Learning About CELLS

Animal Kingdoms • Cell Organization • Studying Cells
• Cell Analog • Cell Processes • Parts of a Microscope
• Student Labs • Writing • and more

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Welcome to the fascinating world of cells. In this book, you will learn many things about the biology of the cells in your body. If you think about it, you are nothing more than the sum of your cells. You could compare your body to a brick building—the building is the sum of all of its bricks. Each brick is the basic unit of structure of the building. The basic unit of structure in everything living is the cell. The cells in your body perform certain tasks, as you will soon discover.

This book will help you understand the amazing concepts of cytology—the study of cells. You will learn what a cell is, who discovered cells, how the cell theory was developed, the difference between a unicellular and a multicellular organism (living thing), how cells are organized, the parts and functions of the cell, and how and why it is important to study cells. It is important that you remember that the simplest unit of life, the cell, is very complex and an integrated piece of the machinery that makes up all living things and how they work.

As student observers, you will use many scientific process skills to discover the world of cells. The reinforcement worksheets that follow each lesson will serve as follow-up activities for checking understanding. They often contain one higher-level thinking question to stretch your mind.

How about it, student observers, are you ready to put on those thinking caps and use your process skills to observe, analyze, debate, design, and report? This unit contains a variety of lessons that will help you practice scientific processes, as you make new discoveries about cells and gain a better understanding of the microbe world.

Teacher note: This book supports the National Science Education Standards and is designed to supplement your existing science curriculum. Each lesson opens with a manageable amount of text for the student to read. The succeeding pages contain exercises and illustrations that are varied and plentiful. Phonetic spellings and simple definitions for terms are also included to assist the student. The lessons may be used as a complete unit for the entire class or as supplemental material for the reluctant learner. The tone of the book is informal; a dialogue is established between the book and the student.
A cell is often defined as the basic unit of structure in all living things. In other words, all living things are made up of cells. They are the smallest things that can be called “alive.” Most living things are made up of many cells (multicellular) that collectively make up the organism (living thing). A brick building is made up of many bricks, which are its basic units of structure. Cells are like the bricks of a building—they are the building blocks of life. All living things are made up of one or many cells. Depending on their size and complexity, many living things are made up of billions, or even trillions of cells. Cells make up who you are and how you work. Cells make up your blood, bone, skin, nerves, and muscles. Cells carry out all your life processes—they are wonderfully specialized to do certain jobs in different regions of your body. Did you know that there are approximately 200 different types of cells in your body? As an example, do you know what cells cover and protect your body? If you answered skin cells, you are absolutely correct.

Listed below are some of the jobs of the specialized cells in your body:

- Movement of body parts: muscle cells
- Support and protection of body: bone cells
- Sending and receiving of messages: nerve cells
- Fighting disease: immune cells
- Transporting materials to all your parts: blood cells

Some living things are made up of only one cell (unicellular) and carry out all the basic life activities within that single cell. The simplest cells in existence are those of bacteria, which are little containers of DNA. They are so simple they do not even have a true nucleus. You will learn more about bacterium cells in another lesson. The fact that they are so simple does not mean that they are unsuccessful, as they are found everywhere and in enormous numbers.

Living Kingdoms

At one time, all organisms were thought to be plants or animals. The development of the microscope led scientists to the discovery of new living things called microscopic organisms. These newly discovered organisms were too small to be seen with the unaided eye. These microscopic organisms (microbes) were placed into another kingdom. As microscopes improved, scientists learned that all microbes were not the same. Some microbes didn’t have a nucleus or other cell structures, so they were placed into a group of their own. Then scientists looked closer at the cells of fungi and learned that they were not like plants and needed a group all their own. Living things share certain characteristics; for example, all living things carry out basic life activities. However, all living things can be very different. Scientists have divided the world of living things into one of these five main groups, called kingdoms.
1. **Monera** (muh NER uh) – Monera means “alone.” This kingdom has only one kind of organism—bacteria. Bacterium cells are one-celled (unicellular) organisms without a true nucleus; some are able to move about.

2. **Protista** (PRŌH tis tuh) – Protists are mostly one-celled organisms that do have a true nucleus. Some are protozoas (animal-like) and move to obtain food. Others are algae (plant-like) and can make their own food. Some protists are fungus-like and obtain their food from what they grow on.

