Biology Handwritten Notes
On
Cell - The Unit of Life
Cell - The unit of life

Historical account:

- Robert Hooke: Thin slice of cork (He observed dead cells)
- Leeuwenhook: Living cells
  - Bacteria
  - Protista
  - Spermatozoa (Cellula)
  - Plant cells
- Robert Brown: Nucleus, orchid root cells
- Fontana: Nucleolus, skin cells of cell
- Schleiden: All plants are composed of cells (1838)
- German Botanist
  - Schwann: All animals are made up of cells, cell membranes, cell walls
  - German Zoologist
1. All theory: Schleiden & Schwann.
   i) All living organisms are composed of cells and their products.
      (Structural unit of life)

2. cyto → cell membrane

   cytoplasm + cell membrane = protoplasm

   Each cell consists of mass of protoplasm

   Plants = C.W.  Animals = C.W X

3. All cells are basically same in structure and activities.

4. All the activities occurring inside an organism is the sum total of all activities occurring inside the cell
   (Functional units of life)

   Drawback:

   How new cells arise? (Could not explain)

   Rudolf Virchow: New cells arise from pre-existing cells.
   (omnis cellula e cellula)

   ⇒ Law of cell lineage
Cell Size:

- **Bacteria**: \( 3 - 5 \mu m \) (longest)
- **Smallest cell**: Mycoplasma \( (0.3 \mu m) \)
- **Largest cell**: Egg (Ostrich)
- **RBCs**: Humans - Diameter \( 7 \mu m \)
- **Longest**: Nerve cell \( 90 \) cm

Cell Shape:

- Disc
- Column
- Cuboidal
- Polygonal
- Thread-like
- Irregular

**Metabolically Active Cells**

- Generally smaller size
- Two reasons:
  1. Nucleus : ratio high
  2. Cytoplasm : ratio high

- Better control of metabolic activities
- Increase exchange of materials between cells and environment
**Plasma membrane** consists of both lipids and proteins.

- Cytoplasm movement of cytoplasm around the nucleus.

<table>
<thead>
<tr>
<th>Prokaryotic Cell</th>
<th>Eukaryotic Cell</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cell wall</td>
<td>Plant cell wall (cytoplasmic wall)</td>
</tr>
<tr>
<td>Mycoplasma (cw-nt)</td>
<td>Protists (cw)</td>
</tr>
<tr>
<td></td>
<td>Fungi (cw)</td>
</tr>
<tr>
<td></td>
<td>Animals (cw x)</td>
</tr>
</tbody>
</table>

**Plasma Membrane** (P.M.)

- Membrane
  -ound single envelope
  - Organellar system

**Non-Membranous**

- Ribosomes
- Cytoplasm
- Chloroplast
- Mitochondria

**Mesosome**

- Help in DNA replication
- Respiratory enzymes

**Cellulose**
- Made up of cellulose

**Membranous protein**

- Dimeric
- Help in attachment of P.M.
Vacuole -> True Vacuole X
- Cell Vacuole + nt
- Covered by proteinaceous membrane

Pseudo Vacuole

Cytoplasm - nt

Cytoplasm + nt

Genetics: not surrounded by nuclear membrane + nt
Matured by membrane

Nucleic acid + protein
- Prochrome, incipient
- Nucleus, chromosome

Nucleus - nt

Nucleous + nt

DNA --> Cytoplasm [ds] --> Nucleus [linear]

Circular [plasmid] --> Mitochondrion

Coiled with the TCH --> Chloroplast

of Polyamines

Transcription & translation

DNA --> RNA --> Protein

Occurs in cytoplasm

Transcription --> Nucleus
Translation --> Cytoplasm

Because in eukaryotes DNA is also nt in chloroplast and mitochondria

Hence they too perform transcription, translation
Flagella
Flagellar protein
Tubulin protein
\[9+2\]
Cytokeleton
Structural framework of Proteinaeous
Tubules and fibres
-nt

Spindle formation (Amitotic cell division)
Sexual Reproduction DNA recombination
+nt
also called as Parasexual reproduction
Cell Wall

Discovery → Robert Hooke

Present in → Plants, Fungi, Prokaryotes, Protists

Components

- Matrix
- Microfibrils
- Depositions

Matrix: Gel-like ground substance

<table>
<thead>
<tr>
<th>H₂O</th>
<th>30-160°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.25-6</td>
<td>7-15%</td>
</tr>
</tbody>
</table>

Hemicellulose

- Heteropolysaccharide
  - Galactose
  - Arabinose
  - Manose
  - Xylose

Rectin

- Heteropolysaccharide
  - Galactose, galactouronic acid
  - Arabinose, acid
(ii) Microfibrils: Structural elements of cell wall
- Various bars of cell wall
- 20 - 40 \( \mu \)m

Plants
- Cellulose
- Chitin

Fungi
- Chitin

(iii) Depositions (0 - 25 \%): can be inter-nt

1. Lignin
   - Sclerenchyma
   - Cork cells
   - Vessels
   - Non-poly saccharides
   - Hardness, stiffness

2. Suberin (hydrophobic)
   - Endodermis
   - Casparian strips
   - Prevents excessive water loss
Chara → multicellular and jacketed sex organs + nt.

