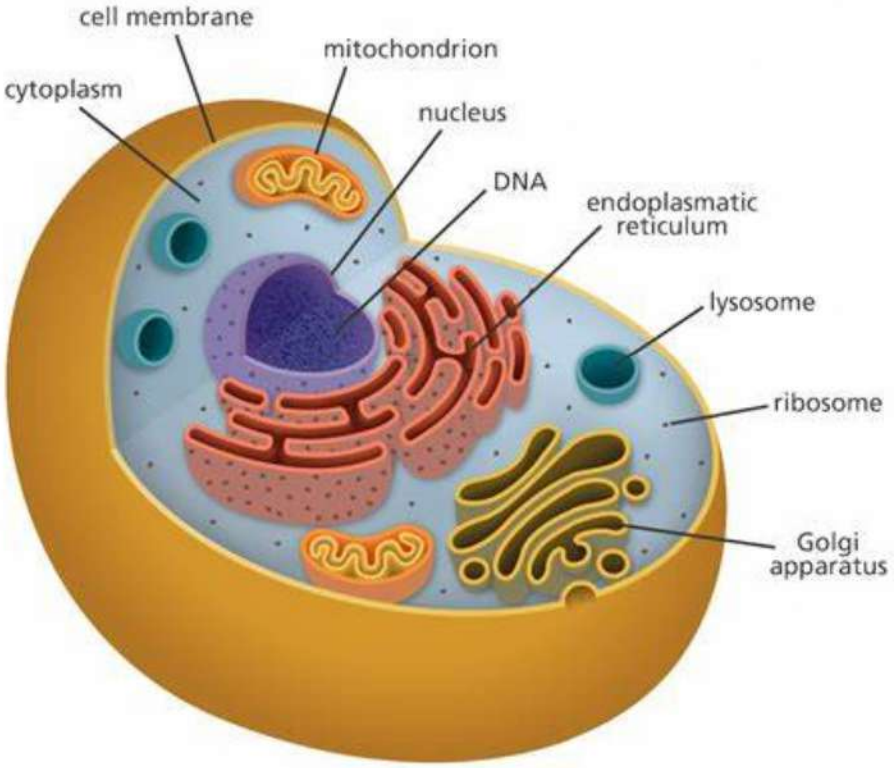
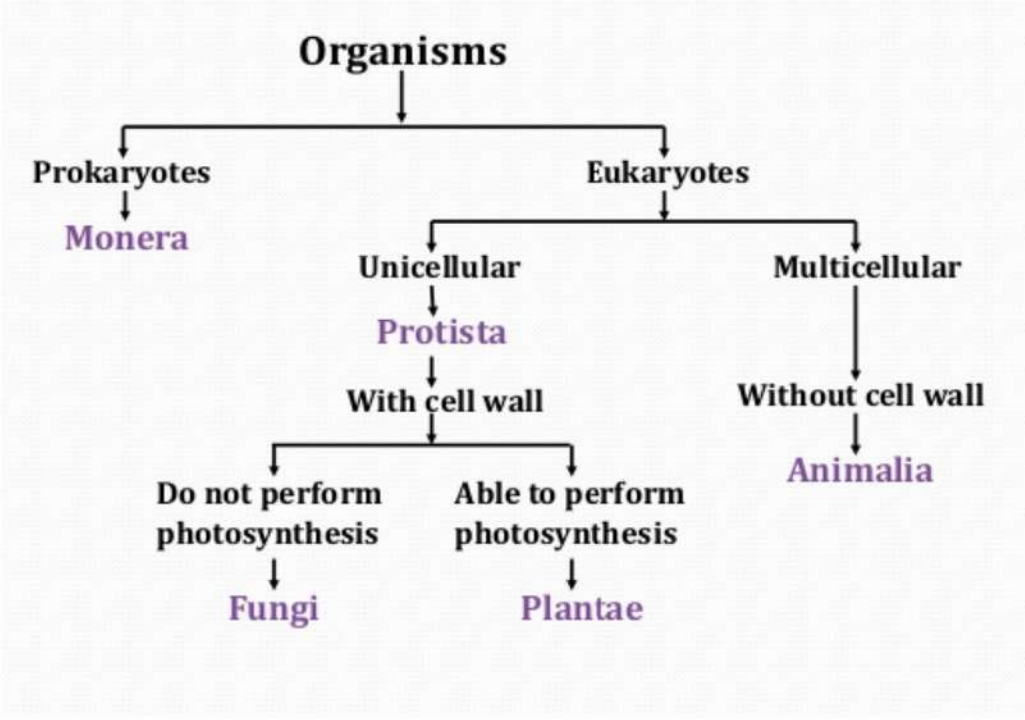
Introduction to Cells

