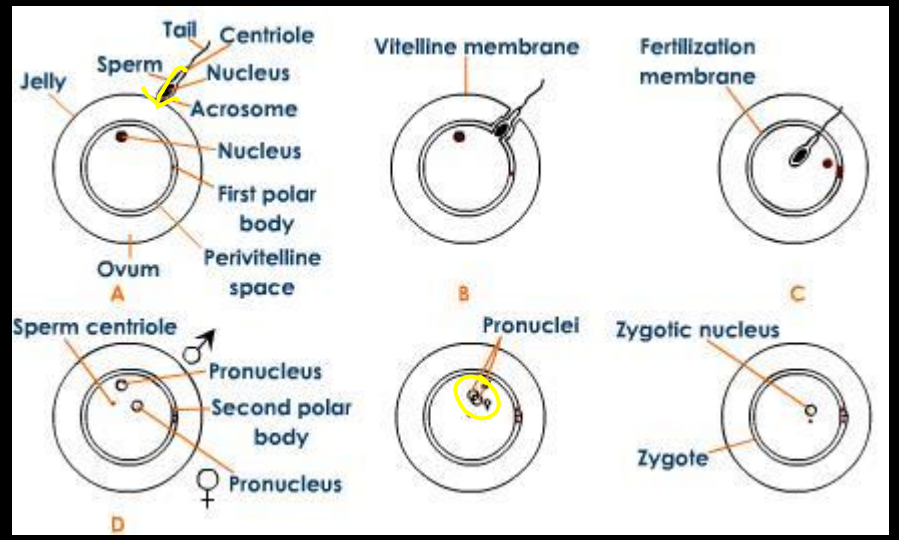
- Prevents the entry of other sperms allowing monospermy, Preventing polyspermy

- After the entry of sperm the secondary oocyte undergoes 2nd meiotic division

- Here ovum and second polar bodies are formed

- 2nd polar bodies move towards the animal pole and sperm towards the ova

- Male and female pronucleus fuses called synkaryon
- Nuclear membrane dissolves at the site of fusion called amphimixis
- Zygote is formed

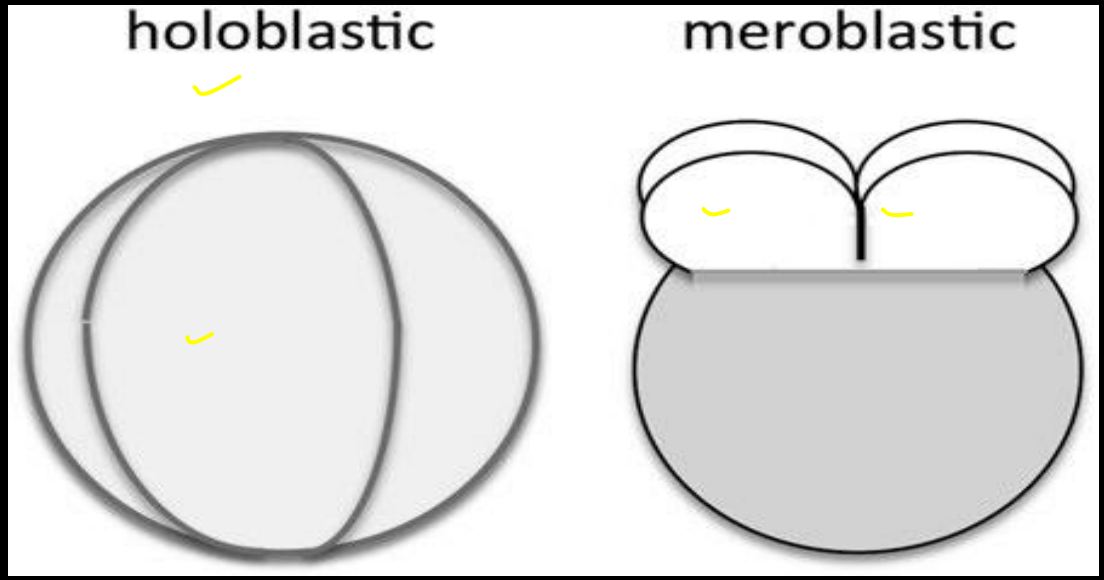


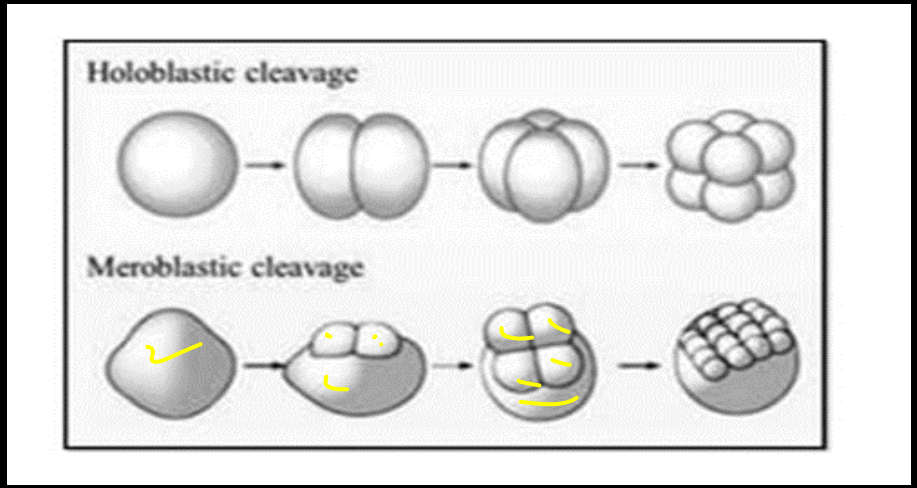
- Cleavage: Segmentation of zygote
- Divides mitotically

Types of Cleavage

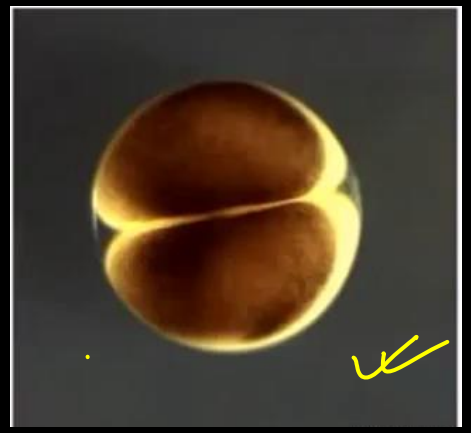
- 1.Holoblastic :complete division of zygote
- a. Equal: equally in to two halves so two equal blastomeres
- b. Unequal: unequally into two so two unequal blastomeres

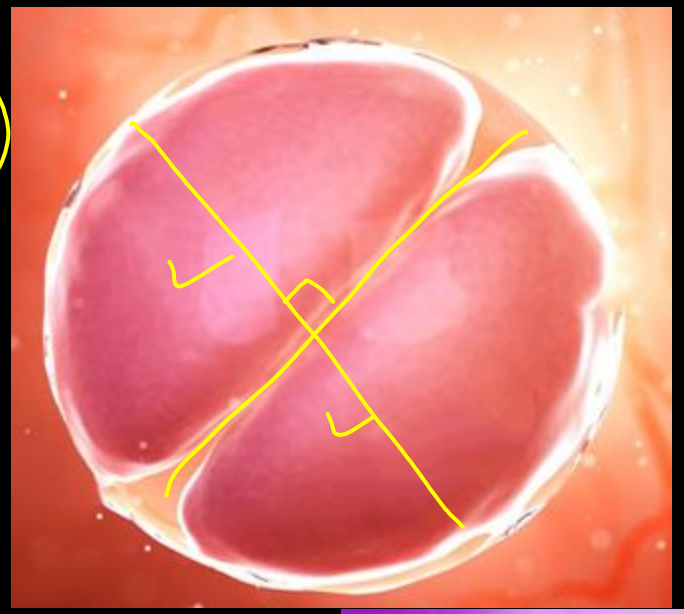
- 2.Meroblastic: zygote is not completely divided so no two complete blastomeres
- a. Discoidal: divides only in one side lacking yolk e.g. reptile,birds, fishes, monotreme mammals, squids etc
- b. Superficial: in centrolecithal egg divides only superficially. Arthropods (insects)





- **1st cleavage**: meridionals(vertical), holoblastic and equal,2 blastomeres are formed

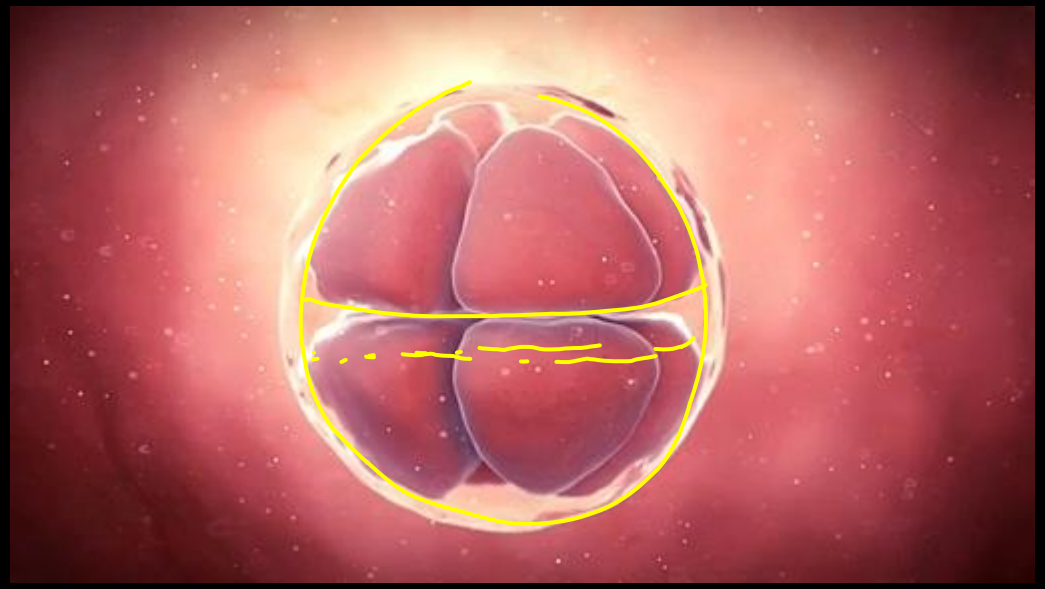




- **2nd cleavage**: meridional(vertical but p, holoblastic and equal,4 blastomeres are formed
- Perpendicular to the 1st cleavage



- **3rd cleavage**: horizontal, holoblastic and unequal,just above the equatorial plane(latitudinal)
- Upper smaller cells called micromeres and lower larger macromeres
- Micromeres divides rapidly as no yolk 8 blastomeres are formed



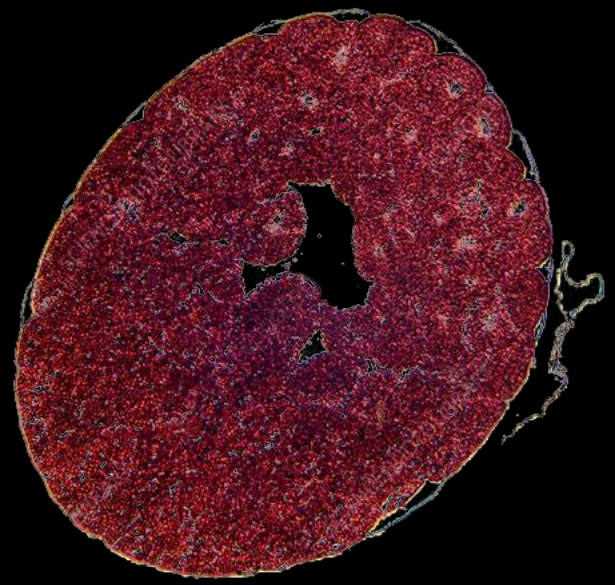
- **4th cleavage**:2 synchronous meridionals (vertical) holoblastic unequal16 blastomeres are formed





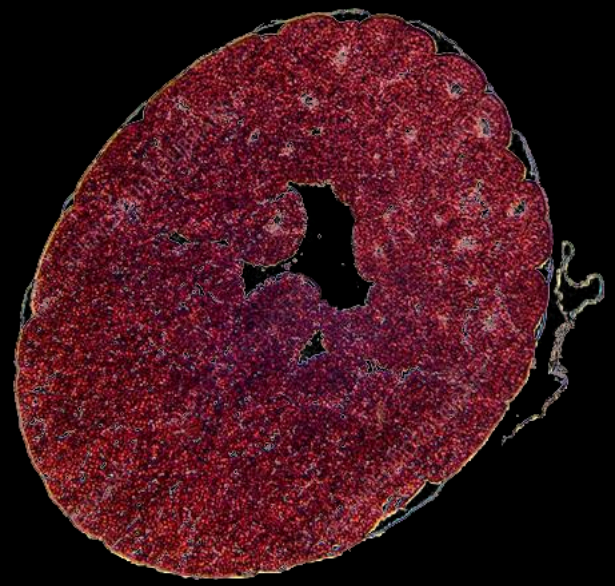
- **5th cleavage**:2 simultaneous horizontal division holoblastic and unequal 32 blastomeres are formed
- Holoblastic common
- Equal 1st and 2nd
- Unequal 3rd 4th and 5th
- So holoblastic unequal





Morulla:

- 32 cell stage
- solid and spherical structure
- not prominent in frog
- Mulberry shaped structure

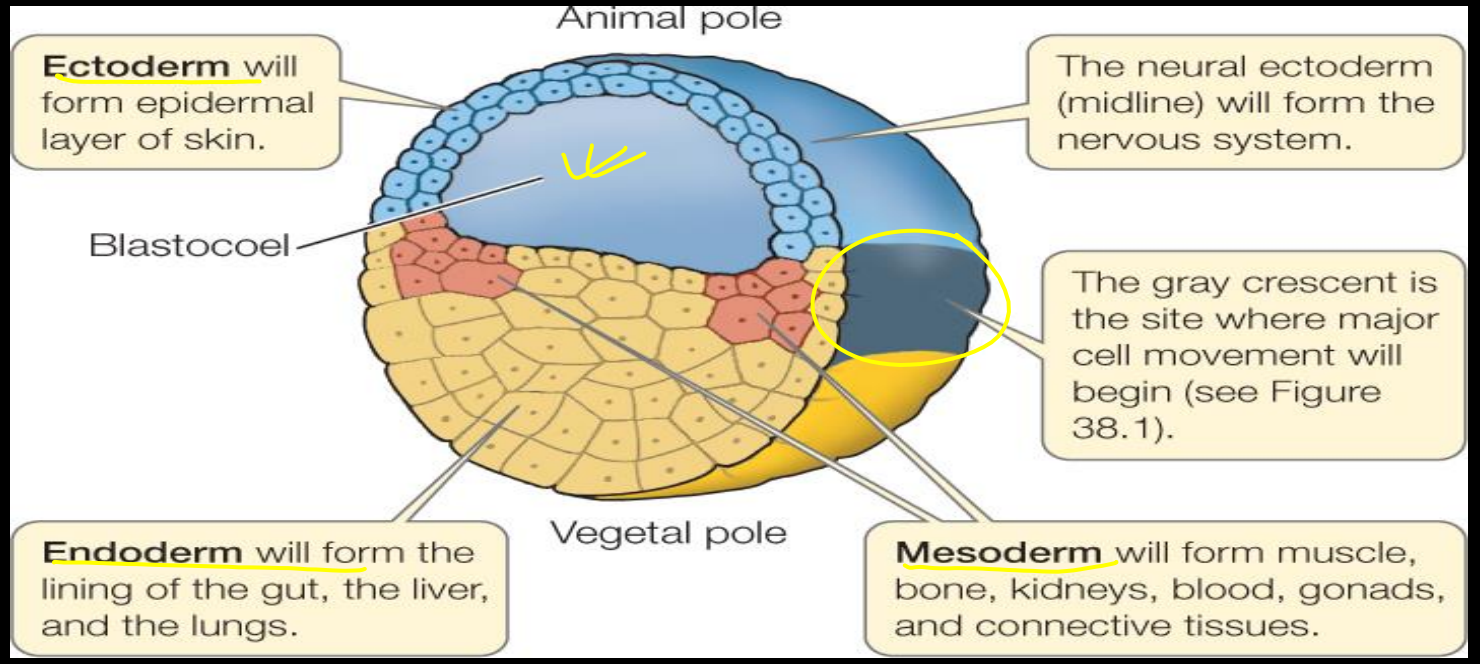




Blastula:

- Hollow and spherical
- Blastocoel is formed filled with alkaline albuminous fluid secreted by surrounding cells
- coeloblastula
- Presumptive areas
- Presumptive ectoderm
- Presumptive mesoderm
- Presumptive Endoderm





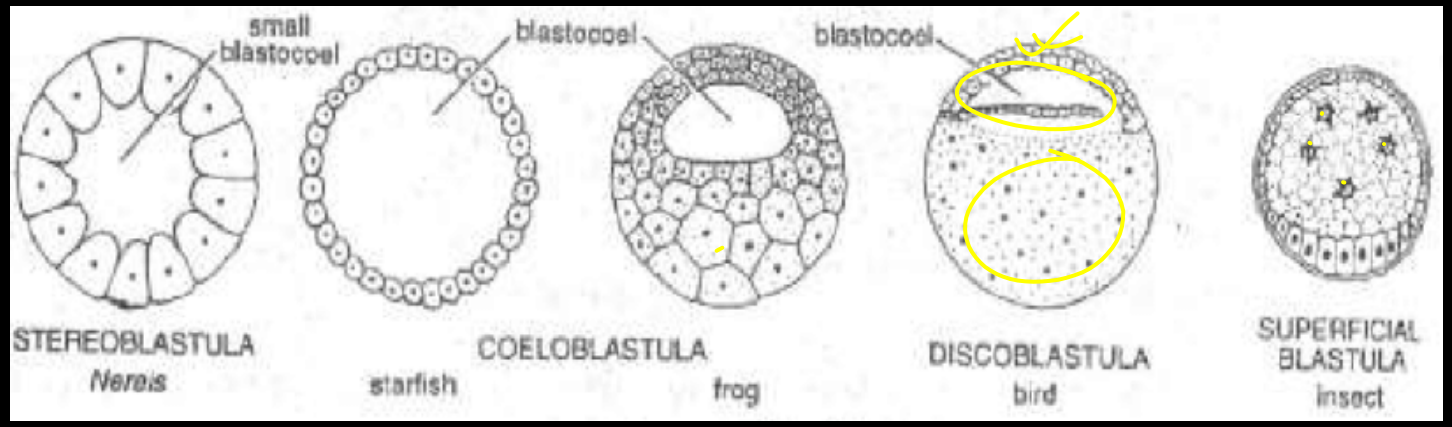
Types of blastula

1.Coeloblastula: It is a hollow blastula containing a large spacious blastocoel. Frog

2.Stereo blastula: with small or almost no blastocoelic space at the center (solid) ***Neris***

3.Disco blastula: Consists of a disc shaped mass of blastomeres overlying a large yolk mass no division at yolk. Reptiles and birds

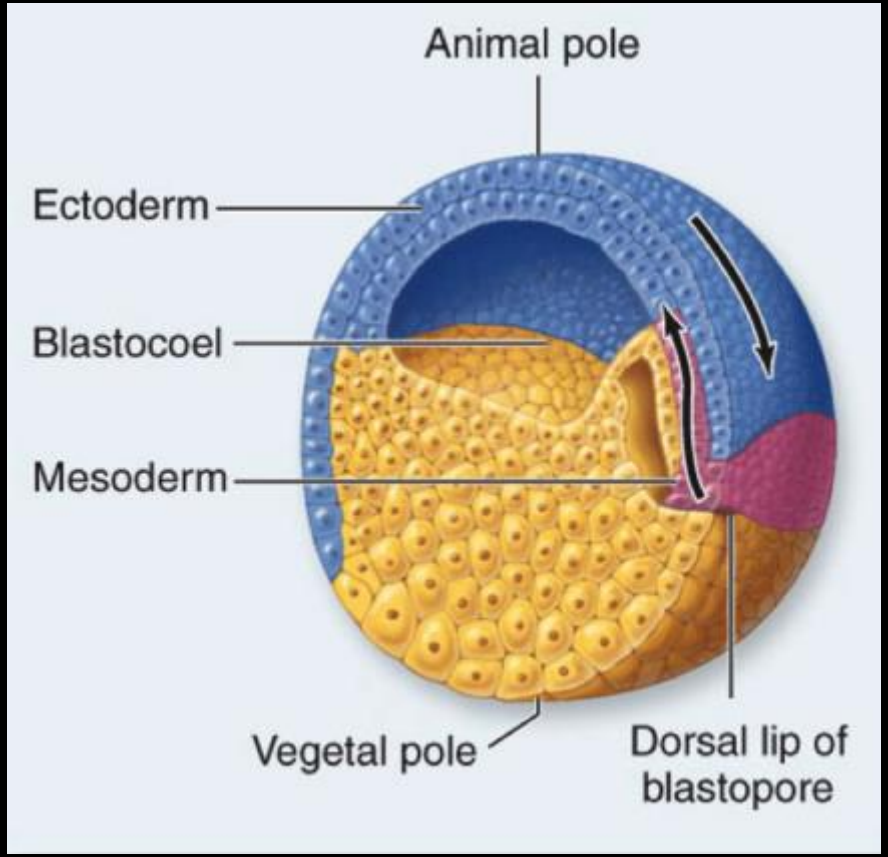
4.Superficial blastula: central yolk, division at periphery. insects



Gastrulation : Formation of gastrula

- Protostomes
- The blastopore develops into the mouth first. Protostomes include primitive invertebrates such as arthropods, mollusks, and annelids.

