

Physiology

World of Revision

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Instructions

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GENERAL & CELLULAR PHYSIOLOGY : PART 1

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Homeostasis

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- Concept of constancy.
- Walter Cannon Termed → **Homeostasis**.
- Claude Bernard Termed → **milieu interior** (Internal environment).

maintenance :

Dynamic process.

Control systems  :

	Negative feedback	Positive feedback	Feed forward control
mechanism	↑ f/b ↓	<ul style="list-style-type: none"> • ↑ f/b ↑ • Amplification (Vicious cycle) 	Anticipatory changes
Examples	<ul style="list-style-type: none"> • Insulin regulation of glucose • Baroreceptor reflex • Endocrine hormone regulation 	'CLAPS' : <ul style="list-style-type: none"> • Clotting • Ca²⁺ entry into SR • LH surge • Action potential • Parturition • Shock 	Body temperature regulation

Gain  :

- Assessment of effectiveness of negative feedback.

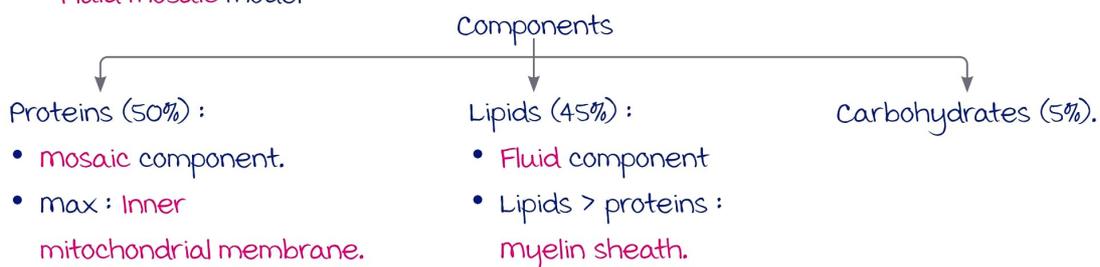
$$\text{Gain} = \frac{\text{Correction}}{\text{Error remaining}}$$

- If Error = 0, **Gain** = ∞ (Role of kidneys in BP regulation).

Cell Membrane

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- **Fluid mosaic** model :



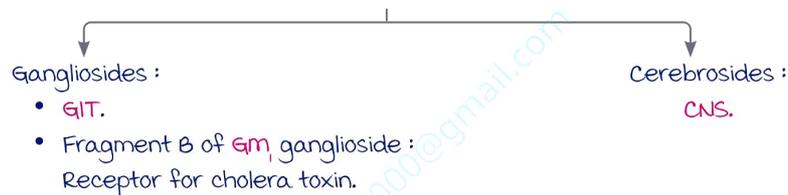
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membrane Lipids :

1. Phospholipids :

	Site	Features
Phosphatidylcholine	Lung	<ul style="list-style-type: none"> AKA lecithin major surfactant
Sphingomyelin	<ul style="list-style-type: none"> Nerve Lung 	<ul style="list-style-type: none"> minor surfactant L/S ratio ≥ 2 : Fetal lung maturity
Phosphatidylserine	Cell membrane : Inner surface	If exposed extracellularly : Signal for apoptosis (eat me signal)
Phosphatidylinositol	Endocrine	Second messenger
Cardiolipin	Heart : mitochondria	-

2. Glycolipids : Lipids + carbohydrates.



3. Sterols :

- Cholesterol
 - Vitamin D synthesis.
 - **Fluidity buffer.**

• membrane fluidity :

	Increased fluidity	Decreased fluidity
Effect on membrane function	Good	Bad
Type of fatty acids	unsaturated (essential)	Saturated
Examples	<ul style="list-style-type: none"> Linoleic acid Linolenic acid Arachidonic acid Omega-3-FA (Fish) 	<ul style="list-style-type: none"> Stearic acid Palmitic acid

membrane Proteins :

	Location	Features
Transmembrane/ integral membrane protein	-	<ul style="list-style-type: none"> Receptor : GPCR Pump : Na⁺-K⁺ ATPase Channel (Cl⁻) : CFTR mutation → CF
Peripheral protein	RBC	mutation of : <ul style="list-style-type: none"> Spectrin : Hereditary elliptocytosis Ankyrin : Hereditary spherocytosis
Lipid/ GPI anchored protein		<ul style="list-style-type: none"> CD-55 } mutation → Paroxysmal nocturnal hemoglobinuria CD-59 }

Cell Organelles

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Endoplasmic Reticulum :

	RER (Granular)	SER (Agranular) 
Ribosomes	⊕	⊖
Functions	<ul style="list-style-type: none"> • Protein biosynthesis • Protein folding with chaperones • ER associated degradation : Destruction of misfolded proteins <p style="text-align: center;">↓ Accumulation ↓ Prion disease</p>	<ul style="list-style-type: none"> • Drug metabolism (Liver) • Calcium storage : Sarcoplasmic reticulum (Skeletal muscle) • Steroid hormone synthesis (Adrenal cortex)

Golgi Apparatus :

Located close to RER.

Functions :

- Cis end → Post translational modification → Trans end
(Receives protein) (E.g. : Glycosylation) (Releases vesicles).
- Protein tagging, sorting & delivery :
I - cell disease : mannose-6-phosphate tagging ⊖.

Lysosomes :

- AKA suicidal bags/residual bodies.
- Acid mediated destruction :
 - Acid lipase.
 - Acid hydrolase.
- Autophagy : Starvation → mitochondrial destruction → Energy release.

Peroxisomes :

- AKA microbodies.
- Abundant in liver & kidney.

Functions :

- VLCFA : Oxidation.
- H₂O₂ : Generation and degradation (Catalase).
- Synthesis of plasmalogens (myelin sheath).