Protein + sugar → glycoprotein

<table>
<thead>
<tr>
<th>3</th>
<th>Cutin</th>
<th>Epidermal cells, reduce water loss from leaves</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(hydrophobic)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>4</th>
<th>Silica</th>
<th>Bristles, Equistilum, Hardness</th>
</tr>
</thead>
</table>

| 5  | Ca, Fe | Chara |

* Layers* → cell wall.

(i) *Middle lamella/cementing layer*

- Composed of Ca Pectate ↑ (more)
- Mg Pectate ↓ (less)

- First structure formed during cytokinesis from cell plate which was formed by Gr.B (Dolgo Bodies)

- Refining of fruits → Dissolution of pectate by (i.e.) PAE → Polygalacturonase (enzyme)

**Primary wall**

- Orientation of microfibril are different and decided by Arlycos proteins

```
+----------+----------+----------+----------+----------+
|          |          |          |          |          |
|          |          |          |          |          |
|          |          |          |          |          |
|          |          |          |          |          |
|          |          |          |          |          |
|          |          |          |          |          |
+----------+----------+----------+----------+----------+
```

```
Primary Wall
Primary

Secondary
Middle lamella
```
<table>
<thead>
<tr>
<th>Primary Wall</th>
<th>Secondary Wall</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cellulose</td>
<td>More 40%</td>
</tr>
<tr>
<td>20%</td>
<td>Long microfibril</td>
</tr>
<tr>
<td>Small microfibril</td>
<td>Straight and</td>
</tr>
<tr>
<td>Wavy and</td>
<td>Tightly arranged</td>
</tr>
<tr>
<td>loosely arranged</td>
<td></td>
</tr>
<tr>
<td>Hemicellulose</td>
<td></td>
</tr>
<tr>
<td>Lipids</td>
<td></td>
</tr>
<tr>
<td>Proteins</td>
<td></td>
</tr>
<tr>
<td>Lignin</td>
<td>X</td>
</tr>
<tr>
<td>Pectin</td>
<td></td>
</tr>
<tr>
<td>more</td>
<td></td>
</tr>
<tr>
<td>Less</td>
<td></td>
</tr>
<tr>
<td>Provides Hydration</td>
<td></td>
</tr>
<tr>
<td>and Elasticity</td>
<td></td>
</tr>
<tr>
<td>Young cell</td>
<td></td>
</tr>
<tr>
<td>Trent in old cell, which</td>
<td></td>
</tr>
<tr>
<td>have stopped growing</td>
<td></td>
</tr>
<tr>
<td>Sub-layers</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>$S_1$, $S_2$, $S_3$</td>
</tr>
<tr>
<td></td>
<td>3 or more</td>
</tr>
</tbody>
</table>
Growth of cell wall

Primary Wall

Secondary Wall

Accessory growths -> Intercalation growths

Deposition of materials, addition of materials within the surface of existing wall, existing membrane

Microfibres

Fibrin fibres

Proteins -> Interweaving the fibrin and microfibres

form 3 independent network

Hemicellulose

Microfibre (Cellulose)

Protein fibres join with themselves with the help of Ca^{+2}

Fibrin microfibrils attached with hemicelluloses with the help of H-bonds.
Desmotubule is the extension of endoplasmic reticulum and connects (E.R) of two cells.

Plasmodesmata

Cell wall → minute pores

Cytoplasmic bridges b/w adjacent cells.

Diagram:

Diameter of Plasmodesmata - 40-50 nm
Function - Transport of chemicals
Present only in plants.

Continuity
Living Material → Non-Living Material

Plasmodesmata → Cell wall (intercellular)
Spaces

Symplast
Apoplastic

(My Companion)
Cephalin, lecithin are both phospholipids. Cholesterol provides stability to membrane.

Lipids and proteins are main components of plasma membrane.