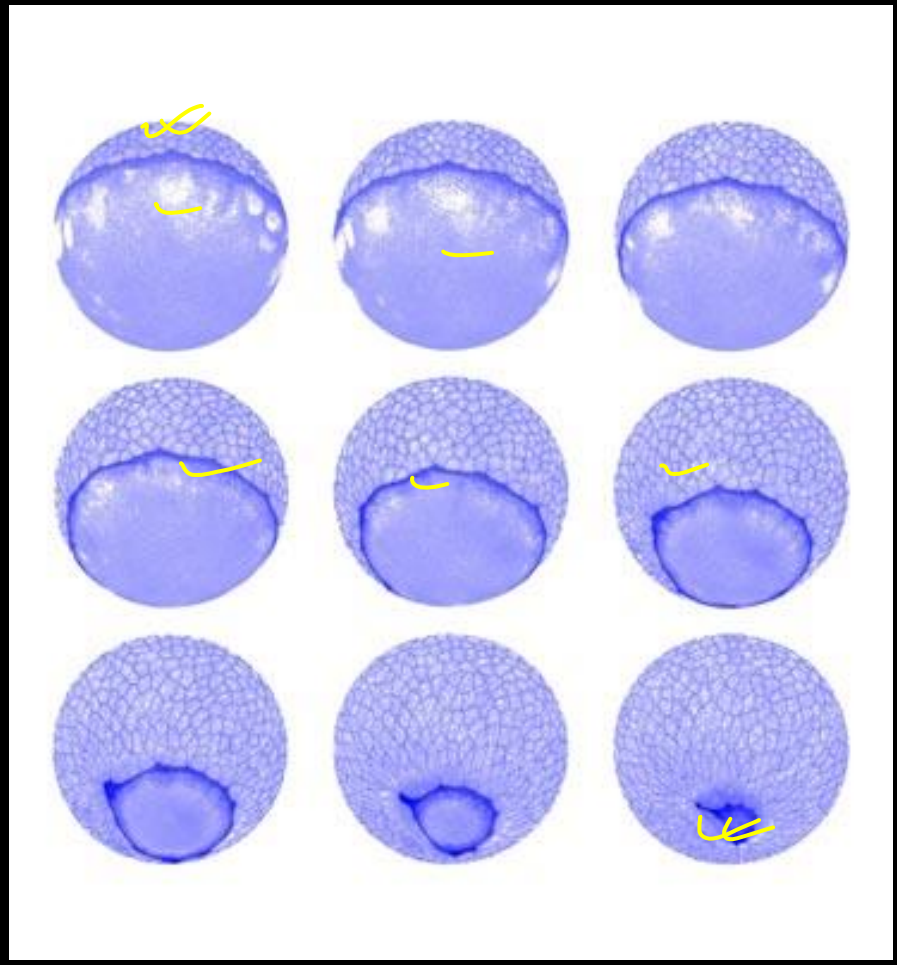
- Deuterostomes
- The blastopore develops into the anus first, and the mouth develops later. Deuterostomes include chordates and echinoderms



Gastrulation : Formation of gastrula

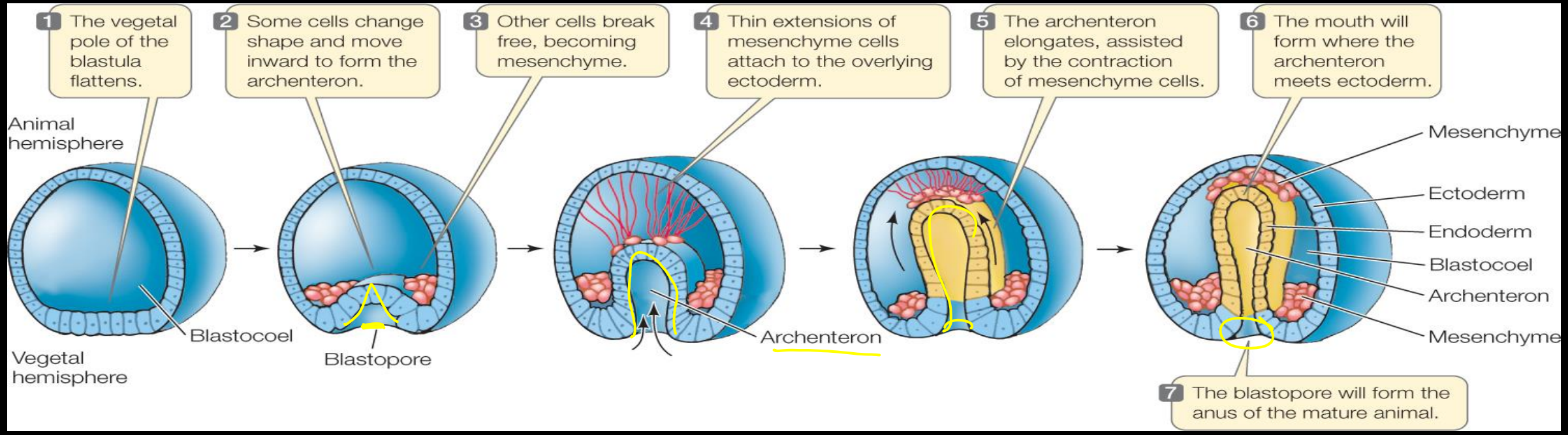
- Completes through

1.Epiboly: overgrowth of the micromeres so that it covers the vegetal hemisphere except in a place called gastrular pit



Gastrulation : Formation of gastrula

- 2. Emboly: the micromeres enter the gastrula from the gastrular pit called invagination
- forming a cavity called archenteron future gut
- the opening of which is blastopore.
- Blastopore forms mouth protostomes
- Blastopore forms anus deuterostomes



Gastrulation : Formation of gastrula

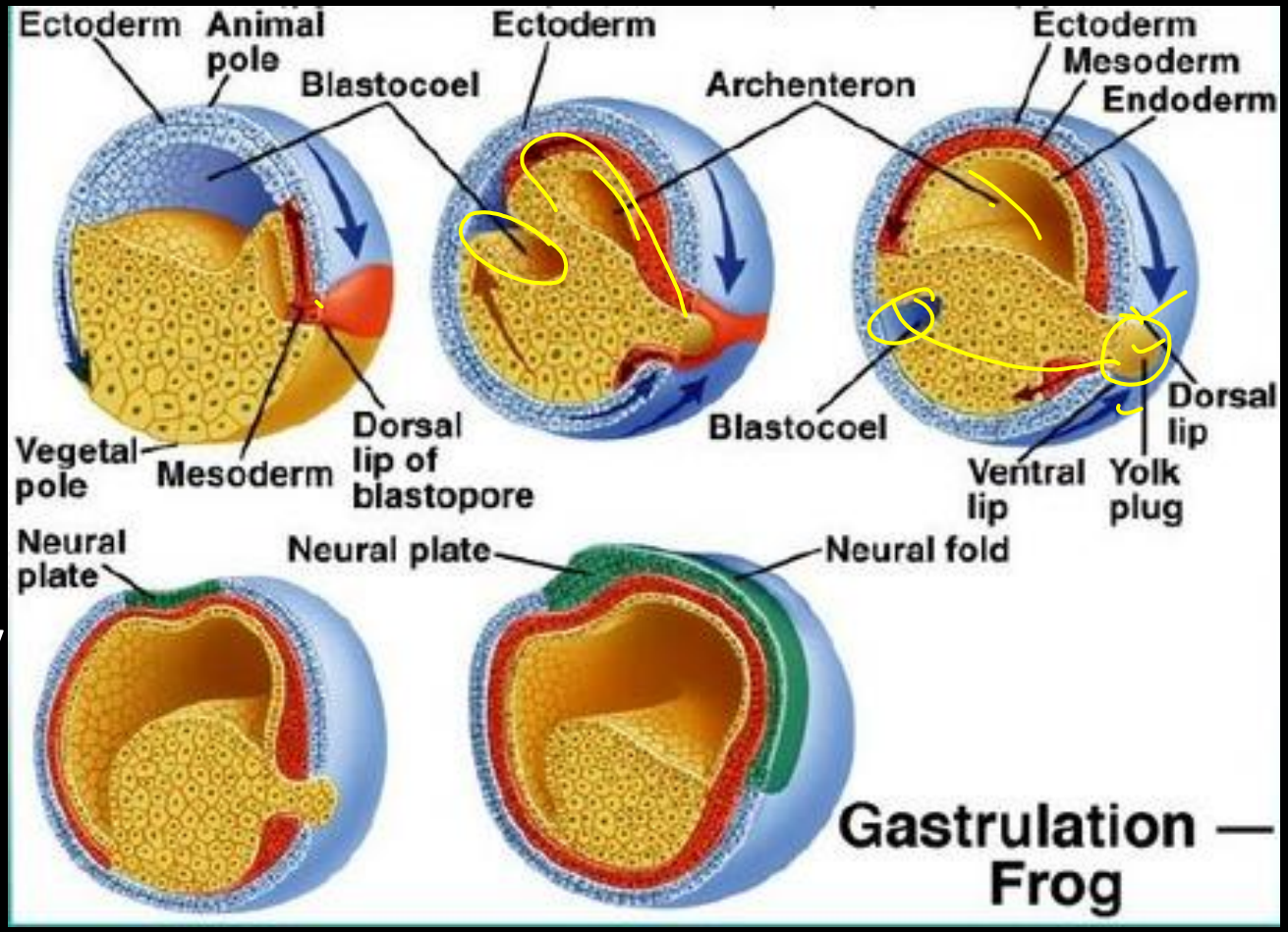
- Archenteron increase in size,
- Micromeres move upward called involution

blastocoel decreases

- finally disappears forming yolk plug
- During the disappearance of blastocoel

dorsal and ventral lip are formed

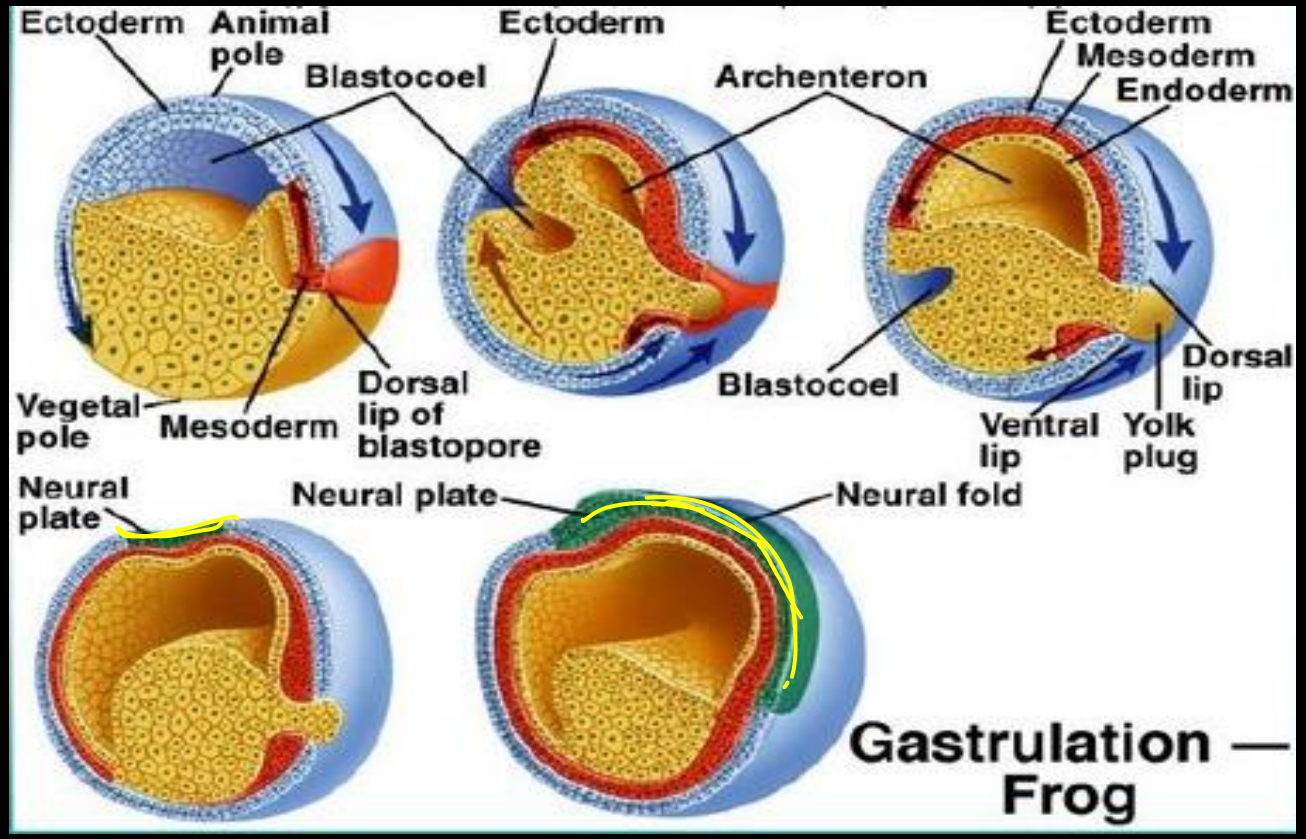
- Archenteron develop Into alimentary canal
- Blastopore forms anus



Nurulation:

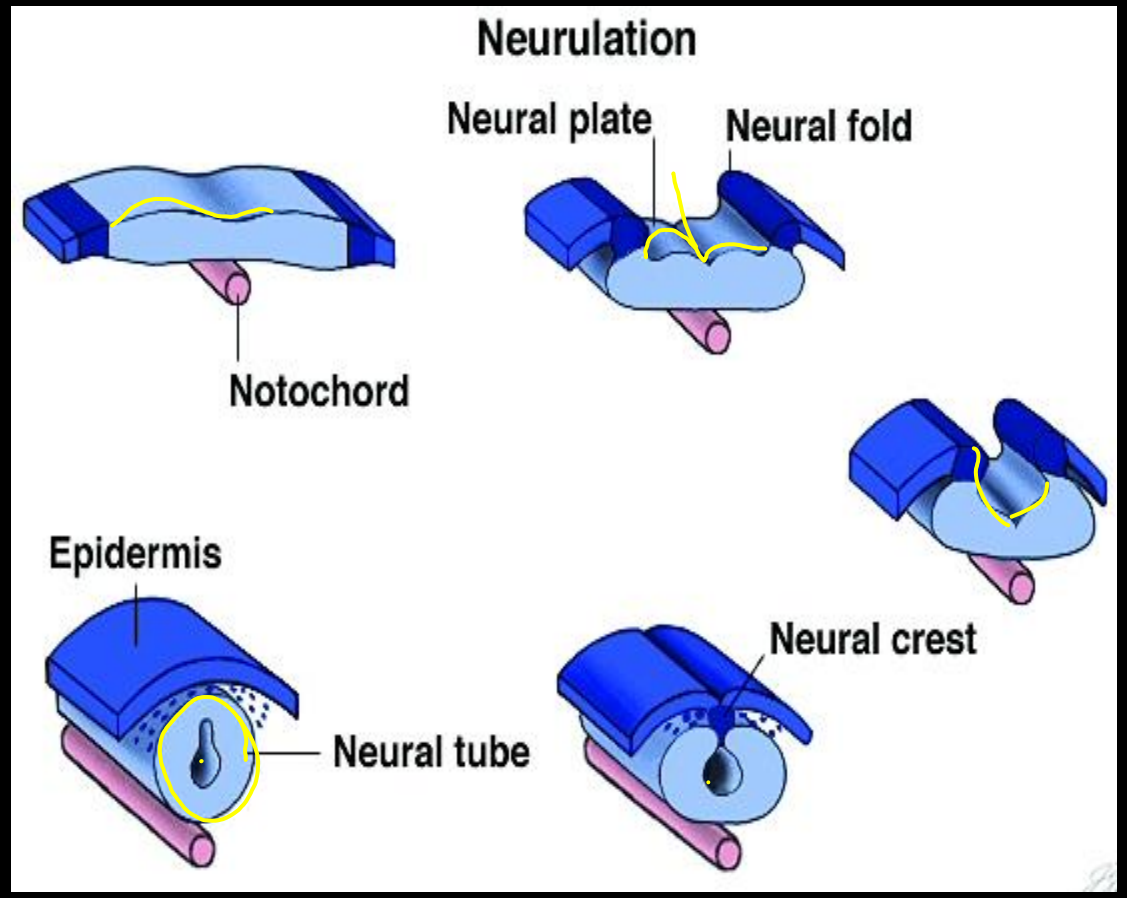
Neural plate formation

- Development process in which neuroectodermal cells are transformed into brain and the spinal cord by neural plate enlargement.



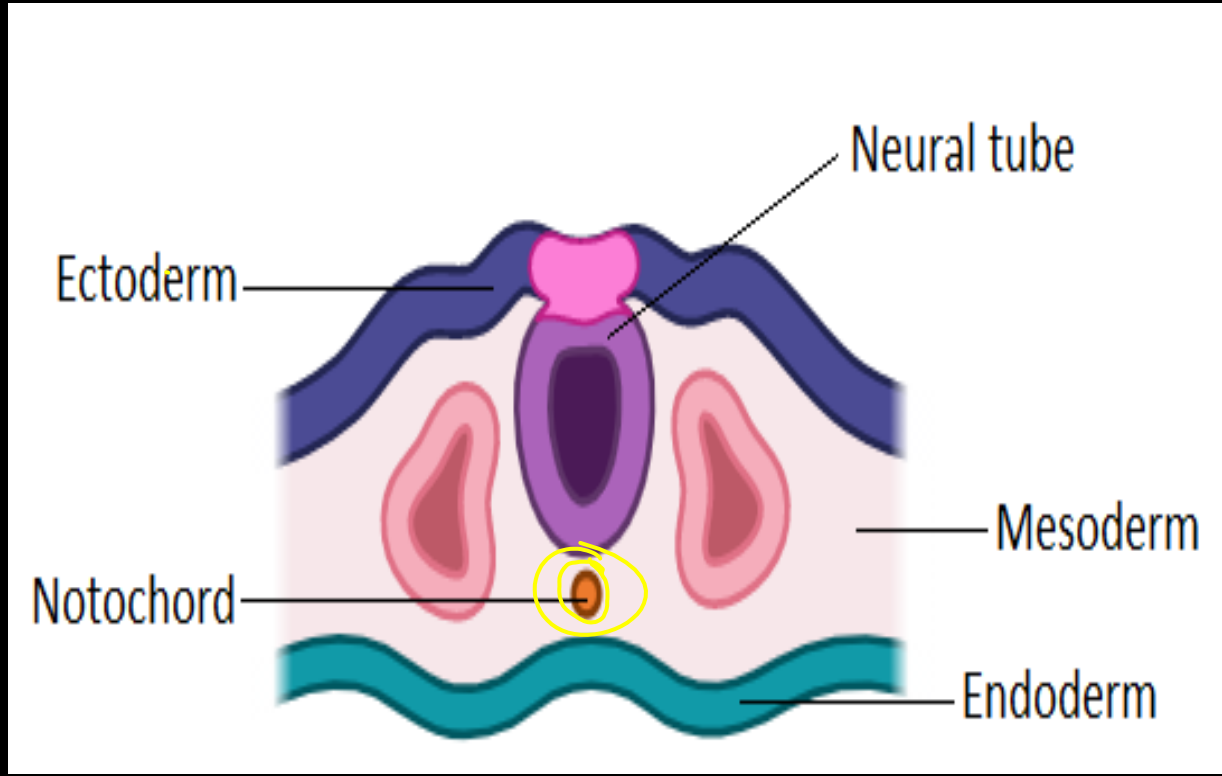
Neural groove formation

- Neural plate cells elongates and forms columnar epithelial tissue.
- The edge of the lateral side of neural plate thickened and rises, called neural folds
- Rapid division at neural fold depression or groove is formed
- Neural fold grows and push the neural plate
- Fuse together forming neural tube with a cavity called neurocoele



Notogenesis:

- Notochord is flexible cartilaginous skeletal rod supporting body.
- Called the rod of mesodermal cells In dorsal part of the embryo
- The notochordal cells are at the roof of archenteron
- separated from ectoderm and mesoderm forms Notochord covered by notochord sheath

