



CELL BIOLOGY

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Introduction to cell biology :

- Also known as Cytology.
- It is the branch of biology that deals with the study of cell and its structure, functions.
- It also concerned with physiological properties, metabolic processes, signaling pathways, life Cycle, chemical composition and interaction of cell with their environment.
- Cells are the fundamental building blocks of life.
- The first form of life on earth about 3-4 billion years ago.
- They are the smallest units of an organism that can be characterized as living.
- Many organisms are multicellular & also Unicellular microorganisms

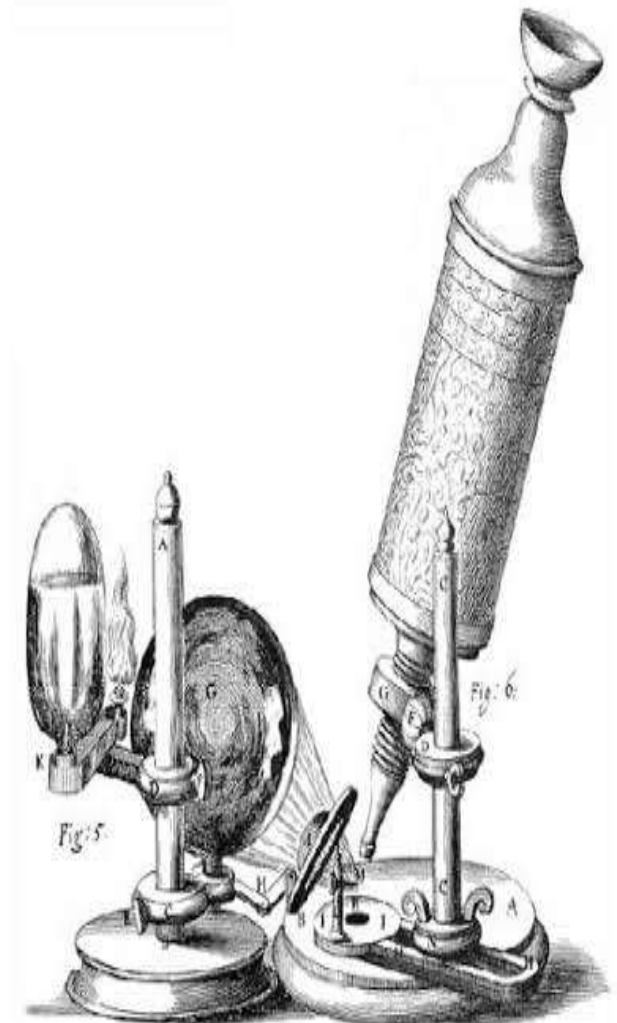
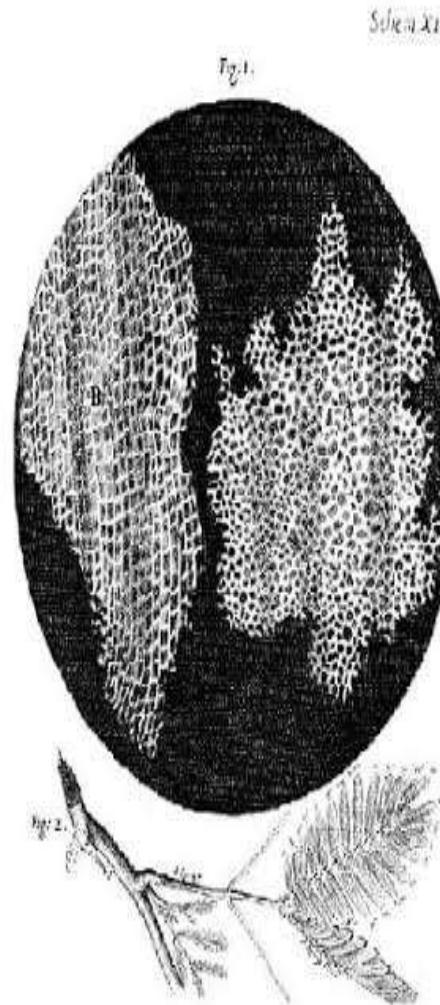
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➤ Robert Hooke was the first to use the word cell in 1665

➤ He observed hexagonal compartment at cork under microscope and that term as cell

➤ Antonie van Leeuwenhoek was the first observe a living cell under a microscope in 1674.