Cell Membrane:

- Thin, elastic, dynamic, semifluid
- Present covering inside and outside cytoplasm
- Cell organelles, cell membrane, plasma

Components:

<table>
<thead>
<tr>
<th>Function</th>
<th>Lipids + carbohydrates</th>
<th>Enzyme H2O</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 - 70%</td>
<td>20 - 79%</td>
<td>1 - 5%</td>
</tr>
</tbody>
</table>

- Types of:
- Cephalin, lecithin, enzymes
- Structural, transport, catalytic

- Intrinsic:
  - Difficult, carrier, cholesterol

- Peripheral:
  - Easily, glycolipids

- Extrinsics:
- Enzymes, glycolipids

- Human:
- Glycolipids, cell membrane

- 52% Protein
- 40% Lipid
\textbf{Different Models - Structure of P.M.}

- \textit{Sandwich/Oblamellar} \textbf{Danielle J. Dawson}

- \textit{Unit Membrane} \textbf{Robertson}

- \textit{Fluid-Mosaic} \textbf{Singer-Nicolson}

\textbf{Dialamellar (PLLP model)}

Lipids, proteins arranged in distinct layers.

- 7.5 Å

Symmetrical: two sides of membrane is same.

- α-globular protein (hydrated)

\textbf{Unit Membrane (PLLP model)}

Asymmetrical membrane

- Outer mucoid protein
- Inner Non-mucoid protein

\textbf{β-Proteins (Mucoid)}

\textbf{Non-mucoid}
Drawbacks:

(i) (50 - 100 Å): Thickness of membrane shows variation.

(ii) Could not explain movement of polar compounds through the membrane.

(iii) Membrane is static.

Out Repair
- Contraction
- Relaxation
- Transport
- Secretion
- Osmosis

Membrane is dynamic.

(iii) Fluid mosaic model: (1972) Singer and Nicolson

Proteins are saddleings in a sea of lipids.

Transmembrane: Integral protein spanning the membrane or whole membrane.
- Tunnel
- Protein

Carbohydrate chain
- Extrinsic protein
- Cholesterol

LEARNING MANTRAS
Glycolipids and glycoproteins are present only on the outer surface of cell membrane.

<table>
<thead>
<tr>
<th>Extrinsic/External/Peripheral Proteins</th>
<th>Intrinsic/Intrinsic Proteins</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amount: 30-90 (less)</td>
<td>70-1 (more)</td>
</tr>
<tr>
<td>Attachment: Head of lipids</td>
<td>Head/tails of lipids</td>
</tr>
<tr>
<td>Renewal: Easier</td>
<td>Difficult</td>
</tr>
<tr>
<td>E.g. Spectrin</td>
<td>E.g. Glycoforin (RBC)</td>
</tr>
<tr>
<td>RBC Membrane</td>
<td>Erythrocyte Transport</td>
</tr>
<tr>
<td>Spectrin + Transmembrane</td>
<td></td>
</tr>
</tbody>
</table>

Glycosylation:

- Protein + S.H \( \rightarrow \) Glycoproteins
- Lipids + S.H \( \rightarrow \) Glycolipid

Glycocalyx = glycolipids + glycoproteins

- Attachment
- Antigenic Properties
- Recognition Centre
Quality and quantity of extrinsic protein is different on either side of plasma membrane which shows asymmetrical nature of plasma membrane.

Asymmetrical nature of plasma membrane:

1. Glycocalyx - outer
   - inner

2. Cholesterol - outer
   - more
   - inner
   - less

3. Extrinsic proteins - outer
   - inner

4. Type of extrinsic proteins are different on outer / inner surface.

5. Phospholipids are different on either side.

- > Semifluid Nature -
  - Fluidity = Movement within the membrane

Lipids

Proteins

1. Rotational Movement

2. Lateral Diffusion

3. Flip-flop Movement
   - Rarely
   - Once
   - Every member

Proteins can undergo rotational movement and lateral diffusion but cannot do flip-flop movement.

X flip-flop movement - not
- Function of fluidity
  (i) Cell growth
  (ii) Cell division
  (iii) Secretion
  (iv) Endocytosis
  (v) Intercellular junctions formation

- Channel
  - Cluster of transmembrane helix: soluble formation
  - Helps in transport of pore (membrane) compounds

- Mitochondria
  - Inner membrane
  - Outer membrane
  - Inner chamber (Matrix)
  - Outer chamber (Intermembrane) space

- Transmembrane proteins
  - Helix
Mitochondria has double membrane envelope.

- Also called: Bio blast
- Chondriosome
- Sarcomosome (mitochondria in muscle fibres)

Discovery: Kollerkeri - Striated muscles of insect.

