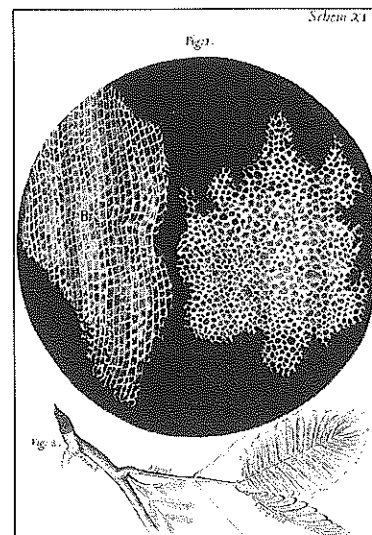


# Review 9

## Structure and Function in Organisms

In the mid-seventeenth century, Robert Hooke peered through his microscope at a very thin slice of bark from a cork tree. He saw tiny little chambers arranged next to each other. These reminded him of the small cells in which monks lived, so he called them **cells**. The image to the right is the first drawing showing the cells in an organism, drawn by Hooke. The discovery of the cell changed the way scientists thought of life. They had thought that four fluids, called humors, combined to make all the parts of organisms. After Hooke's discovery, however, scientists learned that all organisms are composed of cells. This review looks at how these little machines of life organize themselves to form the complex systems of living things.

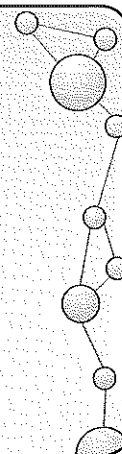


### Words to Know

cell  
cell membrane  
cell theory  
cell wall  
chloroplast  
chromosome  
cytoplasm  
endoplasmic  
reticulum

hormone  
menstrual cycle  
mitochondrion  
mitosis  
nuclear  
membrane  
nucleus  
organ  
organ systems

organelle  
ovum  
ribosome  
sperm  
tissue  
vacuole  
vertebrate



## Word Links

Look at the "Words to Know" list on the previous page. Circle three words that you don't know or that you want to learn more about. Then, on a separate piece of paper, write each word and what you think each word means.

## Cell Theory

Today we believe that our bodies are made almost entirely of cells. It wasn't always so. Here is a brief history of how **cell theory** developed.

- In 1665, Robert Hooke used a microscope to view slices of cork wood. He saw tiny structures that he thought looked like monks' cells.
- In 1838, Matthew Schleiden said that plants are made almost entirely of cells.
- In 1839, Theodor Schwann argued that animals, too, are made almost entirely of cells.
- And in 1855, Rudolf Virchow claimed that all cells come from other cells.

So, modern cell theory says three main things:

1. the cell is the basic unit of structure and function for life;
2. all organisms are made up of one or more cells; and
3. only cells can produce other cells.

When Theodor Schwann published his work on cells in 1839, he argued that cells could appear out of disorganized raw materials. In other words, he claimed that cells formed by spontaneous generation. Explain why this claim is at odds with modern cell theory.

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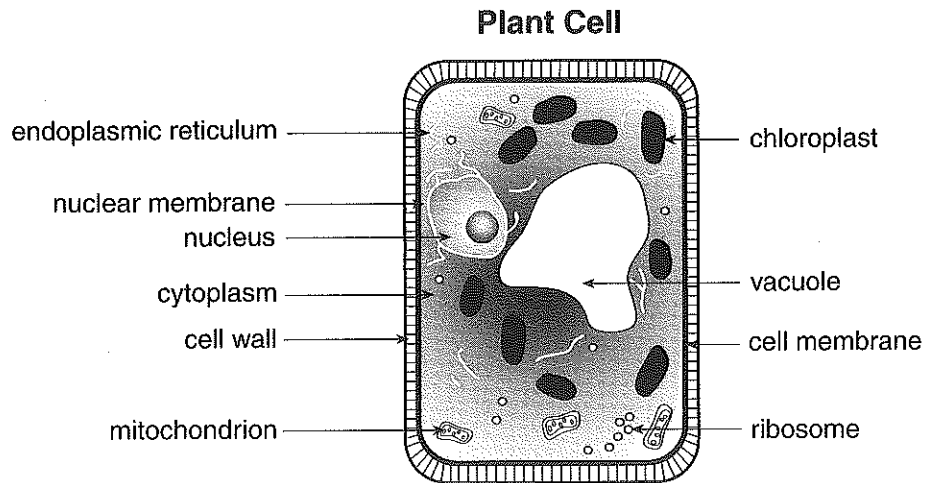
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## Cells