Definition: Cells are the basic structural, functional, and biological units of all living organisms.



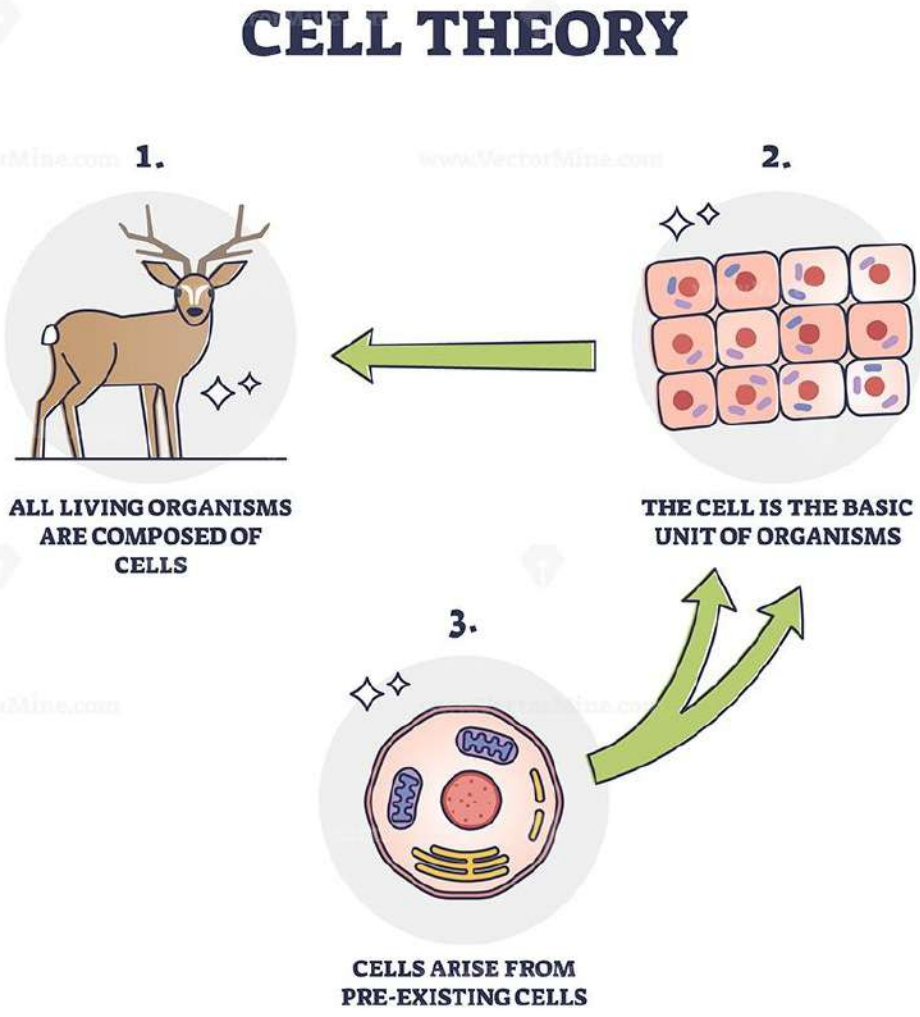
Discovery: Discovered by Robert Hooke in 1665.
Types of Cells:



Prokaryotic Cells: Simple cells without a nucleus (e.g., bacteria).
Eukaryotic Cells: Complex cells with a nucleus (e.g., plants, animals).