3. **Fungi** (FUN jī) – are mostly many-celled (multicellular) organisms that have cells with nuclei and cell walls but lack chlorophyll, so they cannot make their own food. They cannot move about. Instead, they absorb their food from whatever they are growing on.

4. **Plants** – are many-celled organisms that have cells with true nuclei, cell walls, and chlorophyll. They cannot move about; they use sunlight to make their own food.

5. **Animals** – are many-celled organisms that have cells with true nuclei but lack cell walls and chlorophyll. They move about in order to eat other organisms.

As new information becomes available, these kingdoms may change again. Some scientists want to add a sixth kingdom to include **viruses**. At this time, viruses are not considered “alive” and have not been placed into any of the kingdoms of living things.
What Are Cells?: Reinforcement Activity

To the student observer: Explain what a cell is. (Be specific in your answer.)

________________________________________________________________________

________________________________________________________________________

Analyze: What is the relationship between the improved microscopes and the discoveries made about cells?

________________________________________________________________________

________________________________________________________________________

Part I. Directions: Complete the following sentences.

1. _______________ are the building blocks of life.

2. The cells in your body are _______________ to do specific jobs.

3. Cells can be _______________ in all parts of your body.

4. Multicellular organisms have _______________ cells.

5. Unicellular organisms have only _______________ cell.

6. Bacteria are the _______________ cells.

Part II. Directions: Match the specialized cells below to their specific job.

_____ 1. Muscle cells A. Cover and protect the body

_____ 2. Bone cells B. Transport materials to all parts of your body

_____ 3. Nerve cells C. Help the parts of your body move

_____ 4. Immune cells D. Support and protect your body

_____ 5. Blood cells E. Help your body fight disease and infection

_____ 6. Skin cells F. Receive and send messages within your body

Part III. Directions: List the five kingdoms (main groups) of living things.

a. _______________ b. _______________ c. _______________

d. _______________ e. _______________
Let's Get Organized!

Cell Organization
You have learned that all living things are made up of one or more cells. This includes plants, animals, and many microbes. **Microbes**, unicellular organisms made up of only one cell, cause many infectious diseases. **Histologists**, scientists who study cells, have learned many new things. They have noticed that cells have tiny structures inside of them. From studying different cells in different organisms, they discovered that many of these structures are typically found in all cells.

**Organelles**
Scientists named the tiny organs inside the cell **organelles**. Each organelle performs specific functions for the cell. The cell works in much the same way as a busy manufacturing plant. Anything that works, works best if someone is in control. Most things that work need energy to keep things humming along. A cell, like a manufacturer, transforms simple materials into complex substances and packages them to be delivered where they are needed. These are just a few of the responsibilities of various cell organelles. Organelles are the many tiny parts within a cell that make the cell run smoothly and keep it alive.

**Cells**
In multicellular organisms, histologists learned that certain cells that did the same job were similar in their size and shape. As an example, nerve cells are like telephone wires inside your body. They carry messages to all parts of the body by an impulse. They are all long and thin and do the same job. Nerve cells make up nerve tissue. A group of cells that are similar and act together to do a certain job make up a larger part of your body called **tissue**.

**Tissue**
A **tissue** is a group of similar cells that work together to do the same job. Each cell in a tissue does its part to keep the tissue alive. For example, muscle cells are joined together to make muscle tissue. These tissues include leg muscles, arm muscles, and your heart muscle. Cells in your muscle tissue work together to make your body move. You have four main kinds of tissue: muscle tissue, covering tissue, connective tissue, and nerve tissue. Tissues in your body that are similar and do the same job are organized into a somewhat larger part of your body called **organs**.

