Cell Theory:

By definition, a cell is the fundamental and structural unit of all living organisms. It is the smallest biological, structural, and functional unit of all plants and animals. Therefore, cells are the 'Building Blocks of Life' or the 'Basic units of Life'. Organisms made up of a single cell are 'unicellular' whereas organisms made up of many cells are 'multicellular'. Cells perform many different functions within a living organism such as digestion, respiration, reproduction, etc.

For example, within the human body, a lot of cells give rise to a tissue → multiple tissues make up an organ → many organs create an organ system → several organs systems functioning together make up the human body.

- The cell is the basic functional and structural unit of all living organisms.
- All living organisms are made up of cells.
- All cells arise from pre-existing cells.
- One or more cells make up every living entity.
- In organisms, the cell is the fundamental unit of structure and organisation.
- Pre-existing cells give rise to new cells.

The Prokaryotic Cell

Prokaryotic are simple structures, usually unicellular and lack membrane-bound structures. Moreover, the DNA is found in the form of bundles called nucleoids.

The following structures and organelles can be found in a prokaryotic cell, apart from common structures:

1. Nucleoid: Bundles of DNA found in the central region of the cell.
2. Cell wall: The cell wall serves as a structure and protection from the outside environment. Prokaryotes usually have a rigid cell wall made up of peptidoglycans.
3. Capsule: A layer of carbohydrates surrounding the cell wall that helps attach to surfaces.
4. Pili: They are rod-shaped structures involved in DNA transfer and attachment.
5. Flagella: They are thin, hair-like structures that aid in movement.

Prokaryotes are organised into three domains: Eukarya, Bacteria, and Archaeans. Cyanobacteria, a prokaryote, are capable of performing photosynthesis.

Prokaryotic cells produce clones of themselves through binary fission and rely more on horizontal genetic transfer for their variation.

Binary fission is a simpler and faster process than mitosis and involves DNA replication, chromosomal segregation, and ultimately cell separation into two daughter cells genetically identical to the parent cell. In contrast, mitosis does not involve the nuclear envelope, centromere, and spindle formation.

The Eukaryotic Cell

Eukaryotes are complex organisms with a nucleus and other organelles enclosed in a plasma membrane. Here are the primary components of eukaryotic cells.

- Nucleolus: The nucleolus is the part of the nucleus where ribosomal RNA is produced.
- Cell wall: The cell wall, also called the cytoskeleton, provides the structure that enables cell division.
- Mitochondria: They are responsible for energy production; hence, they are known as the cell's powerhouse.
- Endoplasmic reticulum: It plays a role in protein maturation and transportation.
- Vesicles and vacuoles: They are membrane-bound sacs aid in transportation and storage.

Many eukaryotes also have the Golgi apparatus, chloroplasts, and lysosomes.

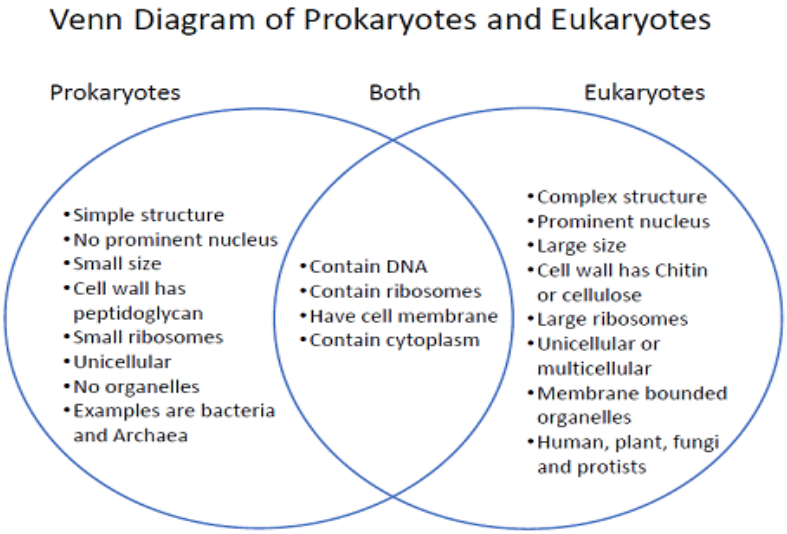
Most eukaryotes undergo sexual reproduction resulting in offspring with genetic material, a mixture of the parents' genome. In this process of sexual recombination, genetic variation is generated.

Mitosis is followed by cytokinesis in eukaryotic cells. This is a multi-stage process in which the nuclear membrane disintegrates, and the chromosomes are sorted and divided so that each daughter cell obtains two sets of chromosomes. Cytokinesis occurs when the cytoplasm divides to produce two genetically identical daughter cells.

Parts of Prokaryotic and Eukaryotic Cells and Venn Diagram

Every cell shares a few common features, whether it is a prokaryote or eukaryote. These components include:

1. Cytoplasm: Comprises the jelly-like fluid in which cellular structures are suspended.
2. Plasma membrane: This membrane encloses the interior of a cell and protects it from its surrounding environment.
3. Ribosomes: These are the factories that synthesise proteins.
4. DNA: A cell's genetic material.



Difference between Prokaryotes and Eukaryotes

Several differences exist between prokaryotes and eukaryotes, including differences in structure—whether a nucleus exists or not if membrane-bound organelles are present, and molecular variation—whether the DNA is circular or linear. The differences are listed below.

Feature	Prokaryotic Cell	Eukaryotic Cell
Presence of nucleus	Absent	Present
Cell size	1-10 µm	10-100 µm
Number of cells	Usually unicellular	Usually multicellular

Cell wall	Complex	Simple
Number of chromosomes	Does not contain a true chromosome instead have a plasmid	One or more
Cytoskeleton	May be absent	Present
Membrane-bound nucleus	Absent	Present
DNA arrangement	Circular	Linear
Ribosomes	Smaller	Larger
Vesicles	Present	Present
Golgi apparatus	Absent	Present
Vacuoles	Present	Present
Permeability of nuclear membrane	Absent	Selective
Mitochondria	Absent	Present
Endoplasmic reticulum	Absent	Present
Microtubules	Absent or rare	Present

Lysosomes and peroxisomes	Absent	Present
Genetic recombination	Partial, unidirectional transfers DNA	Meiosis and fusion of gametes
Example	Bacteria and Archaea	Animals and Plants

Prokaryotes have a diameter range between 0.1-5.0 µm, which is significantly smaller than eukaryotes (10-100 µm). The smaller size of prokaryotes facilitates the exchange of ions, organic molecules, and waste products in and out of the cell quickly. Whereas in the case of larger eukaryotic cells, several structural adaptations have been evolved to enhance cellular transportation. Therefore, prokaryotes are the earliest and most primitive form of life that evolved into complex eukaryotic cells approximately 1.8 billion years ago. They can be differentiated based on genetic materials enclosed by a nuclear envelope. Prokaryotes do not possess membrane-bound organelles, while eukaryotes do