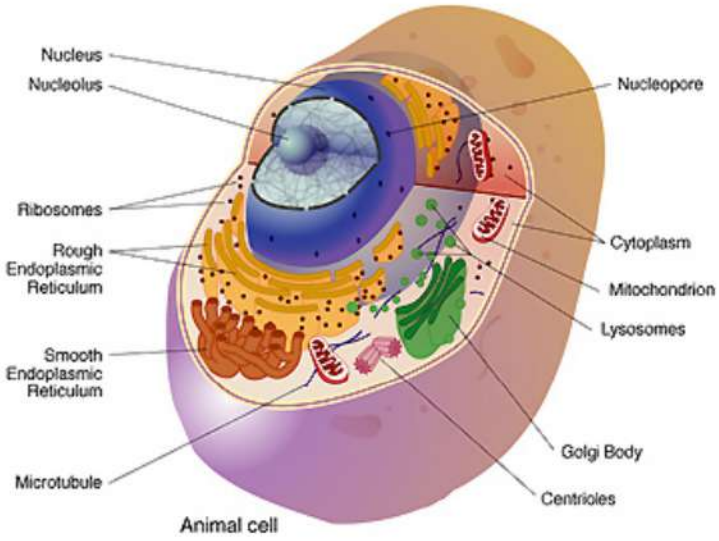
Cell Theory

Key Points of Cell Theory:
1.All living organisms are composed of cells.
2.The cell is the basic unit of life.
3.All cells arise from pre-existing cells.



•Scientists Involved:
•Matthias Schleiden and Theodor Schwann contributed to formulating the cell theory.
•Rudolf Virchow added that cells come from pre-existing cells.

Cell Structure and Organelles



•Cell Membrane: Semi-permeable membrane that controls the entry and exit of substances.
•Cytoplasm: Jelly-like fluid inside the cell where organelles are located.
•Nucleus: Control center containing genetic material (DNA).
•Mitochondria: The powerhouse of the cell, producing energy through cellular respiration.
•Endoplasmic Reticulum (ER):
•Rough ER: Has ribosomes; involved in protein synthesis.
•Smooth ER: No ribosomes; involved in lipid synthesis.
•Golgi Apparatus: Modifies, sorts, and packages proteins for secretion.
•Lysosomes: Contain digestive enzymes to break down waste.
•Vacuoles: Storage organelles; larger in plant cells.

Difference Between Plant and Animal Cells

Plant and animal cells differ in structure and function due to their roles in organisms. Plant cells have a rigid cell wall made of cellulose, which provides structural support and allows them to maintain a fixed, rectangular shape. Animal cells lack a cell wall, so they have a more flexible, irregular shape. Another major difference is that plant cells contain chloroplasts, which enable them to perform photosynthesis, converting sunlight into energy.

animal cell plant cell

Animal cells lack chloroplasts as they do not produce their own food and instead rely on other organisms for energy. Plant cells generally contain a large central vacuole, which helps maintain cell pressure and stores nutrients and waste, while animal cells typically have smaller, multiple vacuoles or may lack them altogether. Additionally, centrioles, which assist in cell division, are found in animal cells but are absent in most plant cells.

