Chapter Quiz

Write your answers on a separate sheet of paper.

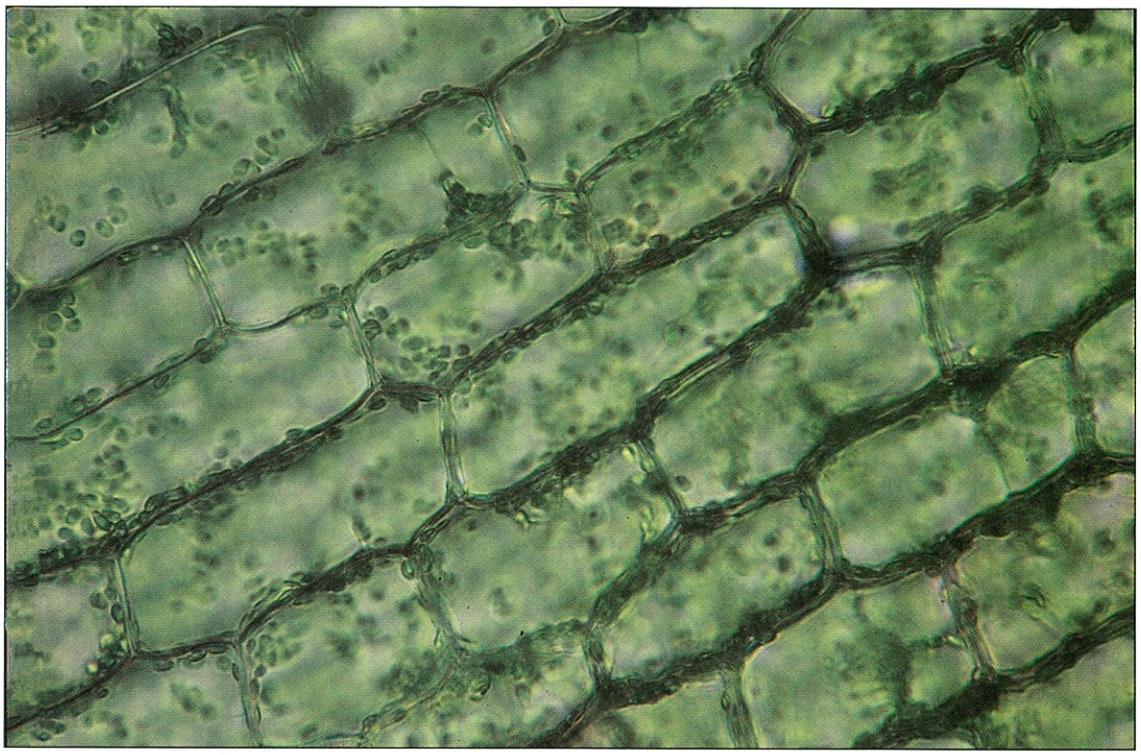
1. Which of the following are organisms: dog, robot, dead fly, pencil? Explain how you know.
2. What would you study if you took a course in zoology?
3. What field of biology is the study of plants?
4. What five characteristics do you share with every other living thing?
5. What do plants use to make their own food?
6. What are three reasons animals must be able to move?
7. Why must plants be able to move?
8. Why are seeds important for a plant?
9. What are ten things in your environment?
10. Do all organisms have the same life spans? Give an example to explain your answer.

Test Tip
Some questions ask for a certain number of items, such as five characteristics or three reasons. Be sure to give the correct number of items in your answers.

Research Project

Research the kinds of organisms that live in the deep ocean, especially near features called hot-water vents. Write a report on how these organisms are able to survive in such a harsh environment. Include in your report a description of the environment and drawings of the organisms.

Chapter 4 Cells and Life



The boxlike objects in the picture might remind you of bricks in a wall. However, these objects are all alive. They make up things you see everyday. What do you think they are? Use the color as a clue.

Learning Objectives

- Explain how Robert Hooke discovered the cell.
- Compare cells, atoms, molecules, and elements.
- Describe the parts of a cell.
- Explain how cells get energy and use it.
- Compare and contrast plant cells and animal cells.
- Describe DNA and its function.
- LAB ACTIVITY: Make models of plant and animal cells.
- ON-THE-JOB SCIENCE: Compare normal cells and cancer cells.

