# Chapter 1
# Introduction to Cell Biology

Both **Living** and **Nonliving Things** are composed of **molecules** made from chemical elements such as **carbon, hydrogen, oxygen**, and **nitrogen**. The organization of these molecules into **Cells** is one feature that distinguishes Living Things from all other matter. The **cell** is the s**mallest unit** of **matter** that can carry on all the processes of **life**.

## 1.1. The Cell Theory

Every living thing-from the tiniest **bacterium** to the largest **whale**-are made of one or more cells. Before the seventeenth century, no one knew that Cells existed. Most Cells are too small to be seen with the unaided eye. They were not discovered until after the invention of the microscope in the early seventeenth century.

### 1.1.1. Invention and Development of Microscopy

One of the First **Microscopes** was made by the Dutch drapery store owner **Anton Von Leewenhoek**. With his hand-held microscope, Leewenhoek became the first person to observe and describe **microscopic organisms** and living cells.

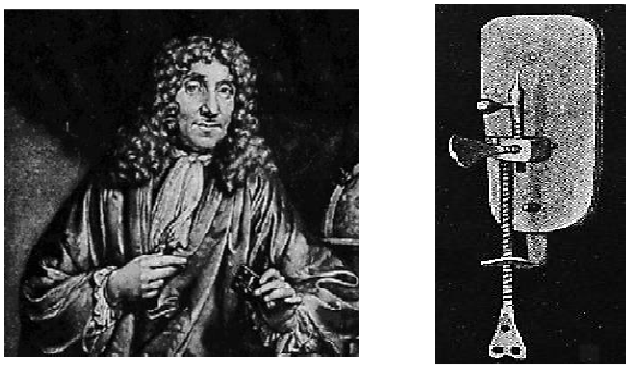

*Fig.1.2. Anton van Leeuwenhoek in1676 (left) with his handcrafted microscope (right)*

In 1665, the English Scientist **Robert Hooke** used a microscope to examine a thin slice of cork and described it as consisting of "a great many little boxes". It was after his observation that Hook called what he saw "**Cells**". They looked like "little boxes" and reminded him of the small rooms in which monks lived, so he called the "**Cells**".

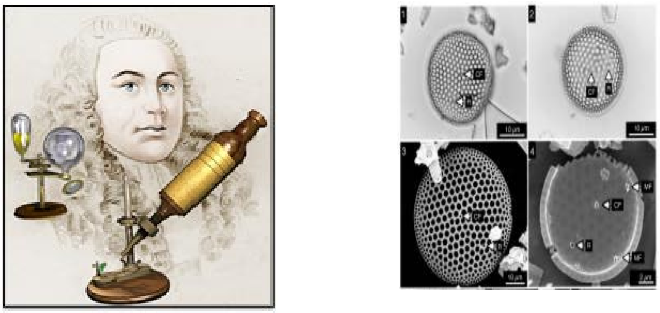

*Fig.1.2. Robert Hooke's image in the background of his microscope (left) and his original honey-comb resembling slides at different magnification powers (right)*

## 1.1.2. The Development of the Ideas of the Cell Theory

In 1838, German Botanist **Matthias Schleiden** studied a variety of **plants** and concluded that "***all plants are composed of cells***". The next year, (1939) the German Zoologist **Theodor Schwann** reported that "***animals are also made of cells***" and proposed *a cellular basis for all life*. In 1855, German Physician **Rudolf Virchow** induced that "*The Animal arises only from an Animal and the Plant Only from a Plant*" or " ***That Cells only arise from pre-existing Cells***". His statement contradicted the idea that life could arise from Nonliving Matter. "*The Theory of Spontaneous Generation*" The process by which life begins when ethers enter nonliving things.

*Matthias Schleiden (1804-81),*

*Theodor Schwann, (1810-1882)*

*Rudolf Virchow (1821-1902*)

*Fig.1.3. Authors of the Cell Theory*

The combine Work of **Schleiden, Schwann**, and **Virchow** make up what is now known as the modern **Cell Theory**. The Cell Theory consist of three Principles:

***A. All living Organism are composed of one or more cells.***
***B. Cells are the basic units of anatomy and physiology in an organism.***
***C. All Cells come only from reproduction of pre- existing cells.***

# 1.2. The Evolution of the Cell

## 1.2.1. Theories on the Origin of Life on Earth

## 1.2.3. Endosymbiosis and Origin of Eukaryotes

The endosymbiosis theory postulates that

1. The **mitochondria** of eukaryotes evolved from aerobic bacteria (probably related to the **rickettsias**) living within their host cell.
2. The **chloroplasts** of eukaryotes evolved from endosymbiotic **cyanobacteria**.
3. Eukaryotic **cilia** and **flagella** may have arisen from endosymbiotic **spirochetes**.
4. The basal bodies from which eukaryotic cilia and flagella develop would have been able to create the mitotic spindle and thus made **mitosis** possible.

