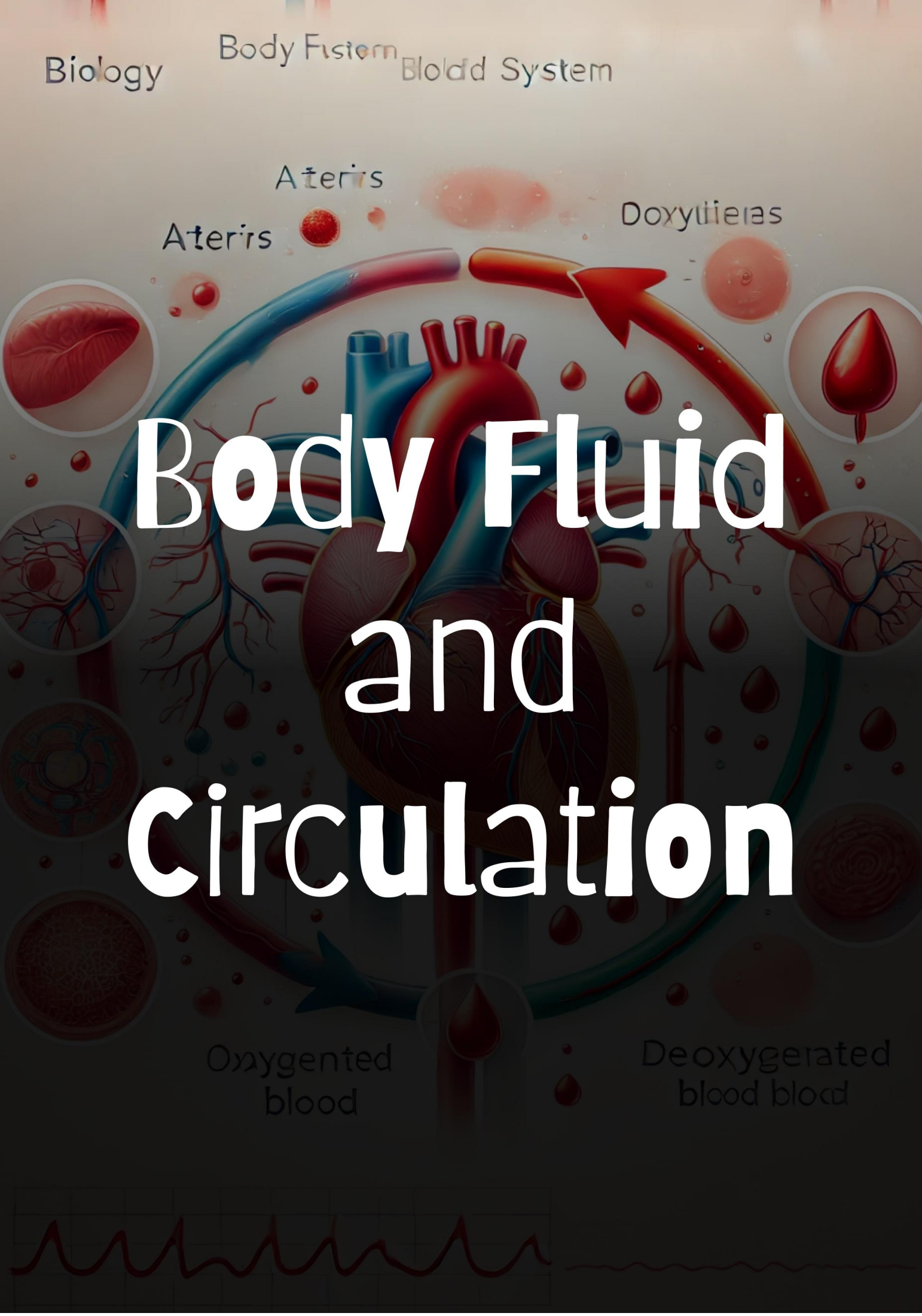


Body Fluid and Circulation

Body fluid and Circulation

- Cardiology — Study of heart
- Study of Blood vessels — Angiology
- Haematology — Study of Blood
- Father of Angiology — William Harvey

On the basis of circulating fluid

Blood Circulatory System
- Blood
- Blood Vessels
- Heart

Lymphatic system

On the basis of origin

Open Circulatory system

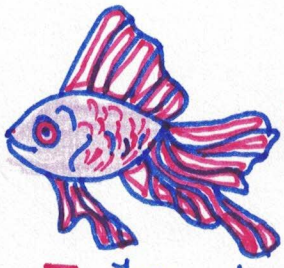
Cavity - sinus
Not well regulated
Pressure ↓↓

Arthropoda, Non-cephalopode Mollusca.