➤ Cell consist of the diversity in their shape, size, structures according to their functions.



Cell Theory:

- Proposed by T. H. Schwann and M. J. Schleiden in 1839
- The basic elements of the classical cell theory state that -
- All living things are composed of cells.
- Cells are the basic unit of structure and function in living thing
- Cells are produced from pre-existing cells.
- All cells are totipotent or plueropotent

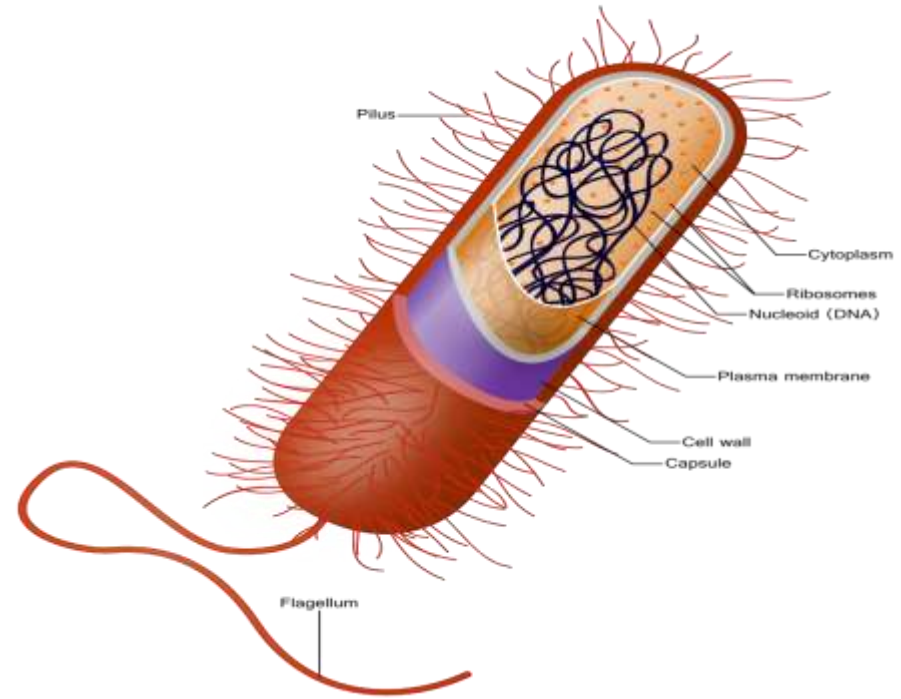


Types of cells :

Two types of cell

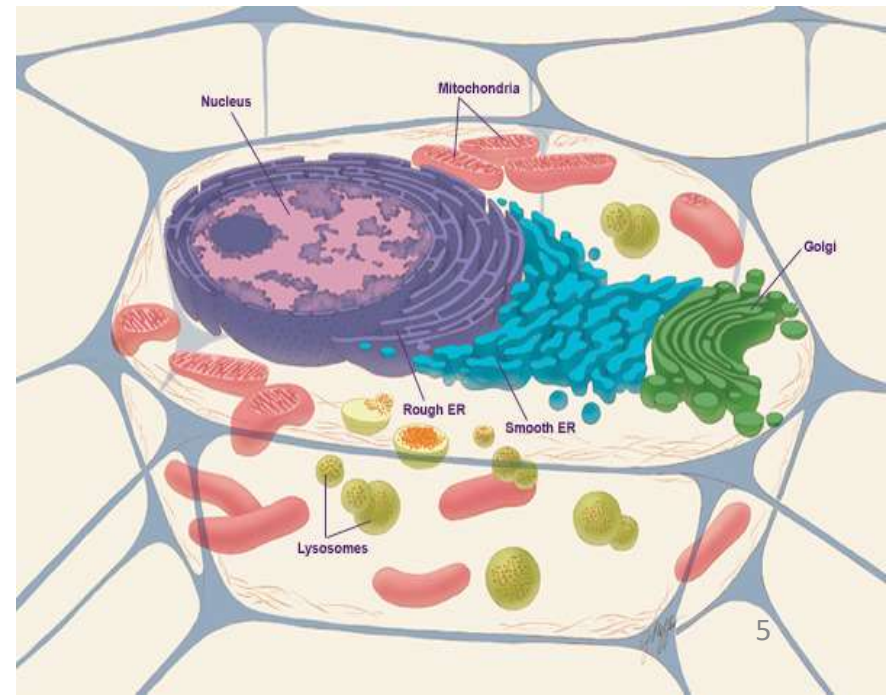
1) Prokaryotic cells:

Pro – Before & Karyon - Nucleus
cells without a nucleus such as bacteria



2) Eukaryotic cells:

Eu – True & Karyon - Nucleus
cells with a distinct nucleus which possess
organized chromosomes that store genetic
material



Importance and Applications of Cell Biology :

- Understanding cells work in healthy and diseased states, cell biologists will be able to develop new vaccines, more effective medicines, plants with improved qualities .
- Forensic medicine uses cell biology and DNA fingerprinting to help solve murders and assaults.
- It helps to get knowledge of cyto-genetics and help to understand Mendel's laws of inheritance and concept of gene.
- It gives knowledge of cyto- pathology and growth of cancer cell
- It helps to study cell physiology and various physiological disorders
- It help in Study of the occurrence of evolution and it indicates how evolution is takes place.
- It helps to study of chromosomal abnormalities and change in number of chromosomes

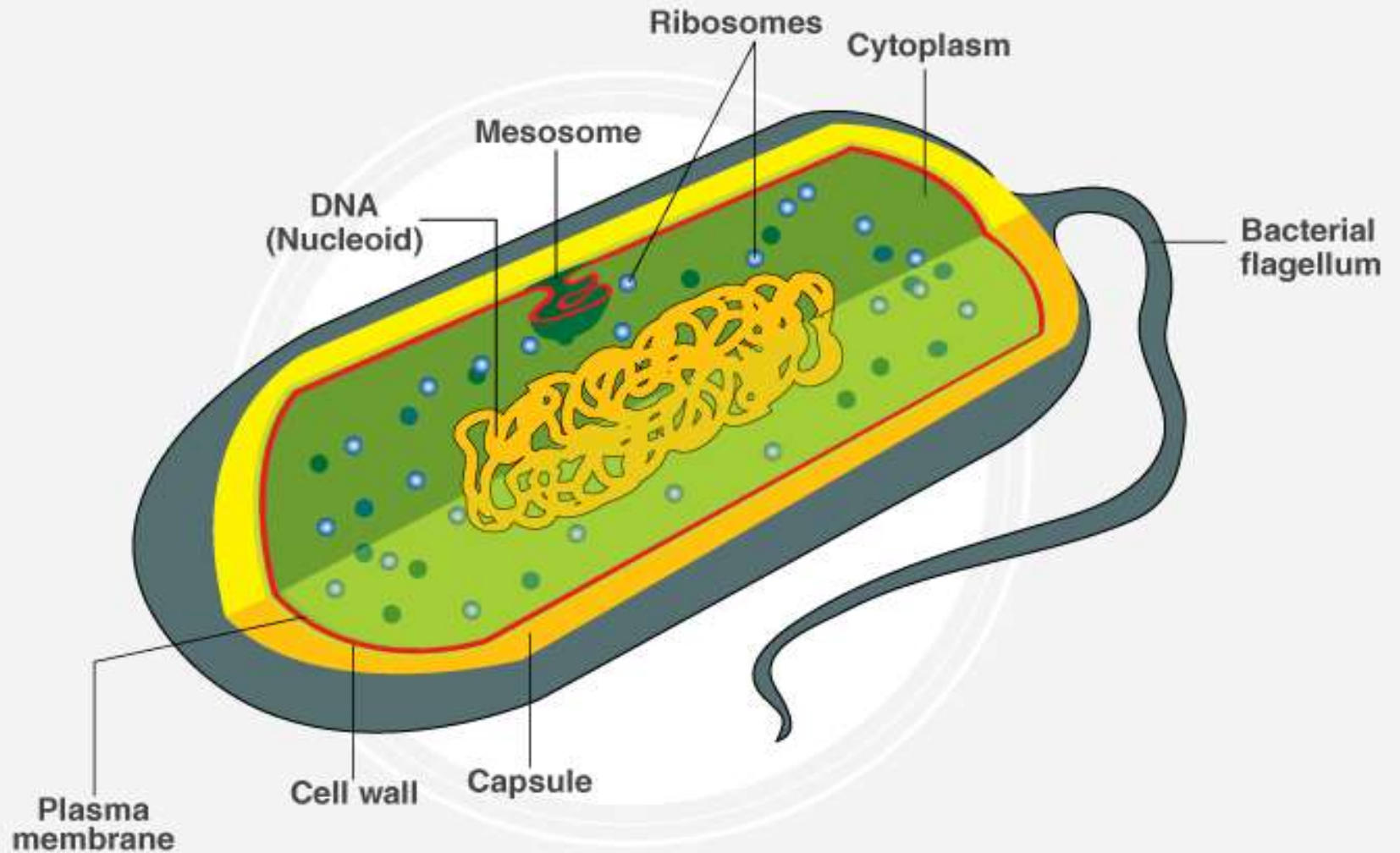
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- The knowledge of cell biology useful develop to genetically modify crops, clone plants and animals
- It also helps produce and ensure high quality food is available at lower costs; to produce purer medicines and in time organs for the many people who need transplants.
- It show the presence of carbohydrates, proteins, lipids, nucleic acid and other organic and inorganic chemical compound in the cell and their metabolic pathways.
- Knowledge of cell structure of living cells is very important in order to carry out cell therapeutics and related genetic studies
- It helps to understand the concept of Cell Death and the concept of cell apoptosis (programmed cell death)