The cells of organisms more complex than bacteria contain many tiny structures called **organelles**. Each organelle has a special form and purpose in the operation, maintenance, repair, and reproduction of the cell. The basic parts of a plant cell are shown in the following diagram.



The following list briefly explains the function of each labeled component.

**Endoplasmic reticulum:** transports materials within the cell

**Nuclear membrane:** encloses and protects the nucleus

**Nucleus:** control center for all cell activity; contains **chromosomes**, which carry the genes for an organism's traits

**Cytoplasm:** clear, thick fluid that holds and supports the cell components

**Cell wall:** the outer, nonliving cellulose structure that helps the plant cell keep its shape

**Mitochondria:** organelles that release energy to support all cell activity

**Chloroplasts:** organelles that contain chlorophyll used by plants in photosynthesis

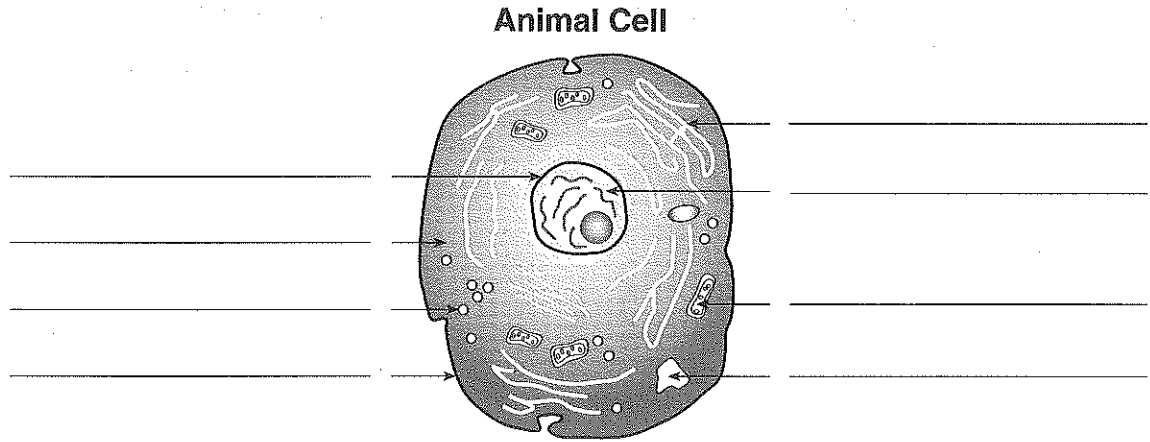
**Vacuoles:** cavities inside the cytoplasm that contain fluid and pigment (coloring)

**Cell membrane:** semipermeable membrane that controls movement of molecules in and out of the cell

**Ribosomes:** organelles that contain the enzymes that help produce proteins

## Sunshine State Standards: SC.F.1.3.3

Animal cells have a lot in common with plant cells. Use the list of plant cell components to label the following animal cell. (Two components of plant cells are not found in animal cells.)



Why don't animal cells need chloroplasts?

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Why is it important for plants to have cell walls? (Hint: Do plants have skeletons?)

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## Mitosis

In **mitosis**, one cell becomes two cells that are identical to each other and to the original cell. Unicellular organisms use mitosis to reproduce. Multicellular organisms use mitosis to grow and to repair damaged cells. Your skin cells, for example, are constantly undergoing mitosis to replace dead or damaged skin cells. When a cell undergoes mitosis, each new cell must have the same number of chromosomes as the original cell. For this reason, each chromosome of the original cell must be duplicated before the cell divides.

