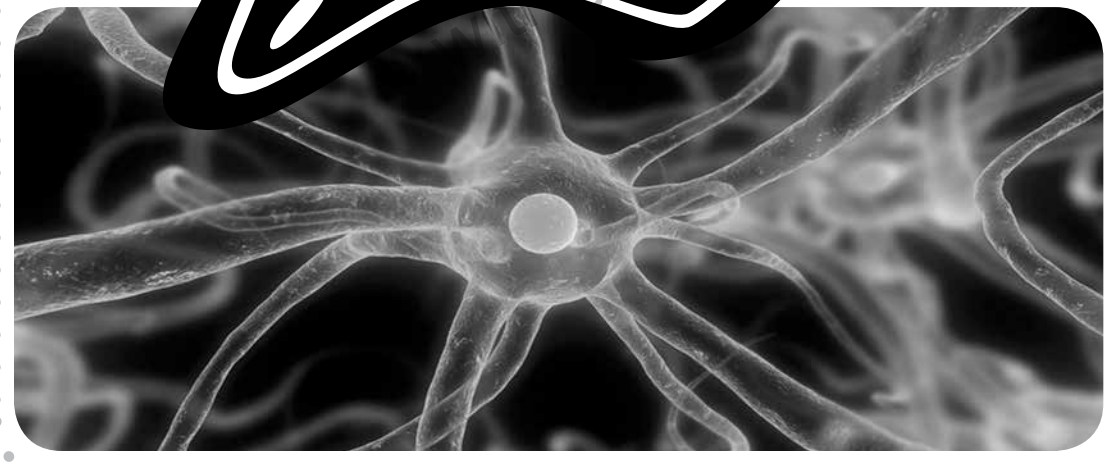
FOCUS ON SCIENCE

# Cells Structure and Function

Advanced Level





Life Science
Dynamic Equilibrium

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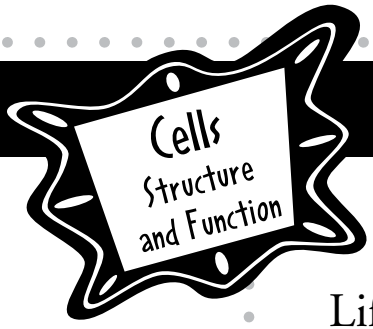



## Scientific Inquiry

**The central purpose of scientific inquiry is to develop explanations of natural phenomena in a continuing, creative process.**

Construct explanations independently for natural phenomena, especially by proposing preliminary visual models of phenomena.

**The observations made while testing proposed explanations, when analyzed using conventional and invented methods, provide new insights into phenomena.**

Design charts, tables, graphs, and other representations of observations in conventional and creative ways to help them address their research question or hypothesis.

Organize results, using appropriate graphs, diagrams, data tables, and other models to show relationships.

## Life Science

**Living things are both similar to and different from each other and from nonliving things.**

Living things are composed of cells. Cells provide structure and carry on major functions to sustain life. Cells are usually microscopic in size.

The way in which cells function is similar in all living things. Cells grow and divide, producing more cells. Cells take in nutrients, which they use to provide energy for the work that cells do and to make the materials that a cell or an organism needs.

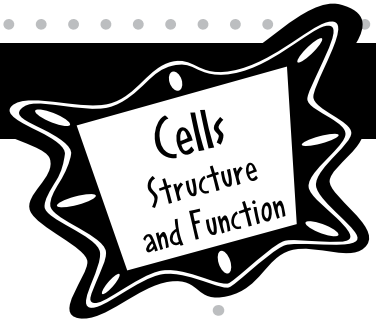
Most cells have cell membranes, genetic material, and cytoplasm. Some cells have a cell wall and/or chloroplasts. Many cells have a nucleus.

Some organisms are single cells; others, including humans, are multicellular.

Cells are organized for more effective functioning in multicellular organisms. Levels of organization for structure and function of a multicellular organism include cells, tissues, organs, and organ systems.

Many plants have roots, stems, leaves, and reproductive structures. These organized groups of tissues are responsible for a plant's life activities.

Multicellular animals often have similar organs and specialized systems for carrying out major life activities.




# English Language Arts

The following is a selective listing of the literacy competencies addressed in this book.

## Literacy Competencies

### Word Recognition

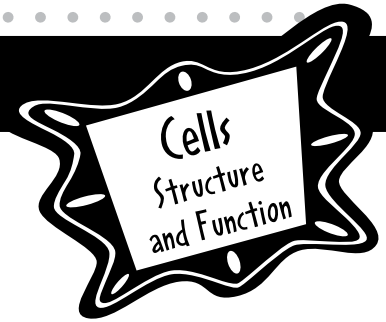
- Recognize at sight a large body of words and specialized-content vocabulary

### Background Knowledge and Vocabulary

- Determine the meaning of unfamiliar vocabulary and idioms by using prior knowledge and context clues

### Comprehension Strategies

- Use a variety of comprehension strategies (e.g., predicting, questioning, summarizing, visualizing, and making connections) to support understanding and response to reading






Published by FOCUScurriculum
866-315-7880
www.focuscurriculum.com


Order Number LS-51AL

Written by Holly Melton
Created by Kent Publishing Services, Inc.
Designed by Signature Design Group, Inc.



## How to Help Your Students Make the Best Use of This Book

Encourage students to develop nonfiction literacy skills by completing the Active Reader activities. Also encourage them to . . .

- Underline main ideas in paragraphs.
- Circle details that support the main ideas.
- Write down questions as they read.
- Circle key words as well as unfamiliar words.

## Printing Instructions

Student Book: print pages 5–42

Assessments: print pages 43–46

Answer Key: print pages 47–50

FOCUS ON SCIENCE

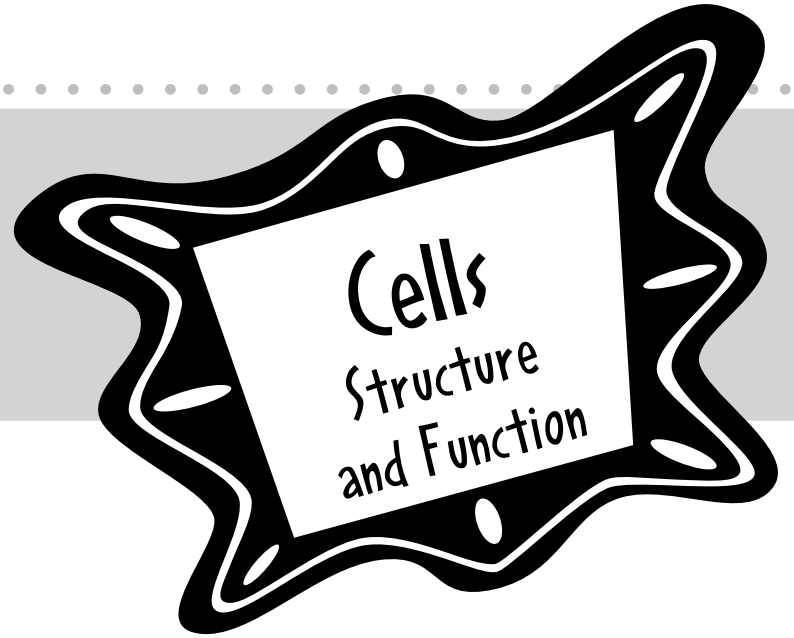
# Cells Structure and Function

**How do human body systems function to maintain homeostasis?**

A baseball pitcher firing off a fastball. A rosebud opening to the sun. A bacterium drifting in a pond. What do they have in common?

They are all alive – and they are all made up of cells. Cells are the basic unit of life. Cells have structures, or parts. They have functions, or jobs. In this book, you will learn what makes up cells and what functions they perform.

The cells in our bodies have the ability to keep everything inside of themselves in the same state. In other words, they can remain stable. For instance, they can avoid becoming too hot or to cold and they can take in nutrients and expel wastes, all so they can do their jobs over and over again. This balance is called homeostasis.




# Table of Contents



## Starting Points



## Chapter 1 The Basic Unit of Life



## Chapter 2 Inside a Cell



## Chapter 3 Cell Work

Starting Points

# Build Background

## Use Your Knowledge

**Stories about cells are often in the news. There are stories about scientists developing medicines that fight cancer cells. There are discoveries of how special cells help salamanders regrow limbs. What news stories have you heard that involve cells? Write two or three sentences about what you have heard.**

## Think About It

**What do you already know about cells? What do you want to find out? Fill in the chart below. One example has been done for you. When you complete this book, come back to this page and list more things you would like to find out.**

| What I Know | What I Want to Find Out |
|---|---|
| 1. People are made up of cells. | 1. How many cells are in a person? |
| 2. | 2. |
| 3. | 3. |


# Build Background

## Sort It

**The words in the box name living things that are made up of cells. Use the words to complete the chart below. One of your entries will be a heading. Add more words to complete the lists.**

| | | |
|---|---|---|
| corn | pine tree | multi-celled organisms |
| elephant | human | amoeba |

| _____ | Single-celled organisms |
|---|---|
| Plants / Animals | |
| rosebush / cat | bacteria |


## Five Minute Cell Hunt

It's a contest! Grab a friend or some classmates and see who can find the most things made of cells in five minutes. Hint: cells are found in living things.

1. **Gather a pencil or pen and a timer, such as a stopwatch.**
2. **Decide where to conduct your "cell hunt." Will you and your fellow contestants hunt in the same place or in separate locations? Where will you go to find the greatest variety of living things? Should you stay in one place or hurry from one place to another?**
3. **Set the timer for five minutes, and START the hunt! Use the chart below to write down everything you see that has cells.**
4. **When the timer goes off, STOP! Compare your results by discussing the questions.**

| Name of Plant, Animal, or Other Living Thing | How Many Did You Find? | Where Found? |
|---|---|---|
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |



### Discussion Questions:

1. **Who found the most living things?** _____
2. **Where were the most living things found? Why was that a good place to find cells?** _____

_____

3. **Did the person who found the most living things also find the most cells? Explain.** _____

_____

Starting Points

# Key Vocabulary

## Rate Your Knowledge

**The words listed below have to do with cells. Each word is important, but some of them may be new. Read each word. Rate your knowledge of each by putting a check or a few words in the appropriate column. After completing this book, come back to this page and write the definitions of words you did not know.**

| | I don't know it. | I've seen it and I think it means . . . | I know it well. It means . . . |
|---|---|---|---|
| cell | | | |
| tissue | | | |
| organ | | | |
| organelle | | | |
| nucleus | | | |
| membrane | | | |
| photosynthesis | | | |
| osmosis | | | |
| cellular respiration | | | |



## Use Word Parts to Unlock Meaning

**Read the prefixes and their meanings in the box. Then draw lines to match the terms to their definitions.**

| Prefix | Meaning |
|---|---|
| *extra-* | outside |
| *uni-* | one |
| *multi-* | many |
| *chlor-* | green |
| *cyto-* | cell |

| Terms | Definitions |
|---|---|
| **1.** extracellular | unicellular green structure in plant where photosynthesis takes place |
| **2.** multicellular | having one cell |
| **3.** chloroplast | contents of a cell within the plasma membrane (except the nucleus) |
| **4.** cytoplasm | having many cells |
| **5.** unicellular | outside of the cell |

# Key Concepts

## The Characteristics of Organisms

**Organisms** are living things. Plants, animals, bacteria, and fungi are organisms. You are an organism, too. Mountains, air, and water are not organisms. Why? They are not living things. It's not always easy to tell the difference between living and nonliving things, but there are characteristics that all living things have in common:

- Living things are made of one or more cells.
- Living things get and use energy.
- Living things grow and develop.
- Living things reproduce.
- Living things respond to their environment.
- Living things adapt to their environment.