The evidence for mitochondria and chloroplasts are as follows:

1. Both **mitochondria** and **chloroplasts** can arise only from pre-existing mitochondria and chloroplasts. They cannot be formed in a cell that lacks them because **nuclear genes** encode only some of the proteins of which they are made.

2. Both mitochondria and chloroplasts have their own **genome** and it resembles that of bacteria not that of the nuclear genome. Both genomes consist of a **single circular molecule of DNA**. There are no **histones** associated with the DNA.
3. Both mitochondria and chloroplasts have their own **protein-synthesizing machinery**, and it more closely resembles that of **bacteria** than that found in the cytoplasm of eukaryotes.
    a. The first amino acid of their transcripts is always **fMet** as it is in bacteria (not **methionine** [Met] that is the first amino acid in eukaryotic proteins).
    b. A number of antibiotics (e.g., **streptomycin**) that act by blocking protein synthesis in bacteria also block protein synthesis within mitochondria and chloroplasts. They do not interfere with protein synthesis in the cytoplasm of the eukaryotes.
    c. Conversely, inhibitors (e.g., **diphtheria toxin**) of protein synthesis by eukaryotic ribosomes do not — sensibly enough — have any effect on bacterial protein synthesis nor on protein synthesis within mitochondria and chloroplasts.
    d. The antibiotic **rifampicin**, which inhibits the RNA polymerase of bacteria, also inhibits the RNA polymerase within mitochondria. It has no such effect on the RNA polymerase within the eukaryotic nucleus.

# 1.3. Diversity of Cellular Structures

Not all cells are alike. Even cells within the same organism show Enormous Diversity in **Size, Shape**, and **Internal Organization**. Your Body contains at least 200 Different Cell Types.

## 1.3.1. Cell Size

A few types of cells are large enough to be seen by the unaided eye. The **Female Egg** is the largest cell in the body, and can be seen without the aid of a microscope. Most cells are visible only with a microscope. Most cells are small for **two reasons**:

1. Cells are limited in size by the **ratio** between their **outer surface area** and their **volume**. A small cell has more surface area than a large cell for a given volume of **cytoplasm.** This is important because the nutrients, **oxygen**, and other materials a cell requires must enter through it surface. As a cell grows larger at some point its surface area becomes too Small to allow these materials to enter the cell quickly enough to meet the cell's need.
2. The cell's nucleus can only control a certain amount of living, active cytoplasm.

## 1.3.2. Cell Shape

Cells come in a variety of Shapes. Notice the **neurons** on the wall, the basic cell of our Nervous System. This diversity of form reflects a diversity of function. Most Cells have a Specific **Shape.** The shape of a cell depends on it's **function.** Cells of the Nervous System that carry information from your toes to your brain are long and threadlike. Blood Cells are shaped like round disk that can squeeze through tiny blood vessels.

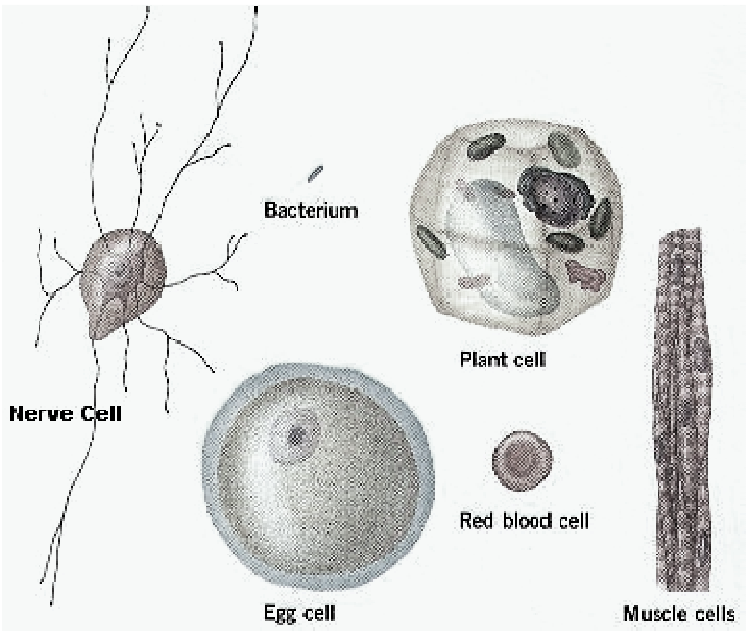


*Fig.1.5. Diversity of Cellular Structures*