PRACHAND NEET

ONE SHOT

ZOOLOGY

Body Fluids and Circulation

By: Vipin Sharma Sir

Topics *to be covered*

1. Blood Grouping
2. Lymph
3. Double Circulation and ECG
4. Questions and PYQs


VIPIN SIR
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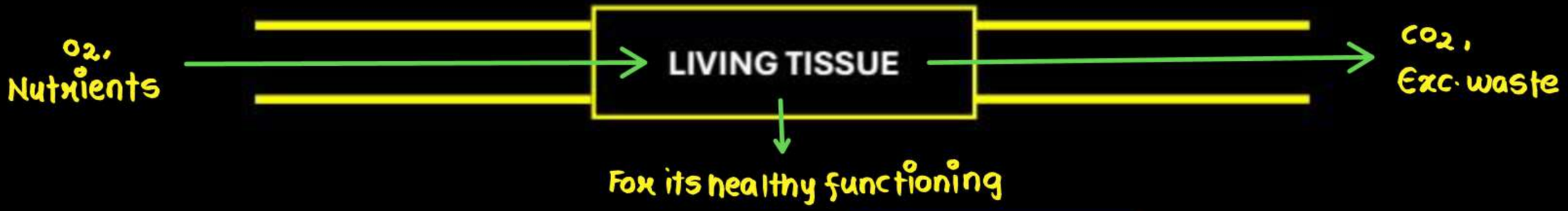
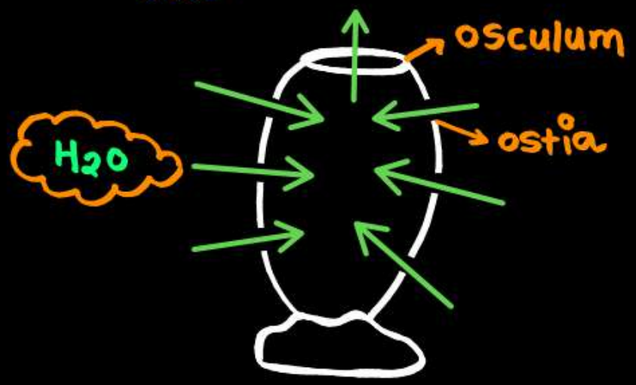
Why Circulation is Needed?



- Mechanism of Circulation differs in **Simple animals** and **complex animals.**

Surrounding H_2O is circulated in body of Porifera via pores

Porifera, Coelenterata



Human beings

Specialised fluids for circulation

- Blood
- Lymph/Tissue fluid

Blood

- **Specialized connective tissue with fluid matrix (fibers are absent)**

Plasma

55% of blood

90-92% is H_2O; 6-8% is proteins + ions + nutrients + (in transit)

ions: Na^+, Ca^{2+}, Mg^{2+}, Cl^-, HCO_3^-

nutrients (in transit) → Glucose, aminoacid, Lipid, Fatty acid

proteins:
1. Fibrinogen: helps in blood clotting
2. Albumin: osmotic balance (pH = 7.4)
3. Globulin: provide immunity

Clotting factors
- XIII : clotting factor
- VI : discarded

* SERUM = Plasma − clotting factors

Formed Elements

45% of blood

formed in diff. locations of body

- RBC → Erythrocyte
- WBC → Leucocyte
- Platelet → Thrombocyte (cell fragment)

Formed Elements

Erythrocytes

- Number: 5-5.5 million/mm^3
- Formed in: Red bone marrow in adults ; yolk sac
- Shape: biconcave disc like
- Nucleus: ⊖nt in matured RBC
- Red due to: ⊕nce of 'Hb'
- Amount of 'Hb': 12-16gm in 100ml blood
- Life span: 120days
- Destroyed in: spleen ⇓ graveyard of RBC

Leucocytes

20-25days

- Number: 6000-8000/mm^3
- White color due to: ⊖nce of Haemoglobin
- Shape: inregular/amoeboid
- Nucleus: ⊕nt
- TYPES

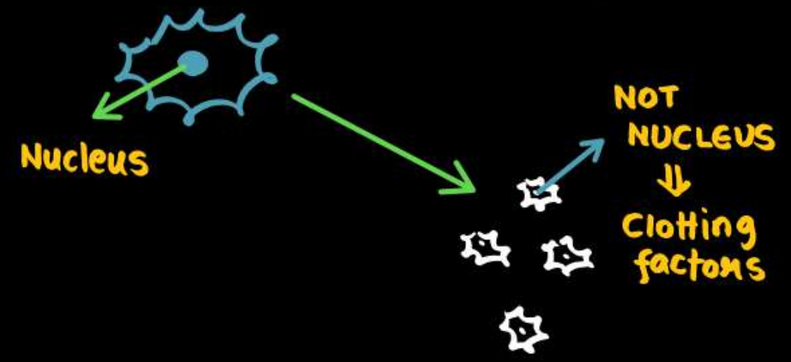
Granulocyte
- Neutrophil
- Eosinophil
- Basophil

Agranulocyte
- Lymphocyte
- Monocyte

Thrombocytes/ Platelets

10-15days

- Number: 1.5-3.5 Lakh/mm^3
- Formed from: megakaryocyte



- Shape: Plate like
- Nucleus: ⊖nt
- Helps in: Blood clotting
- Their reduction leads to: clotting disorder/ blood loss !

Formed Elements

- Erythrocytes
- Leucocytes
- Thrombocytes/ Platelets

Relative abundance

- Never Let Monkeys Eat Banana
- Never → Neutro (60-65%)
- Let → Lympho (20-25%)
- Monkeys → Mono (6-8%)
- Eat → Eosino (2-3%)
- Banana → Baso. (0.5-1%)

Granulocyte

- Neutrophil → Phagocytic
- Eosinophil → Allergic reaction
- Basophil
  - Heparin: anti-coagulant
  - Histamine: vaso-dilation → BP↓
  - Serotonin: vaso-constrict.

Agranulocyte

- Monocyte → Phagocytic
- Lymphocyte
  - B-cells → Humoral immunity
  - T-cells → Cell-mediated immunity

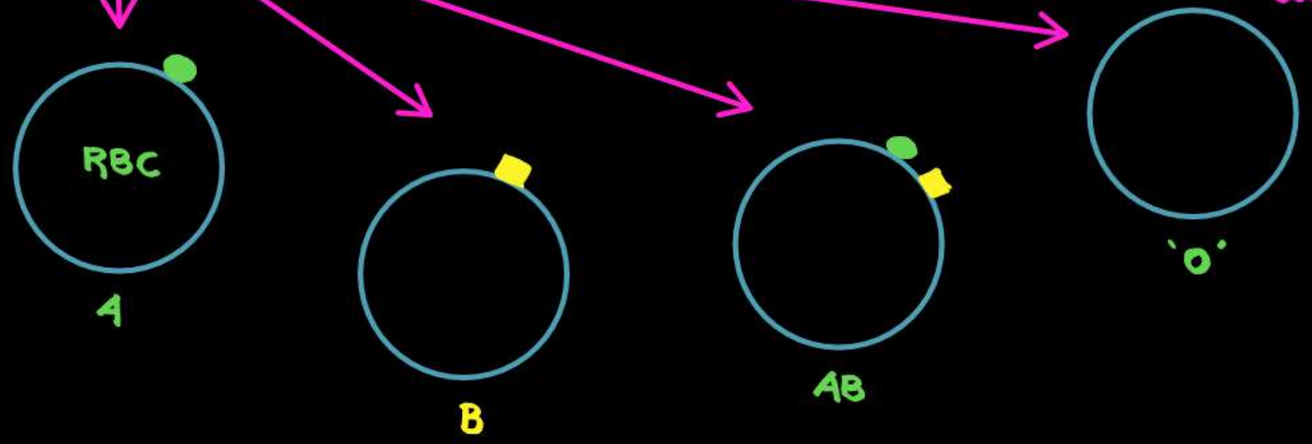
BP↑

Formed Elements

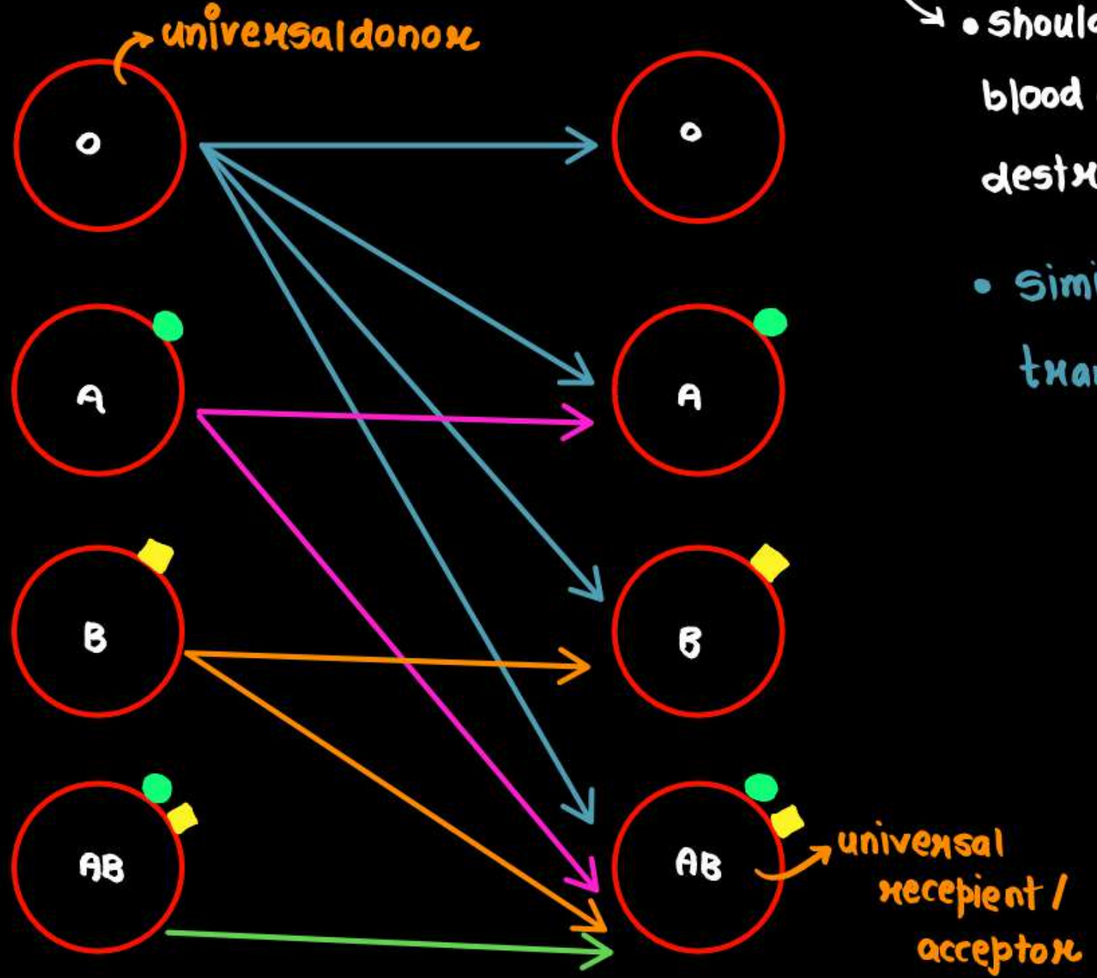
- Erythrocytes
- Leucocytes
  - Granulocyte
    - Neutrophil (N)
      - 3-5 lobed nucleus
    - Eosinophil
    - Basophil
  - Agranulocyte
    - Monocyte
    - Lymphocyte
- Thrombocytes/ Platelets

Blood Grouping

- ABO and Rh Blood Grouping
  - ABO → A, B, AB, O
    - Landsteiner
  - Rh → Rh^{+ve} : 80%, Rh^{-ve} : 20%
    - Landsteiner & weiner
- ABO blood grouping is based on the presence or absence of two antigens on surface of RBC
  - antigen: is a chemical that triggers immune response in our body
  - A, B
  - antibody (weapon)
  - generating



ABO Blood Grouping



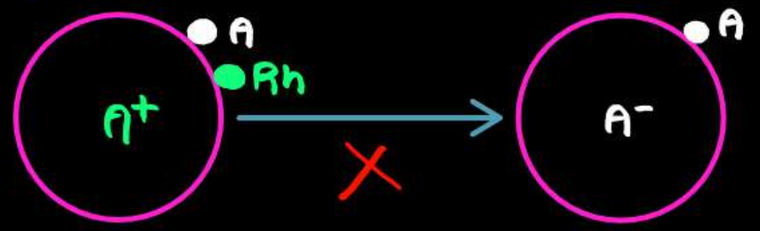
- should be matched before blood transfusion as wrong blood or RBC if injected in accept will cause CLUMPING / destruction of RBC
- Similarly 'Rh' blood group shall also be matched before blood transfusion