**Organs**
An **organ** is a structure that is made up of two or more different types of tissue that work together to do the same job. An organ is the main working part of plants and animals. Each organ does a specific job to make all your systems run smoothly. Your heart is an organ made up of muscle tissue, nerve tissue, and blood tissue. The heart is made up of muscle tissue that contracts, making the heart pump blood. The nerve tissue receives messages from your body that tells the heart how fast to beat or pump the blood. Your body has many organs: stomach, kidneys, and brain to name a few. A group of organs working together to perform a certain job make up an **organ system**.
Organ Systems

A group of similar organs doing the same job make up an **organ system**. Your heart, arteries, veins, and capillaries make up your circulatory system. In many-celled organisms, several systems work together in order to perform life functions efficiently. You have various systems that work together to keep you alive. Organelles make up your cells, your cells make up your tissues, your tissues make up your organs, and your organs make up the systems that keep you alive. You have seven main systems: skeletal, muscular, digestive, circulatory, respiratory, excretory, and nervous.

**EXAMPLES OF THE WAY CELLS ARE ORGANIZED IN THE BODY**

- **Cell** → **Tissue** → **Organ**
- Muscle cell → Muscle tissue → Heart
- Circulatory system (heart, veins, arteries) → The human body
To the student observer: Cut out the terms and arrows on the next page and arrange the terms with an arrow between them so they make the most sense. Hint: Since there are only five arrows, you will only use six terms. One term will be left out.

Directions: When you have a satisfactory arrangement, write the words and draw the arrows in the correct arrangement in the spaces provided.

_________________  __________________  __________________
_________________  __________________  __________________

Analyze: Which term did you leave out? How did you arrange the terms and why?

________________________________________________________________________
________________________________________________________________________

Directions: Complete the following sentences.

1. ________________ are the tiny parts inside a cell.

2. ________________ that do the same job are similar in size and shape.

3. Similar cells that work together make up ________________.

4. A(n) ________________ is a structure made up of two or more different types of tissue.

5. A group of similar organs doing the same job make up a(n) ________________.

6. List the seven main systems that work together to make up a human being.
   a. ________________
   b. ________________
   c. ________________
   d. ________________
   e. ________________
   f. ________________
   g. ________________

7. List the four main types of tissue found in your body:
   a. ________________
   b. ________________
   c. ________________
   d. ________________
Let’s Get Organized!: Cell Organization Cards

- MOLECULES
- SYSTEMS
- ORGANELLES
- TISSUES
- CELLS
- ORGANS
- ORGANISMS
The History of Cells

Pioneers in Cells

We now know the basic unit of all living things is the cell, just as the atom is the basic unit of matter. It was the work and dedication of several scientists that has led us to the place we are today. Some say our time may be looked back upon as the golden age of biology. The reason for this is the fact that the molecules of life can now be analyzed by new techniques to determine their roles and structures in the cell. We have learned many things that have enhanced our understanding of the cause of disease. The effects of this ongoing explosion of knowledge still remain to be seen.

Discovery

The first person to see cells, the building blocks of life, was an English scientist, Robert Hooke. In 1665, he used one of the earliest microscopes to view thin slices of cork. Cork is found in some plants. The first cells observed were no longer living. Hooke found that cork was composed of a honeycomb of hollow chambers that he called cells. What he saw in the microscope was actually the spaces in the cork where cells once lived. Hooke decided to call the hollow structures cells because they reminded him of the small rooms in which monks slept.

Anton van Leeuwenhoek (AN tun van LAY vun hook) was one of the earliest and most successful observers of cells. He was the first person to observe living cells. He observed single-celled organisms swimming about in a drop of pond water. He used a simple microscope that he had made, using a tiny bead for a lens. He manufactured over two hundred simple microscopes that allowed him to observe the wonderful world of tiny “animalcules.” These microbes are now known as bacteria and protozoans.

The Cell Theory

By the 1800s, better microscopes were being made, and scientists had many ideas about cells. Their ideas were put together into a theory, an idea that is consistently supported by data. The credit for the theory goes to two German scientists, Matthias Schleiden, a botanist (one who studies plants), and Theodor Schwann, a zoologist (one who studies animals). Schleiden discovered that plants were made up of cells, and Schwann reported the same to be true of animals; this discovery led to the first part of the Cell Theory. Together they hypothesized that all living things are made up of cells; this was the second part of the Cell Theory. Several years later, Randolph Virchow, a German doctor, hypothesized that cells didn’t just form on their own. He believed that cells divide from existing cells to form new cells. This led to the third part of the Cell Theory. The Cell Theory is one of the major theories in science. It is not based on the hypotheses and observations of only one scientist but is the result of the discoveries of many scientists. Today, the Cell Theory serves as the basis upon which histologists (scientists who study cells) have built their ongoing explosion of knowledge and information in cell biology.

