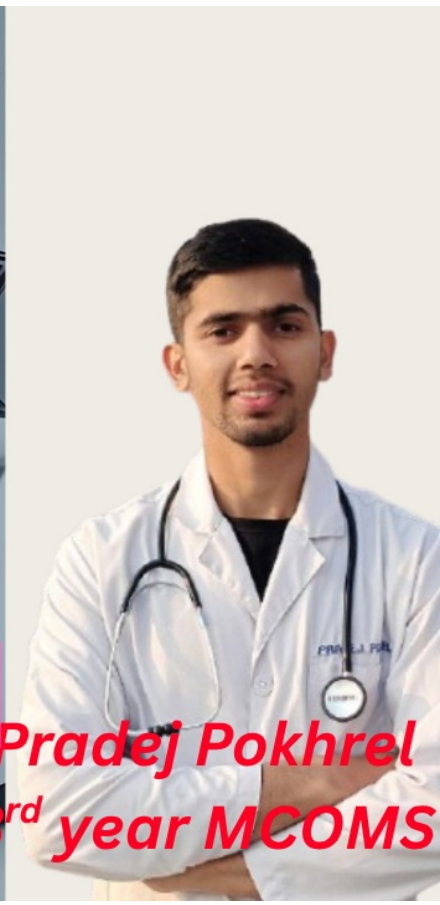
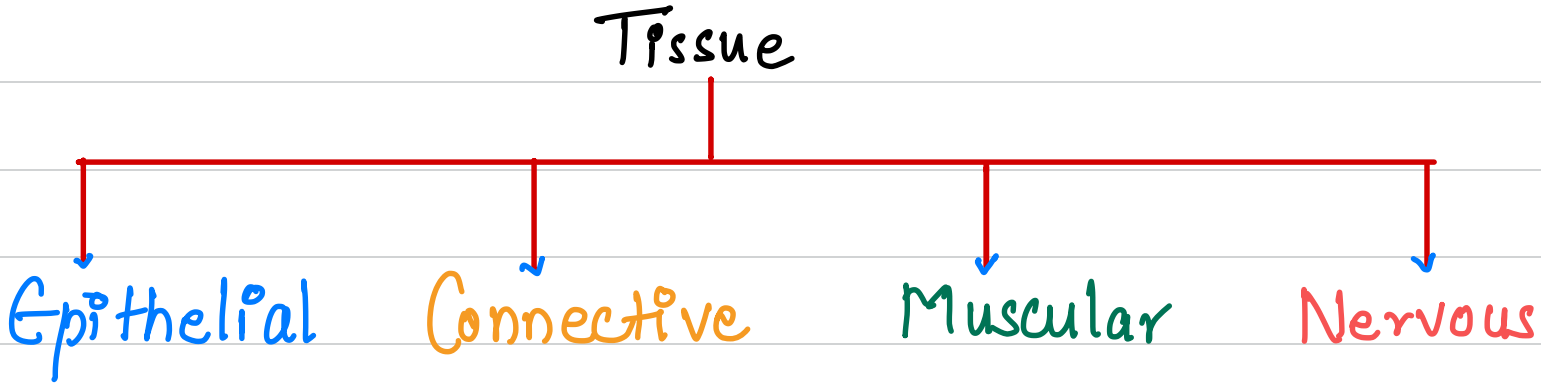

MedStellar magic series
Zoology
Animal tissue
4 marks covered


Pradej Pokhrel
3rd year MCOMS

Animal tissue

① Histology ⟶ Study of tissue
② Term Animal tissue ⟶ Bichat
③ Founder of Histology ⟶ Marcello Malphigi



Epithelial tissue

↳ Lines body surface, body cavities & Glands
↓
Covering tissue

↳ Origin → All 3 germ layer
- → Ecto → Epid. of skin
- → Meso → Coelomic epi
- → Endo → Lining of GI, Respi tract

↳ Avascular

↳ Nerves present

• Protection, Absorption, Secretion, Lubrication, Diffusion

Epithelium

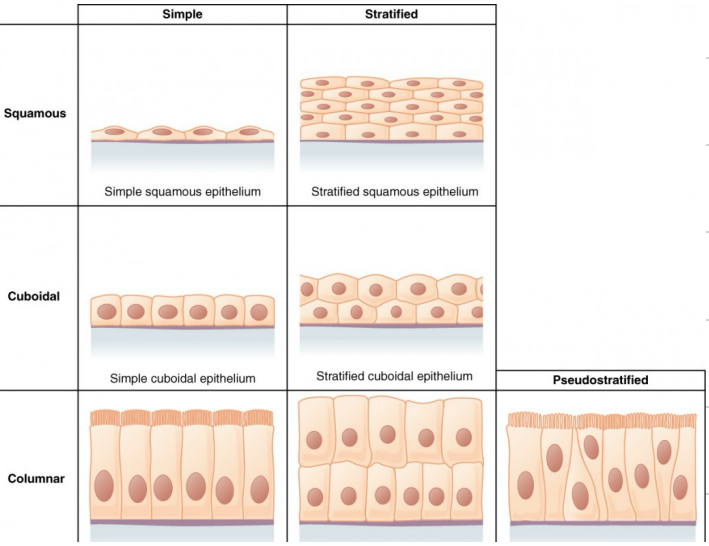
1. Lining epithelium
2. Glandular epithelium

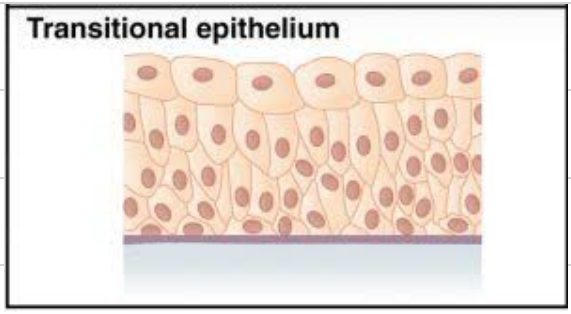
Lining Epithelium

Arrangement of layers
- Simple
- Stratified
- Pseudostratified.

Cell shape
- Squamous
- Cuboidal
- Columnar
- Transitional

Function
Neurosensory
Pigmented
Germinal





Simple Squamous / Pavement

- Alveoli
- Bowman's Capsule
- Coelomic Epithelium
- Descending loop of Henle
- Endothelium

Stratified Squamous

Keratinized

- dessication
- Nail
- Hair
- skin

@ महात्

wear & tear

Non keratinized [Moist area]

- Buccal Cavity
- Oesophagus
- Cornea
- Anal Canal
- Vagina
- Pharynx

@ BOCA vice principle

Cuboidal.

Simple

- Glands
- Germinal epi
- Follicles [Thyroid, Ovary] 2025 CEE
- Nephron
- Choroid plexus
- Retina
- Lens

@ GFR Gives Latest Condition of Nephron

Stratified

- Duct of sweat gland.
- Larger duct

Columnar

Simple

@ Dee Cilia Badharera Vyais

① Ciliated → Oviduct, Bronchioles, Ventricles of brain

② Non ciliated → GI tract [Stomach - ~~Dentate~~]
Digestive glands
Gall bladder.
Uterus

@ GUN

Pseudostratified

Respiratory epi
Olfactory epi
Eustachian tube / Auditory tube.
Penile urethra
Vas deferens
Epididymis

@ PRO VAPER

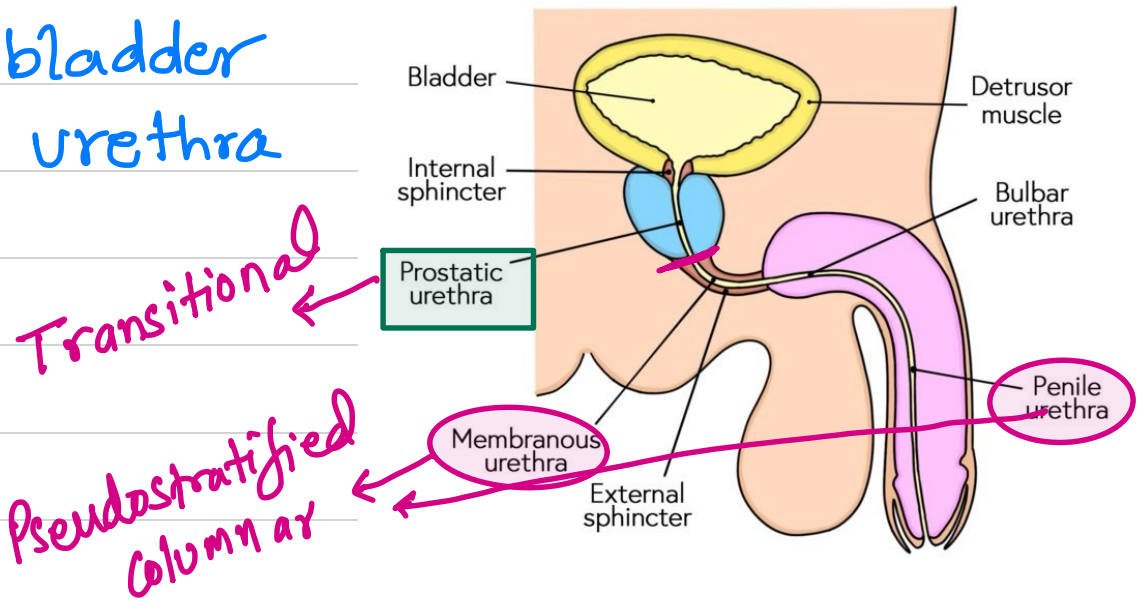
Stratified Columnar

- Conjuctiva
- Ducts of large glands

Transitional

- Strech
- Urothelium

- Renal pelvis & Calyces
- Ureter
- Urinary bladder
- Prostatic urethra



Glandular epithelium

↳ 3 layers

↳ Zymogen granules in cytoplasm

↳ Secretory

Classificⁿ

① Duct
- Endocrine
- Exocrine

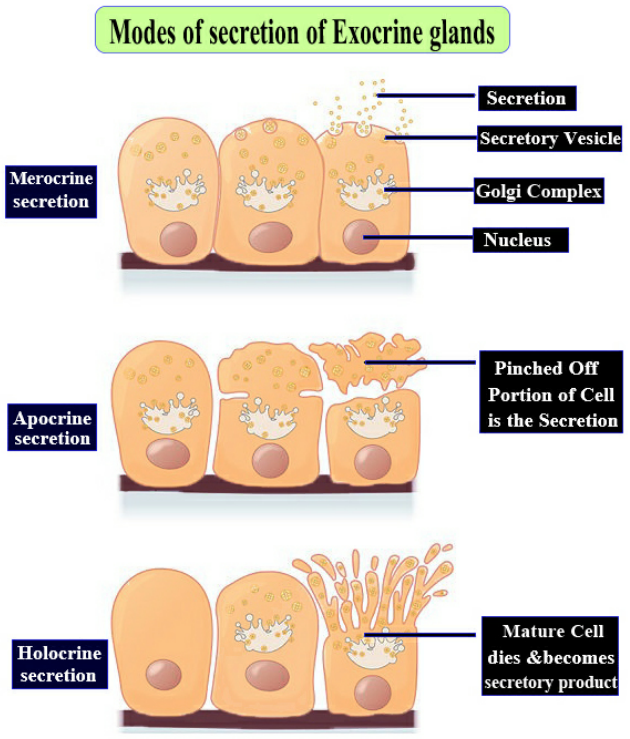
② No. of cells
- Unicellular → eg. Goblet Cell
- Multicellular

