CELL BIOLOGY (SUPPLEMENT)

Father of modern cytology - C. P. Swanson
Father of Indian cytology - A. K. Sharma

- **National centre** for **cell science, pune.**
- Institute of life sciences, **Bhubaneshwar.**
- National Institute of oceanography, **Panjeem** (Goa)
- Advance centre for cell & chromosome Research (Kolkata) .
- National Institute of Immunology, **New Delhi**
- National Brain Research Centre Manesar, **Gurgaon**
- Centre for cellular and molecular biology **hyddrabad.**
- Centre for DNA finger printing and Diagnostics **Hyderabad** (CDEF) .
- nstitute of Genomics and Integrative Biology, **New Delhi.**
- nternational Centre for Genetic Engineering & Biotechnology (ICGEB) - **New Delhi** (also in Italy)

Cytology ⇒ Study of cell structure
Cell biology ⇒ Study of cell structure and function & Reproduction

⇒ **Robert Hook (1665)** in his book **" Micrographia"** coined the term **" Cell" .** He first observed the cell in a piece of cork (dead cells)
(Greek word cella = Small hollow space or Chamber)

⇒ Malpighi (1671) and Grew (1682) first observed living cells in plants and called them ***" Bladders" and*** " Utricles" respectively

⇒ Leeuwnhoek (1674) first observed animal cells (Free animals cells) and called them ***" Animalcule"***

CELL THEORY

M. J. Schleiden (1838) - **German Botanist**
T. Schwann (1839) - **German Zoologist**

(1) Living organisms are made up of cells and substances produced by cell (**Cell is structural units**)
(2) All cells arises from the preexisting cells only (confirmed by **Rudoloph virchow (1855)** by stating **" Omnis celluulae cellula" . Virchow** proposed **" Cell Lineage theory" .** [**Karl Nageli** showed that plant cells arise from the **division** of pre existing cells].
(3) All cells are basically similar in structure and metabolic function.
(4) Vital activities of an organism are due to the activities of its cells (**Cell is functional units**)
(5) Each cell has a unit of heredity.

⇒ **Exception of cell theory :**
According to this theory all the living organism are made up of cells. Viruses are exception of this theory because viruses lacks cell organisation.
According to modern scientists all the **acellular organism - monera and protista, Xanthophytes.** (Vaucharia) **Phycomycetes** (Rhizopus) are exception of cell theory.

⇒ **Cell Principle**

First of cell hypothesis was proposed by Schwann (1839) . It was raised to the status of cell theory by **Schleiden** and **Schwann.** It wa modified, when **R. Virchow** (1855) Put forward the theory of **cell lineage** or development of cells from preexisting cells. (" Omnis cellulae ellula") A a result of these additions the cell theory has been as **" cell principle** or **cell dorctrin"** the cell principle is better than cell theory as it applies almost to all the living things, plants animals and microbes and it also incorporates nearly all the modern findings about a cell.

⇒ **Modern cell theory** or **cell principle states that :**

(i) The body of all living beings is made up of cell and their products.
(ii) Cell is the unit of structure of body of all organisms.
(iii) A cell is made up of a small mass of protoplasm having nucleus, a number of organelles and covering membrane.
(iv) Each cell is capable of independent existence but a cell organelle can not survive independently.
(v) All cells have fundamental similarity in structure, chemical composition and basis metabolic reactions.
(vi) Life exists only in cells because all activities of life are performed by cells.
(vii) New cells arise from pre-existing cells through division.
(viii) Each cell contains the whole complement of genetic information not for itself but for the whole organism (Totipotency)
(ix) Genetic information's is stored and expressed withing the cells.
(x) Life transferred from one generation to the next only in the form of cells.
(xi) All cells of present day organisms have evolved from primitive cells of the remote past. They have a common ancestry.
(xii) The cells of an individual get transformed structurally to perform specified function, loss of centriole in nverce cells. Lost of nucleus in mammalian RBSs & form of sperms.
(xiii) Cells maintain homoeostasis and their internal environment
(xiv) No organism, organ, or tissue can have any activity that is absent in its cells.
(xv) All cells have a full genetic information coded in their DNA but each cell type uses only a part of information require for its special function or structure.