Prokaryotic Cell –

- Small, simple and most primitive
- Nuclear material is not bounded by definite nuclear membrane.
- Organisms like bacteria and cyanobacteria show prokaryotic organization
- Average diameter is about 1 micrometre
- Four forms of bacteria –
 - i) Cocci – spherical or circular in shape
 - ii) Bacilli – rod shape
 - iii) Spirilla- spiral or spring shape
 - iv) Vibrios – Comma shape
- Cyanobacteria or blue green algae are photosynthetic prokaryotes and fix atmospheric nitrogen

PROKARYOTIC CELLS



1) Cell Envelope :

- It consists three basic layers, glycocalyx, cell wall and cell membrane
- These three layers together act as a single protective covering

a) Glycocalyx :

- Outermost layer made up of macromolecules polysaccharide and protein which help in adhesion of bacteria.
- Glycocalyx differs in composition and thickness among different bacteria.
- It could be a loose sheath called the slime layer in some, while in others it may be thick and tough, called the capsule

b) Cell Wall :

- Present below Glycocalyx & provide definite shape and gives strong structural support
- Made up of peptidoglycan or murein
- The cell walls of different bacteria show different types of reactions to Gram's stain.
- Those take up the gram stain are Gram positive and the others that do not are called Gram negative bacteria.

c) Cell membrane :

- Innermost covering of cell Envelope composed of lipids and proteins.
- It separates the interior of the cell from its environment, serves as a barrier and helps in intercellular communication.
- It is the site for critical metabolic processes like respiration, photosynthesis, synthesis of lipids and cell wall constituents
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- It also holds receptor molecules that helps bacteria to detect and respond to chemical in their surroundings

2) Cytoplasm :

- A semi- fluid ground substance or matrix present inner to the cell membrane
- It contains a variety of inorganic and organic compounds which provide a suitable chemical environment for cellular activities.
- It lacks membrane bound organelles such as mitochondria, endoplasmic reticulum, Golgi complex and lysosomes
- Certain membranous structures like mesosomes and chromatophores are observed

a) Mesosomes :

- These are invaginations of plasma membrane into the cell in the form of vesicles, tubules and lamellae
- Mesosomes are involved in the formation of cell wall and in DNA replication and distribution of chromosomes to daughter cells.

b) Chromatophores :

- Usually found in photosynthetic bacteria and cyanobacteria
- They contain different types of pigments such as bacteriochlorophylls, bacteriopheophytin and carotenoids

c) Inclusion bodies:

- A kind of storage granules that lie free in the cytoplasm
- Reserve material in prokaryotic cells are stored in the cytoplasm in the form of inclusion bodies.