③ Mode of secretion

a) Merocrine

b) Apocrine

c) Holocrine



Salivary
Pancreas
Sweat

Mammary
Ceruminous

Sebaceous

④ Nature of Secretion

① Serous → Sweat, Pancreas, Parotid
② Mucus → Goblet cells, Sublingual
③ Mixed. → Submandibular

⑤ Based on Secretory unit

@ Tea Bud ↑

① Simple tubular → Crypts of Liberkuhn
② Simple branched tubular → Gastric & Uterine glands
③ Simple coiled tubular → Sweat [Sudoriferous gland]
④ Simple alveolar → Seminal vesicles & cut. gland of frog
⑤ Simple branched Alveolar → Sebaceous glands

@ cheap TaBLe

⑥ Compound tubular glands → Bulbourethral & Liver

⑦ Compound Alveolar → Sublingual & Submandibular

@ CALM

8. Compound tubulo-alveolar → Parotid, Pancreas

PoPAT

Connective tissue

- Mesodermal
- Most abundant body tissue
- structural framework → Support to diff organs & tissues

Embryonic → Mesenchyme & Mucus Conn tissue
↓
Wharton's jelly

Adult

→ Connective tissue proper
- ↳ Loose connective tissue / Areolar tissue
- ↳ Adipose
- ↳ Reticular
- ↳ Elastic
- ↳ Dense

→ Supporting / Skeletal
- ↳ Bone & Cartilage

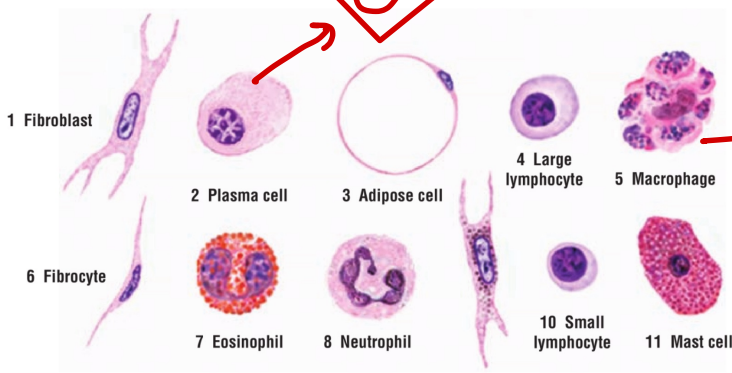
→ Fluid Connective tissue
- ↳ Blood & Lymph

Connective Tissue Proper

1. **Areolar tissue** 2025
   - ↳ Fibroblats → Principle cell → ECM → Proteins
     - Collagen
     - Elastin
     - Reticulin
   - ↳ Macrophages
   - ↳ Mast cells → Histamine, Heparin, serotonin
   - ↳ Plasma cells
   - ↳ Lymphocytes
   - ↳ Adipose cell → store fat

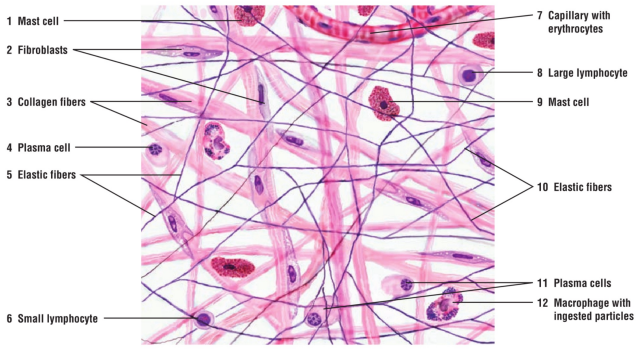
Cart wheel

* Wound healing



→ Phagocytic

↓ Parasitic / Allergic Infec^n



Collagen Fibre (White fiber)

- → Collagen protein
- → Occurs in Bundle, Thick → Great tensile strength
- → Boiling → Gelatin

Types

I → Bone, Tendon, Ligament, Dermis
II → Hyaline & Elastic Cartilage
III → Reticular Fiber
IV → Basal Lamina

Elastic Fibre [Yellow]

- Elastin
- Thin, branched → Allow strech

- Elastic cartilage — Epiglottis
- Ear pinna, Lungs — Eustachian tube
- Ligament — External ear

Reticular fibers → Protect from wound & Infc^n

- Type III Collagen
- Delicate net like framework
  Liver, Spleen, Bonemarrow
  → Filtrate blood & lymph
  → Support Immune system

Adipose Tissue

↳ Adipocytes → Lipid storage & metabolism

Brown Adipocytes

- Multiple small droplets

produce Heat

→ Newborn

→ Hibernating Animal

White Adipocytes

- Single Large droplet
  - → Energy, store fat
  - → Insulation
  - → Cushion.
  - → Leptin

↳ Also contains → Fibroblast, elastic fibers

↳ Found mostly on subcutaneous region.

↳ panniculus adiposes

imp

* Blubber of whale & Hump of Camel

* Horns of Rhinoceros → Matted hair (Keratin)

Dense Connective Tissue

↳ Compactly arranged collagen bundles

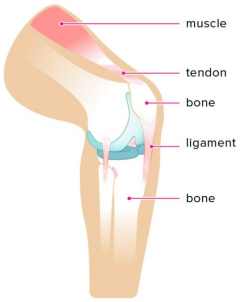
① Dense Irregular → Dermis

② Dense Regular → Tendon & Ligament

Tendon → Bone to Muscle → Strain

Strongest → Achilles

T → Tough



Ligament → Bone to Bone → Sprain.

@ BoBLi

More Elastic → Yellow elastic fibers

strongest

↳ Iliofemoral

① what is wrong about epi. tissue ?
ⓐ avascular ⓑ Ectodermal ⓒ gap junction ⓓ Line glands

② Which of the following are incorrectly matched.

Pleura ⟶ Simple squamous

Sweat gland ⟶ simple cuboidal

Penile urethra → Transitional

Vagina ⟶ Keratinized str. sq. } incorrect

Trachea ⟶ Pseudostratified Ciliated Columnar

③ Secretory unit of sweat gland is

ⓐ Simple tubular ⓑ Simple coiled tubular ⓒ Simple branched alveolar

ⓓ Compound tubulo alveolar

④ which of the following glands secrete products with destruction of cell.

ⓐ Epicrine ⓑ Merocrine ⓒ Apocrine ⓓ Holocrine

⑤ Areolar tissue Connects

ⓐ Bone - Bone ⓑ Bone - muscle ⓒ Integument to muscle ⓓ fat to bone

⑥ Fibro cartilage has which collagen fibre :

ⓐ I ⓑ II ⓒ III ⓓ IV

⑦ which of the following is known as Cart wheel cell ?.

ⓐ Macrophage ⓑ Fibroblast ⓒ Plasma cell ⓓ Mast cell.

Supporting / skeletal connective tissue

↳ Mesodermal

↳ Cartilage & Bone

Cartilages ⟶ soft & pliable

→ Develops from MESENCHYME

→ No blood vessels, nerve & lymphatics

↳ Nutrition by diffusion from Perichondrium

Vascularized

● Covering of Cartilage

* Absent in Fibrocartilage & Articular Cartilage

Cartilage ⟶ Cells + Matrix

↳ Fibers & ground substance

↳ Type II Collagen

① Chondroblasts → Matrix + Collagen Fibre

② Chondrocytes → Mature, embedded in Lacunae

③ Chondroclast → Macrophage of Cartilage

① Hyaline Cartilage

↳ Clear glassy ground substance

Basophilic

- Most abundant
- Most of the embryonic cartilage

eg. Articular Cartilage, Bronchi, Trachea
Larynx, Nasal Septum, Costal Cartilage

→ Type 2 collagen

Calcified
↳ frog

② Elastic cartilage

→ elastic fibres
→ 3E → Epiglottis, Ear pinna, Eustachian tube

③ Fibrocartilage

↳ Strongest Cartilage — Type I Collagen
↳ No perichondreum
↳ Intervertebral disc, Pubic Symphysis, TMJ

* Dead body longer than Live

Bones → Hard & non pliable

Osteology →

Bone ⇒ Cell + Matrix

a) Osteoblast → forming
   ↳ Organic matrix

b) Osteocytes (Mature)
   ↳ Lacunae
   ↳ Nutrition & Ca^{2+} homeos.

c) Osteoclast
   - Bone resorption

↳ Organic [30-40%]
- Collagen I
- proteoglycans
- glycoproteins

↳ Inorganic [40-50%]
Ca. hydroxyapetite crystal
$Ca_{10}[PO_4]_6[OH]_2$
↳ Hardness & Rigidity
↳ Storage of Ca^{2+} & PO_4^{---}

* Osteoid → Unmineralized bone matrix

* Sequestrum → Dead bone

1) Dermal or membranous bone (Investing)

↳ Ossification of Mesenchyme in dermis

eg. Clavicle, Mandible, Maxilla, flat bone of skull.

2) Cartilagenous or replacing

↳ Ossification of hyaline cartilage model.

eg. Vertebrae, Pelvic, Limbs, Ribs

3) Sessamoid.

↳ Ossification of tendon

eg: Patella, Pissiform

On the basis of structure

① Compact / Cortical → Diphysis → Yellow

② Spongy / Cancellous / Trabecular → Epiphysis, Vertebrae → Red Bone marrow

③ Diploë

④ Pneumatic

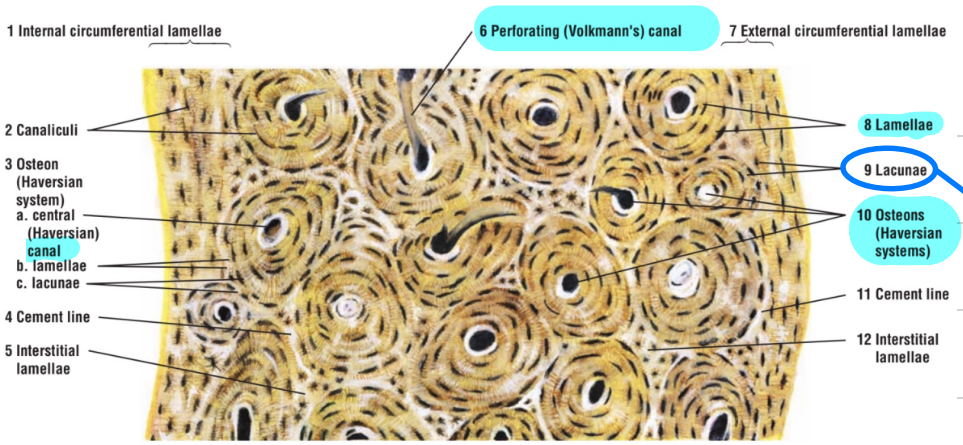


FIGURE 4.17 ■ Dry, compact bone: ground, transverse section. Low magnification.

→ Concentric deposition of matrix.

