7th Grade Science

for Utah SEEd Standards

2019-2020

Utah State Board of Education

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CHAPTER 3

Strand 3: Structure and Function of Life

Chapter Outline

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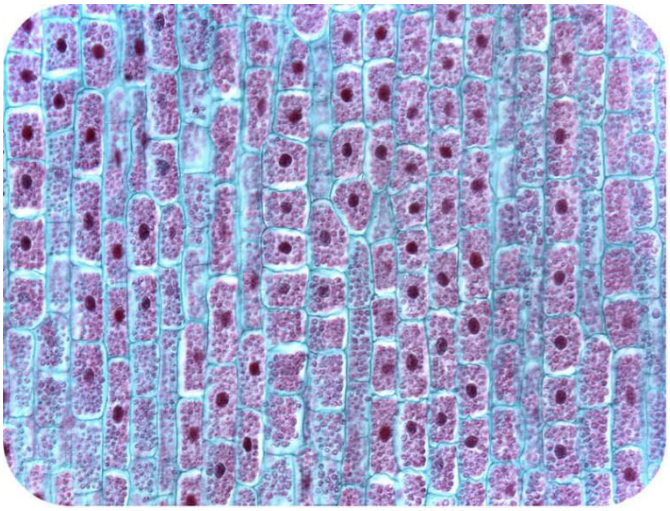
All living things (or things that were once living) are made of smaller structures called cells. The basic structural unit of all living things is the cell. Parts of a cell work together to function as a system. Cells work together and form tissues, organs, and organ systems. Organ systems interact to meet the needs of the organism.

3.1 Cells are the Building Blocks of Life (7.3.1)

Explore this Phenomenon

Pinus pinea (Stone Pine) cone with pine nuts by MPF, CC BY-SA

This is what the pinecone looks like in a microscope.



This is what a coin looks like in a microscope.

Seeds from a pinecone and alloy metals such as coins both look very different when viewed under a microscope. When living things are viewed under a microscope, repeating structures can often be seen.

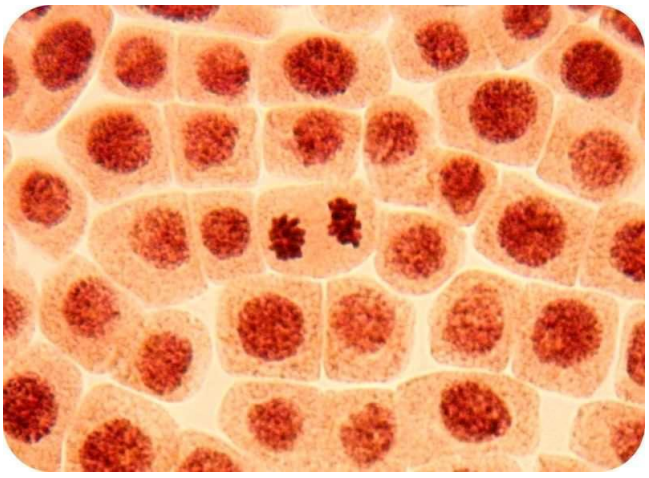
As you read the following section, think about what investigation you could plan and carry out to determine if something is or was once alive.

7.3.1 Cells are the Building Blocks of Life

Plan and carry out an investigation that provides evidence that the basic structures of living things are cells. Emphasize that cells can form single-celled or multicellular organisms, and that multicellular organisms are made of different types of cells.

Cells make up all living things. Different cells have different shapes and sizes that help them perform a specific job. In this section see if you can identify how the structure and function of the tiny cells contribute to the structure and function of the whole organism

Introduction to Cells



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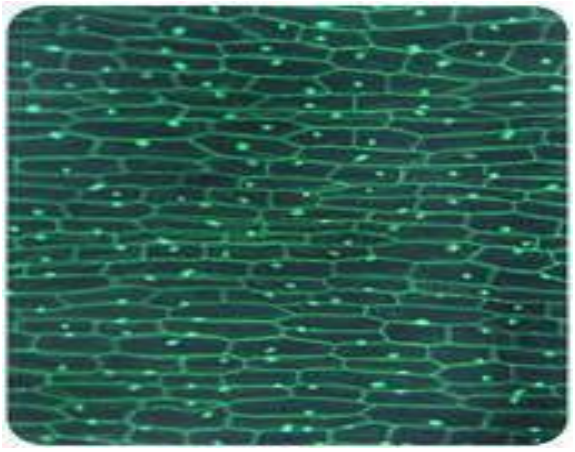
Cells make up all living things, including your own body. The image to the left shows a group of cells. Not all cells look alike. Cells can differ in shape and sizes. In addition, the different shapes usually mean they do different things.