Every living thing is made up of **cells**; but it only takes one cell to be a living thing.

**ACTIVE READER**

***1 Explain*** *Underline the characteristic that answers this question:* How do organisms make sure that when they die, their species continues?

## Good to Know

Long ago, many people thought nonliving things could suddenly turn into living things. For example, people thought piles of hay could turn into mice! Today, people know that nonliving things can't come to life.

Hands On Science

**Make Estimates** Organisms can have as little as one or as many as trillions of cells. You can't count the exact number. But, scientists make estimates based on the type of organism. List some organisms in the first column. Then, fill in the second column with your guess about how many cells it has. Next, do research to find out about how many cells the organism really has. You might be surprised!

| Organism | Number of Cells I Think It Has | Number of Cells It Really Has |
|---|---|---|
| | | |
| | | |
| | | |
| | | |
| | | |

# Chapter 1 The Basic Unit of Life

**FOCUS** Cells are the basic unit of life. As you read this section, find out how the world of cells was discovered and who discovered it.

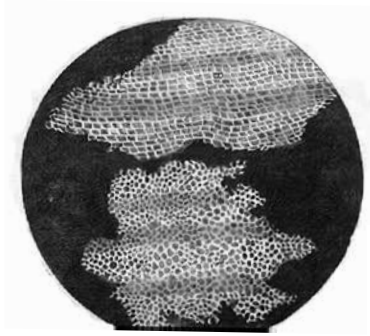
## Microscopes Make a Tiny World Visible

People didn't know that cells existed before the 1600s. That's because they couldn't see them. They couldn't see them because the technology of the times didn't allow it. The history of our knowledge about cells is very much tied to the history of the microscope.

The first microscope was invented around 1595, allowing scientists to observe and study very small objects. As more advanced microscopes were built, scientists could examine ever-smaller objects. It wasn't long before scientists discovered the miniscule and amazing world of cells.

### Robert Hooke

Robert Hooke was an English scientist and inventor. In 1663 he used a crude microscope he had designed to observe thin slices of cork, a woody plant. Hooke noted that the cork looked like a honeycomb. It was full of boxlike pores, or cells, as he called them. Robert Hooke had discovered plant cells!



*This is how cork looks through a microscope. Note the cells.*

*This is the type of microscope Robert Hooke used in his study of plant cells.*



**ACTIVE READER**

***1 Monitor*** *Underline the two sentences that explain why people didn't know about cells before the 1600s.*

***2 Identify*** *Circle the name of the scientist who discovered plant cells. What country did he live in?*

_____

## Good to Know

Robert Hooke thought the pores in the cork looked like the small rooms, or cells, in which monks at a monastery lived. That's why he named them cells.

## Anton van Leeuwenhoek

Anton van Leeuwenhoek was a Dutch businessman who lived at the same time as Robert Hooke. He was probably inspired to explore the microscopic world when he read Hooke's book *Micrographia*. Like Hooke, Anton van Leeuwenhoek invented his own microscope that used one lense and light to view objects. In fact, he made over 500 of them during his lifetime. His microscopes could magnify specimens over 200 times.

Leeuwenhoek was incredibly curious. He examined a huge variety of specimens under his microscopes. He studied both plant and animal tissues, and discovered blood cells. He examined drops of lake water and discovered that the water was populated with tiny, living organisms. He even took scrapings from the teeth of old men who had never brushed their teeth! In them, he found a huge number of swimming "animalcules," or "little animals." What Leeuwenhoek was observing were living bacteria.

*Anton van Leeuwenhoek invented a microscope that looked like this one.*



### FOCUS QUESTIONS

1. **Why is our knowledge of cells tied to the history of the microscope?**

2. **What scientific discoveries and contributions did Robert Hooke and Anton van Leeuwenhoek make?**

### ACTIVE READER

***1 Analyze*** *How do scientists build on each other's work? Support your answer with details from the text.*

***2 Extend*** *Think about Leeuwenhoek's "animalcules." Why do you think he called them "little animals"?*

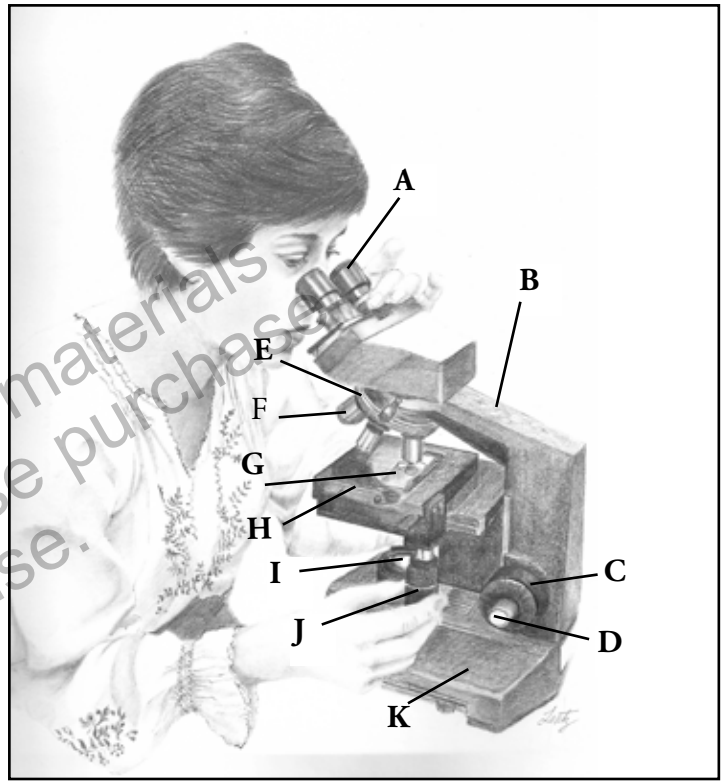
Web Quest

Find out about two types of microscopes: the simple microscope and the compound microscope. How are they different from each other? Which one did Robert Hooke use? Which one did Anton van Leeuwenhoek use?

Hands On Science

## Learn the Parts of a Microscope

The illustration at the right shows the type of microscope used in most science labs today. Study the diagram and answer the questions below.




**A. Ocular Lens (Eyepiece)** (lens that magnifies the image of the specimen, brings light rays into focus)
**B. Arm**
**C. Coarse Adjustment Knob** (makes large changes in focus)
**D Fine Adjustment Knob** (makes tiny changes in focus)
**E. Revolving Nosepiece**
**F. Objectives** (three lenses that each magnify the image of the specimen to a different size)
**G. Slide** (contains the specimen)
**H. Stage** (where the slide specimen is placed)
**I. Light Source/Condenser** (provides light to illuminate the specimen)
**J. Stage Control** (adjusts the position of the stage)
**K. Base**



**Use the diagram above to answer the following questions.**

**1.** What is the name of the part you look through? _____

**2.** Where do you place the slide with the specimen? _____

**3.** Which two parts magnify the image of the specimen? _____

**4.** Which part provides light to make the image brighter? _____

**5.** Which part is used to make tiny changes in focus? _____

**6.** Why do you think a microscope would have lenses that show different magnifications, instead of one lens with only the most powerful magnification?

_____

_____

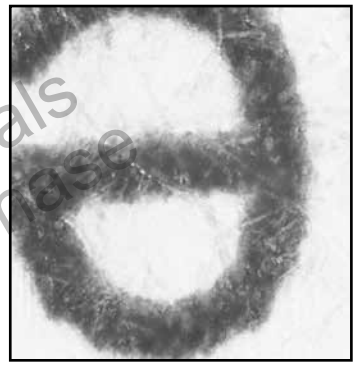
Hands On Science

## Microscope Investigations

Investigate what everyday objects look like under a microscope. Prepare slide specimens of the objects listed below. Look at each specimen under a microscope. Observe things at different magnifications with the different objects. Make notes about the interesting and surprising things you discover.

### Tips for Using a Microscope

- **Make sure the microscope is placed with the arm facing you.**
- **Click the low-power objective lens into place by revolving the nosepiece.**
- **Put a slide on the stage and use the stage clips to secure it.**
- **Turn the coarse adjustment knob or stage control until the lens is very close to the slide.**
- **Look through the eyepiece and turn the fine adjustment knob to bring the specimen into focus.**



*A printed letter e as observed through a microscope*



**The letter *e* cut out from a newspaper** _____

_____

**A strand of your hair** _____

_____

**Small pieces of cloth, with threads showing** _____

_____

**Grains of sugar** _____

_____

**Your choice!** _____

_____

FOCUS

The next part of the chapter explains the development of the cell theory. Read to learn about the three parts of this theory and the scientists who made important contributions to our knowledge about cells.

## The Cell Theory

During the seventeenth and eighteenth centuries, the world of cells became more and more visible. Microscopes became more powerful, and scientists observed specimens in greater detail. Over time, microscopes allowed scientists to see the smaller parts that make up cells. The scientists who followed Hooke and Leeuwenhoek used increasingly powerful microscopes to unlock the secrets of cells. In the 1800s three German scientists used the research of those who came before and their own research to draw important conclusions about cells.

### Matthias Schleiden, Theodor Schwann, and Rudolf Virchow

Matthias Schleiden was a botanist, a scientist who studies plants. In 1838, he concluded that all plants are made of cells. Theodor Schwann was a zoologist, a scientist who studies animals. The year after Schleiden reached his conclusion about plants, Schwann concluded that all animals are made of cells.

Now scientists knew that all living things were made of cells, but they still didn't know where cells came from. In 1855 a German physician named Rudolf Virchow discovered the answer. He said that all cells were formed from preexisting cells. Omnis cellula e cellula, he concluded in Latin. "All cells come from cells."