- Chondriosome collectively called

- Shape:
  - Cylindrical (most common)
  - Spherical
  - Filamentous
  - Racket
  - Club

Outer membrane | Inner membrane

- Lipid ↑ (40:1) ↑ (20:1)
- Protein ↓ (60:1) ↑ (20:1)
- Cardiolipin + n (7 times)

- Enzymes ↑
- Expansion \(\rightarrow\) Shrinkage Capacity smoother

- Autonomy

- Permeability ↑ because of Selectivity Permeable of Cation (LMW protein) can be transferred from vesicles
Outer membrane has greater permeability because it has pores.

At DNA, 70S ribosome, presence of proteins and enzymes.

Characteristics of bacteria in mitochondria.

**Crystalline**

also called

\[ ADP + P \rightarrow ATP \]

- \( F_0 - F_1 \) particles
- Ferricytochrome
- Oxidases
- Elementary particles

- Outer
- Inner

1. **Head** → ATP synthetase
2. **Stalk** → Oxidative phosphorylation
3. **Base** → Generation

→ **Functions of Mitochondria:**

(i) Oxidation of proteins, sugars and fats.

- Aerobic respiration

- Glycolysis → Cytoplasm
- Kreb cycle → Mitochondria (Matrix)

ETS - Oxidative phosphorylation → Inner Mitochondrial membrane

(ii) Synthesis and adaption of fatty acids

- Chlorophyll

C → Cytochrome

A → Alkaloids

P → Amino acids

S → Pyridoxines

(iii) Storage of ions in sarcosome

- Steroids

**learningmantras**
Proplastids are precursor of plastids. Can form by replicating, but this ability is absent in chromoplast.

**Plastid**

- Term -> Hackel
- Semi-autonomous
- ds DNA
- Envelope -> Two membranes
- Storage and synthesis of Organic compounds

**Chromoplast**

- Leucoplast
  - Colourless plastids
  - Pigments
- Starch storage
- Potato tubers, wheat

**Chloroplast**

- Chromoplast
  - Coloured plastids
  - Pigments
  - Colour of chlorophyll
  - Carotenoids
- Collination
- Photosynthetic pigments

**Chromoplast / Proplast**

- Storage of proteins
  - Maize - Aleuron cells
  - Castor - Endosperm

- Colour to fruits
  - Photosynthetic plastids
  - Red dispersal plastids

- Synthesis of lipids
**Chloroplast**

Term - Schimper

Shape

1. Algae (Green)
   - Spirogyra: Ribbon
   - Closterium: Collet
   - Zygmena: Star
   - Oedogonium: Reticulate

2. Higher Plants - Dimensions
   - Spherical: Length - 5-10 µm
   - Oval: Length - 2-4 µm
   - Disc

   - Lens
     - Most common

**Envelope**

- Outer
- Inner
- Strong: Thylakoids
- Permeable: Selectively
- Protein: Membrane complex
- Pores: None

**Inner part of chloroplast**
**Chloroplast**

- RNA formation - nt
- Chlorophyll
- Agranal chloroplast
- Green algae
- A → CI plants
- Leptibunda sphaerae cells
- plants

**Thylakoids** are loose and sac-like hence called **baggie thylakoids**.
Rubisco is the principal/marker enzyme of chloroplast.

Functions of Chloroplasts:

1. Photosynthesis
   - Light
   - Thylakoids
   - Stroma
   - Pigments
   - Light Energy
   - Chemical Energy
   - ATP, NADPH

2. Storage
   - Starch

Transformations
- Tomato
  - Young ovary → Leucoplast
    - Young fruit → Chloroplast
      - Mature fruit → Chromoplast
- Chilli
  - Chloroplast
    - Chromoplast
Network of membranes of the N.A. has a large surface area, hence called one of the best sites for metabolic activities in cell.

**Endomembrane System**

Membranous cell organelles functionally co-ordinated i.e. close association

1. **ER**: Endoplasmic reticulum
2. **Golgi Bodies**
3. **Lysosomes**
4. **Vacuoles**

**Endoplasmic reticulum**

Term - Porter

**Discovery** - Porter & Thompson

Interconnecting membrane-bound structures extends from nucleus to plasma membrane

**Intercellular Space**

- Two components
  - **ER (luminal)**
  - Rest of cytoplasm
    (Extra luminal)
Attachment of ribosome with ER is by larger surface with the help of proteins ribophorins.
Protein formed by ribosome is sent to lumen of ER.