A cell is the smallest structural and functional unit of an organism. Some organisms, like bacteria, consist of only one cell. Large organisms, like humans, consist of trillions of cells. Compare a human to a banana. On the outside, they look very different, but if you look close enough you'll see that their cells are actually very similar.

Observing Cells

Most cells are so small that you cannot see them without the help of a microscope. It was not until 1665 that English scientist Robert Hooke invented a basic light microscope and observed cells for the first time, by looking at a piece of cork, which he got from a tree. You may use light microscopes in the classroom. You can use a light microscope to see cells like in this image of onion cells.



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Cell Theory

In 1858, after using microscopes much better than Hooke's first microscope, Rudolf Virchow developed the hypothesis that cells only come from other cells. For example, bacteria, which are single-celled organisms, divide in half (after they grow some) to make new bacteria. In the same way, your body makes new cells by dividing the cells you already have. In all cases, cells only come from cells that have existed before. This idea led to the development of one of the most important theories in biology, the cell theory.

Cell theory states that:

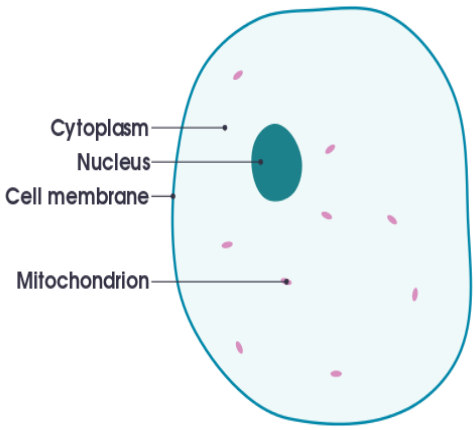
1. All organisms are composed of cells.
2. Cells are alive and the basic living units of organization in all organisms.
3. All cells come from other cells.

As with other scientific theories, many hundreds, if not thousands, of experiments support the cell theory. Since Virchow created the theory, no evidence has ever been identified to contradict it.

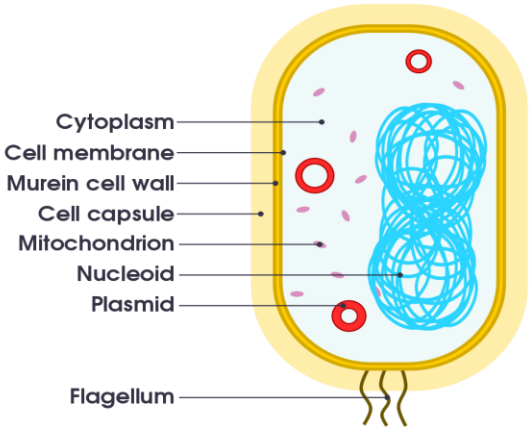
Single-celled vs Multicellular Organisms

Single-celled (unicellular) organisms like bacteria are composed of just one cell, whereas multicellular organisms can be composed of trillions of cells. Multicellular organisms include protists (though single-celled protists also exist)**,** fungi**,** plants and animals. Most plant and animal cells are between 1 and 100 µm (micrometer) in size and therefore can only be observed under the microscope.

The one cell of a unicellular organism must be able to perform all the functions necessary for life. These functions include metabolism, homeostasis, and reproduction. Specifically, these single cells must transport materials, obtain and use energy, dispose of wastes, and continuously respond to their environment. The cells of a multicellular organism also perform these functions, but they may do so in collaboration with other cells.