→ Almond shaped space

↓

One osteocytes



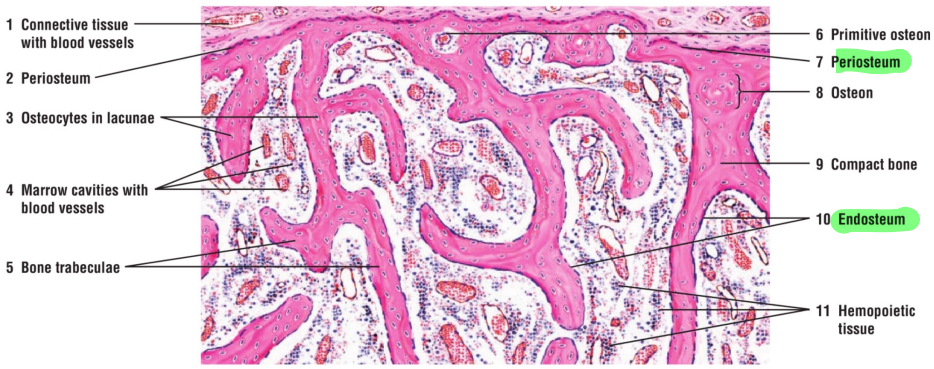
↳ Radiating canals from Lacunae

Blood vessels, Nerve & lymphatics

↑

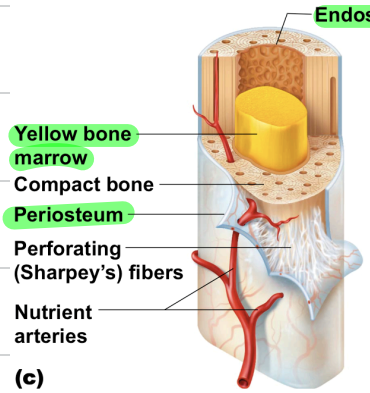
→ Vertical Canal

→ No Haversian Canal



→ Shock absorber

→ Hematopoiesis



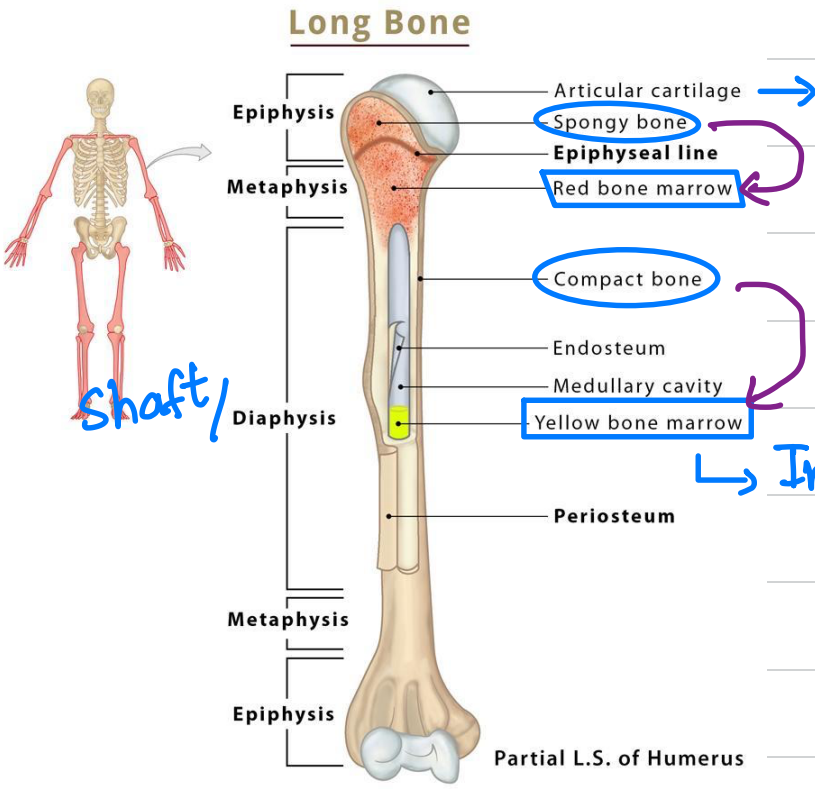
↳ Lines marrow cavity / Medullary cavity

⊛ Haversian System | Osteon

- Haversian Canal
- Lamella, Lacunae, Osteocyte & Canaliculi

* Nutrition & waste removal

2 Haversian Canal are Connected by
↳ Volkman's Canal



Shaft

→ Thin layer of Hyaline Cartilage
↓
Articulate with Another bone at joint

↳ Inactive, Store fat

Bone marrow
↓
Haemopoietic tissue
Adipose tissue

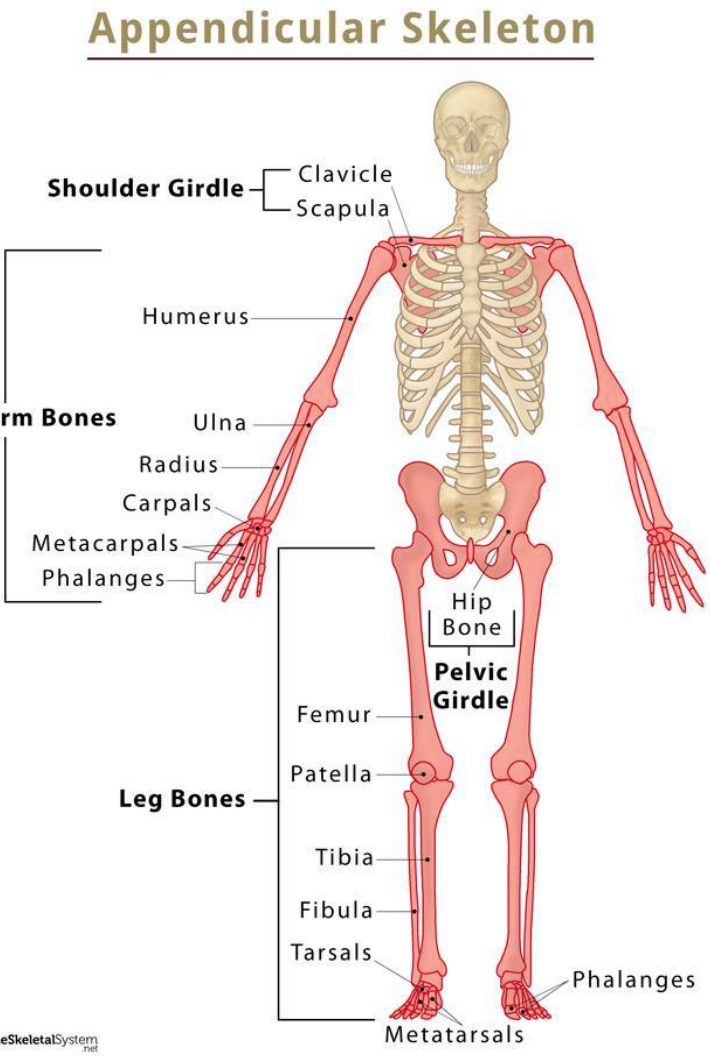
Vit D → Growth & Maintainance of bone
↳
Deficiency → Rickets & Osteomalacia

*

If bone is burnt ⟶ Brittle

If kept in dilute acid ⟶ Soft & flexible
↳ Decalcification

In KOH ⟶ No change



Facts

Total bone 206

Longest bone Femur

Smallest bone Stapes

Don't Articulate – Hyoid

Vertebrae → A 24, C 33

Skull 22

↳ Cranial – 8

↳ Facial – 14

Head → Skull + Ear ossicle + Hyoid

22 + 6 + 1

↳ 29

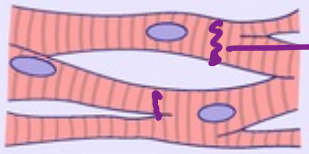
Muscular Tissue

- Mesodermal

Myology → Movement
Myo = Muscle, logy = Study

- Contractility → Shortens

Striped
Somatic

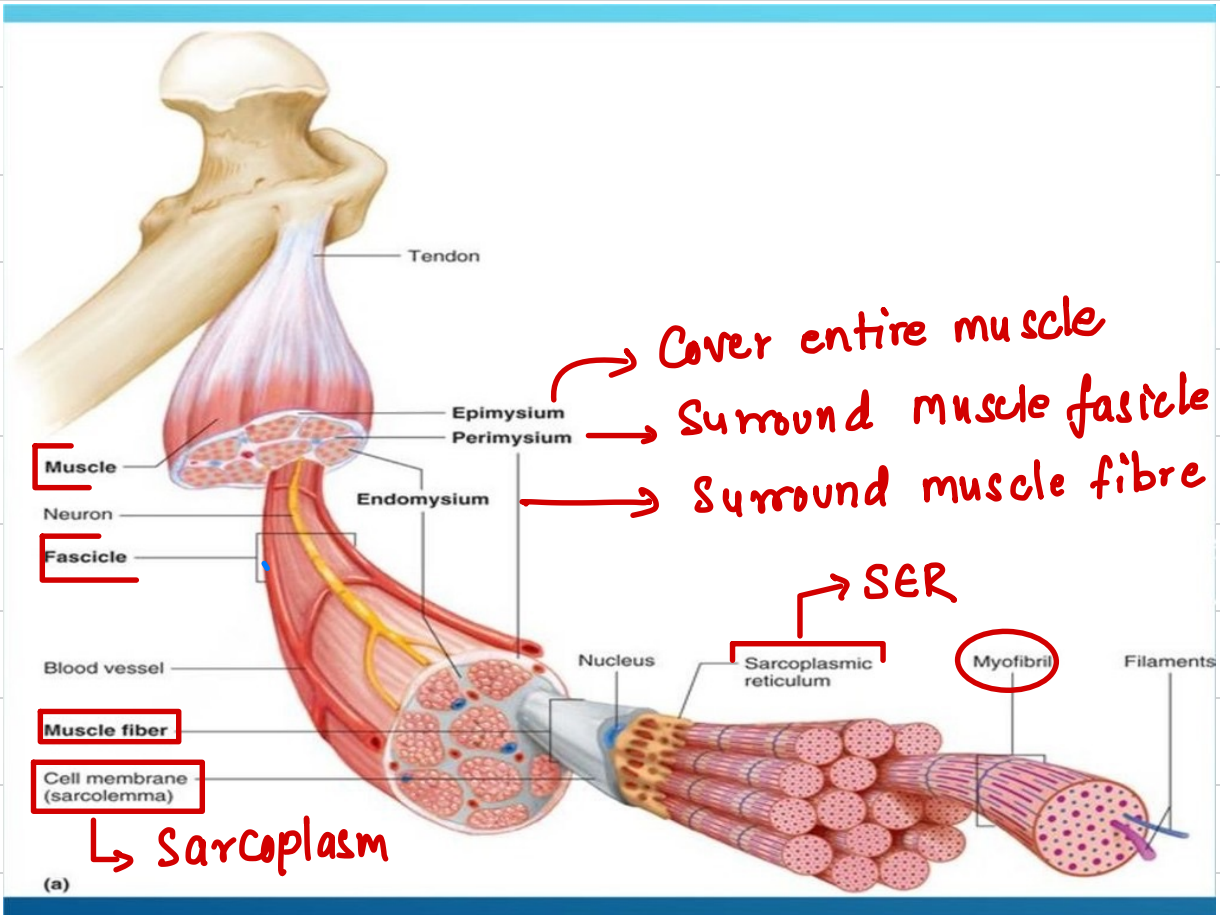
	Main features	Histology
Skeletal muscle	• Fibers: striated, tubular and multi nucleated • Voluntary • Usually attached to skeleton, Tongue, esophagus	Syncitium (Coenocyte) 
Smooth muscle	• Fibers: non-striated, spindle-shaped, and uninucleated • Involuntary • Usually covering wall of internal organs, Blood vessel.	 • visceral • No sarcolemma • ANS • Actin, myosin no troponin
Cardiac muscle	• Fibers: striated, branched and uninucleated • Involuntary • Only covering walls of the heart	 Intercalated disc → Donot fatigue

Jack Westin

Which of the following character is not related with muscle of heart
a. Involuntary. b. Communication junction
c. Intercalated disc d. fatigue ✓

	SK. ⊕	Sm. ⊖	Cardiac ⊕
→ Striations	Multi	Uni	Uni
→ Nucleus	Voluntary	Involuntary	Involuntary
→ Control	Cylindrical	Spindle	Branched.
→ Shape	Somatic	Autonomic	Autonomic
→ Nerve supply			