The Cell Theory states that:

- All organisms are made up of one or more cells.
- Cells are the basic units of structure and function in all organisms.
- All cells come from other cells that already exist.
The History of Cells: Reinforcement Activity

To the student observer: List the pioneers in the study of cells.

_________________________________________________________________
_________________________________________________________________
_________________________________________________________________
_________________________________________________________________

Analyze: Do you believe the cork that Hooke observed could produce new cells? Explain.

_________________________________________________________________
_________________________________________________________________
_________________________________________________________________

Directions: Complete the following sentences.

1. ______________________ are the building blocks of life.

2. ________________________ was the first person to see cells.

3. The first cells observed were dead cells in thin slices of ________________.

4. ________________________ was the first person to observe living cells in a drop of pond water.

5. The __________________________ is one of the major theories in science.

6. The work of ____________________, ____________________, and _____________________ led to the development of the Cell Theory.

7. ______________________ are scientists who study cells.

8. List the three parts of the Cell Theory.
   a. ___________________________________________________________________
   b. ___________________________________________________________________
   c. ___________________________________________________________________
What Are Cells?: Reinforcement Activity (p. 4)
To the student observer: Any logical answer; teacher check.
Analyze: As microscopes improved, we learned more about cells.
Part I
1. Cells 2. specialized 3. found
4. many 5. one 6. simplest
Part II
Part III
a. Bacteria or Monera  b. Protista
c. Fungi  d. Plants
e. Animals

Let's Get Organized!: Reinforcement Activity (p. 7)
To the student observer: Any logical answer; teacher check.
Analyze:
Organelles → Cells → Tissue → Organs → Systems → Organisms
Molecule is not used. I organized them from smallest to largest. **Students may reverse the order, working from largest to smallest.
1. Organelles 2. Cells 3. tissue
4. organ 5. system
6a. Skeletal system  b. Muscular system
c. Digestive system  d. Circulatory system
e. Respiratory system  f. Excretory system
g. Nervous system
7a. Muscle tissue  b. Covering tissue
c. Connective tissue  d. Nerve tissue

The History of Cells: Reinforcement Activity (p. 10)
To the student observer: Any of these: Anton van Leeuwenhoek, Theodor Schwann, Matthias Schleiden
Analyze: No, the cork was no longer living. Only living cells can make new cells.
1. Cells 2. Robert Hooke
3. cork 4. Anton van Leeuwenhoek
5. Cell Theory
6. Schleiden, Schwann, Virchow
7. Histologists
8a. All organisms are made up of one or many cells.
b. Cells are the basic units of structure and function in all organisms.
c. All cells come from other cells that already exist.

What Is a Microscope?: Reinforcement Activity (p. 14)
To the student observer: To look at very small things; micro means “very small,” and scope means “to look at.”
Analyze: You see less of the object in your field of view, but you see greater detail. It zooms in the image.
1. It has two or more lenses.
2. 550X; multiply 10 x 55 = 550
3. Compound light microscope
4. A convex lens curves outward.
5. An electron microscope
6. A stereoscope microscope

The Parts of a Microscope (p. 16)
A. Eyepiece – contains the lens you look through; the top part of the microscope.
B. Body tube - Light passes through this hollow tube; it also maintains the correct distance between the eyepiece lens and the objective lens.
C. Nosepiece – (revolving) holds the objective lenses and rotates to change the magnification.
D. Objective lenses – usually from 10X to 40X magnification; located on the nosepiece.
E. Stage – supports the object (microscope slide) being viewed.
F. Stage clips – hold the microscope slide in place.
G. Diaphragm – changes the amount of light that enters the body tube
H. Mirror or light source – is used to send light up through the hole in the stage, the object, and the lenses.
I. Coarse adjustment knob - turns to raise and lower the body tube or stage for focusing; always use this knob first.
J. Fine adjustment knob – moves slightly and is used to sharpen the image.
K. Arm - supports the body tube and is used to carry the microscope.
L. Base - supports the microscope and is used to carry it; the bottom part of the microscope.

Microscope Quiz (p. 17)