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Peroxisomal storage disorders :

- Zellweger syndrome : **VLCFA** accumulation.
- Refsum's disease : **Phytanic acid** accumulation.

mitochondria :Derived from ovum : **maternal** inheritance.

mitochondrial DNA :

- Double stranded.
- **16,500** base pairs.
- mutation rate : **10 x** nuclear DNA.

mitochondrial disorders :

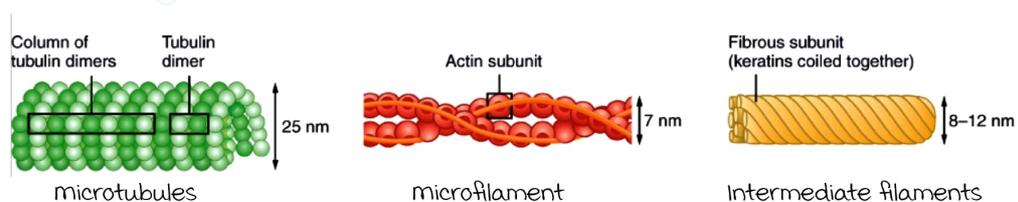
- **mELAS** : **mitochondrial encephalomyopathy**, **lactic acidosis** & **stroke-like** episodes.
- Affects organs with high metabolic rate : muscle, brain.

Nucleus :

- Contains chromosomes (DNA) : Blueprint.
- **Nucleosome** : DNA (String) + histone proteins (Beads).
- **Chromatin** : whole complex of DNA + proteins.
- **Nuclear pore complex (NPC)** :
 - Exportin.
 - Importin.
- Units of heredity - genes.

Cytoskeletal Filaments

00:56:24

microtubules :

Types : Kinesin, dynein, tubulin.

Function :

- **Axonal transport**
 - Anterograde → **Kinesin**.
 - Retrograde (Rabies) → **Dynein**.
 - **Ciliary motility** : Defect → Kartagener syndrome
 - Chromosome separation → **Cell division**.
- Cancer Rx : Vincristine (microtubule inhibitor drug).



microfilaments :

Actin polymerization → Cell movement (*Listeria monocytogenes*).
 → maintains cell structure.

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Intermediate Filaments  :

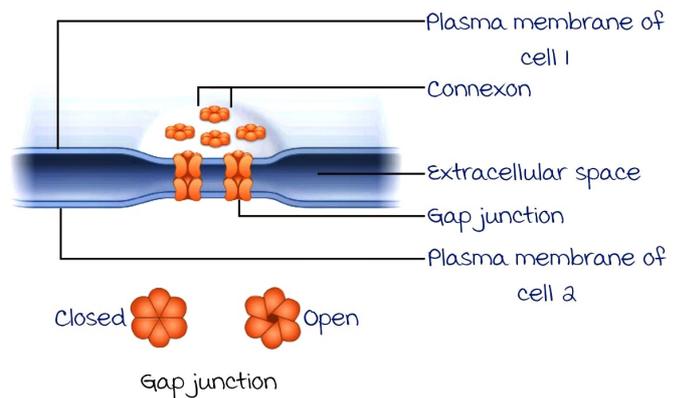
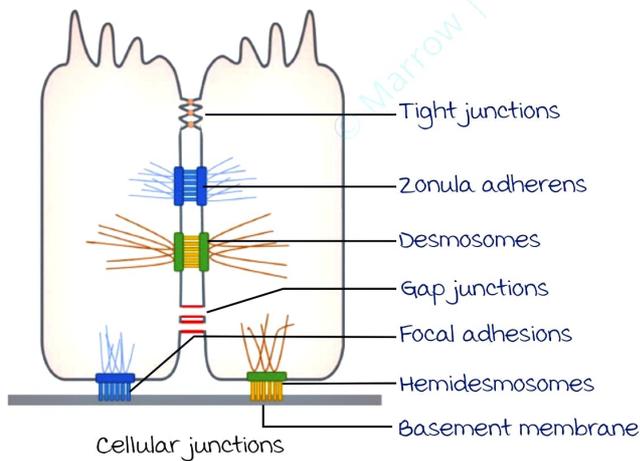
Functions :

- Resist external pressure
- Cellular/tumor markers :

Filament	Tissue	marker for
Keratin	Epithelial cells	Carcinoma
	Liver (<i>Mallory bodies</i>)	Alcoholic hepatitis
Desmin	muscle cells	Rhabdomyosarcoma
Vimentin	Connective tissue (Fibroblast)	Connective tissue tumors
Glial fibrillary acidic protein (GFAP)	Astrocytes	Astrocytoma
Lamin	Nucleus	Progeria (Premature aging)

Cellular Junctions

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Cell junctions	Proteins	Features
Cell-cell junctions  :		
Zonula adherens	Cadherins	<ul style="list-style-type: none"> • Calcium dependent linkages • Linked to actin
Desmosomes	<ul style="list-style-type: none"> • Desmogleins • Desmocollins 	<ul style="list-style-type: none"> • Areas of mechanical stress : Skin, uterine cervix • Antibodies against desmoglein <p style="text-align: center;">↓ Pemphigus vulgaris</p>
Zonula occludens/ Tight junctions	<ul style="list-style-type: none"> • Occludin • Claudin 	<ul style="list-style-type: none"> • BBB, kidney, GIT • Apicolateral • Regulates paracellular transport • Zonula occludens toxin : <ul style="list-style-type: none"> - Produced in cholera - Loosens tight junctions
Gap junctions	Connexon (1 connexon = 6 connexins)	Heart (Functional syncytium arrangement)
Cell-basement membrane junctions :		
Hemidesmosomes	-	A/w intermediate filaments
Focal adhesions	-	A/w actin