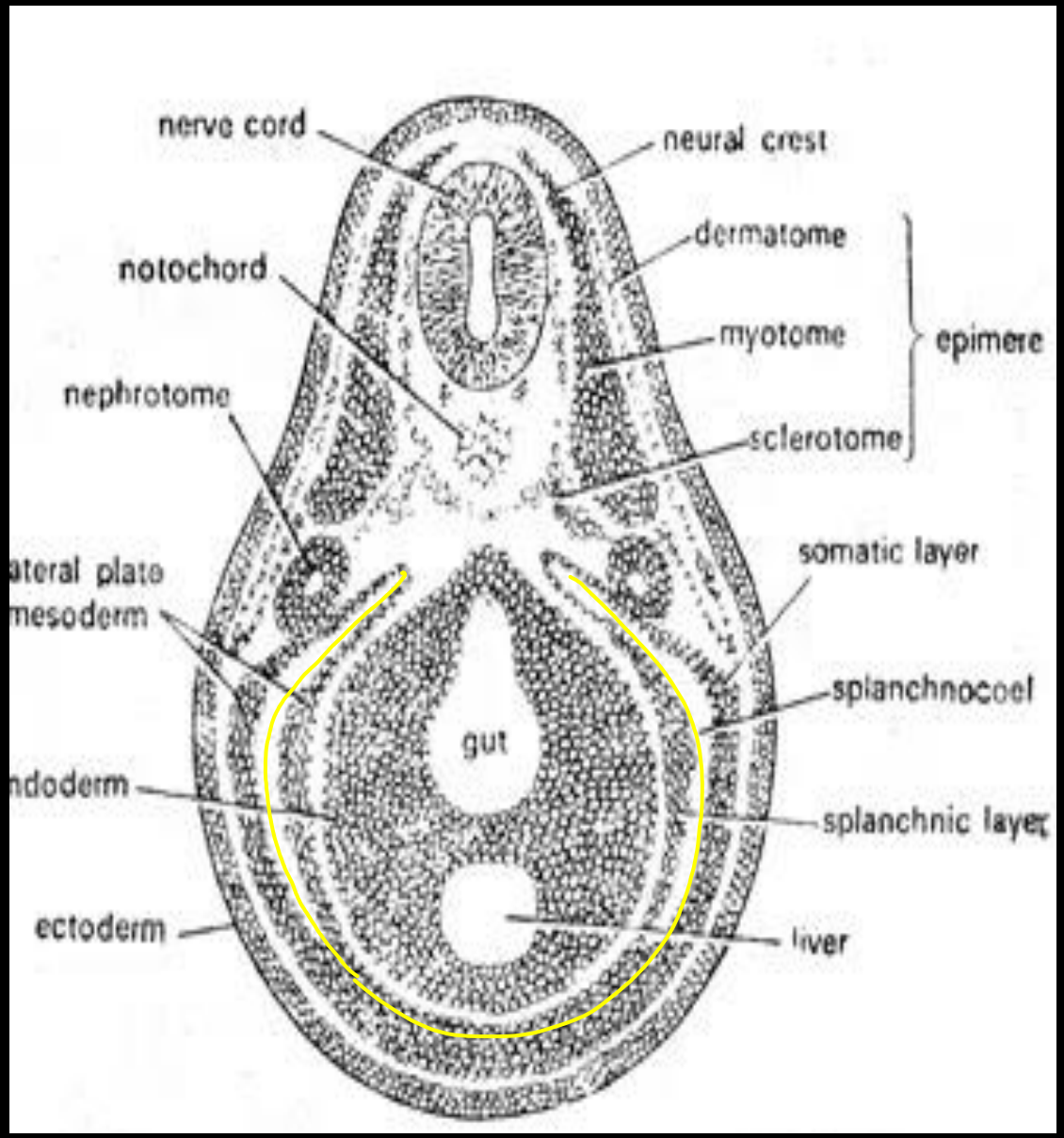


Coelom formation:

- Space between body wall and intestine
- By the splitting of hypomere of lateral plate of mesoderm forms visceral (splanchnic) layer and parital(somatic) layer forming cavity called splanchnocoel

Splanchnocoel extends downward and increase in size as a result splanchnocoel looks like u shaped

- Somatic layer unites with ectoderm and forms body wall
- Visceral layer unites with endoderm and forms gut wall



Fate of Germ layers

ECTODERM	MESODERM	ENDODERM
• Epidermis of skin and its derivatives (including sweat glands, hair follicles) • Epithelial lining of mouth and anus • Cornea and lens of eye • Nervous system • Sensory receptors in epidermis • Adrenal medulla • Tooth enamel • Epithelium of pineal and pituitary glands	• Notochord • Skeletal system • Muscular system • Muscular layer of stomach and intestine • Excretory system • Circulatory and lymphatic systems • Reproductive system (except germ cells) • Dermis of skin • Lining of body cavity • Adrenal cortex	• Epithelial lining of digestive tract • Epithelial lining of respiratory system • Lining of urethra, urinary bladder, and reproductive system • Liver • Pancreas • Thymus • Thyroid and parathyroid glands

Epidermis & cutaneous glands	**Notochord (axial skeleton)**	**□ Epithelium of digestive tract**
stomodeum	Pericardium, pleura, peritoneum	Gastric & intestinal glands
Epithelium of conjunctiva, auditory & olfactory organs	All muscles except the iris & ciliary body	Liver, pancreas & their ducts
Lens, cornea, retina	Skeleton (bone + cartilage)	Pharynx, tonsils, Eustachian tube, thymus, thyroid, parathyroid
Central nervous system	All connective tissues including blood	Respiratory tract, larynx, trachea, lungs
Enamel of teeth	Dermis of skin	The lining of the urinary bladder
Iris & ciliary body	Cardiovascular, excretory & genital systems	
Adrenal medulla	Neuroglia	
	Adrenal cortex	
	Spleen	
	Eye parts except for lens, retina and cornea	

Respiratory System of Frog

Respiration: The process by which complex food substances are broken down into simple diffusible forms with the help of oxygen to release energy.

Respiratory System of Frog

Respiratory system: Organs involved in intake and supply of oxygen to the tissues and to get rid of excess carbon dioxide comprise respiratory system.

In frog, respiration occurs by

A. Lungs

B. Trachae

C. Gills only

D. All

Respiratory System of Frog

Types respiration

1. Branchial Respiration :
   in tadpole or larval stage by gills.
2. Cutaneous Respiration :
   by Skin
3. Buccopharyngeal Respiration :
   by Buccopharyngeal cavity
4. Pulmonary Respiration :
   by lungs

Types of respiration

Branchial Respiration

Larva respires through the gills

External gills 3 pairs

Internal gills 4 pairs

Gill pouches 5 pairs

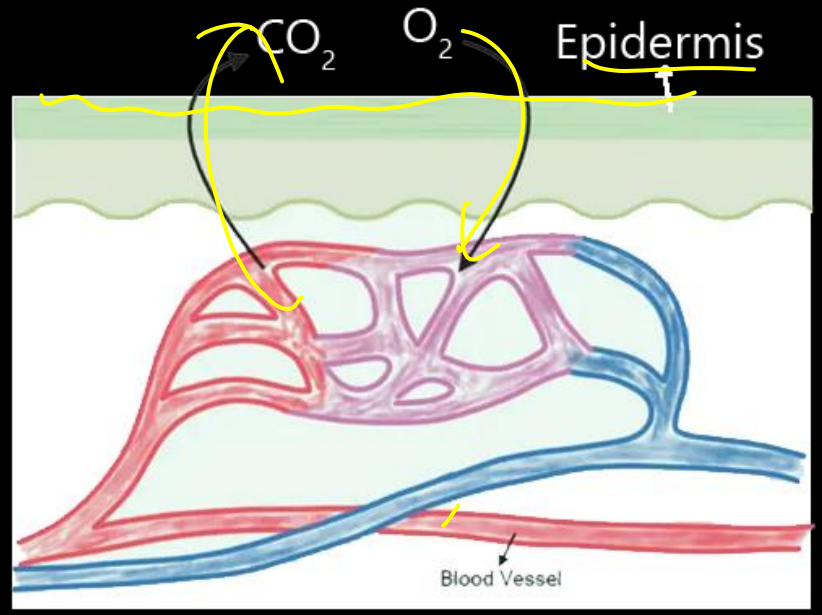
4 pair in number

Richly supplied with blood vessels



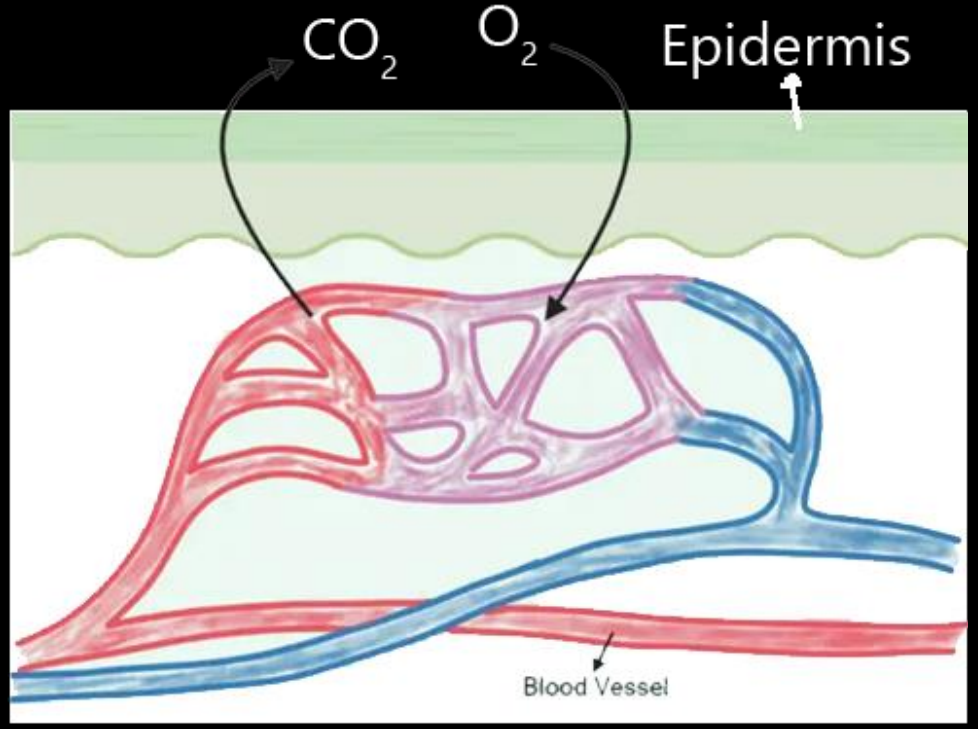
a. Cutaneous respiration

- The skin acts chief respiratory organ mostly in water. The respiration through skin is called cutaneous respiration (30%) .
- During hibernation and aestivation, the frog totally depends on this type of respiration.
- The skin of frog is thin and has fine blood vessels.

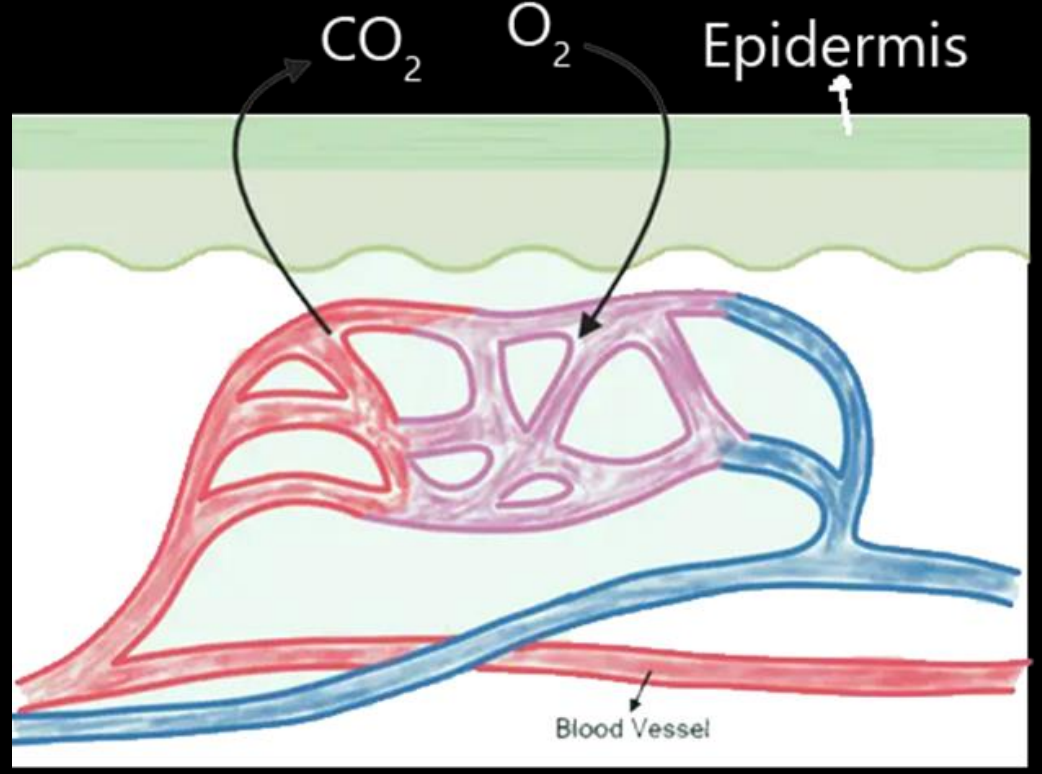


a. Cutaneous respiration

- The skin of frog is thin and has fine blood vessels.
- Mucous gland in the skin of frog, keep its skin moist.
- During gaseous exchange the oxygen first dissolve in the mucus and then diffuse into the blood capillaries.

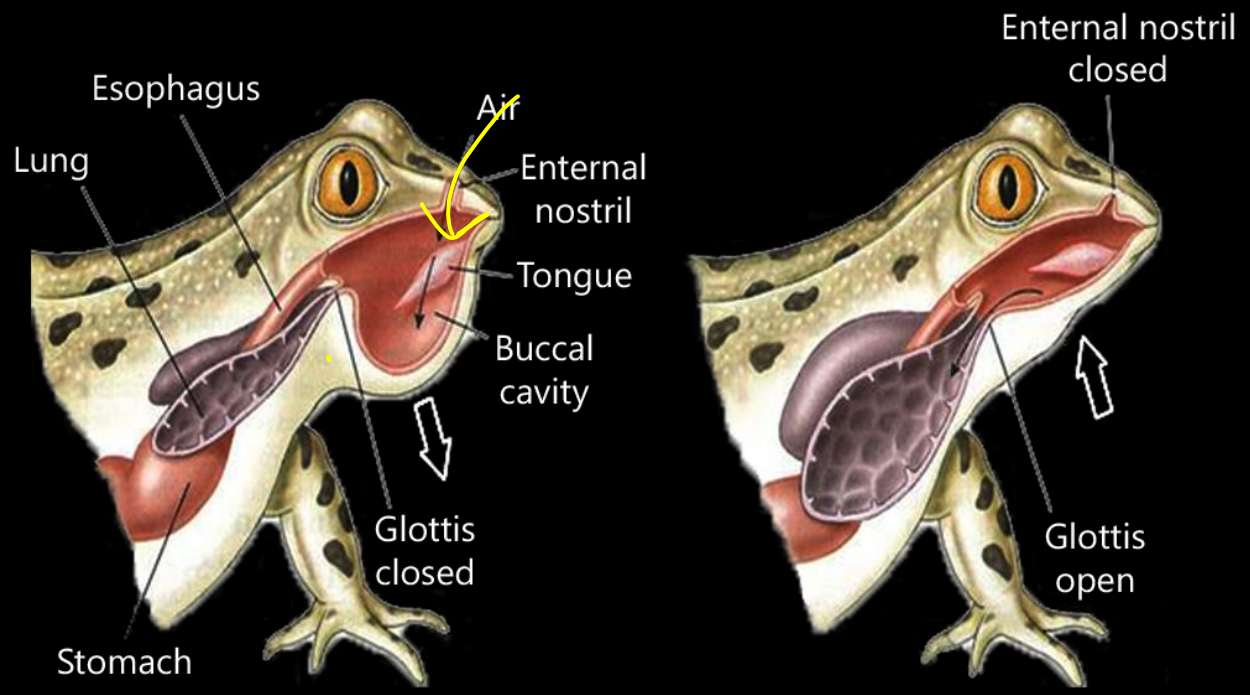


- Oxygen combines with hemoglobin forming oxyhemoglobin and taken into different parts of the body.
- Converted into oxygen and hemoglobin
- Hemoglobin again combines with carbon dioxide.
- And the carbon dioxide diffuses out from the blood into the environment.
- Asphyxia- Skin becomes dry and frog dies.



b. Buccopharyngeal respiration

- The respiration takes place through the lining of buccopharyngeal cavity (5%).
- The buccal cavity consists of moist mucous membrane and richly supplied with blood capillaries.

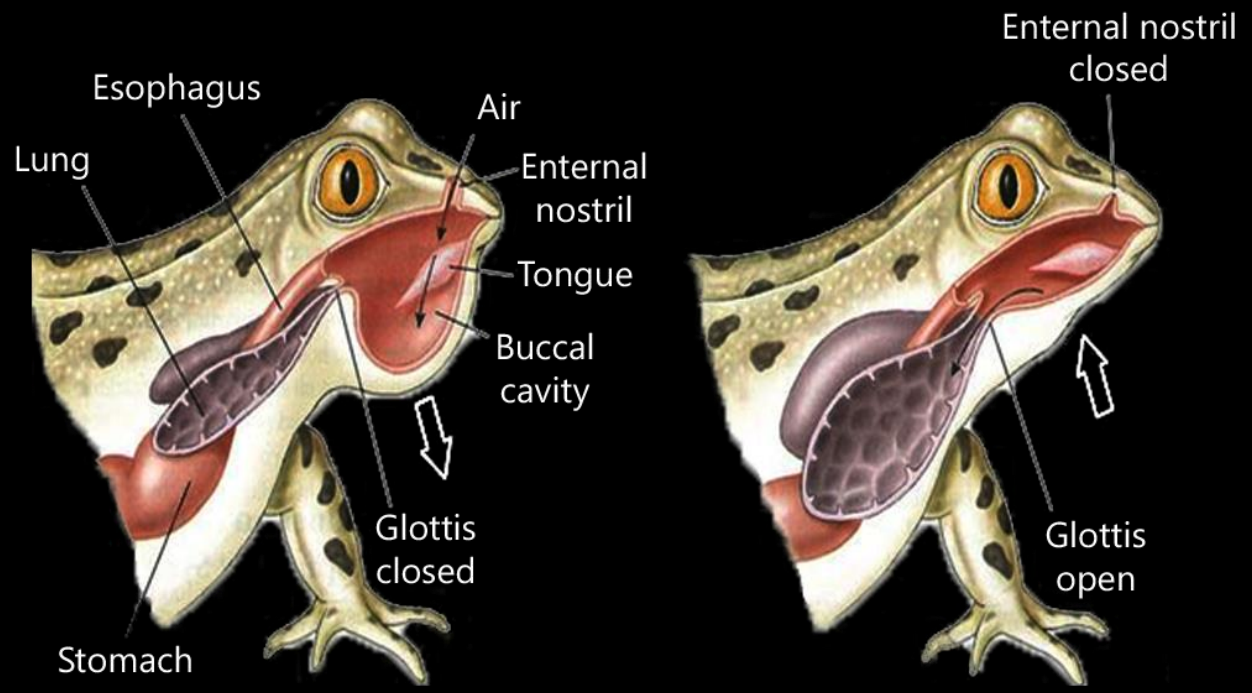


b. Buccopharyngeal respiration

- The air enters into the cavity through external nares and gaseous exchange takes place through the lining of buccal cavity between blood and oxygen present in the cavity by diffusion process.
- Takes place during rest.