*Schwann would say that this rabbit is made of cells. What would Schleiden say about the carrot?*



### ACTIVE READER

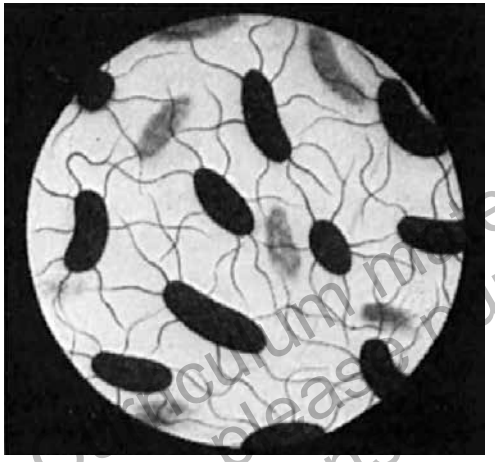
***1 Identify*** *Circle Schleiden's conclusion. Underline Schwann's conclusion. Put parentheses around Virchow's conclusion.*

***2 Extend*** *Which scientist would you like to have been? Why does that kind of science interest you? Do more research on the scientist and share what you find out.*

## The Three Parts of the Cell Theory

The work of Schleiden, Schwann, and Virchow was combined into what has become known as the cell theory. The three parts of the cell theory are:

- All living things are made of one or more cells.
- The cell is the basic unit of life and the smallest living thing that can perform all the functions of life.
- All cells come from cells that already exist.



*Bacterial cells*



### FOCUS QUESTIONS

**1. Explain what the cell theory is in your own words.**

### ACTIVE READER

***1 Analyze*** *Can you connect each scientist to only one part of the cell theory? Why or why not?*

***2 Question*** *A question I still have about cells is...*

### Good to Know

Cells are living things and like other living things, they die. Did you know that about 75 percent of dust is made up of dead skin cells? Every minute, you shed between 30,000 and 40,000 skin cells!

FOCUS

The last part of this chapter gives an overview of types of cells. It also discusses how cells can be organized into tissues, organs, and organ systems.

## Types of Organisms

The cell theory states that the cell is the basic unit of life. Living organisms come in two types: **unicellular** and **multicellular**. Unicellular organisms are organisms that have only one cell. Multicellular organisms have many cells—sometimes trillions, as in humans.

### Unicellular and Multicellular Organisms

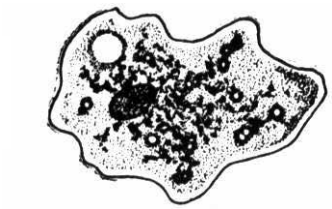
Unicellular organisms include bacteria, the most numerous organisms on the planet. Bacteria are everywhere. They are on land and in water. They live in and on plants. They live in and on animals.

Bacteria are a type of organism called prokaryotes. Most **prokaryotes** are simple, single-celled organisms. The cells of prokaryotes lack a distinct nucleus, or "control center."

Most of the organisms that people have interactions with every day are **eukaryotes**. Animals and plants are eukaryotes. The cells of eukaryotes have a distinct nucleus and many other structures. Eukaryotic cells are much more complex than prokaryotic cells. Eukaryotes can be unicellular or multicellular organisms, though most are multicellular.



*An ameoba is a eukaryote—a unicellular organism.*



ACTIVE READER

***1 Identify*** *Name one unicellular organism and one multicellular organism.*

_____

_____

***2 Analyze*** *Besides the number of cells they have, how do you think unicellular and multicellular eukaryotes might be different from each other?*

_____

_____

_____

_____

## Good to Know

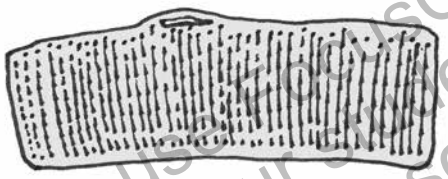
The prefix *pro-* means "early." The prefix *eu-* means "true." The word part karyote means "nucleus." Prokaryotes evolved without a distinct nucleus before the eukaryotes, which have one.

## Cell Specialization

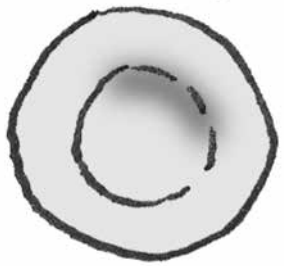
Within multicellular organisms such as animals and plants, cells are different from one another. For example, the human body has skin cells, blood cells, muscle cells, bone cells, nerve cells, and many other kinds of cells. The different kinds of cells are different shapes and sizes. They do different jobs. They all play a part in keeping you alive and healthy.

The cells in multicellular organisms are often organized into tissues, organs, and organ systems. **Tissues** are a collection of cells that work together to perform a specialized job. Bone tissue is made up of bone cells. Nerve tissue is made up of nerve cells. **Organs** are made up of different types of tissues working together; for example, the stomach is an organ that includes muscle tissue, nerve tissue, and blood tissue.

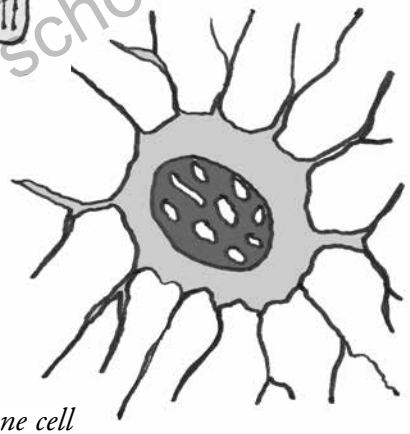
*These are illustrations of only a few of the types of cells in your body.*



*Muscle cell*



*Blood cell*



*Bone cell*



### ACTIVE READER

***1 Identify*** *Underline five types of cells. Circle one type of tissue. Put parentheses around the name of one organ.*

***2 Restate*** *Use context clues to write a definition of the word specialized found in the second paragraph on this page.*

_____

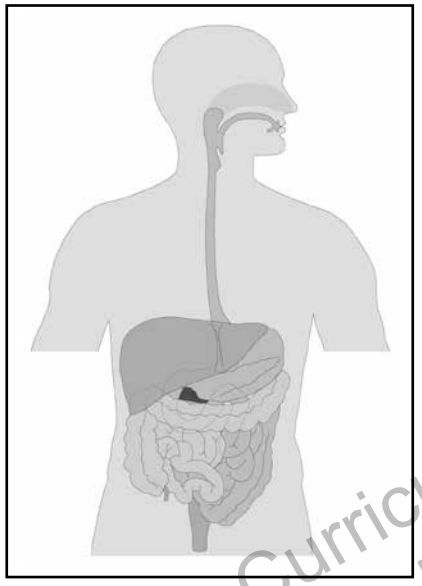
_____

_____

Web Quest

Use the Internet to research more types of cells found in your body.

An **organ system** is a group of organs that work together to perform an important job. The stomach is part of the digestive system, along with the liver, intestines, and other organs. Some other organ systems include the circulatory system, the nervous system, the respiratory system, the muscular system, and the skeletal system.



*The organs of the digestive system include the esophagus, the liver, the stomach, and the intestines.*

*A runner's organ systems work together to support the demands of heavy physical activity.*



## FOCUS QUESTIONS

1. **What is the main difference between prokaryotes and eukaryotes?**

2. **How are tissues and organs different from each other?**

## ACTIVE READER

***1 Identify*** *Name three organs in the human digestive system.*

***2 Extend*** *Think about other organs in the human body. What is one organ in the circulatory system? What is one organ in the respiratory system? What does each do?*

Web Quest

Do research to find out more about one of the organ systems in the human body. What organs are in the system? What is the system's function, and why is it important? Draw a diagram or write a report to show what you learned.

## Stop and Think

This page will help sum up what you have read so far.
Use the tip to help you answer the questions.

**1. Which part of the cell theory explains why a pile of straw cannot change into a mouse?**

(1) The cell is the basic unit of life.
(2) All cells come from cells that already exist.
(3) All living things are made of one or more cells.
(4) All cells work with other cells in an organ system.

**2. Which two scientists are associated with plant cells?**

(1) Anton van Leeuwenhoek and Theodor
(2) Robert Hooke and Matthias Schleiden
(3) Theodor Schwann and Rudolf Virchow
(4) Rudolf Virchow and Anton van Leeuwenhoek

Tip:
Read all the answer choices before making your final decision.

Base your answers to questions 3 and 4 on the statement below and on your knowledge of science.

The cells in multicellular organisms are often organized into tissues, organs, and organ systems.

**3. How are tissues related to organs?** _____

_____

_____

**4. How are how organs related to organ systems?** _____

_____

_____

**Dear Ms. Understanding,**

Microscopes confuse me! Here's an example. I'm looking at this microscopic critter, and he's swimming to the right of the slide. When I move the slide to follow him, he disappears! What's happening?

*Microscope Mike*

**Dear Mike,**

Good question, and here's the answer. Your problem happens because of how microscope lenes work. The glass lenses make everything look reversed. If you want to look to the right, then move the slide to the left. And if you want to know 'what's up?' then move the slide down!

*Ms. Understanding*

# Chapter 2 Inside a Cell

FOCUS

This chapter focuses on cell structures and functions in eukaryotes, in particular, plants and animals. Read this section to find out about the parts that make up a cell.

## Cell Structures

Organisms are unicellular or multicellular. They are prokaryotes or eukaryotes. They can be smaller than a speck of dust or as big as a whale. But all organisms are made up of cells. And each of those cells is made up of smaller parts, or *structures*.

Some of the structures in cells are the same, whether the cell belongs to a housefly or a horse. Other structures are different, depending on whether the organism is a plant, animal, or other kind of organism. Each of the structures within a cell has a job, or function. Some structures produce food. Others store the food and materials like water and waste. Still others release materials to parts of the cell and beyond. By working together, the parts of a cell keep the organism alive and healthy.

*The cells of these two organisms have more in common than you might think.*



ACTIVE READER

***1 Recall*** *How are prokaryotes different from eukaryotes?*

***2 Hypothesize*** *Name one thing you think will be alike about plant and animal cells, and one thing that will be different. Focus your hypothesis on either structures or functions.*

## Entering a Cell

Imagine that you are taking a journey into a cell. How will you get in? Every cell has a barrier that keeps it separate from everything around it. You will have to get through that barrier to see what's inside.

If you want to get inside a plant cell, you'll have to go through the **cell wall** first. The cell wall is a tough, rigid structure. It's made mostly of a material called cellulose. The cell wall protects the cell and gives it structure and shape. Once you get through the cell wall, you have another barrier: the **cell membrane**. The cell membrane is a thin layer made up mostly of protein and fat. Every living cell has a cell membrane. A cell membrane is like a plastic bag with tiny holes in it. It keeps bad things out of the cell, while allowing other substances to come in and go out of it.

Animal cells don't have a cell wall. Instead, they have a **cytoskeleton**, a "framework" inside the cell that gives the cell its structure. (Plant cells also have a cytoskeleton, but it is used for different functions.) Like every living cell, animal cells have a cell membrane. It serves the same purpose as the cell membrane in plants.

Once you have entered a plant or animal cell, you will see a whole world of structures! You will see a **nucleus**, which is directing the whole operation. You will see a variety of other **organelles**. Organelles are the structures that perform specific roles in eukaryotic cells.