close circulatory System

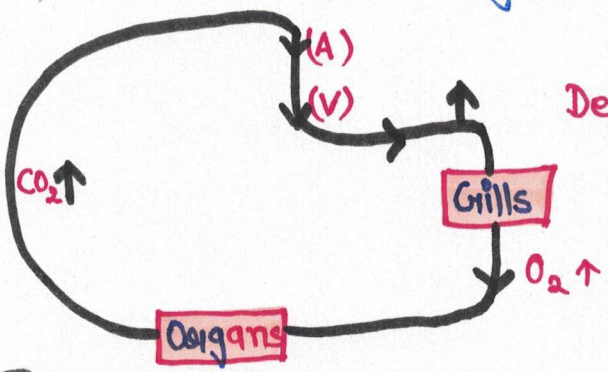
Well developed Regulated
Pressure ↑

Annelida (firstly seen)
Cephalopde, Mullusca

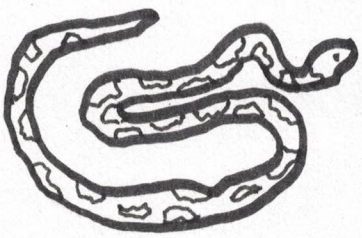


CIRCULATION IN FISH

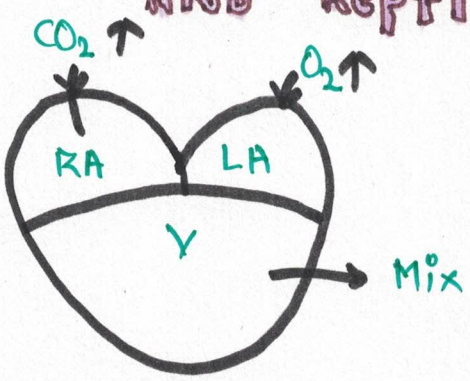
- Two chambers Heart + Single circulation.



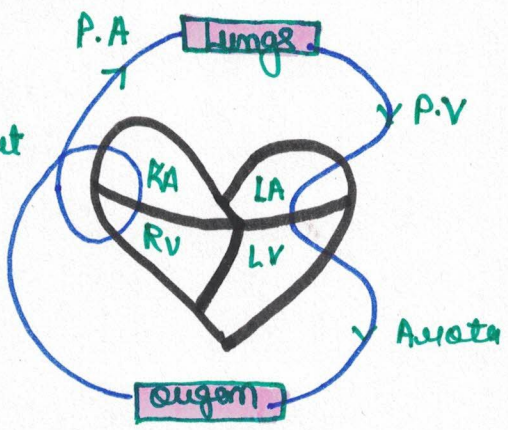
Deoxygenated/venous Heart.



CIRCULATION in Amphibians AND Reptiles



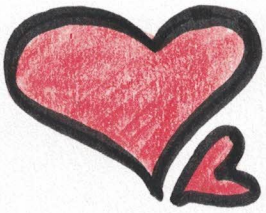
CIRCULATION in BIRDS, MAMMALS and CROCODILE



- Systemic Circulation = L.V → System → R.A
- Pulmonary circulation = R.V → Lungs → L.A

	Fish	Amphibians	Reptiles	Birds	Mammals
No. of Atria	1	2	2	2	2
No. of Ventricle	1	1	1	2	2
No. of chambers	2	3	3	4	4
of circulation	Single	Incomplete double	Incomplete double	Double	Double
Mixing	×	✓	✓	×	×
Sinus venous	✓	✓	✓	×	×
Truncus Arteriosus	✓	✓	×	×	×

- Arterial Heart → Oxygenated → Poraon
- Atrio-venous Heart → Amphibians to Mammals
- Ventral Heart → Vertebrates
- Dorsal Heart → Invertebrates
- Lateral Heart → Earthworm
- Tubular Heart → Cockroach (13 chambers)

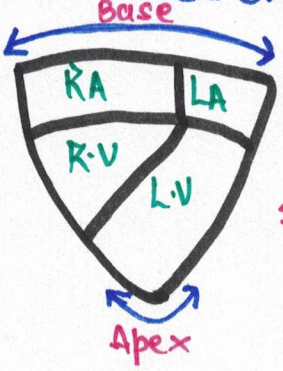


HEART

Meso Dermal, Four chambers, Double circulation
Clenched first (Triangular)

- Present in media - sternal space (tilt Toward leftside)
- Size :→ 5 (length) × 3.5 (width) × 2.2 (thickness) inch
- 250 - 300 gms (Male > Female)

