

**cpo** science







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## Special Thanks

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### **René van Hout** for photos

Johns Hopkins University  
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### **Philip F. Stetkiewicz, Jr.** for photos

Independent photographer

Stock Photography provided by Shutterstock, Inc.

On each page of the student text you will find aids to help find information, understand concepts and answer questions. The following introduction includes sample pages with indicators that point out the page contents and reading aids.

## Unit Pages and Chapter Pages

**UNIT PAGE**

Color that identifies unit →

Unit icon and number →

Topic of unit →

Chapters and titles in unit →

Activity to do at home or school →

Illustration that represents concepts presented in the unit

**UNIT 2**

**Cell Biology**

Chapter 4 *Chemistry and Physics Connections*

Chapter 5 *Cell Structure and Function*

Chapter 6 *Cell Processes*

Chapter 7 *The Microscopic World*

**THIS AT HOME**

Take a magnifying lens home and examine a leaf. First look at the leaf with your normal vision. Sketch a picture of the leaf and identify its structures. Next examine the surface of the leaf with a magnifying glass.

Sketch what you see. Predict what you would see if you looked at the leaf through a powerful microscope. Make a sketch of your prediction.

**Chapter number** →

**Chapter title** →

**Color that identifies unit** →

**CHAPTER PAGE**

**Chapter 5**

**Cell Structure and Function**

Can you name something that you know exists even though you can't see it with your eyes? A drop of pond water has tiny swimming organisms and small bits of plant material, but we can't always see them with our eyes. How do we know there are tiny things in a drop of pond water? We can use a microscope to view the pond water. There are instruments people use every day to help them see things they wouldn't usually be able to see. Have you ever had an X-ray taken of an injury? Do you need to wear glasses or contact lenses to see clearly? Vision systems are even being developed to restore vision to blind people. In this chapter, you will take a journey into a small world that was discovered when the microscope was invented—the world of the cell. Imagine you could shrink yourself and walk into a tiny cell. What is it like inside a cell? It's a fascinating journey!

**Key Questions**

1. What is a cell and how do we know cells exist?
2. Are human cells, animal cells, and plant cells all the same?
3. What is inside a cell, and how is a cell like a cookie factory?

Introduction to the chapter

Thought provoking questions



# Student Text Pages

Section number and title → **5.1 What Are Cells?** ← Short description of what topics are in this section

Main topic on this page → **You are made of cells** ← This illustration will help you understand what you are reading

Large print for important science information → **A cell is the basic unit of structure and function in a living thing.** ← Chapter number and title with icon and color that identifies unit

Main idea of each paragraph is shown here → Each cell carries out the living functions. Each cell in your body shares the characteristics of all living things. Each cell can respond, grow, reproduce, and use energy. Like larger organisms, cells respond to changes in their surroundings in ways that keep them alive. In Chapter 2 we learned that this process is called homeostasis.

Unit number and title → **98 Unit 2 CELL BIOLOGY**

Vocabulary words → **cytoplasm** - a fluid mixture that contains the organelles. It also contains the compounds cells need to survive such as water, salts, enzymes, and other carbon compounds.  
**cytoplasm** - a fluid mixture that contains the organelles and the compounds the cell needs.

The vocabulary box gives you the word and definition →

You will be asked to think about something in the section and write about it in your journal →

**Figure 5.1: Different types of cells found in your body.**

**Figure 5.4: All cells have a cell membrane, organelles, cytoplasm, and DNA.**

**Figure 5.7: These human cheek cells have been stained with methylene blue. How many cells do you see? Can you identify the nucleus in each cell?**

**MY JOURNAL**

Cells are not flat objects like they appear in this text. They are 3-dimensional just like you are. A cell that appears circular on paper is really shaped like a ball.

Find everyday objects that remind you of the different organelles inside of a cell. Collect these objects and make a table listing the object and the organelle it reminds you of.

# Connection Pages and Activity Pages

## CONNECTION

The **Connection** is like a magazine article about an interesting science fact. There is a Connection at the end of each chapter.

Title of the Connection

Main idea heading

Explanation of photo

Unit color and Chapter number

Timeline chart

**Chapter 5 Connection**

### Glow Cell Glow!


**TECHNOLOGY CONNECTION**

You may wear glasses to help you see the chalkboard or to read a book. Sherlock Holmes had his magnifying glass to solve mysteries and to search for clues. Scientists also have their own special looking glass for seeing and *fluorescing* the microscope! Modern day science wouldn't be the same without it. How else would we know about bacteria, viruses, and cells of the human body?

**A brief history of the microscope**

Microscopes are instruments used to magnify objects too small to be seen with the naked eye. The *Janssen* family of Holland invented the first microscope in 1600. This simple instrument was made of glass lenses that were used to make things look larger. In the 17th century, amateur scientist Anton van Leeuwenhoek created a microscope in which tiny organisms could be seen. He used his invention to study pond water and referred to small creatures he saw as "animalcules."

