

The **cell** (from Latin *cellula* 'small room'^[1]) is the basic structural, functional, and biological unit of all known organisms. A cell is the smallest unit of life. Therefore, cells are often described as the "building blocks of life". Cell biology (also called *cellular biology* or *cytology*) is the study of cells.

Types of Cells

Cells are of two types: eukaryotic, which contain a nucleus, and prokaryotic cells, which do not have a nucleus, but a nucleoid region is still present. Prokaryotes are single-celled organisms, while eukaryotes can be either single-celled or multicellular.

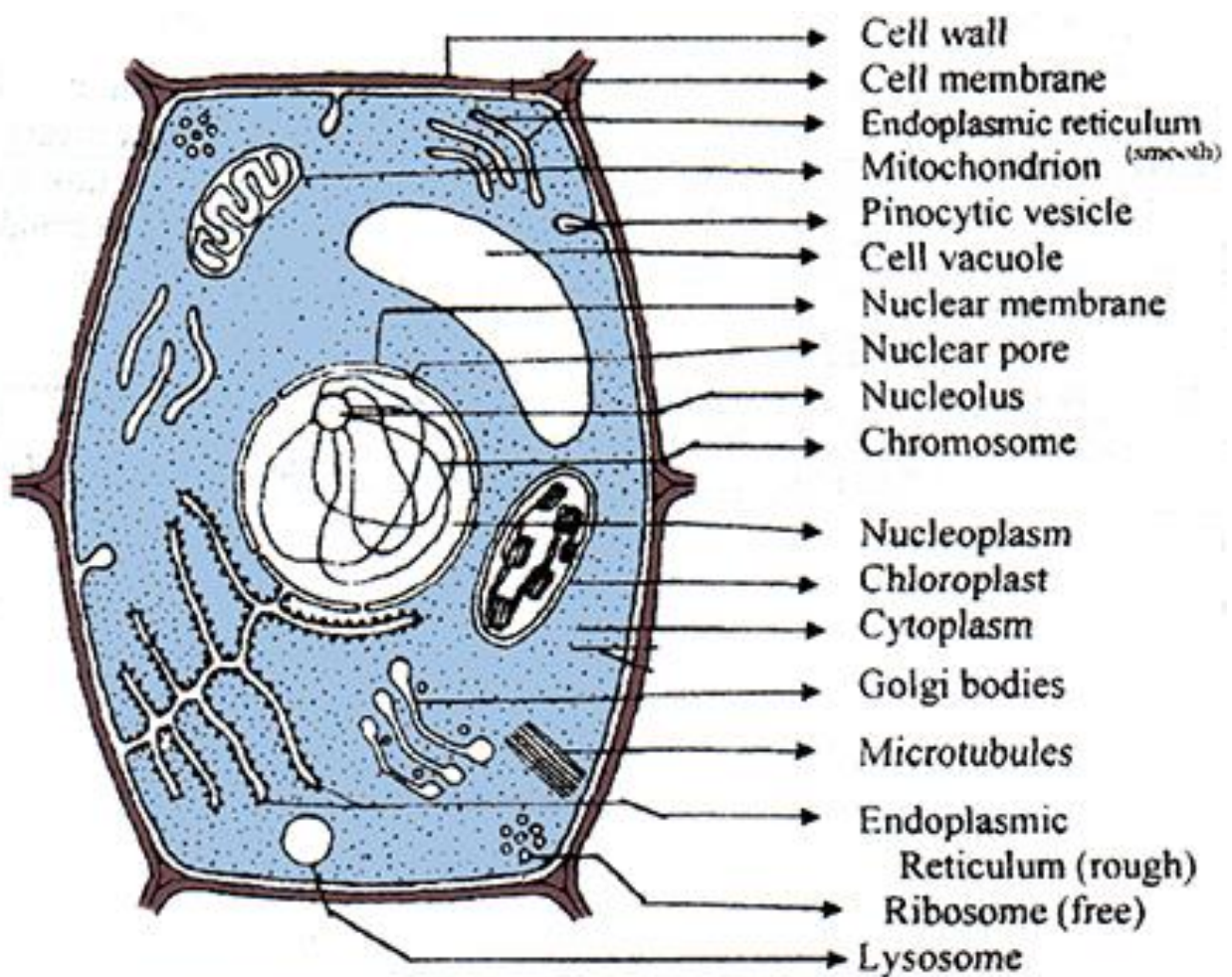


Fig: A typical plant cell seen in an electron microscope.