External Structure of Heart

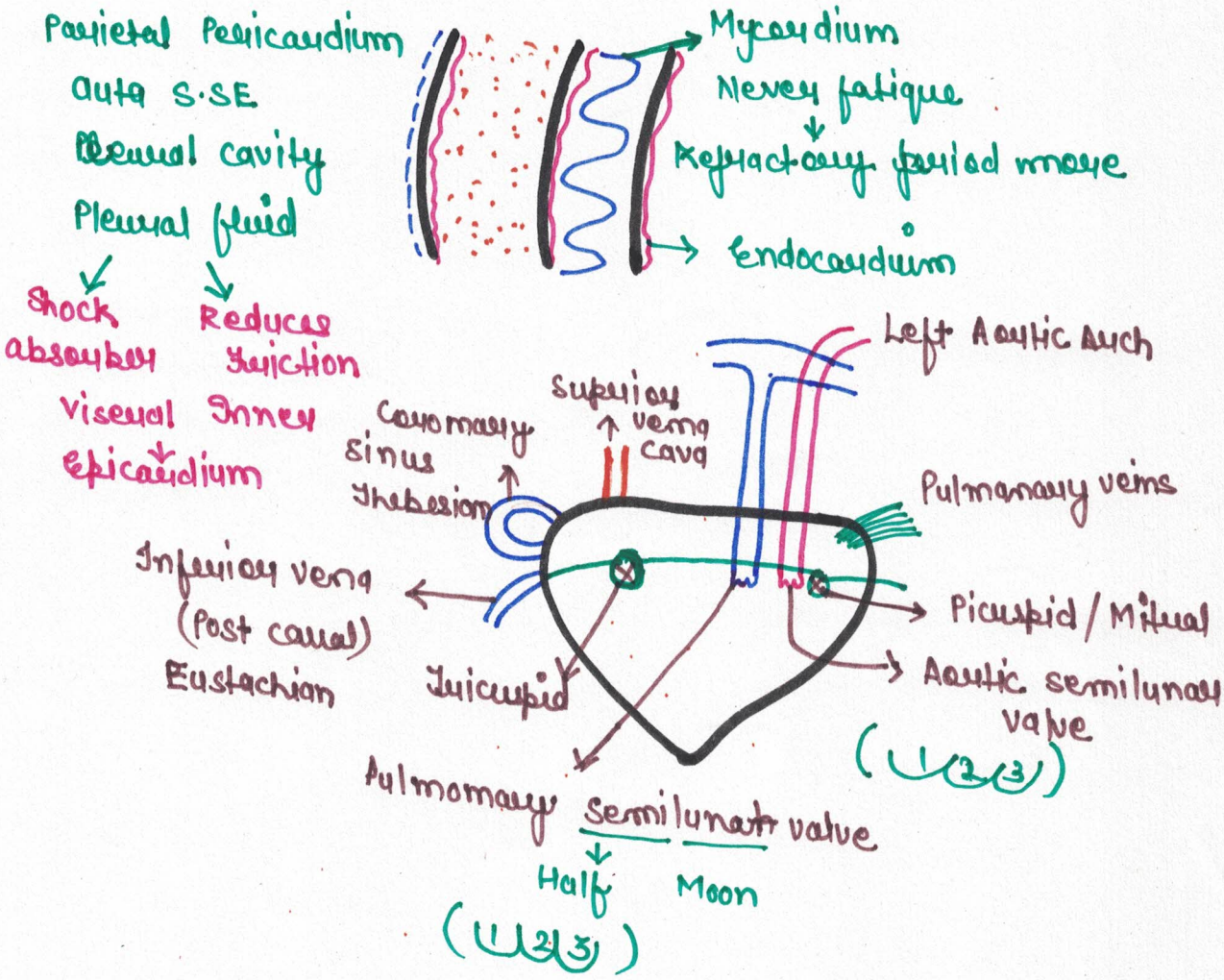


Upper smaller → Auricles
Lower larger → Ventricles

Inter auricular sulcus / thin
Atrio ventricular septum / thick
Inter ventricular sulcus (thick)

Cut Section of Heart

- Thickness of Heart wall depends on Mycardium
- Thickest Mycardium → Left ventricle



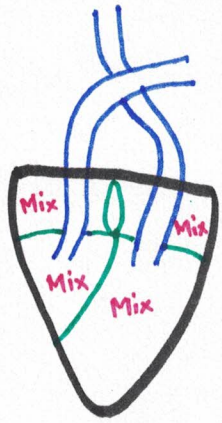
Embyonic Heart	Adult Heart
Foramen Ovale	Fossa ovalis
Ductus arteriosus / Ductus Botalli	Ligamentum arteriosum

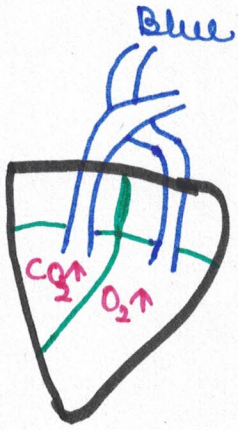
- Lungs Bypas during embryonic circulation.
- Umbilical cord contained 100% mother fetal Blood.
- In Embryonic Heart → Mixed blood in all chambers.

Congenital Heart Disease

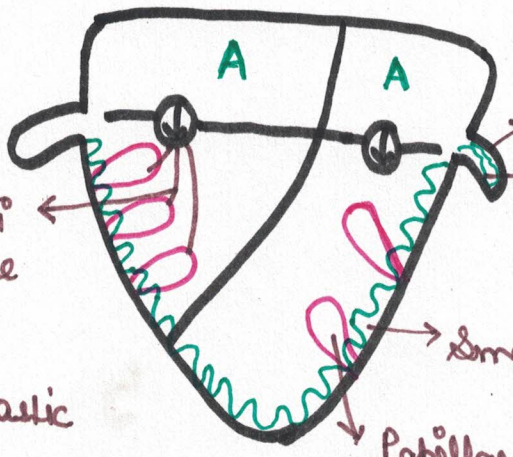
- Patent foramen ovale
- Patent Ductus arteriosus
- Ventricular septal defect

⇒ Mixing of O_2↓ → Hypoxia → Blue baby syndrome





Internal Structure of Heart



- Auricular appendages
- Combect muscles → Mucus → Pectinate
- Small columnae / Trabeculae carneae
- Papillary muscles
- Chordae tendi ← to prevent the backflow
- collagen → inelastic

Heart Beat

- One contraction (Pumping) + one relaxation (filling) ⇒ One Heart beat (Ventricle or apex beat)