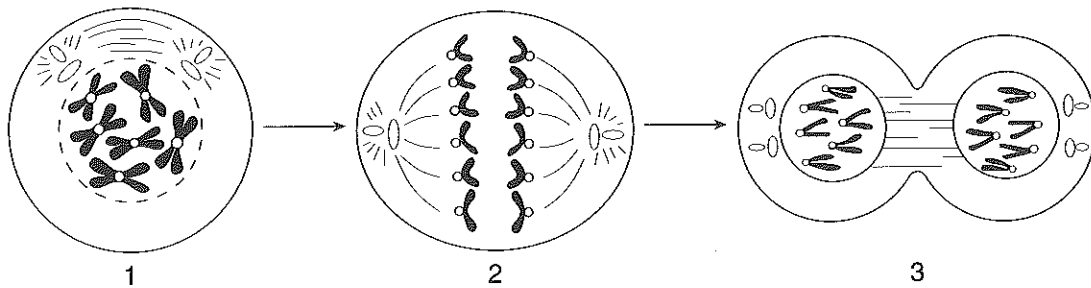
What might happen to a new cell if it did not have the same number of chromosomes as the original cell?

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The following diagram shows three stages of mitosis in a cell with six chromosomes. In the first stage, the six chromosomes have already been duplicated. In the second stage, the nuclear membrane breaks down and the two sets of chromosomes are pulled to opposite sides of the cell. In the third stage, the cell membrane pinches inward and splits one cell into two cells. After the cell divides, each new cell develops a new nuclear membrane to protect the chromosomes.



In the example above, how many chromosomes does each new cell have?

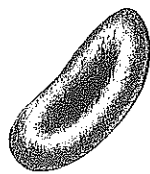
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A human cell has 46 chromosomes. If a human cell undergoes mitosis, how many chromosomes will each new cell have?

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## Types of Cells

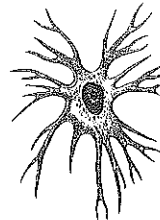
In the human body, different types of cells perform different functions. The following illustration shows four types of cells.



red blood cell



muscle cell



nerve cell



skin cell

- Red blood cells pick up molecules of oxygen from the lungs and carry them to other cells in the body. After red blood cells drop off their oxygen molecules, they are circulated back to the lungs to pick up more.

Sunshine State Standards: SC.F.1.3.1, SC.F.1.3.4

- Muscle cells vary in shape, depending on the jobs they perform. For example, the muscles that help you move your skeleton are rod-shaped. The muscles in the walls of some organs are spindle-shaped, which means that they taper at the edges.
- Your top layer of skin is made of dead skin cells that are constantly flaking off and in need of replacement. Below the top layer of dead skin cells are living skin cells that are constantly undergoing mitosis and pushing their way to the top.

Identify the type of cell that performs the described function.

Separates your inner environment from the outer environment: \_\_\_\_\_

Carries gases to and from other cells: \_\_\_\_\_

Part of a tissue that helps you carry your books: \_\_\_\_\_

The shape of a cell is related to the job it performs in the body. For example, red blood cells are flat and have the depression in the center so they will have more surface area. This makes it easier for them to carry and exchange gases.

The function of a nerve cell is to communicate with other cells. What feature of the shape of a nerve cell would make this job easier?

\_\_\_\_\_  
\_\_\_\_\_

## Tissues, Organs, and Organ Systems

The following descriptions will focus largely on the human body. However, much of what we say about the human body also applies to many **vertebrates**—that is, animals with backbones. Vertebrates include fish, amphibians, reptiles, birds, and mammals.

Cells that do the same job work together to form body **tissues**. Each body tissue is made of a specific type of cell that has a particular function. For example, muscles are made of muscle cells that have the ability to contract and relax. Groups of tissues form **organs** with specific functions. Organs, in turn, work together in **organ systems**. Each function that humans and most other animals must do to stay alive (breathing, eating, thinking, and so on) is made possible by groups of specialized cells arranged into tissues, organs, and organ systems.

Order the following from least to most complex: organ, organ system, organelle, tissue, cell, vertebrate.