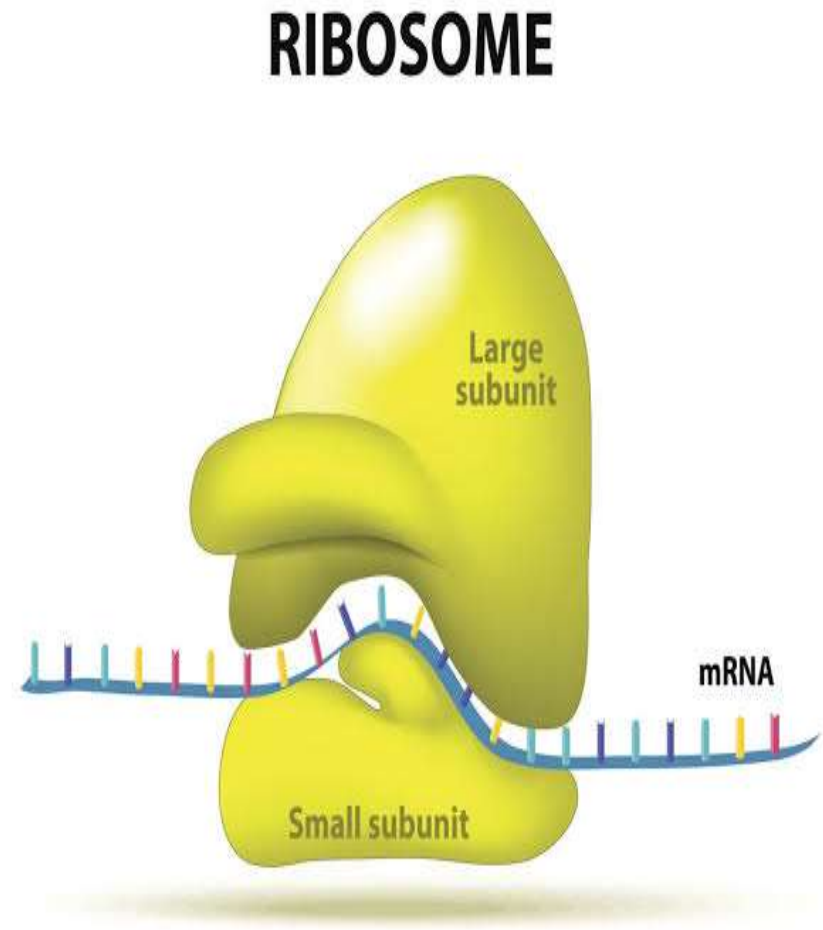
Two types

i) Organic Inclusions : includes starch and glycogen granules

ii) Inorganic Inclusions : includes phosphate and sulphur granules.

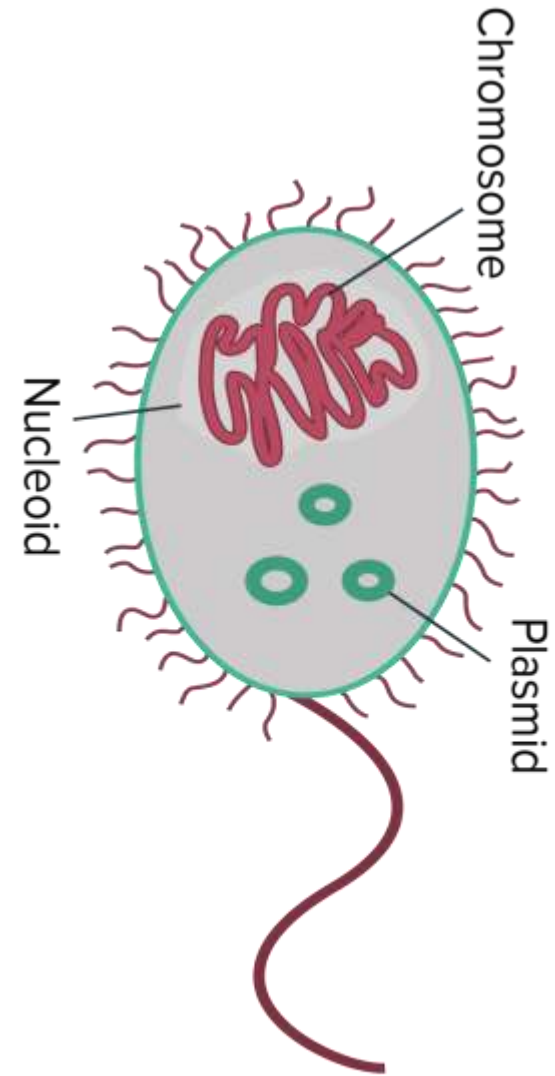
3) Ribosome:

- The cytoplasmic matrix of prokaryotic cell possesses dense particles called ribosomes.
- Made up of RNA and protein
- Prokaryotic ribosomes are 70S type.
- Each 70S is composed of two subunits: 50S and 30S.
- They help in protein synthesis
- Several ribosomes may attach to a single mRNA and form a chain called
- polyribosomes or polysome.
- The ribosomes of a polysome translate the mRNA into proteins.



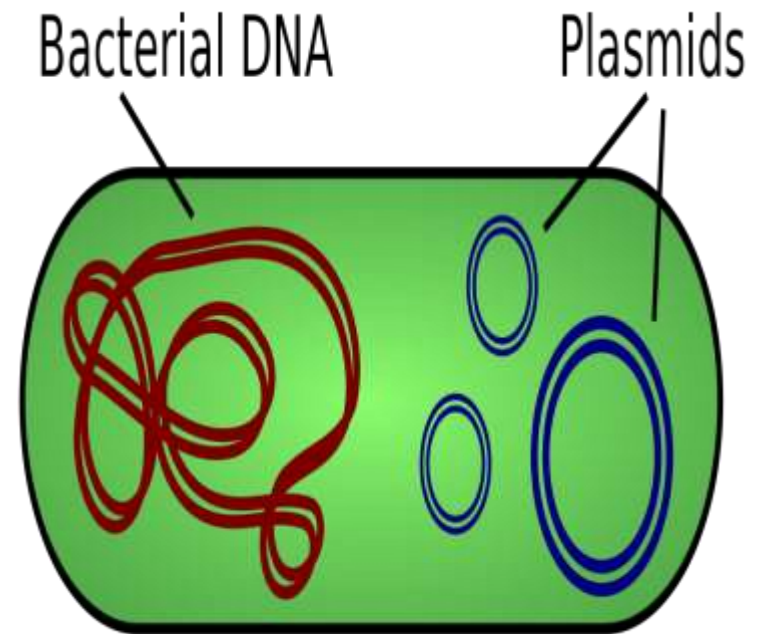
4) Genetic Material (Nucleoid) :

- The prokaryotes do not have membrane bound nucleus
- Genetic material consists of a long, double stranded, circular DNA molecule known as prokaryotic chromosome
- It is highly looped and coiled with associated proteins
- These associated proteins differ from the histone proteins of eukaryotic cells.
- Circular DNA molecule is connected to the plasma membrane through the mesosome.



5) Plasmids :

- The extra chromosomal DNA present in Prokaryotic Cell is called as plasmid
- The prokaryotic Cell may possess one or more additional self replicating molecules of circular DNA or mini chromosomes are the plasmids
- Plasmid can carry out function, such as antibiotic resistance and fertility



| Characteristics | Eukaryotic Cells | Prokaryotic Cells |
|--|--|---|
| Definition | Any cell that contains a clearly defined nucleus and membrane bound organelles | Any unicellular organism that does not contain a membrane bound nucleus or organelles |
| Examples | Animal, plant, fungi, and protist cells | Bacteria and Archaea |
| Nucleus | Present (membrane bound) | Absent (nucleoid region) |
| Cell Size | Large (10-100 micrometers) | Small (less than a micrometer to 5 micrometers) |
| DNA Replication | Highly regulated with selective origins and sequences | Replicates entire genome at once |
| Organism Type | Usually multicellular | Unicellular |
| Chromosomes | More than one | One long single loop of DNA and plasmids |
| Ribosomes | Large | Small |
| Growth Rate/Generation Time | Slower | Faster |
| Organelles | Present | Absent |
| Ability to Store Hereditary Information | All eukaryotes have this ability | All prokaryotes have this ability |
| Cell Wall | Simple: Present in plants and fungi | Complex: Present in all prokaryotes |
| Plasma Membrane | Present | Present |
| Cytoplasm | Present | Present |