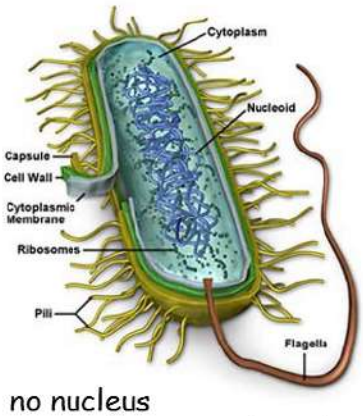
Prokaryotic and Eukaryotic Cells

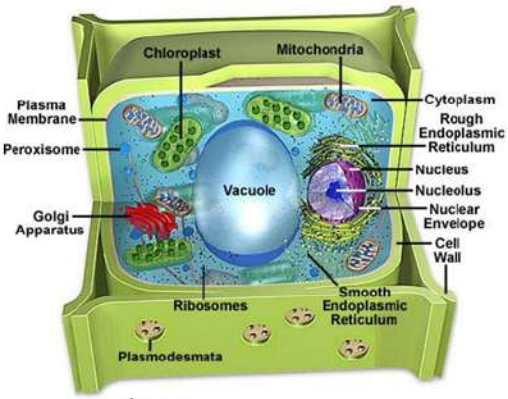
Prokaryotic Cells:
•No nucleus; DNA is in the cytoplasm.
•Lack membrane-bound organelles.
•Smaller in size (0.1-5 micrometers).
•Example: Bacteria.

Eukaryotic Cells:
•Have a defined nucleus with DNA.
•Possess membrane-bound organelles.
•Larger in size (10-100 micrometers).
.Examples: Animal and plant cells.

Prokaryotic vs. Eukaryotic Cells

Prokaryotic vs. Eukaryotic

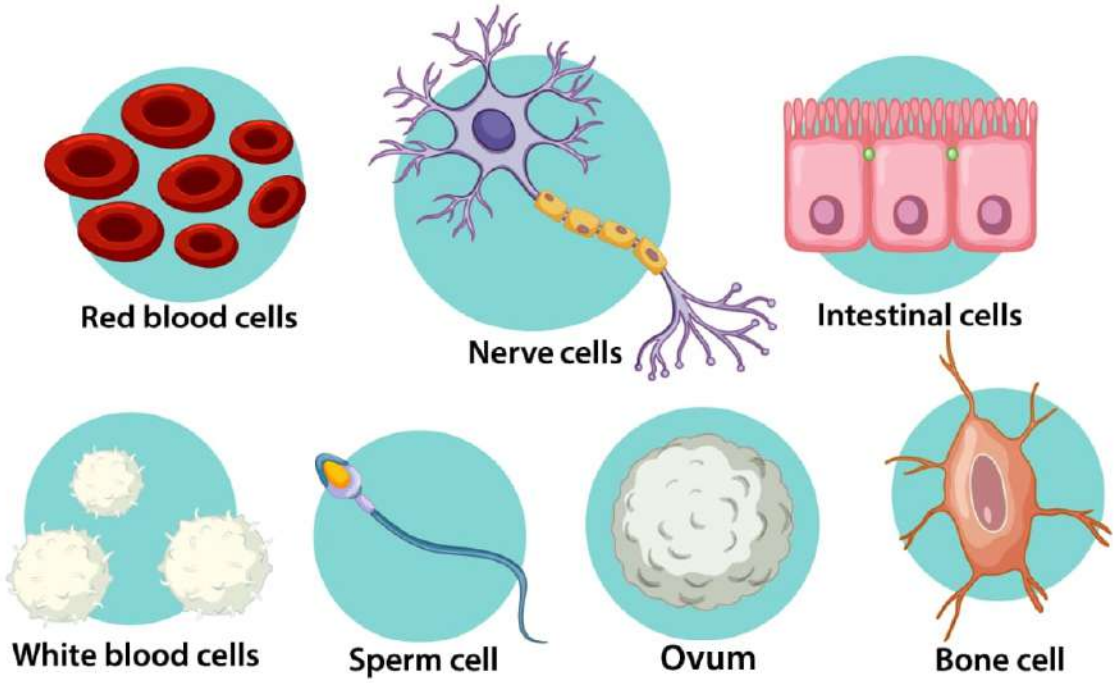




- no nucleus
- no membrane enclosed organelles
- single chromosome
- no streaming in the cytoplasm
- cell division without mitosis
- simple flagella
- smaller ribosomes
- simple cytoskeleton
- no cellulose in cell walls
- no histone proteins