**Occurrence**
- Well developed
  - Plasma cells
  - Spermatocytes
- Poorly developed
  - Liver cells
  - Pancreatic cells
  - Interstitial cells (Testis)

**Components**
- **RER**
  - Ribosomes + nt
- **SER**
  - -nt

**Granular Type**
- 80S

**Agranular Type**
- Ribophorins
- = attachment of ribosome
- absent

Mainly → **RER**
- Lumen of E.R.
- Zones of R.R.

Mainly → **Tubule**
- Vesicles

Incompanion
Glycosylation starts in R.E.R. but finishes in Golgi bodies.

**Development**
- Outer membrane (develops from) R.E.R.
- Nuclear membrane
- Nuclear envelope

**Location**
- Internal
- External

**Function**
- Protein synthesis
- Fat, glycogen, and steroid synthesis
- Metaplasia
- Interstitial cells
- Liver cells
- Adrenal cortex
- Leucocytes
- Muscle cells
- Retinal cells

**R.E.R.**
- Function: Protein synthesis
- Protein modification

- Lysosomal proteins
- Cytoskeletal proteins
- Secretory proteins
- Proteins formed by free ribosomes
- Proteins formed on R.E.R.

**Addition of**
- Oligosaccharide
- Glycoprotein
- Glycosylation
Metabolism of foreign compound is called xenobiotics. Cytosacrome P450 utilised by SER for breakdown of foreign compounds.

SER - Functions:

2. Metabolism of glycogen
   - Form (Arb → Glycogen) - Glycogenesis
   - Breakdown (Glycogen → Arb) - Glycogenalysis
3. Formation of microbodies → spherosome, lysoxysomes
4. Breakdown of alcohol, drugs, pollutants

- Cytosacrome P450 (protein complex) action
- Water evaporation through kidney
- Liphic, soluble compounds, solvent compounds

Muscle contraction and relaxation:
- Release Ca^{2+}
- Uptake Ca^{2+}

- Retinal cells
- Hyaloid bodies: SER
- Nerve cells
- Nuclei granules: RER
- Muscle cells
- Sarcoplasmic reticulum: SER
- Plasmadismata
- Damalidus: SER and RER
**All organelles are absent around golgi bodies.**

- Disperse near the E.R.
- Trans face near plasma
- Some of the golgi vacuoles are transformed into lysosomes.

**Golgi Bodies**
- Vernal cell of plant
- Baker's Bodies

**Occurrence**
- **Metallic Impregnation:**
  - Technique: Silver nitrate
  - Occurrence: Bro X
  - Except: Nature RBi X
  - Nature Sieve tubes

**Components**
- **Cisternae**
- **Tubules:**
- **Vesicles**
- **Golgi Vacuoles**

**Zone of inclusion**
- Membrane
- Ribosome, Kilo
- Chloro

**Interconnection**

- **AV X P X**

**Lysosomes**

**Diastatosomes**

- Interconnected tissue
- Maturation: Secretory vesicle

**In plant, diastatosomes**
- Middle mass of cell companion
• Vitellogenesis → yolk formation
• They can change one type of membrane to another type of membrane.

Functions
- Glycosylation
- Glycolipids
- Oligosaccharides
- Glycoproteins
- Glycosylation

Form
- Acrosome - Tip of sperm break membrane of egg

V. Vitellogenesis → Oocyte (yolk formation)

IV. Secretion - Mucus - Vesicles - ER (Golgi, Cis)

V. Enzymes - Antibodies - PM

Involves in
- Cell wall formation

(vi) Lysosomes

(vii) Root hair formation

R. Transformation of membranes
- ER → Lysosomes → Plasma membrane
Lysosomes

Discovery - Christian de Duve

Occurrence

AV

Plants

RBC (mature) - vacuoles

Slow

Phagosomes

Lysosomes

Granules

Activities

Single membrane

0.2 - 0.8 um

Hydrolase enzymes:

Breakdown of substrate

Acid pH (4-5)

By addition of H2O

(Acid hydrolases)

Hydrolase

About 50 enzymes + others

4-5 pH

Stabilisers

Acid hydrolases: Cholesterol

Nucleases (Deoxyribonucleases)

Heparin

Ratios

Heparinase

Cartilage

4-5 pH

Stabilisers

Low pH

ATP

H+ ATP H+ ATP

Hydrolases

Against

Core gradient

Irritases

Phospholipases

Lipase

Lipids

Carbohydrates

Glucosidase

Phospholipases

Principal

Substrates

Lipases

Lipozyme

Lipozyme

Lipase

Lipase

Lipid-soluble vitamins (A, E)

