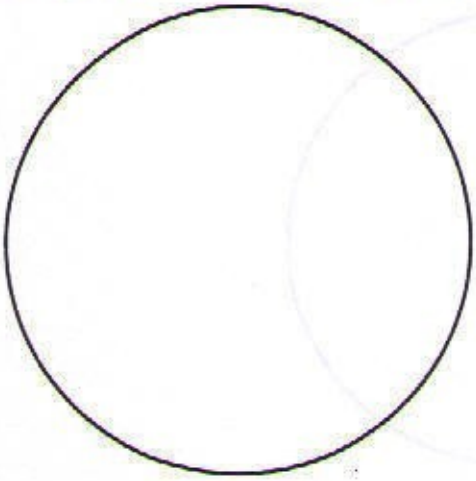
Student Sheet 7.2
Template for Onion Leaf Cell Drawing



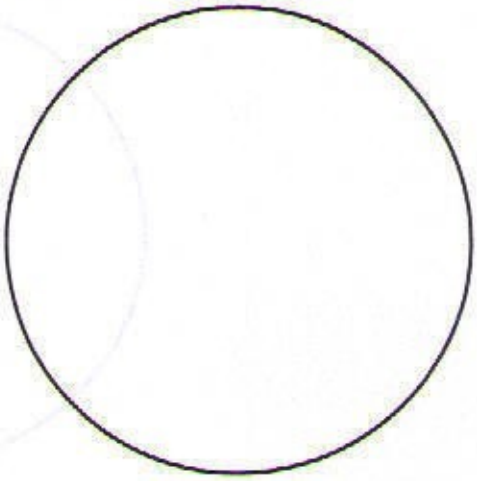
Reflecting on What You've Done

B. Why do you think the bulb of the onion plant is so big? What function does it serve for the plant?

Student Sheet 7.3
Template for *Elodea* Leaf Cell Drawings



1 2 3 4 5 6 7 8 9 10

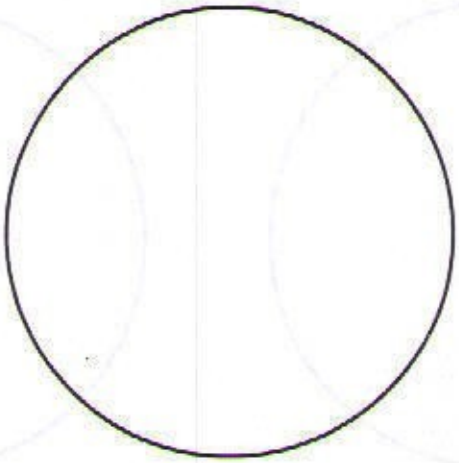


1 2 3 4 5 6 7 8 9 10

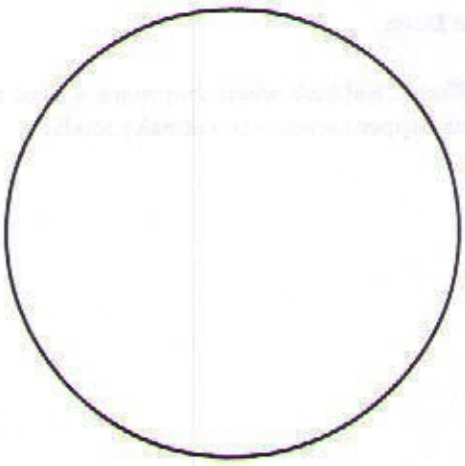
Reflecting on What You've Done

C. What happened to the *Elodea* leaf cells when they were soaked in salt solution. How do you think this relates to what happens when you eat salty foods?

Student Sheet 7.4
Template for Animal Cell Drawings



1 2 3 4 5 6 7 8 9 10



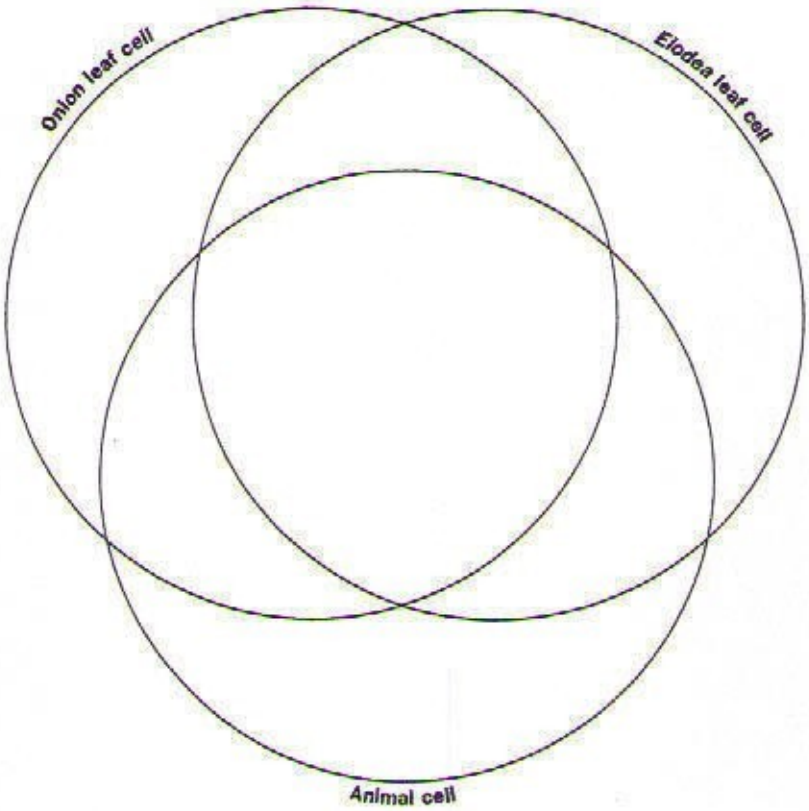
1 2 3 4 5 6 7 8 9 10

(continued)

Student Sheet 7.4 (continued)

Reflecting on What You've Done

D. Use the Venn diagram to show the organelles that you observed in cells from the onion bulb, *Elodea* leaves, and epithelial tissue.



E. If animal cells do not have cell walls, what gives animals such as mammals shape and support?

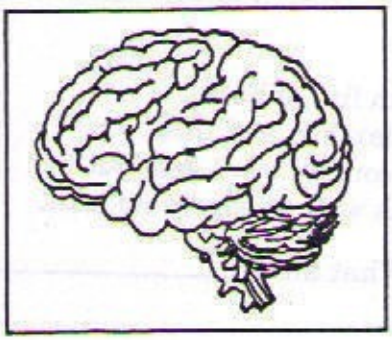
F. Give one example from among the cells you observed in this lesson of how the size and shape of the cell is suited for its particular function.

G. Compare the cells you drew in the inquiries with the one your group sketched during "Getting Started." Based on what you have learned, discuss what you would need to do to make your sketch more accurate.

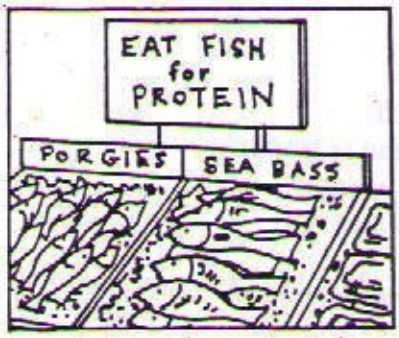
Cell Function

Each drawing below represents a specific function performed by a structure in a single cell. Select the structure from the list below that best relates to each drawing. Write the letter of the structure on the line provided.

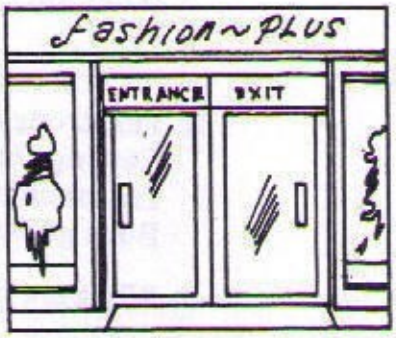
a. nucleus
b. cell membrane
c. chromosome
d. vacuole
e. chloroplast
f. endoplasmic reticulum
g. ribosome
h. lysosome
i. mitochondrion



1. _____

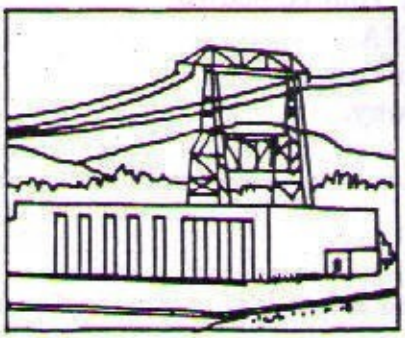


2. _____

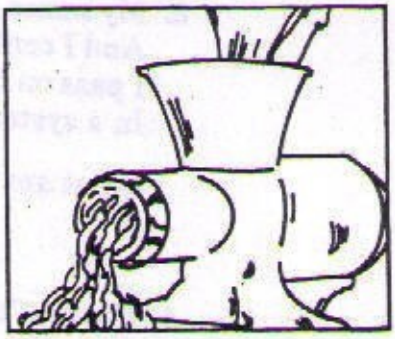


3. _____

4. _____

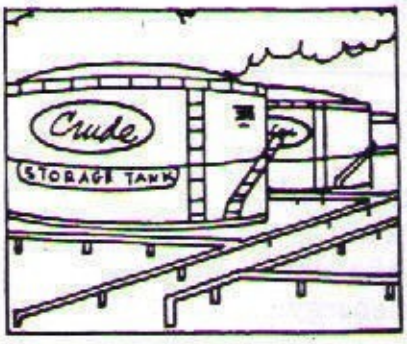


5. _____



6. _____

7. _____



8. _____

9. _____

Can You Identify These Cell Structures?

Read each description and then identify the cell structure. Write your answer on the line provided.

1. I'm a real "powerhouse."
That's plain to see.
I break down food
To release energy.

What am I? _____

2. I'm strong and stiff
Getting through me is tough.
I'm found only in plants,
But I guess that's enough.

What am I? _____

3. My name means "colored bodies,"
And I contain DNA.
I pass on traits to new cells
In a systematic way.

What am I? _____

4. I'm the "brain" of the cell
Or so they say.
I regulate activities
From day to day.

What am I? _____

5. Found only in plant cells,
I'm green as can be.
I make food for the plant
Using the sun's energy.

What am I? _____

6. I'm a series of tubes
Found throughout the cell.
I transport proteins
And other things as well.

What am I? _____

7. I'm full of holes,
Flexible, and thin.
I control what gets out
As well as what comes in.

What am I? _____

8. Proteins are made here
Even though I'm quite small.
You can find me in the cytoplasm
Or attached to E.R.'s wall.

What am I? _____

9. I've been called a "storage tank"
By those with little taste.
I'm a sac filled with water,
Food, enzymes, or waste.

What am I? _____

10. Since I contain many enzymes,
I can digest an injured cell;
And can break down a large molecule
Into a smaller one as well.

What am I? _____

Name _____ Date _____ Class _____

SECTION 1-4 **SECTION SUMMARY**

The Cell in Its Environment

1

Guide for Reading

- By what three methods do materials move into and out of cells?
- What is the difference between passive transport and active transport?

The cell membrane is **selectively permeable,** which means that some substances can pass through it while others cannot. The cell membrane is usually permeable to substances such as oxygen, water, and carbon dioxide. On the other hand, the cell membrane is usually not permeable to some large molecules and salts. **Substances that can move into and out of a cell do so by one of three methods: diffusion, osmosis, or active transport.**

The main method by which small molecules move into and out of cells is diffusion. **Diffusion** is the process by which molecules tend to move from an area of higher concentration to an area of lower concentration. The concentration of a substance is the amount of the substance in a given volume. Diffusion is caused by molecules moving and colliding. The collisions cause the molecules to push away from one another and spread out. Molecules diffuse through the cell membrane into a cell when there is a higher concentration of the molecules outside the cell than inside the cell.

The diffusion of water molecules through a selectively permeable membrane is called **osmosis.** Osmosis is important to cells because cells cannot function properly without adequate water. In osmosis, water molecules move from an area where they are highly concentrated through the cell membrane to an area where they are less concentrated.

The movement of materials through a cell membrane without using energy is called **passive transport.** Diffusion and osmosis are both types of passive transport. When a cell needs to take in materials that are in higher concentration inside the cell than outside the cell, the movement of the materials requires energy. **Active transport** is the movement of materials through a cell membrane using energy. **The main difference between passive transport and active transport is that active transport requires the cell to use energy while passive transport does not.** A cell has several ways of moving materials by active transport. In one method, transport proteins in the cell membrane "pick up" molecules outside the cell and carry them in, using energy in the process. Another method of active transport is engulfing, in which the cell membrane surrounds, or engulfs, a particle. The cell must use energy in this process as well.

Most cells are very small. One reason is related to the fact that all materials move into and out of cells through the cell membrane. Once a molecule enters a cell, it is carried to its destination by a stream of moving cytoplasm. In a very large cell, streams of cytoplasm must travel farther to carry materials from the cell membrane to all parts of the cell. When a cell reaches a certain size, it divides into two new cells.

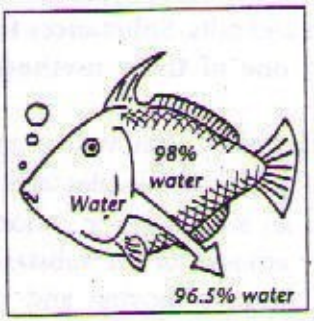
Name _____ Date _____ Class _____

SECTION 1-4 **REVIEW AND REINFORCE**

The Cell in Its Environment

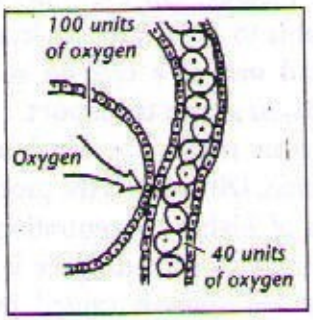
◆ Understanding Main Ideas

Fill in the blank to identify the process illustrated in each of the following figures.



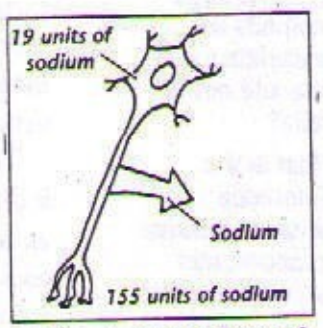
Water moves out of the cells of a saltwater fish and into the ocean.

1. _____



Oxygen moves from the lungs into the bloodstream.

2. _____



Sodium is pumped out of a nerve cell.

3. _____

Answer the following questions on a separate sheet of paper.

4. Explain how osmosis differs from diffusion.
5. Compare and contrast active and passive transport.
6. Identify two methods of active transport.
7. State one reason that cells are small.

◆ Building Vocabulary

If the statement is true, write true. If the statement is false, change the underlined word or words to make the statement true.

_____ 8. Selectively permeable means letting some but not all substances pass through.

_____ 9. Osmosis is the process by which molecules tend to move from an area of higher concentration to an area of lower concentration.