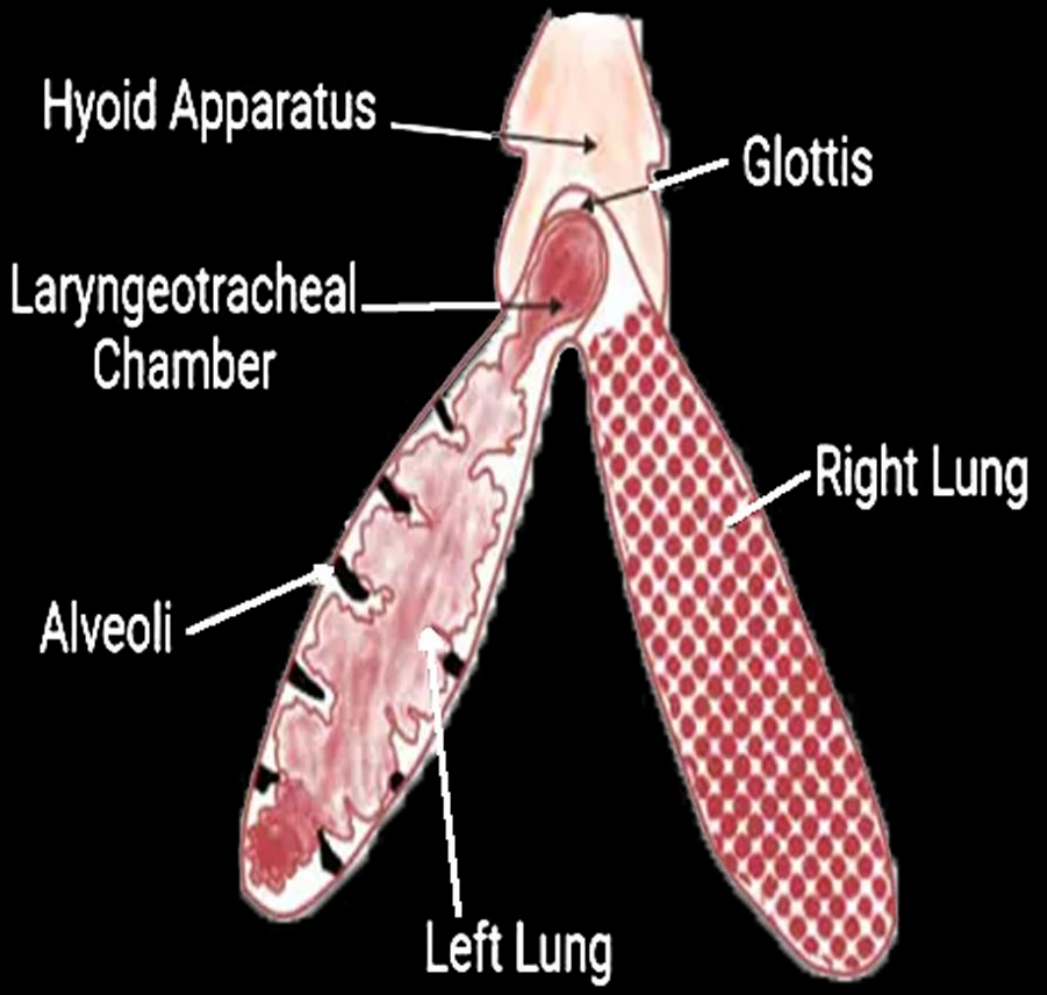
  A)Sitting

  B)Floating
- Completed by inspiration and expiration.



c. Pulmonary respiration

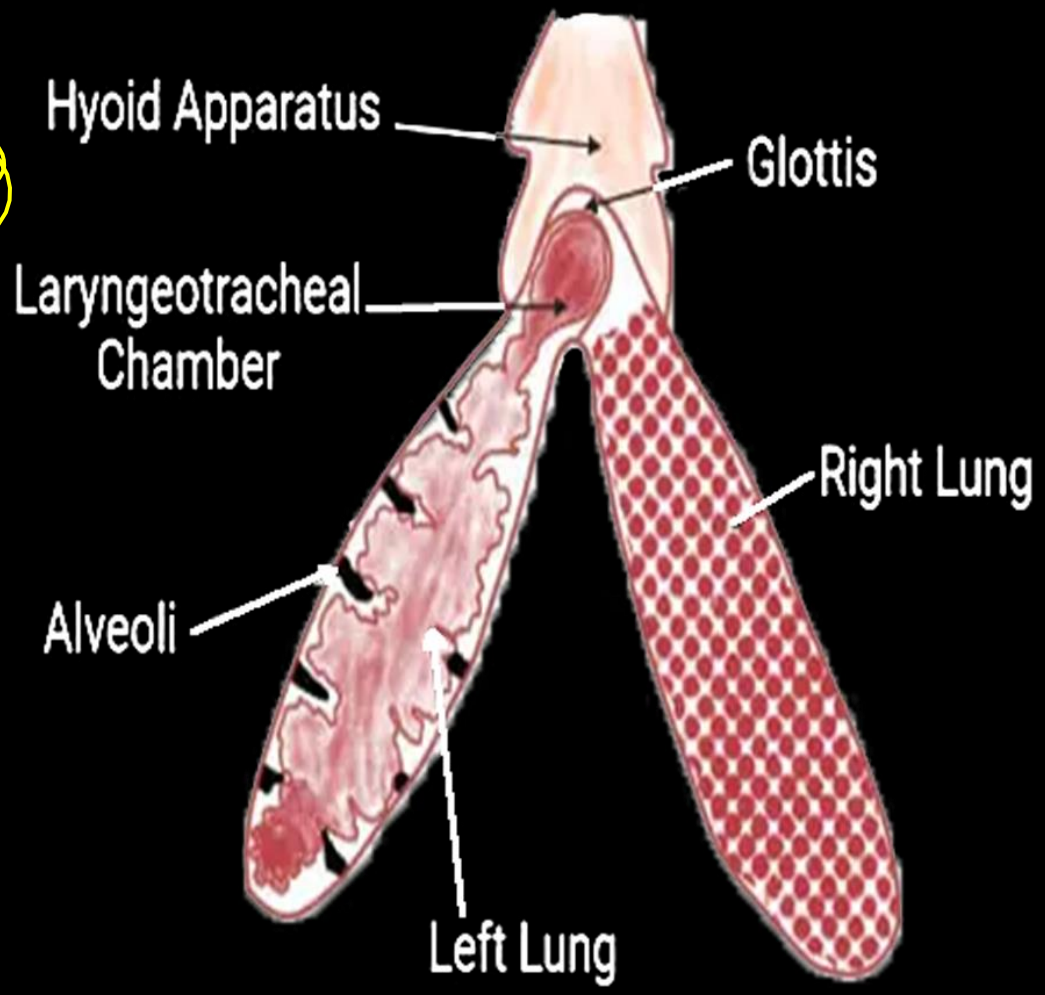
- Frog respires by pulmonary respiration when the need for oxygen is great.
- The respiration through the lungs is called pulmonary respiration (65%).



c. Pulmonary respiration

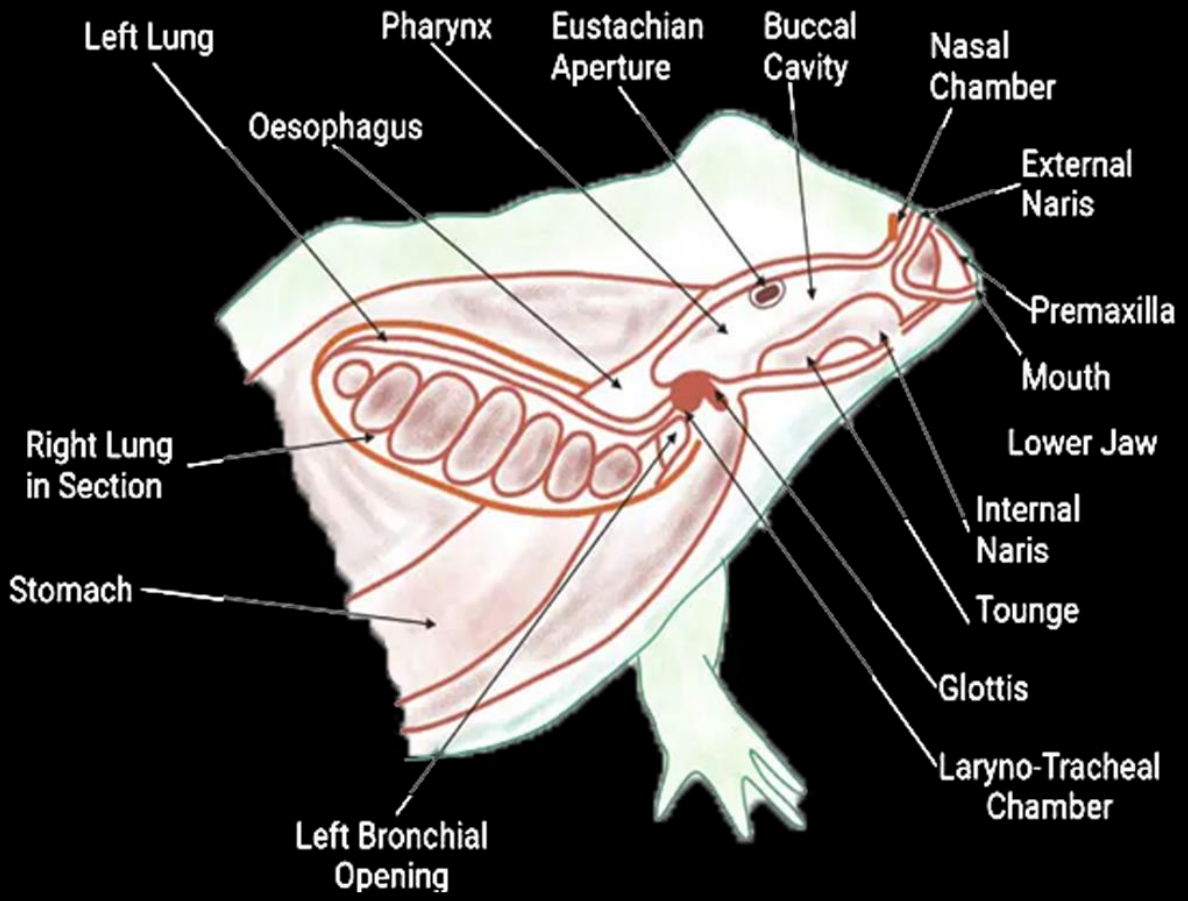
- Takes place during swimming and jumping.
- The passage through which air enters and leaves the lungs, is respiratory tract, comprised of following

Active



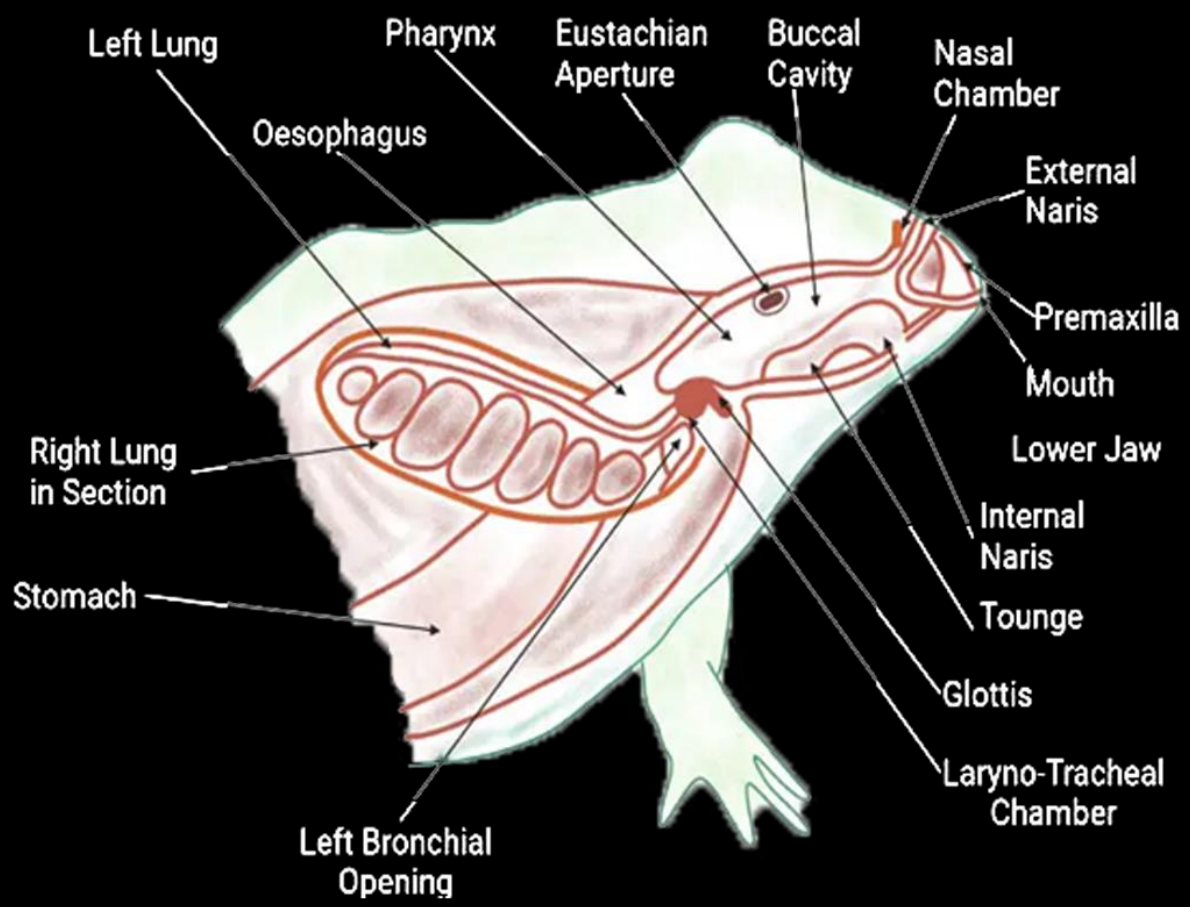
Respiratory tract

- External nares: A pair of opening lies between the eyes and snout.
- Internal nares: A pair of small opening is found in between the maxillary and vomer teeth on buccal cavity.



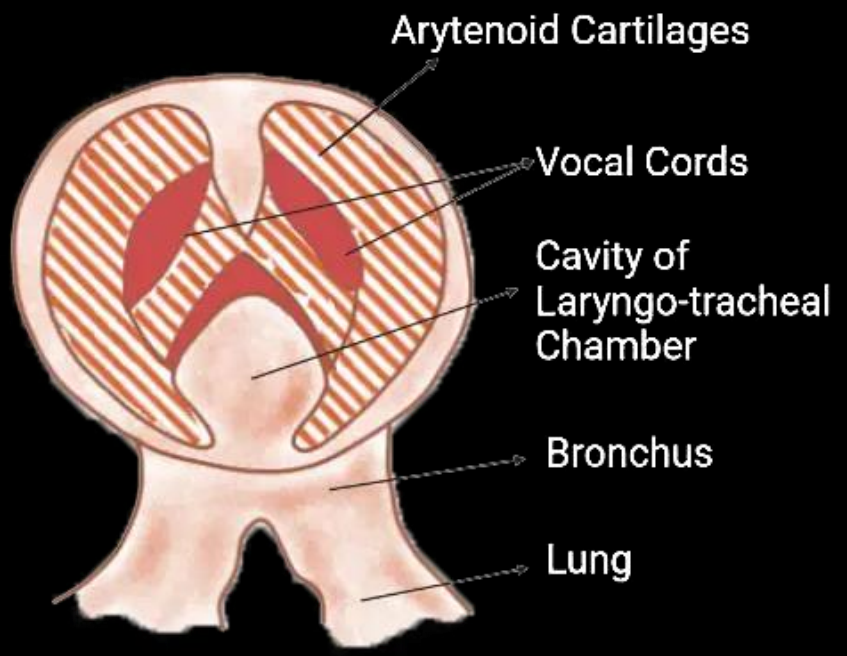
Respiratory tract

- Nasal passage: space between external and internal nares.
- Buccopharyngeal cavity: the space between buccal cavity and pharynx.

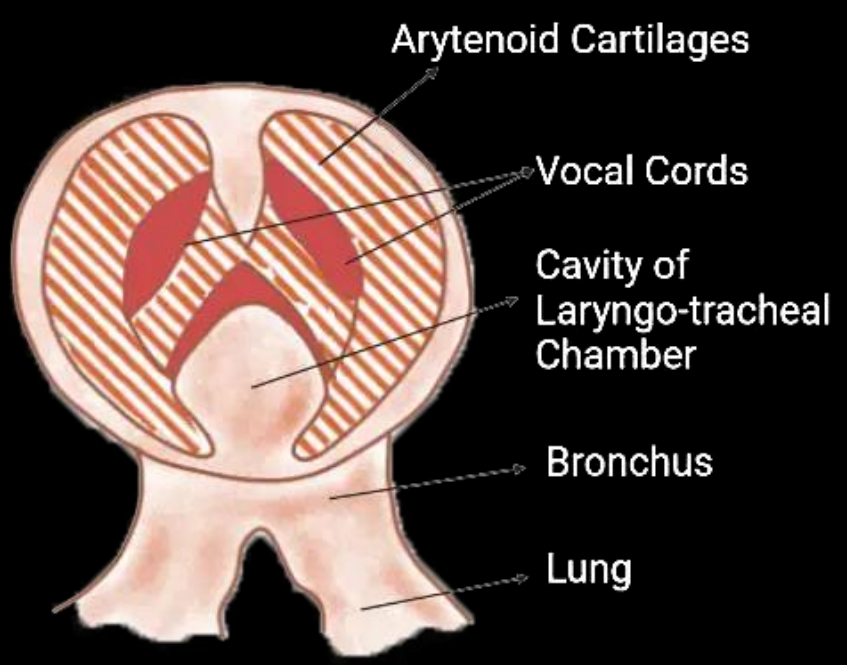


Respiratory Tract

- Glottis: A slit like opening on the floor of pharynx.
- Glottis opens into larynx. Larynx or laryngo-tracheal chamber is a thin walled sound producing chamber.
- Formed by the fusion of larynx and trachea



- Cartilages (2 arytenoid + 1 cricoid) supports the wall of larynx.
- Only male frogs have vocal sacs so as to amplify the croaking sound.
- Bronchi: It is a pair of small tubes.



In frog, voice box is

A. larynx

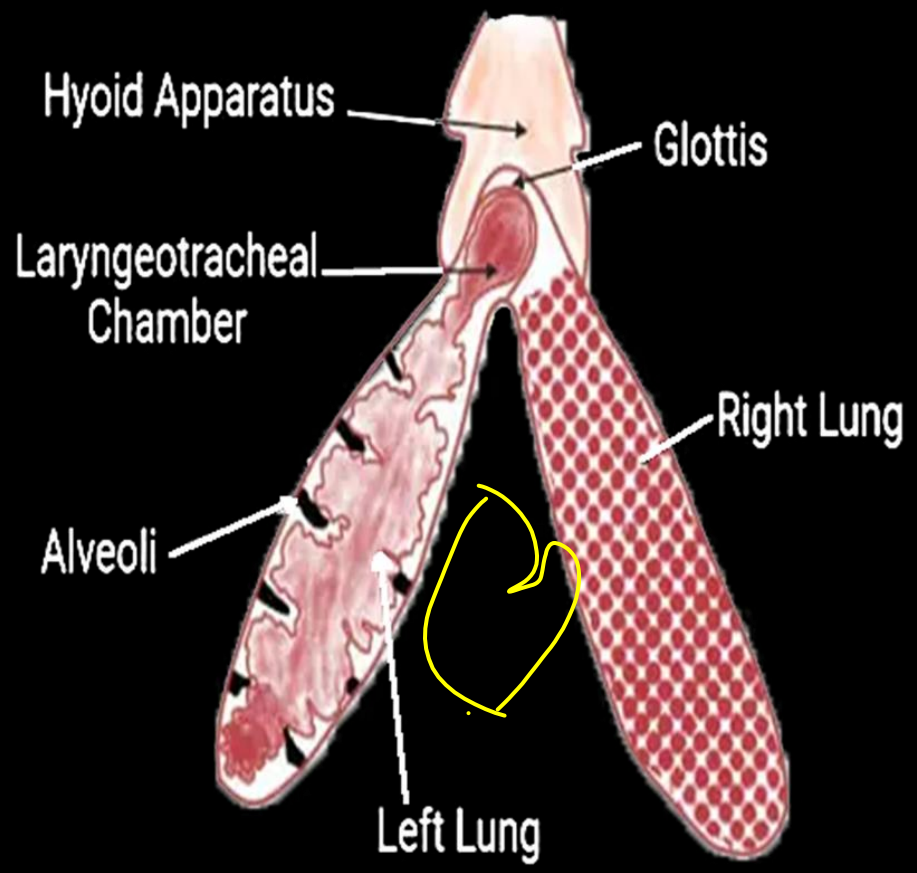
B. vocal sac

C. laryngo-tracheal chamber

D. vocal cord

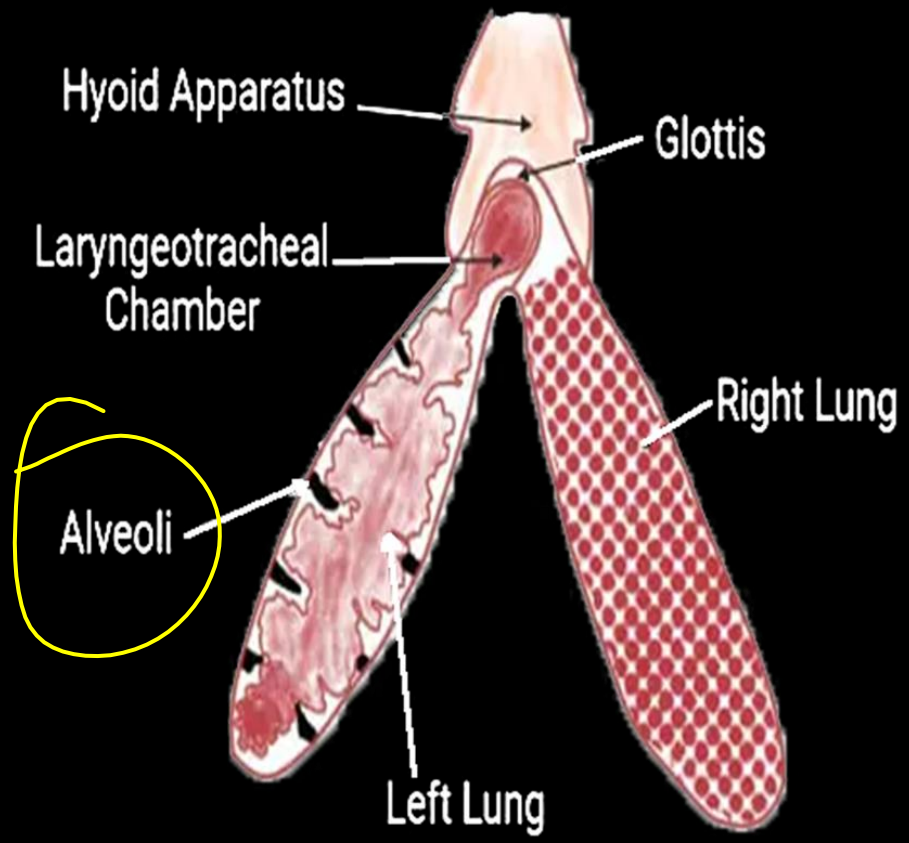
LUNGS

- A pair of lungs which are ovoid, thin-walled elastic sacs.
- They are present within thoracic cavity on either side of heart.