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What is the difference between an organelle and an organ?

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Now, let's turn to the organ systems at work within the human body.

### **The Muscular, Skeletal, and Nervous Systems**

As you study organ systems, you'll notice that you can't think about one system without thinking about at least one other system, too. The systems are closely related, and the body depends on them all working well together.

In the muscular system, for example, individual muscle cells in muscle tissues contract and expand to perform a function. But the muscular system is helpless without the skeletal system. The skeletal system houses and protects important muscles. It also gives the muscular system a framework with which it can move the body. The nervous system controls the actions of the muscular and skeletal systems, allowing us to direct our movements. The nervous system also controls the flow of information in the body, processing all of the stimuli that come in from the senses.

Describe a muscle movement that you can directly control (is voluntary).

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Now describe a muscle movement that you cannot directly control (is involuntary).

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### **The Digestive System**

The digestive system begins with the jaws, teeth, and tongue. As the jaws and teeth grind up the food, salivary glands in the tongue start breaking it down into molecules that the body can use. The esophagus takes the food to the stomach, where acid breaks it down into liquid. This liquid moves to the small intestine, which extracts from the liquid as many nutrients as it can. The liver also plays a role in the digestive process by breaking down fats.

Part of digestion is the breaking down of the food into smaller molecules. Another part of digestion is the absorption into the bloodstream of the simpler food molecules. In which organ does the absorption take place?

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## The Circulatory System

The heart, the blood, and the blood vessels make up the circulatory system. The circulatory system works closely with the respiratory system, which consists of the windpipe and the lungs. What is the relationship between the two systems? To get energy from food nutrients, all cells need a constant supply of oxygen. The process that releases this energy makes carbon dioxide, a toxin that we must get rid of. The circulatory and respiratory systems work together to supply oxygen to and remove carbon dioxide from the blood.

Aurelie claims that the heart belongs to the circulatory, respiratory, and muscular systems. Is she correct? Explain your answer.