_____ 10. The process by which water moves across a selectively permeable membrane is called diffusion.

_____ 11. Diffusion and osmosis are types of active transport.

_____ 12. Passive transport requires energy.

Name: _____

Date: _____ Period: _____

"THE LIVING CELL" ACTIVITY

Directions:
During this activity, you and your partner(s) will rotate to each of the nine stations and perform a task similar to that organelle. Record the organelle name and its job/function, along with your thoughts or observations for each of the stations below. Your entire class needs to work together to perform the functions of your classroom cell. Good luck and have fun!

Station Number	Organelle	Function	Observations
1			
2			
3			
4			
5			
6			
7			
8			
9			

FINAL THOUGHT QUESTIONS

1. Was teamwork important in this activity? Why or why not?

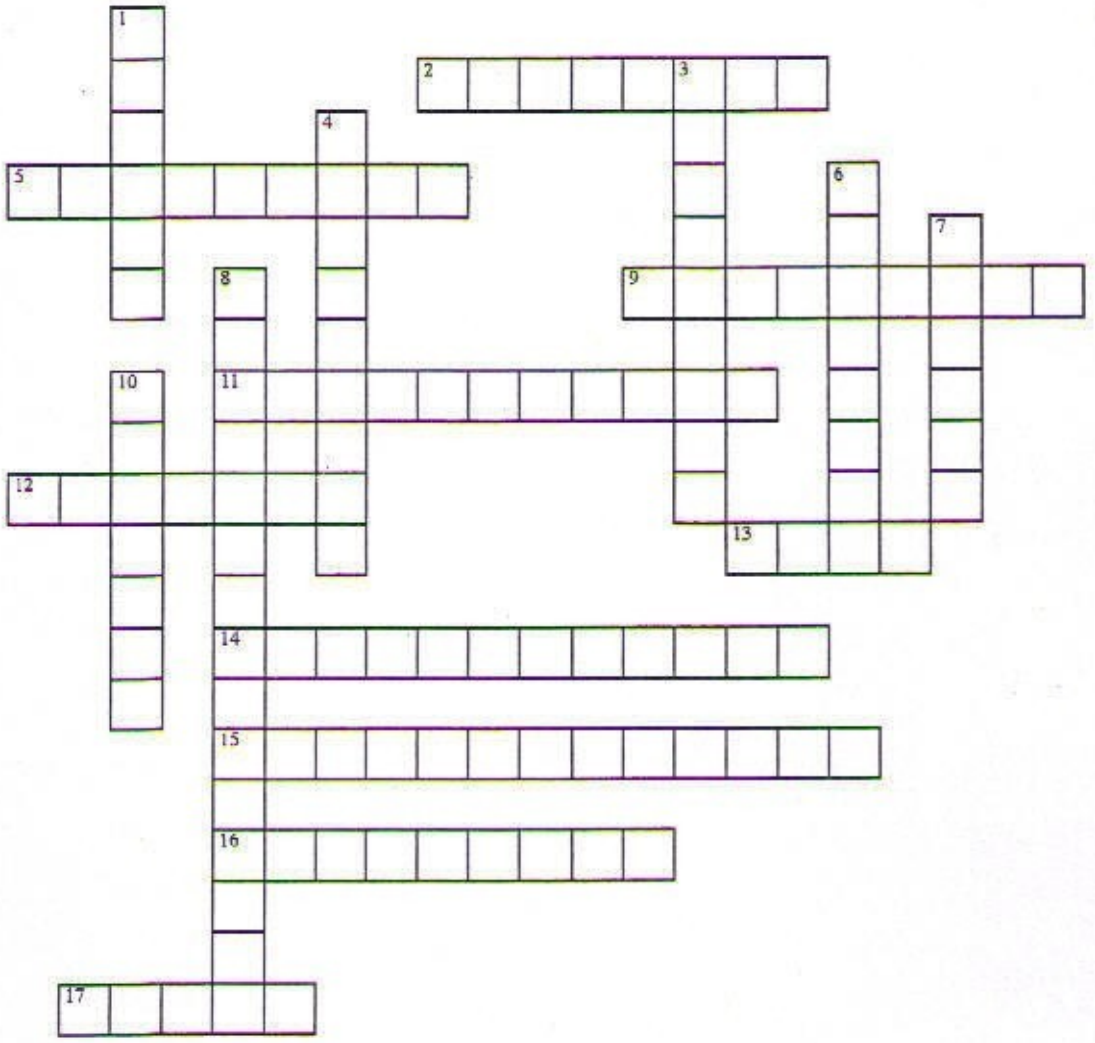
2. Explain how the cell membrane works. Why is this important to a cell?

3. Explain why it is an advantage for a cell to be small in size.

4. Which organelles are only found in plant cells? Why are they not found in animal cells?

5. What did you learn? Would you do anything differently if you had the chance to perform this activity again?

Cells



ACROSS

2 Digests materials for the cell
5 A type of alga observed in lab
9 A form of active transport in which the cell completely surrounds a substance
11 Chloroplasts contain this pigment which is used for photosynthesis
12 Organelle that houses the DNA of the cell
13 The basic unit of structure and function
14 Produces the majority of the cell's energy
15 Composed of many cells
16 Manufacture proteins
17 Cells are composed mainly of this compound

DOWN

1 Leeuwenhoek was the first to observe cells of this type
3 Name given to the small structures inside a cell
4 Contains the majority of the cell's organelles
6 Primarily composed of cellulose
7 A group of cells working together to perform a similar function
8 Completely surrounds the nucleus
10 Is significantly larger in a plant cell

Name: _____
Date: _____ Period: ____ Points: _____

Lesson 7 Study Guide:
Cell Structure and Function

1. What is a cell? How did the invention of the microscope help in its discovery?

2. State what each of the following men did to contribute to the discovery of cells.

   Robert Hooke:

   Anton van Leeuwenhoek:

   Matthias Schleiden:

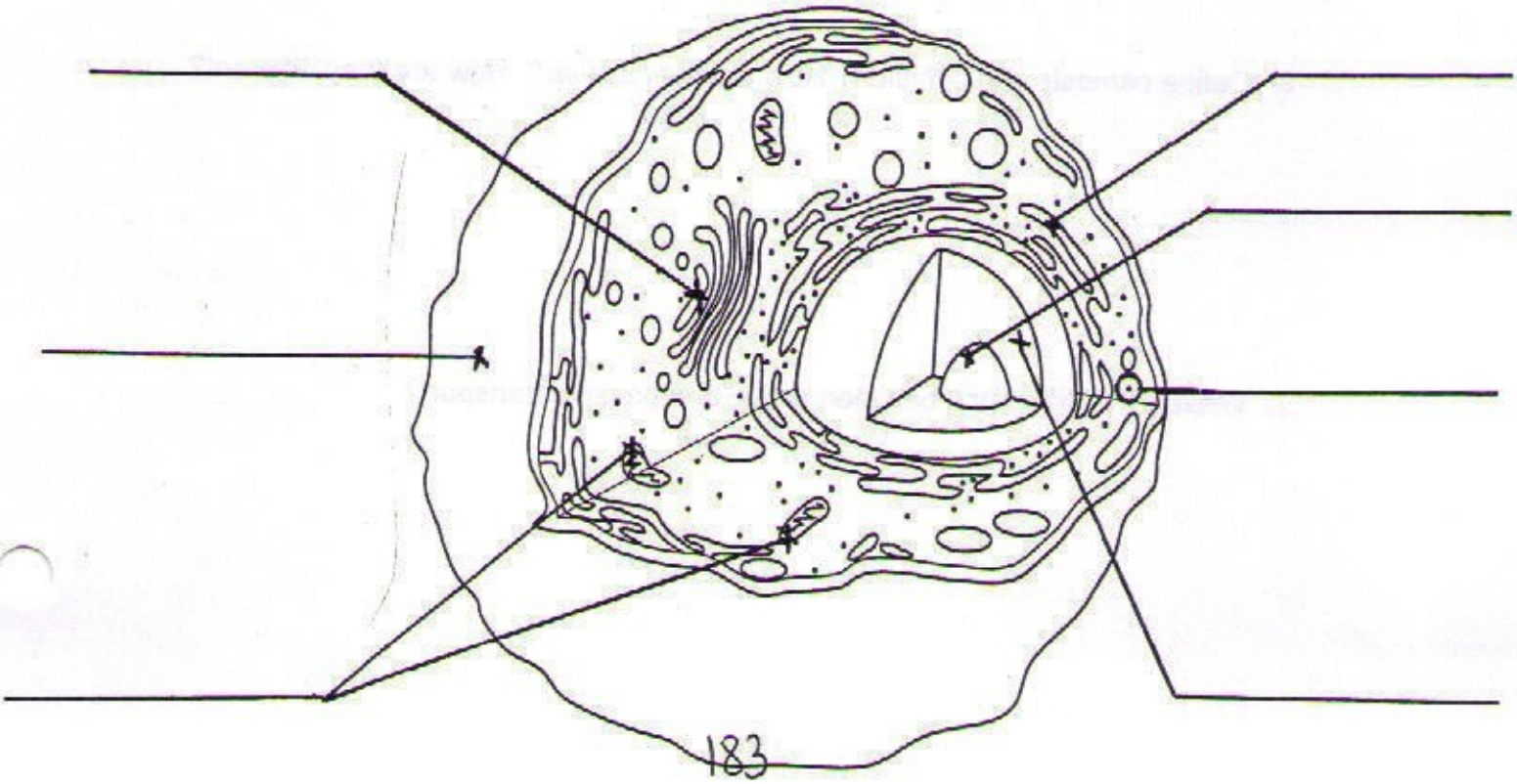
   Theodor Schwan:

3. List the three parts of the Cell Theory.
   1-

   2-

   3-

4. Label each of the indicated parts on the following cell.



5. Complete the table of cell parts with their function and indicate if they are found in a plant or animal cell, or both.

Cell Part	Function	Animal (yes or no)	Plant (yes or no)
Cell Wall			
Cell Membrane			
Nucleus			
Nucleolus			
Cytoplasm			
Mitochondria			
Endoplasmic Reticulum (ER)			
Ribosomes			
Golgi Body			
Chloroplasts			
Vacuole			
Lysosome			

6. Define osmosis and diffusion. How are they similar? How are they different?

7. What is the difference between active and passive transport?

8. If a cell is in a solution that is highly concentrated with salt molecules, what will happen to the cell?

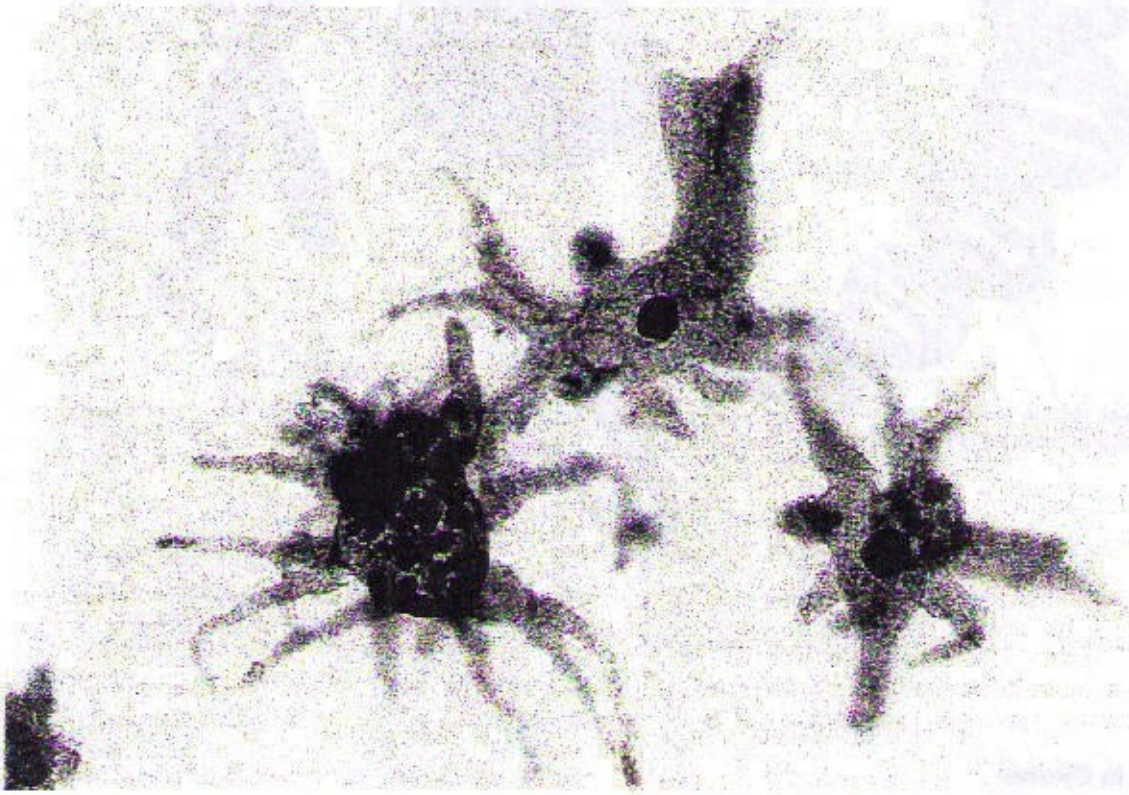
9. What components/ingredients make up cells? Order these components from the highest percentage to the lowest percentage found in the cell.

10. How can you determine if you are viewing a plant cell, an animal cell, or a bacterial cell? Explain.

11. How can temperature affect the rate of diffusion? Explain.

Genetics & Heredity

Multiply, Divide, and Survive



COURTESY OF CAROLINA BIOLOGICAL SUPPLY COMPANY

Cells sometimes require different stains to highlight various organelles. This often results in a colorful slide.

Late in the 19th century, scientists developed dyes to stain cell structures so they could be seen more clearly through a microscope. This technique, called "staining," allowed scientists for the first time to observe cells in different stages of their life cycles. They could see what happens as cells grow and divide.

As a result of these studies, scientists now know that most cells containing nuclei undergo a series of steps, called "mitosis" and "cytokinesis," to divide into two cells. The stages of mitosis and cytokinesis are collectively called "cell division."