ABO Blood Grouping

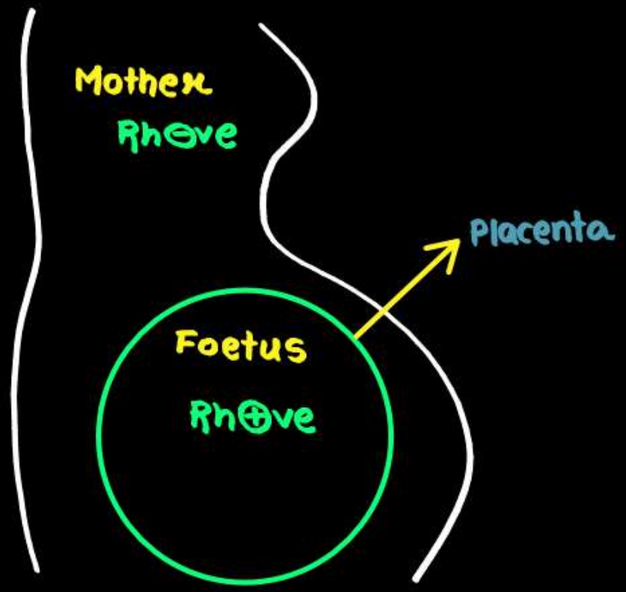
RELATIONSHIPS BETWEEN BLOOD TYPES AND ANTIBODIES				
Blood Type	Antigens on Red Blood Cell	Can Donate Blood To	Antibodies in Cerum	Can Recieve Blood From
A	A	A, AB	Anti-B	A, O
B	B	B, AB	Anti-A	B, O
AB	A and B	AB	None	AB, O
O	None	A, B, AB, O	Anti-A and Anti-B	O

Rh Blood Grouping

- What is Rh Blood group
  - ↳ antigen was similar to what seen in monkey
  - ↳ Rhesus monkey
  - ↳ ⊕nt in 80% humans ∴ Rh^{+ve}



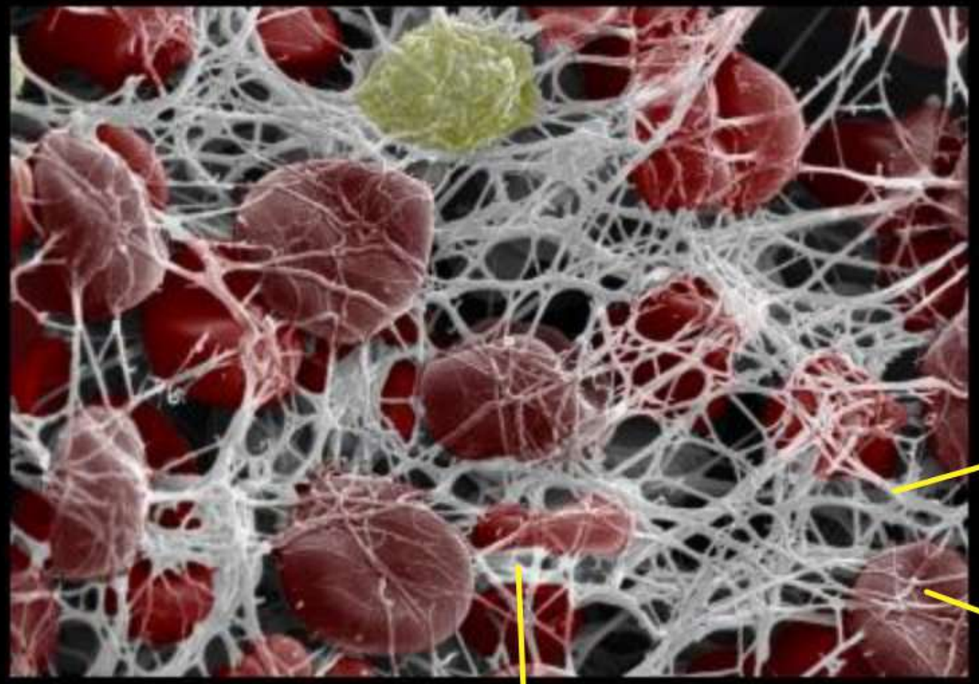
- Special case of Erythroblastosis foetalis (Rh incompatibility)
  - ↳ • During delivery of first Rh⊕ve baby, there are chances of foetal blood to get exposed to maternal blood
    ∴ mother will make Anti-Rh-antibody



RHOGAM ⊖

- 2nd Rh⊕ve baby can suffer from Anemia & Jaundice

Blood Clotting/ Coagulation



Fibrin

Dead & damaged formed elements

Clot/coagulum

Trauma or injury

↓

Platelet / tissue factor will activate

↓

Clotting will start

Blood Clotting/ Coagulation: Mechanism

Injury / Trauma → Platelet activated / Tissue factor released → Thrombo'p'lastin released

Thrombo'K'inase released

Prothrombin —Ca^{2+}→ 'T'hrombin

Fibrinogen —Ca^{2+}→ 'Fibrin' (Clot)

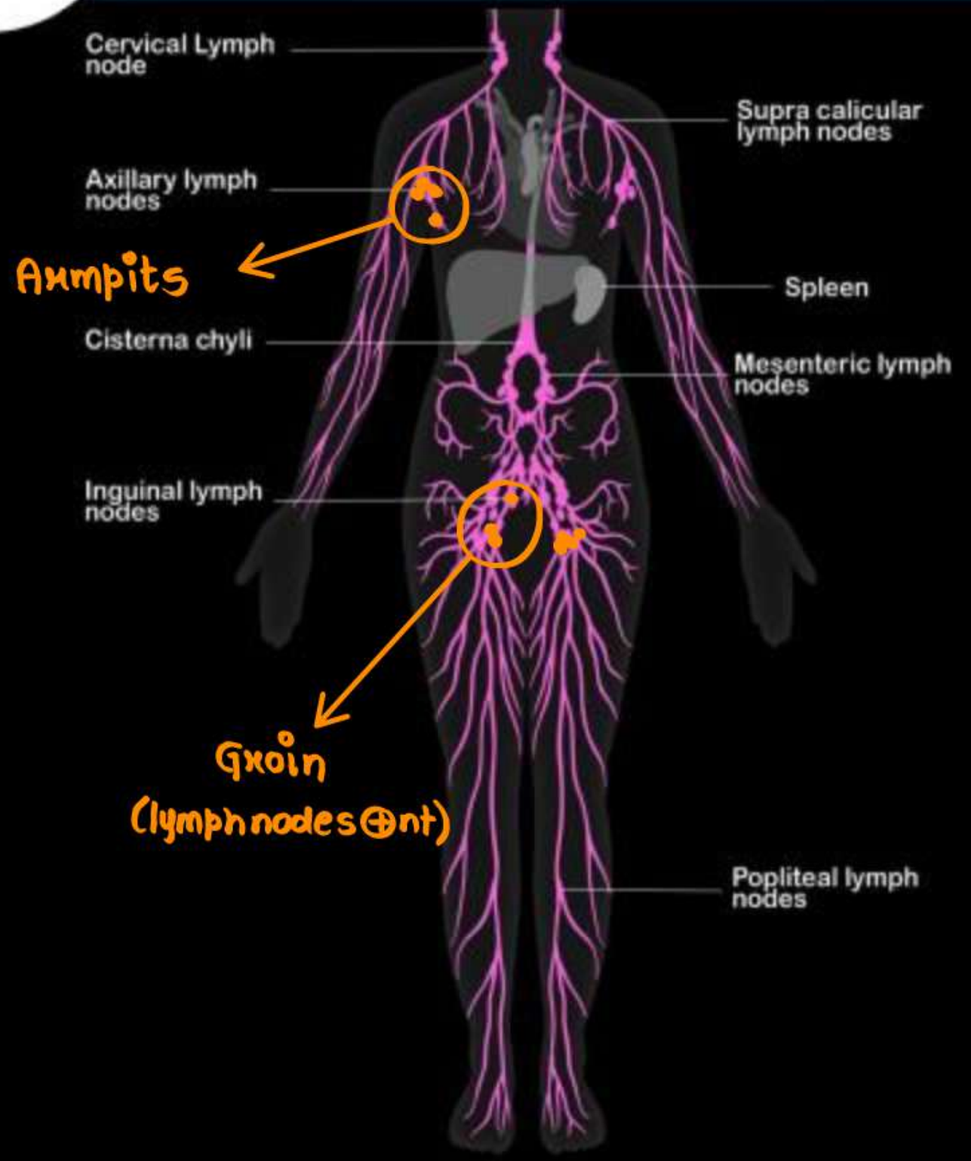
Thrombin

Packet - Fiber

plastin | Kinase | Fibrin

- Ca^{2+} is imp.
  - clotting factor
- Vit. 'K'
  - 'Knoon'