  72 Systole + 72 Diastole ⇒ 72 Heart beat/min

  ↓ Heart Rate

- Surface area $\propto \frac{1}{\text{Heart Rate}}$

- Adult → 72 (70 – 75/min)
- New born baby → 120
- Embryo → 140
- Child → 100
- Rabbit → 210
- Frog → 64

- Heart beat → Female > Male

TACHYCARDIA
Tachycardia

- Breathing rate ↑ → Heart Beat ↑
- CO_2 and H^+ ↑
- Sympathetic nervous system ↑
- Weakning of myocardia
- During Blood Loss

BRADYCARDIA
Bradycardia

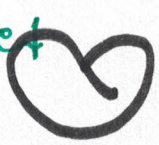
- Breathing rate ↓ → Heart Beat ↓
- CO_2 and H^+ ↓
- Parasympathetic nervous system.
- Stronger myocardium

ON THE BASIS OF ORIGIN OF HEART BEAT

Neurogenic

- If we cut the nerve beating stops

Annelida, Arthropoda



Myogenic

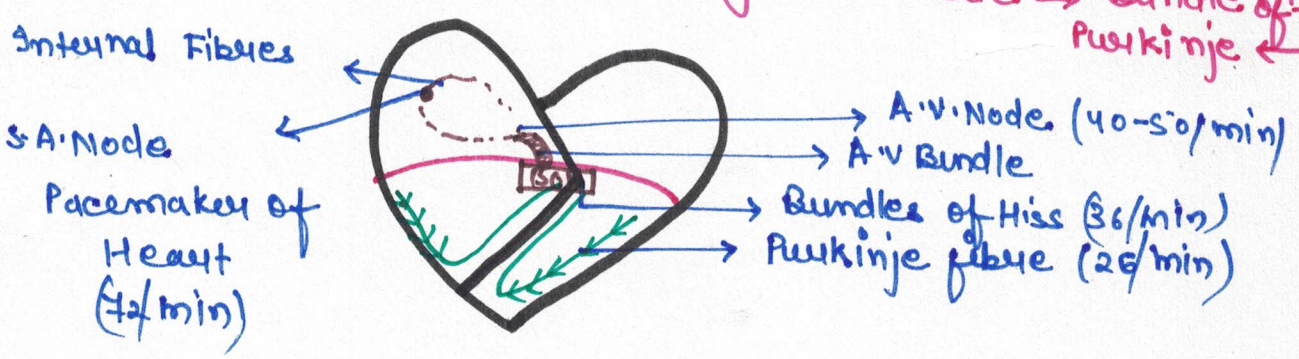
- If we cut the nerve beat continues.

Myogenic and auto excitable

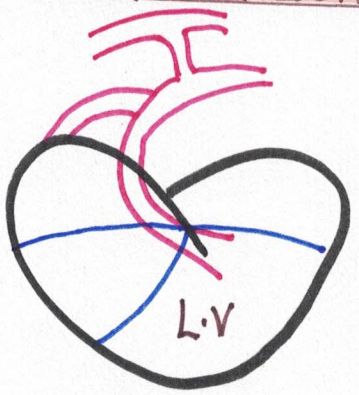
Conduction Pathway

- Two muscular nodes are present in our heart.
- Sino Auricular Node (S.A Node)
  Right upper corner (eustachian) of Right atria.
- Atrio Ventricular Node (A V. Node)
  Lower Left corner of Right atria
- ★ Massage delayed at A · V Node (Pace Setter)
- IMPULSE GENERATE
  SA Node > A.V. Node > Bundle of Hiss > Purkinje fibre
- CONDUCTION SPEED
  Purkinje fibre > Bundle of Hiss > S.A Node > A V. Node
  4/m/s 1 m/s 0.5 m/s 0.1 - 0.3 m/s

SA · Node → Inter Nodal Pathway → A·V Node → Bundle of Hiss → Purkinje



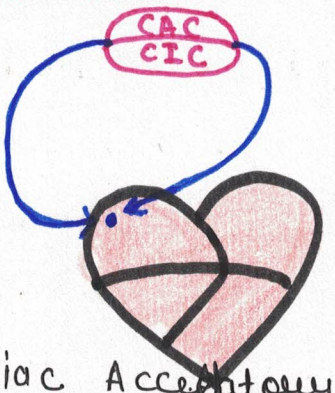
CORONARY CIRCULATION



∴ Left anterior descending artery (L.A .D.A)

→ Lumen = Narrow
Widows Artery.

REGULATION ON CARDIAC ACTIVITY



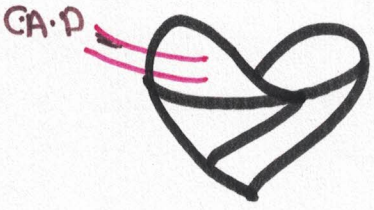
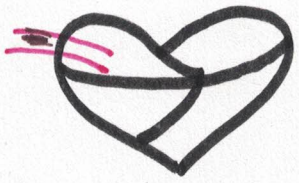
SNS
A↑
NA↑
Thy↑

PNS ↓
Vagus ↓
Ach ↓

C.A.C = Cardiac Accelatory centre
C.I.C = Cardiac Inhibitory Centry.
C.A.D = Coronary Artery disease
C.A.B.G = Coronary Artery Bypass Grafting
C.V.A = Cerebro Vascular Accident
C.P.R = Cardio Pulmonary Resuciatation