Characteristic	Prokaryotic cell	Eukaryotic cell
Size of cell	Typically 0.2-2.0 μ m in diameter	Typically 10-100 μ m in diameter
Example	Bacteria and Archaea	Animals and Plants
Nucleus	Absent	Present
Membrane-enclosed organelles	Absent	Present; examples include lysosomes, Golgi complex, endoplasmic reticulum, mitochondria & chloroplasts
Flagella	Consist of two protein building blocks	Complex; consist of multiple microtubules
Cell wall	Usually present; chemically complex	Only in plant cells and fungi (chemically simpler)
Plasma membrane with steroid	Usually no	Yes
Cytoplasm	No cytoskeleton or cytoplasmic streaming	Cytoskeleton; cytoplasmic streaming
Ribosomes	Smaller	Larger
Cell division	Binary fission	Mitosis
Number of chromosomes	One, but not true chromosome	More than one
Sexual reproduction	No meiosis; transfer of DNA fragments only (conjugation)	Involves meiosis

Prokaryotic cells, as well as eukaryotic cells, are covered with the plasma membrane, which is located on top of the cell membrane or mucous capsule. Despite of its relative simplicity, prokaryotes are typically independent cells. Table 4.1 presents the major differences between prokaryotic and eukaryotic cells.

- The cell nucleus is a membrane-bound structure that contains the cell's hereditary information and controls the cell's growth and reproduction.
- In general, a eukaryotic cell has only one nucleus. However, some eukaryotic cells are enucleated cells (without a nucleus), for example, red blood cells (RBCs); whereas, some are multinucleate (consists of two or more nuclei), for example, slime **molds**.

