

In 1665, Robert Hooke first introduced the world to cells. When he examined thin slices of a cork tree under a microscope, Hooke observed that the cork was divided into tiny compartments. These compartments reminded Hooke of the rooms where monks reside. The monks' rooms were called cells, and so Hooke gave the same name to the cork compartments. After Hooke's discovery, many scientists became interested in cells. Through thousands of observations and experiments, much about the structure and functions of living cells was uncovered.

In the mid-19th century, German scientists Theodor Schwann, Matthias Schleiden, and Rudolph Virchow developed the cell theory. The cell theory is one of the fundamental principles of biology. The original version of the cell theory states:

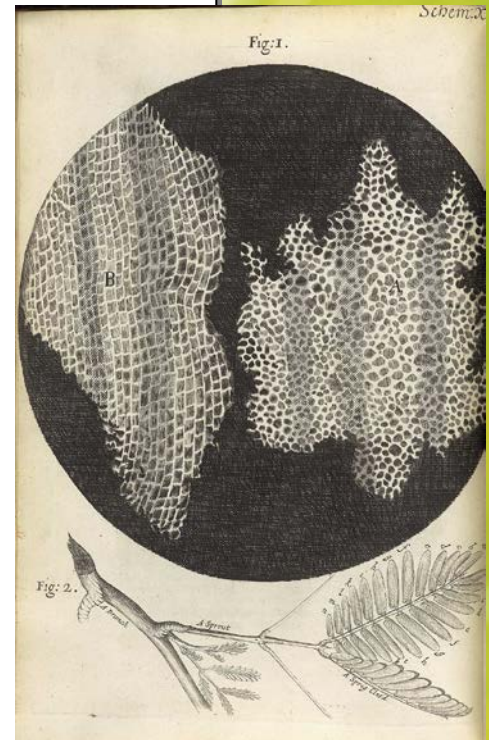
- Cells are the basic unit of life.
- All living organisms, both unicellular and multicellular, are composed of cells.
- Cells arise from pre-existing cells.

Like many scientific theories, the cell theory has been revised as new information has been discovered. Today the cell theory also includes:

- Cells contain hereditary information (DNA) that is passed from one cell to another during cell division.
- The flow of energy in living organisms occurs in cells.
- All cells have the same basic chemical composition and structure.

The six parts of the cell theory have continued to develop. Scientists from around the world have collected data about cellular structure and function. Interestingly, all cells, from single-celled bacteria to complex humans, are very similar.

There are two basic types of cells: prokaryotic and eukaryotic. Prokaryotic cells, such as bacteria, do not have nuclei or other membrane-bound structures. Prokaryotes are mostly unicellular organisms. Eukaryotic cells, which include plant, animal, and



Robert Hooke drew his observations of cork cells.

fungi cells, are more advanced and contain at least one nucleus and many membrane-bound structures. Eukaryotic cells generally make up multicellular beings.

The cell's main job is to organize the functions of the living organism. Many cells working together for a common function form tissue. There are many different kinds of tissue. Muscle tissue helps with movement. Cardiac tissue controls the heart. Nerve tissue carries messages from the brain to locations throughout the body.

Tissues form such organs as the heart, stomach, and skin. Organs coordinate to keep an organism alive. Muscles move the body, but they cannot function without input from the brain or blood pumped from the heart. Each organ is part of a larger organ system. The digestive system absorbs nutrients from food. The immune system fights off disease and infection. Collectively the organ systems make up an entire organism.