Bile salts

Steroidal hormones

O2 deficiency
Autophagy: digestion of dead cell organelles

Autolysis: digestion of dead cell by breakdown of lysosome

Cathepsin: digests tail of tadpole

Functions:

Intercellular digestion → Autophagy

Extracellular digestion

Autophagy: Intracellular scavenging (organella dead)

Autolysis: digestion of dead cells

Disease: WBC kill bacteria, viruses

Metamorphosis of frog

Tadpole: Adult

(Tail) → Tail

Diseases due to improper functioning:

Epithelial: Polymyositis

Residual vacuole ⇒ Hepatitis

increase

Lysosome → Enzymes

Substrate → Storage diseases

Kuru

Huntington

Fabrel

Zay sack

Neuman Pick

Storage leads to neurological disorder
- True membrane is made up of phospholipid bilayer.
- Tonoplast has channels which take ions and other materials actively by use of ATP.

Vacuoles:

- Non-cyttoplasmic areas present in the cytoplasm.
- From cytoplasm separated with the help of specific membrane.

Origin: ER

Contrastive:

- Soft
- Vacuole
- Digestion
- Crass

Food Vacuole

Pero for:

- EW: Protozoans, Plants
- 12 + Plaegem
- Algae
- Young, Small, Prosteties
- B (G) A
- Mature, large central, Higher animals

Volume of cell:

- Digestion
- Regulate
- Ion and other ions and other
- Absorption
- Digestion-food
- Storage of
- Amino acid
- Sugar
- Waste material
- Pigments - Anthocyanin
- Esters

*** Anthocyanin is water soluble pigment which gives colour to flower/plant

GERL -> A complex formed by golgi bodies, endoplasmic reticulum and lysosomes.
Microbodies are related with oxidation which are not used for respiration.

**Microbodies**

- Single membrane, bound organelles
- 0.2 - 1.5 μm (diameter)

Oxidation reactions not associated with respiration.

**Peroxisomes**

- Oxidizes long-chain fatty acids, drugs, alcohol, toxins;
- Primary role is detoxification.

**Lysosomes**

- Degradation, internal digestion;
- Breakdown of cellular waste.

**Glyoxysomes**

- Detoxification, storage, energy production in plants.

**Spherosomes**

- Found in plant cells.

<table>
<thead>
<tr>
<th>Peroxisomes</th>
<th>Glyoxysomes</th>
<th>Spherosomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

**Occurrence**

- Plants: Yes, Animals: Yes

<table>
<thead>
<tr>
<th>Peroxisomes</th>
<th>Glyoxysomes</th>
<th>Spherosomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Long lived</td>
<td>Short lived</td>
<td>Short lived</td>
</tr>
</tbody>
</table>

**Animals**

- Breakdown of fatty acids, amino acids, alcohol, drugs, toxins;
Ferrosome is concerned with smallest and largest enzyme. Both formation and breakdown happen occurs in ferrosome.

**Oxidase enzymes**

1. Hydroxy acid oxidase
2. Pyroxy acid oxidase
3. Amino acid oxidase
4. Molate oxidase

**Byproducts**

- Hydrogen peroxide
- Water

**Catalase**

Breakdown of H₂O₂

**Largest enzyme**

**Plants**

Photosynthesis (Light dependent)

- O₂ uptake and release of CO₂ by green parts of plants.
- Involvement of 3 organelles
  - P: Peroxisome
  - C: Chloroplast
  - M: Mitochondria

Glyoxysomes

Fats

Glyoxylate enzymes

Gluconeogenesis

Glyoxylate pathway

- In endoplasmic
- Fatty seed
- Castor
- Groundnut

Sphaerosomes

C₆H₁₁ (Sugar)

Synthesis and storage of fats in fatty seeds
Palade discovered the ribosomes are made from RNA.
- Higher the rate of sedimentation, larger the size of protein

Ribosomes / Palade particles

- Brown & Robinson → Plant cell

- Palade → Animal cell

- rRNA + Proteins (ribosomal) → Made up of

- Nucleoprotein organelles

- Non-membranous

- + rib in Euc & pro (-rib in RBC)

- Sedimentation co-eff: (known as sedimentation)
  (Svedberg unit - $S$)

- 70S $< 80S$ (larger)

- Centrifugation machine forces
- An object in rotation

- Prokaryotes
  ↓
- Eukaryotes

- Cytoplasma
  ↓
- Eukaryosomes (20S)
  ↓
- Organelles

- Mitochondrion
  $70S$
- Endoplasmic reticulum
  $70S$
- Peptidyltransferase is a ribozyme-based enzyme.