- nucleus
- membrane enclosed organelle
- chromosomes in pairs
- streaming in the cytoplasm
- cell division by mitosis
- complex flagella
- larger ribosomes
- complex cytoskeleton
- cellulose in cell walls
- DNA bound to histone proteins

Specialized Cells

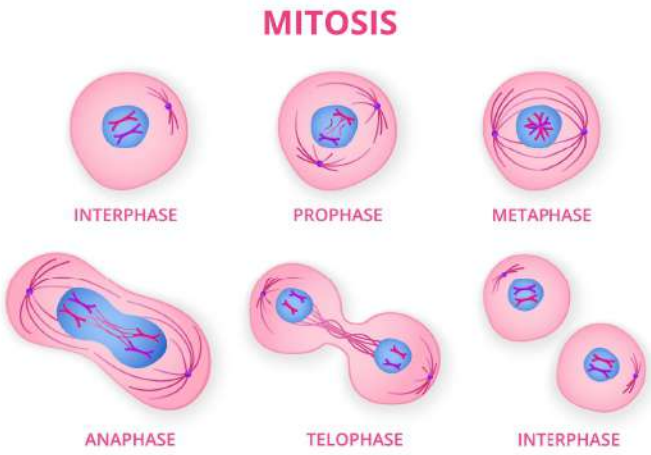


•Red Blood Cells: Carry oxygen in the blood.
•Muscle Cells: Contract to allow movement.
•Nerve Cells: Transmit nerve impulses.

•Root Hair Cells (plants): Absorb water and minerals from soil.
•Xylem Cells (plants): Transport water through the plant.