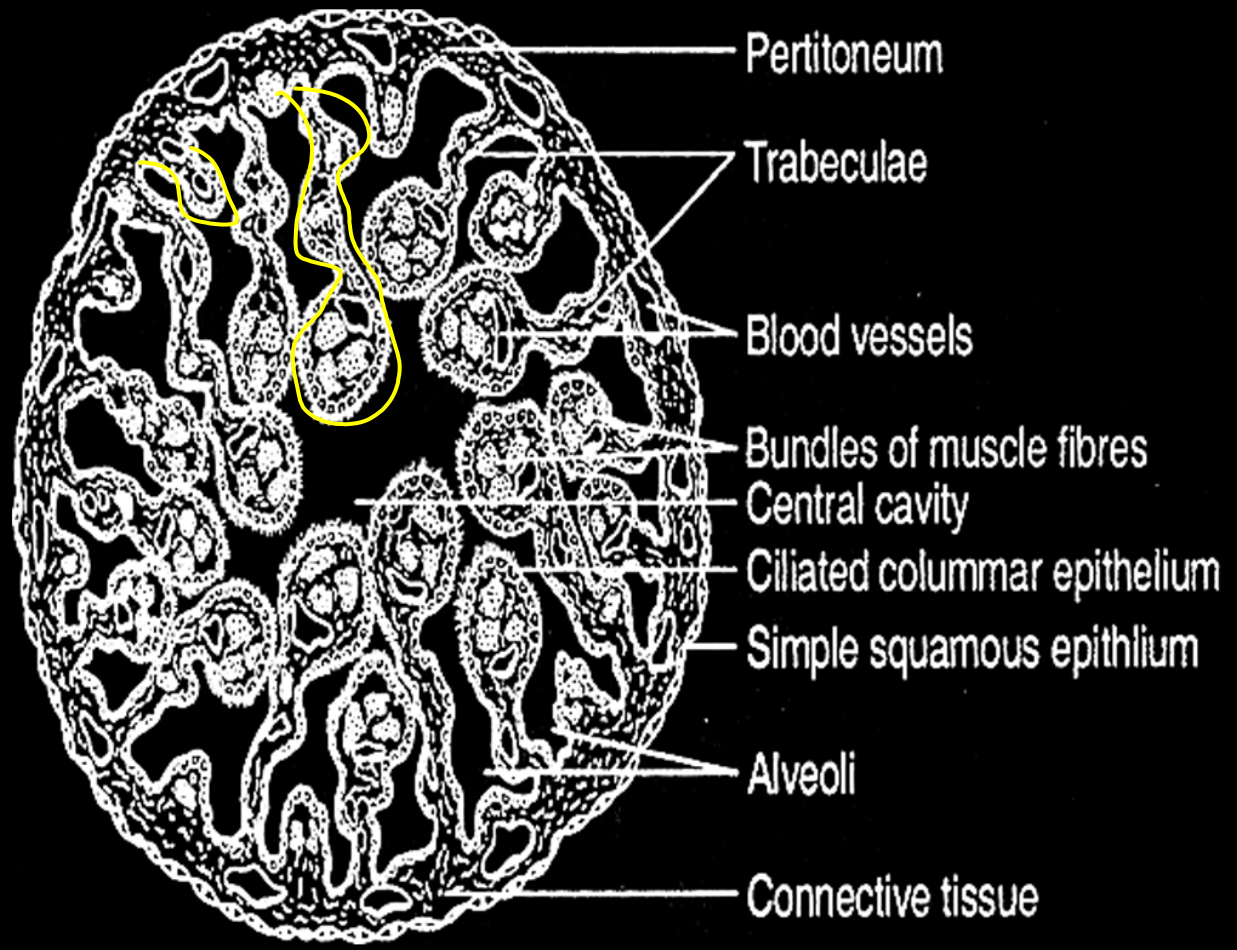


LUNGS

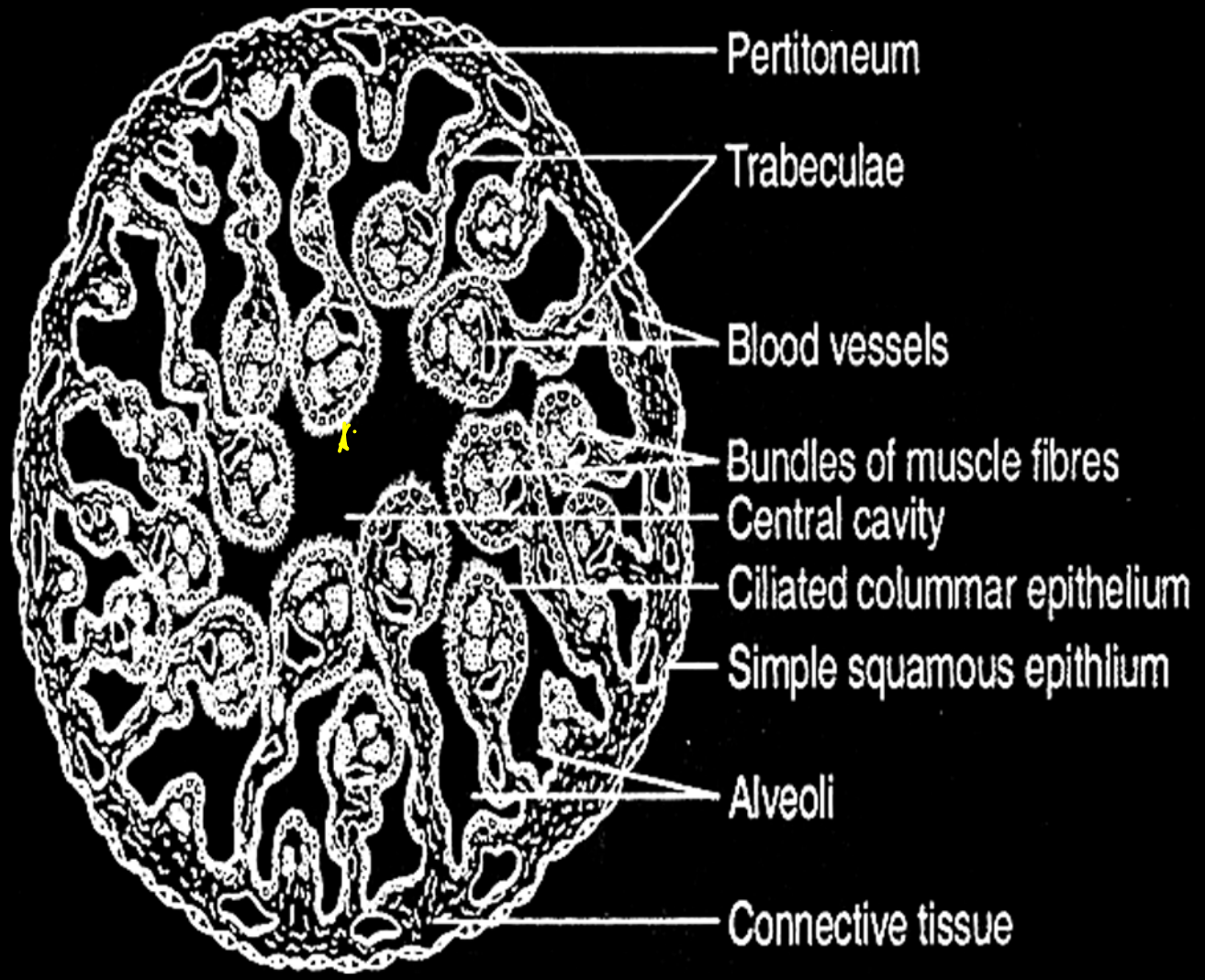
- Numerous small thin-walled air sacs are present in the lungs called alveoli and supplied by blood vessels.
- The air enters into the alveoli of the lungs through the external nares, internal nares, buccopharyngeal cavity, glottis, laryngotracheal chamber, and bronchi.



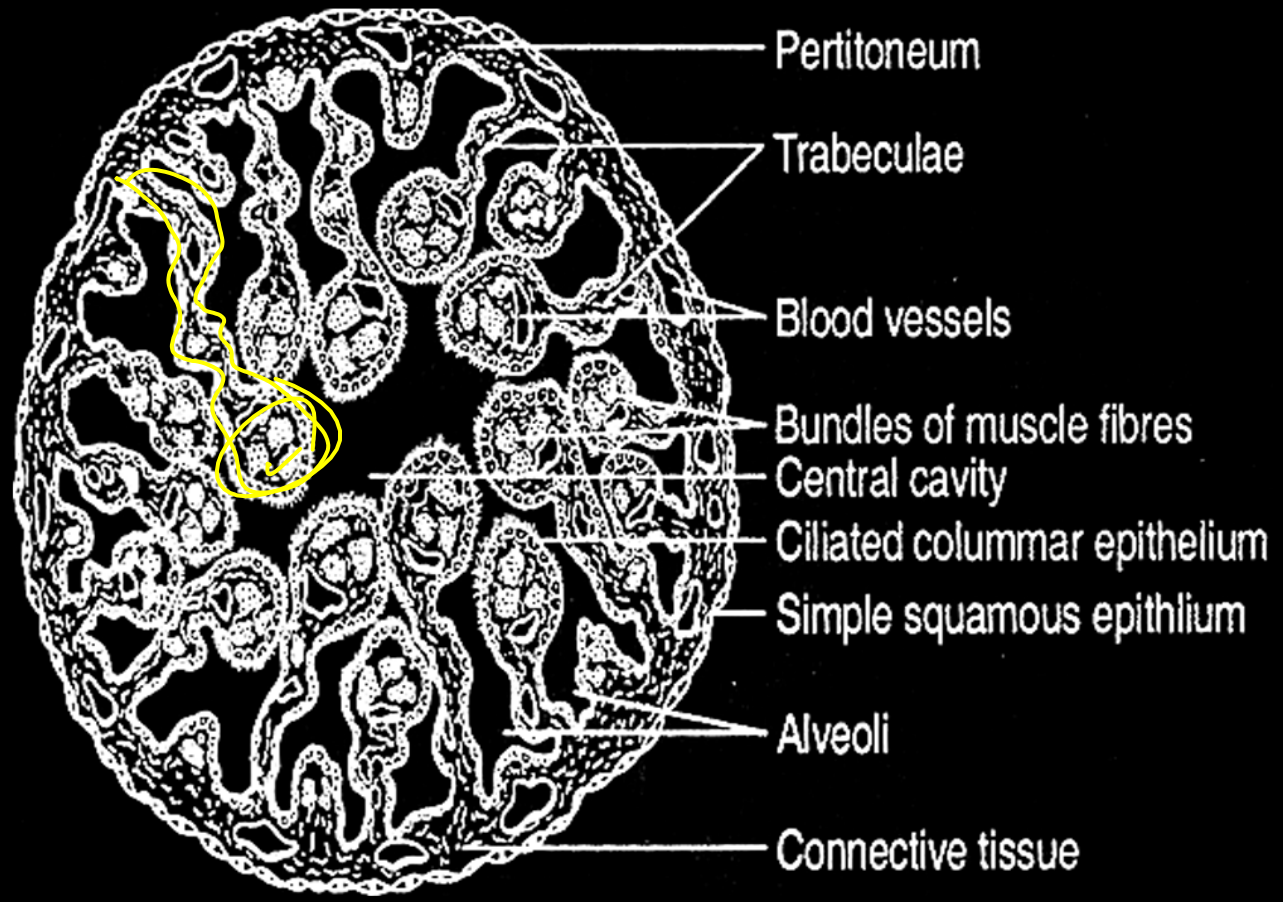
- Site of gaseous exchange
- Structural and functional unit of lungs are alveoli
- Size of alveoli is larger than humans but less in number
- Histologically, Lungs is covered by outer membrane called visceral peritoneum.



- Below to it is layer of connective tissue. Connective tissue contains blood vessels nerves and smooth muscles.
- Inner layer is made of epithelium
- Walls of alveoli are made of flattened cells and profuse supply of blood vessels.



- Inner layer - thin and flat cells (squamous epithelium). Cells are ciliated and cylindrical at the tip of septa.
- Alveoli -lined by highly vascular and glandular squamous epithelium



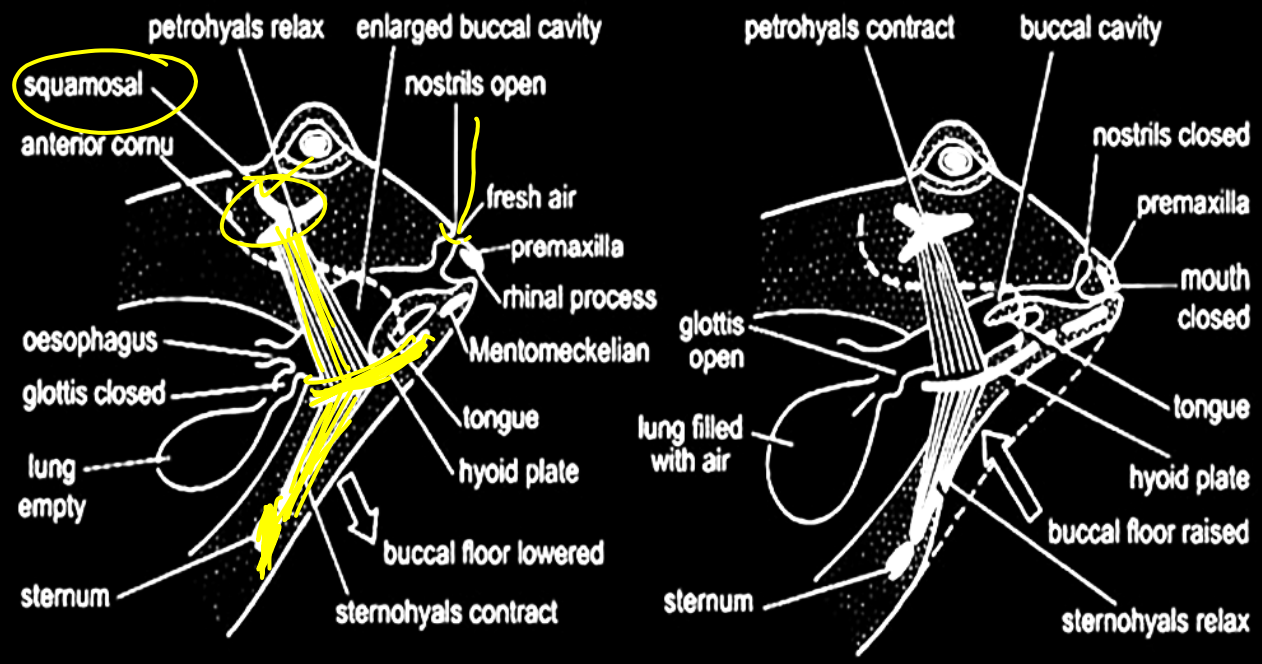
Mechanism of pulmonary respiration

- **It includes two steps**

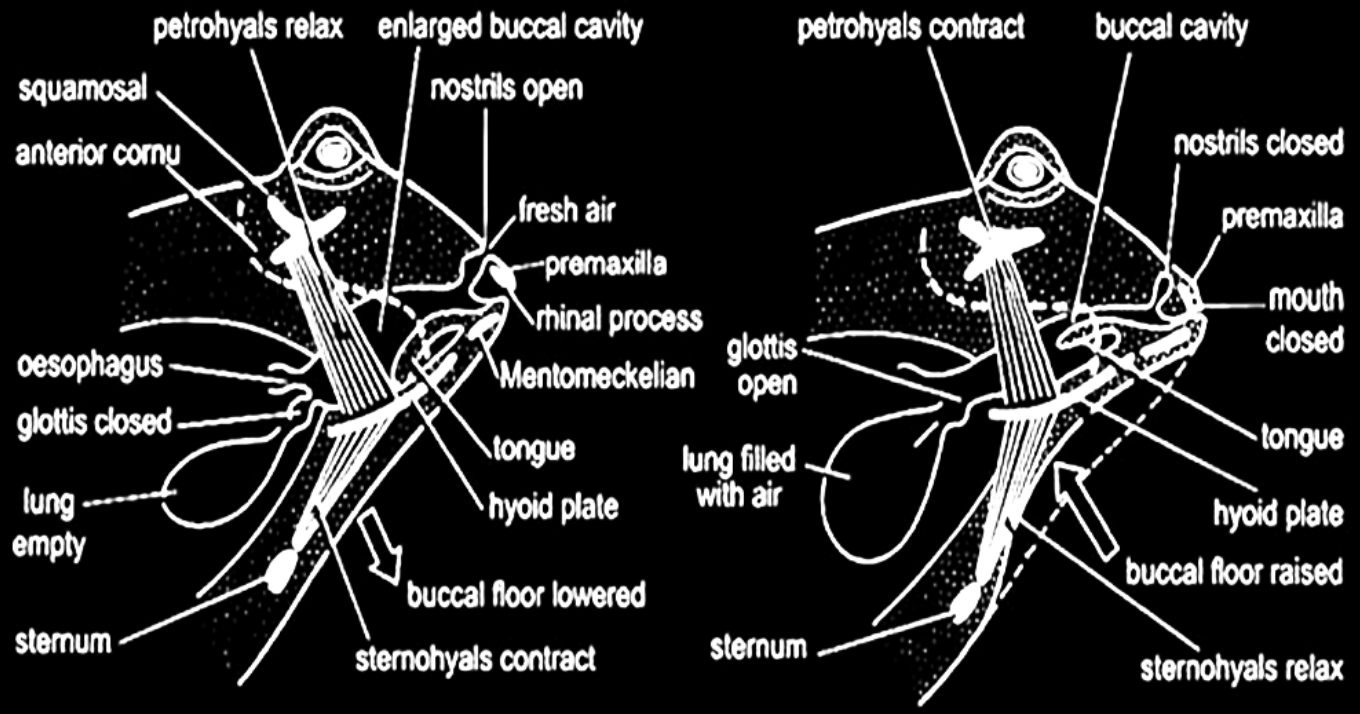
  i. Inspiration

  ii. Expiration

- During pulmonary respiration the mouth of the frog remains closed.
- The inspiration and expiration of the air is done by the action of the buccal cavity.
- Cartilaginous structure, hyoid apparatus(bone), is present in floor of buccal cavity.



- **Respiratory muscles**
- **Sternohyal and Petrohyal muscles** are responsible for action of buccal cavity.
- **Sternohyal muscles** are attached at the lower end to sternum and at upper end of the hyoid apparatus.
- **Petrohyal muscles** are attached below to upper surface of hyoid and above to the squamosal bone of skull.



Contraction of sternohyal muscles

↓

Increase volume of bucco-pharyngeal cavity

↓

Decrease pressure of air inside bucco-pharyngeal cavity

↓

Air rushes into the cavity through external nares

↓

Contraction of sub-mental muscles pushes the mento-mechkelian bones of lower jaw forwards and then pushes the premaxillae upward. This closes the external nares.

↓

Contraction of pterohyal muscles

↓

Decrease volume of bucco-pharyngeal cavity

↓

Increase air pressure inside the cavity

↓

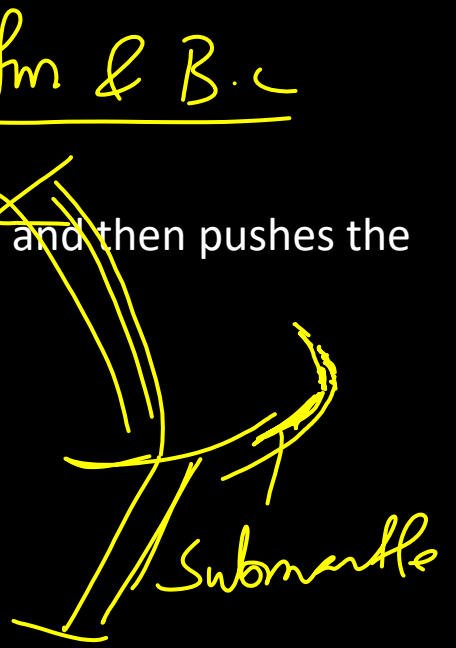
Glottis open

↓

Air rushes into the lungs

↓

Alveoli (Gaseous exchange between air and blood)



Muscles involved in respiration in frog are

A. external and internal intercostals

B. petrohyal and sternohyal

C. false and true vocal cords

D. lingual and orbital muscles

Expiration

- The process of exhaling of CO2 is called **expiration.**
- It is the reverse process of inspiration.
- The external nares remain closed.
- Glottis is opened, the air is drawn into the cavity from the lungs by lowering its floor and relaxation of submental muscles.
- As buccal floor is raised, the glottis is closed due to which external nares open.
- The air is passed out through the external nares

Contraction of lungs and abdominal muscles.