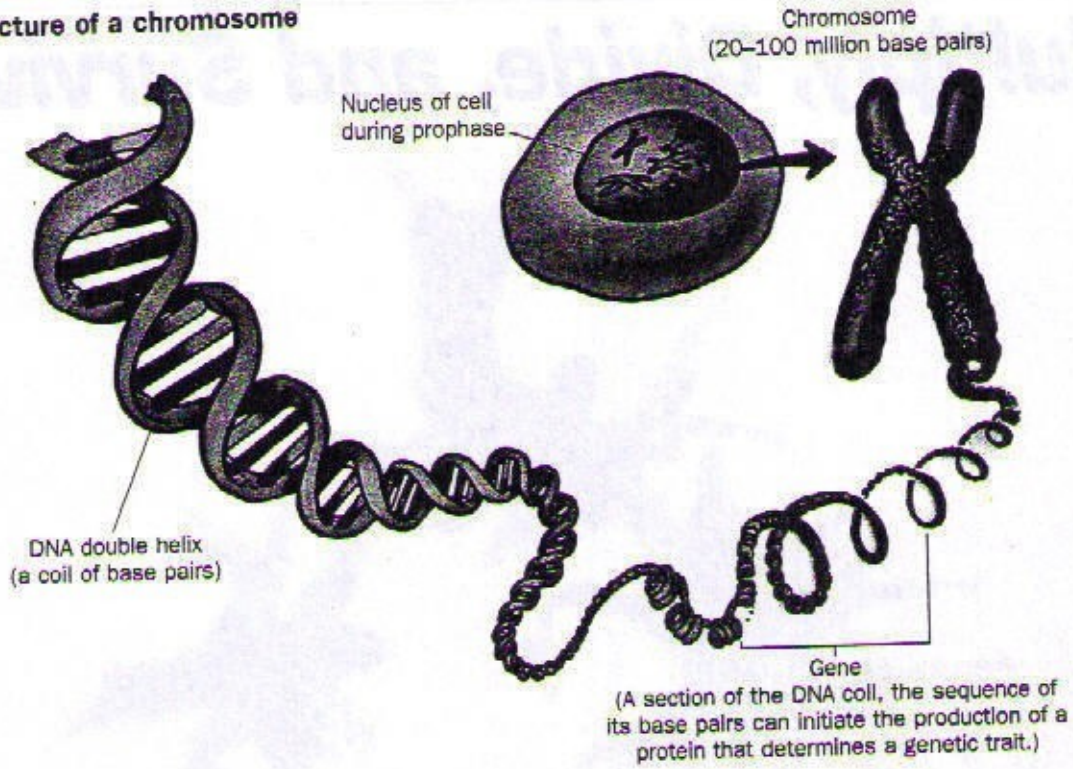
Using their newly developed dyes, those 19th-century scientists also were able to observe some rod-shaped structures in the nuclei that became noticeable just before the cells began to split. Those structures are called "chromosomes." Chromosomes, composed of a substance called "DNA" (deoxyribonucleic acid), are very important because they contain all of the hereditary information for each organism.

Pairing Up

Chromosomes occur in pairs. Although the number of chromosome pairs varies among organisms, all members of the same species have a unique number.

You might expect that complex organisms would have a greater number of chromosomes than simpler organisms. This is not the case. For example, humans have 23 pairs of chromosomes in each body cell, while rose plants, which are less complex, have 35 pairs. Wisconsin Fast Plants have 10 pairs of chromosomes. Fruit flies have 4 pairs. Hereditary units called "genes" appear in the same locations on both chromosomes of each pair.

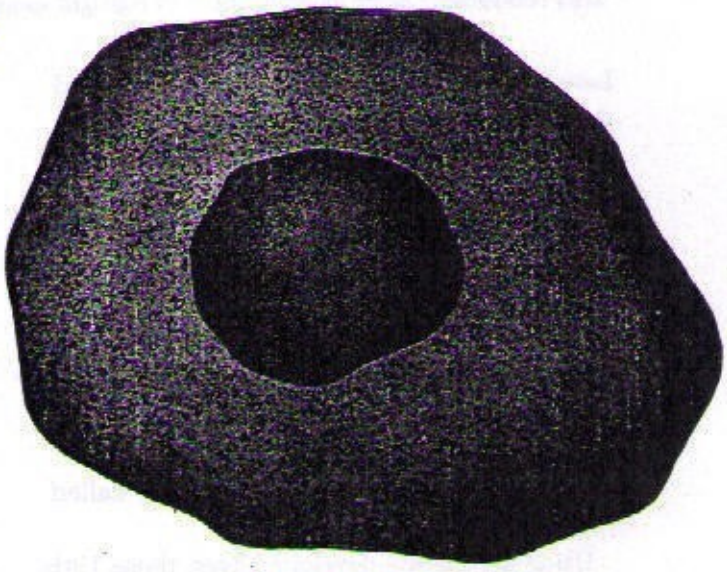
Structure of a chromosome



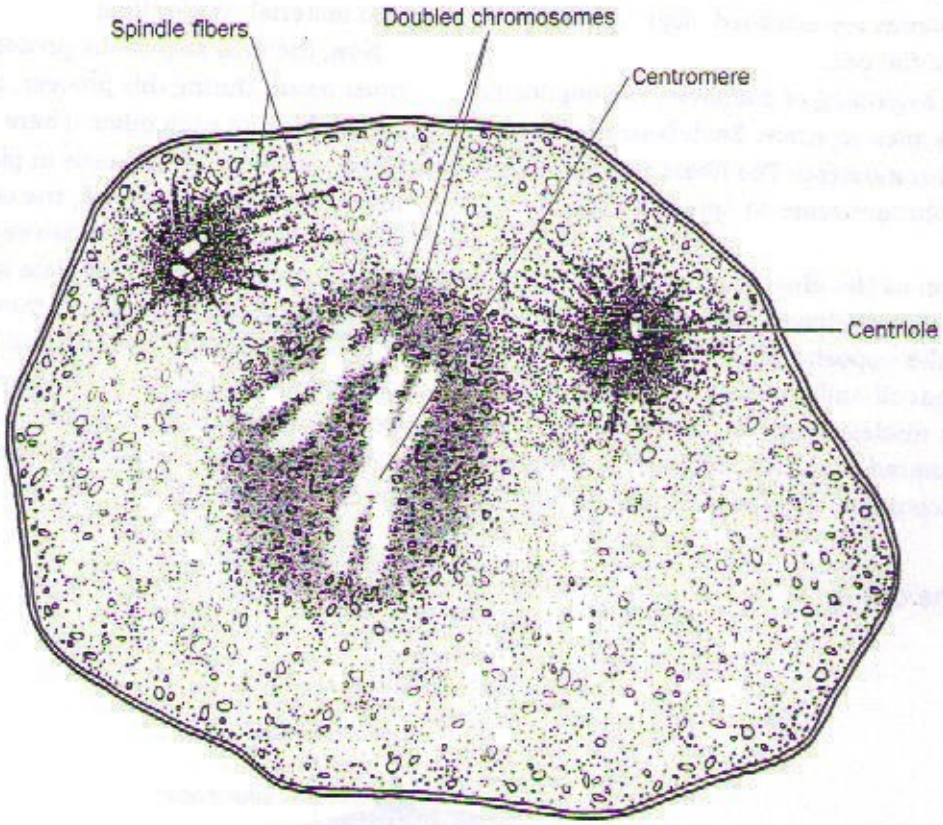
Going In Circles

Like humans, cells have a life cycle. The cell's life cycle has stages, or phases. When cells are not dividing, they are in a stage called "interphase." During this phase, cells are busy carrying on their life processes, which include growing. The chromosomes are not visible because they are elongated and blend into the rest of the nuclear material. In this condition, they are referred to as "chromatin." The DNA, which makes up the threads of chromatin, duplicates during this phase. Near the end of interphase, the cell makes its final preparations for mitosis by producing the necessary organelles for each daughter cell. Because the chromatin threads are still elongated at this point, they are not yet recognizable, even under a compound microscope. A cell in this stage might look like the one shown here.

(continued)



By the end of interphase, the chromosomes have duplicated. At this point human cells have 46 doubled chromosomes in their nuclei.



This is how an animal cell might look toward the end of prophase. Only two of the doubled chromosomes are shown.

Mitosis consists of a series of phases during which the DNA, which duplicates during interphase, first coils and condenses into chromosomes. Then the chromosomes detach from each other and separate into the nuclei of what will soon become two new cells. These new cells are known as "daughter cells." Although scientists describe the process of mitosis as having four phases—prophase, metaphase, anaphase, and telophase—it is actually continuous. Each phase passes smoothly into the next. Dividing mitosis into phases is comparable to viewing a movie, then selecting individual frames, or "snapshots," that best represent each part of the movie.

During prophase, the chromatin threads begin to coil. They shorten and become much thicker. At this point they are referred to as chromosomes and can be observed through a compound microscope. A mesh-like structure of fine, spindle fibers develops. As the nuclear envelope disintegrates, these fibers guide the movements of the chromosomes. As though they were being tugged along by the fibers, the duplicated chromosomes begin to move toward the middle of the cell.

During metaphase, the chromosomes line up in the middle of the cell. Their centromeres, which are the places where the duplicated chromosomes are attached, align in the exact middle of the cell.

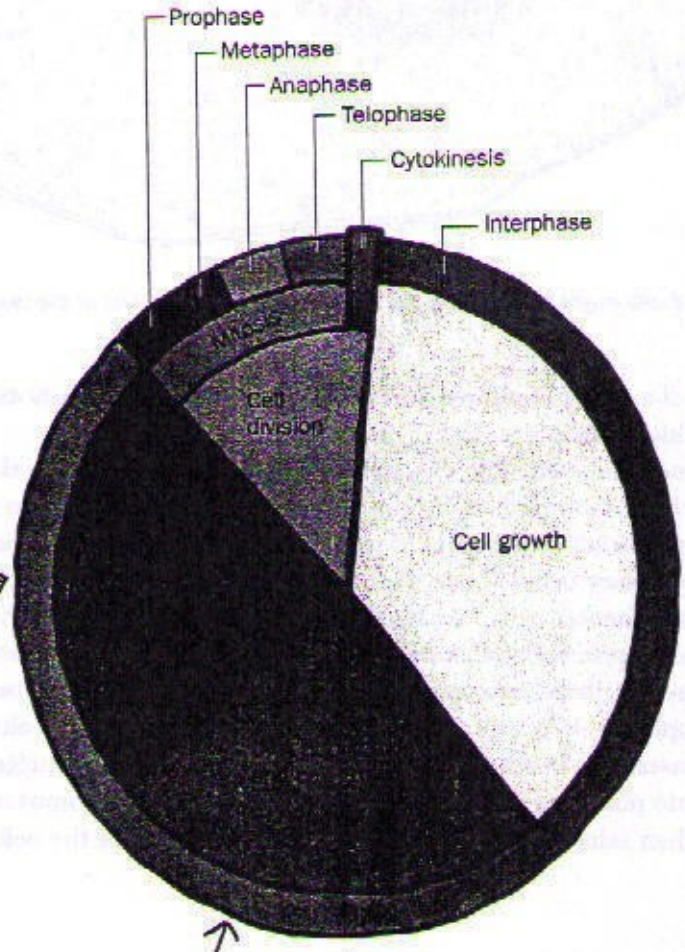
At the beginning of anaphase, the duplicated chromosomes separate. Each becomes an individual chromosome. The fibers shorten, drawing the chromosomes to opposite ends of the cell.

As soon as the chromosomes reach the ends of the cell, telophase begins. This phase is almost the opposite of prophase. The chromosomes uncoil and elongate and begin to blend into the nuclear material. A nuclear envelope forms around each new nucleus. The fibers break down and disappear. Mitosis is now complete. The daughter cells are considered to be in interphase. The two nuclei that result are identical. This means that their DNA, or genetic material, is identical.

Now, the final step in the process, cytokinesis, must occur. During this process, the daughter cells split from each other. There is a major difference between cytokinesis in plant and in animal cells. In an animal cell, the cell membrane pinches inward and forms two separate daughter cells. In a plant cell, a cell plate begins forming in the middle of the cell and grows outward until it becomes a part of the cell wall between the daughter cells. Cell walls help give the plant support. Animal cells have no cell walls.

The illustration below summarizes the stages in the cell cycle. □

The cell cycle



Cell Growth →

DNA Duplication + cell growth

Name _____ Date _____ Class _____

SECTION 2-3 **SECTION SUMMARY**

Cell Division

Guide for Reading

- What events take place during the three stages of the cell cycle?
- What is the role of DNA replication?

2

The regular sequence of growth and division that cells undergo is known as the **cell cycle.** The cell cycle is divided into three main stages.

The first stage of the cell cycle is called **interphase. During interphase, the cell grows to its mature size, makes a copy of its DNA, and prepares to divide into two cells.** During the first part of interphase, the cell doubles in size and produces all the structures needed to carry out its functions. After a cell has grown to its mature size, the cell makes a copy of the DNA in its nucleus in a process called **replication.** At the end of DNA replication, the cell contains two identical sets of DNA.

Once interphase is complete, the second stage of the cell cycle begins. **Mitosis** is the stage during which the cell's nucleus divides into two new nuclei. **During mitosis, one copy of the DNA is distributed into each of the two daughter cells.** Scientists divide mitosis into four parts, or phases: prophase, metaphase, anaphase, and telophase. During prophase, the threadlike chromatin in the cell's nucleus begins to condense into tiny rods. Scientists call each doubled rod of condensed chromatin a **chromosome.** Each identical rod, or strand, of the chromosome is called a **chromatid.** The two strands are held together by a structure called a centromere. As the cell progresses through metaphase, anaphase, and telophase, the chromatids separate from each other and move to opposite ends of the cell. Then two nuclei form around the chromatids at the two ends of the cell.

After mitosis, the final stage of the cell cycle, called **cytokinesis,** completes the process of cell division. **During cytokinesis, the cytoplasm divides, distributing the organelles into each of the two new cells.** Each daughter cell has the same number of chromosomes as the original parent cell. At the end of cytokinesis, each cell enters interphase, and the cycle begins again.

How long it takes a cell to go through one cell cycle depends on the type of cell. The length of each stage in the cell cycle also varies.

A cell makes a copy of its DNA before mitosis occurs. **DNA replication ensures that each daughter cell will have all of the genetic information it needs to carry out its activities.** The two sides of the DNA ladder are made up of alternating sugar and phosphate molecules. Each rung of the DNA ladder is made up of a pair of molecules called nitrogen bases. There are four kinds of nitrogen bases: adenine, thymine, guanine, and cytosine. Adenine only pairs with thymine, and guanine only pairs with cytosine. DNA replication begins when the two sides of the DNA molecule unwind and separate. Next, nitrogen bases in the nucleus pair up with the bases on each half of the DNA molecule. Once the new bases are attached, two new DNA molecules are formed. The order of the bases in each new DNA molecule will exactly match the order in the original DNA molecule.

Name _____ Date _____ Class _____

SECTION 2-3 REVIEW AND REINFORCE

Cell Division

◆ Understanding Main Ideas

Fill in the blanks in the table below. Then answer the questions that follow in the spaces provided.

Phases of Mitosis

Phase	Event
Prophase	1. _____
2. _____	Chromosomes attach to spindle fibers
Anaphase	3. _____
4. _____	New nuclear membranes form

5. Which stage of the cell cycle usually lasts longest?

_____

6. During which stage of the cell cycle does DNA replication occur?

_____

7. During which stage of the cell cycle does the cell membrane pinch the cell in two?

_____

◆ Building Vocabulary

Match each term with its definition by writing the correct letter in the blank.

_____ 8. Regular sequence of growth and division that cells undergo

_____ 9. First stage of the cell cycle

_____ 10. Process in which DNA is copied

_____ 11. Stage of the cell cycle during which the cell's nucleus divides

_____ 12. Doubled rod of condensed chromatin

_____ 13. Each identical rod of a chromosome

_____ 14. Final stage of the cell cycle

a. interphase
b. mitosis
c. cell cycle
d. chromatid
e. cytokinesis
f. replication
g. chromosome

Name: _____

Date: _____ Period: ____

TITLE: MODEL OF THE STAGES OF MITOSIS

PROBLEM: (What is the question you would like to answer by collecting evidence/data?)

_____

BACKGROUND INFORMATION: (What do you already know about the above problem?)