Nucleus

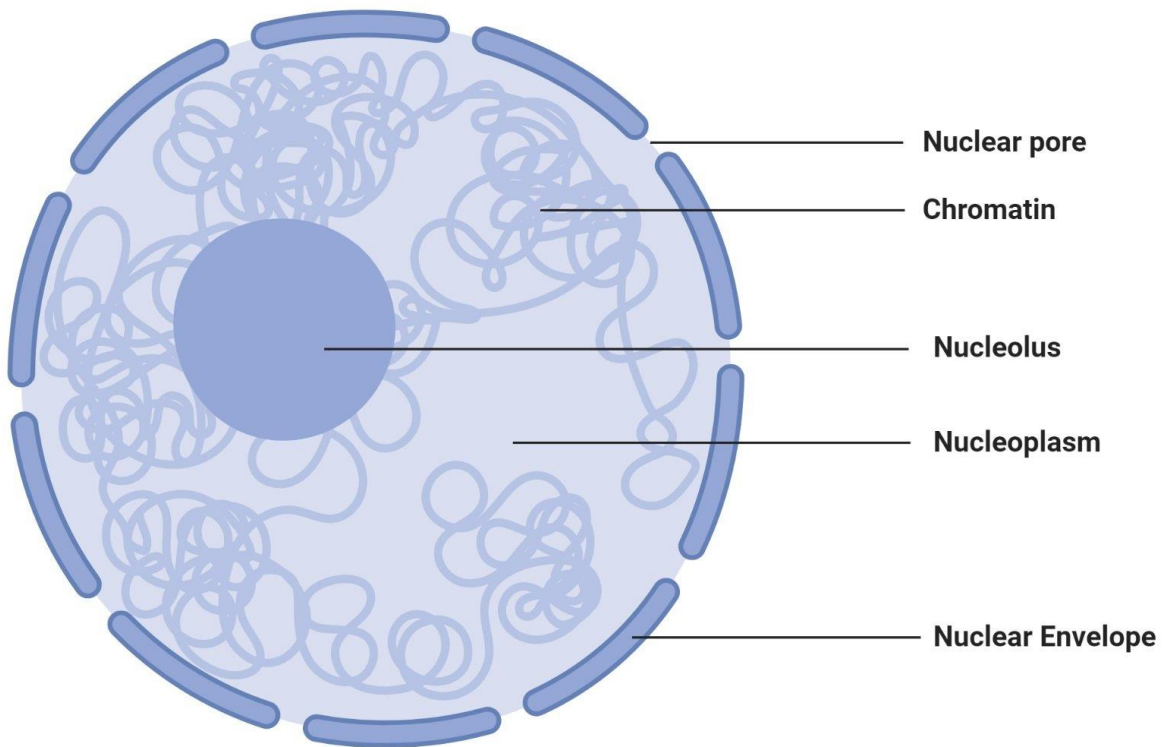


Figure: Nucleus,

Functions of Nucleus

The main function of the cell nucleus is to control gene expression and mediate the replication of DNA during the cell cycle.

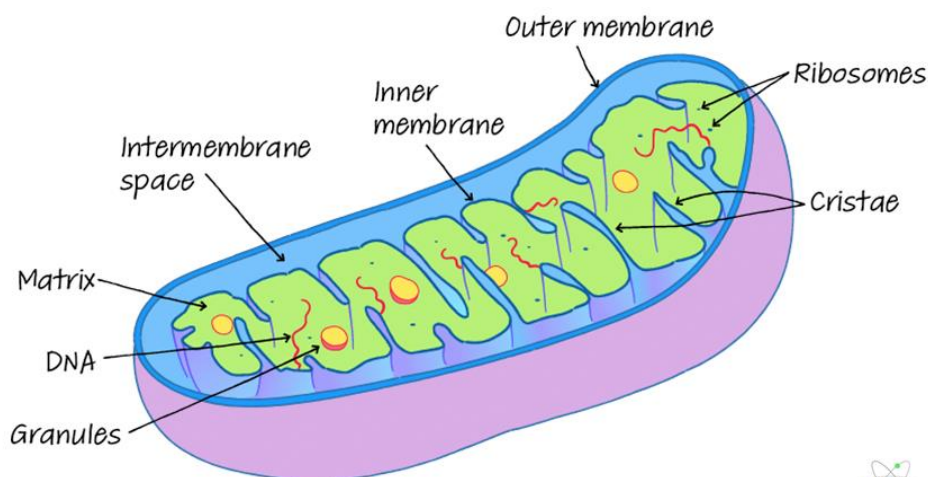
- It controls the hereditary characteristics of an organism.
- The organelle is also responsible for protein synthesis, cell division, growth, and differentiation.
- Storage of hereditary material, the genes in the form of long and thin DNA (deoxyribonucleic acid) strands, referred to as chromatin.
- Storage of proteins and RNA (ribonucleic acid) in the nucleolus.

- The nucleus is a site for transcription in which messenger RNA (mRNA) are produced for protein synthesis.
- During the cell division, chromatins are arranged into chromosomes in the nucleus.
- Production of ribosomes (protein factories) in the nucleolus.
- Selective transportation of regulatory factors and energy molecules through nuclear pores.

Mitochondrion

Mitochondrion, membrane-bound organelle found in the cytoplasm of almost all eukaryotic cells (cells with clearly defined nuclei), the primary function of which is to generate large quantities of energy in the form of adenosine triphosphate (ATP). Mitochondria are typically round to oval in shape and range in size from 0.5 to 10 μm . In addition to producing energy, mitochondria store calcium for cell signaling activities, generate heat, and mediate cell growth and death.

The number of mitochondria per cell varies widely—for example, in humans, erythrocytes (red blood cells) do not contain any mitochondria, whereas liver cells and muscle cells may contain hundreds or even thousands. The only eukaryotic organism known to lack mitochondria is the oxymonad *Monocercomonoides* species. Mitochondria are unlike other cellular organelles in that they have two distinct membranes and a unique genome and reproduce by binary fission; these features indicate that mitochondria share an evolutionary past with prokaryotes (single-celled organisms).



Function

The mitochondrion is the site of ATP synthesis for the cell. The number of mitochondria found in a cell are therefore a good indicator of the cell's rate of metabolic activity; cells which are very metabolically active, such as hepatocytes, will have many mitochondria.