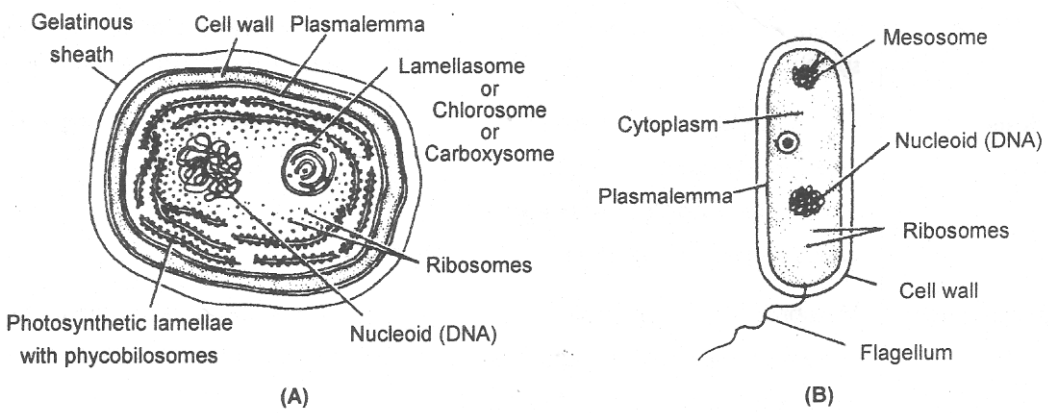
Objections :

(a) Nucleus in absent in prokaryotes, mature RBCs.
(b) Prokaryotes lack a number of cell organelles present in eukaryotes.
(c) Virus do not obey theory of cell lineage
(d) A number of nuclei present in coenocyte or syncytium.

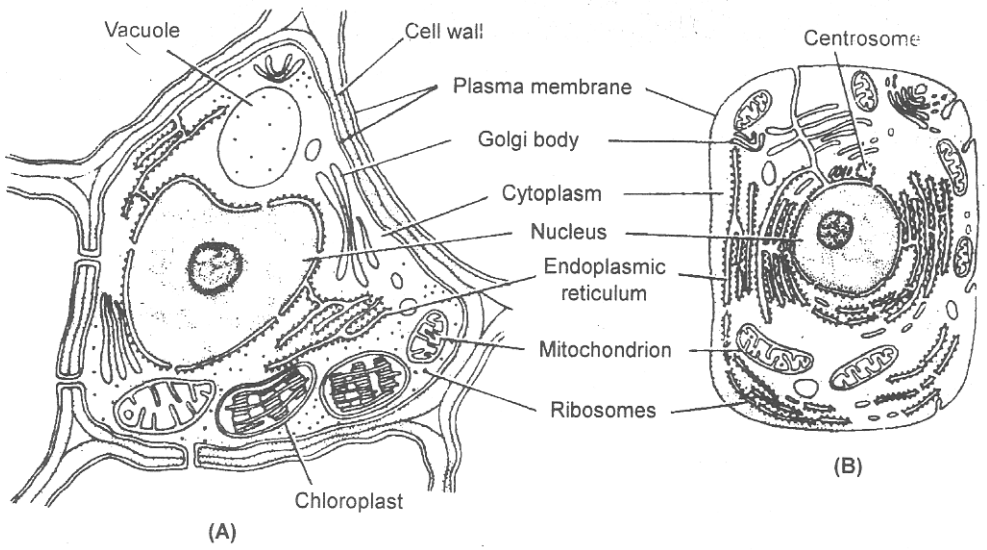
DIFFERENCES BETWEEN PROKARYOTIC & EUKARYOTIC