_____

_____

_____

HYPOTHESIS: (Give a possible explanation to the problem that is stated above.)

_____

_____

EXPERIMENT:

MATERIALS NEEDED: (What materials or supplies will you need in order to complete the experiment?)

- 16-2cm pieces of pipe cleaners
- copy of the lab
- 1 pair of scissors
- transparent tape
- 1 metric ruler
- 1 plastic bag
- 1 black marker

PROCEDURE: (Record all the steps you took in completing the task/experiment.)

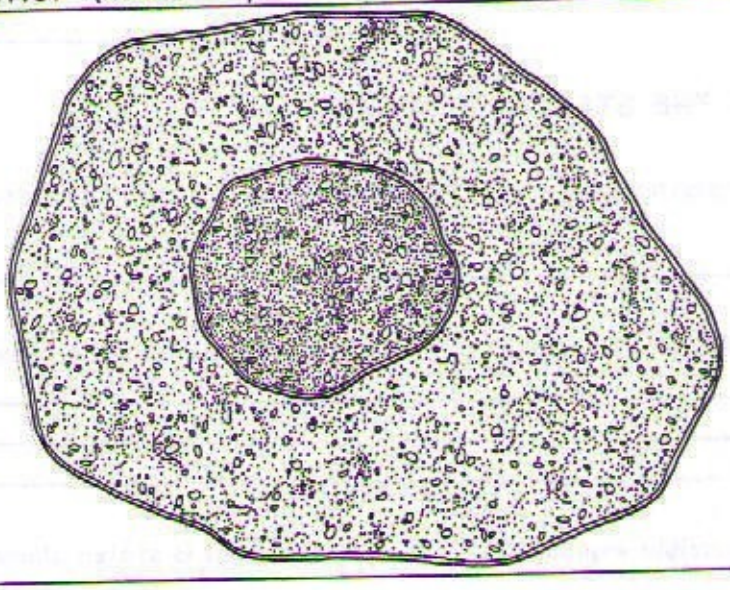
Part 1

1. Work with your partner to cut the pipe cleaners that were provided.
2. Place the end of the pipe cleaner on the zero end of the ruler.
3. Use your marker to place a mark at 2-cm intervals. Repeat this with all the pipe cleaners.
4. Use your scissors to cut the pipe cleaners at the marks you made.
5. Watch and listen as your teacher models the behavior of chromosomes during interphase and mitosis.

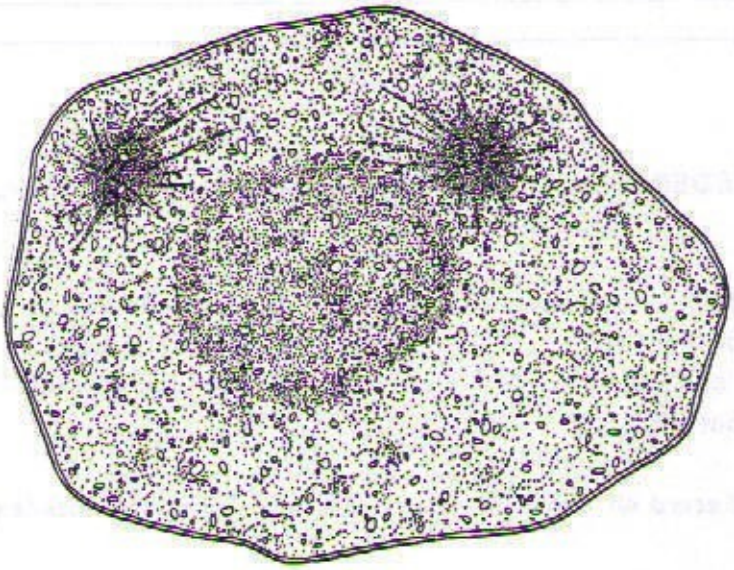
Part 2

6. Use your pipe cleaners to create a snapshot of what happens to chromosomes during interphase and mitosis. Each 2-cm piece represents a single strand or chromatid.
7. Two pairs of chromosomes will then need to be taped down on the cell pictures (that have chromosomes) found in your data/observation section of the lab. Use all 16 pipe cleaners to illustrate what happens during the stages of mitosis. REMEMBER: CHROMOSOMES ARE NOT PRESENT IN EVERY STEP.
8. Label the following on each cell where it applies: nucleus, nuclear membrane, cell membrane, cytoplasm, chromosome, spindle fibers, centriole. REMEMBER: EACH OF THESE LABELS MAY NOT APPLY TO EVERY CELL PICTURED.
9. Answer all conclusion questions.

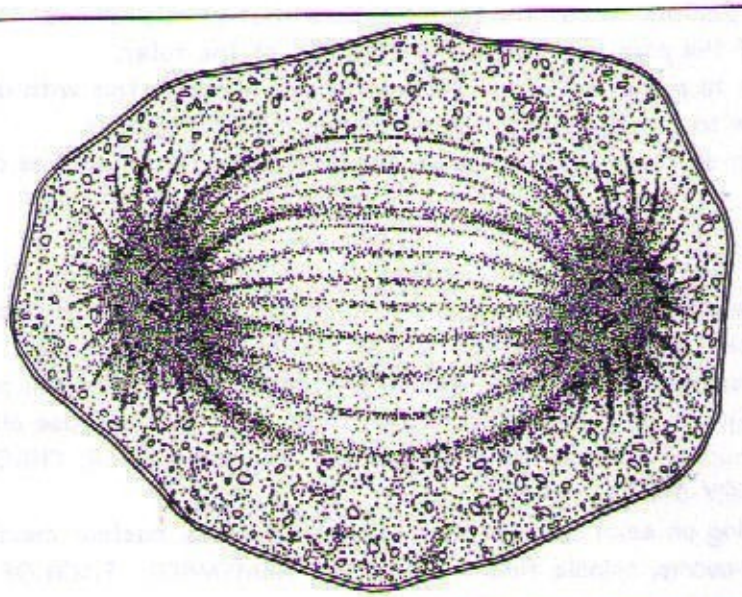
DATA/OBSERVATIONS: (Record all your data/observations that are gather through the lab.)



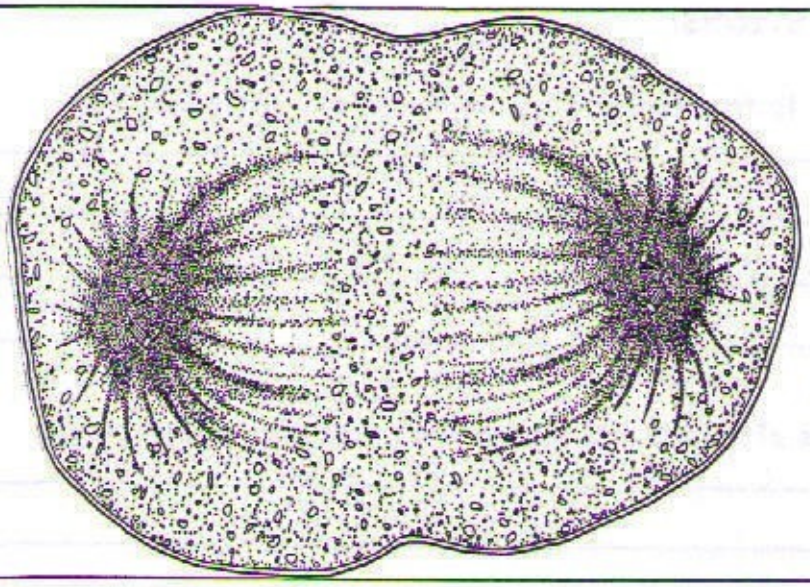
INTERPHASE



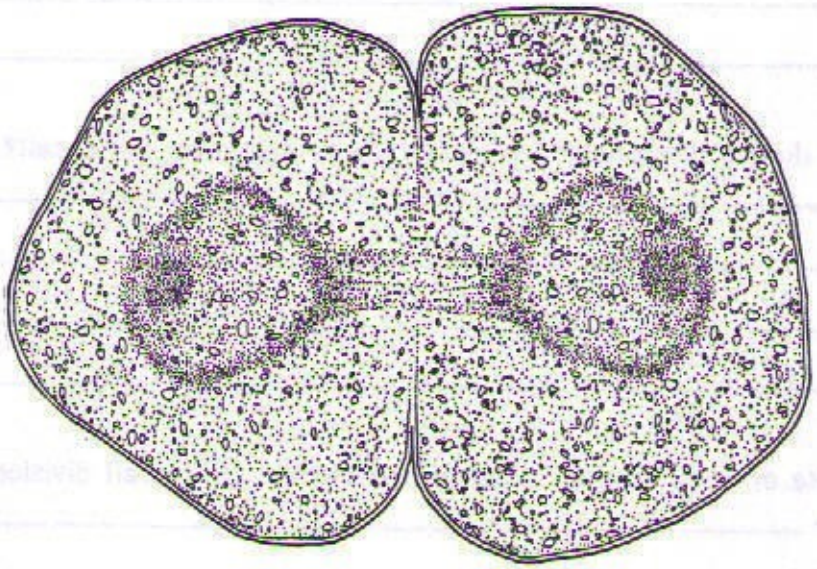
PROPHASE



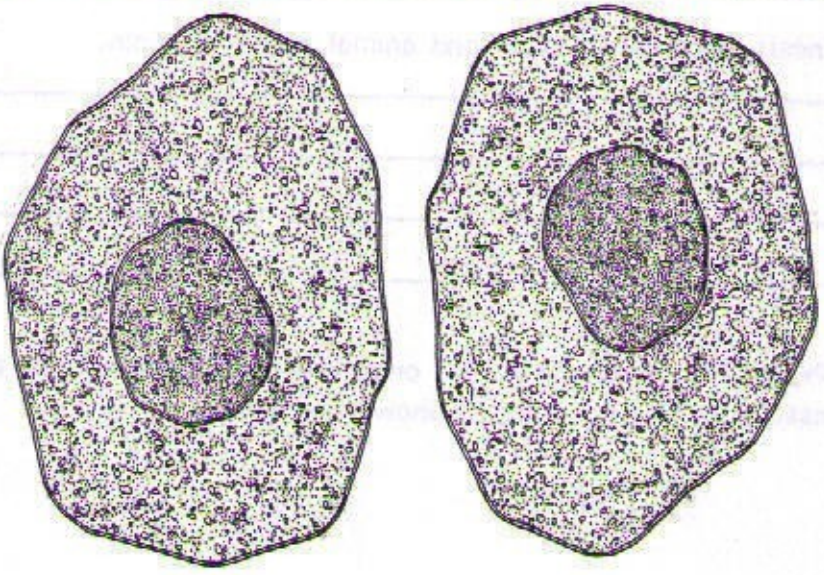
METAPHASE



ANAPHASE



TELOPHASE



DAUGHTER CELLS- BEGINNING OF INTERPHASE

CONCLUSION QUESTIONS:

1. What happens to the chromosomes during the cell cycle? Explain.

2. List the stages of mitosis and explain what happens at each stage.

3. What happens during interphase? Why is this so important for a cell?

4. List the purpose of each of the following structures during cell division.
   Spindle fibers- _____
   Centriole- _____

5. How is cytokinesis different in plant and animal cells? Explain.

6. CHALLENGE PROBLEM: If a cell divides once every 20 minutes, how many cells will result in 24 hours, assuming that none dies? Show your work.

Name: _____

Date: _____ Period: ____

TITLE: Multiplying and Dividing

PROBLEM: How long does it take for an average cell to divide?

BACKGROUND INFORMATION: (What do you already know about the problem?)

_____

_____

_____

HYPOTHESIS: (Give a possible explanation to the problem that is stated above.)

_____

_____

EXPERIMENT:

MATERIALS NEEDED:

- microscope
- colored pencils
- calculator (optional)
- copy of the lab
- prepared root tip slides

PROCEDURE:

Part 1

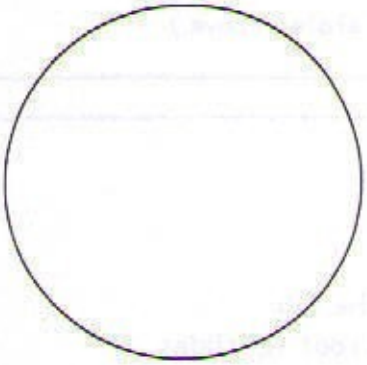
1. Report to your assigned lab station.
2. Observe the slide that is present on the microscope stage. DO NOT CHANGE THE OBJECTIVES OR MOVE THE SLIDE. EACH SLIDE IS SET ON A PARTICULAR CELL.
3. Draw the cell you are observing in the first circle of your observations and data section of the lab.
4. Appropriately color you cell and record the magnification of the microscope.
5. Identify the stage of the cell cycle that this cell is going through. Write the stage on the designated line below your drawing.
6. Your teacher will tell you when it is time to rotate to the next station. Once you have rotated, repeat the five steps above.

Part 2

1. Return to low power. Find an area of the slide with many cells undergoing cell division. Switch to the magnification that lets you see about 50 cells at once (for example, 100X).
2. Examine the cells row by row, and count the cells that are in interphase. Record that number in the data table under *first sample*.

3. Examine the cells row -by -row four more times to count the cells in prophase, metaphase, anaphase, and telophase. Record the results in the data table under *first sample.*
4. Move to a new area on the slide. Repeat steps 3-5 and record your counts in the column labeled *second sample.*
5. Fill in the column labeled *total number* by adding the numbers across each row in the data table.
6. Add the totals for the five stages to find the total number of cells counted.