↓

Decrease in volume of lungs

↓

Increases pressure inside lungs

↓

Closure of external nares Contraction of sternohyal muscles to increase volume of bucco- pharyngeal cavity

↓

Decrease in the air pressure inside the cavity

↓

Air rushes from lungs to the cavity through glottis

↓

Contraction of sub-mental muscles

↓

Premaxillae move back to its original position

↓

External nares open

↓

Contraction of pterohyal muscles to decrease the volume of cavity. Pressure increases inside the cavity

↓

Glottis closed

↓

Air rushes outside through external nares

Physiology of respiration.

1. External respiration.
2. Gaseous transport.
   A) Transport of O2.
   B) Transport of CO2 :-
   i) As carbonic acid (10%)
   ii) As Bicarbonate (80%)
   iii) As Carbamino compound (10%)
3. Internal respiration.

Circulatory system of frog

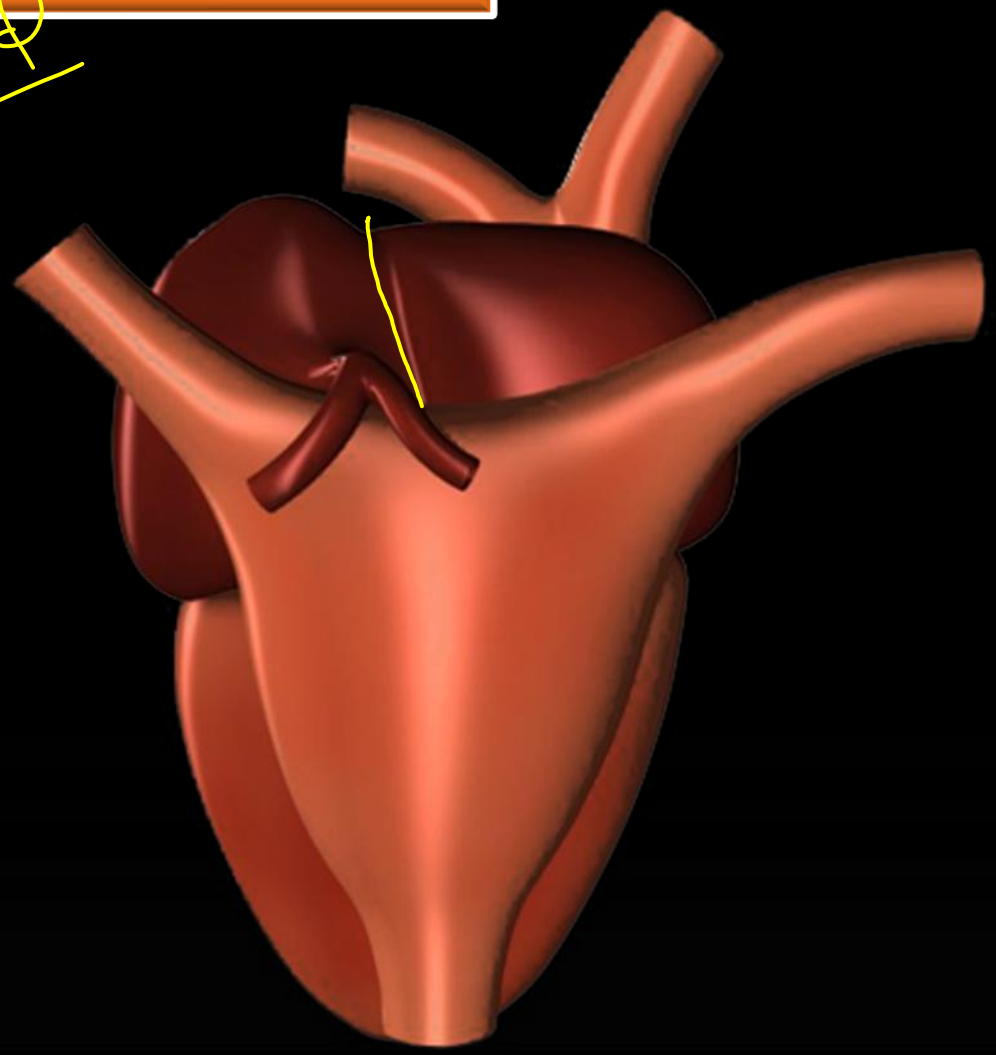
- Circulation is the continuous flow of fluid, especially blood carrying different substances, through the tissues of an organism.
- The blood vascular or circulatory system of frog is closed type.
- Incomplete double circulation where oxygenated and deoxygenated blood gets mixed up in the ventricle.
- Arteriovenous heart

Circulatory system of frog

- The blood circulatory system consists of:
- Heart
- Blood
- Blood vessels

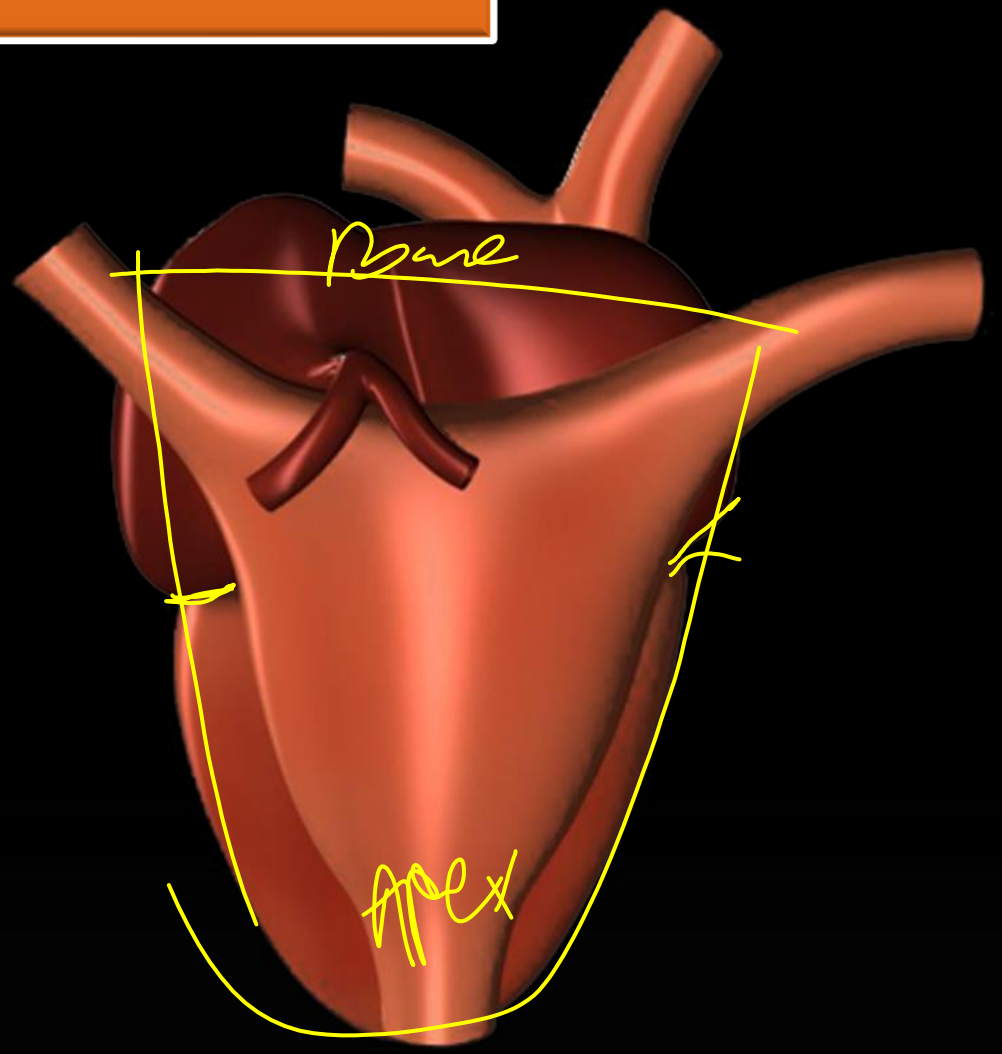
External features

- **Heart**
- **Mesodermal In origin.**
- Three chambered besides sinus venosus and truncus arteriosus.
- Two auricles separated by faint inter auricular groove.
- Thin walled and light in color compared to ventricle.



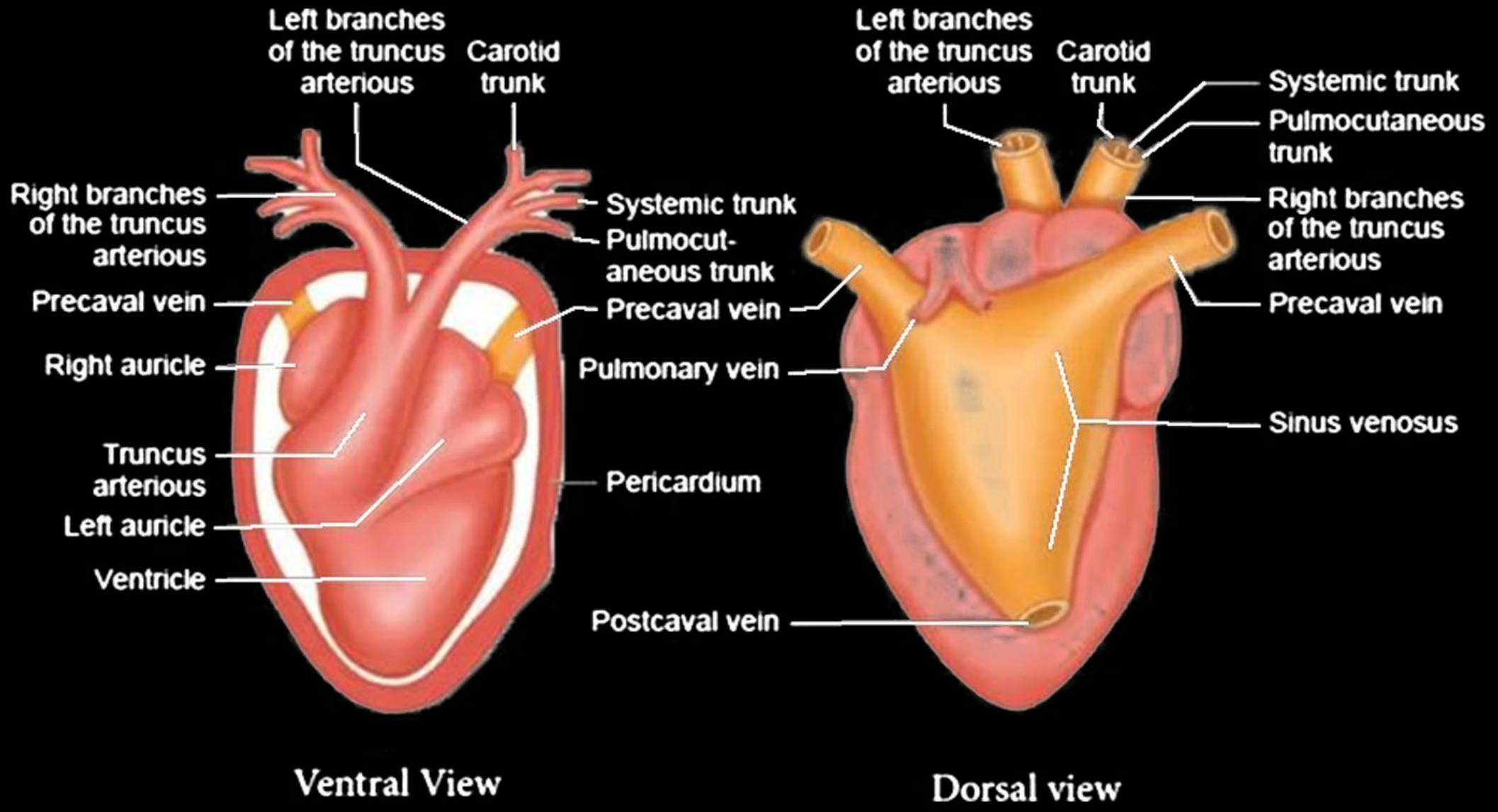
External features

- **Heart**
- Auricles and ventricle are separated by transverse ventricular groove called coronary sulcus (Auriculoventricular sulcus).
- It is reddish in color and somewhat conical or triangular in shape.
- It has the broad base which is directed anteriorly and the narrow apex posteriorly.



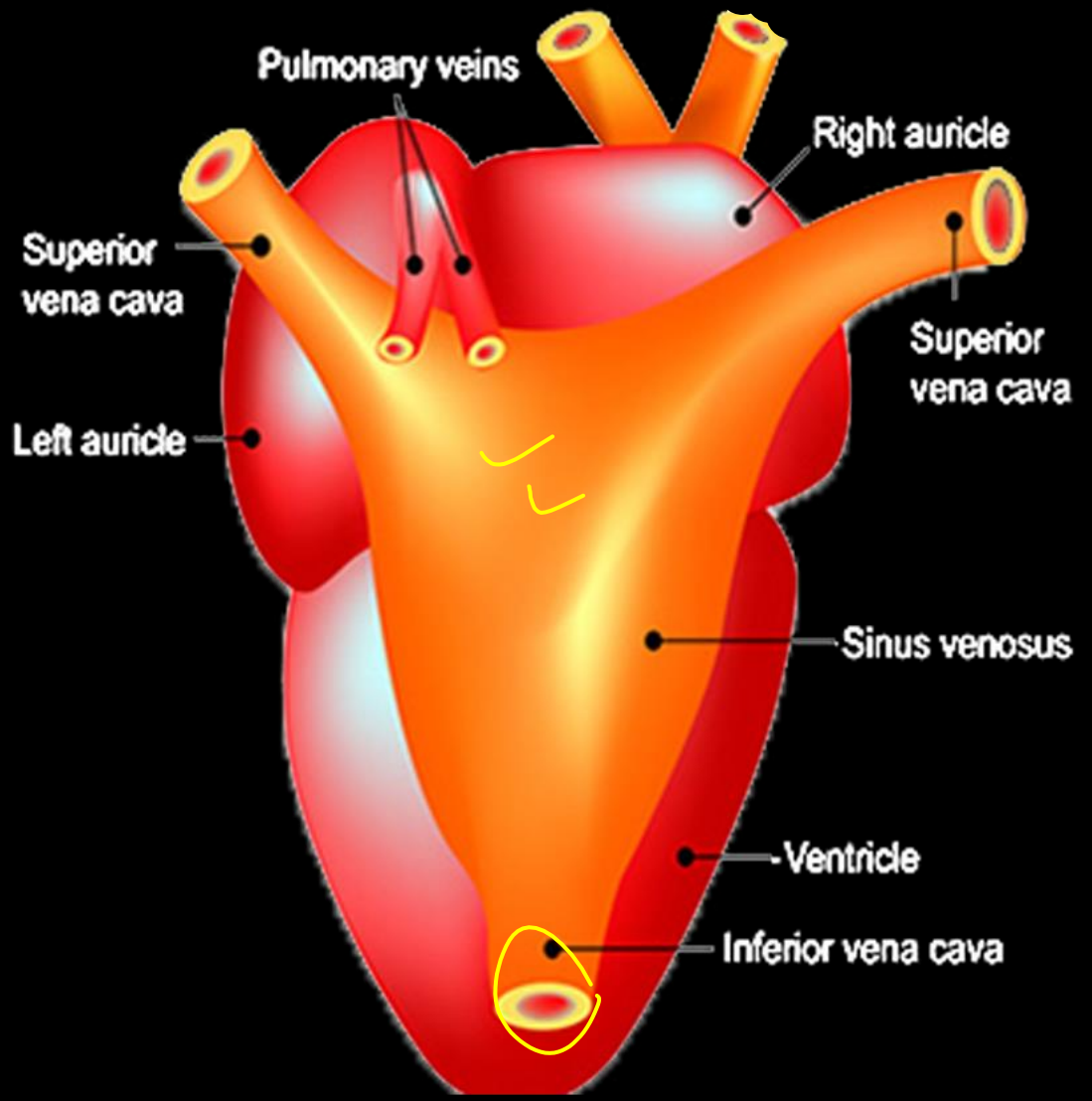
- **Pericardium:**
- Thin, transparent, two-layered sac, pericardium, encloses the heart.
- The outer parietal and inner visceral pericardium.
- The cavity between two pericardial layer contains pericardial fluid.
- It protects heart from mechanical shocks, keep it moist and free movement during beating.
- Two additional chambers are present in the heart of the frog i.e. sinus venosus and truncus arteriosus.

Truncus arteriosus and Sinus venosus.

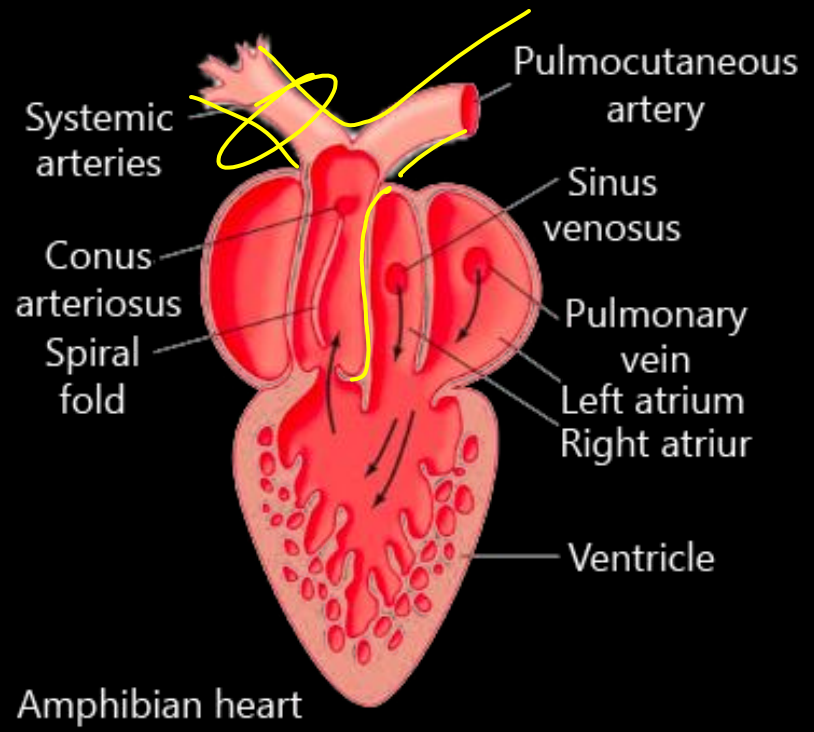


- **Sinus venosus**

Is a dark colored, thin-walled and triangular chamber attached dorsally to heart formed by the union of two anterior pre-cavals and one posterior post-caval.