In the 19th century, microscopes became more widely used as their quality increased. Microscopes continued to improve in magnification and clarity during the 19th and 20th centuries.



**Microscope Timeline**

- 1590 - Giovanni Galvani built the first microscope made of two glass lenses.
- 1675 - Anton van Leeuwenhoek created the first microscope in which he saw "animalcules."
- 18th century - Microscopes were used to examine the structure of plants and animals.
- 19th and 20th centuries - Microscopes continued to improve in magnification and clarity.
- Early 20th century - Fluorescent microscopes, invented by Robert Boyle, used light filters and mirrors to produce color images of tiny organisms and structures.
- 1932 - Invention of the electron microscope.
- 1938 - Invention of the scanning electron microscope.
- 1961 - Invention of the transmission electron microscope.

In 1822, the glass-contrast microscope allowed scientists to study colorless materials. In 1938, the electron microscope made it possible to see objects that could never have been seen before. In fact, it allowed scientists to see materials as small as the diameter of an atom! Finally, the scanning tunneling microscope was invented in 1981. This powerful instrument gave scientists three-dimensional images of incredibly small objects.

**Rainbows and wavelengths**

All observations made under the microscope depend on what we see with our eyes. It is important to understand how we see color. The colors of the spectrum (for the rainbow) that are visible to the human eye are shown below.

### The fluorescence phenomenon


In the mid 1800s, the British scientist Sir George G. Stokes discovered a mineral called *fluorapatite*. This mineral glowed when lit with ultraviolet light. The fluorapatite absorbed the UV light and produced a glowing light that is visible to the human eye. Stokes referred to this phenomenon as "fluorescence."

### Development of fluorescent microscope

Scientists in the early twentieth century worked on the development of the first fluorescent microscope. It would take decades until it became perfected and more widely used. Today, the use of fluorescent microscopes is an important tool in cellular biology. Scientists use

**Research with fluorescence**

There are countless ways the fluorescent microscope is used in scientific research. An example is Dr. Thomas Hock, who has been working in the cellular biology field for 28 years. He has worked in a variety of settings, and much of his work has involved the use of the fluorescent microscope. Dr. Hock used fluorescent microscopy early in his career to study disorders related to high blood pressure. Using this tool, he explored how cells of the cardiovascular system move. Dr. Hock also used the fluorescent microscope to study the behavior of cells that make up our immune system. Today, Dr. Hock is a senior staff investigator at Vertex Pharmaceuticals in Cambridge, Massachusetts. At Vertex, he and his fellow scientists use fluorescence microscopy to study new medicines. He explains that he enjoys his work as a scientist because he must be a creative thinker and that each day is never the same.



**Mouse cells stained to show the nucleus and cytoskeleton.**

*Photo by Wey-Je Carlsboom, PhD*


**Questions:**

- How has the development of the microscope progressed over the past several hundred years?
- How are wavelengths related to how we see color?
- How was fluorescence first discovered?
- How is the fluorescent microscope used in cellular biology?

**Chapter 5 Activity**

### Building a Scale Model of a Cell

Cells appear in all shapes and sizes. In animals, cells can be long like the motor neurons that run from the tips of your toes to the base of the neck. Other cells in your body can be small like the red blood cells. Cell models are a good way to help you identify cell structures. Often it is not clear how the size of the cell is related to the size of the organelles. In this activity, you will explore the relationship of cell size to organelle size by creating a scale model.



| Organelle             | Average Size (µm) | Scaling Factor (1 µm = 1 cm) | Model Size (cm) |
|-----------------------|-------------------|------------------------------|-----------------|
| Cell Diameter         | 31                | 31 µm = 1 centim             | 31              |
| Nucleus               | 5                 |                              |                 |
| Mitochondria          | 4-2               |                              |                 |
| lysosome              | 2                 |                              |                 |
| Endoplasmic Reticulum | 5-10              |                              |                 |
| Gold Body             | 7-2               |                              |                 |
| Vacuole               | 2                 |                              |                 |
| X-chromosome          | 10                |                              |                 |

**Applying your knowledge**

- What is the smallest organelle in a typical animal cell?
- What is the largest organelle in a typical animal cell?
- How is your model of the cell different than models the teacher used in class, or models you may see in a text book?
- This method does not apply only to cells. Can you think of other examples where scale models are used?
- How might you build a 3-dimensional scale model of a cell? With a classmate, propose a method for creating a scaled 3-dimensional model of a cell with all the organelles. What types of things could use to represent the cell boundaries? What things might use to represent the organelles? Begin by writing up your ideas in a proposal. Your teacher may ask you to build your model as a project.

**Unit 2 CELL BIOLOGY**

## ACTIVITY

An **Activity** is another hands-on project that you can do in school or at home. This activity will help you learn more about the information in the chapter.