Words to Know

cell	the smallest, most basic unit of life
element	matter that is made of only one kind of atom
chemical bond	a force that holds atoms together
molecule	two or more atoms that are joined by chemical bonds
cytoplasm	the watery substance in a cell
cell membrane	the thin covering that holds a cell together
nucleus	the part of a cell that controls all the other parts (plural, *nuclei*)
vacuole	an enclosed space in a cell that stores food molecules, water, and waste
mitochondrion	a cell part that helps the cell store and use energy (plural, *mitochondria*)
cellular respiration	the process cells use to release energy from food molecules
cell wall	the thick covering around a plant cell membrane
chloroplast	a plant cell part that stores a green material called chlorophyll
chlorophyll	the green material inside chloroplasts that absorbs sunlight so plants can make their own food
DNA	a molecule in the nuclei of cells that controls many of the characteristics of living things

4-1 The Basic Units of Life

Words to Know

cell	the smallest, most basic unit of life
element	matter that is made of only one kind of atom
chemical bond	a force that holds atoms together
molecule	two or more atoms that are joined by chemical bonds

The Discovery of the Cell

A microscope is a tool for viewing objects too small to be seen by the eyes alone. The first microscope was invented nearly 400 years ago. It opened up a whole new world to scientists.

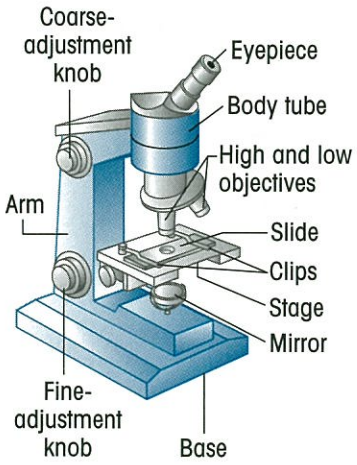


Figure 4-1
Compound microscope

A microscope has many parts. The *stage* is a platform where the object to be viewed is placed. The *eyepiece* is the part that you look through. It contains a *lens* that magnifies the image of the object. The *objectives* also have lenses that magnify. The *coarse-* and *fine-adjustment knobs* are used to move the stage up and down. This makes the object appear clearer.

In 1665, the English scientist Robert Hooke used a microscope to look at a piece of tree bark. Through the microscope, he saw what looked like many small boxes. Hooke thought that the boxes looked like the small rooms that monks live in. These rooms are called cells. So Hooke called the boxes that he saw in the tree bark "cells."

Robert Hooke studied many plants under the microscope. They all seemed to have cells. Hooke's discovery proved to be very important. We now know that the **cell** is the smallest, most basic unit of life.

✓ **How did Robert Hooke discover cells?**

Atoms and Elements

Cells are made of matter. Everything, living or nonliving, is matter. All matter on Earth is made of atoms.

Matter that is made of only one kind of atom is called an **element.** There are 112 different elements. Some are made only in laboratories, but most elements are found in nature. Oxygen, carbon, helium, and hydrogen are a few examples of elements. The Periodic Table of Elements in the Appendix at the end of this book lists all the elements.

Look at the pie chart. It shows the elements found in your body. The human body is 65% oxygen, 18% carbon, and 10% hydrogen. The other 7% of the human body is made of small amounts of other elements, such as nitrogen, calcium, and phosphorus.

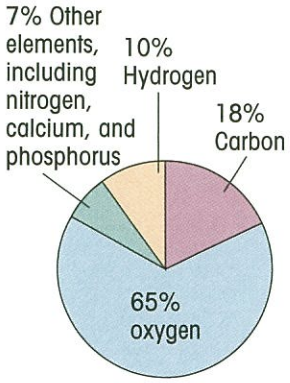
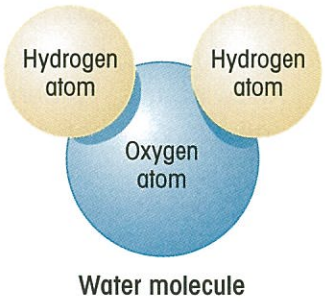


Figure 4-2 *This pie chart shows the elements in the human body.*

Often, two or more atoms are joined together by chemical bonds. A **chemical bond** is a force that holds atoms together. Two or more atoms that are joined by chemical bonds form a **molecule.** A water molecule forms when two hydrogen atoms join an oxygen atom.