### FOCUS QUESTIONS

**1. What structures do all eukaryotic cells have?**

**2. How is entering an animal cell different from entering a plant cell?**

### ACTIVE READER

***1 Identify*** *What does a cell wall do?*

***2 Compare*** *How are a cytoskeleton and a cell wall alike and different?*

***3 Explain*** *How does a cell membrane allow some substances to pass through?*

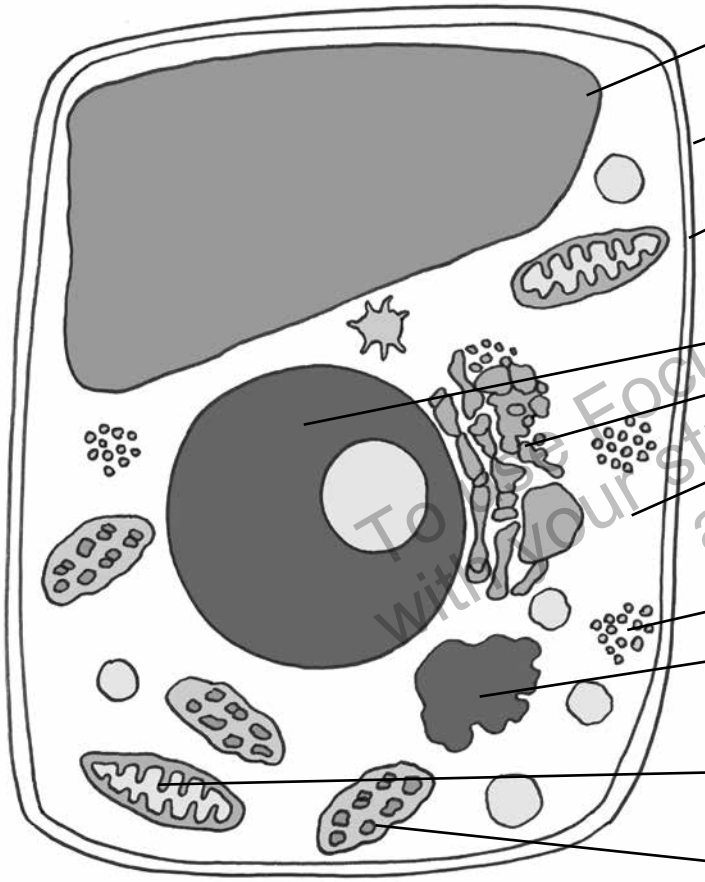
### Good to Know

The cell membrane is also known as the plasma membrane. Organelles means "little organs," because they work like organs to help the body function as a whole.

FOCUS

The diagrams in this section show the structures in a plant and animal cell. The captions explain the function of each structure. Compare the diagrams and then read to learn more.

## Plant Cell



**Vacuole** large sac that stores water, food, waste, and other materials

**Cell wall** rigid wall surrounding cell membrane

**Cell membrane** protects the cell and regulates what enters and leaves it

**Nucleus** directs all cell activities

**Endoplasmic reticulum** passageways that transport materials

**Cytoplasm** jelly-like fluid containing the contents of the cell (excluding the nucleus)

**Ribosomes** produce proteins

**Golgi bodies** process and package substances, send them to other parts of the cell and beyond

**Mitochondria** "powerhouses" that transform energy

**Chloroplasts** get energy from the sun and use it to produce food



### ACTIVE READER

***1 Identify*** *Which organelle is the "control center" of the cell?*

_____

***2 Analyze*** *Why do you think Golgi bodies have been called the cell's "post office"?*

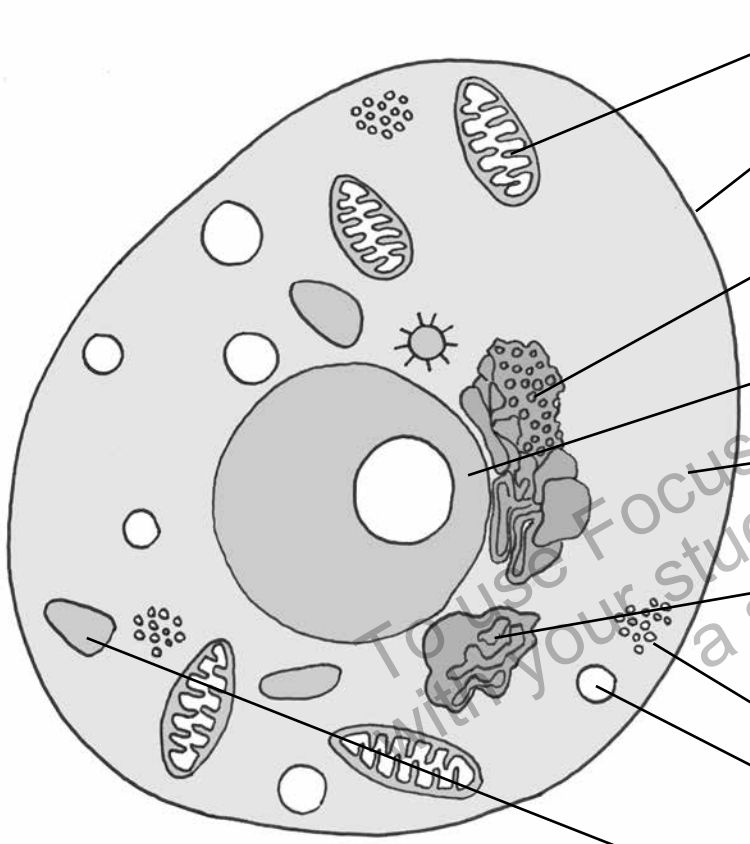
_____

_____

_____

_____

## Animal Cell



**Mitochondria** "powerhouses" that transform energy

**Cell membrane** protects the cell and regulates what enters and leaves it

**Endoplasmic reticulum** passageways that transport materials

**Nucleus** directs all cell activities

**Cytoplasm** jelly-like fluid containing the contents of the cell (excluding the nucleus)

**Golgi bodies** process and package substances, send them to other parts of the cell and beyond

**Ribosomes** produce proteins

**Lysosomes** chemically break down food particles, waste, and unneeded cell parts

**Vacuole** sac that stores water, food, waste, and other materials



### ACTIVE READER

***1 Compare/Contrast***
*How is the vacuole in the animal cell different from the vacuole in the plant cell?*

_____

_____

***2 Analyze*** *Why do you think lysosomes have been called the cell's "garbage disposal"?*

_____

_____

_____

_____

Web Quest

Use the Internet to research why vacuoles are different in plant and animal cells.

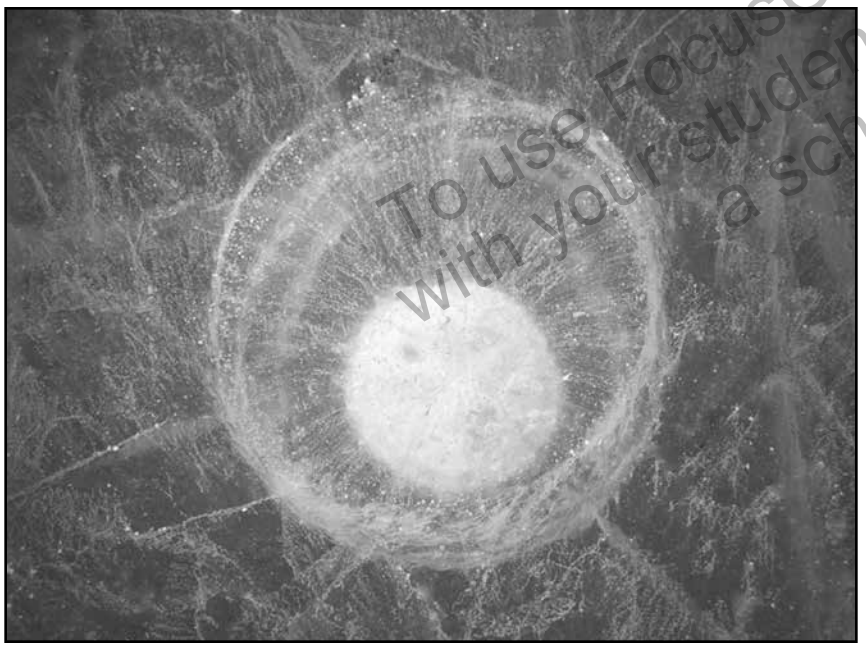
## Continuing the Journey

Imagine that you are continuing your journey through the cell. You have passed through the cell membrane and are inside the cytoplasm. The cytoplasm is a jelly-like fluid that is constantly moving. The organelles "drift around" in the **cytoplasm**.

The diagrams on preceeding pages name the organelles and summarize the jobs they do. Here are a few more details about some of the organelles.

The nucleus is the "brains" of the cell. It stores the cell's hereditary materials and it directs the cell's activities. The nucleus contains smaller parts, including a nucleolus. The nucleolus makes the **ribosomes**, the organelles that produce proteins. You can find ribosomes in many parts of the cell. Some float around in the cytoplasm. Others are attached to the walls of the endoplasmic reticulum.

The **mitochondria** are organelles that change the energy in food into the energy a cell needs to carry out its functions. You will find out more about mitochondria and the work they do in the next chapter.



*Cell nucleus with nucleolus*



### ACTIVE READER

***1 Identify*** *Underline the sentence that tells what a nucleolus does.*

***2 Reflect*** *Which gives you more information about the nucleus, the photograph on this page or the diagrams on the previous pages? Explain your answer.*

_____

_____

_____

_____

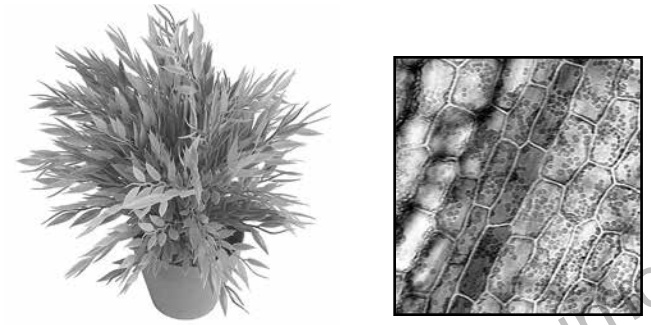
_____

Web Quest

The nucleus of a cell contains parts such as the nucleolus, chromatin, and more. Research the nucleus of a cell. Draw a diagram of a nucleus and label its parts. For each part, write a brief description of its function.

## The Chloroplasts

In addition to the cell wall, there's another sure way to know you're in a plant cell: there are large green structures floating in the cytoplasm. These green structures are **chloroplasts**, and only plant cells have them. Chloroplasts are what make plant leaves green. They are the organelles that take light energy and use it to make food. You will learn more about that process in the next chapter.



*The cells in this plant contain chloroplasts, which can be seen under a microscope.*

### FOCUS QUESTIONS

1. **Explain two ways in which plant and animal cells are different from each other.**

_____

_____

2. **Explain two ways in which plant and animal cells are alike.**

_____

_____

### ACTIVE READER

***1 Extend*** *What is the name of the process in which plants use light energy to make food?*

_____

### Good to Know

Not all plant cells have chloroplasts. Most underground plant cells lack chloroplasts because chloroplasts need light for their development. For example, both potato and onion plants contain parts with cells that grow underground. Can you think of others?

