Cell Theory

Reflect

How would you figure out what something is made of? Would you try to take it apart, or use a tool to look at it more closely? Scientists in the 1600s were very interested in what made up living organisms. Their observations and conclusions are still relevant today.

Advances in technology drove the discovery and description of cells

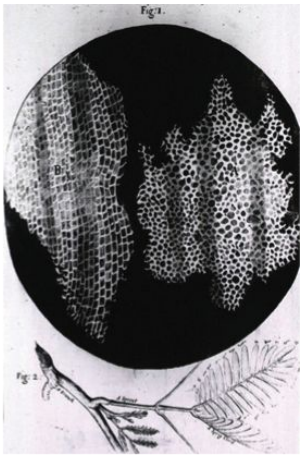
The discovery of cells depended on advances in technology, in particular, microscopes. In the 1590s, Zacharias Janssen worked on both telescopes and microscopes. Janssen, with his father, discovered that looking at an object with more than one lens made its image even larger. They invented the first simple compound microscope, using two lenses and a tube. The next major advance was made around 1668 by Antonie van Leeuwenhoek, who both built microscopes and used them to study cells, such as algae and bacteria. Technology remained static until the 1850s, when German microscope manufacturer Carl Zeiss hired glass chemist Otto Schott and physicist Ernst Abbe and they started to make many improvements on the microscopes they produced. All of these microscopes relied on light. Modern light microscopes can be used to see objects larger than 200 nanometers. Electron microscopes were developed in the 20th century. They can be used to see objects as small as 0.05 nm, or 4,000 times smaller!

A compound microscope with a single eyepiece and two objective lenses.

Discover Science: The Cell Theory

Before the 1600s, people did not know that cells existed at all. This may be hard to believe, considering how much we know about cells now. Scientists did believe that living things were composed of one or more basic building blocks, but they did not know what those building blocks looked like. Thanks to the work of Robert Hooke, Antonie van Leeuwenhoek, Matthias Jakob Schleiden, Theodor Schwann, Rudolf Virchow, and other scientists, the cell theory was developed.

The British scientist Robert Hooke was the first person to observe matter made up of what he called *cells*. In the 1660s, Hooke used a microscope to look at cork from the bark of a cork oak tree. He noted the cork looked like it was made of small compartments that reminded him of the rooms, or cells, in which monks lived. For this reason, Hooke named the structures he observed cells. Hooke was unknowingly observing nonliving cell walls. Antonie van Leeuwenhoek was also observing living cells under a microscope around this time (1660s–1700s). He examined what he called *animalcules*, what we now call *microorganisms*. Based on his notes, scientists today think that van Leeuwenhoek was observing algae and bacteria.



This magnified image of cork tissue is from Robert Hooke's book "Micrographia."

Matthias Jakob Schleiden, Theodor Schwann, and Rudolf Virchow are the three scientists who are typically given credit for the development of the cell theory. Schleiden studied plants and discovered they were made of cells. Around the same time, Schwann discovered animals were made of cells. In 1838, Schleiden and Schwann proposed the first two parts of the current cell theory. The theory states that all living things are made of cells and that cells are the basic units of structure and function in living things. Virchow developed the third part of the cell theory, which states that all cells arise from preexisting cells.

Look Out!

The term *theory* is used in a variety of ways in everyday speech. In science, a theory is defined as an explanation of some part of the natural world that—
came about through the scientific method,
is supported by many different types of evidence, and
has been repeatedly tested and confirmed through observation and experimentation.

Another example of a theory in biology is the germ theory of disease. It states that microorganisms, too small to see using just the human eye, invade another organism and cause disease.

The cell theory is one of the fundamental theories of biology.
In its modern form, cell theory has the following parts:

- All living things we know of are composed of cells.
- Every living cell comes from another living cell, through the process of cell division. • Cells are the basic unit of life.
- An organism's function depends on the functions of its cells.
- Chemical reactions happen in cells.
- Cells contain inherited information in DNA and pass this DNA from cell to cell.
- All cells are composed of the same biological building blocks.

What Do You Think?

Cell theory has multiple parts. Which part do you think is most important?

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Discover science: Looking for life on Mars
Scientists believe that several planets and moons in our solar system either had or may currently have life. Conditions necessary for life to develop include liquid water, and the presence of elements that make up life on earth. Since cell theory states that life is composed of cells, scientists look for rocks containing either living or fossil cells. To date, no widely accepted evidence of cells has been found anywhere except on Earth.

Mars rover looking for signs of life

Try Now

In the 1930s, farmers observed that livestock died when given a diet rich in selenium. Scientists V.R. Potter and C.A. Elvehjem performed experiments to try to figure out how selenium was killing the livestock. They used yeast as a model. They measured respiration (specifically oxygen uptake) of yeast cells with and without selenium. They discovered that yeast cells had much less respiration with selenium present (Potter and Elvehjem, 1936).

Which parts of the cell theory does their data support?

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References
Hooke, R. (1664) Micrographia: Some physiological descriptions of minute bodies made by magnifying glasses with observations and inquiries thereupon. London: Martyn & Allestry.

Potter, V.R., Elvehjem, C.A. (1936). The effect of selenium on cellular metabolism: The rate of oxygen uptake by living yeast in the presence of sodium selenite. Biochemical Journal, 30(2):189–196.

Connecting With Your Child

While most cells cannot be seen without a microscope, some can. Unfertilized chicken eggs, the kind that comes from the grocery store, are composed of a single cell. With your child, carefully crack a single egg and let it drop onto a flat surface. A dark surface makes it easier to see the different parts. See if you can identify the yellow yolk (the cell), the clear egg white (a protein around the cell) . Also identify the cell's the genetic material from the hen, which looks like a small white dot on the yellow yolk.

A broken egg showing the egg white and yolk

Ask your child to look back at the drawing by Robert Hooke and describe how the chicken egg is similar and different from the dead cork cells Hooke observed.