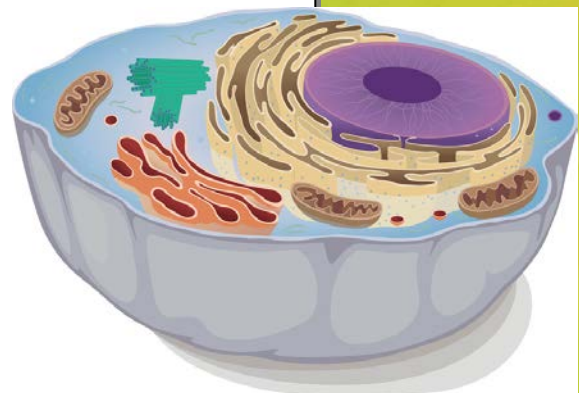
It should be remembered that life starts with the cell. The parts of a cell have specific functions that support tissues, organs, and organ systems. These cell parts are called "organelles."

The cell membrane is a double layer of fatty acids that forms the cell's boundary and contains its parts. Both prokaryotes and eukaryotes are contained within a cell membrane.

The nucleus contains DNA and directs the cell's activity. It is surrounded by a separate membrane called the "nuclear envelope." Since prokaryotes do not have a contained nucleus, their DNA is free-floating in the cytoplasm.

Cytoplasm is a jelly-like substance that fills the cell and contains all of the organelles.

The endoplasmic reticulum is a folded mass of tubes that stores proteins and produces fats that are sent to other cell



In a eukaryotic animal cell, each organelle performs a unique function for the cell.

parts. Endoplasmic reticulum can be smooth or rough. Rough endoplasmic reticulum is studded with ribosomes that are used in protein synthesis.

Mitochondria are a bean-shaped mass of membranes. The mitochondria serve as centers for cellular respiration and provide energy for the cell.

The Golgi apparatus, shaped like a stack of pancakes, packages proteins and other materials for movement around the cell.

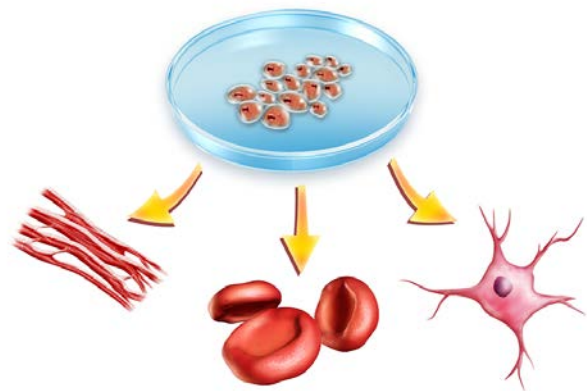
Vacuoles are sacs that store water, food, and/or waste products. Plant cells have a large central vacuole for storing water.

Lysosomes are acid-containing sacs that break down wastes for removal from the cell.

Plant and animal cells are very similar; however, there are a few differences. Such organelles as the cell wall and chloroplasts are found only in plant cells and can be used to differentiate between plant and animal cells. The cell wall is a rigid membrane surrounding the cell. It gives structure and support to plants. Chloroplasts are green, disk-shaped organelles containing the pigment chlorophyll. Photosynthesis takes place in chloroplasts.

Eukaryotic cells have the same basic structures, but not all eukaryotic cells are alike. Early in an organism's life cycle, all of its cells are identical. These base cells are called stem cells. As the organism grows, the cells differentiate, or specialize. Cells change depending on the function they will perform. The genetic material in a cell directs its differentiation.

Compare a muscle cell with a nerve cell, called a neuron. The size, shape, and structure of neurons differ to suit their



The stem cells in the Petri dish differentiate to form muscle cells (left), blood cells (center), and neurons (right).

functions. Muscle cells are long and thin and contain many mitochondria. The muscle cell's shape allows it to stretch and contract to produce movement. The many mitochondria provide energy for quick response. Neurons are long, thin cells with appendages on both ends. The long appendages help send electric signals to and from the brain and through the body.

Since Robert Hooke's cell discovery, the scientific community has carefully explored these microscopic units of life. Knowing how cells function is the first step to understanding life itself. Today, experiments with stem cells, somatic cell nuclear transfer, gene therapy, and other technologies open up a wealth of new cellular possibilities.