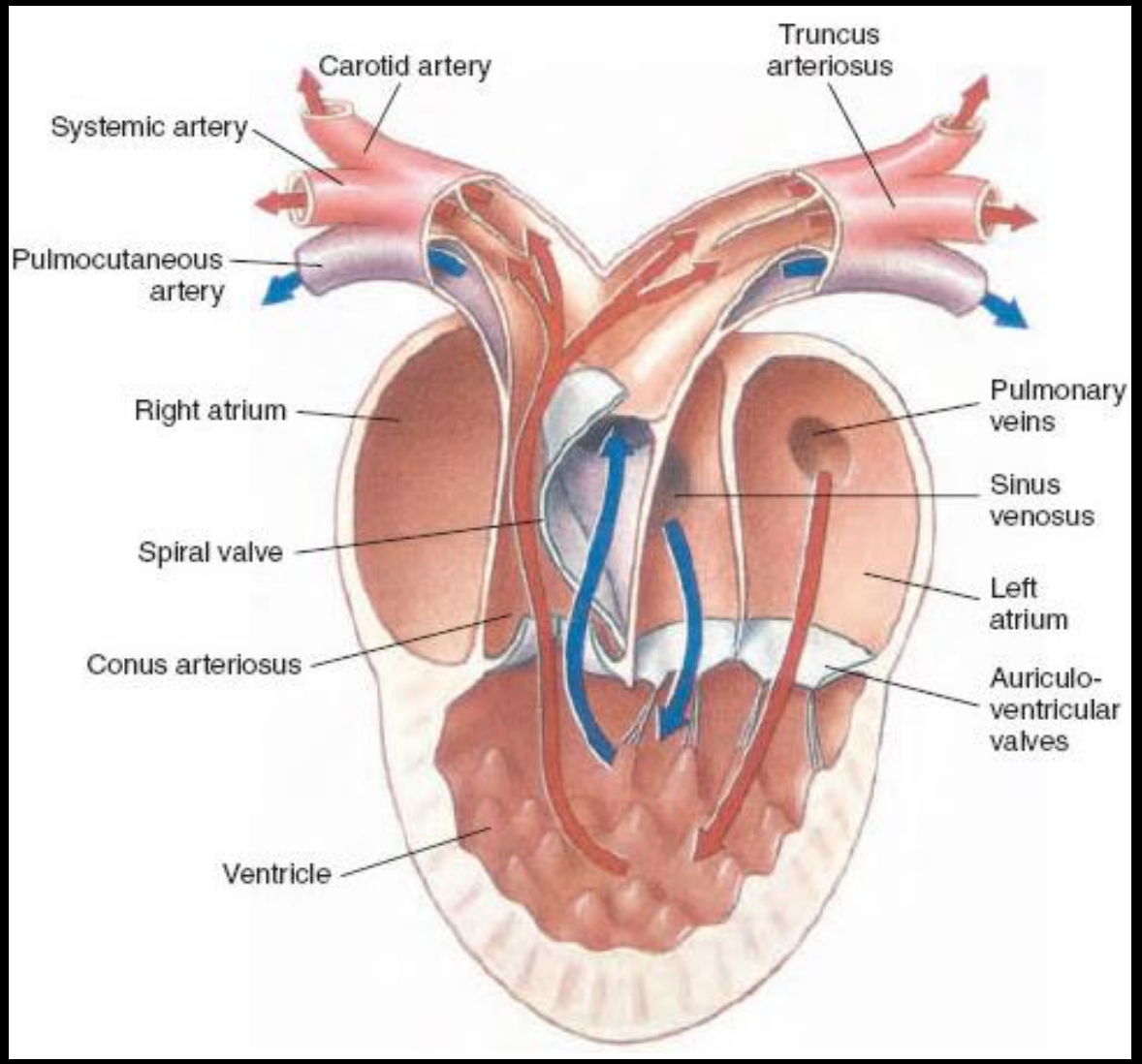
- **Truncus arteriosus** is a tubular chamber that arises anteriorly from the right ventral side of ventricle. **Spiral valve** is found in it.
- It immediately bifurcates anteriorly into two branches or trunks , each again breaks into three arches : carotid, systemic and pulmocutaneous.



Amphibian heart

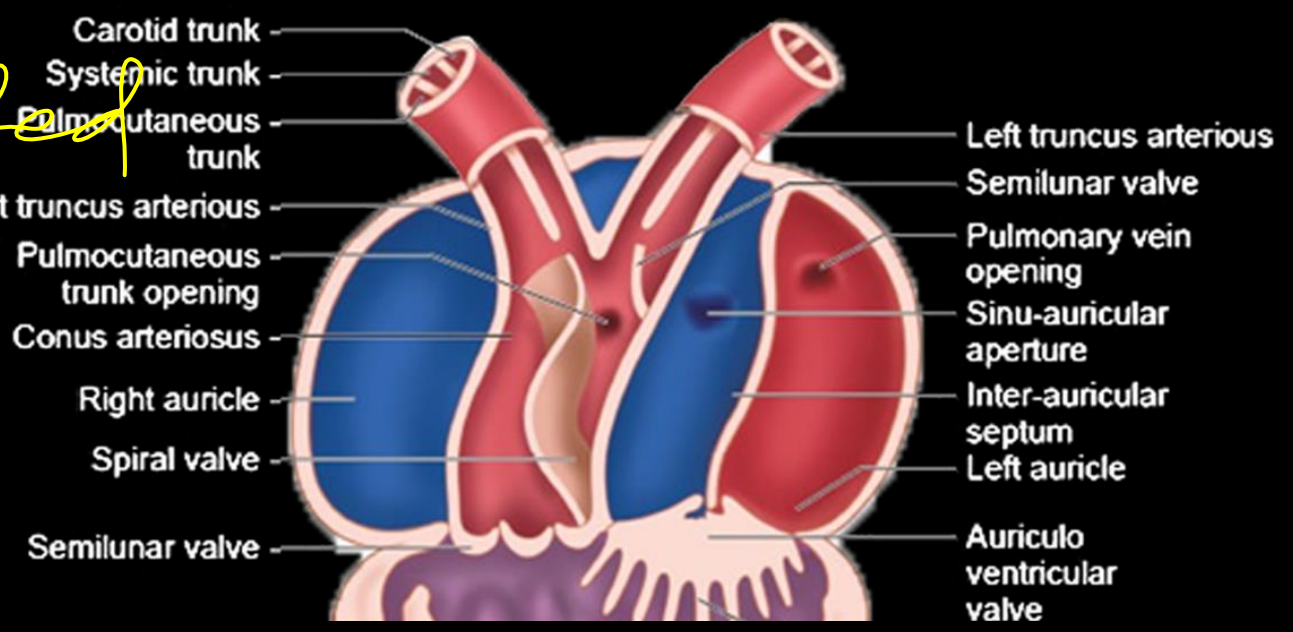
Internal structure of frog's heart

- It is hollow and muscular.
- In order to keep the unidirectional flow of blood, the various chambers are separated by valves.

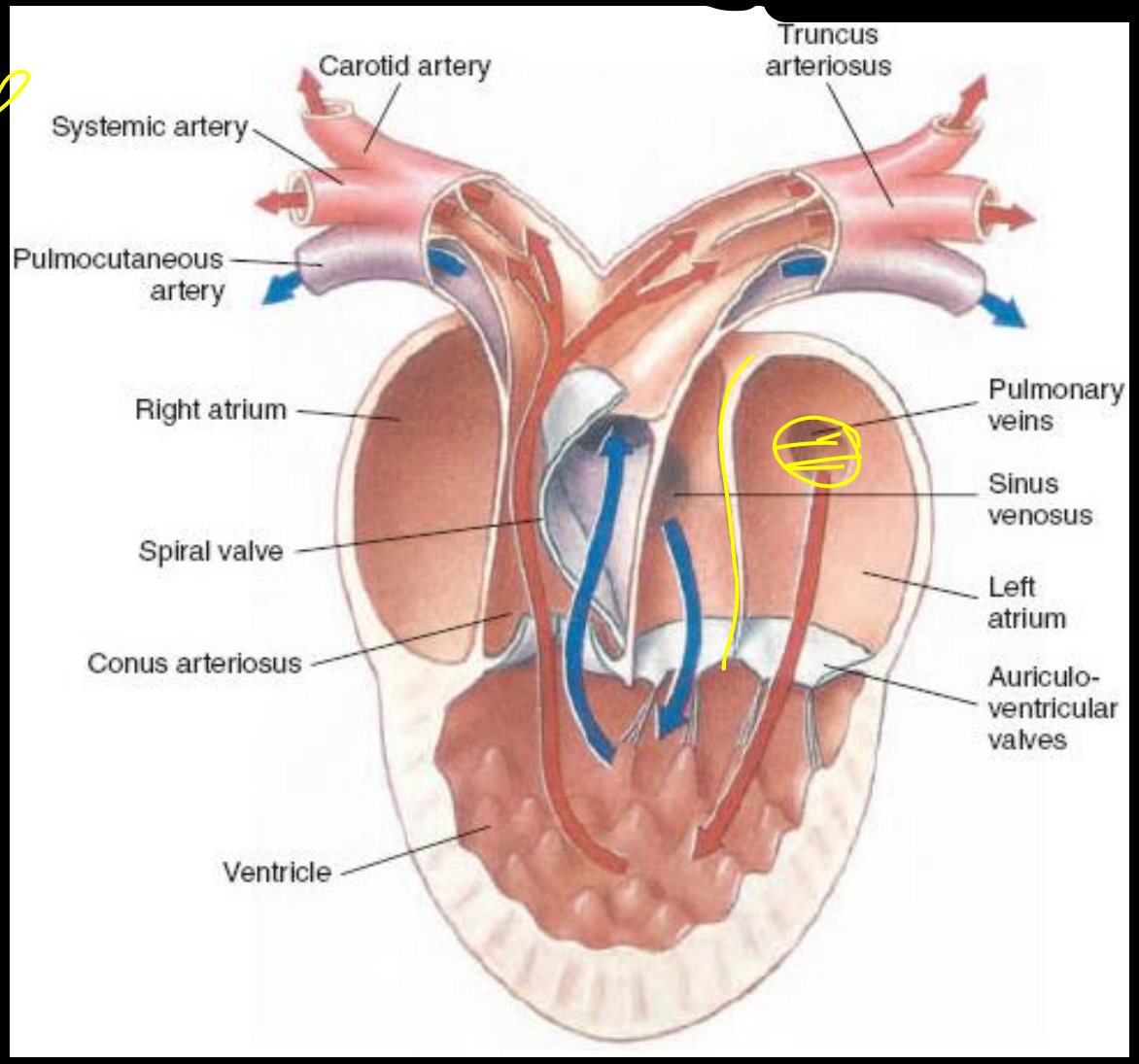


Auricles

- There are two auricles, left and right.
- They are thin walled and separated by a thin vertical **inter-auricular septum.**
- The left auricle is smaller than the right.
- Sinus venosus open to right auricle through the sinu-auricular aperture guarded by two valves called Sinu-auricular valves.

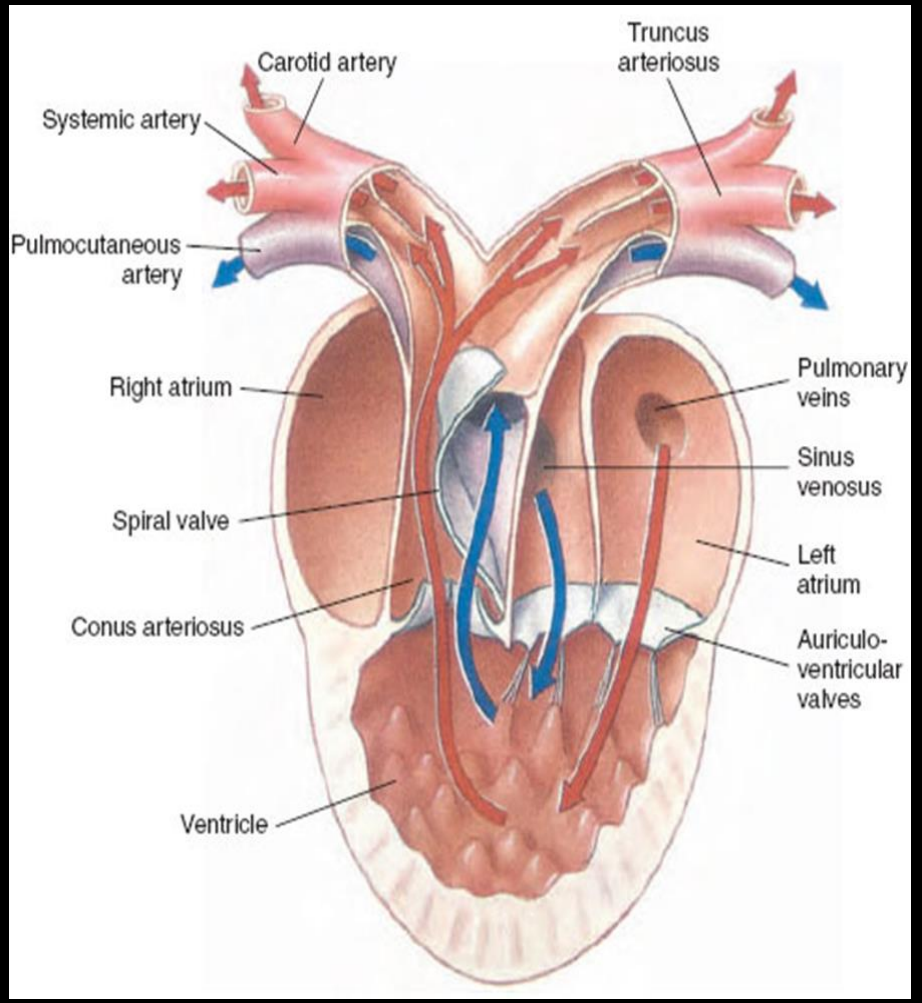


- Two pulmonary vein opens into left auricle through single opening.
- Close to inter-auricular septum that prevents the back flow of the blood.
- Both auricles open into single ventricle by a common large **auriculo-ventricular aperture** guarded by two pairs of flap-like **auriculo-ventricular valves(1D,1V,2L).**



Ventricle

- **Ventricle**
- Most conspicuous ,muscular ,triangular chamber of heart.
- Its inner surface consists of **columnae carnae or trabculae** consisting fissures.
- These highly reduce the cavity of ventricle.
- **Chordae tendineae** are thread like structure that connects the flaps of **auriculo-ventricular valves to the wall of ventricle.**



Frog's heart does not have

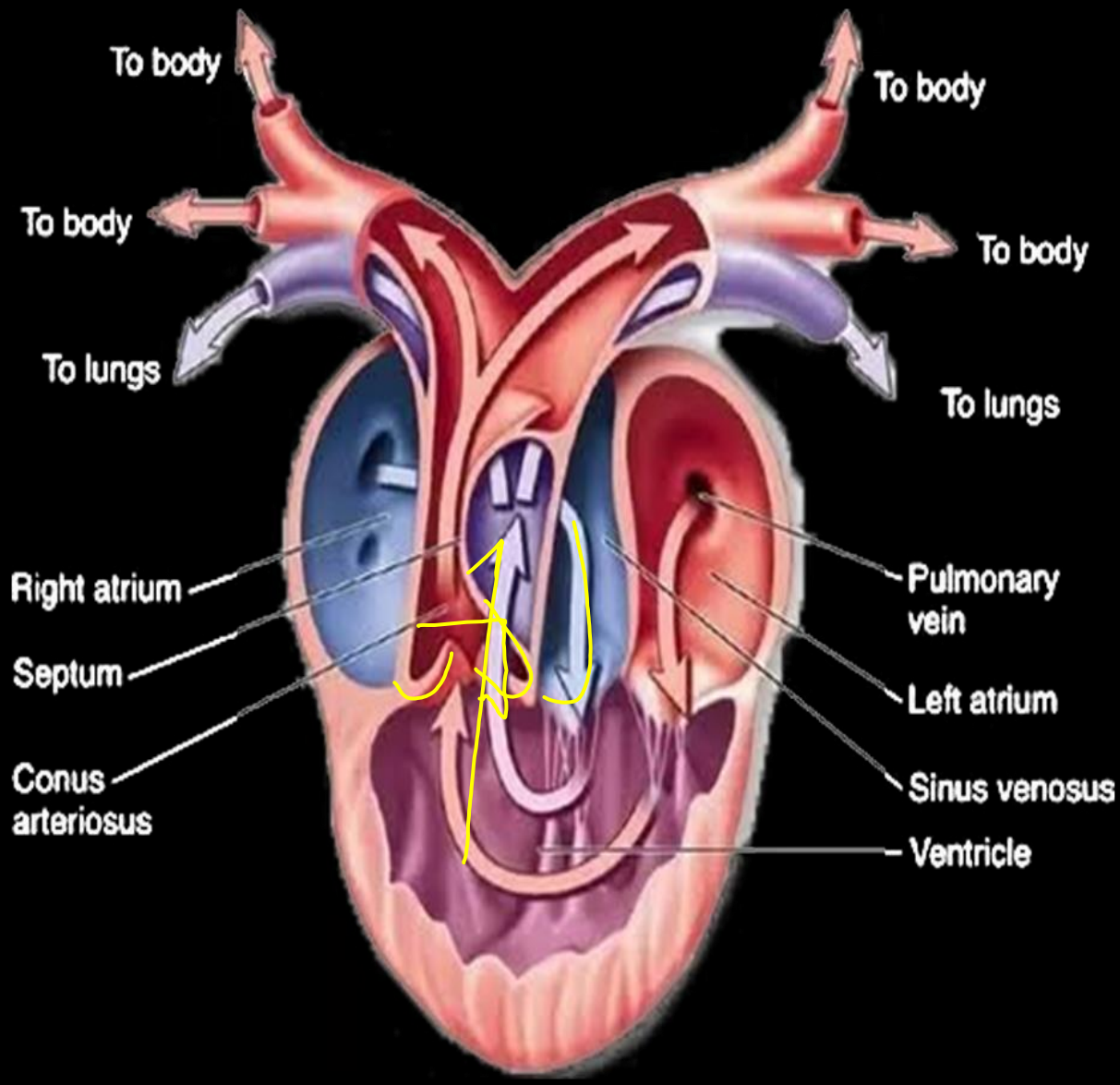
A. Sinus venosus

B. SA node

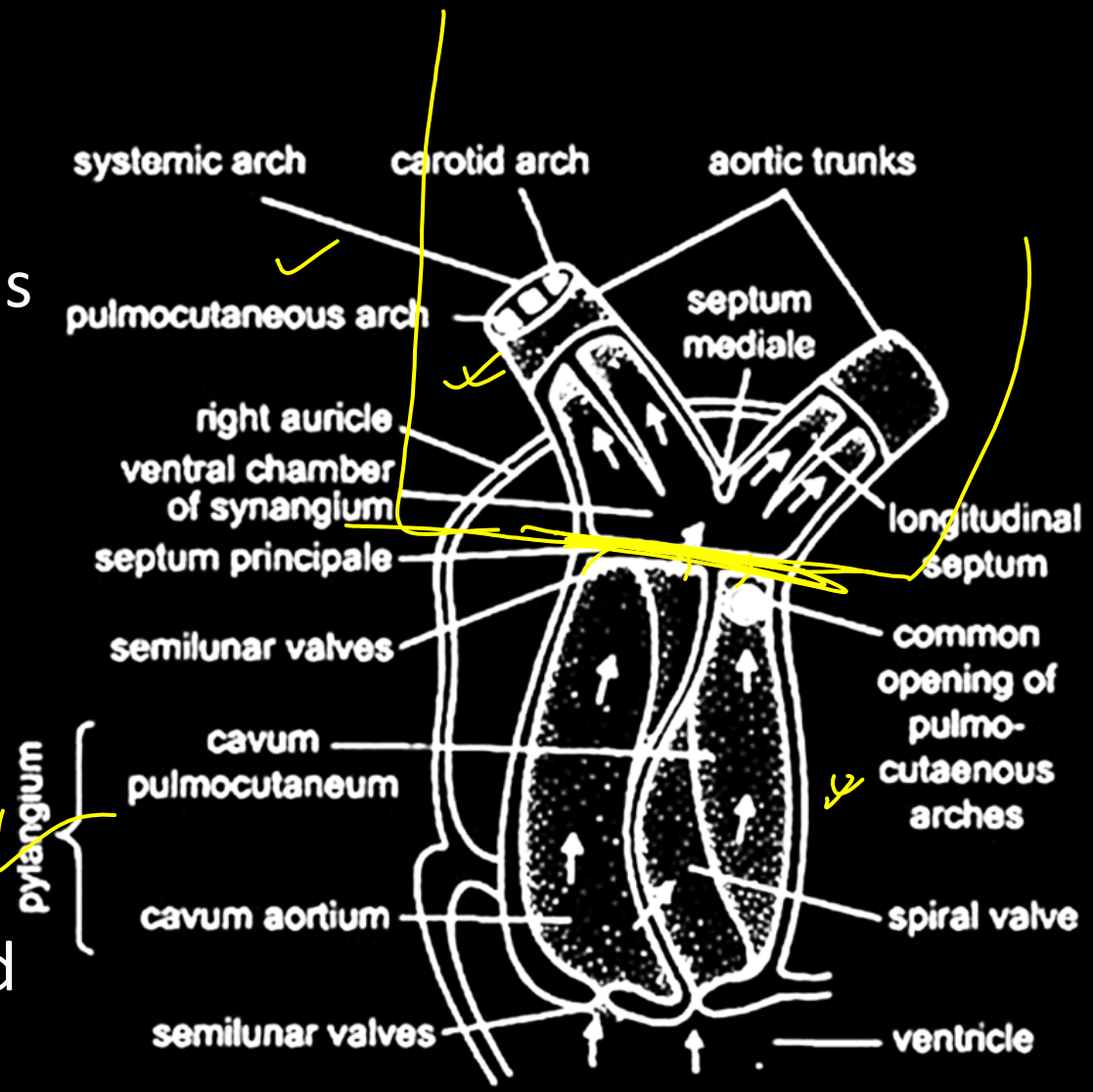
C. Inter auricular septum

D. AV node

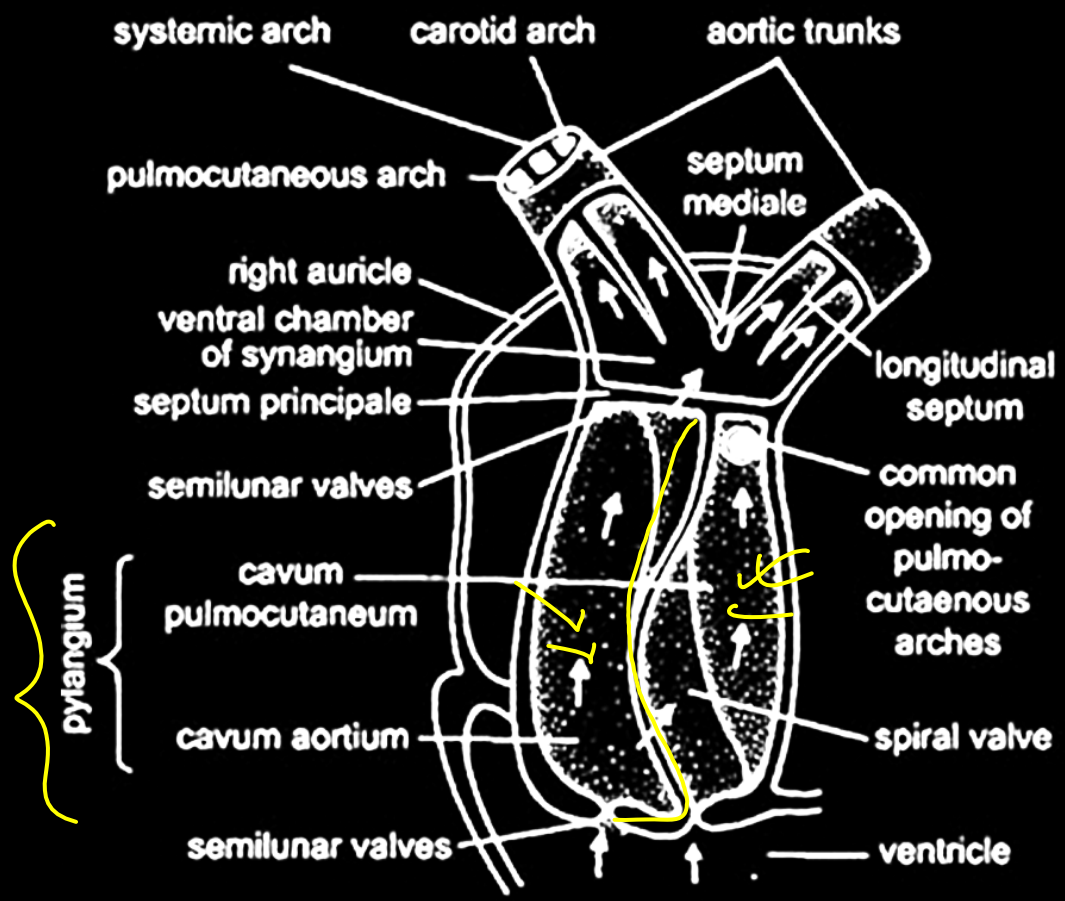
- **Truncus arteriosus:**
- Tubular structure that arise from upper right part of ventricle.
- 3 semilunar valves guard the opening of ventricle into truncus arteriosus preventing the backflow of blood from truncus into ventricle.
- First rows of semilunar valves