Skeletal muscle



→ Cover entire muscle

→ Surround muscle fascicle | bundle

→ Surround muscle fibre | muscle cell

→ SER

↳ Sarcoplasm

Muscle
Fascicle
Fiber
Myofibril
Actin, Myosin

Muscle proteins

Contractile
- Actin
- Myosin

Regulatory
- Troponin
- Tropomyosin

Structural
Titin

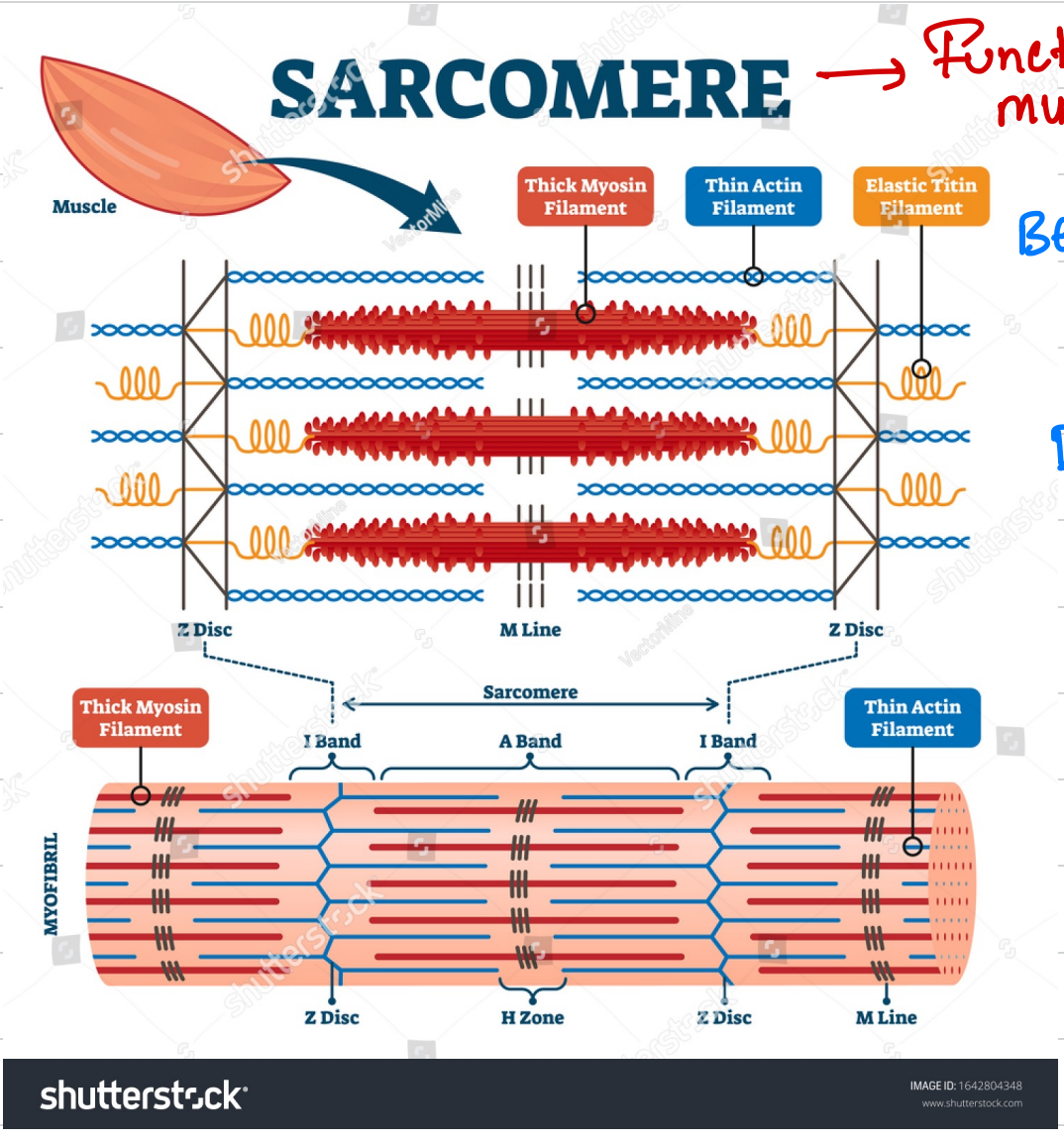
Largest protein in body

- Hold thick filament

→ Store glycogen → (Muscle & liver stores)

→ Myoglobin

→ K^+ → Most abundant mineral



→ Functional unit of muscle contraction

↓

Betⁿ two Z-disc or krause membrane

↓

Divide myofibrils into sarcomere

Alternating dark & light bands → Transverse striation

Myosin → Thick → Thick filament

Actin → Thin filament

= Light

■ Dark

@ DALI

Dark → A band [Myosin + Actin]

Light → I band [Actin]

H zone → Only Myosin

Z disc → Anchor Actin

M line → Anchor Myosin.

Contraction → Actin slide over Myosin

↳ I & H band shortens

Neuromuscular Junction

↓

Ach

↓

Nicotinic receptor

↓

Action potential

↳ Release of Ca^{2+} from Sarcoplasmic reticulum → Muscle contraction

Ca^{2+} ← Muscle relax

* chemical → Mechanical energy

- Rigor mortis ⟶ Muscle can't relax [dlt Low ATP]
- Tetanus → Continuous contraction without relaxation
  ↳ Clostridium tetani
- Tetany
  ↳ dlt hypocalcemia

- **Muscle fatigue**

Prolonged heavy exercise
↓
Anaerobic glycolysis
↓
Lactic acid ⟶ Pyruvate —(Liver)→ Glucose
↓
Contractile enzymes can't functional optimally → fatigue

*

Largest ⟶ Gluteus Maximus
Smallest ⟶ Stapedius
Longest ⟶ Sartorius [Tailor's muscle
Strongest ⟶ Masseter
Peripheral heart ⟶ Calf muscle [Soleus + Gastrocnemius]

Muscular dystrophy ⟶
Myasthenia gravis ⟶
Poliomyelitis ⟶

Q. During sternous exercise glucose is converted to
(a) Acetic Acid (b) Glycogen (c) Lactic acid (d) Fructose

Q. Smooth Muscle fibers are
(a) Unstriped, Unbranched, non striated, Uninucleate & Involuntary
(b) Unstriped, Unbranched, non striated, multinucleate & Involuntary
(c) Striped, Unbranched, striated, multinucleated & Voluntary → SK
(d) Striped, Branched, striated, Uninucleated & Involuntary
↳ Car

Q. Skeleton & Muscle're derived from ?

@ Ectoderm & Endoderm ⓑ Endoderm ✓ⓒ Meso. ⓓ Ectoderm

Q. In mammals Longitudinal Haversian canal're connected by transvers

@ Haversian Canal ⓑ Bidder's Canal ✓ⓒ Volkmann's Canal ⓓ Inguinal Canal

Q. Outer covering of bone is called

@ Perichondrium ⓑ Periosteum ⓒ Pericardium ⓓ Perimysium

Q. Yellow bone marrow is found especially in medullary cavity of

@ Spongy bone ✓ⓑ Long bone ⓒ Short bone ⓓ All of above

↳ Diaphysis

Q Intercalated disc're found in

✓@ Cardiac ⓑ Smooth ⓒ striated ⓓ Ligaments

Q Cartilage present between the joint of long bone is

@ Fibrous ⓑ Elastic ✓ⓒ Hyaline ⓓ None

Q which mineral is needed for muscle contraction ?

✓@ Ca ⓑ Mg ⓒ Lactic acid ⓓ All

Vascular Tissue / Fluid Connect Tissue

Blood

- Softest tissue
- Mesodermal.
- pH 7.35–7.45 [7.4]
- 7–8 % of body weight
- ~ 5 ltr. M > F

pH → Bicarbonate buffer

Most effective in Blood

Body fluid [42L]

↳ 60 % of body wt

- 2/3rd [28] Intracellular [K+]
- 1/3rd (14) Extracellular Na+
  - Interstitium (11) L
  - Plasma (3) Ltr

Blood

- Plasma 55%
  - Water 91–92%
  - Plasma proteins (8%) → Liver
    - Albumin
    - Globulin
    - Immunoglobulin
    - Fibrinogen
- 45% Blood cells / Formed elements / Corpuscles
  - RBC
  - WBC
  - Platelets

① Albumin

- Most abundant plasma protein
- Maintains osmotic equilibrium

↓ Albumin ⟶ Edema CEE 2022

- Transports Hormones, drugs, Bilirubin etc.

② Globulin

α, β, γ → Immunoglobulin ⟶ Produced by plasma cell

α, β
↓
- Transport
- Complement

A:G = 1.5-2.5 : 1
↳ Reversed in cirrhosis

- Ig A → Mucosal Immunity, secretions
  Milk. [Colostrum]
  Dimeric
- Ig D – On B cell surface
  ↳ Activate B cells
- Ig E → Allergy, Parasitic, Anaphylactic
  → Binds Mast cell, Basophils
  ↳ Histamine
- Ig G
  - Most abundant
  - Cross placenta
  - Long term Immunity
  - Complement activation
  - 4 subtypes
- Ig M → Pentameric
  → Largest → Intravascular
  → 1st to appear
  ↙ Produced in Fetus

③ Fibrinogen
[factor I]

Q. All plasma protein produced by liver except:

- Albumin
- α-globulin
- γ-globulin
- Fibrinogen

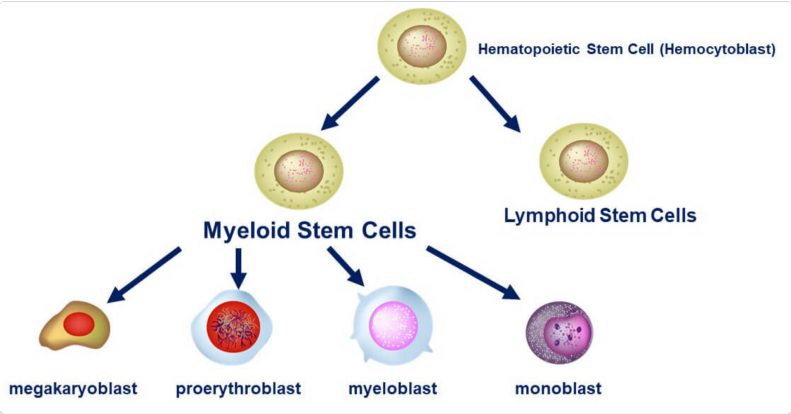
Blood cells

Haemopoiesis → Hematopoietic stem cell [Multipotent]
↳ Hemocytoblast

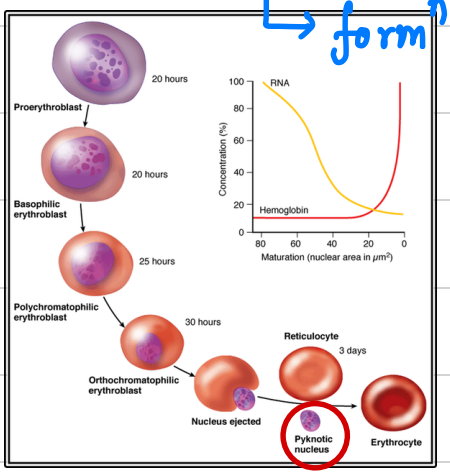
↳ 1st 2 month → Yolk Sac
↳ 2nd trimester → Liver
↳ 3rd trimester → Bone marrow

Adult → Bone marrow

↳ Myeloid → Erythrocytes, Megakaryocytes, Granulocytes, Monocytes
↳ Lymphoid → B & T lymphocyte



Erythropoiesis
↳ form of RBC



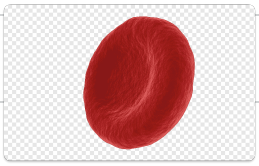
Q. WBC is produced by

✓ (a) Red bone marrow
(b) White bone marrow
(c) Yellow bone marrow
(d) Megakaryoblast

Erythrocytes / RBC.