Simple diagram of animal cell by domdomegg, CC-BY



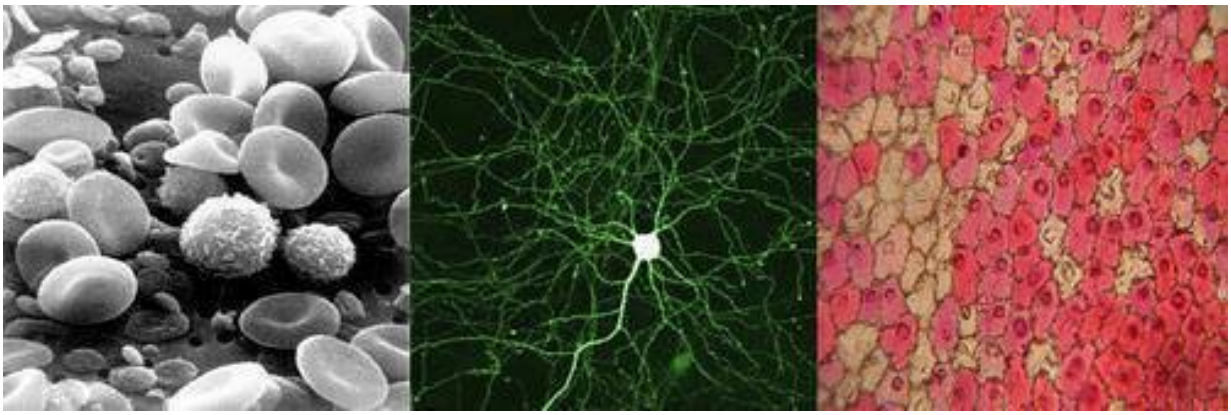
Simple diagram of bacterium by domdomegg, CC-BY

Specialized Cells for Multicellular Organisms

Although cells share many of the same features and structures, they also can be very different. Each cell in your body are designed for a specific task. In other words, the cell's function is partly based on the cell's structure. For example:

- Red blood cells are shaped with a pocket that traps oxygen and brings it to other body cells. These cells also have a large surface area that aids in oxygen transfer.
- Nerve cells are long and stringy in order to form a line of communication with other nerve cells, like a wire. Because of this shape, they can quickly send signals, such as the feeling of touching a hot stove, to your brain.
- Skin cells are flat and fit tightly together to protect your body.

As you can see in the next images, cells are shaped in ways that help them do their jobs. Multicellular (many-celled) organisms have many types of specialized cells in their bodies.



Red blood cells (*left*) are specialized to carry oxygen in the blood.

3.2 Function of Cell Parts (7.3.2)

Explore this Phenomenon

Sheep Around A Tree by Henry Burrows, https://flic.kr/p/2amNCJW, CC BY-SA

All living things must have energy to survive. The sheep in this picture are eating grass to get energy to live. If trees do not eat, construct an explanation as to how they get the energy they need for survival.

7.3.2 Functions of Cell Parts

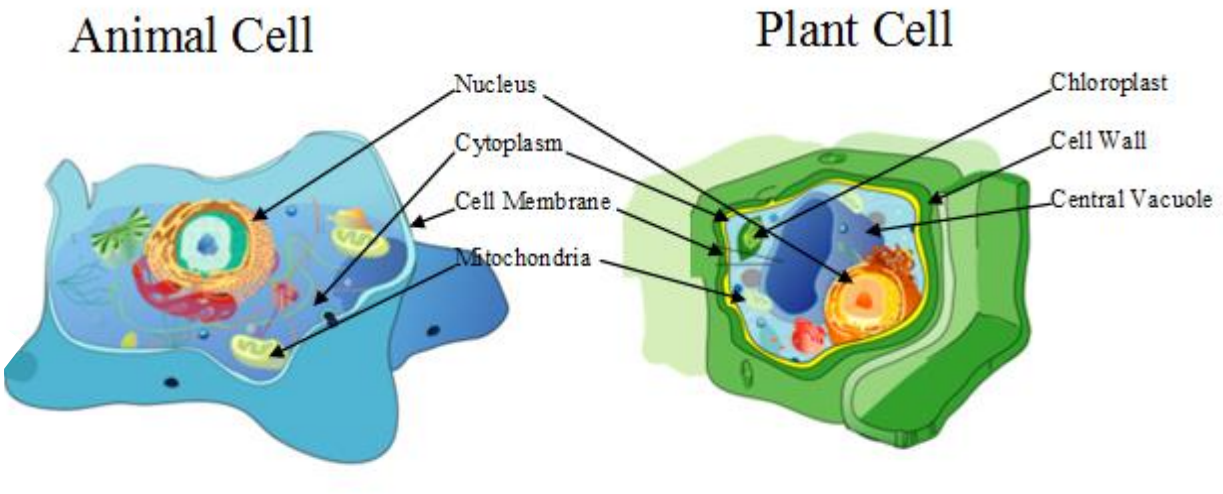
Develop and use a model to describe the function of a cell in living systems and the way parts of cells contribute to cell function. Emphasize the cell as a system, including the interrelating roles of the nucleus, chloroplasts, mitochondria, cell membrane, and cell wall.