ISCHEMIC HEART DISEASE

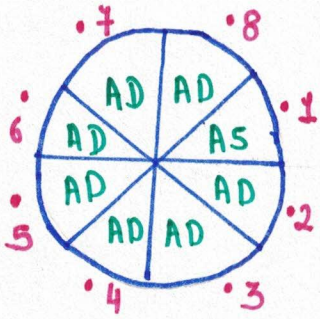
ISCHEMIC HEART DISEASE

MYOCARDIAL ISCHEMIC	MYOCARDIAL INFARCTION
	
Lumen Narrow Blood supply ↓ O_2 ↓ (Hypoxia) Weakning of Myocardium (Jactyon) Acute chest pain (Angina Pectoris) Reversible. Streptokinase enzyme (IVS) is used to dissolve the clot	Luman → Narrow or Block Blood supply stop O_2 supply stop (Anoxia) Cardiac tissue die (Necrosis) Heart Attack Irreversible.

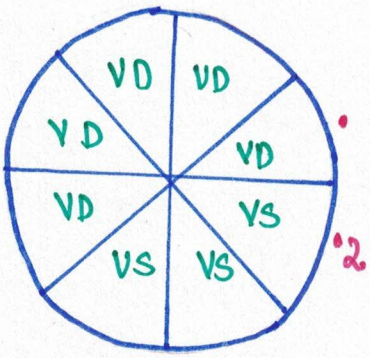
In Artifical pacemaker withum battery used.

Cardiac Cycle

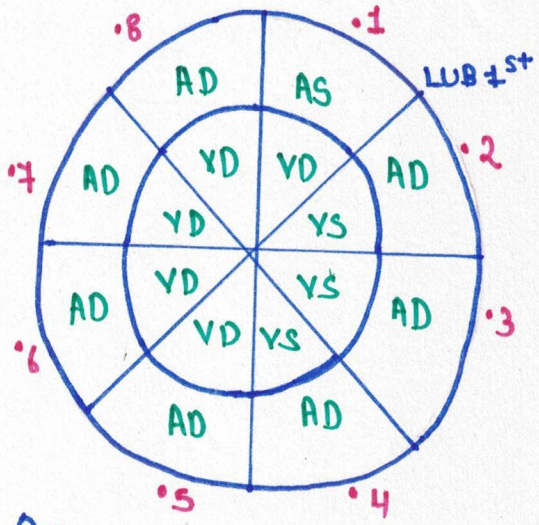
- 72 cycle completed in 60 sec.
  so, 1 cycle completed in 0.8 sec.



ATRIA



VENTRICLE
Message delayed at A-V Node



Joint dis^{n} → ·4,

VENTRICULAR SYSTOLE

Due to closing of tricuspid and bicuspid → LUB

- Isometric contraction
- Period of ejection

VENTRICULAR DIASTOLE

Due to closing of semilunar valves → DUB

- Isometric Relaxation
- Rapid Inflow.
- Diastasis

ATRIAL SYSTOLE

30% Blood flow increase.

ATRIAL DIASTOLE

Atria recieve venous blood (Systemic vein x pulmonary vein)

Diastolic Filling of Ventricles

- Rapid inflow → 70%, S_3, Passive, fast
- Diastasis → 5%, Passive, slow
- Atrial systole → 25%, Active, fast, S_4

→ Joint Diastole

Volumes related to cardiac cycle

- End diastolic volume (EDV) = 120 ml
- End systolic volume (ESV) = 50 ml

STROKE VOLUME

- Blood pumped by each ventricle in each Cardiac cycle
  EDV - ESV ⇒ 70 ml

CARDIAC OUTPUT

- Blood pump by each ventricle in a minute
- Stroke volume × Heart Rate
- 70 × 72 ≈ 5000 ml/min
- In human stroke volume and heart rate changable so, cardiac output also changable (athletes).

EJECTION VOLUME

- $\frac{\text{Stroke volume}}{\text{End Diastolic volume}} \times 100$

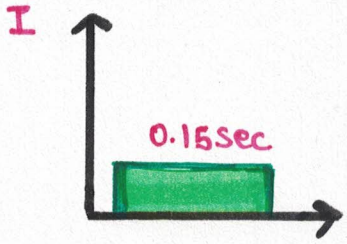
$\frac{70}{120} \times 100 = 60\%$

Sound Of Heart

- Stethoscope → Lennac (discovered it).

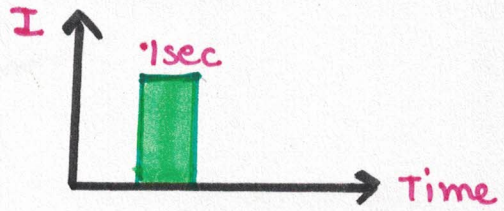
LUB

- First heard sound
- At the begining of ventricular systole due to closing of tricuspid and bicuspid (A.V. valves)
- Dull and prolonged



DUB

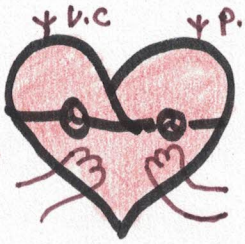
- Second heard sound
- At the beginning of ventricular diastole at the closing of semilunar valves.
- Sharp but for short duration.