## Stop and Think

This page will help sum up what you have read so far.
Use the tip to help you answer the questions.

**1. If you think of a cell as a city, the endoplasmic reticulum is the**

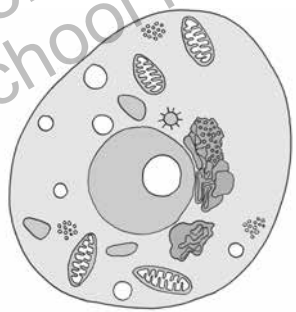
(1) mayor's office.
(2) city streets.
(3) library.
(4) grocery stores.

**2. A cell membrane is important because it**

(1) directs the operation of the cell.
(2) controls what comes into and goes out of the cell.
(3) contains the cell organelles except for the nucleus.
(4) stores water, food, waste, and other cellular materials.

**Tip:**
To answer question 1, look at the diagrams of cells in this chapter and read the description of the endoplasmic reticulum. Then compare its function with the functions described in the answer choices.

The diagrams below show two types of cells. Use them and your knowledge of science to answer questions 3 and 4.



**3. What type of cell is shown at the left? What is one feature that helped you identify it?**

_____

**4. What type of cell is shown at the right? What is one feature that helped you identify it?**

_____

**Dear Ms. Understanding,**

I've heard that the nucleus contains all the hereditary materials for a cell. What does this mean?

*Baffled in Brooklyn*

**Dear Baffled,**

Great question! This means that the nucleus holds all the information needed to make every cell in that organism. The nucleus of every cell contains the exact same hereditary materials.

*Ms. Understanding*

Hands On Science

## Make a Cell Model

Research and create a model of a plant or animal cell. Your cell model should include examples of all the main organelles. It should also include a key that explains what each organelle does.

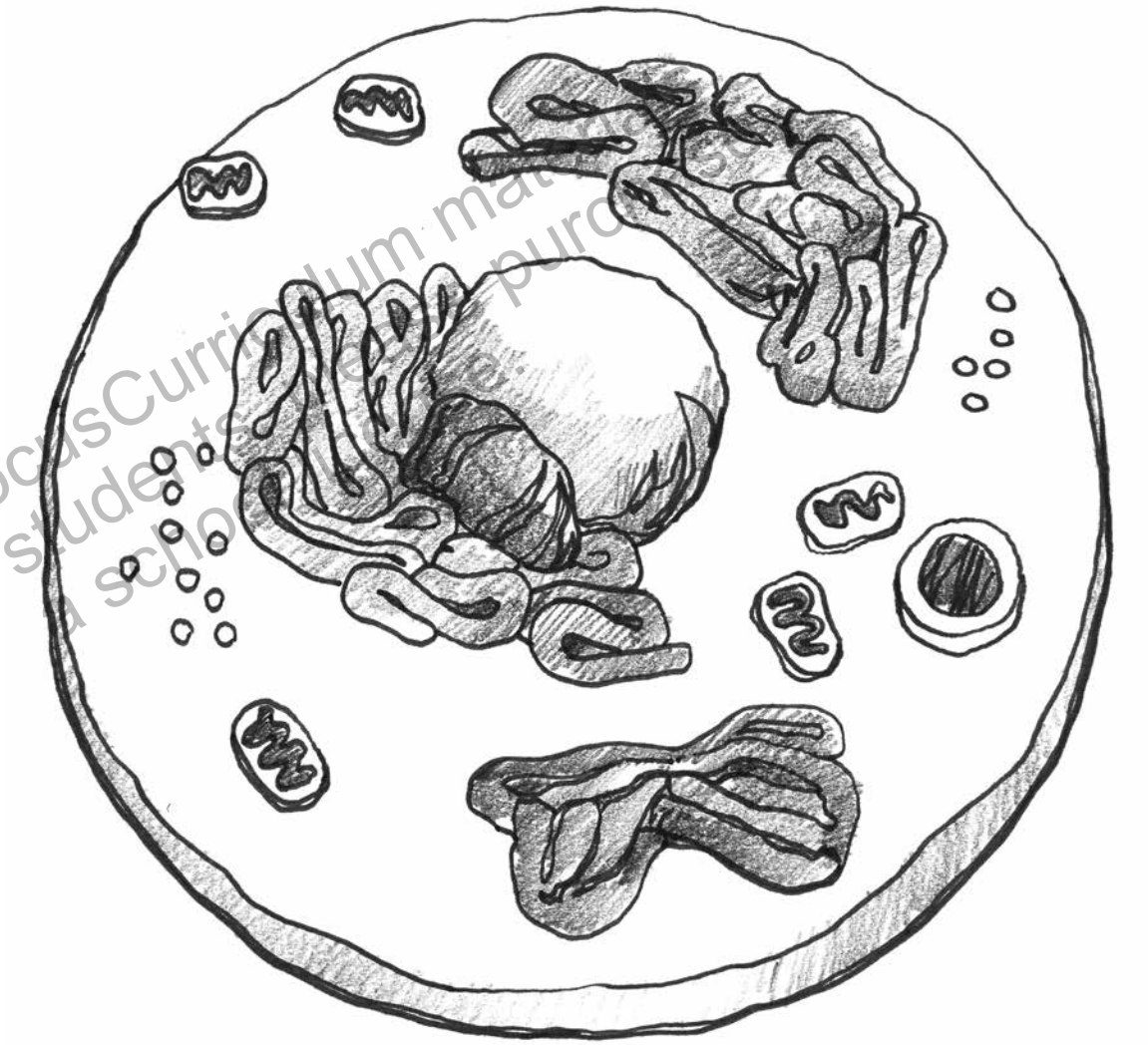
### Materials

scissors, tape, glue, construction paper, coloring pencils or markers, your information about cells (notes or this book).

To make a more elaborate model, use strange or unusual objects for organelles, such as food or other interesting items.

### Procedure

1. Review this book to decide whether you want to build an animal or plant cell.
2. Draw a rough draft of what your cell model will look like.
3. List all the materials you will use to make your model.
4. Gather the materials.
5. Create a key that identifies and tells the function for each organelle or cell part.
6. Build your model. Use it to explain the cell's structures and functions to a friend or family member.



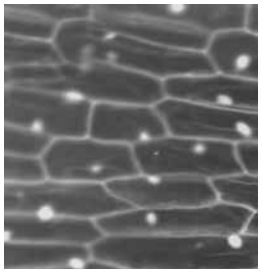
Hands On Science

# Investigate Plant and Animal Cells

Do these microscope labs to compare and contrast plant and animal cells.

## Materials

microscope, clean slides and cover slips, pipettes, iodine solution for staining cells, paper towels, toothpicks, onion pieces, elodea leaves (a simple water plant), forceps (tweezers), labsheet for drawings and answering questions



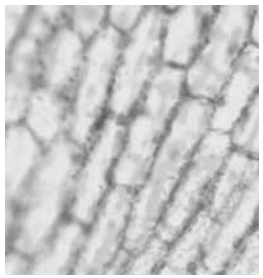
## Part A: Onion Cells

1. Use a prepared onion cell slide or make your own slide of the onion tissue, or "skin." If you make your own slide, use the iodine solution to stain the tissue so that you can see it better under the microscope.
2. Find the stained onion cells under your "search" objective lens, and then change focus to low power. Draw at least 5 cells on your labsheet in the correct circle.
3. Change your magnification to high power and draw at least 2 good cells. In the high power drawing, label the following on one cell: cell wall, cytoplasm, nucleus.

**Answer these questions on the back of the labsheet.**

1. What is the general shape of the onion cell? Is it more round shaped or more square shaped?
2. How can you tell you are looking at a plant cell as opposed to an animal cell?
3. Describe the cell nucleus.





## Part B: Elodea Cells

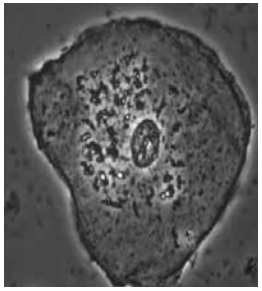
1. Use a prepared elodea cell slide or make your own slide of an elodea leaf.
2. Find the elodea cells under your "search" objective lens, and then change focus to low power. Draw 7–10 cells on your Labsheet in the correct circle.
3. Change your magnification to high power, and look for cells that have actively moving green chloroplasts. You may have to look carefully for this movement. Draw at least 5 of these cells on your labsheet. In the high power drawing, label the following on one cell: cell wall, cytoplasm, green chloroplasts.

**Answer these questions on the back of the labsheet.**

1. What is the general shape of the elodea cell?
2. What is the function of the chloroplasts?
3. Why were no chloroplasts found in the onion cell?

Hands On Science

# Investigate Plant and Animal Cells *(continued)*



## Part C: Human Cheek Cells

1. Make a slide of the tissue cells of your cheek. To do this, put a drop of iodine solution on a slide. Gently scrape the inside of your cheek with the flat side of a toothpick. Stir the toothpick in the iodine stain and throw the toothpick away. Put a coverslip onto the slide.
2. Find the stained cheek cells under your "search" objective lens, and then change focus to low power. Find a set of cells that are not clumped together. Draw at least 5 cells on your labsheet in the correct circle.
3. Change your magnification to high power and draw at least 2 separate cells. In the high power drawing, label the following on one cell: cell membrane, cytoplasm, nucleus.

**Answer these questions on the back of the labsheet.**

1. What is the general shape of the human cheek cell?
2. What organelles can be seen in the cheek cell?
3. What are 3 organelles that are not visible, but should be present in the cheek cell?

Hands On Science

# Investigate Plant and Animal Cells
Labsheet

**Use the circles below on this labsheet to draw what you see.**

## Part A: Onion Cells

*Low power*

*High power*

## Part B: Elodea Cells

*Low power*

*High power*

## Part C: Human Cheek Cells

*Low power*

*High power*

# Chapter 3 Cell Work

**FOCUS** This chapter is about the work cells do to keep organisms healthy and functioning. In the first section, read to find out how cells transport materials.

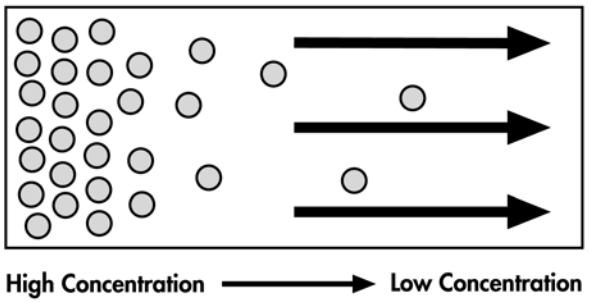
Cells have important jobs to do. They are responsible for obtaining food, creating fuel, building proteins, transporting materials, and getting rid of wastes. Much of the work requires moving materials in and out of the cells by crossing cell membranes.