In the last section, you were able to analyze how the structure and number of different cells contribute to an organism. In this section, you will see how different cell parts contribute to the function of the cell. Pay attention to how the shape and size of the cell parts might contribute to their function in the cell.

Organelles

Cells are defined as the basic unit of all living things. This means that the cell is the smallest unit that can still be considered living. Cells are a working system of parts just as a bicycle is a working system of parts. You can break a bicycle down into smaller parts, but it will no longer function as a bicycle. If a cell were broken down further, it would no longer be considered a living thing.

But what makes up a cell? Cells are made up of smaller structures called organelles. Organelles are common to most cells. The word organelle means “little organs”. Each organelle has its own function or job in the cell to keep the cell alive. The following information describes the structure and function of some organelles in cells:



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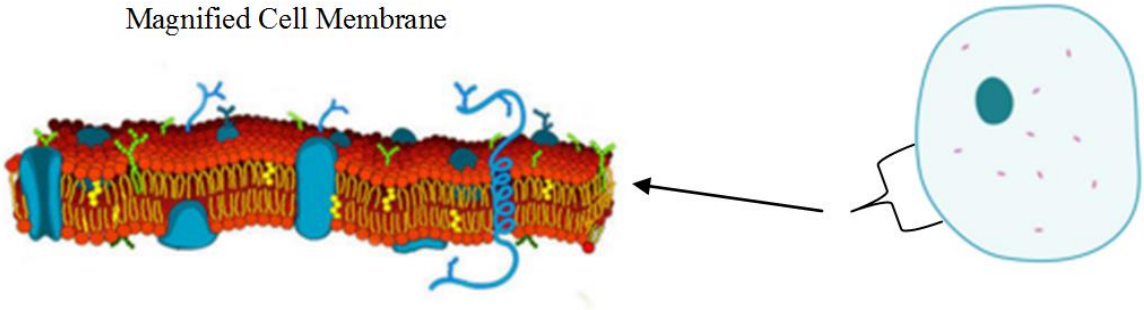
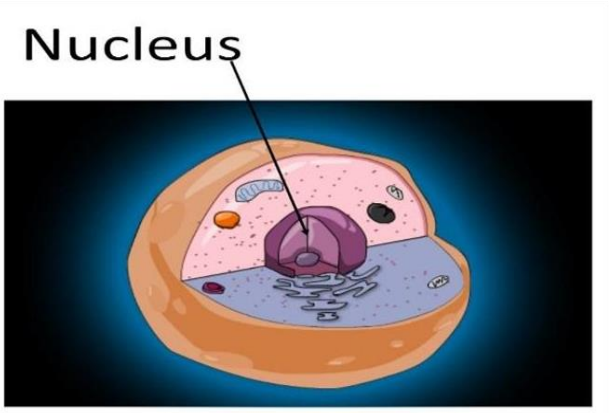
Cell Membrane



The cell membrane is the layer surrounding the cell. The function or job of the cell membrane is to hold all of the cell's contents together and to control what goes in and out of the cell. The cell membrane is semipermeable, which means that some things can freely cross it and some things cannot. This helps the membrane control what can or cannot cross into and out of the cell. Food, water, oxygen and waste products are examples of particles that need to pass the membrane to get into and out of the cell.

Nucleus

The nucleus is the control center of the cell. It contains the genetic information (DNA) and controls all the activities of the cell.



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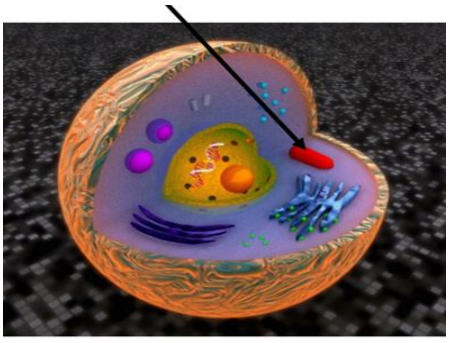
Mitochondria



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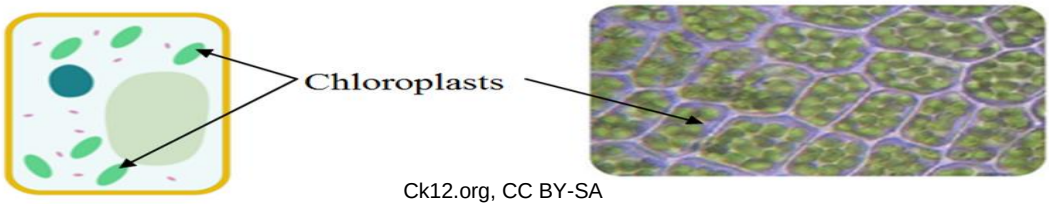
All cells need energy to survive. In the mitochondria, small molecules of food are broken apart using oxygen. The energy that was holding the molecules together is released for our use. Food is the energy source for our bodies. Just as we use the stored energy in wood to make a fire to heat some water, the food that we eat needs to be broken down in order to release energy so that our bodies can function. Mitochondria are responsible for doing this in cells. The process whereby food is broken down to release energy is called cellular respiration.