Mammals — 120

↳ Round, biconcave, non-nucleated



except

Camel & Llama → Oval & nucleated

@ CLOwN

Frog

↳ Oval, Biconvex, nucleated, 100 days

* **Largest** Among vertebrates

↓

Amphiuma & Proteus

*

Smallest → Musk deer

@ SiMa PAL

* RBC → No nucleus, Mitochondria, Golgi, Centrosomes

↓

Glucose

↳ space for Hb, Biconcave shape

↳ Spectrin

↳ ↑ surface area fo gas exch

Folate & B12

↳ Nuclear maturation, DNA synthesis

↳ Def. ⇒ Megaloblastic Anemia

Blood → Isotonic to Normal Saline [0.9 % NaCl]

Distilled water

→ Hypotonic → RBC swells & Brust → Hemolysis

↳ Hypertonic → RBC shrink

RBC → 7-8 µm

↓

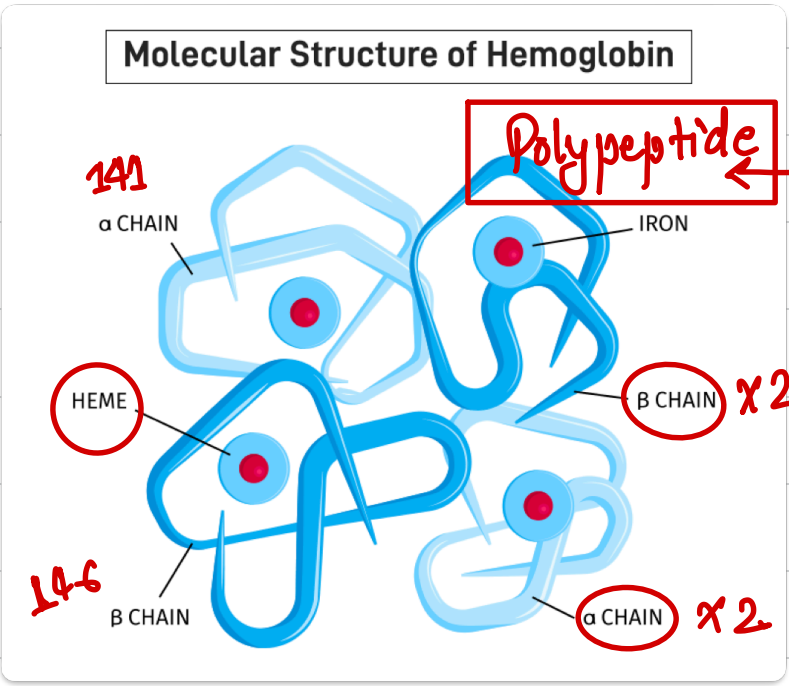
Cytoplasm

↓

Hb → Respiratory Pigment [33 % of RBC]

↳ Transport O_2.

↳ Tetramer



1 Hb

↓

Polypeptide ← 4 globin + 4 heme

↓

$4(Fe^{2+} + porphyrin)$

↓

$4\ O_2$'re carried

Oxy-Hb → Bright red.

deoxy-Hb → Dark red [Bluish under skin]

Hb A → 2α & 2β

Hb F → 2α & 2γ → More affinity

↓

2,3 BPG bind weakly.

$Hb + Fe^{3+} \rightarrow$ Methaemoglobin

$Hb + CO \rightarrow$ Carboxyhemoglobin (Toxic)

$Hb + CO_2 \rightarrow$ Carbaminohemoglobin

↳ Transport CO_2

Normal Hb level

Newborn → 16 - 20 mg/dL

Male → 13.5 - 17.5 mg/dL

Female → 12 - 16 mg/dL

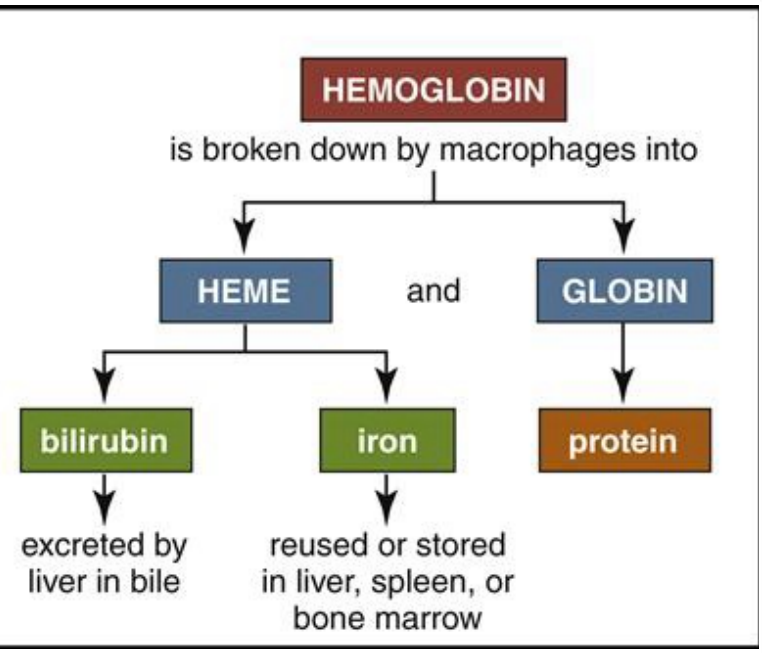
} avg → 15 gm/dL

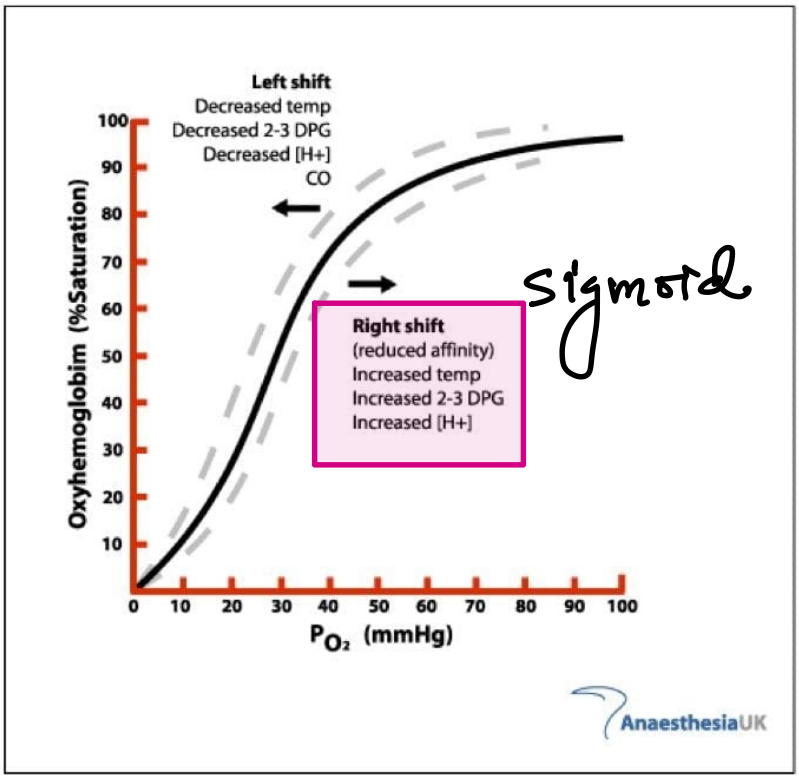
1 gm Hb → 1.34 ml of O_2

15 gm → 20.1 ml of O_2

∴ 100ml blood → ~20 ml of O_2

Breakdown of Hb





Anemia

- ↓ RBC or ↓ Hb

Types

① Microcytic ⟶ Iron deficiency
② Megaloblastic ⟶ Folate & B12 deficiency
③ Pernicious ⟶ Lack of IF [↓ B12 absorption]
④ Aplastic ⟶ Bone marrow failure
⑤ Sickle cell Anemia
↳ Glutamate is replaced by Valine at 6th position on β chain
↳ Protection against Malaria
⑥ Thalassemia → Defective globin chain

Bacteremia → Presence of bacteria
Septicemia → Multiplication

* Cyanosis ⇒ deoxy-hb > 5 gm/dL

* Polycythemia ⟶ High RBC
* Erythropenia ⟶ Low RBC

~5 Million	mm³

Hematocrit (packed cell volume)

$$\frac{\text{Vol. of RBC}}{\text{Vol. of Blood}} \times 100\ \%$$

→ ~ 3 x Hb

M → 40-54 %

F → 36-47 %

Hypoxia [Low O_2]

↓

Stimulate **Erythropoietin** ← kidney

↓

Erythropoiesis

↓

[More RBC, More Hb] → **Red cheeks**

↓ ⇓

↑ O_2 Carrying Capacity **↑RBC no.**

* Graveyard of RBC → **Spleen.** → Blood bank

* Plasma - Clotting factor

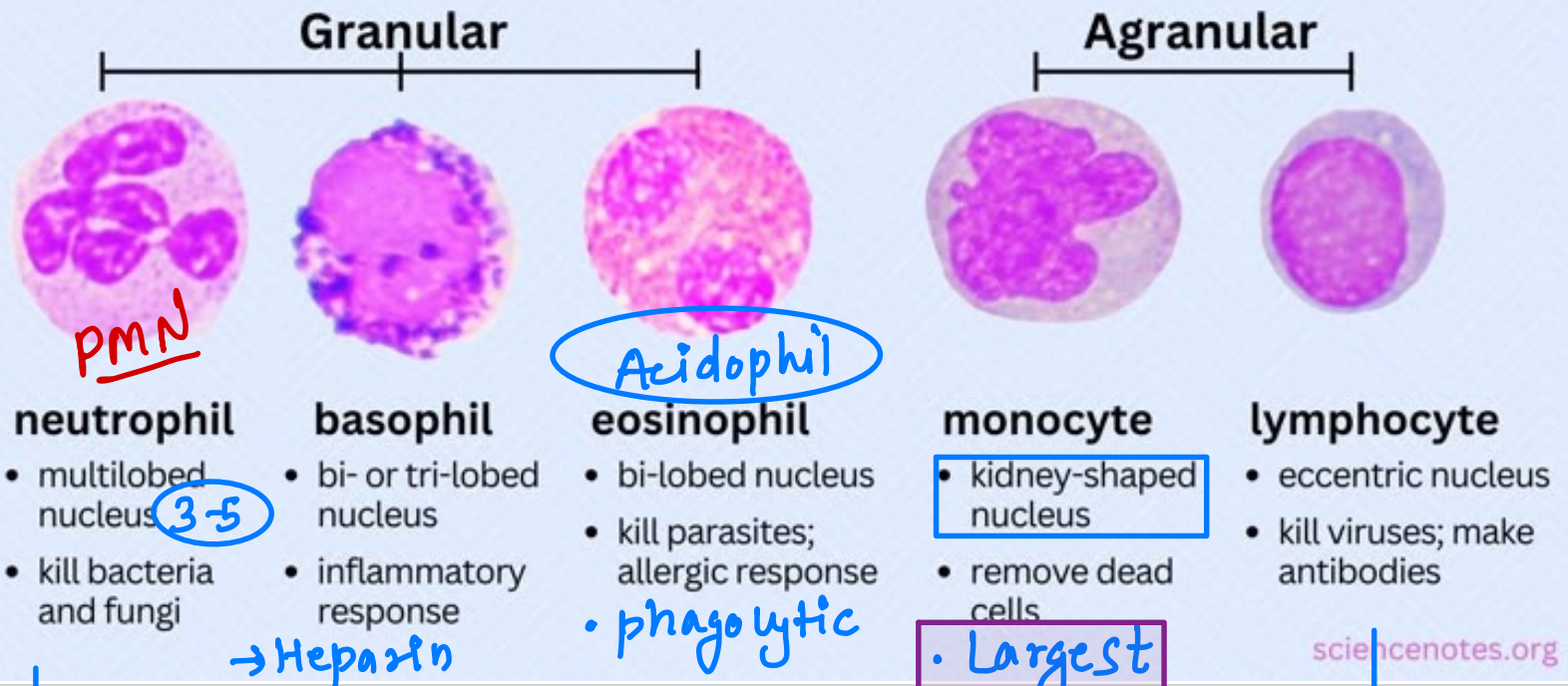
→ Serum

Leukocytes

10-13 days ← (White Blood Cells) → 4000 - 11000 /mm³

Leukocytes or white blood cells are part of the immune system.