✓ **How many kinds of atoms are in an element?**



Water molecule

Figure 4-3 *Water molecules are made of two hydrogen atoms and one oxygen atom.*

The Building Blocks of Life

Everything in the universe is made of atoms. But only living things have cells. Cells are the building blocks of life. Think of how bricks are put together to make a house. In this same way, cells are put together to make a living thing.

A cell is like a very tiny water balloon. It is watery inside and has a thin outer covering. All living things, including ants, flowers, and people, are made of cells.

Although you cannot see most cells without a microscope, they are much bigger than atoms and molecules. Many molecules make up a cell.

Your own body has about 100 trillion cells. This is 20,000 times greater than the number of people in the world. However, many organisms are made of just one cell. These simple organisms can only be seen with a microscope.

✓ **What are the building blocks of life?**

Lesson Review

1. What did Robert Hooke see through his microscope?
2. What are molecules made of?
3. How many different elements are there?
4. **CRITICAL THINKING** Is water an element? Explain your answer.

On the Cutting Edge

CLOTH THAT CAN "BREATHE"

Water molecules are bigger than air molecules. Knowing this, Wilbert Gore and his son Bob had an idea. Why not make cloth with a weave too tight to let in water molecules but loose enough to let out air molecules? The cloth would be waterproof. It would also "breathe," meaning it would let hot air out. If you have ever worn rubber rain gear, you know what a good idea this cloth was!

It took them many years, but the Gores finally made such a cloth. They called it GORE-TEX® fabric. Today, this material is made into tents, jackets, and other things that need to be waterproof and also "breathe."

This jacket is made of a waterproof material that "breathes."

CRITICAL THINKING Why are boots that do not "breathe" less comfortable to wear?

4-2 Understanding Cells

Words to Know

cytoplasm	the watery substance in a cell
cell membrane	the thin covering that holds a cell together
nucleus	the part of a cell that controls all the other parts (plural, *nuclei*)
vacuole	an enclosed space in a cell that stores food molecules, water, and waste
mitochondrion	a cell part that helps the cell store and use energy (plural, *mitochondria*)
cellular respiration	the process cells use to release energy from food molecules
cell wall	the thick covering around a plant cell membrane
chloroplast	a plant cell part that stores a green material called chlorophyll
chlorophyll	the green material inside chloroplasts that absorbs sunlight so plants can make their own food
DNA	a molecule in the nuclei of cells that controls many of the characteristics of living things

Parts of a Cell

Most of a cell is made up of a watery, sometimes gooey, substance called **cytoplasm.** Other parts of the cell float around in the watery cytoplasm.

All cells are surrounded by a **cell membrane.** This thin covering holds a cell together. The cell membrane lets food molecules and other materials pass into the cell. It also lets wastes pass out of the cell.

Near the center of the cell is the nucleus. The **nucleus** is the cell's "command post." It controls all the other parts of the cell.

The enclosed spaces in a cell are called vacuoles. Each **vacuole** is used to store food, water molecules, and waste. A vacuole acts as a storeroom for the cell.

The cells also contain mitochondria. A **mitochondrion** is a cell part that helps the cell store and use energy. Mitochondria are the powerhouses of the cell.