Chloroplast



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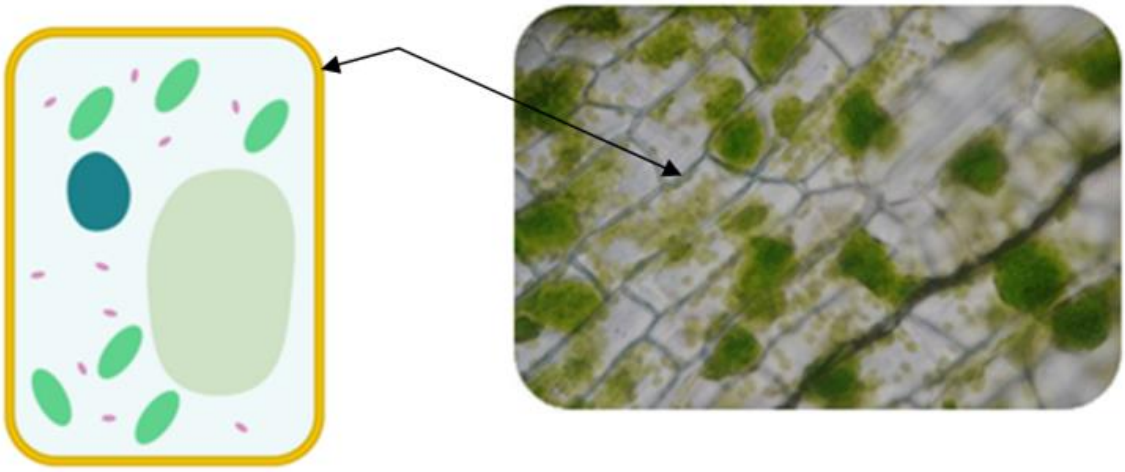
Plants do not consume food like animals do. They have to make their own food in order to release energy in the mitochondria needed for survival. The chloroplasts are organelles in plant cells that make food through a process called photosynthesis. Chloroplasts are only found in plant cells, but not in animal cells. These green structures make food for the plant by converting the energy of sunlight into sugar using carbon dioxide and water.

Cell Wall

Plant cells need a cell wall. The cell wall is a rigid outer barrier that supports and protects the cell. Plants do not have a skeleton to offer the strength and support like an animal does.



The cell wall in plant cells is the outermost layer of the cell.
(ck12.org, CC BY-SA)

The Cell as a System

Each organelle in the cell plays a key role in helping the cell to survive. The nucleus tells the organelles what to do and when to do it. The cell membrane allows materials in and out that the organelles need to do their jobs. The chloroplasts in the plant cell produce the food that plants need to survive. The mitochondria takes the food that is produced by the chloroplasts or let in by the cell membrane and releases the energy

stored inside the food. The energy is then used by the cell to do other jobs. The cell wall in plants helps protect the cell and provides strength for the plant to grow tall. How are these functions of the organelles similar to the functions of other systems you know?

How are plant and animal cells different?

Even though plants and animals are both made of cells, plant cells differ in some ways from animal cells.

First, in addition to a cell membrane, plant cells have a cell wall that supports and makes the cell somewhat rigid. Plant cells need this cell wall because they do not have a skeleton to offer the strength and support that an animal does. A cell wall gives the plant cell strength and protection. It is the strength of trillions of cell walls in a tree that makes them strong enough to grow as tall as they are. Animals do not need cell walls because their bones and muscles support them. Animal cells only have a cell membrane.

Second, plant cells have chloroplasts that capture the sun's energy to convert carbon dioxide and water to sugar. They make their own food. Since animals have to get food to eat from other sources, they do not need chloroplasts.

Think like a Scientist

Fill in the table below. Put a checkmark for each organelle/structure that is found in each cell type.

Organelle/Structure	Plant Cell	Animal Cell
Cell Wall		
Cell Membrane		
Nucleus		
Mitochondria		
Chloroplast		