They account for ~1% of blood volume and occur in lymphatic tissue.



neutrophil	basophil	eosinophil	monocyte	lymphocyte
• multilobed nucleus (3-5) • kill bacteria and fungi	• bi- or tri-lobed nucleus • inflammatory response	• bi-lobed nucleus • kill parasites; allergic response	• kidney-shaped nucleus • remove dead cells	• eccentric nucleus • kill viruses; make antibodies

sciencenotes.org

→ Heparin
→ Histamine

• phagolytic

• Largest
• Phagolytic

→ Phagolytic

→ 1st to response in Aute Infⁿ

→ Policeman of Blood.

→ 1st Line defence against Bact

→ Most abundant

B & T lympho.
↓
Plasma Cell
↓
Antibody producⁿ

* Memory cell.

* Smallest

→ Leucocytosis → ↑ WBC [Infec^{n}, Leukemias]
→ Leucopenia → ↓ WBC

DLC

N → 50-70% → Bacterial
L → 20-40 %. → Viral
E → 1-6 %. → Parasite, Allergy.
B → 0-1 %.
M → 2-10 %.

Monocytes → Tissue → Macrophage

- Brain → Microglia
- Liver → kupfer cell
- Bone → Osteoclast
- Cartilage → Chondroclast
- Kidney → Mesangial cell
- Lung → Dust cell
- Skin → Langhan's / Dendritic cell

Thymus → Hassal Corpuscle
Spleen → Sinusoidal
CT → Histiocyte

Diapedesis → Amoebic movement of Leukocy

Thrombocytes (Blood Platelets)

7-10 d

↳ Anucleated

↳ Formed by fragmentation of Megakaryocytes

↳ 150,000 - 4,50,000 / mm^3

Thrombocytosis ⟶ >4,50,000

Thrombocytopenia ⟶ <1,50,000

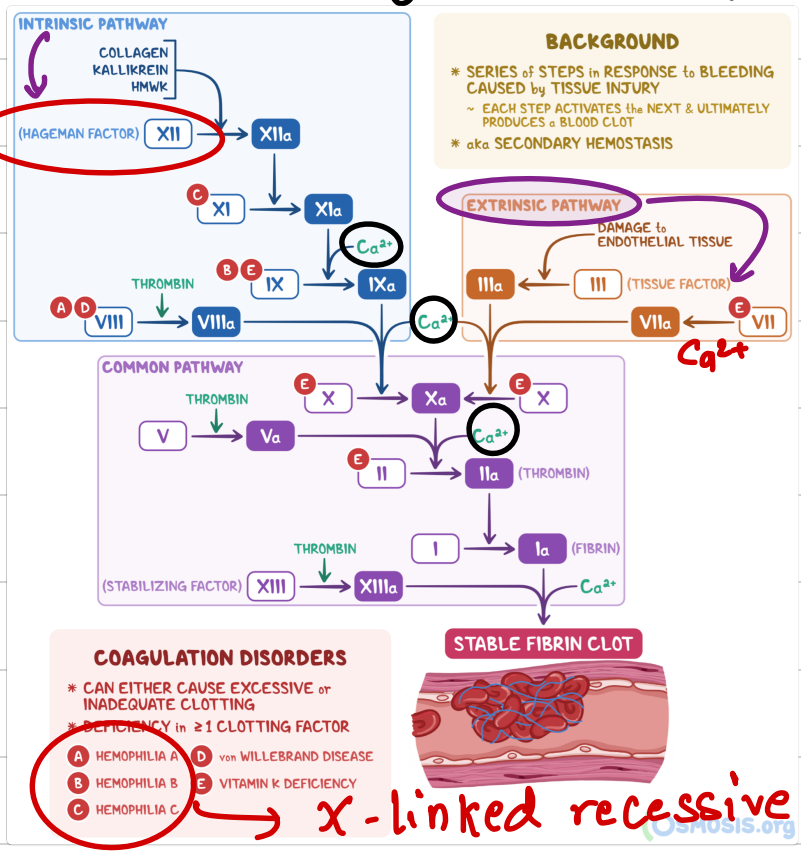
↳ eg. Dengue

↳ Phospholipid

Blood Clotting

↳ 2-8 min

- Stop bleeding / Hemorrhage



Clotting Factor	Synonym(s)
Fibrinogen	Factor I
Prothrombin	Factor II
Tissue factor	Factor III; tissue thromboplastin
Calcium	Factor IV
Factor V	Proaccelerin; labile factor; Ac-globulin (Ac-G)
Factor VII	Serum prothrombin conversion accelerator (SPCA); proconvertin; stable factor
Factor VIII	Antihemophilic factor (AHF); antihemophilic globulin (AHG); antihemophilic factor A
Factor IX	Plasma thromboplastin component (PTC); Christmas factor; antihemophilic factor B
Factor X	Stuart factor; Stuart-Prower factor
Factor XI	Plasma thromboplastin antecedent (PTA); antihemophilic factor C
Factor XII	Hageman factor
Factor XIII	Fibrin-stabilizing factor
Prekallikrein	Fletcher factor
High-molecular-weight kininogen	Fitzgerald factor; high-molecular-weight kininogen (HMWK)
Platelets	

[a]These are listed here mainly for historical interest.

Thrombosis → Clotting inside intact vessel.
↳ Thrombus

if travelled through blood → Embolus.

Mineral. – Ca^{2+}
Vitamin – K

II, VII, Ix, x.
↳ Vit K dependent

Anticoagulants

Natural Anticoagulant → Heparin
↳ Inhibit II, Ix, x.

Hirudin
→ Saliva of Leech

Blood Bank
↳ Blood + Anticoagulant [4°c]

CPD / CPAD → Citrate Phosphate Dextrose Adenine
ACD → Acid Citrate dextrose
EDTA → Ethylene Diamine Tetra-Acetic Acid

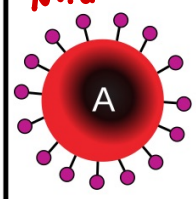
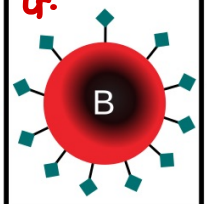
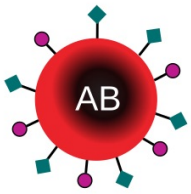
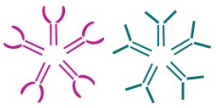
Human Blood Grouping

ABO System

- Based on glycoprotein
- Incomplete / Co-dominance
- Karl Landsteiner
- Also in Semen, Saliva, Amniotic fluid

Rhesus System

- Based on Rh or D antigen
- only in RBC membrane
- 85 % Rh positive
- Dominant Trait

	Group A	Group B	Group AB	Group O
Red blood cell type				
Agglutinin Antibodies in plasma	 Anti-B	 Anti-A	None	 Anti-A and Anti-B
Antigens in red blood cell	 A antigen	B antigen	 A and B antigens	None

Agglutinogen

O → peptic ulcer

A → Gastric Ca.

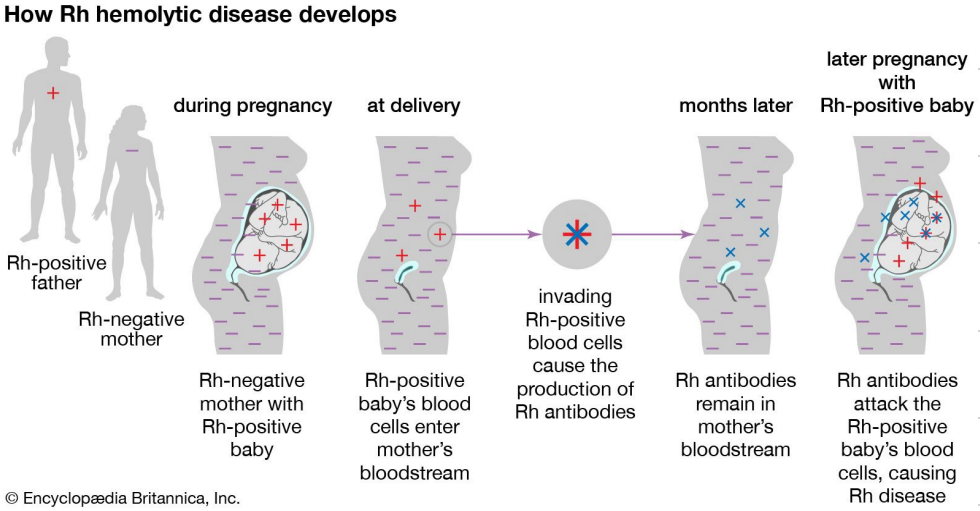
@ PUCA

Universal donor ⟶ O^{-ve}

Universal reciever ⟶ AB^{+ve}

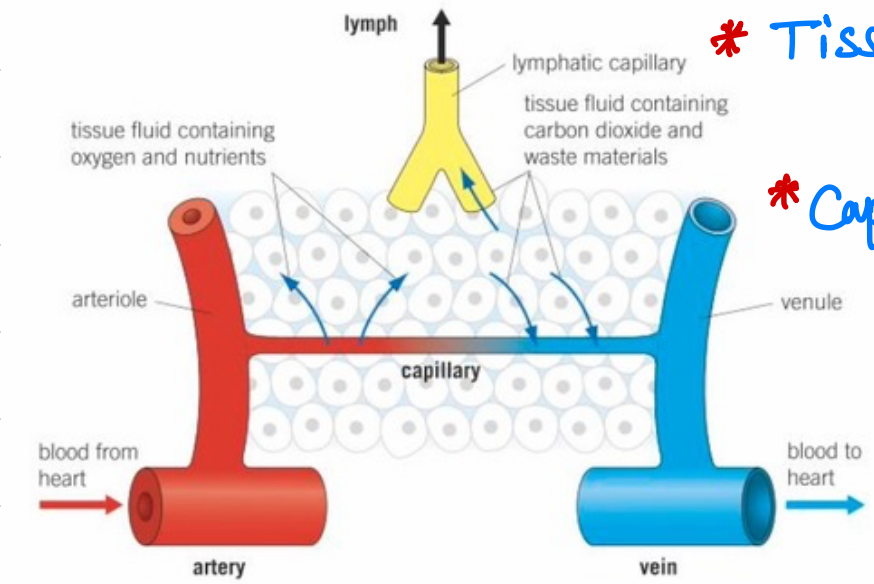
Erythroblastosis Fetalis

↳ Hemolytic reaction in 2nd child from Rh positive father & Rh Neg Mother.