CHARACTERS	PROKARYOTICS CELL	EUKARYOTIC CELL
(1) Nuclear Membrane	Nuclear membrane absent (Prok. are single membranous system)	Nuclear membrane present Eukaryotes are double enveloped system (compartmentalisation)
2) Nucleus	Well organised nucleus absent, thus nuclear material is called s **Incipient nucleus/prokaryon/ Genophore / nucleoid** etc.	present Nucleus well organised
(3) Cell organelles	Membranous cell organalles are absent (like Mitochondria plastids E. R. golgibody, Microbody)	Membranous cell organalles are present. (Plastids only in plants)
(4) Ribosome	70-S type	80-S types and 70-S (Mito. & chlroplast)

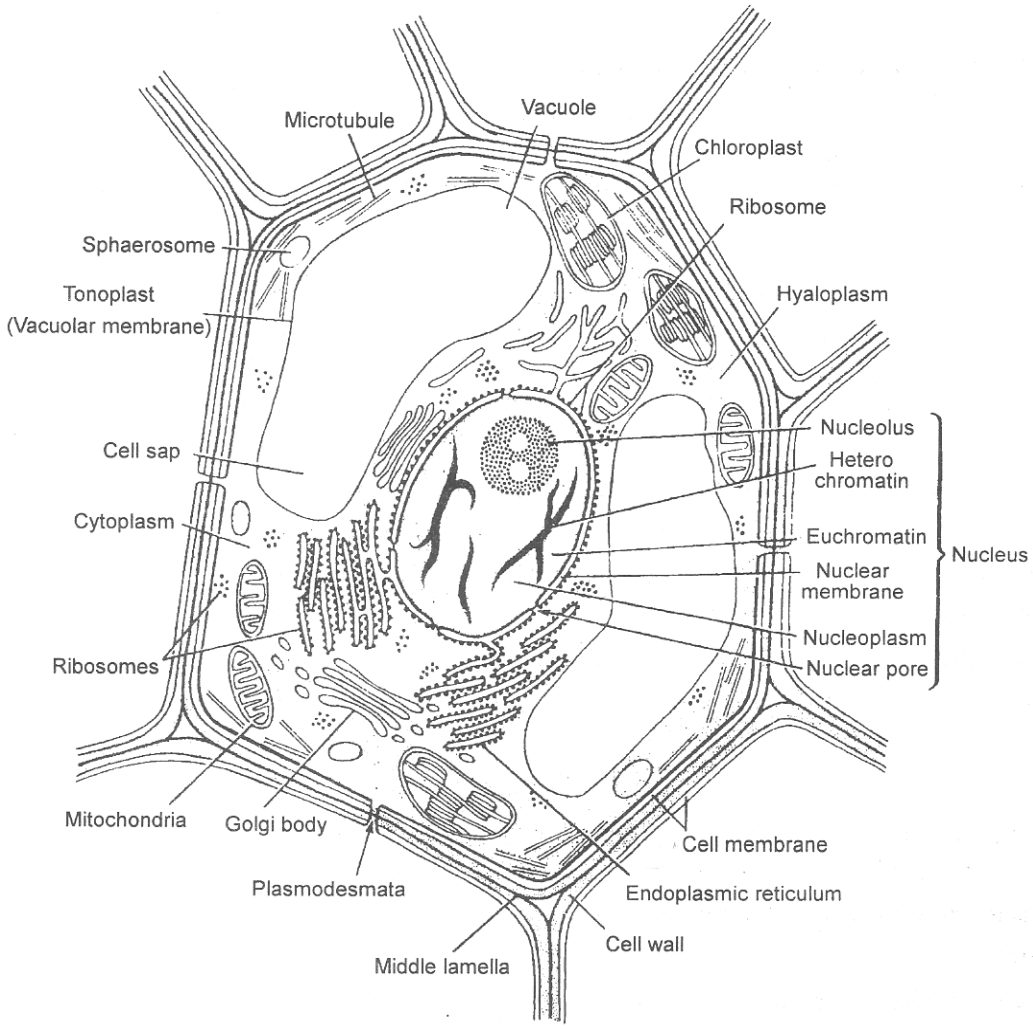
(5) Cell wall	Present (made by peptidoglycan/ Murien/Muramic acid/Mucopeptide)	Present in plant cells only (made by cellulose or chitin)
(6) Resp. Enzymes	Presents in Mesosome mainly in aerobic cell.	Found in cytoplasm and Mitochondira
(7) Flagella	Flagella are Made up of **Flagellin** protein.	Flagella re elevn stranded, Made up of Tubulin protein (9+2 arrangement)
(8) Photosynthesis	Takes place in **Carboxysomes** or lamelles or **chlorosomes** in BGA (in Bacteria chromatophores membrane infoldings)	Chloroplasts
(9) Cylosis	Cytoplsmic streaming absent	Present
(10) Chromosomes	**Naked** or **folded genome** made by Mainly **circular-ds-DNA** (G-C Cih) (Histome protein absent)	True chromosomes & more than one (Histome asso. with DNA)
(11) Cell division	Amitosis only	Mitosis & meiosis (R. D.) mainly
(12) Ploidy level	Consider as haploid	Haploid, Diploid, Polyploid
(13) Sexuality	Sexuality or true Sexual Reproduction absent in prokaryotic cell[In Bacteria genetic - recombination or parasexual reproduction by con]- ugation, transduction & transformation]	Sexuality or sexual reproduction present (Meiosis, gamete formation & true fertilization occurs)
(14) Vacuoles	Absent but gas vacole may presen	Present as sap vacuoles in plant cell
(15) Protein Synthesis	takes place in cytoplasm	Transcription in nucleus & Translation in cytoplasm on ribosome's.
Examples :	**Bacteria Cyanobacteria (BGA) Mycoplasma (PPLO) Ricketsias, Actinomycetes. [Monera]**	All **plant** & **Animals cells** including **Human cells.** **Protista, algae, Fungi protozoa.**