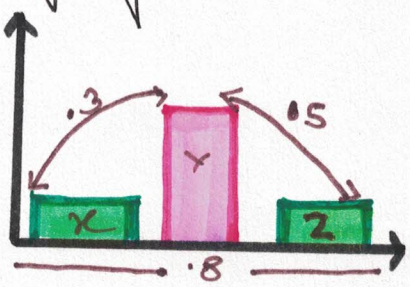


Murmur

- Any abnormal heart sound.
- Valvular stenosis → Narrowing of valves.

J.D → A.S → VS
OR
ADKVD → AS → VS





Distribution of Blood

Distribution

- Heart 7%
  - Coronary artery
- lungs 9%
  - Bronchial artery
- systemic 84%
  - Artery 13%
  - vein 64%
  - capillary 7%

Blood Pressure

- Sphygmomanometer ⇒ Discovered by Hales → In House (1st time)
- Systolic ⊕ pumping / Diastolic ⊖ Resting.
- Measured at ~~Brachial~~ artery (Fore arm) 120 / 80
- Sympathetic Nervous system increases the blood Pressure.
- Blood Pressure ∝ Na^+
- Male > Female
- Obesity → B.P ↑ , Exercise → B.P ↑
- Old age → B.P ↑ (Due to reduce elasticity)

PULSE

- Sphygmograph
- Pulse rate ⇒ 72/min ⇒ Heart Beat
- Pulse Pressure = Systolic → diastolic
  = 120 → 80
  = 40 mm of Hg
- Measured at wrist (Radical artery)

DISORDERS

- Hypertension → More than normal B.P, 140/80
  - Primary Hypertension
  - Secondary Hypertension
- Majorly affected organ → Heart, Kidney, Brain (CNA)
- Hypotension → Less than 110/70 → Anaemia, Valvular stena.

ATHEROSCLEROSIS

~~Atherosclerosis~~

Cholesterol + Ca^{2+} + P.D. G.E

Plaque

Lumen → Narrow

Mostly in coronary artery.

ARTERIOSCLEROSIS

~~Arteriosclerosis~~.

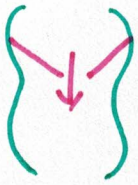
Deposition of Ca^{2+}

Hardening of artery

Heart block

- Any defect in conduction pathway (Mainly A.V. Node)

Valves
To prevent
Backflow



Dilation of vein
Saphenous vein
(largest)

Heart attack

- Suddenly damage of cardiac tissue due to inadequate blood supply.

Heart failure

- When heart not pumping blood effectively to fulfill the demand of body.

Sometimes it is called congestive heart because congestion of lungs is the main reason you ill

Cardiac Arrest

- When heart stop beating (Not act as a pumping station)

Cardiac Arrest

↓ Ventricular Asystole

↓ Ventricular fibrillation

Blood Vessels

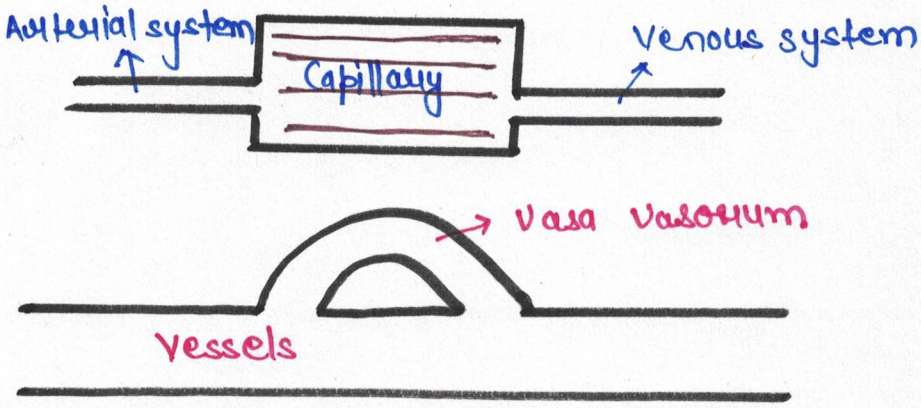
- Arteries, veins, capillary
- Blood vessels made up of three layers.

Tunica Externa	Tunica Media	Tunica Interna
Loose connective tissue + collagen and elastic fibres + longitudinal muscles.	Smooth muscles + elastic fibres	Endothelium (S.S.E)

- Thickness of blood vessels depends on tunica media.

CAPILLARY

- Made up of only endothelium.
- Surface area high.
- 5 to 7% of blood.