✓ **What are some parts of a cell?**

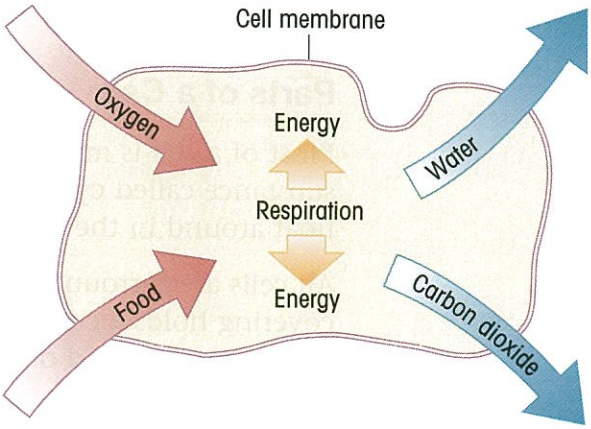
How Cells Get Energy

Remember
Each cell in your body has all the characteristics of life. A cell can get and use food. It can move and grow. A cell can also reproduce and respond to the environment. To do these things, a cell needs energy.

Cells get their energy from food. Food molecules pass through the cell membrane into the cytoplasm. Then the molecules are broken down in the mitochondria.

Cells use oxygen to release energy from the food molecules. The oxygen gets into the cells through the cell membrane. The process cells use to release energy from food is called **cellular respiration.**

Cellular respiration also produces certain byproducts. Byproducts are products that are not needed by the cell. They are leftovers. These byproducts leave the cell through the cell membrane.



FOOD MOLECULES + OXYGEN → ENERGY + WATER + CARBON DIOXIDE

Figure 4-4
The byproducts from cellular respiration are water and carbon dioxide.

✓ **How do cells get energy?**

Plant Cells and Animal Cells

Plant cells are different from animal cells in a few important ways. First, a plant cell has a **cell wall.** The cell wall is the thick covering around a plant's cell membrane. It is harder and stronger than the cell membrane.

Plant cells usually have much bigger vacuoles than animal cells do. This is because plant cells must store a lot of water. Animal cells can have many small vacuoles.

Another important difference is that plant cells have chloroplasts. A **chloroplast** is a plant cell part that stores a green material called **chlorophyll.** Chlorophyll absorbs sunlight. Plants use the sunlight to make their own food.

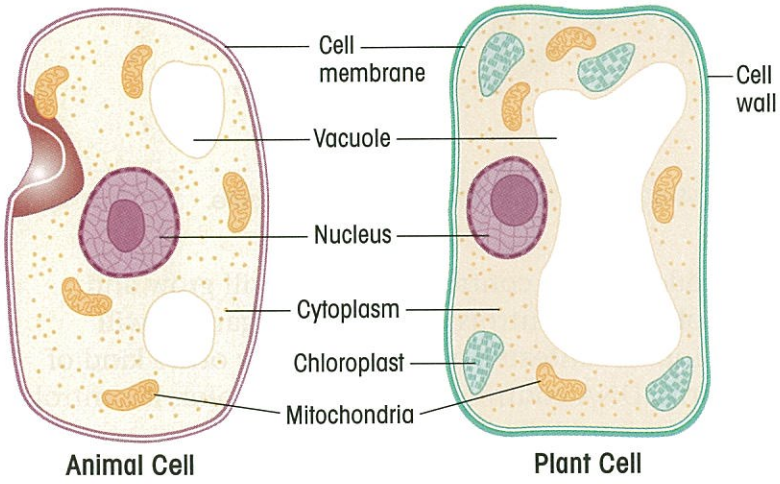


Figure 4-5 *A plant cell has some structures that an animal cell does not.*

✓ **What are the main differences between animal cells and plant cells?**

Science Fact

Cells come in different sizes. The largest cell is the yolk of an ostrich egg. It is about the size of a baseball. Bacteria are tiny single-celled organisms. Hundreds of bacteria could fit on the period at the end of this sentence.

DNA: A Code for Life

Inside the nucleus of all cells is a very important kind of molecule called **DNA.** DNA controls many of the characteristics of living things. It is one of the largest molecules found in living things. Thousands of smaller molecules join together in a certain order to make DNA. The order of the molecules makes up a kind of "life code" that controls all the activities of the cell.

Figure 4-6 *This is a model of a DNA molecule.*

This is the first photo ever taken of DNA. See if you can find the twisted ladder.