(A) A cell of blue-green alga, (B) A bacterial cell



(A) A plant cell (B) An animal cell



A plant cell (Electron microscopic structure)

Diffrences beteween Animal & Plant cell

CHARACTERS	NIMAL CELL	PLANT CELL
(1) Cell Wall	Cell wall absent in animal cell.	Cell wall present only in plant cell (Bacteria consider as plant due to presence of CW)
(2) Plastids	Plastids or chloroplasts absent in animal cell. No. - Chlorophyll	Plastids presents in plant cells. (Except - Fungi)
(3) Centrosome	Centrosome found in animal cells	Centrosome absent in plant cell (Except-Lower plants)
(4) Vacuoles	Absent of small, Temporary vacuoles may presents	Sap/True vacuoles are present in plant cells.
(5) Cell division	Cytokinesis by **constriction formation** or furrowing. (Cell division is **amphiastral)**	Cell division by **cell plate** (phragmoplast) formation. (Cell Div. **anastral** type)
(6) Reserve food	Reserve food is glyocgen in animal cells.	Mainly strach is reserve food in plant cells

Units of Measurement

1 millimeter (mm)	=	1/10 cm
1 micron (μ) or micrometer (μm)	=	1/1000 mm
1 millimicron ($m\mu$) or nanometere	=	1/100 μ
1 Angstrom (A0)	=	1/10 $m\mu$

ongest cell (Human) : Nerve cells - 90 cm. > Egg cell 100 nm > Sperm 60 nm > Kidney cell 30 nm > RBC 7. 5 nm
Logest plant cell : fibers of ramine (**Boehmeria nivea**) - upto 55 cm.
Largest cell : ostrich egg - 11 × 17 cm
Smallest cells : **Mycoplasma laidlawii -** 0. 1 μ
Virus & Prions : Akaryota
Mesokaryotes : Dianoflagellates
Prokaryotes : Bacteria Spirochaetes BGA, Actinomycetes, Mycoplasma

NONLIVING INCLUSION.

Nonliving and temporary structures of ctoplasm called **" Paraplasm'** or **" Metaplasm"** or **" Deutoplasm"** These includes excretory materials (waste products) , stored food and secretory materials.