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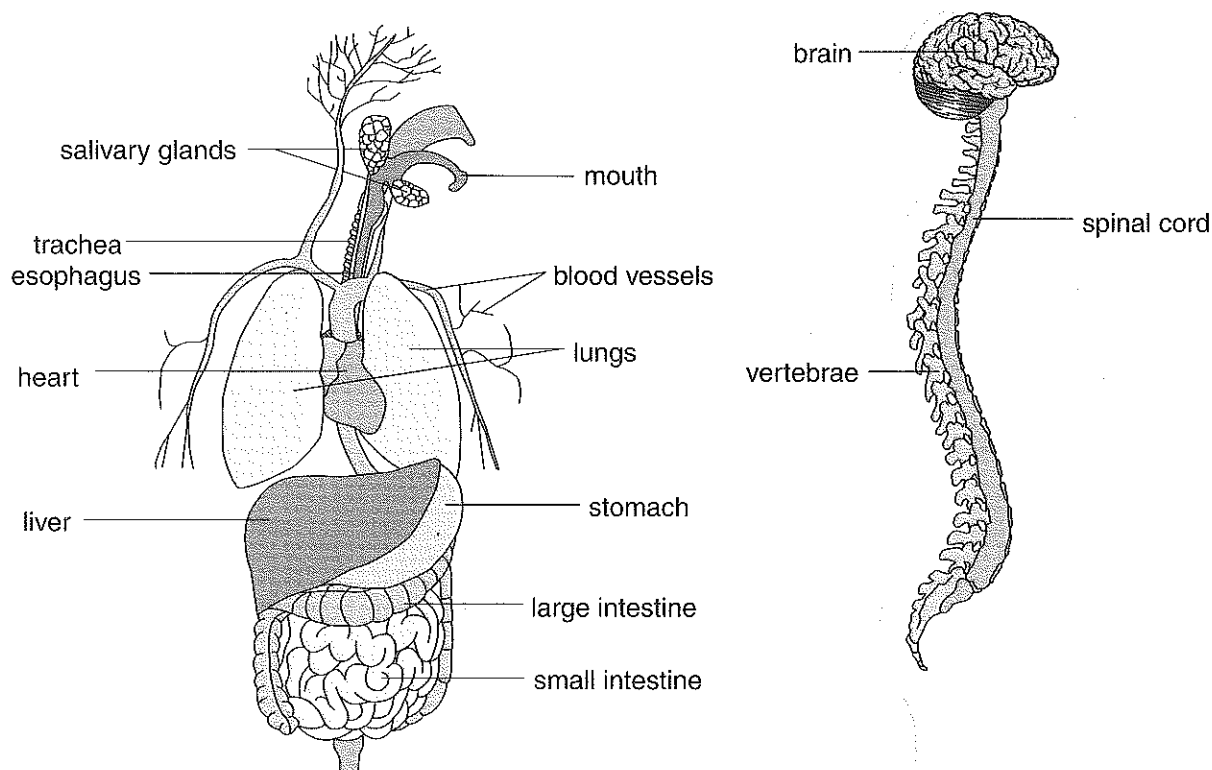
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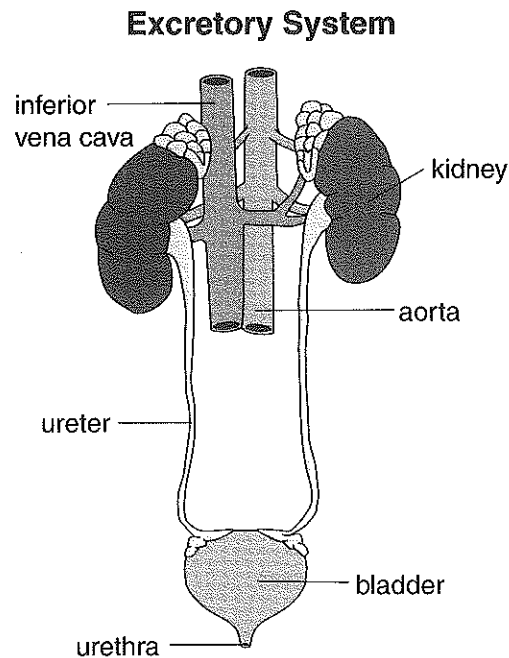
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## The Excretory System

Wastes from the digestive and circulatory systems are gathered by the excretory system and discharged from the body. The main organs involved in excretion are the kidneys. The kidneys bring in and filter toxic substances from the blood. The filtered blood is released back into the body, and the unwanted substances turned into a liquid called urine. The ureters carry urine from the kidneys to the bladder, where it is stored until it can be released.



How are the digestive system and excretory system related?

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Give another example of related body systems, and explain how they are related.

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## The Nervous and Endocrine Systems

The endocrine and nervous systems are another pair of systems that work closely together. The endocrine system is controlled by the hypothalamus, a part of the brain that controls the glands that produce hormones. **Hormones** are chemicals that travel in the bloodstream to different parts of the body. Hormones have many functions: They stimulate growth, regulate body temperature, help with digestion, and so on. Among other glands, the hypothalamus controls the pituitary gland. The pituitary gland is sometimes called the “master gland” of the human body because it produces so many different kinds of hormones.

The endocrine system relies upon the nervous system for the information it needs to respond to such changes quickly. The amount of time that it takes for the nervous system to send a signal throughout the body and then react is called reaction time.

What would happen if your nervous system was slow to respond when you touched a hot surface with your hand?

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Name two other systems in your body that must respond to the signal from the nervous system so you can remove your hand from a hot surface.