## Transporting Materials

Materials can be transported across cell membranes in two different ways: **active transport** or **passive transport**. In active transport, the cell has to use energy to move the materials through the cell membrane. Passive transport, on the other hand, doesn't require the cell to use its own energy. You can think of it like this: active transport is like climbing UP a playground slide. Passive transport is like sliding DOWN it.

### Passive Transport

**Diffusion** and **osmosis** are both types of passive transport. In both diffusion and osmosis, small molecules move from an area of high concentration to an area of lower concentration. Have you ever sprayed air freshener into the air? You probably noticed how the scent gradually spread outward from the point where you sprayed it, until the whole room was filled with odor. Or maybe you have put food coloring into a glass of water. At first, the food coloring was one blob of color. But over time, the color spread until all the water was that color. Both of these are examples of diffusion. The molecules in the air freshener and in the food coloring were highly concentrated in one spot at first. Then they moved outward and spread.




*This diagram shows how molecules move from areas of high concentration to areas of lower concentration.*



**ACTIVE READER**

***1 Identify*** *Underline the sentence that names two types of passive transport.*

***2 Analyze*** *Use what you learned about diffusion to give another real-life example of it.*

_____

_____

_____

## Good to Know

Molecules in a substance are always moving. As they move, they bump into each other. The more molecules there are in one area, the more they bump into each other. The collisions make them bounce away from each other. These collisions gradually cause the molecules of a substance to spread out further and further. Finally they reach equilibrium, the point at which they are evenly spaced.

Diffusion occurs in cells through cell membranes, too. Remember, the cell membrane is **semipermeable**; that is, it lets some things through and keeps other things out. The cell membrane allows small molecules like water and oxygen to pass through. Cells need both water and oxygen to survive.

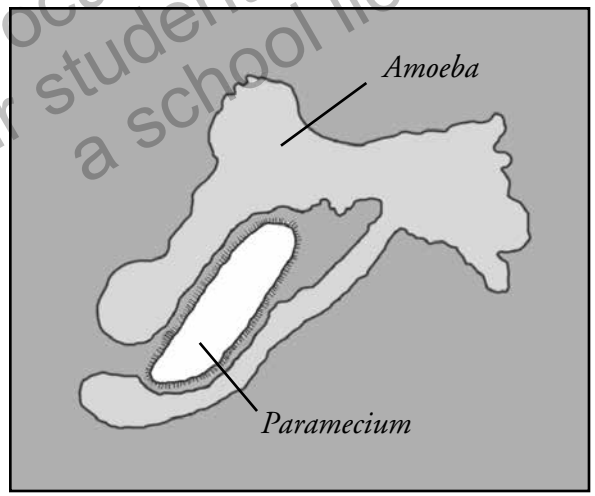
Osmosis is a special type of diffusion. It is the diffusion of water through a semipermeable membrane. Since many cellular processes depend on water, osmosis is a very important form of passive transport.

## Active Transport

As you have learned, in passive transport molecules move across cell membranes from areas of higher concentration to areas of lower concentration. But sometimes cells need to take in substances that are already present in higher concentrations inside the cell. In this case, cells need to use energy. They need to use active transport.

Active transport works in different ways. One way involves *transport proteins*. These "energetic" proteins pick up needed molecules outside of the cell and carry them into cells. They also carry molecules out of the cell. Calcium, sodium, magnesium, and potassium are a few important substances carried by transport proteins.

Another type of active transport is known as *transport by engulfing*. Single-celled amoebas use this process. They simply surround, or engulf, a smaller organism. Then the cell membrane encloses the organism, creating a vacuole in the cell, and devours the organism. The same process happens inside the human body when a white blood cell devours a bacterium.




*This illustration shows an amoeba engulfing a paramecium—a form of active transport.*



### ACTIVE READER

***1 Identify*** *Underline the two forms of active transport.*

***2 Analyze*** *Explain why transport by engulfing takes energy.*

## FOCUS QUESTIONS

1. **How are active transport and passive transport different from each other?**

2. **Explain how the two forms of active transport work.**



Hands On Science

**Egg Osmosis** In this experiment, an egg represents a cell. Follow the procedure below to watch osmosis in action.

**Materials:** two raw eggs, clear containers large enough to hold them, vinegar, corn syrup, water (distilled water works best)

**Procedure:**

1. Carefully place each egg into a container filled with vinegar. The vinegar must cover the egg.
2. After 24 hours, look at your eggs. What has happened?

3. Dump the vinegar and very gently rinse the eggs. Return them to their containers.
4. Fill one container with corn syrup. Fill the other with water.
5. Wait 24 hours again. Look at your eggs. What has happened to each egg? Using the term osmosis, explain why they are different.

FOCUS

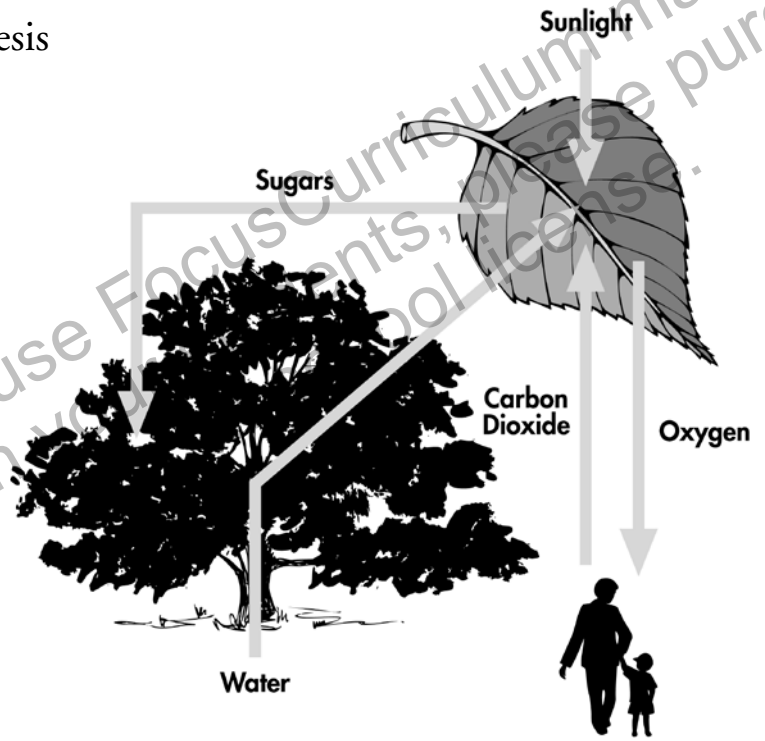
Read the next section to find out how cells convert light into food, and food into fuel.

## Photosynthesis and Cellular Respiration

Cells need energy. During **photosynthesis**, plants get energy from the sun and use it to make food. Plants and animals use the energy stored in food to make a form of energy the cell can use. The process of creating cell energy is called **cellular respiration**.

### Light into Food: Photosynthesis

In Chapter 2 you learned about chloroplasts. These are the organelles in plant cells that are involved in photosynthesis. (Remember—organelles work like little organs to help the whole cell do its job.) Chloroplasts use energy from sunlight to combine carbon dioxide (from the air) with water to make food. The food takes the form of simple sugars like glucose.




*This diagram shows how plants use the energy from sunlight as well as carbon dioxide and water to make food and create oxygen.*



### ACTIVE READER

***1 Identify*** *Underline the sentence that defines cellular respiration.*

***2 Review*** *Chloroplasts are organelles. What are some other organelles found in a cell?*

_____

_____

_____

_____

### Good to Know

The word *photosynthesis* can be divided into two parts: photo and synthesis. *Photo* comes from the Greek *phos* meaning "light;" *synthesis* comes from the Greek *suntesis* meaning "to put together." Photosynthesis puts together, or creates, new substances in the presence of light energy. What other words do you know that begin with the word part *photo*?

## Food into Fuel: Cellular Respiration

Energy is stored in food. However, cells can't immediately use food as fuel. First, they need to convert the energy in food into a form the cells can use. They do this through the process of cellular respiration.

In Chapter 2 you learned about mitochondria. These are the organelles that are used during cellular respiration. Recall that mitochondria are the "powerhouses" that produce energy. Plants and animals both have mitochondria.

How does cellular respiration work? It involves chemical reactions. Most of the chemical reactions happen in the mitochondria. The mitochondria have a good structure for the process. They have an outer membrane and an inner membrane. The inner membrane folds over and over, giving a lot of surface area for the chemical reactions to occur. During cellular respiration, glucose is broken down in the presence of oxygen into carbon dioxide and water. In the process, the energy that was stored in the glucose is released and used by the cell to do work.

In a way, cellular respiration is the reverse reaction of photosynthesis. Photosynthesis uses carbon dioxide and water to produce glucose and oxygen. Cellular respiration breaks down glucose in the presence of oxygen and releases carbon dioxide and water.

*Cutaway diagram of a mitochondrion, an organelle used in cellular respiration*

### ACTIVE READER

***1 Identify*** *What is another word for* glucose?

_____

***2 Analyze*** *How are photosynthesis and cellular respiration alike and different?*

_____

_____

_____

_____

_____

_____

### FOCUS QUESTIONS

**1. In your own words, explain what photosynthesis is.**

_____

_____

**2. What two cell organelles are discussed in this section? What process is each involved in?**

_____

_____

**FOCUS**

The underlined sentence tells why proteins are important in the body. Read this section to find out how the body creates proteins.

## Protein Building

Protein building is one of the most important functions of the cell. That's because proteins are essential to organisms. In the human body, they are responsible for such important work as carrying oxygen in the blood, digesting food, fighting bacteria and viruses, and speeding up chemical reactions, They are even in charge of strengthening your fingernails and hair!

### Structures of Proteins

Proteins are large molecules. They are made up of smaller "building block" molecules called **amino acids**. Although there are only twenty common amino acids, they can be arranged and connected in thousands and thousands of different ways. The specific amino acids used and the ways in which they are linked together determine the kind of protein that is made.

People eat food to get protein sources. Many animal and plant foods contain proteins or amino acids. Some amino acids are called essential because the body cannot make them; they must be consumed in food. Animal protein sources include fish, chicken, beef, pork, dairy products, and eggs. Plant protein sources include beans, peas, soy, nuts, seeds, and grains such as rice. Plant sources often lack one or more essential amino acids; however, when combined with other kinds of plant proteins they can achieve a balance of essential amino acids.

*Proteins come in many different forms. Spider webs and bird feathers are both made of proteins.*



**ACTIVE READER**

***1 Analyze*** *Scientists have compared the 20 common amino acids to the 26 letters of the alphabet. Why is this a good comparison?*

## Good to Know

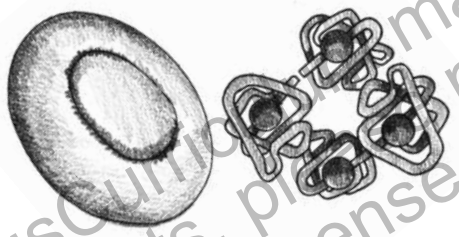
People get protein from food, but the protein in food isn't used directly. During digestion, the food proteins are broken down into amino acids. Ribosomes then assemble the amino acids into proteins the body can use.