(1) ***Excretory or Waste materials***

(A) ***Inorganic***

(a) ***Cystolithis*** - Crystals of calcium carbonate. These crystals are pedicillite and appear like a cluster of grapes inside plant cells.
e. g. ***Hevea*** (Rubber plant) , ***Ficus,*** Cucurbitaceae, Acanthaceae, **Justicia**

(b) ***Calcium oxalate*** - Two types of Crystals -

(i) ***Raphides*** - needle like crystals which occur solitary or in groups.
e. g. ***Eichornima, Pistia, Rubber plant***

(ii) ***Spheroraphides*** or ***Drus*** or conglomerate crystals, these are star like crystals, of calcium oxalate.
e. g. ***Colacacia, Pistia Carica papaya*** (papaya) , ***Atropa, Nerium, Dioscorea***

(c) ***Silica*** - cell wall in grasses and ***Equisetum*** impregnated with silica. Silica particles also occur in cytoplasm of ***Belladona*** leaves and roots.

(B) ***Organic***

(a) ***Nitrogenous***

(i) ***Alkaloids*** - Nitrogenous waste materials, bitter in taste and insoluble in water. Alkaloid are of great medicinal importance.

Name of Alkaloid	Source	Use
(1) Morphine	Capsule of ***Papaver soniferum***	Analgesic and sedative
(2) Codeine	-do-	Cough and cold
(3) Reserpine	Rootsof ***Rauwolfia serpentina***	Lowers blood pressure
(4) Quinine	Bark of ***Cinchona officinalis***	Malaria
(5) Atropine	Leaves of ***Atropa balladona***	Dilates pupil of eye
(6) Ephedrine	Entireplant(Mainlystem)of***Ephedra***	Cough, Asthama
(7) Curcumine	Rhizome of ***Curcuma longa***	Antihelmintic
(8) Aconita	Roots of ***Aconitum napellus***	Neuralgiaand Rheumatism
(9) Cocaine	Leaves of ***Erythroxylon coca***	Local anaesthetic
(10) Strychine	Seeds of ***strychnos nuxvomica***	Nervous disorder

(ii) ***Glycosides*** -Nitrogen containing degration products of carbohydrates e. g. Digitoxin obtained from leaves of Fox glove (***Digitalis purpurea***) . Digitoxin is used as heart stimulant.

(b) ***None nitrogenous***

(i) ***Tannins*** - Derivatives of glycosides, solube in water. Tannis are bitter in taste. These occur more in unripe fruits. Tea leaves ahve 18% tannis, kattha obtained from heart wood of ***Acacia ctechu*** have high concetnration of tanning.

(ii) ***Resin*** - Oxidation products of essential oils. These occur as viscous water insolulbe fluid inside plants. Formation of resins takes place inside special ducts called resin ducts. Resins commonly occurs in Pines.

⇒ Canada Balsam obtained from ***Abies balsemia*** is a type of ***Resin.***

(iii) ***Gums*** - Water soluble degradation products of plant cell wall.

⇒ ***Gum arabic*** - obtained from ***Acacia senegal*** and ***A. arabica.***
Guar gum - Obtained from poods of ***Cyamopsis tetragonoloba***
Bengal Kino - Stem of ***Butea monosperma***

(iv) ***Lates*** - Composition of latex vary in different plants. It may contain sugars, starch grains amino-acids minerals, alkaloids toxins resing gums, oils etc. Latex is produced in laticiferous tissue composed of either latex cells or latex vessels. Latex eg. **Hevea brasiliensis** serves the function of protection, healing wounds, nutrition etc. Plants which provide latex for bioful are called petrocrops. (firt studied by calvin) Jatropa, Calotropis, Euphorbia etc.

(v) ***Essential oils*** - Highly aromatic water soluble volatile organic compounds. Chemically they are termpends. They perform a number of functions. ; attract insects repel animals and act as antiseptic substance e. g. Rose oil, sandal wood oil, Jasmine oil, Khus-Khus oil, camphor (**Cinnamomum camphora**) , Lemon glass oil, pamososaoil, Eucalyptus oil etc.