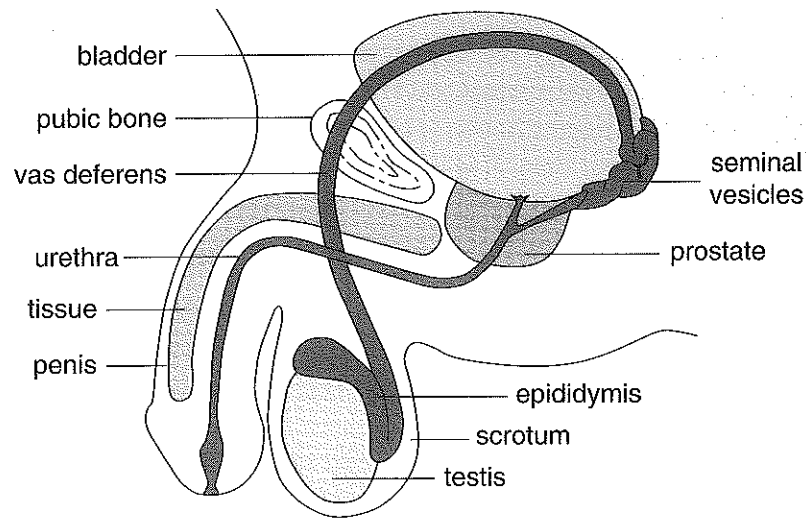
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## The Reproductive System

One important task of the endocrine system is to regulate the reproductive system. In humans, the reproductive system typically becomes mature (physically capable of producing offspring) between the ages of 12 and 16.

In males, the reproductive system includes the penis, the testes, the sperm tubules, and the scrotum. The endocrine system releases hormones that travel to two testes located in the scrotum that hangs behind the penis. The testes contain tiny tubes called sperm tubules that produce the male sex cells, called **sperm**. (The testes also produce the hormone testosterone, which causes the development of characteristics such as facial hair and a deepening voice.) Immature sperm travel to the epididymis, where they gain the ability to swim. When ready, the sperm travel through the sperm duct. The prostate gland and the seminal vesicles produce fluids that mix with the sperm, producing the substance called semen. Semen leaves the body through the penis via the urethra.

### Male Reproductive System



How does the endocrine system control development of the male reproductive system?

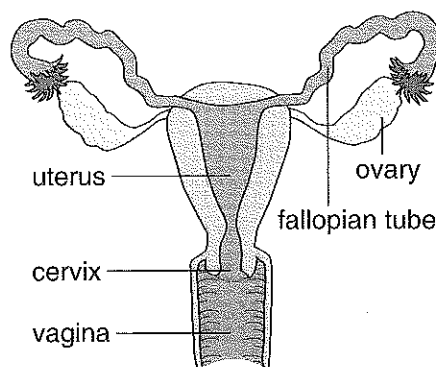
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In females, the reproductive system includes the ovaries, the fallopian tubes, and the uterus. These components all participate in a female's **menstrual cycle**, which prepares the female body for a possible pregnancy. In the menstrual cycle, the endocrine system tells the ovaries to make a hormone called estrogen. Estrogen does two things. First, it causes the walls of the uterus to develop a lining rich in blood vessels. This lining will help the uterus to accept and sustain a fetus, should the female become pregnant. Second, about 14 days into the menstrual cycle, estrogen causes ovulation.

### Female Reproductive System



Sunshine State Standards: SC.F.1.3.1, SC.F.1.3.4

Two things happen during ovulation. First, an ovary releases a mature egg cell, called an **ovum**. Second, the ovary that made the ovum produces progesterone, a hormone that helps maintain the lining of the uterus. The ovum enters a fallopian tube, where it stays for about 48 hours. If an ovum and a sperm cell do not join during this time, the ovaries stop producing estrogen and progesterone. When estrogen and progesterone levels fall, the egg disintegrates and the walls of the uterus are shed. The bleeding during a female's menstrual cycle is caused by the shedding of the blood-rich lining of the uterus. This entire cycle takes about 28 days.

Why is it difficult for a woman to know exactly when she is fertile?

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### Word Links

Now that you've read through this review, go back to the words you circled in the "Words to Know" list. Write each word in the "Word Links" table your teacher has provided you. Fill out one row for each word.

### Keys to Keep

- 🔑 Cells are the building blocks of life.
- 🔑 Cells replicate by mitosis to make exact copies of themselves.
- 🔑 There are many types and shapes of cells in the body, to perform different functions.
- 🔑 Multicellular organisms have levels of organization: cells, tissues, organs, and organ systems.
- 🔑 Organ systems work together to perform life functions.