## Functions of Proteins

Proteins are the "worker molecules" of the body. They play a part in almost every activity that takes place in the body. Different proteins have different jobs. Some proteins are used to build the structures in an organism. For example, proteins such as collagen and keratin are responsible for forming bones, teeth, hair, and the outer layer of skin. Proteins also help maintain the structure of blood vessels and other tissues.

**Antibodies** are immune system proteins. They fight invaders in the body, such as viruses and bacteria. **Hemoglobin** is the protein that carries oxygen in your blood to all the parts of your body.

Proteins play a key role in the chemical processes that take place in cells. **Enzymes** are proteins that speed up chemical reactions. We could not live without enzymes. They speed up processes that would otherwise take a long time, or could not be done at all. Enzymes play a key role in food digestion, breathing, and just about every other important life process.



*Red blood cells are saucer-shaped cells that contain hemoglobin, which is shown at the right. Hemoglobin is the protein that carries oxygen to the other cells in your body.*



### FOCUS QUESTIONS

1. **What are amino acids, and what are they used for?**

2. **Why are enzymes important?**

### ACTIVE READER

***1 Identify*** *Underline the name of each specific protein described on this page.*

***2 Describe*** *In your own words, describe the work of two of the proteins you underlined.*

## Conclusion

In this book you learned that cells are the basic unit of life. You discovered how plant cells and animal cells are alike and different. You learned about the structures that make up cells and the functions that cells perform. So the next time you eat a slice of pizza or take a run, think about the amazing work every cell in your body is doing.

## Stop and Think

This page will help sum up what you have learned in Chapter 3.
Use the tip to help you answer the questions.

**1. Which of these is an example of diffusion?**

(1) a plant getting energy from sunlight
(2) hair growing up through the scalp
(3) an amoeba devouring a paramecium
(4) the smell of perfume spreading through air

**2. Which type of protein is responsible for speeding up chemical reactions?**

(1) hemoglobin
(2) bacteria
(3) enzymes
(4) antibodies

**Tip:**
If you can't remember the meaning of a new word, check the glossary.

Use the statement below and your knowledge of science to answer questions 3 and 4.

**Material can be transported across cell membranes by way of passive or active transport.**

**3. How does passive transport work?** _____

_____

_____

**4. How does active transport work** ? _____

_____

_____

**Dear Ms. Understanding,**

Why is it called cellular respiration? Are the cells breathing or something?

*Respiring in Ronkonkoma*

**Dear Respiring,**

In a way, the cells are breathing! They are taking in oxygen and giving off carbon dioxide—like we do with our lungs when we breathe.

*Ms. Understanding*

# Glossary

**active transport** – the process by which the cell uses energy to move materials through the cell membrane

**amino acids** – building block molecules that make up proteins

**antibodies** – immune system proteins that fight bacteria and viruses

**cells** – basic structural and functional units of all living organisms

**cell membrane** – the thin layer that encloses the cytoplasm and controls the movement of substances into and out of the cell

**cell wall** – a tough, rigid layer that envelopes most plant cells and is located outside the cell membrane

**cellular respiration** – the process by which the energy stored in food is converted into a form of energy the cell can use

**chloroplasts** – organelles in plant cells that are used during photosynthesis

**cytoplasm** – the jelly-like fluid containing the contents of the cell (excluding the nucleus)

**cytoskeleton** – the framework in animal cells that gives the cell its structure

**diffusion** – the main form of passive transport, in which molecules move from a region of high concentration to a region of lower concentration

**enzymes** – proteins that speed up chemical reactions

**eukaryotes** – complex organisms whose cells contain a distinct nucleus and many other structures

**hemoglobin** – proteins in the red blood cells that carry oxygen to all the parts of the body

**mitochondria** - the "powerhouse" organelles that produce energy

**multicellular** – organisms that have many cells

**nucleus** – the part of the cell that directs the cell's activities

**organs** – parts of the body made up of different types of tissues working together to perform a function

**organ system** – a group of organs that works together to perform a function

**organelles** – structures within a cell that perform certain functions

**organisms** – living things including plants, animals, bacteria, and fungi

**osmosis** – the diffusion of water molecules across a semipermeable membrane

**passive transport** – the process by which the cell transports materials through the cell membrane without using energy

**photosynthesis** – the process in which plants convert sunlight into food energy

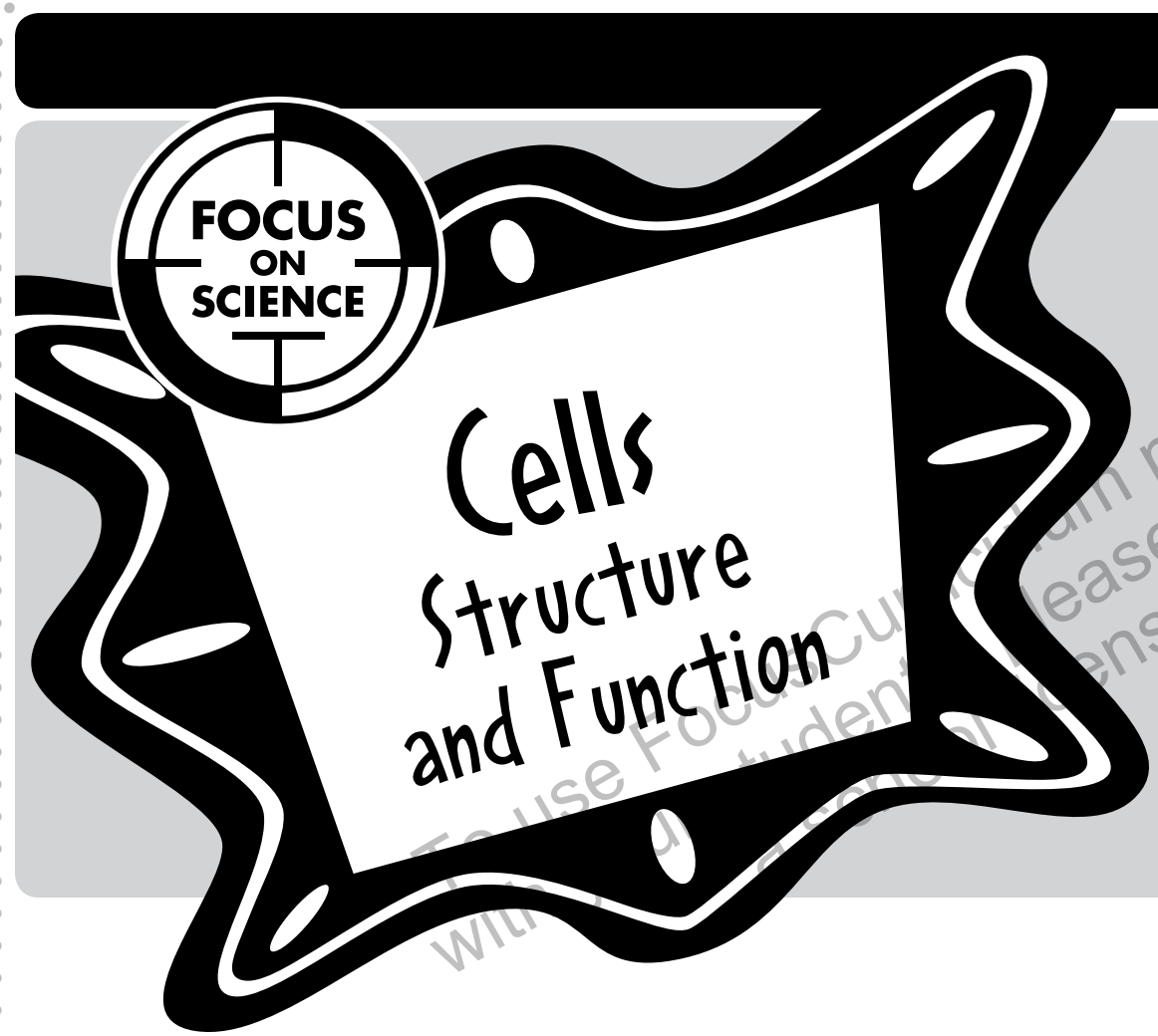
**prokaryotes** – simple organisms that lack a cell nucleus and have very few organelles

**ribosomes** – organelles that produce proteins

**semipermeable** – allowing only certain substances to pass through

**tissues** – collections of cells with a common structure and function

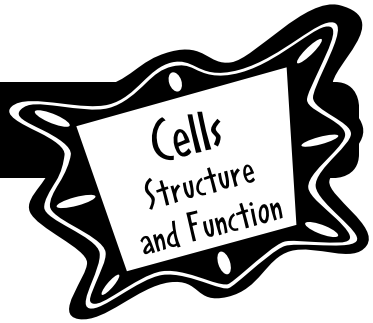
**unicellular** – organisms that have only one cell






# Assessments

# Check Understanding




In the Answer Document on this page, mark your answer in the row of circles for each question by filling in the circle that has the same number as the answer you have chosen.

1. How is active transport different from passive transport?

   (1) Active transport requires energy

   (2) Passive transport requires energy.

   (3) Active transport carries materials into cells.

   (4) Passive transport carries materials out of cells.

2. Which cell structure performs a function for a cell that is similar to the function that the brain carries out for a body?

   (1) vacuole

   (2) nucleus

   (3) chloroplast

   (4) Golgi body

3. What happens during cellular respiration?

   (1) Plants make energy from sunlight.

   (2) Wastes are transported out of the cell.

   (3) Water crosses a semipermeable membrane.

   (4) Food energy is converted into energy cells can use.