Lymph/ Tissue Fluid/ Middle Man



2 types of systems

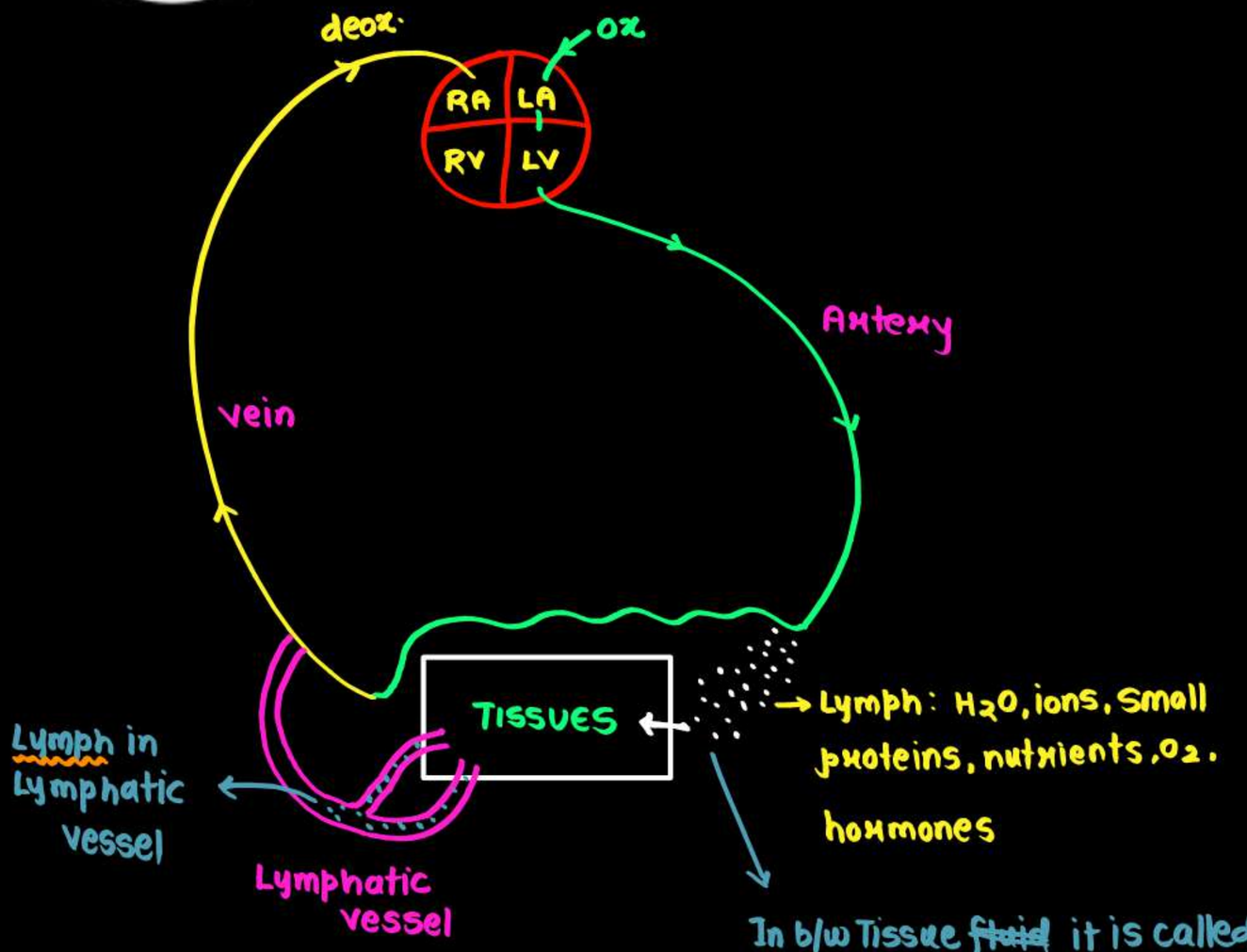
Blood vascular System

- Blood
- Blood vessels
- Heart

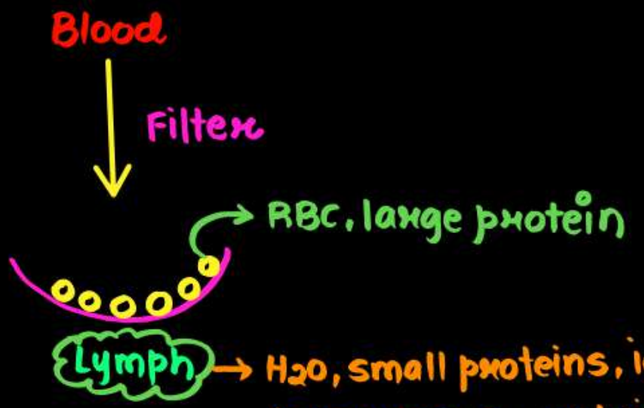
Lymphatic system

- Lymph
- Lymph vessel
- Lymph nodes
  - ⇓
  - Contain lymphocyte
  - ∴ immunity

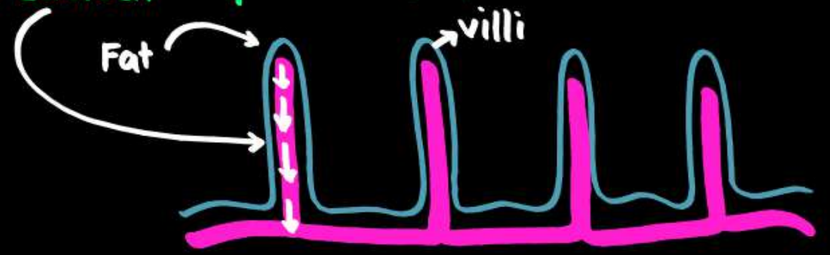
Lymph/ Tissue Fluid/ Middle Man



In b/w Tissue ~~fluid~~ it is called Tissue fluid



* Lacteal: important lymph vessel in intestine

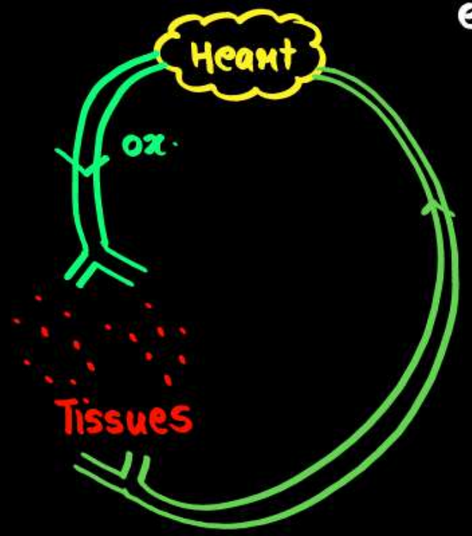


Circulatory System

Open

- Blood flows openly in body spaces/sinuses
  ∴ all tissues & cells are bathed in blood

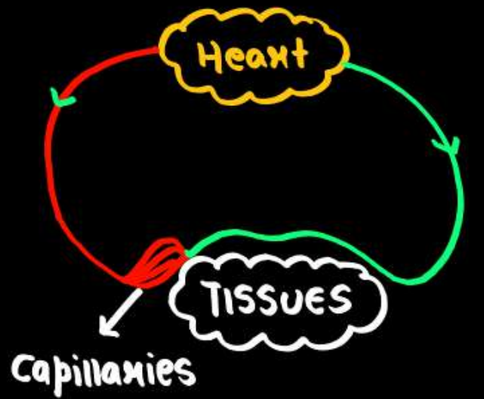
e.g., Anthropoda



Closed

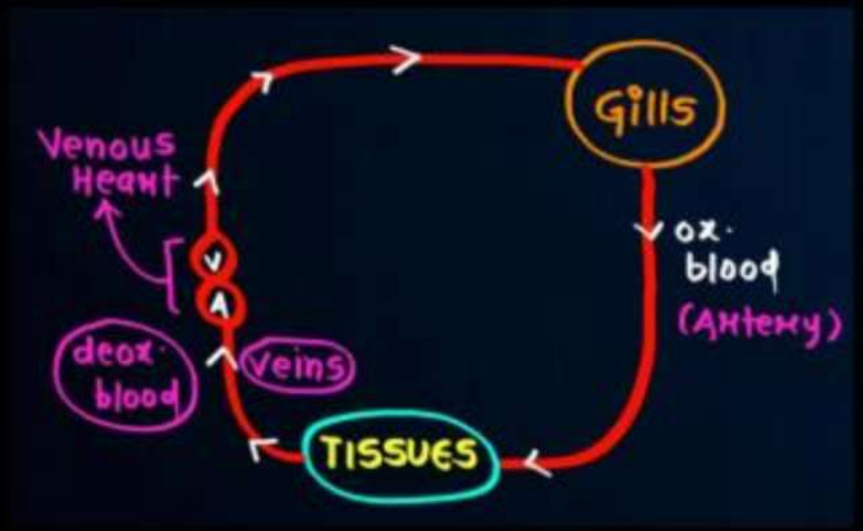
- Blood flows in closed blood vessels like arteries, veins & capillaries

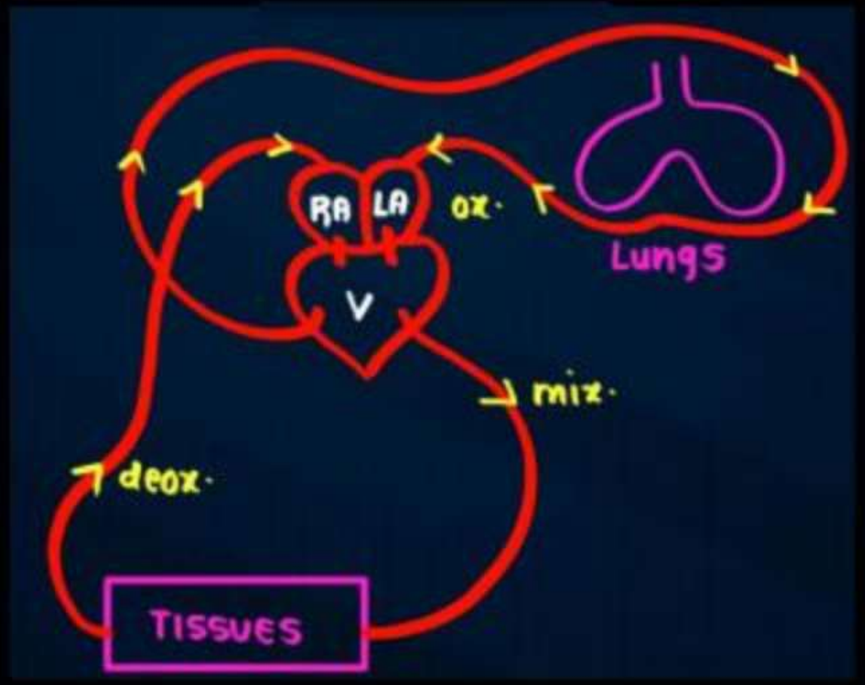
e.g., Annelida, chordata

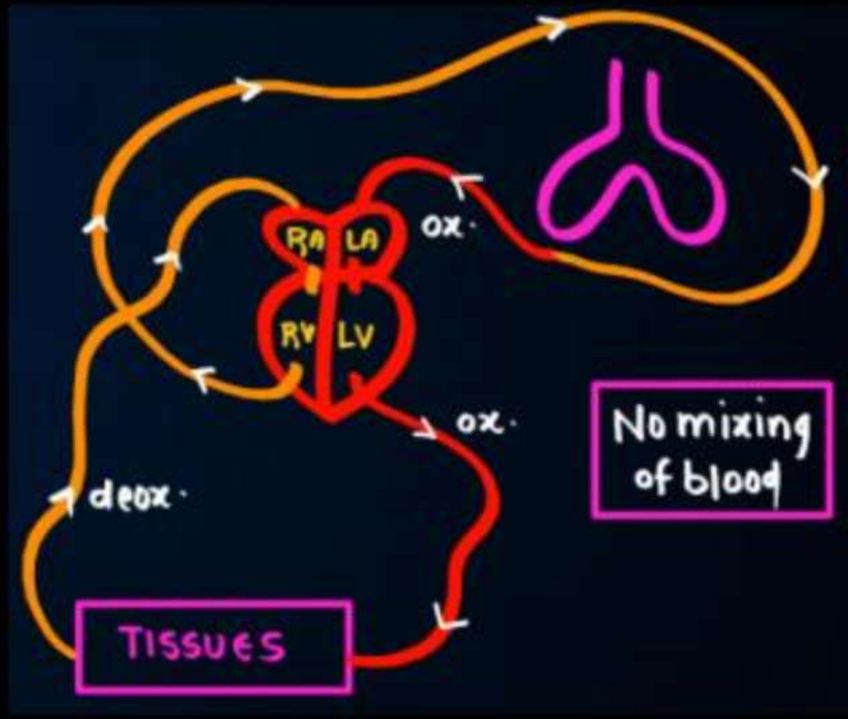


Comparison of Heart among Vertebrates

Organisms	Pisces	Amphibians and Reptiles	Aves and Mammals (with CROCODILE)
Chambers in Heart	2 (1 Atria + 1 ventricle)	3 (2 Atria + 1 ventricle)	4 (2 Atria + 2 ventricle)
Type of Circulation	Single	Incomplete Double	Compl. Double

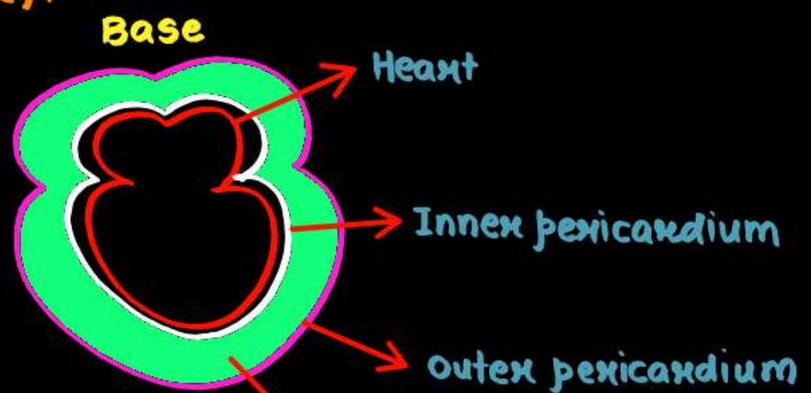




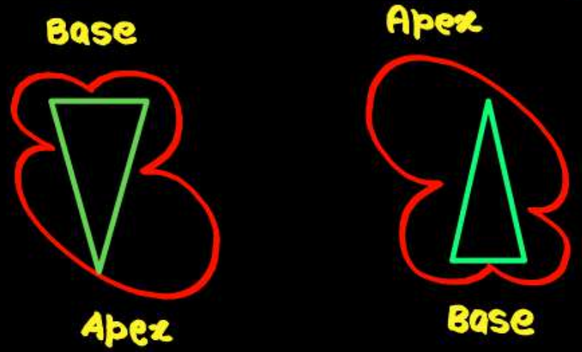


Human Circulatory System/ Blood Vascular System

- Blood vascular system consist of: Blood + Blood vessels + Heart
- Origin of Heart: : Mesodermal
- Size: of your clenched fist → tilted towards left
- Cover: double walled peri-cardium

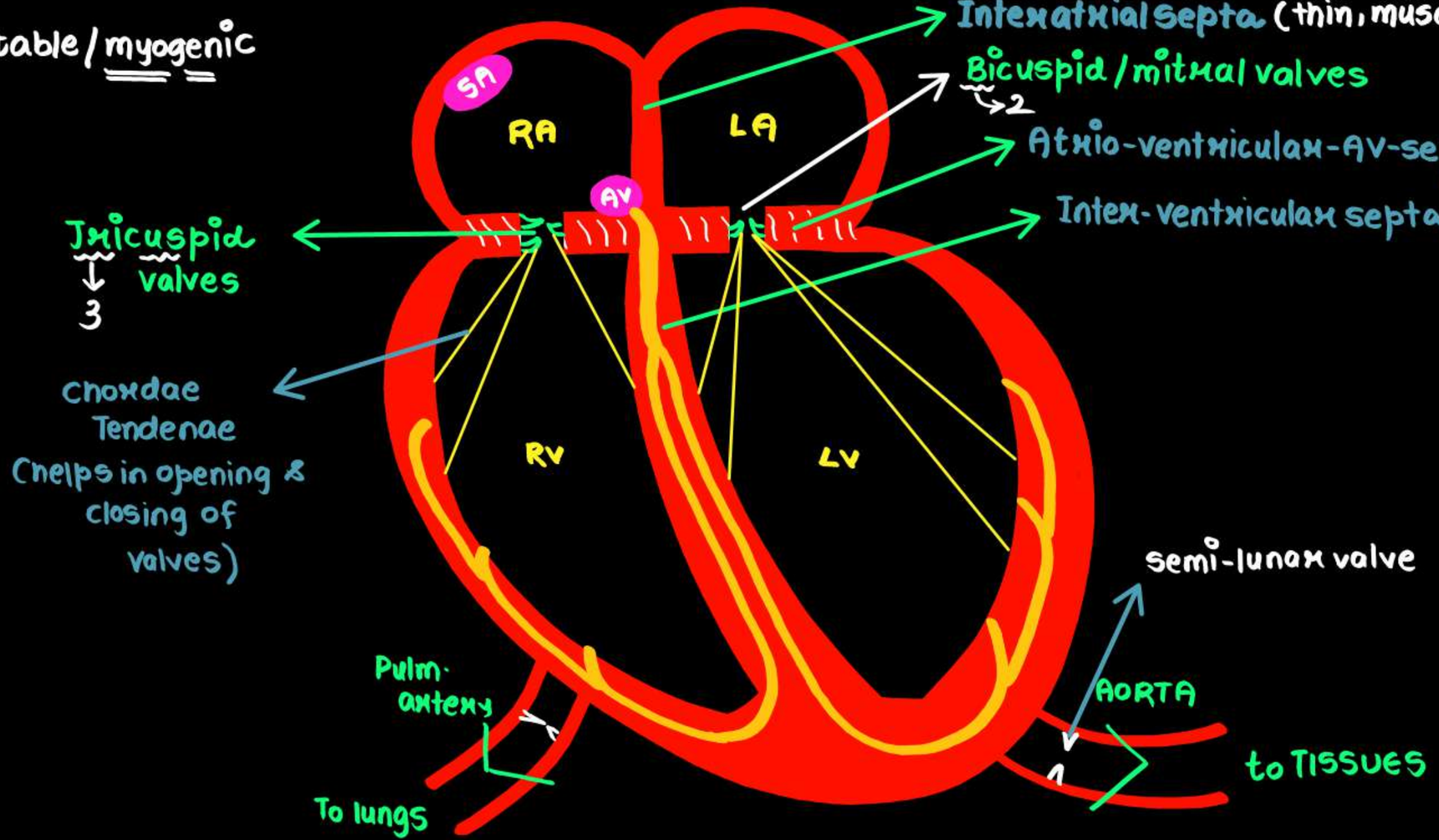


- Orientation:



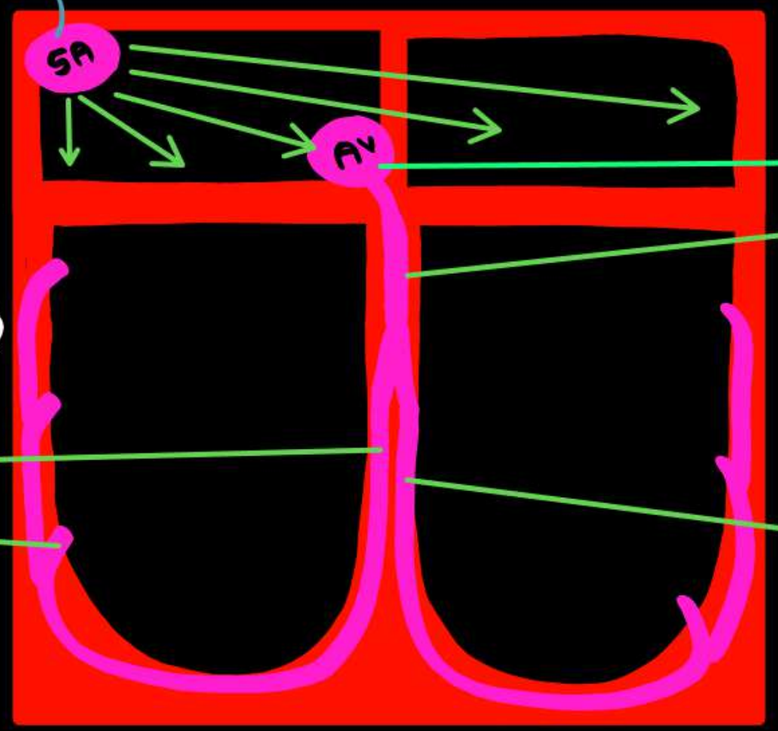
Structure of Heart

- Autoexcitable / myogenic



Nodal Tissues

1. Sinu-atrial node (SA)
   - ⊕nt on upper rightside of RA
   - Pacemaker
   - Initiates the action potential for contract. of heart (~72times/min)



⊕nt in lower left side of RA

2. Atrioventricular node (pace-setter)
3. AV bundle (His)
4. Right bundle
   Purkinje fibers
5. Left bundle

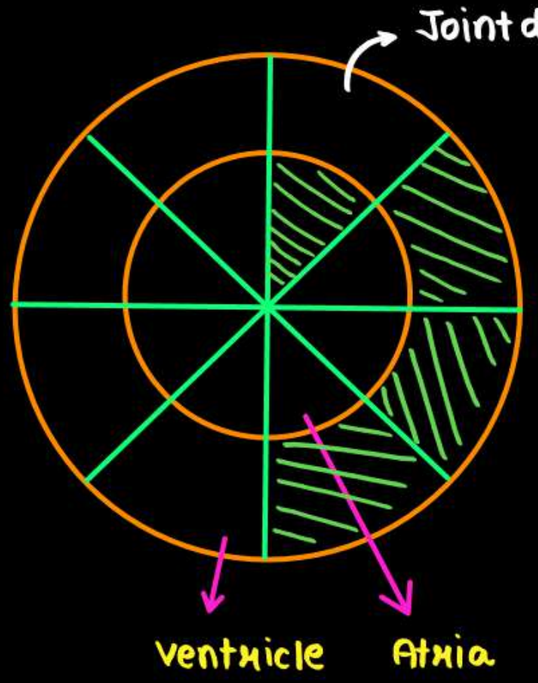
* Path of signal
  1 → 2 → 3 → 4 → 5

Cardiac Cycle: Basics (SV and CA)

- All the events occurred in heart during 1 heart beat
- Duration = $\frac{60}{72}$ = 0.8 sec

Systole & diastole
(Contract) (rest)

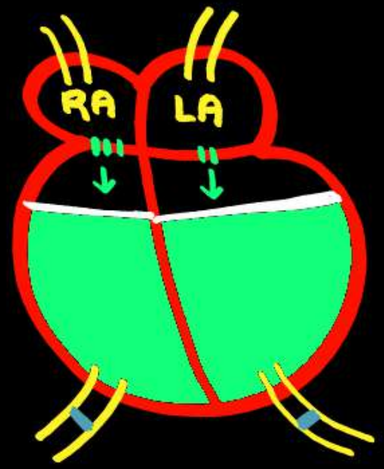
Atria 0.1 sec
Ventricle 0.3 sec.
Atria 0.7 sec
Ventricle 0.5 sec.



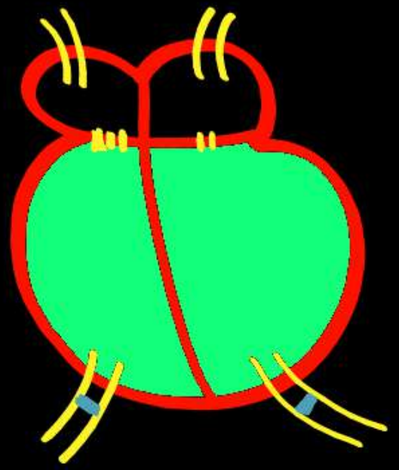
- Stroke volume
  ⇓
  Amt. of blood pumped by a ventricle in 1 heart beat = 70ml

- Cardiac output = amt. of blood pumped by a ventricle in a minute
  = 72 × 70 = 5L

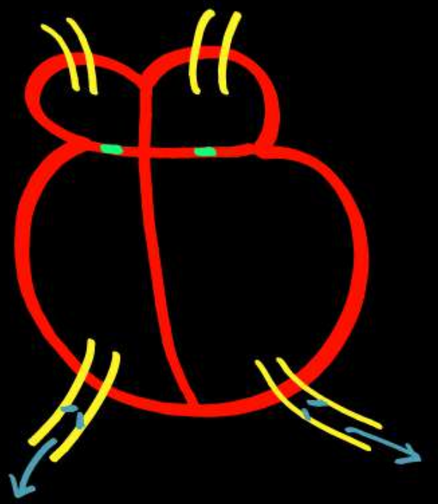
Cardiac Cycle



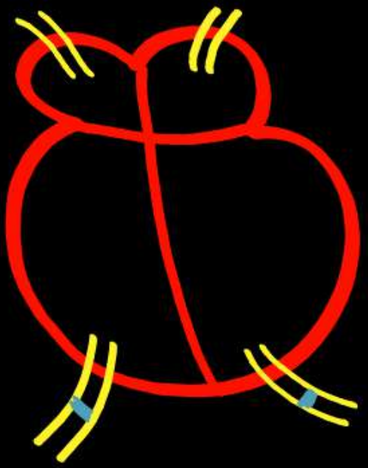
- Joint diastole
- TVi & Bicuspid valves open
- 70% vol. of ventricles filled
- Semilunar valve closed



- Atrial systole
- TVi & bicuspid valve open
- Semilunar valve closed
- Ventricles 100% full



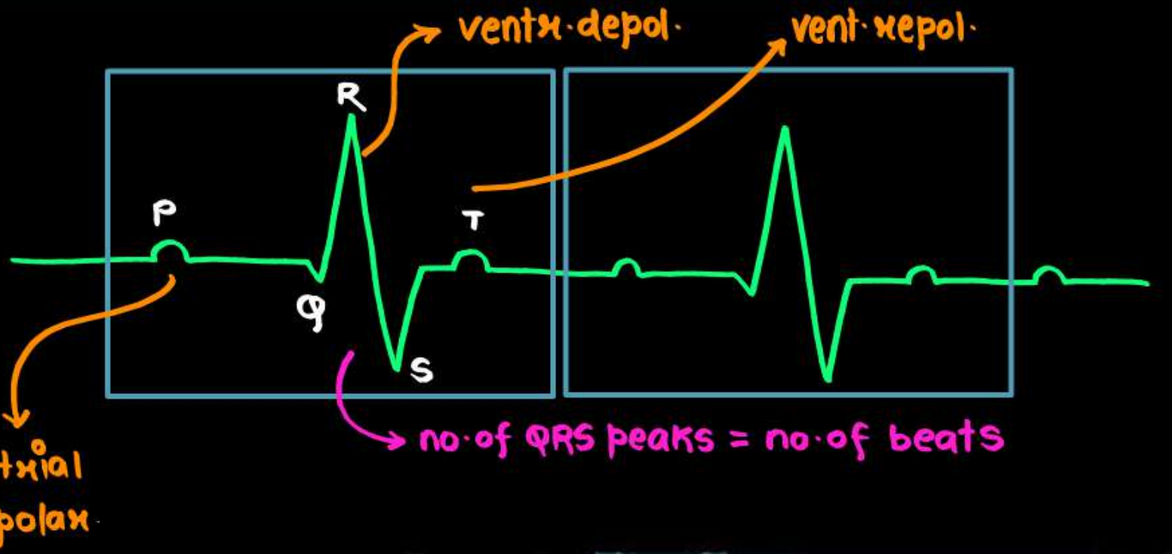
- Ventricular systole
- TVi & bicuspid valve close → LUBB
- Semilunar valve open

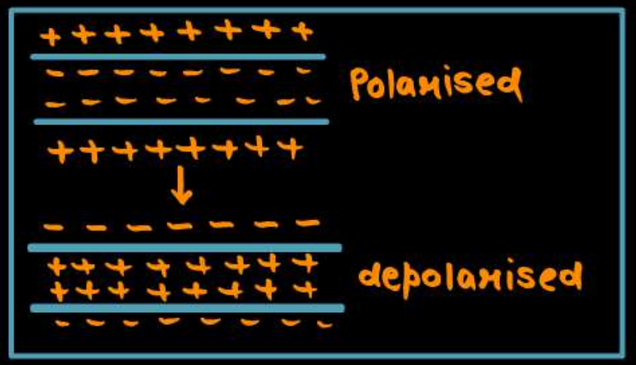


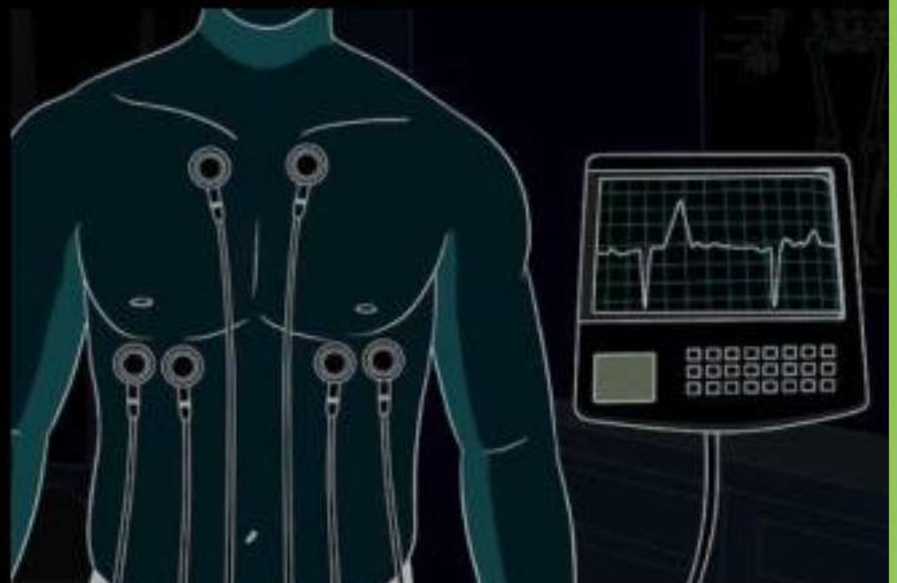
- Semilunar valves closed → DUBB
- Ventricular diastole