Questions to help you understand the article's main idea

Data table for recording results

Questions to help you apply what you learned from this activity

**Chapter 5 Connection**



## SECTION REVIEW

By answering these questions, you will have a quick check on what you remembered from the section.

# Assessment Pages

## CHAPTER TEST

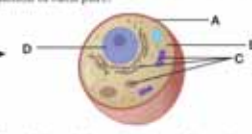
These questions are answered after reading the chapter.

This tells you where to find the information

**CHAPTER 5: CELL STRUCTURE AND FUNCTION**

### 5.1 Section Review

1. What is the basic unit of structure and function in a living thing called?
2. How did the invention of the microscope contribute to our understanding of living things?
3. Who was the first to discover cells?
4. Draw a timeline that shows the dates, discoveries, and scientists involved in the development of the cell theory.
5. What are the four statements of the cell theory?
6. What are specialized cells? List three examples.
7. What are four similarities that all cells share?
8. List the cell part for each letter on the diagram below. What is the function of each part?



**CHALLENGE**

1. Write a paragraph that agrees or disagrees with the following statement: "Muscle cells are completely different than nerve cells." Give the reasons for why you agree or disagree in your answer.
2. Explain three differences between molecules and cells.
3. Conduct Internet research to find out about the largest cell in the world.

**5.1 What Are...**

B. Classify each item below as having prokaryotic or eukaryotic cells.

- a. *Streptococcus*, a bacteria that causes strep throat.
- b. Yeast, a type of fungi use to make bread.
- c. A euglena, a one-celled protist that uses a whip to move around.
- d. *Acidophilus*, a bacteria used to make yogurt.

Graphs, diagrams, or charts will help you in answering questions

This gives you an interesting way to learn more about information in the section

These questions ask you to answer questions in writing or solve a problem

### Chapter 5 Test

#### Vocabulary

Select the correct term to complete the sentences.

|               |                       |              |
|---------------|-----------------------|--------------|
| cell membrane | cytoplasm             | mitochondria |
| cell wall     | cytoplasmic streaming | vacuole      |
| nucleus       | golgi body            | prokaryotic  |
| cytoplasm     | lysosome              | stroma       |

#### Section 5.1

1. Bacteria are \_\_\_\_\_ cells.
2. The \_\_\_\_\_ outside what enters and exits the cell.
3. A structure inside a cell that does a certain job is called an \_\_\_\_\_.
4. The fluid mixture with organelles and other small compounds in cells is the \_\_\_\_\_.
5. Eukaryotic cells all have a \_\_\_\_\_ that contains DNA.

#### Section 5.2

10. Cells can only have one of certain organelles like the nucleus. Which organelles can a cell have many of the same kind? Explain your answer.
11. Which organelle would cause a lot of damage to the cell if it were to break open? Why?
12. Potato cells don't have chloroplasts. If you saw these cells under the microscope, how would you tell that they were plant cells?

#### Section 5.3

4. If you were trying to classify an unknown organism by looking at its cells, what could its cells tell you?

#### Section 5.4

1. Explain the connection between a wilted plant and cell parts like the vacuole and the cell wall.

#### Math and Writing Skills

##### Section 5.1

1. Imagine that you are Anton van Leeuwenhoek and you have just observed the first blood cells, bacteria, and single-celled protists. Write a letter to a friend describing your amazing discoveries.
2. Write an imaginary dialogue that could have taken place between Matthias Schleiden and Theodore Schwann after they observed plant and animal tissue under a microscope.
3. Many of the cells in your body are 0.01 mm long. Use that measurement to complete these calculations.
  - a. An amoeba - a unicellular protist - is 1 mm long. How many body cells would you have to stack end to end to equal the size of an amoeba?
  - b. Figure out what your height is in millimeters by multiplying your height in meters by 1000. How many body cells would you have to stack end to end to equal your height?
  - c. The length of a swimming pool is 25,000 mm. How many body cells would you have to stack end to end to equal the length of the pool?
  - d. Prokaryotic cells are approximately 1/10 the size of eukaryotic cells. How big are prokaryotic cells?

#### Chapter Project

Cells have organelles with many unique jobs like golgi body and endoplasmic reticulum. It is often helpful to have a way to help you remember the names of the structures and their functions. Create a song or poem about cell structure, using the guidelines below. Record the song or poem and play it back for the class or perform it live. If you don't like solo-work, join some classmates and do this as a group project. Make sure everyone contributes verses to the song or poem!

1. Choose one type of cell, either a plant cell or an animal cell.
2. Choose a popular song for the melody or rap. If you create a poem, make the verses rhyme.
3. The song or poem must include each structure listed on the animal or plant cell diagram in your book. In addition to naming the structures, you must use the song or poem to help you remember the function of each structure.
4. Submit your creation for approval, memorize it, and then share the song or poem with your classmates. When it comes time for a written test on cell structure, you might be listening a tune to help you remember the answers!

This gives you a different way of practicing or learning information from the chapter



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