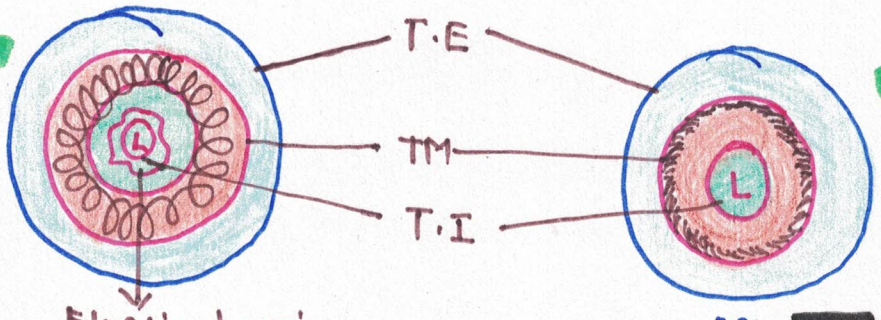


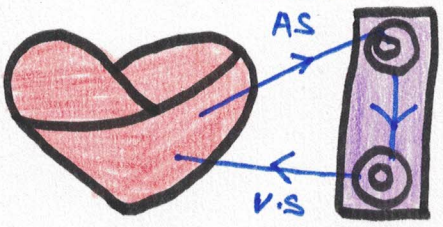
ARTERY

- Only 13% blood
- Deeply situated
- Get empty after death
- No valves
- Oppose backflow
- Not collapse
- Comes oxygenated blood.
- Tunica Media is thick
- Thicker as compared to vein.
- Pressure high
- Red coloured.

VEIN

- 64% blood
- Bluish coloured.





Portal System
Portal vein

Heart → organ
↓
Arterial system

organ → Heart
↓
venous system

organ → organ
↓
Portal system.

PORTAL SYSTEM (P.S)

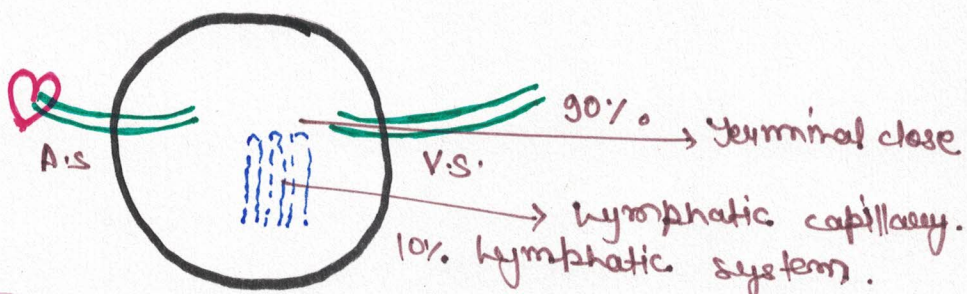
- RENAL P.S
  - Posterior body part
  - ↓ Renal portal vein
  - KIDNEY
- HEPATIC P.S
  - Alimentary canal Gut
  - ↓ Hepatic portal vein.
  - LIVER
- HYPOPHYSEAL P.S
  - Hypothalamus
  - ↓ Hypophyseal Portal vein
  - ADENOHYPOTHYSIS

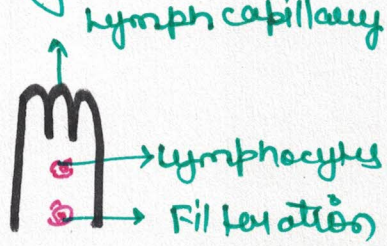
??? Ventricular systole is because of
1) cells
2) Tissue ✓
3) organ
4) organ System

- Lungs, Liver and Heart Receive oxygenated and deoxygenated blood both.

LYMPHATIC SYSTEM

- Middle man of body → Lymph
- In frog blood circulation close, lymph circulation open.
- In human both circulation close.
- Study of blood circulation → Mysentery.