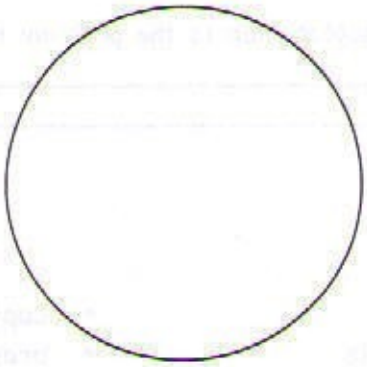
DATA/OBSERVATIONS:



Magnification: _____

Stage: _____

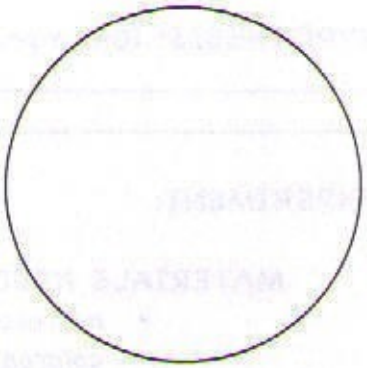
(Station #1)



Magnification: _____

Stage: _____

(Station #2)



Magnification: _____

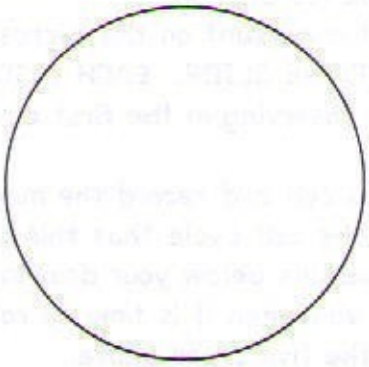
Stage: _____

(Station #3)

Magnification: _____

Stage: _____

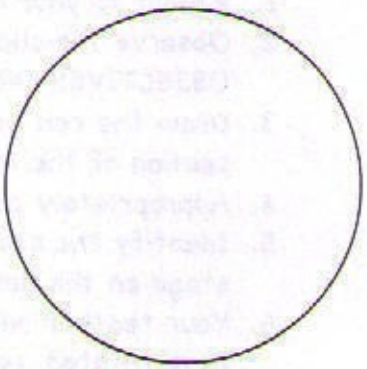
(Station #4)



Magnification: _____

Stage: _____

(Station #5)



Magnification: _____

Stage: _____

(Station #6)

Data Table

Stage of the Cell Cycle	First Sample (# of cells)	Second Sample (# of cells)	Total Number of cells
Interphase			
Prophase			
Metaphase			
Anaphase			
Telophase			
			Grand Total: _____

CONCLUSION QUESTIONS:

1. Which stage of the cell cycle did you observe most often? Why?

2. The cell cycle of some root tips takes about 720 minutes (12 hours). Use your data and the formula below to find the number of minutes each stage takes. Show your work!

$$\text{Time for each stage} = \frac{\#\text{of cells at each stage}}{\text{Total \# of cells counted}} \times 720 \text{ min.}$$

Interphase = _____	Work:
Prophase = _____	Work:
Metaphase = _____	Work:
Anaphase = _____	Work:
Telophase = _____	Work:

3. Use the data to compare the amount of time spent in mitosis with the total time for the whole cell cycle.

4. List the three steps in the Cell Cycle. What happens during each step?

5. Why must the DNA replicate before the cell divides?

Name: _____

Date: _____ Period: _____

KID DISCOVER QUESTIONS (pages 8-9)

1. What are the four kinds of tissues in the human body? What are each of their functions?

2. Which tissues in the human body is the most abundant?

3. What happens during the process of mitosis?

4. What happens during the process of meiosis?

5. How many total chromosomes does each human cell (except sex cells) contain?

6. Explain where a baby's DNA comes from.

Name _____ Date _____ Class _____

SECTION 2-4 **SECTION SUMMARY**

Cancer

Guide for Reading

- How is cancer related to the cell cycle?
- What are some ways that cancer can be treated?

2

Cancer is a disease in which cells grow and divide uncontrollably, damaging the parts of the body around them. There are more than 100 types of cancer. Cancer can occur in almost any part of the body. Cancers are often named by the place in the body where they begin. In the United States today, lung cancer is the leading cause of cancer deaths among both men and women.

Scientists think that cancer begins when something damages a portion of the DNA in a chromosome. The damage causes a change in the DNA called a **mutation. Cancer begins when mutations disrupt the normal cell cycle, causing cells to divide in an uncontrolled way.** Without the normal controls on the cell cycle, the cells grow too large and divide too often. As the cell divides, more and more abnormal cells like it grow near it. In time, these cells form a tumor. A **tumor** is a mass of abnormal cells that develops when cancerous cells divide and grow uncontrollably. Some of the cancerous cells may break off the tumor and enter the bloodstream. In this way, the cancer can spread to other areas of the body.

Doctors usually treat cancer in one or more of three ways: surgery, radiation, or drugs that destroy the cancer cells. When a cancer is detected before it has spread to other parts of the body, surgery is usually the best treatment. If doctors can completely remove the cancerous tumor, a person may be cured of the disease. If, however, the cancer has spread or the tumor cannot be removed, doctors may use radiation. Fast-growing cancer cells are more likely than normal cells to be destroyed by radiation. **Chemotherapy** is the use of drugs to kill cancer cells. It is effective because the drugs spread throughout the body, killing cancer cells or slowing their growth. Unfortunately, none of these cancer treatments is perfect. Most have unpleasant, or even dangerous, side effects. Scientists continue to look for new ways to treat cancer.

Scientists estimate that almost two thirds of all cancer deaths are caused either by tobacco use or unhealthful diets. Smoking is the main cause of lung cancer. Unhealthful diets may lead to almost as many cancer deaths as does tobacco. A diet that is low in fat and includes a lot of fruits, vegetables, and grain products can help lower a person's risk of some types of cancer.

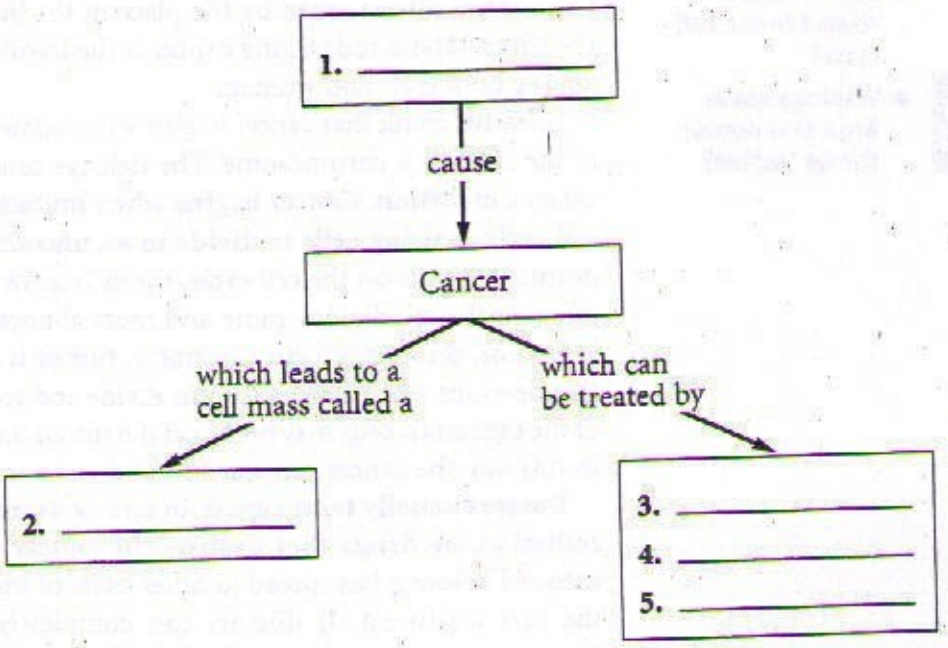
Name _____ Date _____ Class _____

SECTION 2-4 **REVIEW AND REINFORCE**

Cancer

◆ Understanding Main Ideas

Complete the concept map below. Then answer the questions that follow.



Write your answers on a separate sheet of paper.

6. How do mutations lead to cancer?
7. How can cancer spread from a tumor to other parts of the body?
8. What are two ways the risk of some types of cancer can be reduced?

◆ Building Vocabulary

Fill in the blank to complete each statement.

9. _____ is a disease in which cells grow and divide uncontrollably.
10. A change in the DNA is called a(n) _____.
11. A(n) _____ is a mass of abnormal cells.
12. The use of drugs to kill cancer cells is called _____.

Name _____ Date _____ Class _____

Deaths From Cancer

Cancer is a leading cause of death in the United States. Cancer death rates by age and sex in the United States for 1980 and 1990 are given in the table below.

Death Rates From Cancer, United States, 1980 and 1990

Age at Death (years)	Males		Females	
	1980	1990	1980	1990
25–34	13	13	14	13
35–44	44	39	53	48
45–54	197	163	172	166
55–64	521	533	362	376
65–74	1,093	1,122	607	677
75–84	1,791	1,915	903	1,010
85 and older	2,370	2,740	1,256	1,372

Note: The death rate is the number of deaths for that sex and age group per 100,000 people of that sex and age group in the United States population.

Answer the following questions on a separate sheet of paper.

1. In which age groups of males were there declines in cancer death rates between 1980 and 1990?
2. In which age groups of females were there declines in cancer death rates between 1980 and 1990?
3. Which sex had higher death rates from cancer at all ages over 54 years of age in both 1980 and 1990?
4. Which sex and age group had the biggest increase in cancer death rates from 1980 to 1990?
5. What percent of males aged 85 years and older died from cancer in 1980? In 1990?

Lesson 8 Study Guide

Review

- What is the function of the main organelles of plant and animal cells?
- What does the Cell Theory state?
- What types of lenses are found on a compound microscope?
- What happens during diffusion, osmosis, and active transport?

Cell Division

- The three stages of the Cell Cycle are: interphase, mitosis, and cytokinesis.
- During interphase, the cell matures and copies its DNA. During mitosis, the cell's nucleus divides into two nuclei. During cytokinesis, cell division is complete and two identical daughter cells are formed.
- The stages of mitosis are: Prophase, Metaphase, Anaphase, and Telophase.

  Prophase: the chromatin condenses to make chromosomes
  Metaphase: the chromosomes line up in the middle of the cell
  Anaphase: the chromosomes separate at the centromere
  Telophase: the new nuclear membrane forms; two nuclei apparent

- A DNA molecule is made up of nitrogen bases, sugars, and phosphates. The nitrogen bases make up the rungs of the ladder and the sugars and phosphates make up the sides.
- Adenine always pairs with Thymine. Cytosine always pairs with Guanine.
- During DNA replication, a cell makes an exact copy of its DNA.
- Chromatin is the thin, uncoiled genetic material found within the nucleus. A chromosome is a double rod of condensed chromatin. A chromatid is one of the strands of a chromosome. Two chromatids will attach together at the centromere to form a chromosome.
- **Be able to view and identify pictures of a cell in various stages of the cell cycle.**

Cancer

- Cancer is a disease in which cells grow and divide uncontrollably.
- Cancer is thought to begin when a cell's DNA becomes mutated.
- A tumor is a mass of abnormal cells.
- The use of tobacco products and an unhealthy diet are the two leading causes of cancer.

Heredity—Passing It On

In Lesson 8, you learned about mitosis. When mitosis occurs in humans, all 23 pairs of chromosomes duplicate and a full set of chromosomes passes into each daughter cell. Mitosis is important because we need exact copies of cells to replace old or dying cells throughout our bodies. These cells need to be exactly like their parent cells so they are able to continue doing their jobs. If offspring were produced through mitosis, as they often are in single-celled organisms, each offspring would be identical to its parent.

In sexual reproduction, a new individual is formed that has different looks, abilities, and behaviors from its parents. This occurs because one type of cell in an organism's body undergoes a process somewhat similar to mitosis—but with a different outcome.

During this process, called "meiosis," parents produce sex cells (eggs or sperm) that contain exactly half as many chromosomes as body cells. In humans, each male sex cell, or sperm, has 23 single chromosomes—one from each original chromosome pair. Each female sex cell, or egg, also has 23 single chromosomes. Human sex cells have only half as many chromosomes as body cells because when the sperm fertilizes the egg to form a new individual, the chromosomes unite to form 23 pairs. The offspring receives half of his or her chromosomes from the mother and half from the father. The traits of the offspring are determined by the genes that pair during fertilization. Each parent donates one chromosome from each pair; therefore, only one gene from each pair is donated as well.

Genes can be paired in four possible combinations, as shown in Table 19.2: Gene Pair Possibilities. When *both* genes in a pair are the same for a trait, the condition is called "homozygous." Using height in pea plants as an example, if both parents donated a dominant

gene, the offspring would have a homozygous condition. The symbol for this trait in the offspring would be "TT." If both parents donated a recessive gene, the symbol would be "tt." This condition also would be homozygous because both genes would be the same.

When one parent donates a dominant gene and the other donates a recessive gene, the resulting condition is called "heterozygous." It can be symbolized by "Tt" or "tT." The order in which the upper- and lower-case symbols are written is irrelevant; however, the dominant gene is often written first.

Table 19.2 Gene Pair Possibilities

Homozygous	TT or tt
Heterozygous	Tt or tT

The term describing the gene pairs found in the DNA is "genotype." The genotype is the internal code for a trait in an organism. The way the trait is expressed, or displayed, in the organism is called the "phenotype." The phenotype, therefore, is the result of having a specific genotype, as shown in Table 19.3: Height in Pea Plants. For example, when the genotype is "Tt" for height in pea plants, the phenotype is tall because the gene for tall pea plants (T) dominates the gene for short pea plants (t). The "TT" gene pair gives the same phenotype, tall, even though the genotype is different. □

Table 19.3 Height in Pea Plants

Genotypes	TT or Tt	tt
Phenotypes	Tall	Short

Name _____ Date _____ Class _____

SECTION 3-1 **SECTION SUMMARY**

Mendel's Work

Guide for Reading

- **What factors control the inheritance of traits in organisms?**

3

Gregor Mendel was curious about the physical characteristics, or **traits,** of pea plants. The passing of traits from parents to offspring is called **heredity.** Mendel's work was the foundation of **genetics,** the scientific study of heredity.

Pea plants are useful for studying heredity because they have many traits that exist in only two forms. They also produce large numbers of offspring, making it easy to collect large amounts of data. Their flower structure makes it easy to set up crosses between specific plants.

Mendel crossed two pea plants that differed in only one trait—height. He crossed purebred tall plants with purebred short plants. These parent plants, the P generation, were **purebred** because they always produced offspring with the same form of the trait. The offspring of this cross, which Mendel called the first filial, or F_1, generation, were all tall. It seemed as if the shortness trait had disappeared. When the F_1 plants were allowed to cross, about three fourths of the F_2 generation were tall and about one fourth were short. From his results, Mendel reasoned that individual factors, one from each parent, control the inheritance of traits. Today, scientists call the factors that control traits **genes.** The different forms of a gene are called **alleles.**

Individual alleles control the inheritance of traits. Some alleles are dominant, while other alleles are recessive. A **dominant allele** is one whose trait always shows up in the organism when the allele is present. A **recessive allele** is masked, or covered up, whenever the dominant allele is present. A trait controlled by a recessive allele will only show up if the organism inherits two recessive alleles for the trait.

In Mendel's cross, the purebred tall plant has two alleles for tall stems. The purebred short plant has two alleles for short stems. The F_1 plants are all **hybrids,** they have two different alleles for the trait—one allele for tall stems and one for short stems. Geneticists use a capital letter to represent a dominant allele and a lowercase version of the same letter for the recessive allele. Mendel presented his results in 1866. However his work went unnoticed for over 30 years. In 1900, three different scientists rediscovered Mendel's work. Many of the principles that Mendel discovered still stand to this day. Because of his work, Mendel is often called the Father of Genetics.

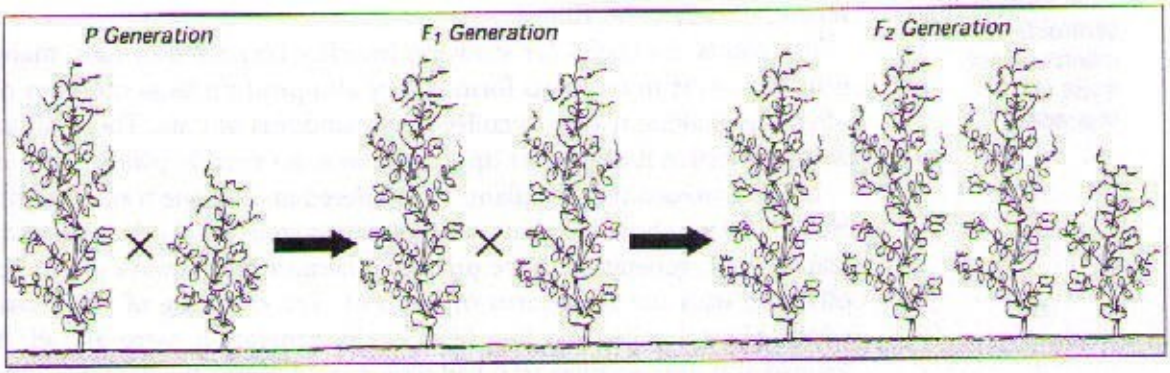
Name _____ Date _____ Class _____

SECTION 3-1 REVIEW AND REINFORCE

Mendel's Work

◆ Understanding Main Ideas

Study the figure. Then answer the following questions on a separate sheet of paper.