ECG

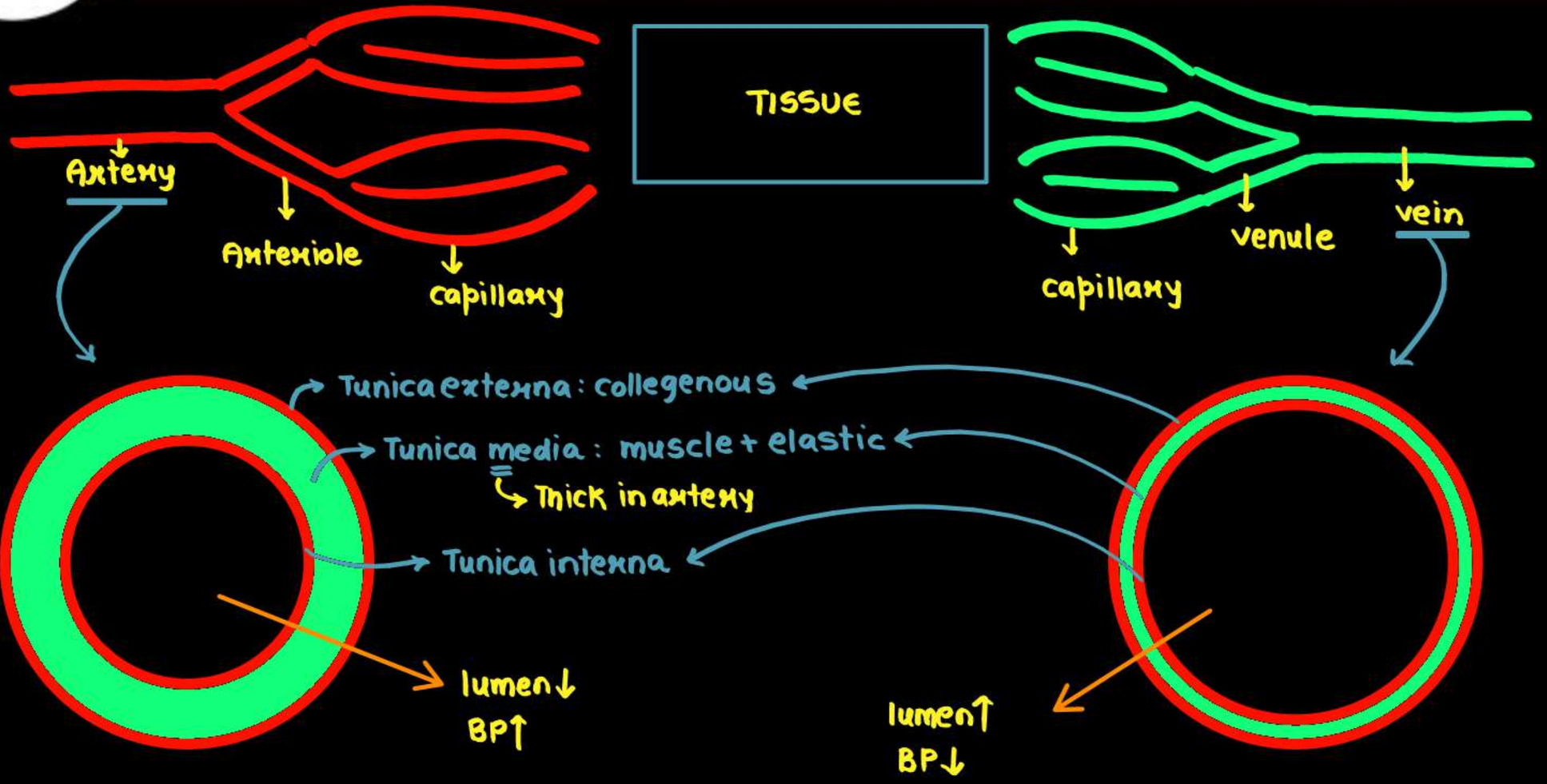
- Machine: Electrocardiograph
- paper: Electrocardiogram
- 3 leads are used: 2 at wrist
  1 at left ankle



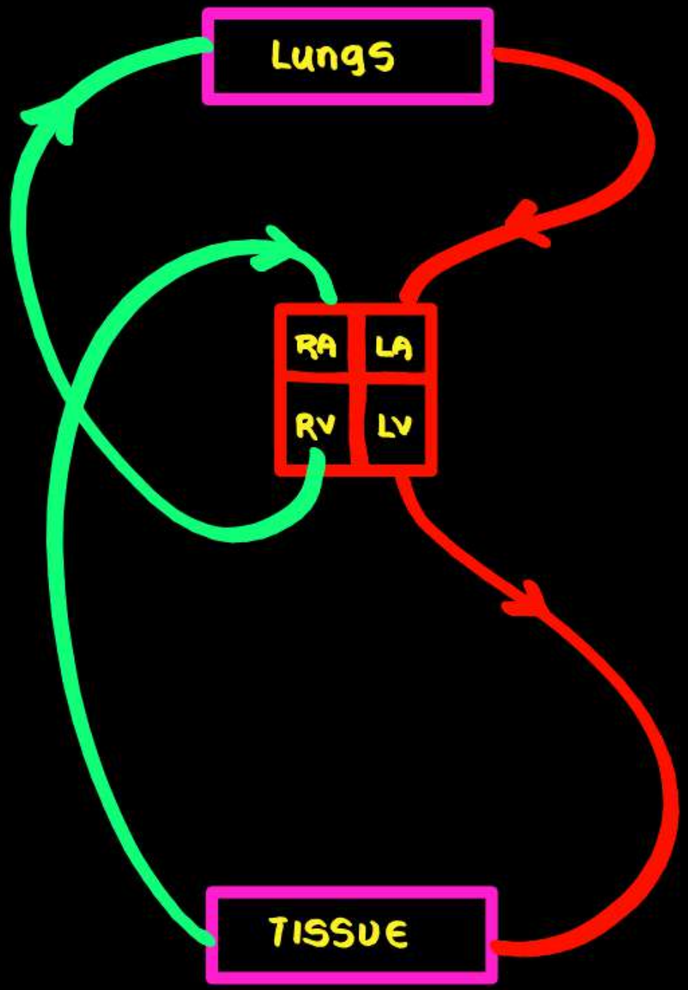




Arteries, Veins and Capillaries

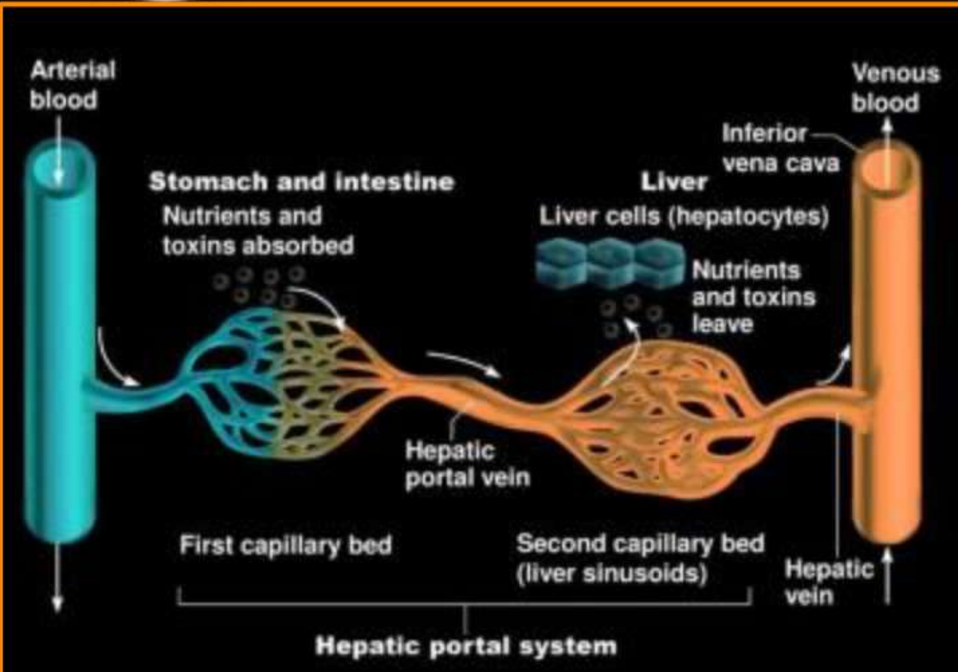


Double Circulation



1st : Pulmonary : 'to' & 'from' lungs
2nd : Systemic : 'to' & 'from' organs

Hepatic Portal System and Coronary Circulation



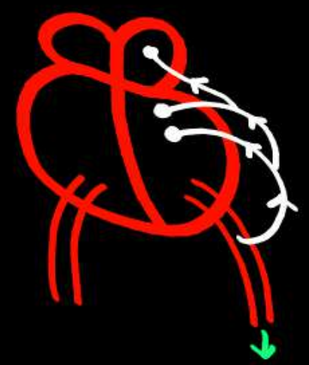
Intestine sends its deox. blood

Hepatic portal vein

to liver

Send it further for purification

'to' & 'from' the heart



to organs

Regulation of Cardiac Activity

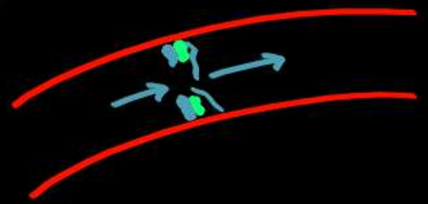
- Autoexcitable / myogenic

Medulla regulates cardiac activity via ANS

- Sympathetic ANS
  - Fight & Flight
  - SV↑ ; CA↑
- Parasympathetic ANS
  - Sleep & eat
  - SV↓ ; CA↓

Adrenal medulla
⇓
Adrenaline↑
SV↑ ; CA↑

Disorders

S. No.	Disease	Features (systolic → diastolic)
1	High Blood Pressure (Hypertension) ⇓ high	Normal BP: 120/80mmHg Hypertension: 140/90mmHg Leads to Heart, brain, kidney damage
2	Coronary Artery Disease (CAD)/ Atherosclerosis	Affects vessel that supplies blood to the heart muscles Deposition of Calcium, fat, cholesterol and fibrous tissue makes the lumen of arteries narrow 

Disorders

S. No.	Disease	Features
3	Angina or Angina pectoris	Acute chest pain due to no enough oxygen reaching heart muscles More common in persons of middle and elderly age (can occur at any age in male and females)
4	Heart Failure/ Congestive Heart Failure	Heart is not pumping blood effectively; congestive lungs are one of the main symptoms
	Cardiac Arrest	Heart Stops Beating
	Heart Attack	Heart muscles damaged due to inadequate O_2 supply

Body Fluids and Circulation

- It is important to move substances 'to' & 'from' cells
- Sponges, Coelenterates: circulate water around them in their body
- Higher animals: Have special fluids like blood & lymph

Blood

Plasma

- Makes 55% of blood
- It is straw coloured, viscous fluid
- 90-92% is H_2O
- 6-8% are proteins
  - Fibrinogen: clotting
  - Globulins: Immunity
  - Albumin: Osmotic balance
- Rest: ions & nutrients (transit) → $Na^+, Ca^{++}, Mg^{++}, HCO_3^-, Cl^-$ & AA, glucose

NOTE: Serum = Plasma - Clotting Factor

Formed Elements

- Makes 45% of Blood

Neutrophil (phagocytic)	Granulocyte	60-65%
Lymphocytes (b and T cells for immunity)	Agranulocyte	20-25%
Monocytes (phagocytic)	Agranulocyte	6-8%
Eosinophil (resist infections and are associated with allergic reactions)	Granulocyte	2-3%
Basophil (secrete histamine, serotonin, heparin): involved in inflammatory reactions	Granulocyte	0.5-1%

- WBC: colourless; nucleated; 6000 - 8000/mm^3
- RBC: 5-5.5 million/mm^3; formed in red bone marrow in adults; biconcave; enucleated;
  - have red coloured 'Fe' containing pigment called 'Hb': 12-16gm/100ml of blood
  - Life Span = 120 days after which they are destroyed in graveyard