Lymph

Blood - (RBC + Platelet)



* Tissue fluid
  ↳ exchange bet^{n} Blood & Tissue

* Capillaries
  ↳ exchange bet^{n} blood & Tissue fluid.

* Lymph in Intestinal Vili
  ↓
  Lacteals
  ↓
  Absorp^{n} of fat

PYQ

1. Which of the following increases during allergy ?
(a) IgE ✓ (b) Ig A (c) IgM (d) Ig D

2. Blood vessels near wound dilate & become more permeable in response to which material released from damaged tissue ?
(a) Pyrogen (b) Antibodies (c) Histamine ✓ (d) Interferon

3. WBC that're non specific killer of microbes are ?
(a) B-cells (b) killer T (c) Helper T (d) Phagoyte ✓

4. Very good power of regeneration is found in
(a) Lung (b) Liver ✓ (c) Spleen (d) Kidney

5. Substance produced in body for defence is
(a) Platelets (b) Antigen (c) Thrombins (d) Lymphoytes ✓
(Antibody better)

6. In diapedesis which of the following squeezes out of narrow capillaries ?
(a) RBC (b) Plasma (c) Platelets (d) WBC ✓

7. Clotting of blood is delayed by

(a) Prothrombin (b) Heparin (c) Calcium (d) vitamin k

↳ Anticoagulant

8. Metal present in hemoglobin

(a) Fe^{+} (b) Fe^{++} (c) Fe^{+++} (d) Fe^{++++}

9. which of the following is added during blood transfusion ?

(a) Heparin (b) EPD (c) Citruclive (d) CDDA.

10. Prothrombin, Fibrin & thrombin're synthesized in

(a) spleen (b) Liver (c) kidney (d) Bone marrow

11. Which of these liver cell acts as phagoyte ?

(a) kupfer cell (b) Hansen cell (c) Dieter's cell (d) Aunar cell.

12. A baby with blood group A cannot belong to parents of

(a) Father O, Mother AB

(b) Father A, Mother B

(c) Father B, Mother O

(d) Father AB, Mother A

F. M.

$I^B I^O$ or $I^B I^B$ × $I^O I^O$

↓

Cant give $I^A I^O / I^A I^A$

13. Which one of the following is largest WBC ?

(a) Acidophils (b) Basophils (c) Lymphoytes (d) Monoytes

14. Histamine is secreted by

(a) Lymphocyte (b) Basophil ✓ (c) Monocyte (d) Eosinophil

15. Acidophils are

(a) WBC ✓ (b) Connective tissue (c) Bone cells (d) Articular cartilage

↳ Eosinophils

16. Which of the following human cell donot contain Mitochondria?

(a) Neuron (b) RBC ✓ (c) WBC (d) Hepatocyte

↳ No nucleus, Mt, Golgi

17. Serum is

(a) Plasma (b) Plasma - Ca^{2+} (c) Plasma - fibrinogen ✓ (d) Blood - Cells

↳ plasma

18 Which of the following Leucocyte doesn't contain granules?

(a) Neutrophil (b) Basophil (c) Eosinophil (d) Monocyte ✓

Phil - granule

19. Memory cells is/are

(a) T cell only (b) B cells only (c) Both ✓ (d) None

20. Which of the following is anticoagulant?

(a) Heparin ✓ (b) Protein (c) Fibrinogen (d) Thromboplastin

21. Antibody producing blood cells are

(a) Lymphocytes (b) Monocytes (c) Basophils (d) Neutrophils

↳ B lymphocyte → plasma cell – Ab

22. Immunological function of blood is due to

(a) Monocytes (b) Lymphocytes (c) Acidophils (d) Neutrophils

23. Universal donor blood group

(a) O (b) AB (c) B (d) A

$O^{-ve} > O$

Q. In human body which cell has No nucleus

(a) WBC (b) RBC (c) Neuron (d) Plasma cell

Nervous Tissue

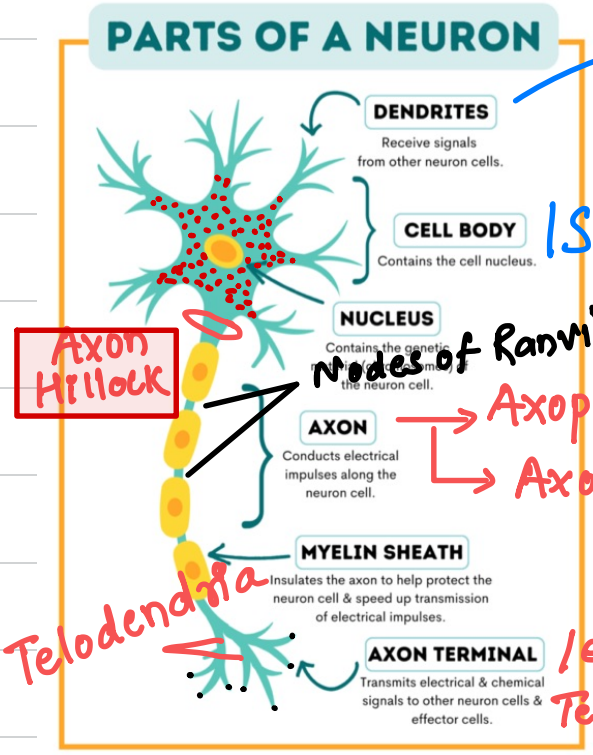
→ Ectodermal

Except [Microglia, Meninges,]

Nervous tissue

- → Neuron → Longest cell.
  - ↳ structural unit
- → Neuroglia

Neuron → Cyton + Neurite



Impulse towards cell body

Afferent, multiple

Axon Hillock

Nodes of Ranvier

Telodendria

/Soma/Cyton/Perikaryon

↳ Cytoplasm → Nissl's granules

→ Trigoid body

→ Modified RER

↓

Protein synthesis

↳ Absent in Axon Hillock & Axon.

→ Axoplasm

↳ Axolemma

↳ Efferent

/end bulb

Terminal boutons

Types of Axon

Myelinated / Medullated

↳ Surrounded by **Meylin sheath**

- Phospholipid (Sphingomyelin)
- Prevent ion loss
- Protect the nerve

↳ Nodes of Ranvier

↳ Fast / Saltatory Conduction

↳ White in color

- White matter
- Preganglionic autonomic
- Aδ fiber of pain
- Cranial & Spinal nerve

Form^{n} of Myelin sheath

@ COPS

CNS → Oligodendrocytes

PNS → Schwann Cell.

↓

Neurilemma

↓

Helps in Regeneration

* Least regenerative Capacity

* Donot divide

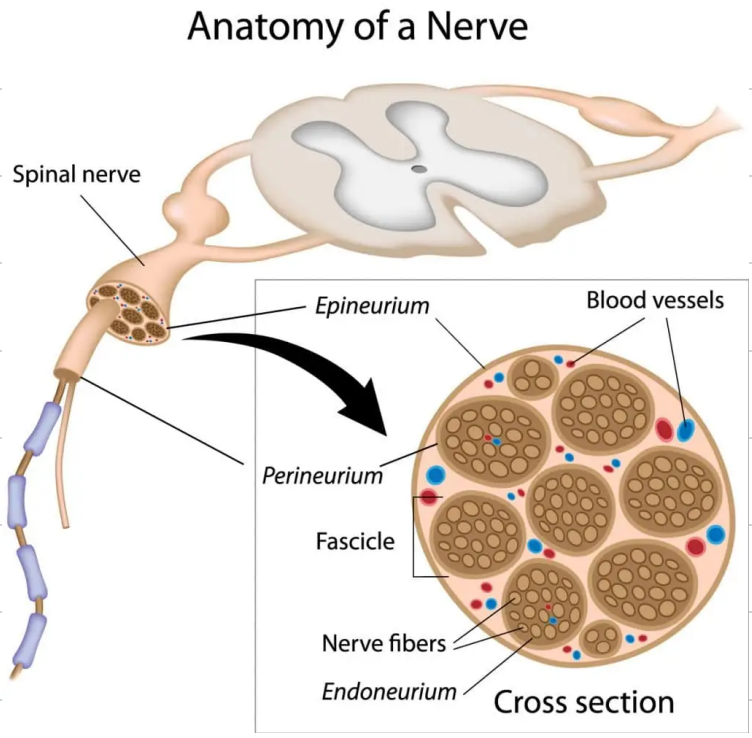
↳ Max at birth

Unmyelinated

↳ Gray matter

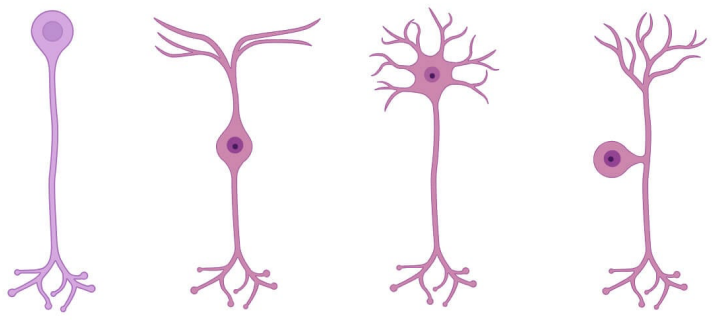
↳ Post ganglionic

↳ C fibers of pain



Based on number & Nature of process

- **Unipolar**
  - Invertebrates
  - Mesencephalic Nucleus of Cs
- **Pseudounipolar**
  - Dorsal root gang. (pain, temp. touch)
- **Bipolar**
  - Retina
  - Olf. epi
  - Cochlea
- **Multipolar**
  - Somatic motor neurons
  - Purkinje cell
  - (Most of the neurons
- **Apolar**
  - Hydra
  - Chromaffin Cell



Dorsal root @ Dr. साब

Sensory → Afferent @ SAME → Towards CNS. [Brain & S.C]

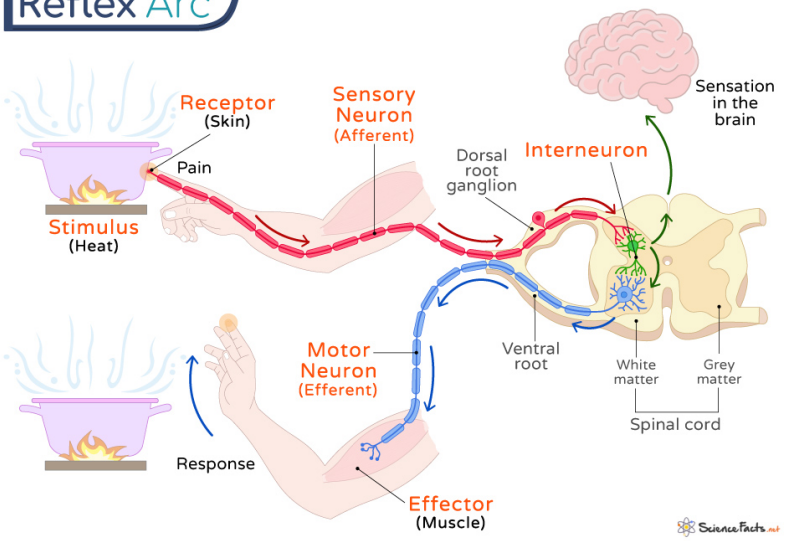
Motor → Efferent → Away from CNS

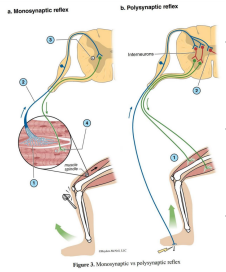
↳ Ventra root

Interneuron

Neuron ≠ Nerve

Reflex Arc





Monosynaptic

- knee jerk, patellar reflex

Polysynaptic

- withdrawl reflex, Plantar [Babinski] reflex

Reflex

Rapid Automatic, Unconscious, involuntary response to stimuli

↓

Integration Centre [Spinal Cord & Brain] CNS

↓ ↓

Spinal reflex Cranial reflex

↓ ↓

Fast Slow

Inborn / unconditioned

↳ Coughing, sneezing, pupilary light reflex, withdrawl.