1. What trait in pea plants is being studied in the cross above?
2. What are the two alleles of this trait?
3. Which allele is the dominant allele? Explain how you know.
4. Which allele is the recessive allele? Explain.
5. What alleles do the F_1 offspring have? Explain which allele was inherited from which parent.

◆ Building Vocabulary

Match each term with its definition by writing the letter of the correct definition on the line beside the term.

_____ 6. genetics
_____ 7. alleles
_____ 8. traits
_____ 9. recessive allele
_____ 10. genes
_____ 11. hybrid
_____ 12. heredity
_____ 13. dominant allele

a. the passing of traits from parents to offspring
b. an organism with two different alleles for a trait
c. factors that control traits
d. physical characteristics of organisms
e. an allele whose trait always shows up in the organism
f. the different forms of a gene
g. the scientific study of heredity
h. an allele whose trait is masked in the presence of a dominant allele

Name: _____
Date: _____ Period: ____

TITLE: Making It More Personal

PROBLEM: What happens during the process of meiosis?

BACKGROUND INFORMATION: (What do you already know about the problem?)

_____

_____

_____

HYPOTHESIS: (Give a possible explanation to the problem that is stated above.)

_____

_____

_____

EXPERIMENT:

MATERIALS NEEDED:

- copy of the lab
- scissors
- spinner

PROCEDURE:

The article "What are the Chances?" explains how genes pair randomly during meiosis and fertilization. This article can be used for reference while conducting this lab.

- *You will use the pictures in your student textbook for assistance. These pictures can be found on pages 220-221.*
- *If you are a male, you will record your data on the "male worksheet" 19.2A. If you are a female, you will record your data on the "female worksheet" 19.2B.*

Part 1: Tongue Rolling

1. Try to roll your tongue (see figure 19.4).
2. If you can easily roll your tongue, you are a "tongue-roller". The tongue-roller gene is dominant (R) over the non-tongue-roller gene (r).
3. Record your alleles for this trait on the top pair of chromosomes on your male or female worksheet. Refer to figure 19.5. HINT: If you can roll your tongue, assume you are heterozygous for this trait (Rr). If you cannot roll your tongue, you are homozygous for this trait (rr).

Part 2: Widow's Peak

4. Have your partner observe your hairline. If you have bangs, you will need to pull them back.

5. A widow's peak (W) is dominant over no widow's peak (w). Use figure 19.6 as a visual.
6. Record your alleles for this trait on both chromosomes, just below the tongue-roller genes.

Part 3: Facial Features

7. Some people have dimples, while others do not. Think about your facial features.
8. Having smile dimples (D) is dominant over not having smile dimples (d).
9. Record your alleles for this trait on both chromosomes, just below the widow's peak genes.

Part 4: Ear lobes

10. Have your partner observe your ears. You may need to pull your hair back.
11. Hanging ear lobes (H) are dominant over attached ear lobes (h). Have your partner determine how your ears are attached. See figure 19.7 for guidance.
12. Record the symbols for these genes in the last space on your chromosome.

Part 5: DNA Replication

13. Toward the end of interphase, each chromosome in a future sex cell makes an exact copy of itself. To represent this process, you should now copy the appropriate trait symbols onto each duplicated chromosome (the second row of chromosomes).

Part 6: Division

14. At the bottom of your student sheet, there are 4 single chromatids. These are a result of the separation of the chromosomes during division.
15. Label each chromosome with the appropriate symbols for the four traits in the chromatids numbered 1-4.

Part 7: The Fertilization Process

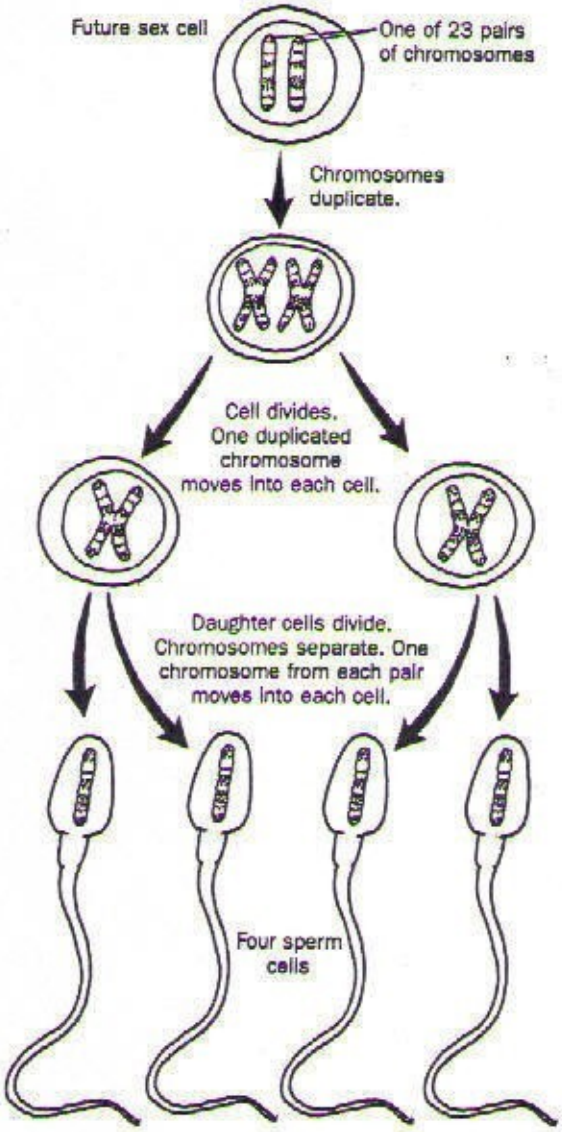
16. Pair up with a classmate of the opposite gender.
17. Record your classmates alleles on the sheet opposite yours (the male or female sheet 19.2A or 19.2B)
18. Use the spinner to decide which chromosomes (1, 2, 3 or 4) will pair. Spin the spinner to determine the male sex cell and then spin again to determine the female sex cell. The female number will also be used to determine which fertilized egg will contain your data.
19. Record those chosen alleles (from the above step) in the corresponding fertilized egg (19.2C). This simulates the fertilization process.

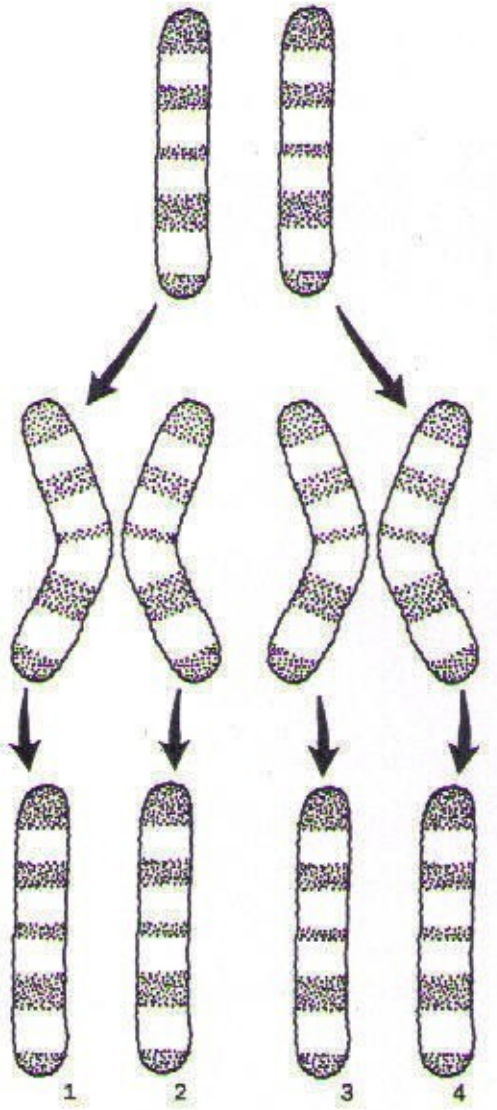
Part 8: Observing the Traits of the Offspring

20. Examine the gene pair for each trait in the fertilized egg (19.2C). List the genotype and phenotype for each trait next to the fertilized egg.
21. Discuss with your partner, which traits of the newly formed offspring differ from those of the male parent, the female parent, and from both parents.
22. Answer all conclusion questions.

DATA/OBSERVATIONS:

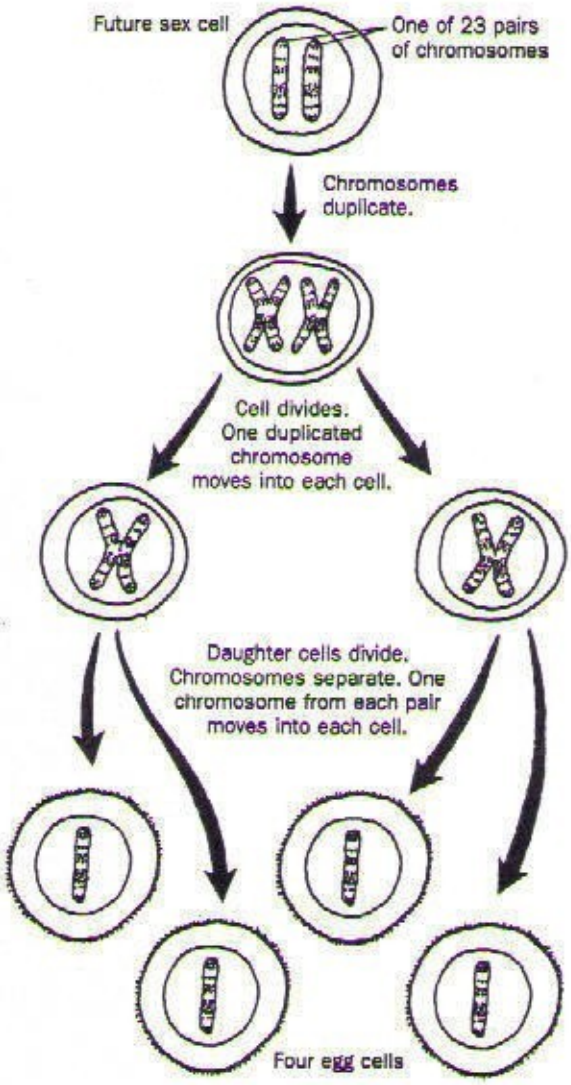
Student Sheet 19.2A
Traits, Meiosis, and Fertilization—Male

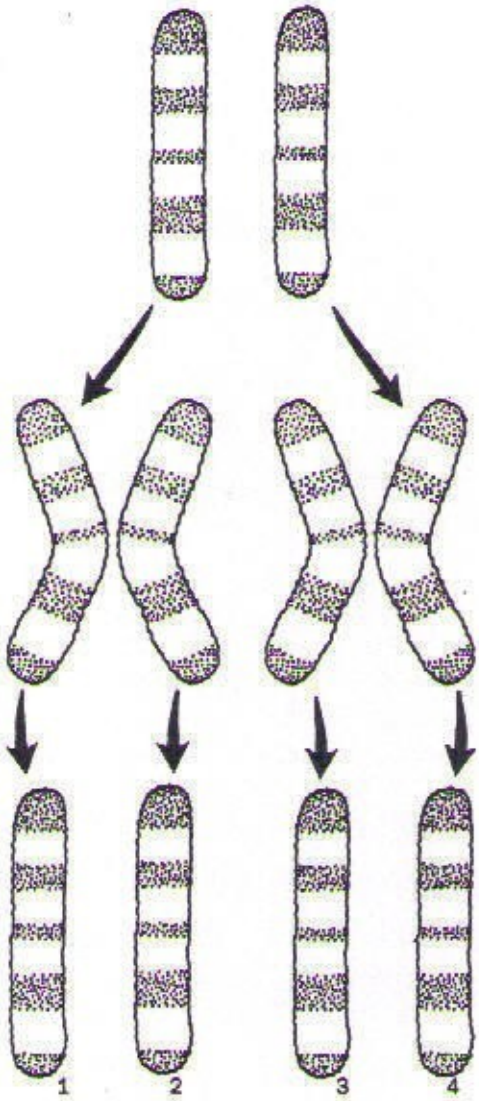




Four chromosomes, one in each sperm cell

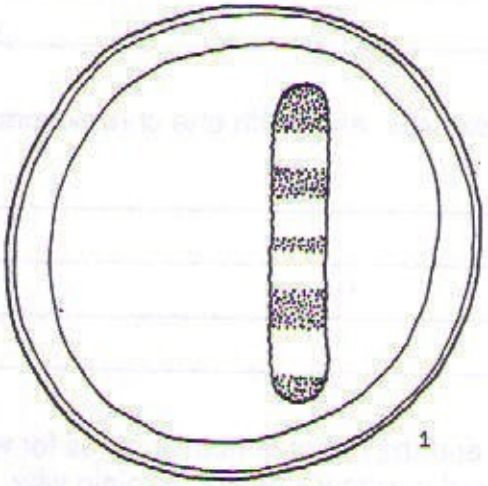
Student Sheet 19.2B
Traits, Meiosis, and Fertilization—Female

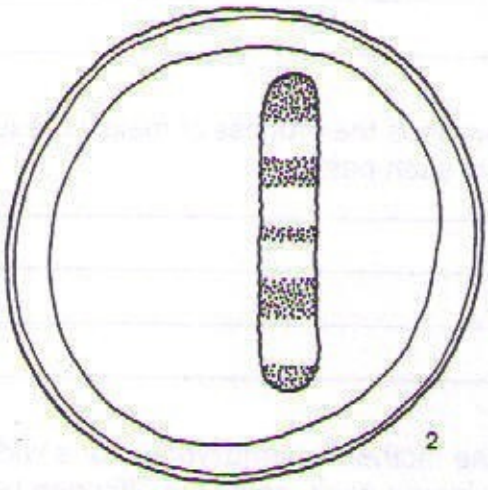


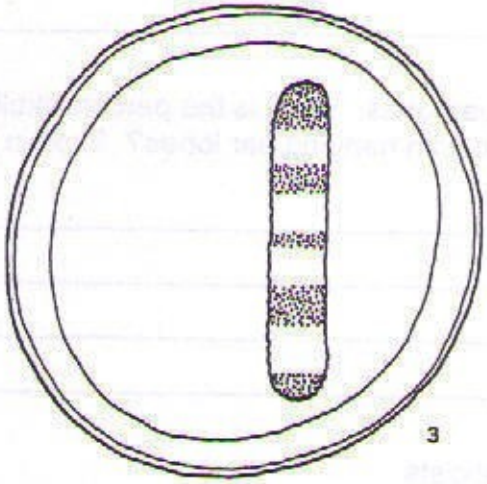


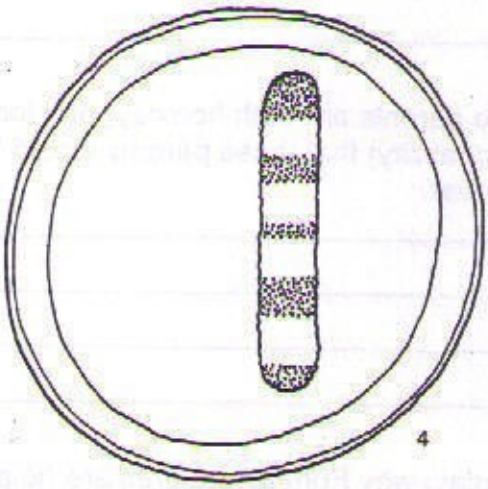
Four chromosomes, one in each egg cell

19.2 C









CONCLUSION:

1. It is possible that the offspring could express a trait that neither parent did. Explain how this could happen. Use your vocabulary in your answer.

