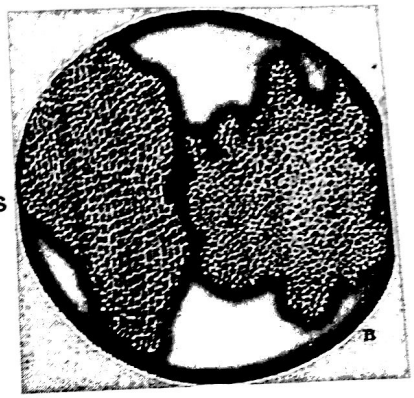
Cell Theory



The **CELL THEORY,** or cell doctrine, states that all organisms are composed of similar units of organization, called cells. The concept was formally articulated in 1839 by Schleiden & Schwann and has remained as the foundation of modern biology. The idea predates other great paradigms of biology including Darwin's theory of evolution (1859), Mendel's laws of inheritance (1865), and the establishment of comparative biochemistry (1940).

Formulation of the Cell Theory

In 1663 an English scientist, Robert Hooke, discovered cells in a piece of cork, which he examined under his primitive microscope. Actually, Hooke only observed cell walls because cork cells are dead and without cytoplasmic contents. Hooke drew the cells he saw and also coined the word CELL. The word cell is derived from the Latin word '*cellula*' which means small compartment. Hooke published his findings in his famous work in 1665.

Ten years later Anton van Leeuwenhoek (1632-1723), used his own (single lens) monocular microscopes and was the first person to observe living bacteria and protozoa. Leeuwenhoek looked at animal and plant tissues, at mineral crystals, and at fossils. He was the first to see microscopic single celled protests. He discovered blood cells, and was the first to see living sperm cells of animals.

It is upon the works of Hooke and Leeuwenhoek that Schleiden and Schwann built their Cell Theory.

In 1838, Theodor Schwann and Matthias Schleiden were enjoying after-dinner coffee and talking about their studies on cells. It has been suggested that when Schwann heard Schleiden describe plant cells with nuclei, he was struck by the similarity of these plant cells to cells he had observed in animal tissues. The two scientists went immediately to Schwann's lab to look at his slides. Schwann published his book on animal and plant cells (Schwann 1839) the next year, devoid of acknowledgments of anyone else's contribution, including that of Schleiden (1838).

It was Schleiden, who brought the nucleus to popular attention, and to asserted its all-importance in the function of a cell. He came to believe that the nucleus is really the most important portion of the cell, in that it is the original structure from which the remainder of the cell is developed. He outlined his views in a paper that mentioned that these ideas came in part from the ideas of a friend Schwann.

Schwann was puzzling over certain details of animal histology which he could not clearly explain. Schwann recognized a cell-like character of certain animal tissues. Schwann felt that this similarity could not be mere coincidence, and it seemed to fit when Schleiden called his attention to the nucleus. Then at once he reasoned that if there really is the correspondence between vegetable and animal tissues that he suspected, and if the nucleus is so important in the vegetable cell as Schleiden believed, the nucleus should also be found in the ultimate particles of animal tissues.

Soon Schwann was convinced that his original premise was right, and that all animal tissues are composed of cells not unlike the cells of vegetables. Adopting the same designation, Schwann propounded what soon became famous as the CELL THEORY. So expeditious was his observations that he published a book early in 1839, only a few months after the appearance of Schleiden's paper. The main theme of his book was to unify vegetable and animal tissues. Accepting cell-structure as the

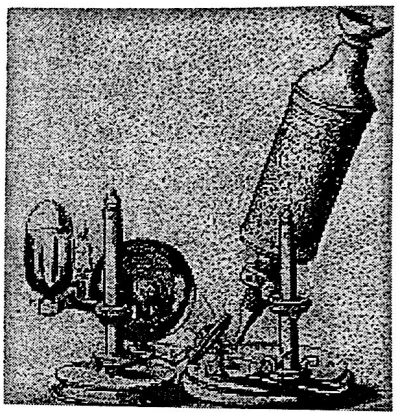
basis of all vegetable tissues, he sought to show that the same is true of animal tissues.

In his book, Schwann summarized his observations into three conclusions about cells:

1) The cell is the unit of structure, physiology, and organization in living things.
2) The cell retains a dual existence as a distinct entity and a building block in the construction of organisms.
3) Cells form by free-cell formation (aka *spontaneous generation*).

We know today that the first two tenets are correct, but the third is clearly wrong.

Later, the correct interpretation of cell formation by division was finally promoted by others and formally stated by Rudolph Virchow's powerful dictum, "All cells only arise from pre-existing cells".
The modern tenets of the Cell Theory include:



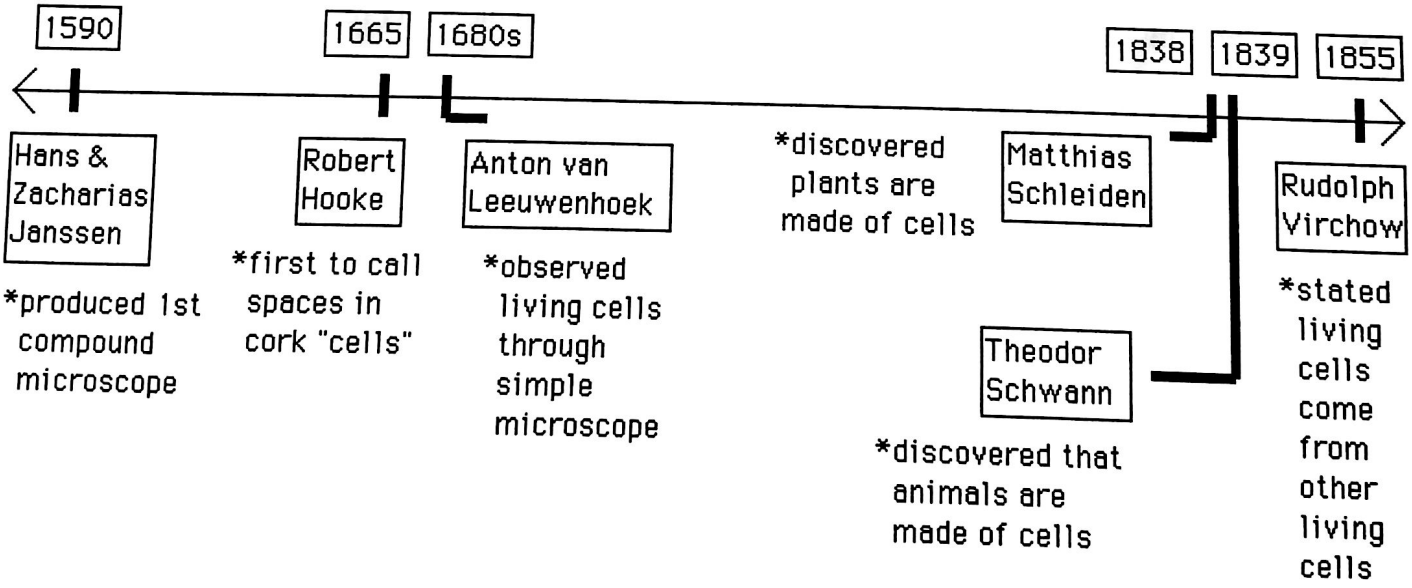
1. All known living things are made up of one or more cells.

2. The cell is the basic structural and functional unit of all living things.

3. All cells come from pre-existing cells by division.
   (spontaneous generation does not occur).

As with any theory, its tenets are based upon previous observations and facts, which are synthesized into a coherent whole via the scientific method. The Cell Theory is no different being founded upon the observations of many using the microscope as a tool.

CELL THEORY HISTORICAL TIMELINE



Cell Diversity

Cells make up all living things, so they have some characteristics that are common to all cells. Not all the cells in your body are alike, they are specialized to the jobs that they do. In fact, there are over 200 types of cells in your body. The cells of other organisms are specialized as well. We are going to learn about the differences among cells

Let's review:

What are the things that all cells must have?

1. A cell must have a membrane surrounding it
2. A cell must have genetic material that holds instruction for maintenance and reproduction.

That is where the similarities end!

Cell Size

Some cells are large enough to be seen without a microscope. For example, giraffe nerve cells (6 ft long!) and frogs eggs (1.5 mm). Most cells are unable to be seen without a microscope. Cells are limited by how large they can grow by their surface area and the amount of volume they have. As surface area increase so does volume, but volume increase more rapidly. If the volume gets too large too fast, the cell will not be able to get enough nutrients, oxygen, and other materials into it to support the large volume.

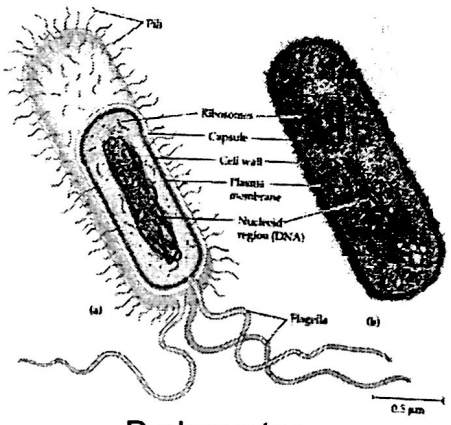
Cell Shape

A cell's shape is determined by it's function. For example, Nerve cells have long extensions to send message through the body. Epithelial cells are flat and broad to cover and protect surfaces. White blood cells are round and can change shape to engulf invaders

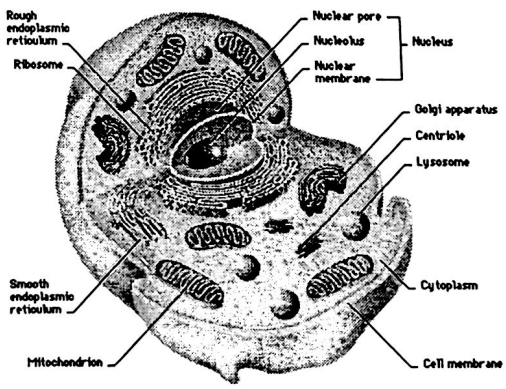
Internal Organization

As stated above above, it is only necessary to have DNA/RNA and a membrane, but cells can have many more <u>organelles</u> (a cell component that performs functions in the cell) in them. Two important organelles are the <u>cell membrane</u> and the <u>nucleus</u>

There are two important groups of cells <u>prokaryote</u> and <u>eukaryotes.</u> Prokaryotes are cells that have a cell membrane and ribosomes but have no nucleus, genetic information is floating around in the cytoplasm. Eukaryotes are cells that have a cell membrane and ribosomes, a membrane bound nucleus and also other organelles in them.



Prokaryotes



Eukaryotes