Acquired / Conditioned

↳ Cycling, Dancing

Non excitable ← Neuroglia / Supporting Cell / Glial cell

* Can divide

Central

① Astrocyte / Star shaped
- Most Abundant
- Blood Brain Barrier
- Absent in CTX

② Oligodendrocytes
- Myelin sheath

③ Ependymal Cell
- Lining of ventricles & Neurocoel
- Ciliated
- Blood CSF barrier

④ Microglia
↳ phagocytic

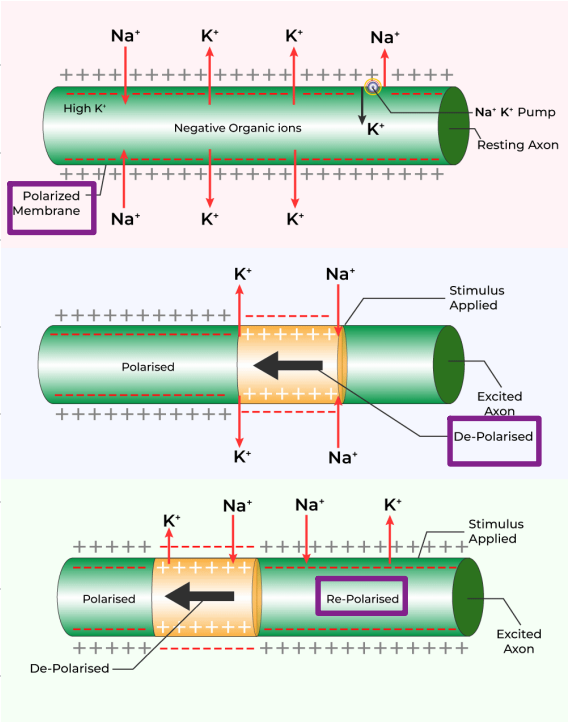
Peripheral

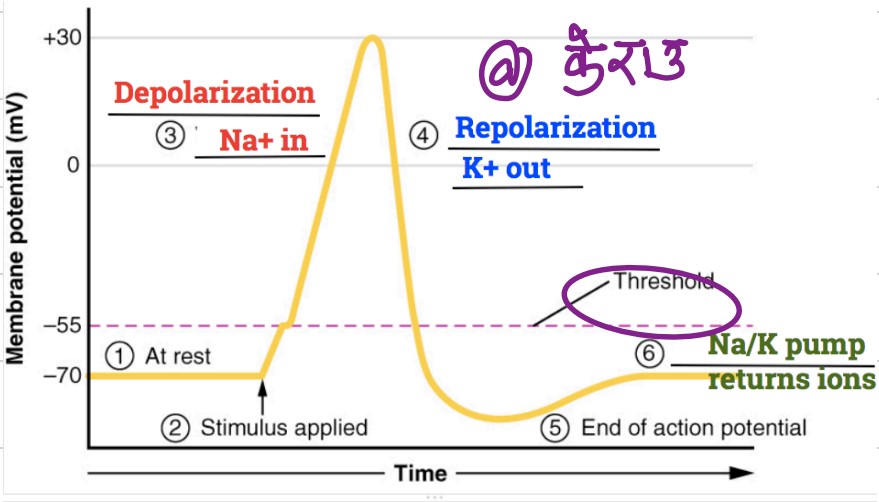
① Schwann cell (Neurolemmocyte)
- Myelin sheath
- Neurilemma
  ↳ Regeneration

② Satellite cell
↳ Nutritional & structural support to PNS.

	Cell body	Axons
PNS	Ganglia	Nerve
CNS	Nucleus	Tract

↳ Electrical Signal
Nerve Impulse Conduction





@ कैरेक्टर

Refractory period → 1-2 ms

RMP is measured by → Cathode Ray Osciloscope

Nerve → −70 mV
Skeletal → −90 mV
Cardiac → −90 mV
Smooth → −55 mV

Velocity ∝ Myelination
Temperature
Diameter

RMP is due to → K^+ leaky channel
Na^+-K^+ pump.

Action potential → Unidirectional

Synapse:

↳ Communication between neurons & neurons / muscle cell

↳ 20-40 µm

Depolarization of presynaptic neuron

↓

Opening of Ca^{2+} channel

↓

Ca^{2+} influx

↓

Exocytosis of vesicle

↓

Release of Neurotransmitter

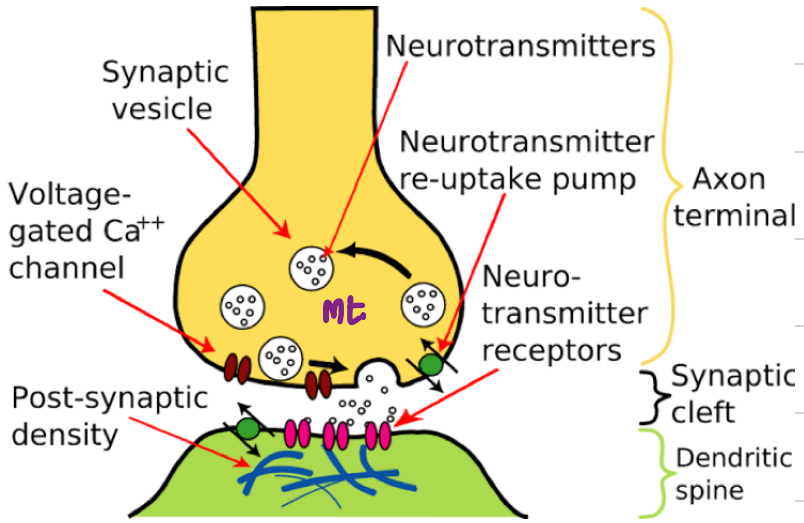
↓

Binds to post-synaptic receptor

↓

① If open Na^+ channel → Excitatory eg. Glutamate, Ach

② If open Cl^- channel → Inhibitory eg. GABA, Glycine



* Alzhimer's disease ⟶ ↓ Ach

Parkinson's disease ⟶ ↓ Dopamine

CEE 2021

Q1.Which is the largest muscle of human body?
a. Gluteus maximus b. Gluteus minimus c. Masseter d.Stapedius

Q2...lines the cavity of brain and secretes CSF.
a. Astrocytes . b. Glia cells c. Schwann cells d. Ependymal cells

Q3.Which is incorrect?
a. Myosin-contractile protein b. Myoglobin-Red muscle
c. Troponin-Fibrous protein d. Smooth muscle Involuntary muscle

Which is learned behaviour?
a. Tendon reflex. b.Saliavation
c. Blinking of eye. d.Cycling and dancing I

CEE 2022

Q4. Universal donor is
a. O b. A c. AB d. B

Q5. The deficiency of albumin protein causes:
a. Edema b. Hypertension c. Hypotension d. Hypocalcemia 7

Q6.Colostrum from mother milk contains:
a. Immunoglobulin A b. Diseases resistance c. Macrophagesd.Leucocytes

Q7.Horns of Rhinoceros are modified form of:
a. Epidermis b.Odontoblast c.Mesodermal tissues d. Matted hair

Q8.When there is net influx of positive ions in neuron, then there occurs:
a. Repolarization b.Depolarization c. Hyper polarization d. Resting potential

Q9.Anticoagulant most commonly used to store bloodin blood banks:
a. Citrate phosphate taurocholate
b. Citrate phosphate gluconate
c Citrate phosphate dextrose
d. Citrate phosphate glycolate...

Q10.Local anesthesia prevent the pain by closing:
a. Voltage gated K* lon b. Voltage gated Mg** lon
c. Voltage gated Na* lon d. Voltage gated Ca** ion

Q11.Haversian canals are interconnected by
a. Volkman canal b. Lacunae c. Canaliculi d. Bidders canal

Q12.Intercalated discs and branched muscles are found in:
a.Smooth muscle b.Cardiac muscle c.Striated muscle d.Non-striated muscle

CEE 2023

Q13.Which of the following tissue protects the body?
a.Epithelial tissue b.Connective tissue
c.Nervous tissue d.Muscular tissue

Q14.Areolar tissue connect:
a.Bone to bone b.Bone to muscle
c.Fat body with muscle d.Integument with muscle

Q15.Which of the following tissue can be stretched?
a. Columnar b. Squamous
c.Transitional d. Cuboidal

Q16.When there is +ve and -ve potential in the membrane of neuron before any stimulus, it is called:

a. Action potential b.Resting potential

c.Hyper potential d.Threshold potential

Q17.What happens when a person lives in high altitude for some days

a. Increase rbc production. b. Decrease rbc production

c. Increase rbc size. d. Decrease rbc production

CEE 2024

Q18.Which tissue is responsible for fat storage and heat insulation

a. Areolar. b. Adipose. c. Muscular d. Insulin

Q19.What kind of tissue line urinary bladder

a.Simple columnar. b.Cuboidal epithelium

c. Transitional epithelium d. Squamous epithelium

Q20.Pseudostratified epithelium is found in

a. Trachea b. Stomach

c. Stomach. d. Larynx

Q21.T lymphocytes and B lymphocytes both originate from bone marrow where does T lymphocytes mature?

a. Blood b. Thymus.

c. Spleen. d.Tonsils

Q22.The gland which shows complete breakdown for the release of its secretion is called:

A. Endocrine. B. Merocrine

C. Apocrine. D. Holocrine

Q23.What is the primary function of smooth muscle?

A. Voluntary movement B. Pumping of blood

C. Involuntary movement of hollow organs. D. Locomotion

Q24.Which vitamin is responsible for maturation of erythrocytes?

A. Vitamin C B. Vitamin B12 ← B_9

C. Vitamin K D. Vitamin D

↳ Megaloblastic Ane

Q25.What happens to RBCs of humans in high altitude?

A. Increases in size B. Increases in number

C. Decreases in size D. Both a and b.

Q26.Which of the following protein helps in transportation?

A. Keratin B. Albumin

C. Ricin D. Actin

Q27.Patients with sickle cell anemia are:

A. More prone to Malaria B. More prone to Typhoid

C. Less prone to Malaria D. Less prone to Typhoid

CEE 2025

Q28.Thyroid gland is lined with
a. Columnal epithelium b. Cuboidal epithelium
c. Stratified squamous d. Psedostratified

Q29.If only one (K*) enters instead of two K+ ions then the membrane potential will be
a. More negative b. Less negative
c. More positive d. Less positive

Q30.If the doctor gives his own blood immediately to the patient in emergency then the blood of doctor is
a. Golden blood b. O group
c. A group d. AB group

Q31.Areolar tissue connects?
a. Muscles to bone b. Bone to bone
c. Integuments with muscle. d. Fat with bone

Q32.Pap smear is test of cervical cancer. The fluid is taken out from cervix, and analyses it.
Then which epithelium lines the cervix?
a. Keratinized stratified squamous epithelium
b. Simple luboidal epithelium
c. Simple columnar epithelium
d. Non keratinized stratified squamous epithelium

Q33. Which of the following is absent in CNS?

a. Schwann cell. b. Ependymal cell

c. Oligodendrocytes. d. Astrocytes

Mucin is

a Glycoprotein b. Mucopolysaccharides

c. Glycolipid d. Cholesterol