4. Which of the following organs is part of the digestive system?

   (1) liver

   (2) heart

   (3) lungs

   (4) brain



**Answer Document**

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1. | ① | ② | ③ | ④ | | 3. | ① | ② | ③ | ④ |
| 2. | ① | ② | ③ | ④ | | 4. | ① | ② | ③ | ④ |

# Check Understanding



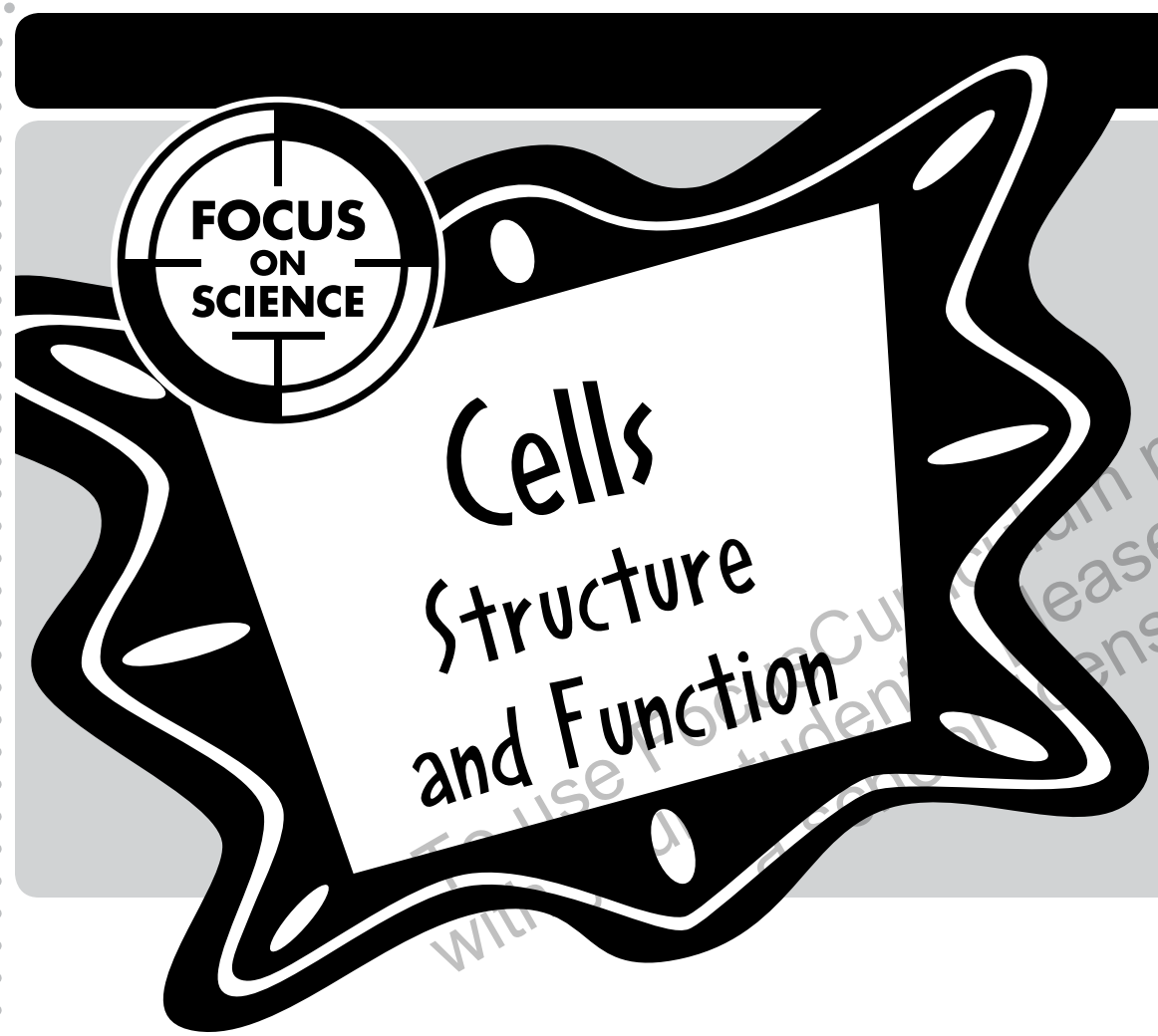
Base your answers to questions 5 and 6 on the photographs below.

Photograph A

Photograph B

5. What process is shown in the photographs?

6. What happened to make the liquid in Photograph A become the liquid in Photograph B?






# Answer Key

# Answer Key

Page 8: Starting Points
Build Background
Use Your Knowledge: Answers will vary according to the student's prior knowledge.
Think About It: Answers will vary according to the student's knowledge and questions.

Page 9: Starting Points
Build Background
Sort It:

| Multi-celled organisms | | Single-celled organisms |
|---|---|---|
| Plants | Animals | |
| rosebush<br>corn<br>pine tree | cat<br>elephant<br>human | bacteria<br>amoeba |

Page 10: Think Like a Scientist
Five Minute Cell Hunt: Answers will vary.

Page 11: Starting Points
Key Vocabulary
Rate Your Knowledge: Answers will vary depending on each student's knowledge.
Use Word Parts to Unlock Meaning: extracellular – outside of the cell; multicellular – having many cells; chloroplast – green structure in plant cells where photosynthesis takes place; cytoplasm – contents of a cell within the plasma membrane (except the nucleus); unicellular – having one cell

Page 12: Starting Points
Key Concepts
Active Reader: 1. Underline: Living things reproduce.
Hands On Science: Make Estimates: Answers will vary depending on the organisms students choose.

Page 13: Chapter 1
Active Reader: 1. Underline: That's because they couldn't see them. They couldn't see them because the technology of the times didn't allow it. 2. Circle: Robert Hooke; England

Page 14: Chapter 1
Active Reader: 1. They read and study the work of other scientists. 2. The phrase "little animals" describes how the bacteria looked to Leeuwenhoek.
Focus Questions: 1. We could neither see nor study cells before the invention of the microscope. 2. Hooke: microscope, plant cells; Leeuwenhoek: blood cells, bacteria

Page 15: Chapter 1
Hands On Science: Learn the Parts of the Microscope: 1. ocular lens; 2. stage; 3. objectives; 4. light source/condenser; 5. fine adjustment knob; 6. Some detail is better viewed at a less powerful magnification.

Page 16: Chapter 1
Hands On Science: Microscope Investigations: Answers will vary.

Page 17: Chapter 1
Active Reader: 1. Circle: all plants are made of cells; Underline: all animals are made of cells; Put parentheses around: all cells were formed from preexisting cells. 2. Answers will vary depending on the scientists chosen.

Page 18: Chapter 1
Active Reader: 1. No. Each scientist built on the work of the others.
Focus Questions: 1. Answers will vary but students' responses should mention the three aspects of the cell theory—all living things are made of cells, single cells are the smallest form of a living thing, and all cells come from other cells.

Page 19: Chapter 1
Active Reader: 1. A bacteria is unicellular. A human is multicellular. 2. They would have different ways of carrying out life functions, including eating and reproducing.

Page 20: Chapter 1
Active Reader: 1. Underline: skin cells, blood cells, muscle cells, bone cells, nerve cells; Circle: bone tissue, nerve tissue; Put parentheses around: stomach; 2. Specialized means particular, not like others.

# Answer Key

Page 21: Chapter 1
Active Reader: 1. esophagus, liver, stomach, intestines; 2. Answers will vary but may include the heart, which pumps blood, and lungs, which transfer oxygen to the blood.
Focus Questions: 1. Prokaryotes do not contain a nucleus; eukaryotes do. 2. Tissues are a collection of cells that perform a specific job. Organs are a collection of various types of tissues that work together.

Page 22: Chapter 1
Stop and Think: 1. (2); 2. (2); 3. Organs are made up of different types of tissues working together.; 4. An organ system is a group of organs that work together to perform a job.

Page 23: Chapter 2
Active Reader: 1. Prokaryotes have no nucleus. 2. Answers will vary but might include similar structures such as a nucleus, ribosomes, mitochondria, and different structures such as the cell wall that is present in plant cells, but not animal cells.

Page 24: Chapter 2
Active Reader: 1. A cell wall protects the cell and gives it shape. 2. A cytoskeleton in animal cells and a cell wall in plant cells both give the cell its structure. Cytoskeleton is present in both plant and animal cells, but a cell wall is present only in plant cells. 3. It has tiny holes that allow some things to pass through.

Focus Questions: 1. All eukaryotic cells have a cell membrane, cytoskeleton, nucleus, and organelles. 2. To enter an animal cell, a substance has to pass through a cell membrane. To enter a plant cell, a substance must pass through a cell wall before reaching the cell membrane.

Page 25: Chapter 2
Active Reader: 1. nucleus; 2. Golgi bodies send substances to other parts of the cell.

Page 26: Chapter 2
Active Reader: 1. The vacuole in the animal cell is much smaller than the vacuole in the plant cell.; 2. Lysosomes break down food particles and waste.

Page 27: Chapter 2
Active Reader: 1. Underline: The nucleolus makes the ribosomes, the organelles that produce proteins. 2. Answers will vary, but the students may point out that the diagram has more explanatory information.

Page 28: Chapter 2
Active Reader: 1. photosynthesis
Focus Questions: 1. Plant cells have a cell wall which is missing in animal cells. They also have chloroplasts for photosynthesis, which animal cells do not. 2. Both plant and animal cells have structures such as a nucleus, nucleolus, and mitochondria. They also both have cytoplasm.

Page 29: Chapter 2
Stop and Think: 1. (2); 2. (2); 3. Sample answers: plant cell: A plant cell has a large vacuole.; 4. Sample answers: animal cell: An animal cell has a very small vacuole.

Page 30: Chapter 2
Hands On Science: Make a Cell Model: Responses will vary.

Page 31: Chapter 2
Hands On Science: Investigate Plant and Animal Cells: Responses will vary.

Page 34: Chapter 3
Active Reader: 1. Underline: Diffusion and osmosis are both types of passive transport. 2. Examples will vary, but could include smoke from a chimney or dish soap in a sink full of water.

Page 35: Chapter 3
Active Reader: 1. Underline: transport proteins, transport by engulfing. 2. Transport by engulfing takes energy because the cell creates a vacuole and devours the organism that has been engulfed.

# Answer Key

Page 36: Chapter 3
Focus Questions: 1. Active transport requires energy on the part of the cell. Passive transport does not require the cell to use any energy. 2. In one form of active transport, proteins carry needed molecules into the cell. In transport by engulfing, the cell surrounds the molecule or single-celled organism and devours it.

Page 36: Chapter 3
Hands On Science: Egg Osmosis: Responses will vary.

Page 37: Chapter 3
Active Reader: 1. Underline: The process of creating cell energy is called cellular respiration. 2. Answers will vary, but students may list lysosomes, ribosomes, mitochondria, golgi bodies, vacuoles, and others.

Page 38: Chapter 3
Active Reader: 1. sugar; 2. Cellular respiration is the opposite of photosynthesis in that glucose is broken down in the presence of oxygen to release carbon dioxide and water. Energy is also released and used by the cell.
Focus Questions: 1. Answers will vary depending on the student's knowledge of photosynthesis. 2. Chloroplasts are involved in photosynthesis. Mitochondria are involved in cellular respiration.

Page 39: Chapter 3
Active Reader: 1. The comparison is good because the twenty amino acids can be combined in many ways to create different proteins just as letters can be combined in many ways to create words.

Page 40: Chapter 3
Active Reader: 1. Underline: collagen, keratin, antibodies, hemoglobin, enzymes; 2. Answers will vary.
Focus Questions: 1. Amino acids are used in combination to create proteins. 2. Enzymes are important because they speed up processes within the body.

Page 41; Chapter 3
Stop and Think: 1. (4); 2. (3);
3. Passive transport. Small molecules move from an area of high concentration to an area of lower concentration.; 4.Active transport: When transport proteins pick up needed molecules outside the cell or by engulfing a smaller organism and devouring it.

Page 45: Assessments
Check Understanding: 1. (1); 2. (2); 3. (3); 4. (1)

Page 46: Assessments
Check Understanding: 5. diffusion; 6. The molecules in the dark liquid moved from an area of high concentration to nearby areas of lower concentration until the dark liquid was diffused throughout the clear liquid.