The code in DNA controls how cells will grow and multiply. DNA controls whether an organism will grow into an anteater, a human, or any other kind of life form. DNA controls a person's eye color. It controls whether an animal will be tall or short.

In 1953, American scientists James Watson and Francis Crick formed a model of the structure of DNA. The model was shaped like a twisted ladder. The model explained how cells are able to reproduce themselves. In 1963, the two scientists received the Nobel Prize for their work. In 1989, the first photograph was taken of DNA. The photograph showed that Watson and Crick's model of DNA was correct.

Today, information about DNA is being used in criminal courts. Since every person has a different DNA code, scientists can identify people by the DNA in their cells. Sometimes, a person can be found guilty or innocent of a crime based on information about his or her DNA.

✓ **How do molecules of DNA determine many of the characteristics of living things?**

Lesson Review

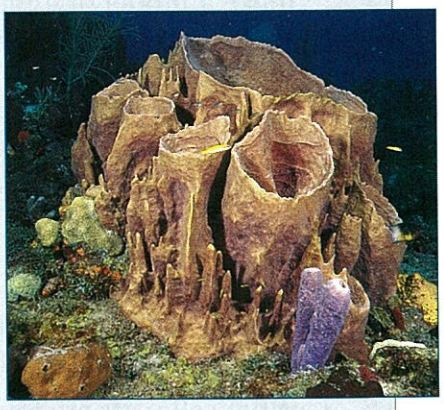
1. What are four cell parts found in both animal cells and plant cells?
2. What are the byproducts of cellular respiration?
3. What does chlorophyll allow a plant to do?
4. **CRITICAL THINKING** How could police prove that a strand of hair found at the scene of a crime belongs to a suspect?

A Closer Look

DNA IN SPONGES

Sponges are animals that live on the ocean floor. They are simple animals. Yet, thanks to their DNA, sponges can do some amazing biological tricks.

If a person loses an arm or a leg, that person cannot grow a new one. A sponge can grow new parts. Its DNA has a code for growing the new parts. If part of a sponge is cut off, the cells reproduce to replace that part. In fact, if you were to cut a sponge into many pieces, each piece would grow into a complete new sponge. Now that's a pretty good trick!



Sponges can grow new body parts.

CRITICAL THINKING How does DNA help a sponge grow new parts?

LAB ACTIVITY
Making Models of Cells

BACKGROUND
All cells have many of the same structures. However, plant cells are different from animal cells in a few important ways.

PURPOSE
You will make a model of a plant cell and an animal cell.

MATERIALS
paper, pencil, corn syrup, 2 plastic sandwich bags, 1 clear plastic cup, 2 small balls, 4 peas, 2 marbles, 1 small plastic egg, 6 peanuts in shells

WHAT TO DO
1. Use the materials to make a model of an animal cell. The first chart shows what to use for each cell part.
2. Use the rest of the materials to make a model of a plant cell. The second chart shows what to use for each cell part.
3. Describe on a separate sheet of paper how each cell part in your models is similar to the actual cell part that it represents.

Animal Cell	
For...	**Use...**
Cell membrane	Bag
Nucleus	1 ball
Mitochondria	3 peanuts
Vacuoles	2 marbles
Cytoplasm	Corn syrup (Fill bag.)

Plant Cell	
For...	**Use...**
Cell membrane	Bag
Cell wall	Cup (Put bag in cup.)
Nucleus	1 ball
Mitochondria	3 peanuts
Vacuole	Plastic egg
Chloroplasts	4 peas
Cytoplasm	Corn syrup (Fill bag.)

DRAW CONCLUSIONS
- What cell parts are found in both a plant cell and an animal cell?
- What cell parts are found in a plant cell but not in an animal cell?
- Based on the models you made, what can you say about plant cells and animal cells?

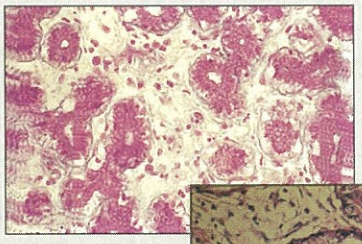
ON-THE-JOB SCIENCE
Histologic Technician

Estella is a histologic (his-tuh-LAJ-ik) technician. She works in a hospital laboratory. In the hospital, doctors who perform operations sometimes remove a sample of the patient's skin or other tissues. The cells in the tissue are then examined to see if they are healthy. The doctors send the tissue sample to Estella so that she can prepare it for an examination.