2. How does the process of meiosis result in four sex cells, each with one chromosome from each pair?

3. If the mother is homozygous for a widow's peak and the father is homozygous for without a widow's peak, could the offspring be born without a widow's peak? Explain why.

4. Two parents are both homozygous for attached ear lobes. What is the percent likelihood (probability) that those parents would have a child with hanging ear lobes? Explain your answer.

5. Explain why Punnett squares are helpful to geneticists.

What Are the Chances?

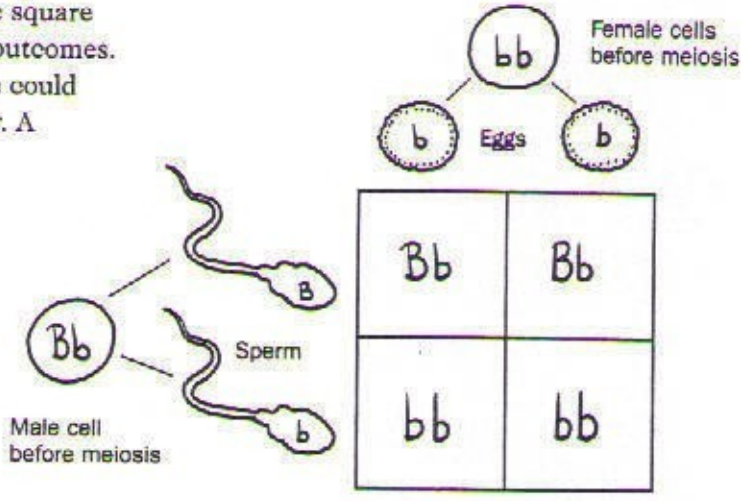
Reginald Punnett

Early in the 20th century, an English geneticist at Cambridge University developed a tool to display the possible ways that genes could pair during a genetic cross. His name was Reginald Punnett, and the tool came to be known as the "Punnett square."

Punnett used the square to illustrate the probability of the outcomes that could result from a cross, or mating, between two parents, primarily in sweet peas. The simplest Punnett square consists of a large box divided into four small boxes. To use it, you would write the genes for a trait from one parent (usually the female) above the square, and the genes for the same trait from the male on the left side of the square. Because only one chromosome from each pair passes into an offspring's sex cell during sexual reproduction, each egg above the square would contain only one gene from the female's genotype, while each sperm to the left of the square would contain only one gene from the male's genotype. Inside the square itself, you would write the possible outcomes.

As an example, a brown-eyed male could have the genotype "Bb" for eye color. A blue-eyed female could have the genotype "bb." To use a Punnett square to illustrate a cross between these parents, you would take each gene for eye color from the male and show how it could combine with each gene for eye color from the female. The shortcut for writing the cross between these parents would be "Bb × bb."

A Punnett square does not predict which genes actually will become part of the offspring's genotype. It only shows the probability that specific genotypes will occur. In this illustration, only one trait is shown in each sperm and egg. However, most organisms pass on thousands of traits during fertilization. □



This example of a completed Punnett square shows the possible genotypes from a cross between a brown-eyed male with the genotype "Bb" and a blue-eyed female with the genotype "bb."

Name _____ Date _____ Class _____

SECTION 3-2 **SECTION SUMMARY**

Probability and Genetics

Guide for Reading

- How do the principles of probability help explain Mendel's results?
- How do geneticists use Punnett squares?

3

Probability is the likelihood that a particular event will occur. The principles of probability predict what is *likely* to occur, not necessarily what *will* occur. For example in a coin toss, the coin will land either heads up or tails up. Each of these two events is equally likely to happen. In other words, there is a 1 in 2 chance that a tossed coin will land heads up, and a 1 in 2 chance that it will land tails up. A 1 in 2 chance can be expressed as a fraction, $\frac{1}{2}$, or as a percent, 50 percent. The result of one coin toss does not affect the results of the next toss. Each event is independent of another.

When Gregor Mendel analyzed the results of his crosses in peas, he carefully counted all the offspring. Over time, he realized that he could apply the principles of probability to his crosses. **Mendel was the first scientist to recognize that the principles of probability can be used to predict the results of genetic crosses.**

A tool that applies the laws of probability to genetics is a Punnett square. A **Punnett square** is a chart that shows all the possible combinations of alleles that can result from a genetic cross. **Geneticists use Punnett squares to show all the possible outcomes of a genetic cross and to determine the probability of a particular outcome.** In a Punnett square, all the possible alleles from one parent are written across the top. All the possible alleles from the other parent are written down the left side. The combined alleles in the boxes of the Punnett square represent all the possible combinations in the offspring.

Two useful terms that geneticists use to describe organisms are genotype and phenotype. An organism's **phenotype** is its physical appearance, or its visible traits. An organism's **genotype** is its genetic makeup, or allele combinations. When an organism has two identical alleles for a trait, the organism is said to be **homozygous.** An organism that has two different alleles for a trait is said to be **heterozygous.**

For all of the traits in peas that Mendel studied, one allele was dominant while the other was recessive. This is not always the case. In an inheritance pattern called **codominance,** the alleles are neither dominant nor recessive. As a result, both alleles are expressed. For example, in Erminette chickens, the alleles for feather color are codominant. Heterozygous chickens (F^BF^W) have both black and white feathers. Codominant alleles are written as capital letters with superscripts to show that neither is recessive.

Name _____ Date _____ Class _____

SECTION 3-2 REVIEW AND REINFORCE

Probability and Genetics

◆ Understanding Main Ideas

Complete the two Punnett squares below, and then answer the questions on a separate sheet of paper.

1. Punnett Square A:

	B	b
B		
b		

2. Punnett Square B:

	Bb	bb
	Bb	bb

3. In the cross between two black guinea pigs shown in Punnett Square A, what is the probability that an offspring will be black? White?

4. Is it possible that the cross between two black guinea pigs in Punnett Square A would not produce a white guinea pig? Explain.

5. What color are the guinea pig parents in the cross shown in Punnett Square B?

6. Which guinea pig parent(s) in Punnett Square B is homozygous? Which is heterozygous? Explain how you know.

7. Calculate the probability that an offspring will be black in the cross in Punnett Square B. What is the probability that an offspring will be white?

◆ Building Vocabulary

Match each term with its definition by writing the letter of the correct definition on the line beside the term.

_____ **8.** heterozygous

_____ **9.** Punnett square

_____ **10.** genotype

_____ **11.** codominance

_____ **12.** probability

_____ **13.** homozygous

_____ **14.** phenotype

a. a chart that shows all the possible combinations of alleles that can result from a genetic cross

b. the likelihood that a particular event will occur

c. an organism that has two identical alleles for a trait

d. an organism's physical appearance

e. an organism's genetic makeup, or allele combinations

f. an organism that has two different alleles for a trait

g. inheritance pattern in which the alleles are neither dominant nor recessive

Name: _____

Date: _____ Period: ____

Probability and Punnett Squares

Directions:
Complete the following Punnett Squares and answer the questions that follow. Use the italicized clues as guidance for each set of squares. Use the following symbols to indicate the correct allele pair:

♂ = male ♀ = female

In guinea pigs, black fur is dominant over white fur.

1. **Cross a heterozygous black fur male with a heterozygous black fur female.**

What percent of the offspring will have black fur?

_____

What percent of the offspring will have white fur?

_____

In guinea pigs, black fur is dominant over white fur.

2. **Cross a homozygous white fur female with a heterozygous black fur male.**

What is the probability of having offspring with black fur?

_____

What is the probability of having offspring with white fur?

_____

In humans, blue eyes are recessive to brown eyes.

3. Cross a homozygous brown eye male with a heterozygous brown eye female.

What is the percent likelihood that these parents will have blue eye children?

_____

What are the possible genotypes of the offspring?

_____

In humans, blue eyes are recessive to brown eyes.

4. Cross a heterozygous brown eye male with a homozygous blue eye female.

What is the percent likelihood that the children will have blue eyes?

_____

What are the phenotypes of each parent?

_____

In humans, brown hair is dominant over blonde hair.

5. Cross a homozygous blonde hair father with a heterozygous brown hair mother.

What is the probability of having blonde children?

_____

What are the possible genotypes of the offspring?

_____

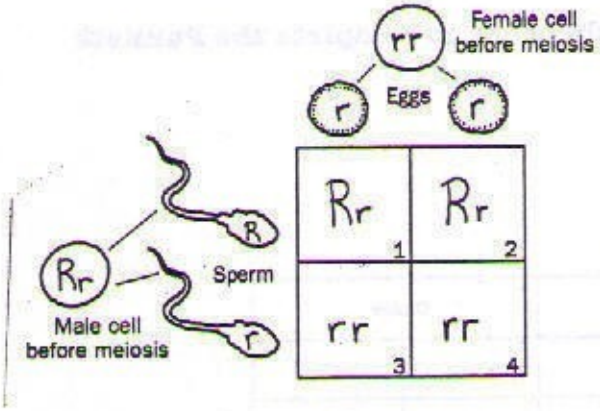
Name: _____
Date: _____ Period: _____

Directions:
Use the information that is provided in the table below to complete the Punnett squares and answer the questions that follow.

Table 1 Facial Traits for Clyde and Claire

Traits		Clyde		Claire	
Dominant	**Recessive**				
Round head (R)	Block head (r)	R	r	R	R
Widow's peak (W)	Straight hairline (w)	W	w	W	w
Wide nose (N)	Narrow nose (n)	n	n	N	n
Hanging earlobes (H)	Attached earlobes (h)	h	h	H	h
No freckles (G)	Freckles (g)	G	g	G	g
Eyebrows unconnected (E)	Eyebrows connected (e)	E	E	E	E
Dark hair (black or brown) (D)	Light hair (blonde) (d)	D	d	d	d
Dark-colored eyes (black or brown) (B)	Light-colored eyes (green or blue) (b)	B	b	b	b
Male (XY)	Female (XX)	XY	Male	XX	Female

Example:

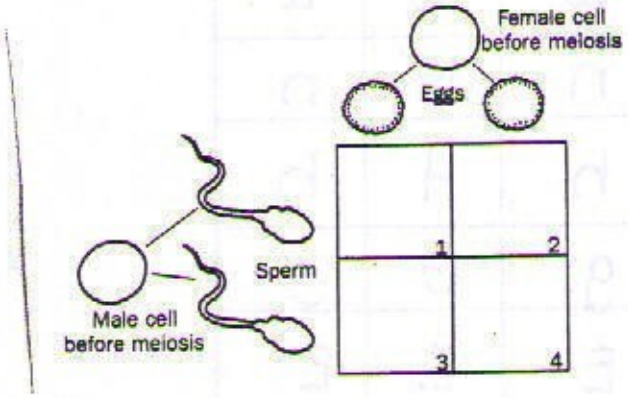


Genotype of the mother = rr

Phenotype of the father = round head

Percent likelihood of offspring with a round head = 50%

1. Head shape (round/block)

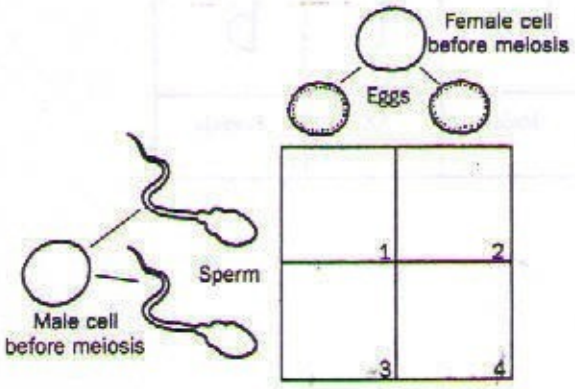


Genotypes of the offspring = _____

Phenotype of the mother = _____

Percent likelihood of offspring with a block head = _____

2. Type of hairline (widow's peak/no peak)

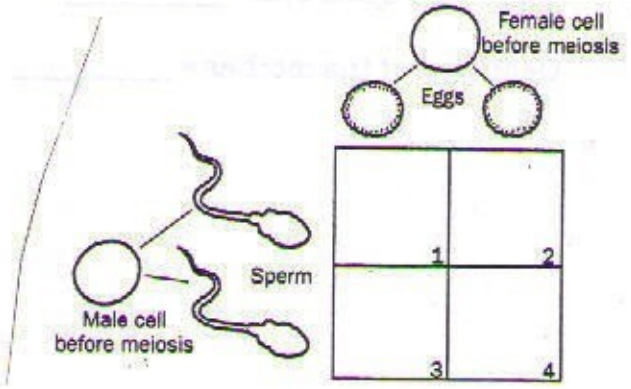


Genotype of offspring (#3) = _____

Phenotype of offspring (#1) = _____

Percent likelihood of offspring without a widow's peak = _____

3. Type of nose (wide/narrow)

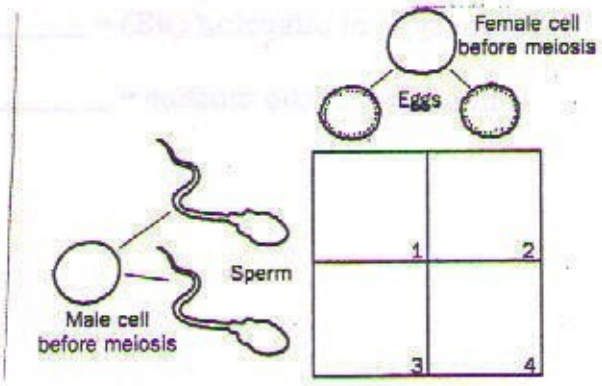


Genotype of the mother = _____

Genotype of the father = _____

Phenotype of offspring (#4) = _____

4. Attachment of earlobes (hanging/attached)



Phenotype of the father = _____

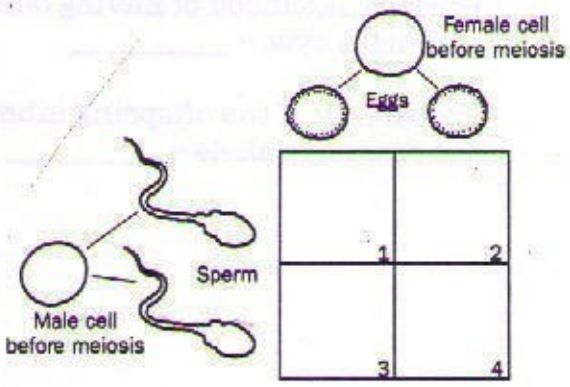
Genotype of offspring (#2) = _____

Genotypes of both parents =

_____

_____

5. Facial pigmentation (no freckles/freckles)

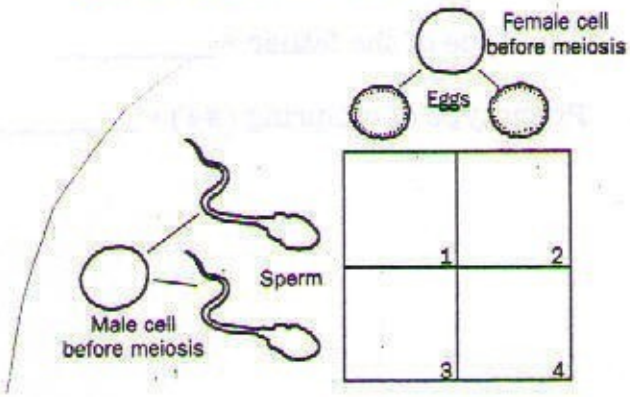


Phenotype of the mother = _____

Phenotype of the father = _____

Genotype of offspring (#4) = _____

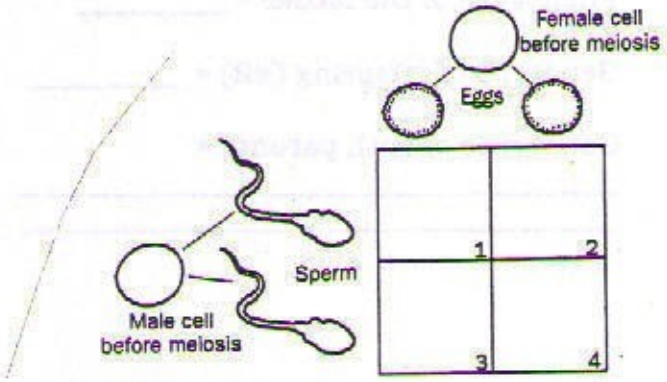
6. Eyebrow arrangement (connected/unconnected)