- **mRNA** is the smaller subunit cofG structure.

- Passage of mRNA coded information sequence of amino acids.

- Larger subunit dome structure.

- Passage of mRNA coded information sequence of amino acids.

- Less 1-2mM Mg concentration.

- 70S 16S rRNA 23S rRNA 5.8S rRNA 3S protein.

- 80S 18S rRNA 33S protein.

- 30S 16S rRNA 21S protein.

- 50S 5S rRNA 3.4S protein.

- 60S 5.8S rRNA 40S protein.

- RNA: Protein 60:40.

- More RNA, less protein.

- Less RNA, more protein.

- Peptide bond peptide transferase (associated with larger subunit).

- (Ribozyme)
Cytoskeleton:

- **Supportive**
  - Proteins frame-work of (not molecular) fibers and tubules.

- **Intermediate filament**

<table>
<thead>
<tr>
<th>MT</th>
<th>MF</th>
<th>IF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microtubule</td>
<td>Microfilament</td>
<td>Intermediate filament</td>
</tr>
</tbody>
</table>

- **Hollow structure**
- **Solid**

<table>
<thead>
<tr>
<th>Diameter</th>
<th>MT</th>
<th>MF</th>
<th>IF</th>
</tr>
</thead>
<tbody>
<tr>
<td>250 Å</td>
<td>50-60 Å</td>
<td>100 Å</td>
<td></td>
</tr>
</tbody>
</table>

- **Actin**
- **Tubulin**

<table>
<thead>
<tr>
<th>Location</th>
<th>MT</th>
<th>MF</th>
<th>IF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cytoplasm</td>
<td>Cytoplasm</td>
<td>Cytoplasm + nucleus</td>
<td></td>
</tr>
</tbody>
</table>

- **Functions**
  1. Cytokinesis
     - Plants
     - Cell plate
  2. Chromosome movement

**Kinetochores**

- **My companion**
**Microfilament** help plasma membrane to contract different kinds of stress.

- **Actin**
- Cell Movement
- Flagella
- Cilia
- Intracellular transport, i.e., amoeboid movement
- Cytokeleton
- Stress fibres
- Nucleus
- Basket around nucleus
- Endocytosis
- Endocytosis in detail

**GTP-dependent** kinase

- Polymerization
  - $250 \text{A}$

**Tubulin**

- $\alpha + \beta$
- Calcium
- Calmodulin
- Protofilaments
- 13 strands

**MTD**: Microtubule Organizing Centre

- **MTG**: Microtubule Generators
- Nucleating Centre
- Function of MTOC performed by:
  - Basal Bodies
  - Microtubules
  - Lincocochne
  - Formation occurs ***satellite*** / Masses / centrioles
Centriole result in formation of basal body. Formation in centrosome surrounded by kinectosomes.

Centriole

Non-membranous hollow microtubule
M.T (made up of)
Animal cell

Cart wheel structure

Centrosome

3 M.T
1 Join
Tubulin fiber
M.T

Incomplete
Complete
13 protofilaments

Functions:
- Centrioles result in the formation of basal bodies.
- Basal bodies
- Basal granules
- Ectoplasm
- Cilia and flagella
- Centrioles are organelles lacking DNA but capable of replication in S phase.
Cilia and flagella are formed from proteins dynein, tubulin, nexin.

Cilia and Flagella - 3 Parts

Basal Body 
Basal Plate 
Shaft

9 + 2 Basal Body

Triplet fibres

1. Transformed to
doublet fibres

2. Fibrillar single present in centre

2 M.T 
Jain
Doublet Fibre

Incomplete B

Dynin Protein (Arm)

ATP split

ATP Hydrolysis
Energy

Centriole - Axoneme - Cilia and flagella

9 x 3
9 x 2
11
2 + M.T
18
+ 2
20 M.T

No. of microtubules

Dynein and muscle myosin protein are analogous as both utilise ATP for contraction. (My conclusion)
Intermediate Filaments (IF) form a fibrous structure called fibrous lamina which holds ends of chromatin.

- Nuclear envelope consists of two membranes.
- Bidirectional transport occurs through nuclear pore.

**Nucleus**

- **Nucleus**: Robert Brown (1831) discovered. Discovery - orchid root cell - also coined the term 'Nucleus'.

**Cell**

- Uninucleated
- Multinucleolated

**Synetium**: due to joining of several cell

**Occurrence**: Pro (except RBC, some tubes).

- Nuclear Envelope
- Nucleoplasm
- Chromatin

**Nucleolus**: Holds end of chromatin

**Nuclear Envelope**

- Perinuclear space [10-50 nm]
- Inner membrane
- Outer membrane

**Eukaryote**: Endohyge

**Ribosomes**: Smaller

**R.F.K.**
* Chromatin is seen during interphase subdivision.
  Chromosomes are seen during mitotic phase.
* Majority of the chromatin is euchromatin.