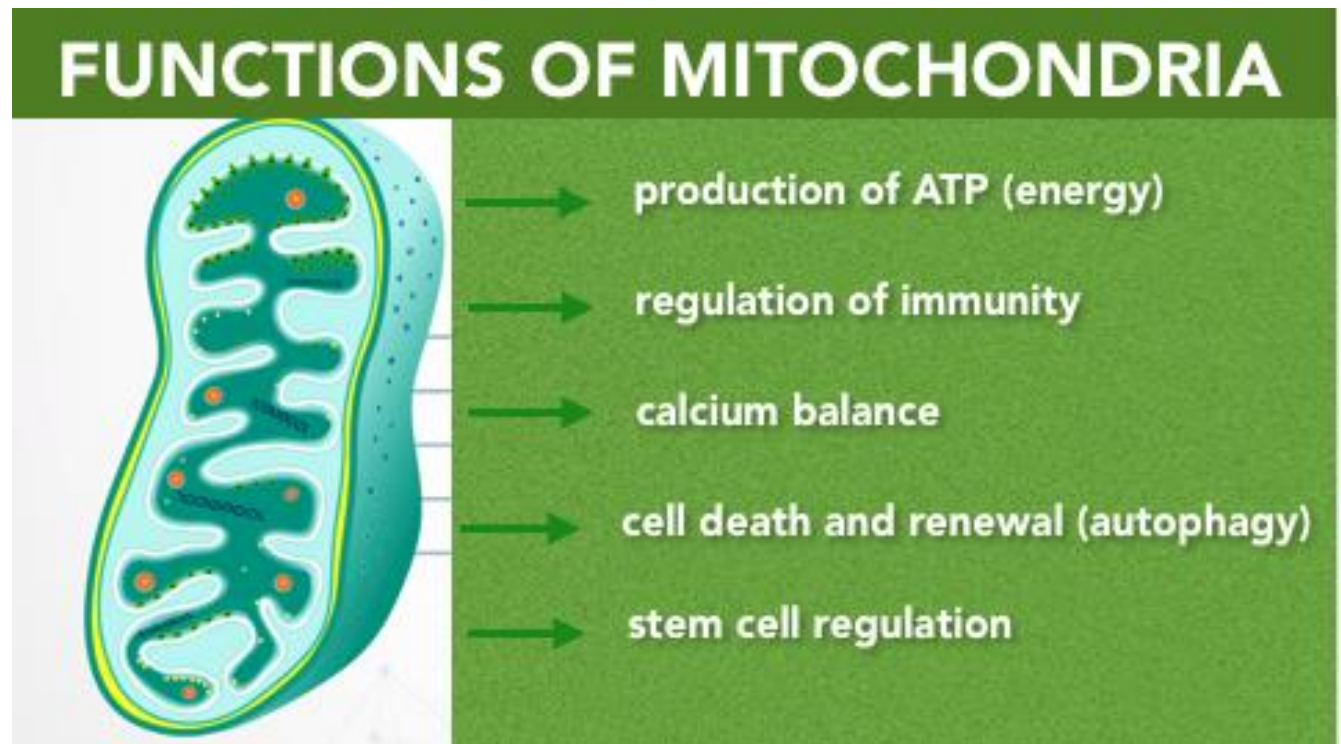
Mitochondria also have a role to help maintain the intracellular environment. They:

Producing energy

Heat production

Storing calcium

Cell death



Endoplasmic Reticulum:

“Endoplasmic Reticulum is a complex network of tubular membranes exclusively present in the cytoplasm of the eukaryotic cell.”

What is Endoplasmic Reticulum?

Endoplasmic reticulum transpires in two forms: a type with ribosome-studded surface and another with a smooth surface. The latter is called the **smooth endoplasmic reticulum**, and the former is called the **rough endoplasmic reticulum**. These membranes form continuous folds, eventually joining the outer layer of the nuclear membrane. Except for sperm cells and red blood cells, the endoplasmic reticulum is observed in every other type of eukaryotic cell.