Percent likelihood of offspring having connected eyebrows = _____

Genotype of the mother = _____

7. Hair color (dark hair/light hair)

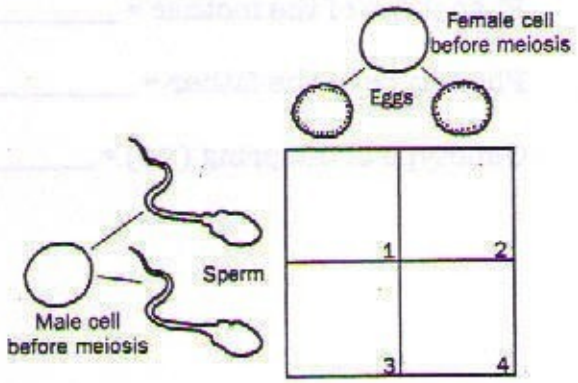


Probability of the offspring having dark hair = _____

Genotype of offspring (#3) = _____

Phenotype of the mother = _____

8. Eye color (dark eyes/light eyes)

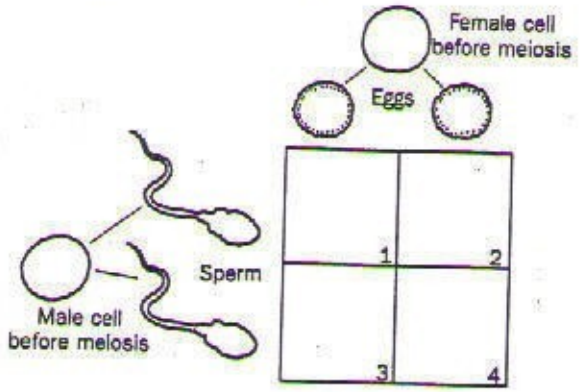


Genotype of offspring (#2) = _____

Percent likelihood of having offspring with light eyes = _____

Probability of the offspring inheriting the recessive allele = _____

9. Sex (male or female)



Percent likelihood of having a boy = _____

Percent likelihood of having a girl = _____

Monohybrid Crosses

Name _____

OOMPA LOOMPA GENETICS

SHOW WORK HERE!

_____ = gray face

_____ = gray face

_____ = orange face

1. OOmpas generally have gray faces, which is caused by a dominant gene. The recessive condition results in an orange face. Develop a "key" to show the possible genotypes and phenotypes for the OOmpah's face colors.

2. Two heterozygous OOmpahs are crossed. What proportion of the offspring will have orange faces? _____

3. A gray faced OOmpah (homozygous) is married to an orange faced Oompah. They have 8 Oompah children.
How many of those children will have gray faces? _____

4. Otis Oompah has an orange face is is married to Ona OOmpah who has a gray face. They have
60 Oompah children, 30 of those children have orange faces. What is Ona and Otis OOmpah's genotype? _____Show the cross.

5. Odie Oompah has a gray face, in fact everyone in Odie's family has a gray face, and the family likes to brag that they are a "pure" line. Much to his family's horror, he married Ondi Oomah, who *gasp* has an orange face.
What will be the phenotypes of their children? _____

What are the genotypes of the children? _____

6. Ona Oompah (from #4) divorces Otis and marries Otto. Otto has an orange face.
What is the probability that Ona and Otto's children will have an orange face? _____

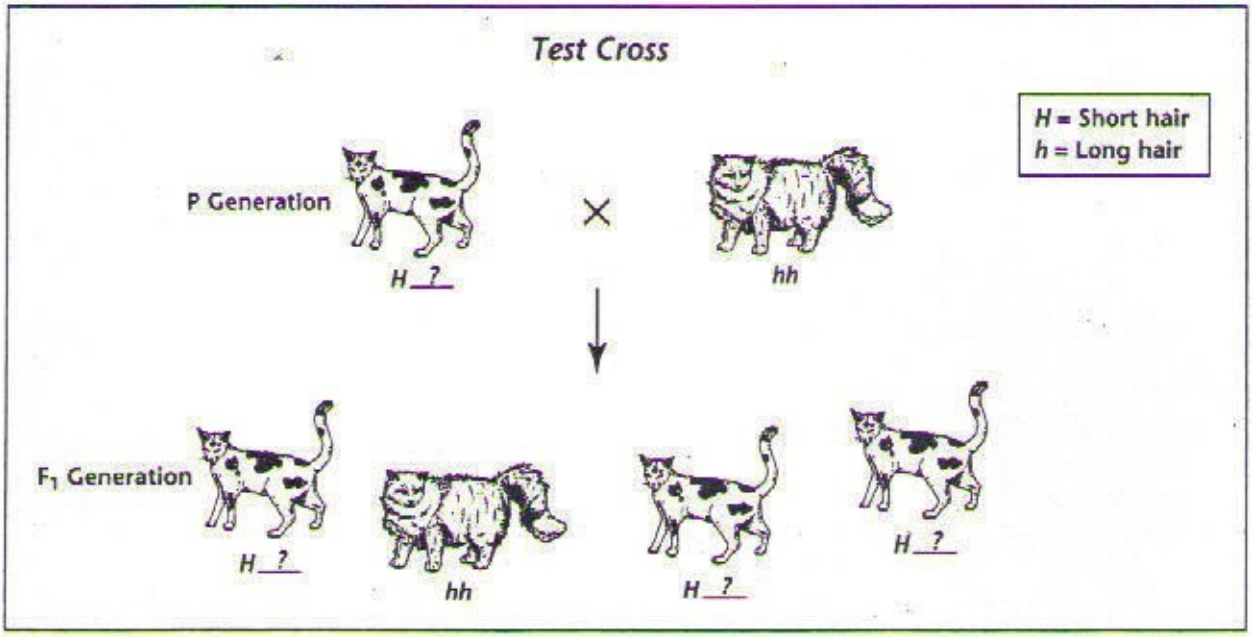
Monohybrid Crosses

Name _____ Date _____ Class _____

The Test Cross

When an organism has a trait controlled by a dominant allele, it can either be a hybrid or a purebred. To find out which, geneticists can use a test cross. In a test cross, the organism with the trait controlled by a dominant allele is crossed with an organism with a trait controlled by a recessive allele. If all offspring have the trait controlled by the dominant allele, then the parent is a purebred. If any offspring has the recessive trait, then the dominant parent is a hybrid. Study the test cross below, then answer the questions.

3



Answer the following questions on a separate sheet of paper.

1. Is the long-haired cat in the P generation a hybrid or a purebred? Explain your answer.
2. Is the short-haired cat in the P generation a hybrid or a purebred? Explain your answer.
3. If the short-haired cat in the P generation were purebred, what would you expect the offspring to look like?
4. In horses, the allele for a black coat (*B*) is dominant over the allele for a brown coat (*b*). A cross between a black horse and a brown horse produces a brown foal. Is the black horse a hybrid or a purebred? Explain.
5. In guinea pigs, the allele for a smooth coat (*S*) is dominant over the allele for a rough coat (*s*). Explain how you could find out whether a guinea pig with a smooth coat is a hybrid or a purebred.

Name _____ Date _____ Class _____

SECTION 3-3 **SECTION SUMMARY**

The Cell and Inheritance

Guide for Reading

- **What role do chromosomes play in inheritance?**
- **What events occur during meiosis?**

3

In the early 1900s, scientists were working to identify the cell structures that carried Mendel's hereditary factors, or genes. In 1903, Walter Sutton observed that sex cells in grasshoppers had half the number of chromosomes as the body cells. He also noticed that grasshopper offspring had exactly the same number of chromosomes in its body cells as each of the parents. He reasoned that the chromosomes in body cells actually occurred in pairs, with one chromosome in each pair coming from the male and the other coming from the female.

From his observations, Sutton concluded that genes are located on chromosomes. He proposed the chromosome theory of inheritance. **According to the chromosome theory of inheritance, genes are carried from parents to their offspring on chromosomes.**

Organisms produce sex cells during meiosis. **Meiosis** is the process by which the number of chromosomes is reduced by half to form sex cells—sperm and eggs. During meiosis, the chromosome pairs are separated and distributed to produce two different sex cells. Each sex cell has only one chromosome from each pair. When they combine, each sex cell contributes half the number of chromosomes to produce offspring with the correct number of chromosomes.

Punnett squares show the results of meiosis. When chromosome pairs separate, so do the alleles of genes located on the chromosomes. One allele from each pair goes to each sex cell. Punnett squares show this in the separation of alleles that the parents can pass to the offspring.

Chromosomes are made up of many genes joined together, like beads on a string. Each chromosome contains a large number of genes, each controlling a particular trait. Each chromosome pair has the same genes. The genes are lined up in the same order from one end to the other. However, the alleles for some of the genes might be different, making the organism heterozygous for some traits. If the alleles are the same, the organism is homozygous for those traits.

Name _____ Date _____ Class _____

SECTION 3-3 REVIEW AND REINFORCE

The Cell and Inheritance

◆ Understanding Main Ideas

Complete the table below by filling in the spaces with the correct stage of meiosis—Beginning, Meiosis I, Meiosis II, End.

Event	Stage in Meiosis
The double-stranded chromosomes move to the center of the cell and separate.	1. _____
The chromosome pairs separate.	2. _____
Four sex cells form with half the number of chromosome as the parental cells.	3. _____
The chromosomes are copied.	4. _____
The centromeres divide and separate.	5. _____

Answer the following questions in the spaces provided.

6. What is the chromosome theory of inheritance?

_____

_____

7. Why is it important that sex cells have half the number of chromosomes as body cells?

_____

_____

_____

_____

_____

◆ Building Vocabulary

Fill in the blank to complete the statement.

8. The process by which the number of chromosomes is reduced by half to form sex cells is called _____.

Name _____ Date _____ Class _____

SECTION 4-1 **SECTION SUMMARY**

Human Inheritance

Guide for Reading

- Why do some human traits show a large variety of phenotypes?
- Why are some sex-linked traits more common in males than in females?
- How do geneticists use pedigrees?

Many human traits are controlled by a single gene with one dominant allele and one recessive allele. As with tall and short pea plants, these human traits have two distinctly different phenotypes, or physical appearances. For example, the allele for a widow's peak, which is a hairline that comes to a point in the middle of the forehead, is dominant over the allele for a straight hairline.

Some human traits are controlled by a single gene that has more than two alleles. Such a gene is said to have **multiple alleles**—three or more forms of a gene that code for a single trait. An example of a human trait that is controlled by a gene with multiple alleles is blood type. There are four main blood types—A, B, AB, and O—controlled by three alleles.

Some human traits show a large number of phenotypes because the traits are controlled by many genes. The genes act together as a group to produce a single trait. Height and skin color are both examples of human traits controlled by many genes. When more than one gene controls a trait, there are many possible combinations of genes and alleles. There is an enormous variety of phenotypes for height, for example, and human skin color ranges from almost white to nearly black, with many shades in between.

The effects of genes are often altered by the environment—the organism's surroundings. For example, people's diets can affect their height.

As with other traits, your sex is controlled by your chromosomes. If you are female, you have two X chromosomes. If you are male, you have an X and a Y chromosome. Whether you inherited an X or Y chromosome from your father determines your sex.

Genes on the X and Y chromosomes are often called **sex-linked** genes. Traits controlled by sex-linked genes are called sex-linked traits. **Because males have only one X chromosome, males are more likely than females to have a sex-linked trait that is controlled by a recessive allele.** One example of a sex- linked trait that is controlled by a recessive allele is red-green colorblindness. A **carrier** is a person who has one recessive allele for a trait and one dominant allele. Although a carrier does not have the trait, the carrier can pass the recessive allele on to his or her offspring.

Geneticists interested in studying inheritance patterns in humans need to trace the inheritance of traits through many generations in a number of families. **One important tool that geneticists use to trace the inheritance of traits in humans is a pedigree.** A **pedigree** is a chart or "family tree" that tracks which members of a family have a particular trait.

Name _____ Date _____ Class _____

SECTION 4-1 REVIEW AND REINFORCE

Human Inheritance

◆ Understanding Main Ideas

Fill in the Punnett squares for dimples, a trait controlled by a dominant allele (A), and colorblindness, a trait controlled by a recessive sex-linked allele (B). Then answer the questions that follow.

A: Dimples

	D	d
d	1. _____	2. _____
d	3. _____	4. _____

5. Does either the mother or the father in A have dimples?

_____

6. What percentage of children are likely to have dimples?

_____

B: Colorblindness

	X^c	Y
X^c	7. _____	8. _____
X^c	9. _____	10. _____

11. Is either the mother or father in B colorblind?

_____

12. What percentage of female children are likely to be colorblind?

_____

13. What percentage of male children are likely to be colorblind?

_____

◆ Building Vocabulary

Fill in the blank to complete each statement.

14. Three or more forms of a gene that code for a single trait are called _____.

15. _____ are alleles passed from parent to child on a sex chromosome.

16. A(n) _____ is a person who has one recessive allele for a trait and one dominant allele for the same trait.

17. A(n) _____ is a chart that tracks which members of a family have a particular trait.