**Nucleoplasm / Nuclear sap:**
Transparent colloidal complex

**Raw Material -> DNA RNA (for synthesis)**
Nucleotide \( \rightarrow \) DNAP, RNAP

- **Chromatin**
  - Flemming
  - Thread, coiled elongated structure

- **Cell cycle**
  - Interphase
  - Cell division
  - Chromatin

- **Chromatin**
  - Heterochromatin
    - Darkly stained
    - Compact
    - Transcriptionally inactive
    - 10\% of chromatin

  - Euchromatin
    - Lightly stained
    - Loosely packed
    - Transcriptionally active
    - 90\% of chromatin

- Intermediate filament
  - Forms fibrous lamina
  - Holds the ends of chromatin
The telomeres seal the end of chromosome and maintain its structural identity.

A chromosome consists of two chromatids.

Chromosomes get coiled and folded during condensation of chromatin fibers.

- somatic cells = 2 sets = 2n
  (diploid)
- gametes = 1 set = n
  (haploid)

3 pairs Homologous chromosomes

Humans 2n = 46 = 23 pairs

Cell/Centromere

Chromosomes

(In a typical chromosome 4 telomeres are present)
- Secondary construction forms nucleus.
- Satellite chromosome acts as markers.
- Humans have 5 pairs SAT chromosome.

- Median
  (Metacentric)

- Near centre
  (Sub-metacentric)

- Near end
  Acrocentric

- Telocentric at the end
  - Not in humans.

- Satellite (SAT-Chromosome)

  Secondary construction / NOR (Nuclear organised Region)

- Bimentary construction

- Nuclear chromosomes (Chromosomes having NOR)

  13, 14, 15, 20, 21

  In humans

  Nucleus is known as ribosome factory.

- Membrane

  → $Ca^{++}$ (maintenance) of nucleus
Similarity of mitochondria with bacteria

1. Parin
2. ds DNA - circular
3. Self replication - binary fission
4. Porins

=> Bacterial endosymbionts

Bundle sheath cells of C₄ plants have agranal chloroplast.

Hence, C₄ plants have both agranal and agranal condition.

Initiation of glycosylation occurs in the cist of rough endoplasmic reticulum but termination occurs in golgi bodies.

cytochrome P450 cause conversion of lipid soluble compounds to water soluble compounds, through hydroxylation, to be excreted through kidney.
Lysosomes allow the movement of simpler substance but not the complex ones.

Endocytosis

1. Primary/Primary
2. Secondary
3. Residual vacuole
4. Autophagosome
5. Autolysosome
6. Cytolysosome

Isolation envelope

Endoplasmic reticulum

Golgi bodies

Food (cell eating)

Phagosome (solid)

Food

Liquids (cell drinking)

Pinosomes (liquid)

Exocytosis / Ectophagy / cell vomiting digestive vacuole

Exocytosis = Ectophagy = cell vomiting

With increase in age no. of lysosomes will increase but no. of mitochondria will decrease.

Polymorphism
**Centriole**
- *cart wheel structure*

**Masses**
- Satellite
- MTOC

**Hub**
- 9 spokes (9)

**A-B linker** (nexin protein)

**Central axoneme**

**Peripheral axoneme**

**Plasma membranes**
**Central sheath**

**Transition junction**

(A diagram of a centriole with labeled parts)
Animals contain two non-membranous organelles i.e. centrioles and ribosomes whereas plants have only one i.e. ribosome.

**Nucleolus (Ribosome factories)**

* non-membranous

- **Perinuclear chromatin**
- **Intranuclear chromatin**

**DNA**

$\text{form}$

$\Rightarrow$ RNA + protein

(Paras fibrillae)

protein contention

Paras granulosa

Ribosomal Subunit

* Ribosomes of nucleolus are non-functional.

- Protein factory = ribosome
- Ribosome factories = nucleolus
- Janus Green stain is used to observe mitochondria.

- Hemicellulose is absent in bacteria, algal cell walls.

- Mitochondria is related to maternal cytoplasmic inheritance related to male sterility in plants.

- Maximum formation of mRNA occurs in nucleolus.

- In germinating seeds, glyoxysomes are responsible for converting fats into carbohydrates.

- In maturing fatty seed spherosomes are responsible for converting forming fat.