Endoplasmic Reticulum Function

As stated above, the endoplasmic reticulum is categorised into two types, and both these types of ER perform specific functions:

Smooth Endoplasmic Reticulum Function:

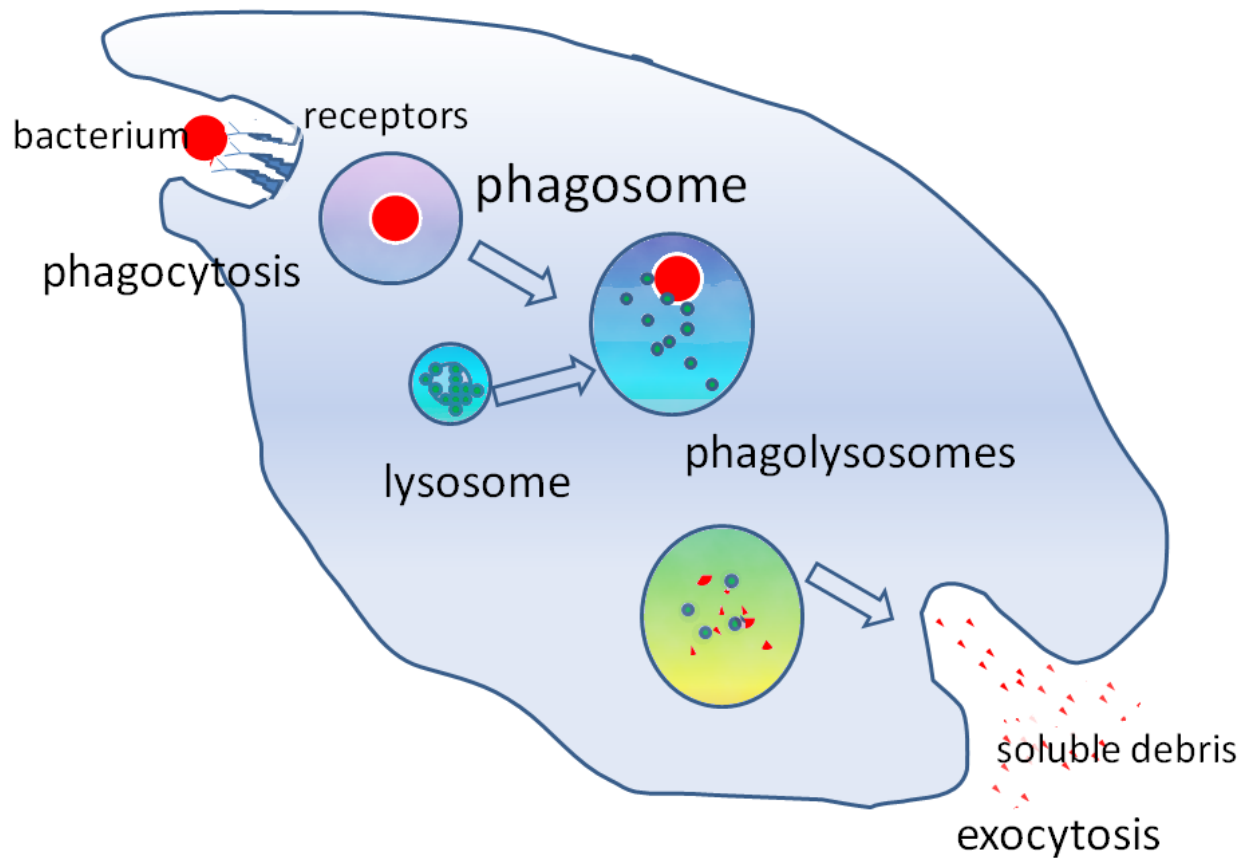
- Smooth ER is responsible for the synthesis of essential lipids such as phospholipids and cholesterol.
- Smooth ER is also responsible for the production and secretion of steroid hormones.
- It is also responsible for the metabolism of carbohydrates.
- The smooth ER store and release calcium ions. These are quite important for the nervous system and muscular system.

Rough Endoplasmic Reticulum Function:

- The majority of the functions of rough ER is associated with protein synthesis.
- Rough endoplasmic reticulum also plays a vital role in protein folding.
- Also ensures quality control (regarding correct protein folding).
- The second most important function after protein synthesis and protein folding is protein sorting.

Lysosome

A lysosome is a membrane-bound cell organelle that contains digestive enzymes. Lysosomes are involved with various cell processes. They break down excess or worn-out cell parts. They may be used to destroy invading viruses and bacteria. If the cell is damaged beyond repair, lysosomes can help it to self-destruct in a process called programmed cell death, or apoptosis.



Lysosome