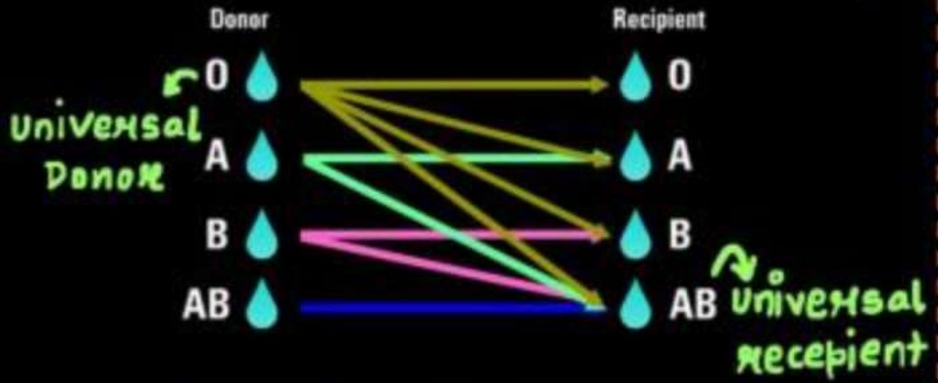
Main Funct: Transport of gases

- Platelet/thrombocytes/cell fragments: formed from megakaryocyte cells of Bone marrow; 1.5-3.5 lakh/mm^3 of blood; help in clotting

∴ Reduction in their numbers cause clotting disorders

Blood Groups

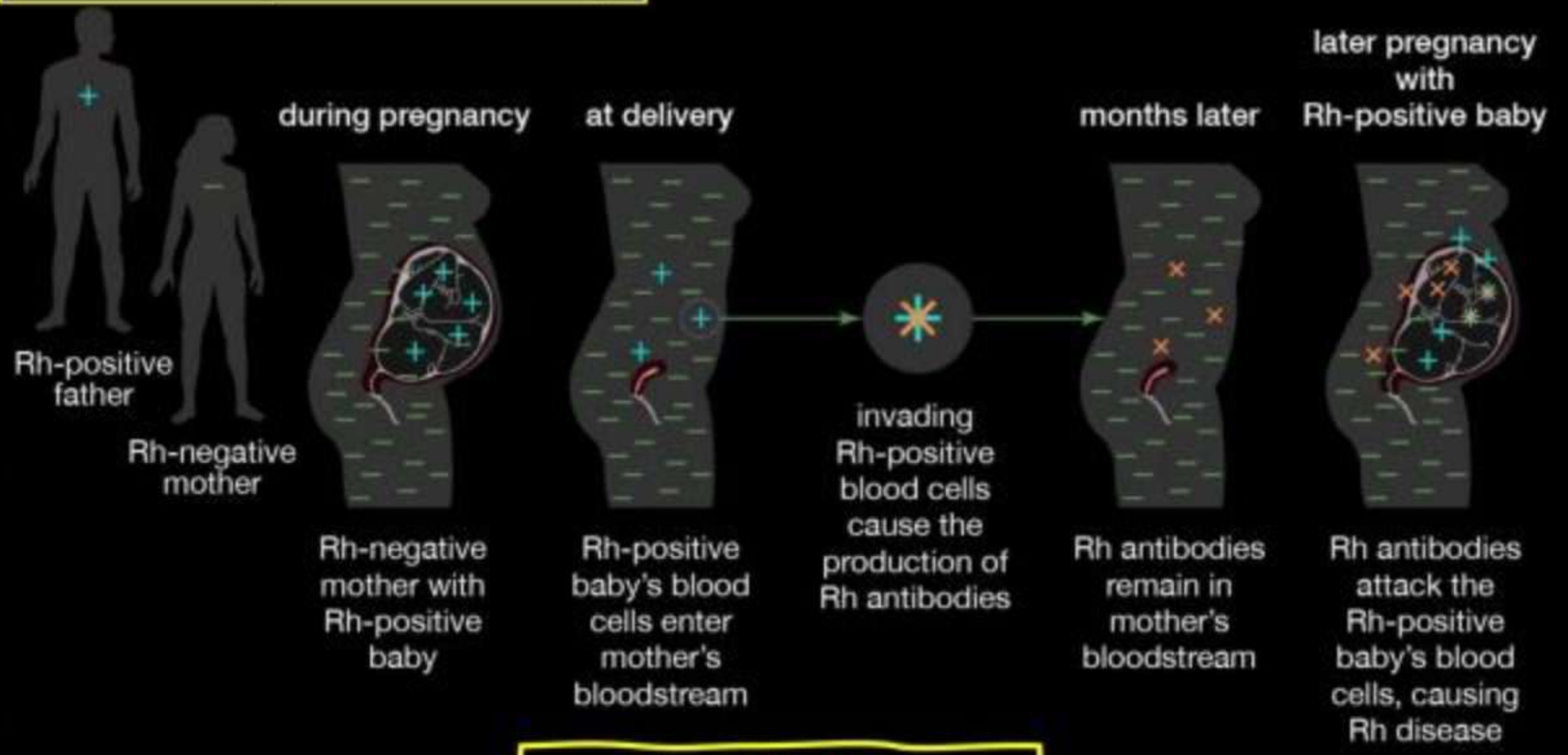
- Most common groupings: ABO, Rh



Rh-Blood Groups

- Similar to one present in Rhesus monkey
- 80% humans are Rh⊕ve
- Need to be matched before blood transf--usion.
- Special case of Rh-incompatibility is Erythroblastosis foetalis where mother is Rh⊖ve & father & child are Rh⊕ve

How Rh hemolytic disease develops



Blood Clotting

- Injury/Trauma → Tissue factors/platelets activated
- Activates Thromboplastin
- Activates Thrombokinase
- Prothrombin → Thrombin
- Fibrinogen —Ca→ Fibrin

Lymph (Tissue Fluid)

- Lymph, lymph nodes & lymph vessels

Circulatory Pathways

Single Circulation

Pisces (2-chambered) = 1A + 1V (Fishes)

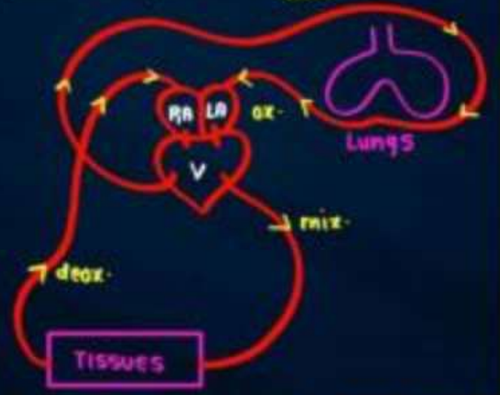
- Blood will enter heart only once

Incomplete Double

Mixed

Amphibian + Reptile = 3 chambered (except Crocodile) (2A + 1V)

- Heart will get blood twice



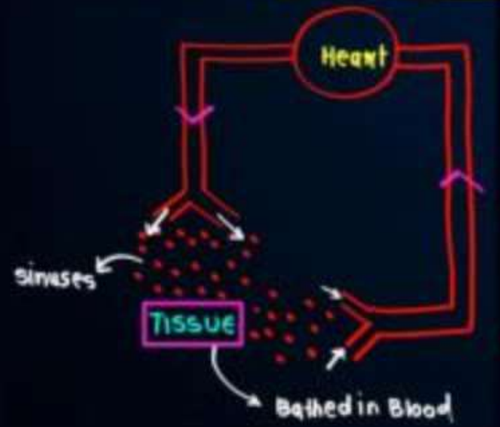
Complete Double

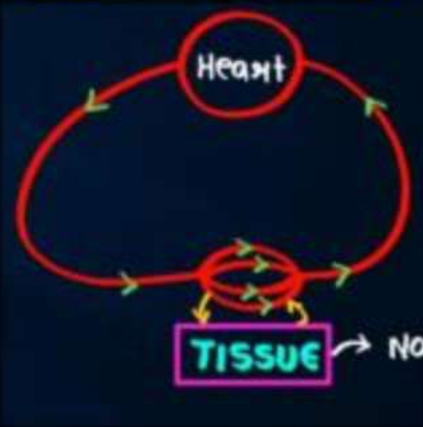
Birds + Mammal + Crocodile = 4-chambered (2A + 2V)