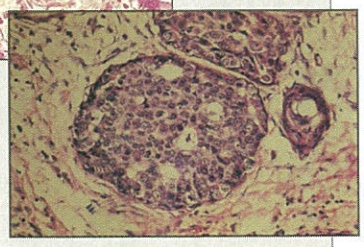
Estella checks that she has prepared her slides correctly.

Estella freezes the tissue and cuts off a very thin layer. Then she places the layer on a microscope slide. She stains the cells in the tissue with a dye. Then a doctor called a pathologist examines the cells through a microscope.

The pathologist might see cancer cells in the tissue. Cancer cells reproduce very quickly. They can crowd out and kill a person's healthy cells. Doctors treat cancer cells by removing these cells from the person's body or by destroying them with drugs or radiation.



A. Normal cells



B. Cancer cells

The photos to the right were taken through a microscope. Photo A shows normal cells. Photo B shows cancer cells from the same part of the body.

Use the photos to answer these questions.

1. How are normal cells and cancer cells alike?
2. How are the normal cells and cancer cells different?

Critical Thinking

Why do you think Estella stains the cells with a dye before a pathologist examines them under a microscope?

Chapter

4 Review

Summary

The cell is the basic unit of all living things. The cell has various parts that work together to keep it alive. There are many kinds of cells, including plant cells and animal cells. All cells need energy to survive.

Lesson 4.1

The invention of the microscope led to the discovery of cells. Cells are made of matter, and matter is made of atoms. Matter that is made of only one kind of atom is an element. Molecules are atoms that are joined by a chemical bond.

Lesson 4.2

The nucleus controls activities of the cell. Cells release energy from food molecules by cellular respiration. Plant cells have some parts that animal cells do not have. DNA controls many of an organism's characteristics.

Vocabulary Review

Write *true* or *false* for each sentence. If the sentence is false, replace the underlined term with another term to make the sentence true.

1. Oxygen is an element because it is made of only one kind of atom.
2. Food molecules pass into a cell through the vacuole.
3. A molecule covers the cell membrane in plants.
4. Cell parts that help the cell store and use energy are called mitochondria.
5. Plants are green because they have cytoplasm.
6. The nucleus controls all the other parts of a cell.
7. Vacuoles float in the DNA of a cell.
8. Chlorophyll is found in a chloroplast.

Chapter Quiz

Write your answers on a separate sheet of paper.

1. What did Robert Hooke discover?
2. What is the Periodic Table of Elements?
3. How are molecules formed?
4. Why is the nucleus called the cell's "command post"?
5. What three things do vacuoles store?
6. What are three reasons why cells need energy?
7. What two things must pass into a cell in order for it to get energy by cellular respiration?
8. Why are plant cells able to make their own food but animal cells are not?
9. What does the structure of a DNA molecule look like?
10. How does DNA determine a person's eye color?

Test Tip
Make flash cards of important terms to help you study for a test. Write a term on one side of the card. Write the meaning of the term on the other side.

Research Project

A cell has other parts in addition to those shown in the drawings on page 55. Use library references to find out about two other cell parts, such as ribosomes, endoplasmic reticulum, nucleolus, and lysosomes. Draw and label the cell parts and write what they do.

Chapter 5 The Kingdoms of Life

Scientists divide organisms into groups to make them easier to study. This photo shows organisms from three different groups, called kingdoms. What do you think those kingdoms are?

Learning Objectives

- Name the kingdoms of life.
- Explain the relationship between a kingdom, phylum, and species.
- Compare protists, monera, and fungi.
- Compare plants and fungi.
- Name one member of each kingdom.
- LAB ACTIVITY: Observe protists that live in pond water.
- SCIENCE IN YOUR LIFE: Identify antibacterial products in your home.