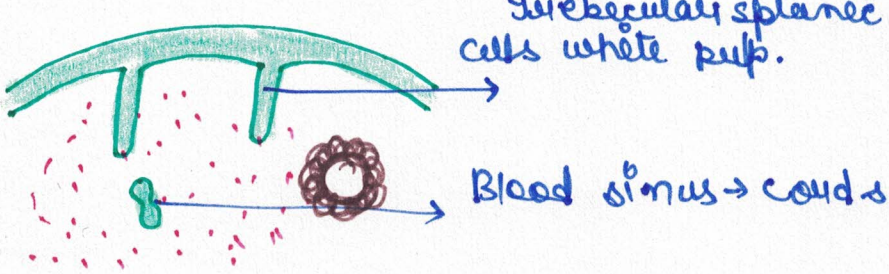


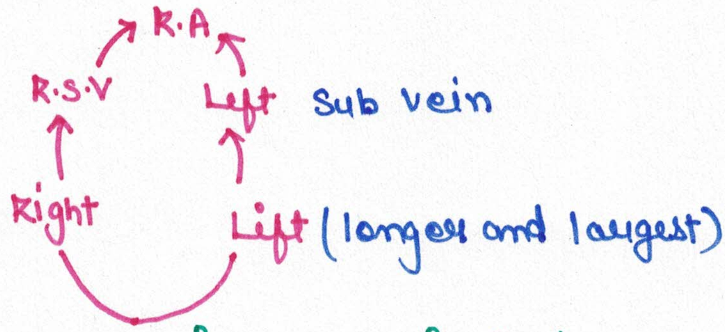
Lymph

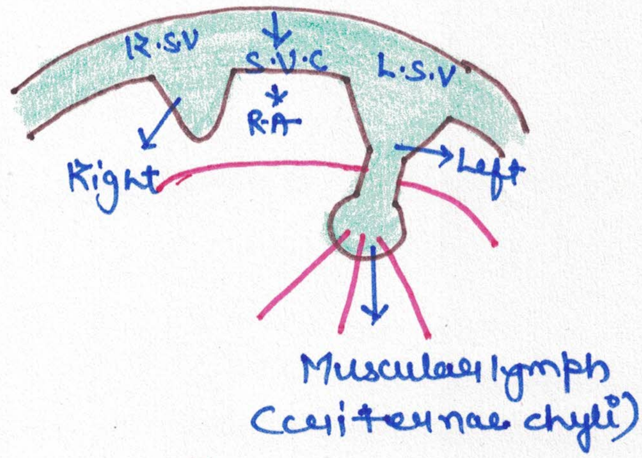
- Colourless tissue fluid (RBC absent).
- Platelets absent
- Has clotting capacity but takes more time.
- CO_2 & waste materials more.
- Solute. proteins less and insoluble protein more.
- In blood neutrophils more but in lymph lymphocyes.
- lymph capillaries are absent in epidermis, cornea hair nails, bone, marrow, Spinal cord, cartilage, waste particle.
- Lymph nodes mainly present in neck, arm, intestine (Payer's patches), (inguinal canal) groining region.
- Lymph colourless but in lacteals (Intestine → Milky white lymph
- lymph vessels have more valves.

Spleen

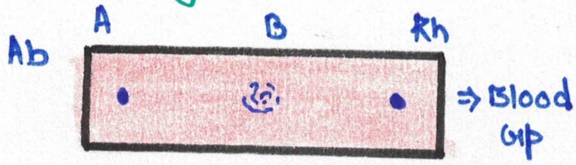
- Mesodermal
- Reddish brown
- Reticular endothelial tissue.
- Red and white pulp present
- Cords of Billroth present
- Junction bank of body.
- Blood bank of body
- Graveyard of RBC
- Store iron
- During malaria → Splenomegaly (enlargement of spleen)
- Haemopoitic (embryo) but in Bone marrow.
- Antibody protection
- If spleen remove least effect on body.
- Dead RBC removed by Liver + Spleen
- Blood filter apparatus Liver + kidney.

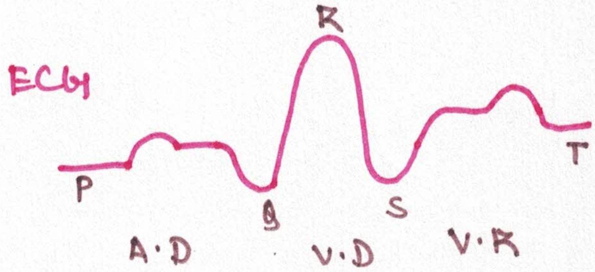




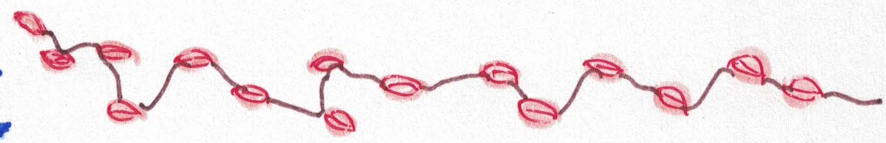


Thoracic lymphatic duct
↑
Lymph capillary → Lymph vessels





BLOOD



Plasma - 55% ; Corpuscles - 45%

RBC (99%) + WBC + Platelets (1%) ≈ RBC

Dead RBC + Liver spleen + Haem / Globulin

Haem < Porphyrin Ring / Iron

Porphyrin Ring < Billirubin / Billuverdin > Blue Juice.

PLASMA

INORGANIC

Gaseous	IONS	SALT
O_2	K^+	Nacl
CO_2	HCO_3^-	
NH_2	Cl^-	
	Na^+	

ORGANIC

PROTEIN	ANTICOAGULANT	DEFENCE	NUTRIENT
	HEPARIN		
		Lypozome	Glucose
Albumin 4%, Smallest, BCOP ‖ 30; Globulin (α β γ)	Prothrombin 3%, Fibrin 3% — Blood cloting.	Properdin	Vitamins
			Minerals
			Cholestrol

RBC

ERYTHROCYTES

- Biconcave
- 7.5 μ
- Immature → nucleated
- Mature → enucleated
- camel and Lama → Biconvex
- Mitochondria absent
- Golgi body absent
- Endoplasmic Reticulum absent
- Krebs cycle absent
- Glycolysis
- spongy (Not amoeboid)
- A, B & Rh antigen are present
- Carbonic anhydrase (Zn) → Rxn 5000 times ↑.
- Single Rate Yellow → Deep Red → due to Hb.
- 60% H_2O, 40% others → 90% Hb ie 36
- Molecular wt. 67,200 D ie. 26.5 crore molecule.
- Endo skeleton → Stromatin.

Donnon's Membrane → Permable for +ve
Impermeable for -ve

PLATETS

- In other animals → spindles cell.

BLOOD CLOTTING

- Artifical anti-coagulant → sodium citrate, sodium oxalate & EDTA (blind calcium)

Thromboplastin $\xrightarrow{Ca^{++}\text{ exposure to }O_2}$ Thrombokinase / Prothrombinase

Prothrombin $\xrightarrow{\text{Antiheparin}}$ Thrombin

Fibrinogen (3% largest Manamer, soluble) → Fibrin (Polymers insoluble)

Male × Female

(+) (−) → (+)