- Heart will get blood twice

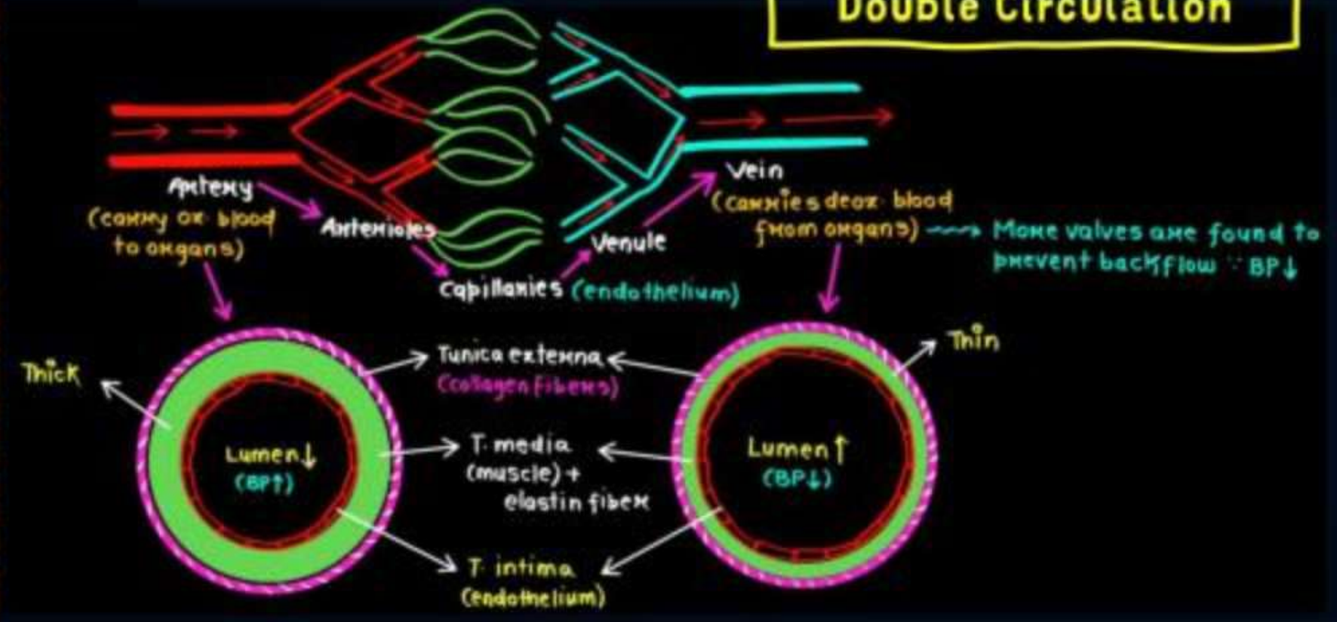
Circulatory Pathways

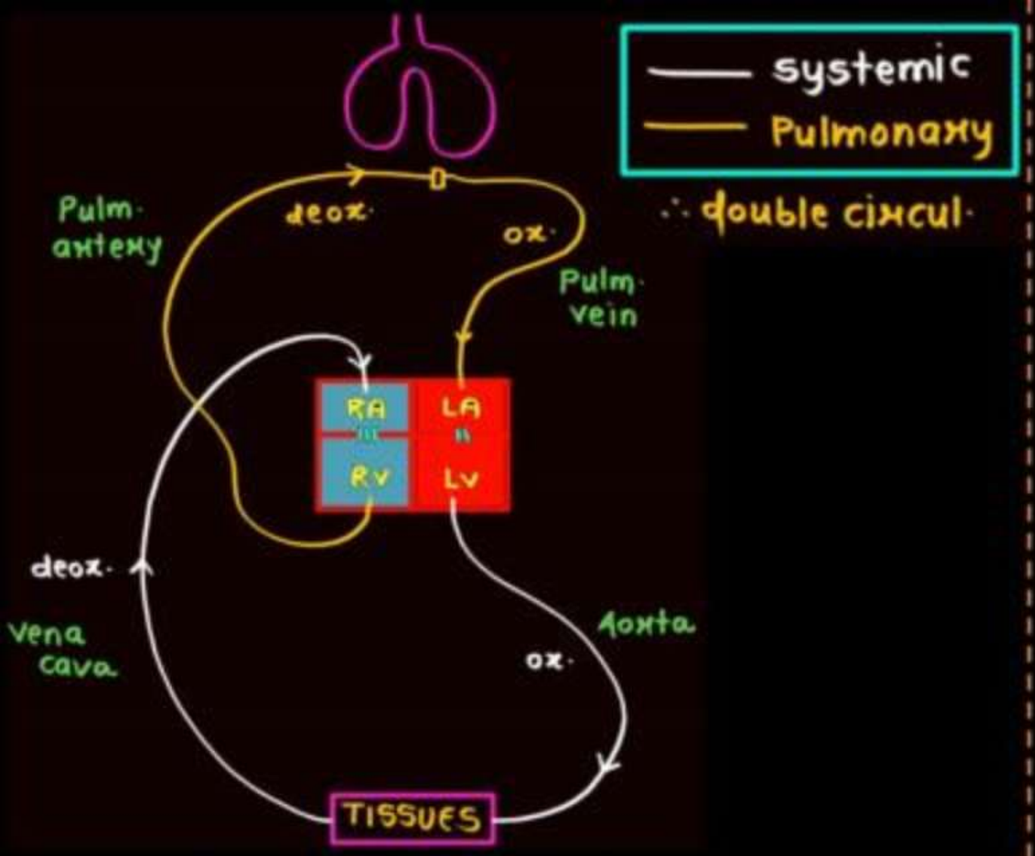
open — closed



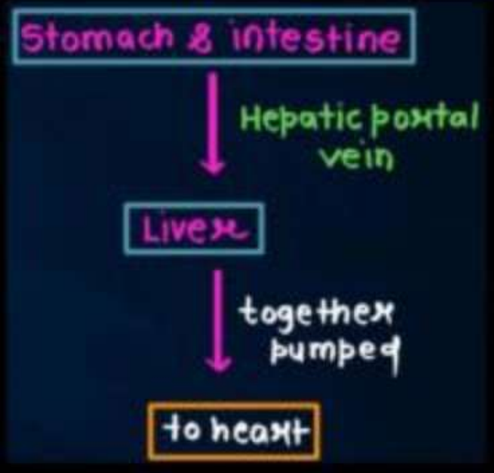


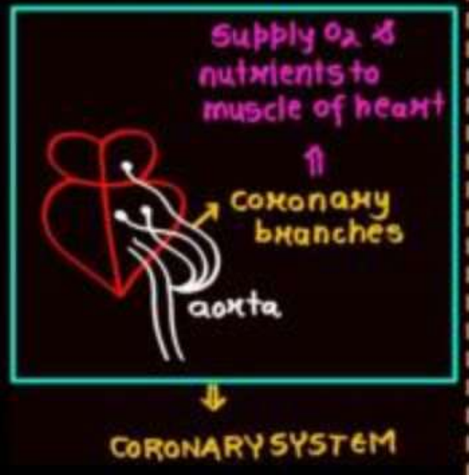
Double Circulation





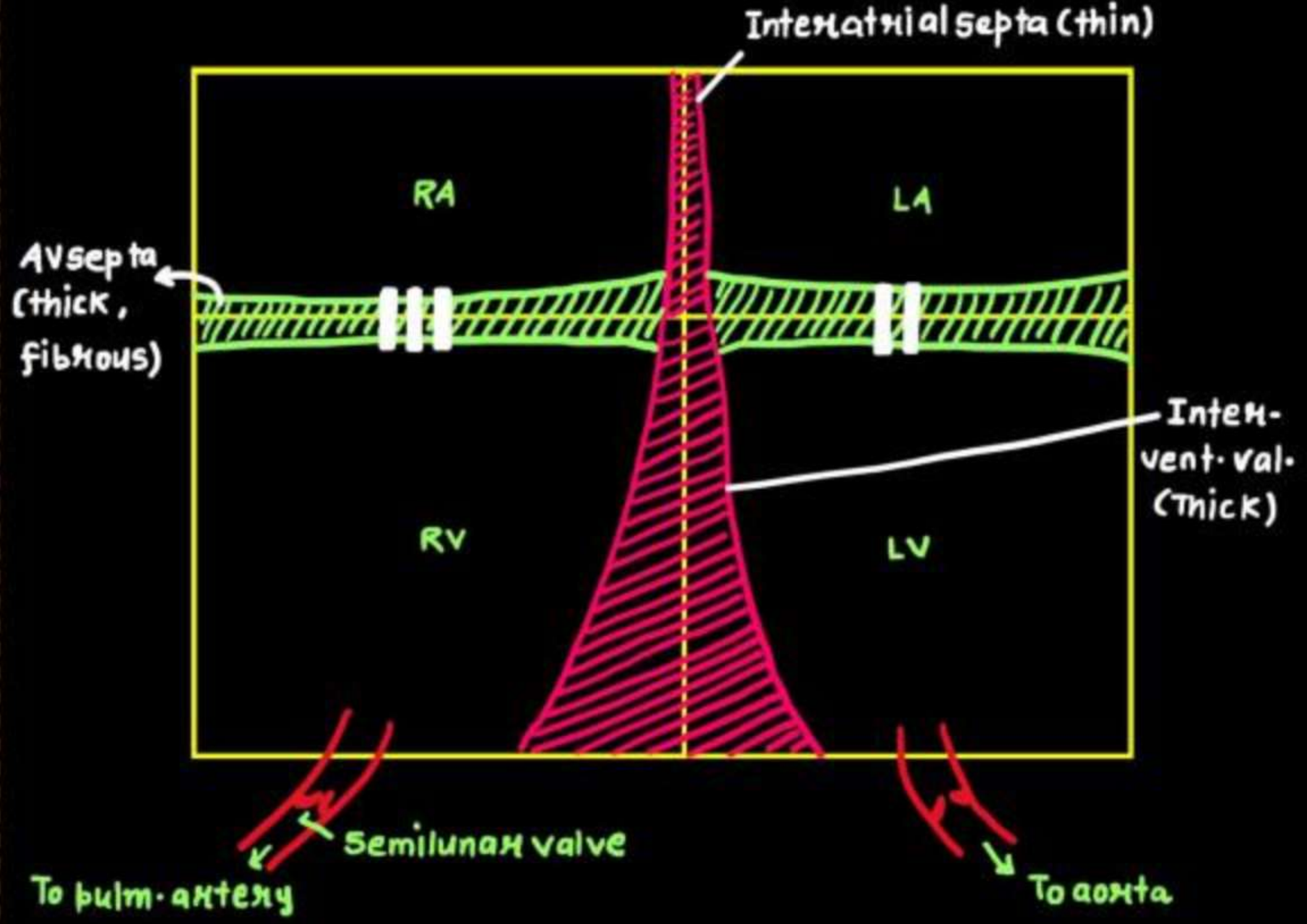
Portal Circulation





Human Heart

- Mesodermally derived ; ⊕nt in thoracic cavity b/w lungs ; size of a clenched fist ; protected by double walled memb. pericardium



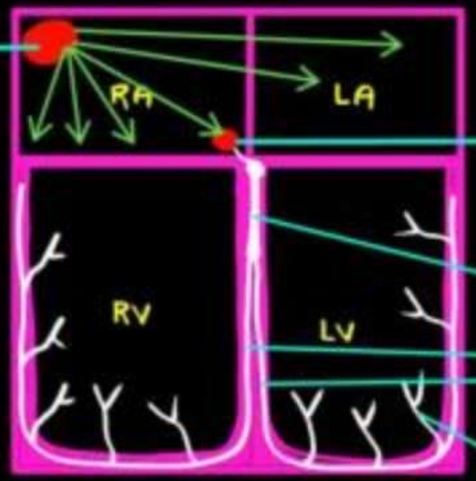
Signal Transmission

Nodal Tissue

① SA node / Sinu atrial node
- Pacemaker of Heart
- Initiates the signal for heart contraction
- 70-75 times/min (72 avg.)

⇓

Heart can autogenerate its signals for contraction
∴ Autoexcitable
∴ Myogenic



② AV node (Atrio-ventricular node) ← Lower left part of RA
- Pace-setter

③ Bundle of His

④ Left & Right bundles

⑤ Purkinje fibers

- Conduction of signal: ① → ② → ③ → ④ → ⑤

Cardiac Cycle

- All events in one heart beat; includes systole & diastole; duration = 0.8 sec.

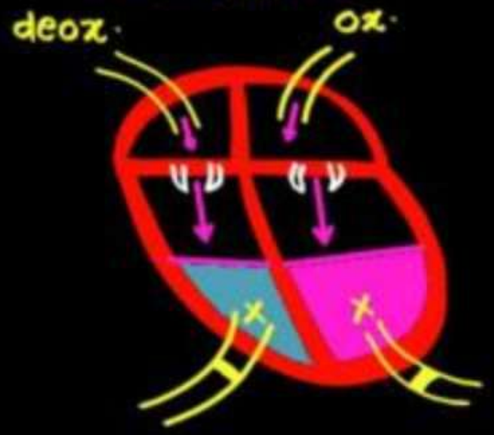
(contr.) Atria 0.1s, ventricles 0.3s
(relax.) Atria 0.7s, ventricles 0.5s

- Stroke Vol.: Blood vol. pumped by each ventricle in one beat = 70 mL
- Cardiac output: SV x No. of beats = 70 x 72 = 5 L

Circulatory Disorders

Disorder	Details
Hypertension (high BP)	Normal: 120/80 Hyper: 140/90 mmHg Affect heart, kidney, brain etc.
Coronary artery disease (CAD) or Atherosclerosis	Ca^{++}, fat, cholesterol, fibre deposited in vessel that supply blood to heart
Angina Pectoris	Acute chest pain; No oxygen reaching heart muscle
Heart failure	Blood not pumped effectively (called congestive as lung congestion is a major symptom)
Cardiac Arrest	Heart stops beating
Heart attack	Muscle damaged due to inadequate blood supply

Joint Diastole

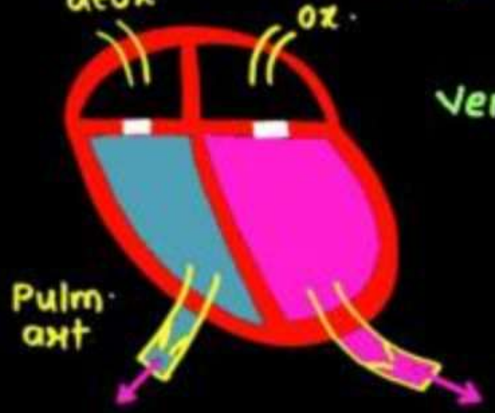


- Atria & ventricles are at rest
- Tricuspid & Bicuspid valves = OPEN
  ∴ 70% of ventricles = FILLED
- Semilunar valves are closed

Atrial systole

- Atria contract
- ventricles are full
- Tricuspid & bicuspid = OPEN
- Semilunar = closed

Ventricular systole



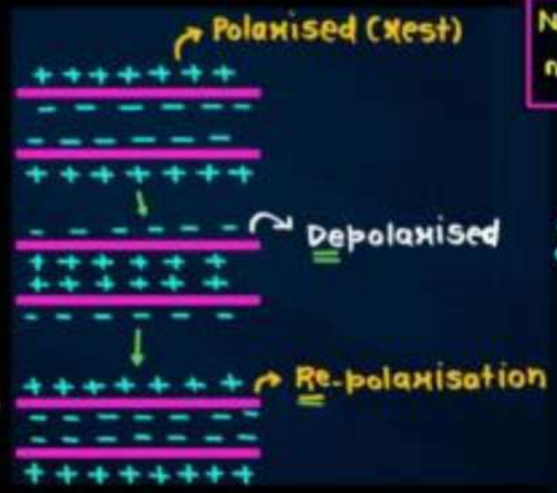
- Atria = relax
- Ventricles = contract
- Tri & Bicuspid closed
  ↓
  LUBB
- Semilunar valve = OPEN

Vent. diastole

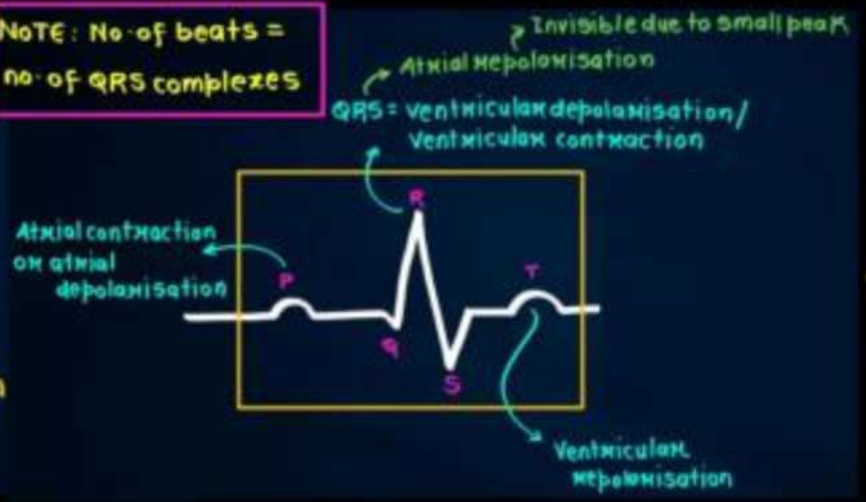
- Semilunar valves closed : DUB → 2nd sound

ECG

- Machine: Electrocardiograph
- Graph: Electrocardiogram
- Standard ECG: 3-leads
  ↓
  Left ankle, left & right wrist



NOTE: No. of beats = no. of QRS complexes



Regulation

By medulla

- SANS: Active
  PSANS: Rest
  ↓
  by adrenaline, nor-ad, thyroxine

QUESTION (NEET PYQ EXAM 2024)

Following are the stages of pathway for conduction of an action potential through the heart

A. AV bundle
B. Purkinje fibres
C. AV node
D. Bundle branches
E. SA node

Choose the correct sequence of pathway from the options given below

(1) E-C-A-D-B
(2) A-E-C-B-D
(3) B-D-E-C-A
(4) E-A-D-B-C

QUESTION (NEET PYQ EXAM 2024)

As per ABO blood grouping system, the blood group of father is B^+, mother is A^+ and child is O^+. Their respective genotype can be

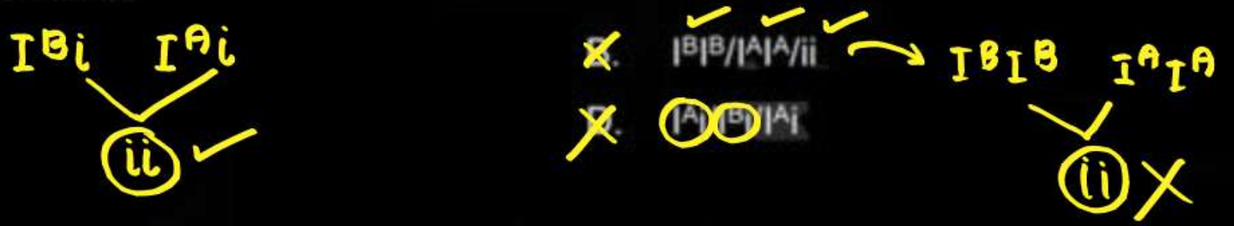
A. $I^Bi/I^Ai/ii$

B. $I^AI^Bii/I^Ai/I^Bi$

C. $iI^B/iI^Ai/I^AI^B$

D. $I^BI^B/I^AI^A/ii$

E. I^AI^B/I^Ai



Choose the most appropriate answer from the options given below :

(1) A only

(2) B only

(3) C & B only

(4) D & E only

QUESTION (NEET PYQ EXAM 2024)

The mother has A+ blood group the father has B+ and the child is A+. What can be the possibility of genotypes of all three, respectively?