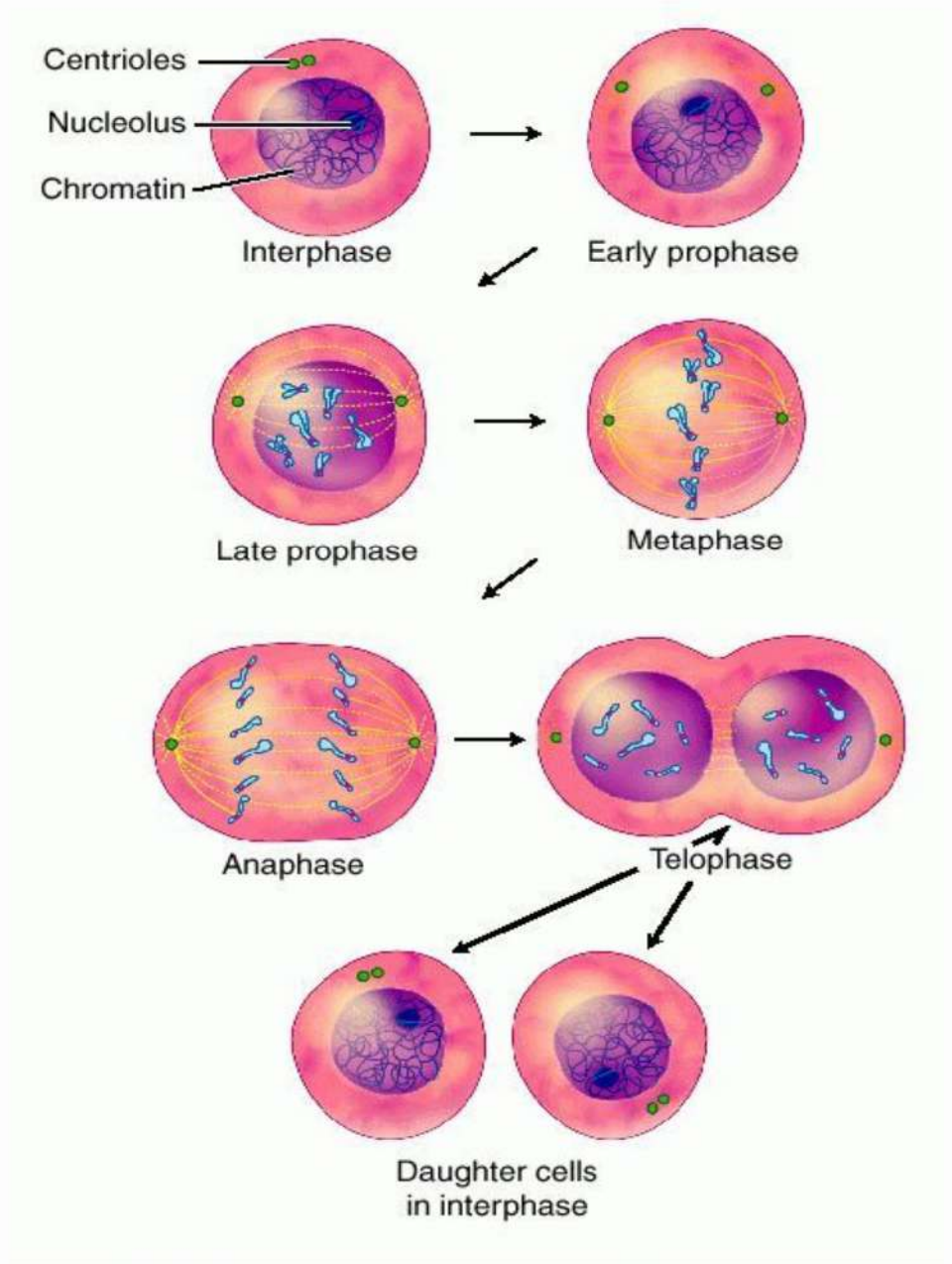
Cell Division

Mitosis:
•Type of cell division resulting in two identical daughter cells.
•Occurs in somatic (body) cells for growth and repair.
•Phases: Prophase, Metaphase, Anaphase, Telophase.



Mitosis is a fundamental process of cell division that results in two genetically identical daughter cells, each containing the same number of chromosomes as the original cell. It plays a crucial role in growth, development, and tissue repair in multicellular organisms. The process is divided into several phases: prophase, where chromatin condenses into visible chromosomes; metaphase, where chromosomes align at the cell's equatorial plane; anaphase, during which sister chromatids are pulled apart to opposite poles; and telophase, where the nuclear membrane re-forms around the separated sets of chromosomes. Finally, cytokinesis occurs, dividing the cytoplasm and completing the cell division. Mitosis ensures the accurate distribution of genetic material, maintaining genetic continuity across generations of cells.

Meiosis
•Produces four non-identical daughter cells.
•Occurs in reproductive cells to form gametes.
•Reduces chromosome number by half (haploid cells).



Meiosis is a specialized type of cell division essential for sexual reproduction in eukaryotic organisms, resulting in four genetically diverse haploid gametes (sperm or eggs). The process consists of two main stages: Meiosis I and Meiosis II. In Meiosis I, homologous chromosomes pair up during prophase I, where crossing over occurs, exchanging genetic material and increasing diversity. The chromosomes align at the cell's equator in metaphase I, are pulled apart in anaphase I, and the cell divides in telophase I, resulting in two cells, each with half the original chromosome number. Meiosis II resembles mitosis; the sister chromatids of each chromosome are separated, resulting in four haploid gametes. This reduction in chromosome number and the introduction of genetic variation are crucial for maintaining the species' genetic diversity and stability during reproduction.

Functions and Importance of Cells

Functions:

•Support and structure of the organism.
•Metabolism and energy production (in mitochondria).
•Genetic material storage and transfer (in the nucleus).
•Regulation of cellular activities.

Importance of Cells:

•They form the basis of life.
•Specialized cells allow for diversity in functions, leading to complex organisms.
•Cell studies are fundamental to understanding biology and medical research.

Conclusion

Cells are the basic units of life, forming the foundation of all living organisms. They are highly specialized to carry out diverse functions, whether they are part of a plant or an animal. Through understanding the differences and functions of plant and animal cells, we gain insights into how complex organisms develop, survive, and interact with their environment. This foundational knowledge of cell structure and function is essential in biology, as it underpins many fields, including medicine, genetics, and ecology.