(A) $I^AI^A \mid I^Bi \mid I^Bi$

(B) $I^AI^A \mid I^Bi \mid I^Ai$

(C) $I^Bi \mid I^AI^A \mid I^AI^B$

(D) $I^Ai \mid I^Bi \mid I^Ai$

(E) $I^Ai \mid I^Bi \mid I^Ai$

Choose the **correct** answer from the option given below:

(1) C and D

(2) D and A

(3) A and B

(4) B and E

QUESTION (NEET PYQ EXAM 2024)

'Lub' sound of Heart is caused by the_____

(1) closure of the semilunar values ⇝ dub

(2) opening of tricuspid and bicuspid values

(3) opening of the semilunar valves

(4) closure of the tricuspid and bicuspid valves

QUESTION (NEET PYQ EXAM 2024)

A person with blood group ARh^- can receive the blood transfusion from which of the following types?

A. BRh^- B^- ✗ (A^-)

B. $ABRh^-$ AB^- ✗

C. ORh^- O^-

D. ARh^- A^-

E. ARh^+ A^+ ✗

Choose the correct answer from the options given below :

(1) D and E only

(2) D only

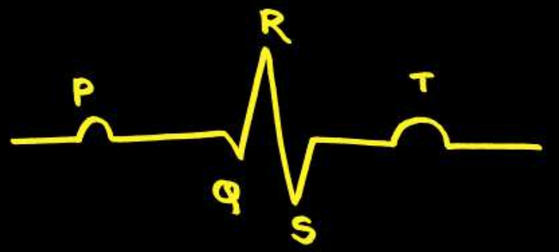
(3) A and B only

(4) ✓ C and D only

QUESTION (NEET PYQ EXAM 2023)

Match **List-I** with **List-II**. **(2023, Manipur 2023)**

List-I (ECG)		List-II (Electrical activity of heart)	
A.	P-wave	P.	Depolarisation of ventricles
B.	QRS complex	Q.	End of systole
C.	T wave	R.	Depolarisation of atria
D.	End of T wave	S.	Repolarisation of ventricles



Choose the **correct** answer from the options given below.

(1) A-(S) B-(P) C-(R) D-(Q)

(2) A-(P) B-(S) C-(R) D-(Q)

(3) A-(S) B-(R) C-(P) D-(Q)

(4) A-(R) B-(P) C-(S) D-(Q)

QUESTION (NEET PYQ EXAM 2023)

Match **List-I** with **List-II**. **(Manipur 2023)**

List-I		List-II	
A.	Eosinophils	P.	6-8%
B.	Lymphocytes	Q.	2-3%
C.	Neutrophils	R.	20-25%
D.	Monocytes	S.	60-65%

Choose the **correct** answer from the options given below.

(1) A-(S) B-(P) C-(Q) D-(R)

(2) A-(S) B-(P) C-(R) D-(Q)

(3) A-(Q) B-(R) C-(S) D-(P)

(4) A-(Q) B-(R) C-(P) D-(S)

QUESTION (NEET PYQ EXAM 2023)

Which of the following statements are **correct**? **(2023)**

A. Basophils are most aboundant cell of the total WBCS.

B. Basophils secrete histamine, serotonin and heparin.

C. Basophils are involved in inflammatory response.

D. Basophils have kidney shaped nucleus.

E. Basophils are agranulocyte.

Choose the **correct** answer from the options given below.

(1) A and B only

(2) D and E only

(3) C and E only

(4) B and C only

QUESTION (NEET PYQ EXAM 2022)

Given below are two statements; (2022)

Statement-I: The coagulum is formed of network of threads called thrombins.

Statement-II: Spleen is the graveyard of erythrocytes.

In the light of the above statements, choose the most appropriate answer from the options given below.

(1) **Statement-I** is incorrect but **Statement-II** is correct.

(2) Both **Statement-I** and **Statement-II** are correct.

(3) Both **Statement-I** and **Statement-II** are incorrect.

(4) **Statement-I** is correct but **Statement-II** is incorrect.

QUESTION (NEET PYQ EXAM 2022)

Which one of the following statements is **correct**? (2022)

(1) Increased ventricular pressure causes closing of the semilunar valves.

(2) The atrio-ventricular node (AVN) generates an action potential to stimulate atrial contraction.

(3) The tricuspid and the bicuspid valves open due to the pressure exerted by the simultaneous contraction of the atria.

(4) Blood moves freely from atrium to the ventricle during joint diastole.

QUESTION (NEET PYQ EXAM 2022)

Arrange the following formed elements in the decreasing order of their abundance in blood in humans. **(2022 II)**

(a) Platelets
(b) Neutrophils
(c) Erythrocytes
(d) Eosinophils
(e) Monocytes

Choose the most appropriate answer from the options given below.

(1) (a), (c), (b), (d), (e)
(2) (c), (a), (b), (e), (d)
(3) (c), (b), (a), (e), (d)
(4) (d), (e), (b), (a), (c)

QUESTION (NEET PYQ EXAM 2021)

Which enzyme is responsible for the conversion of inactive fibrinogens to fibrins? **(2021)**

(1) Renin
(2) Epinephrine
(3) Thrombokinase
(4) Thrombin

QUESTION (NEET PYQ EXAM 2021)

Persons with 'AB' blood group are called as "Universal recipients". This is due to; **(2021)**

(1) absence of antigens A and B in plasma.

(2) presence of antibodies, anti-A and anti-B, on RBCs.

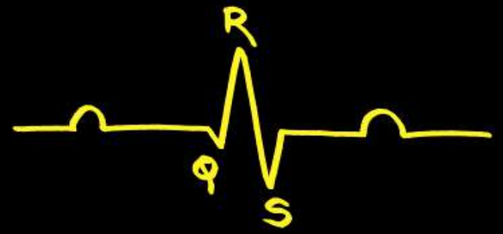
(3) absence of antibodies, anti-A and anti-B, in plasma.

(4) absence of antigens A and B on the surface of RBCs.

QUESTION (NEET PYQ EXAM 2020)

QRS complex in a standard ECG represents; (2020)

(1) depolarisation of auricles.
(2) depolarisation of ventricles.
(3) repolarisation of ventricles.
(4) repolarisation of auricles.



QUESTION (NEET PYQ EXAM 2020)

Match the following **List-I** and **List-II** select the **correct** option. **(2020)**

List-I		List-II	
A.	Eosinophils	P.	Immune response
B.	Basophils	Q.	Phagocytosis
C.	Neutrophils	R.	Release histaminase, destructive enzymes
D.	Lymphocytes	S.	Release granules containing histamine

	A	B	C	D
(1)	(S)	(P)	(Q)	(R)
(2)	(P)	(Q)	(S)	(R)
(3)	(Q)	(P)	(R)	(S)
(4)	(R)	(S)	(Q)	(P)

QUESTION (NEET PYQ EXAM 2020)

Which of the following is associated with decrease in cardiac output?
(2020 Covid)

(1) Parasympathetic neural signals
(2) Pneumotaxic centre
(3) Adrenal medullary hormones
(4) Sympathetic nerves

QUESTION (NEET PYQ EXAM 2020)

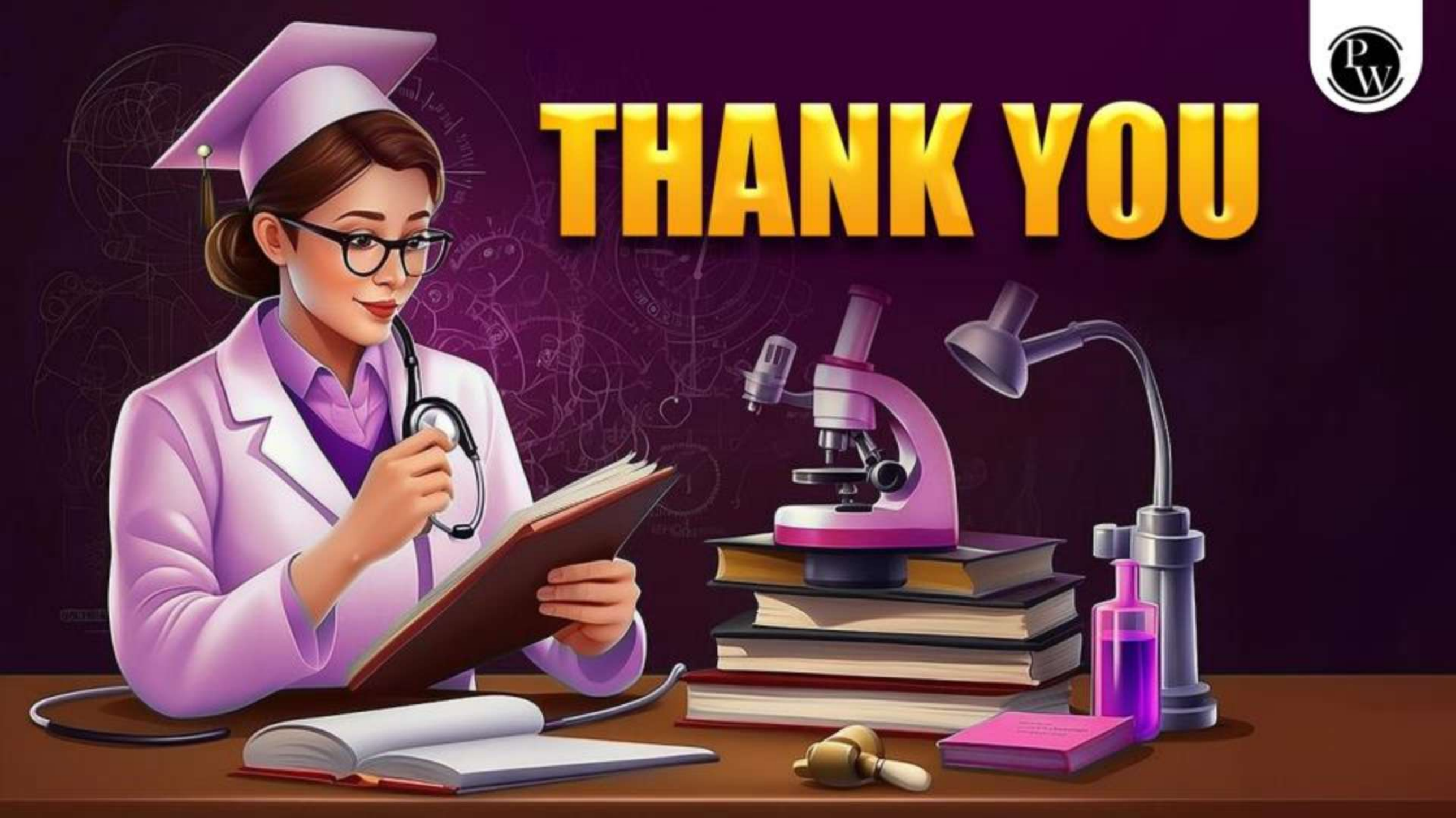
Which of the following conditions cause erythroblastosis foetalis? **(2020 Covid)**

(1) Mother Rh^{-ve} and foetus Rh^{+ve}

(2) Both mother and foetus Rh^{-ve}

(3) Both mother and foetus Rh^{+ve}

(4) Mother Rh^{+ve} and foetus Rh^{-ve}


THANK YOU