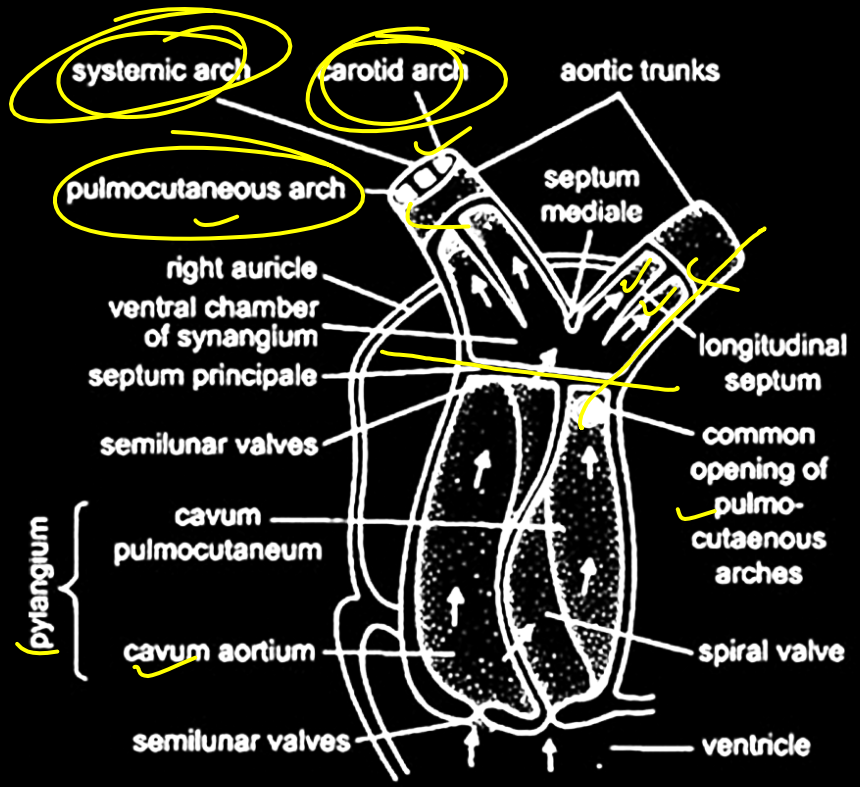
- **Truncus arteriosus:**
- The spirally twisted cavity of truncus arteriosus is divided unequally by another set of 3 semilunar valves called second rows of semilunar valves.
- i. **Conus arteriosus** or **pylangium**: long proximal thick-walled
- ii. **Bulbus arteriosus** or **synangium**: short distal thin-walled

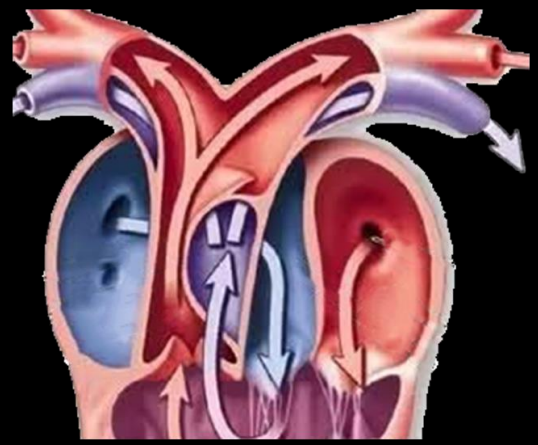


- The cavity of conus or pylangium is divided incompletely into a left dorsal **cavum pulmocutaneum** and a right ventral **cavum aorticum** by a large twisted longitudinal **spiral valve.**
- The spiral valve is attached dorsally while its ventral edge is free.



- **Synangium**
- It divides into two aortic trunks and each trunk gives three arches. They are
- **i. carotid arch -** carries blood to the head region
- **ii. systemic arch -** the different parts of the body
- **iii. pulmocutaneous arch -** skin and lungs for the oxygenation of blood.





Phylangium is also known as

A. Conus arteriosus

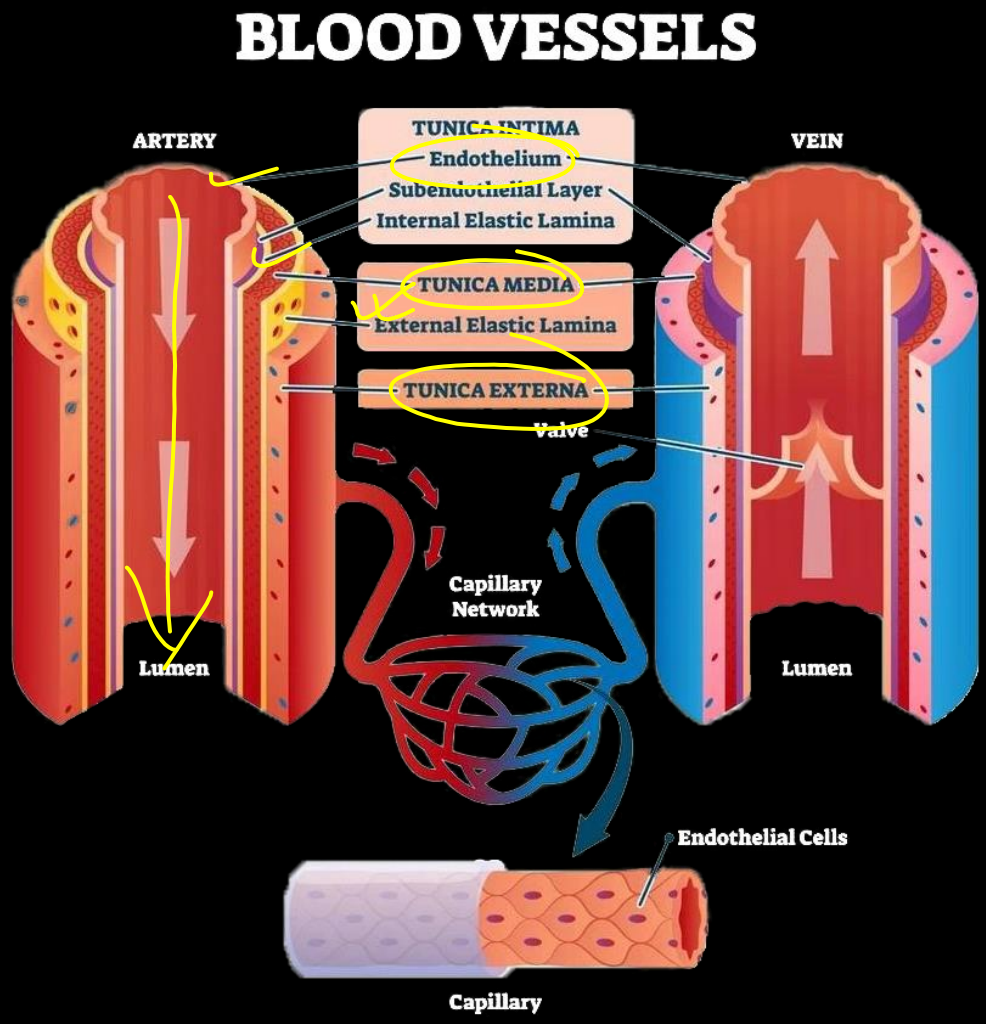
B. Bulbus arteriosus

C. Spiral valve

D. Truncus arteriosus

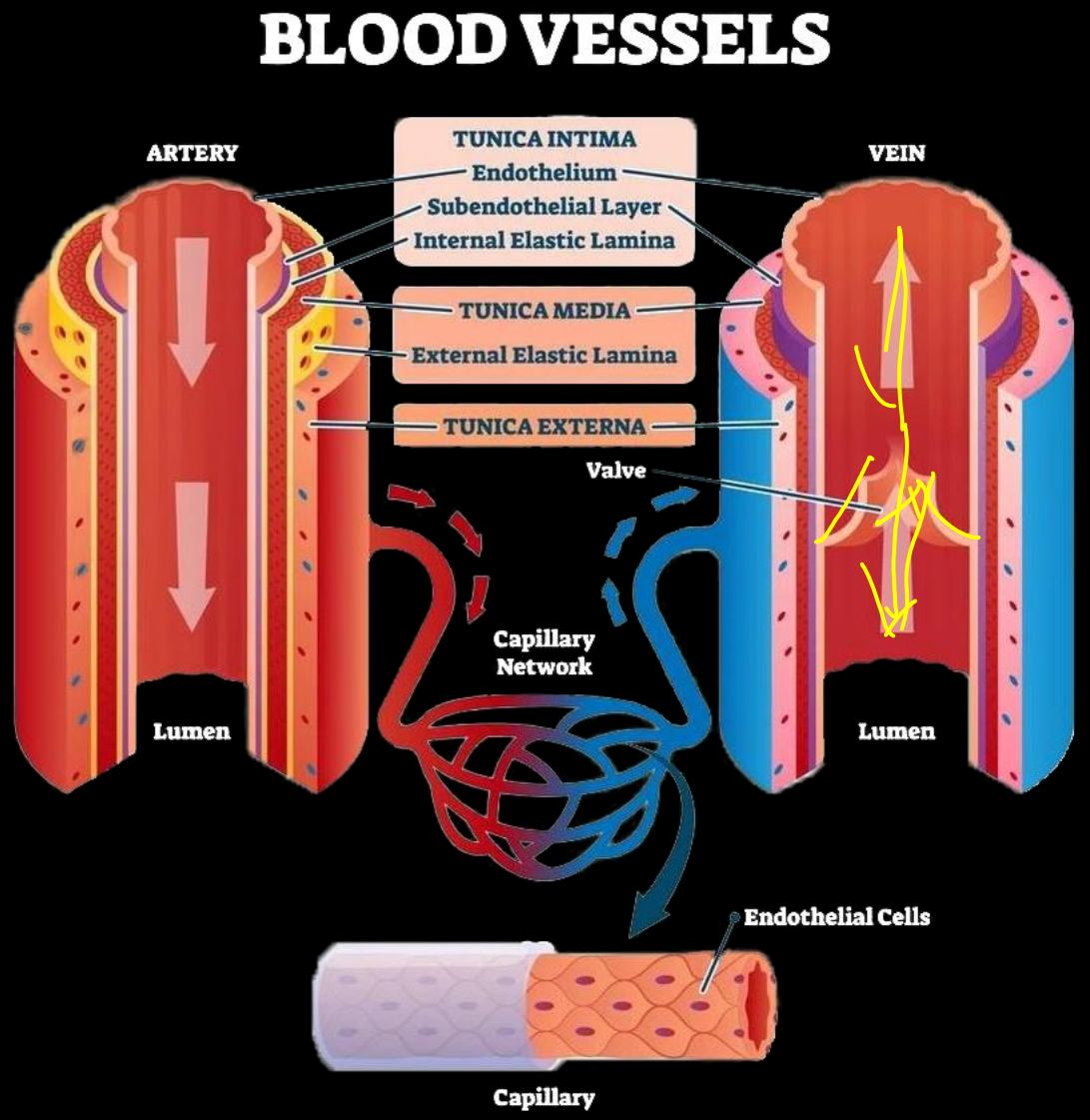
Blood Vessels

- Arteries
- They transport blood away from the heart.
- Their walls are thicker and stronger.
- They are characterized by thick tunica media and thin tunica adventitia.
- They can withstand high pressure.
- No valves.



Blood Vessels

- Veins
- They return blood to heart.
- They are less elastic and relatively thin walls.
- Tunica adventitia is thicker whereas tunica media is thin.
- These vessels are adapted to withstand low pressure.
- Have valves.



Working of heart

- Frog heart is **myogenic heart.**
- The **contraction -systole**
- whereas the **relaxation -diastole**.
- The wave of contraction starts in sinus venosus and spreads through out the heart and ends in truncus arteriosus.

Valve present in between truncus arteriosus and ventricle is

A. Sinuauricular valves

B. Auriculoventricular valves

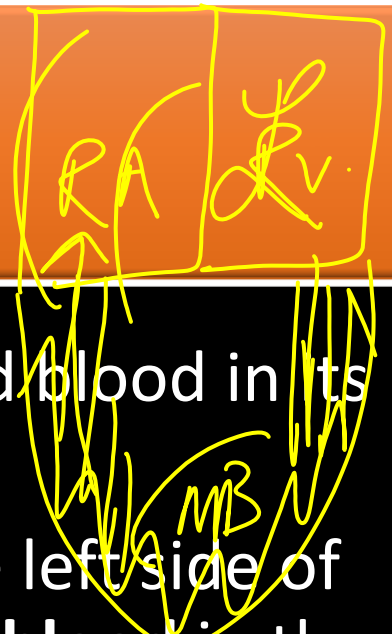
C. 1st set of semilunar valves

D. 2nd set of semilunar valves

- The **sinu-auricular node (S.A node)**is present in the sinus venosus, which initiates the contraction of heart beat and the wave transfers toward auricles, ventricles and end of truncus arteriosus.
- The different chambers of heart contract in a regular sequence and the valves prevents the back flow of blood.

- When sinus venous contracts**, deoxygenated venous blood** is forced into the **right auricle** through **sinu-auricular aperture.**
- At the same time, the **oxygenated blood** from **lungs** is poured into **left auricle** through common **pulmonary vein.**
- Now, the two auricles contract almost simultaneously forcing their blood into ventricle through the single **auriculo-ventricular aperture** guarded by sinu-auricular valves.

Conventional older view:



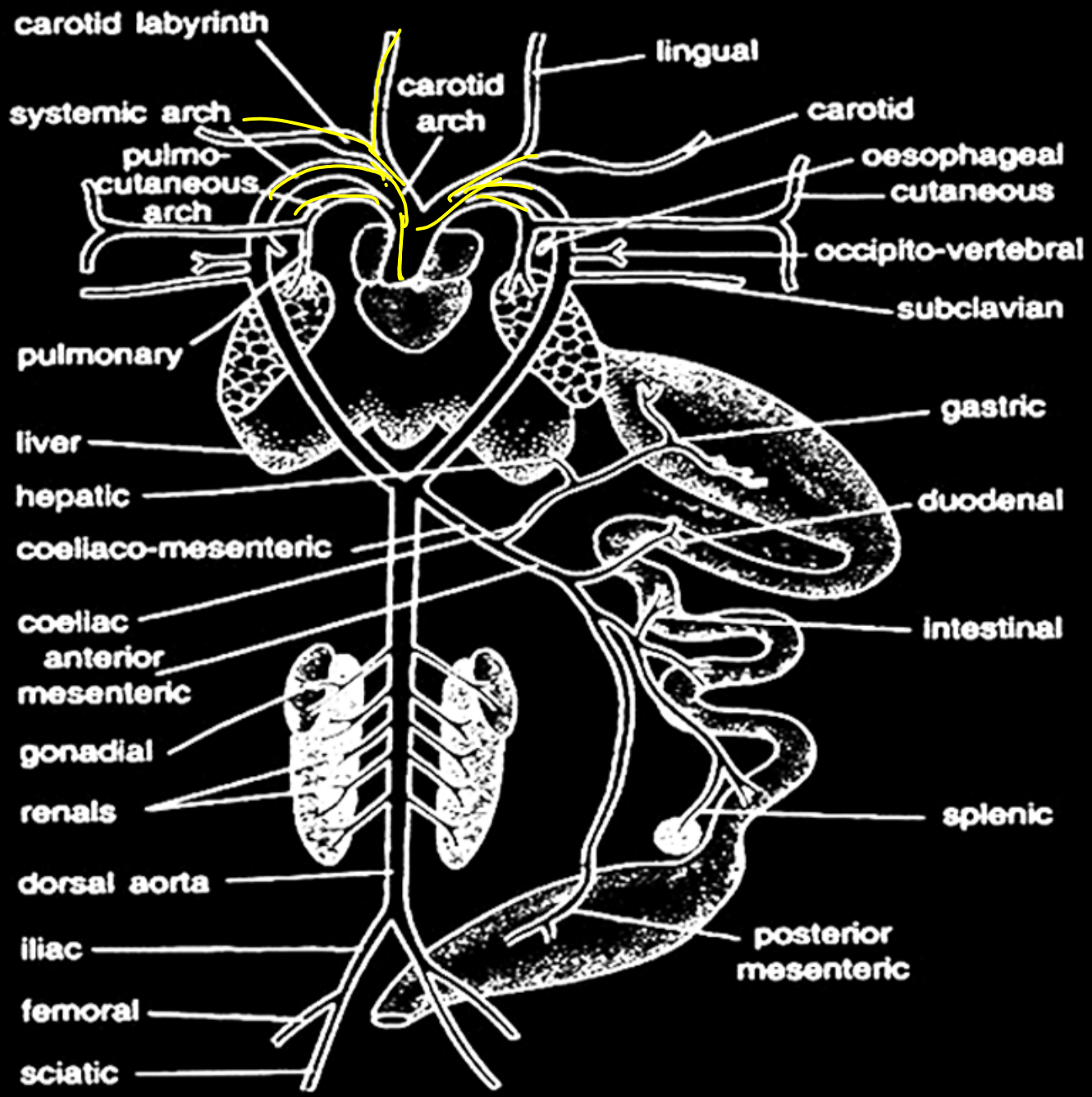
- The ventricle possesses only deoxygenated blood in its right side received from right auricle.
- Only **oxygenated blood** is contained in the left side of ventricle received from left auricle, **mixed blood** in the middle region.
- The mixing of two types of blood was **prevented** because of the presence of **columnae carnae.**
- As the contraction of ventricle initiates, firstly, the deoxygenated blood from the right side, flows into the **truncus arteriosus.**

- Then it is directed by the **spiral valve** into **cavum pulmocutaneum** then to the common opening of **pulmocutaneous arches** and is carried to **lungs and skin** for **oxygenation.**
- The opening of pulmocutaneous arches is now closed by the **spiral valve.**
- **Mixed blood** passes through **cavum aorticum** then through **systemic arch** to **different parts of the body.**
- **Pure blood** passes through **cavum aorticum** then through **carotid arch** to the **head region.**
- **Carotid labyrinth** prevents passage of **mixed blood** to the **head region.**

Modern view:

- **Right auricle** receives **mixed blood.**
- **Left auricle** receives **oxygenated blood.**
- All pockets of **ventricle** receives **mixed blood.**
- **Mixed blood** passes through **cavum aorticum** and **cavum pulmocutaneum** then through **all three arches** to **different parts of the body.**
- Spiral valves supports conus arteriosus and prevents its collapsing. It doesn't take part in turning of blood.
- Carotid labyrinth is sensory in function and detects pressure changes only.

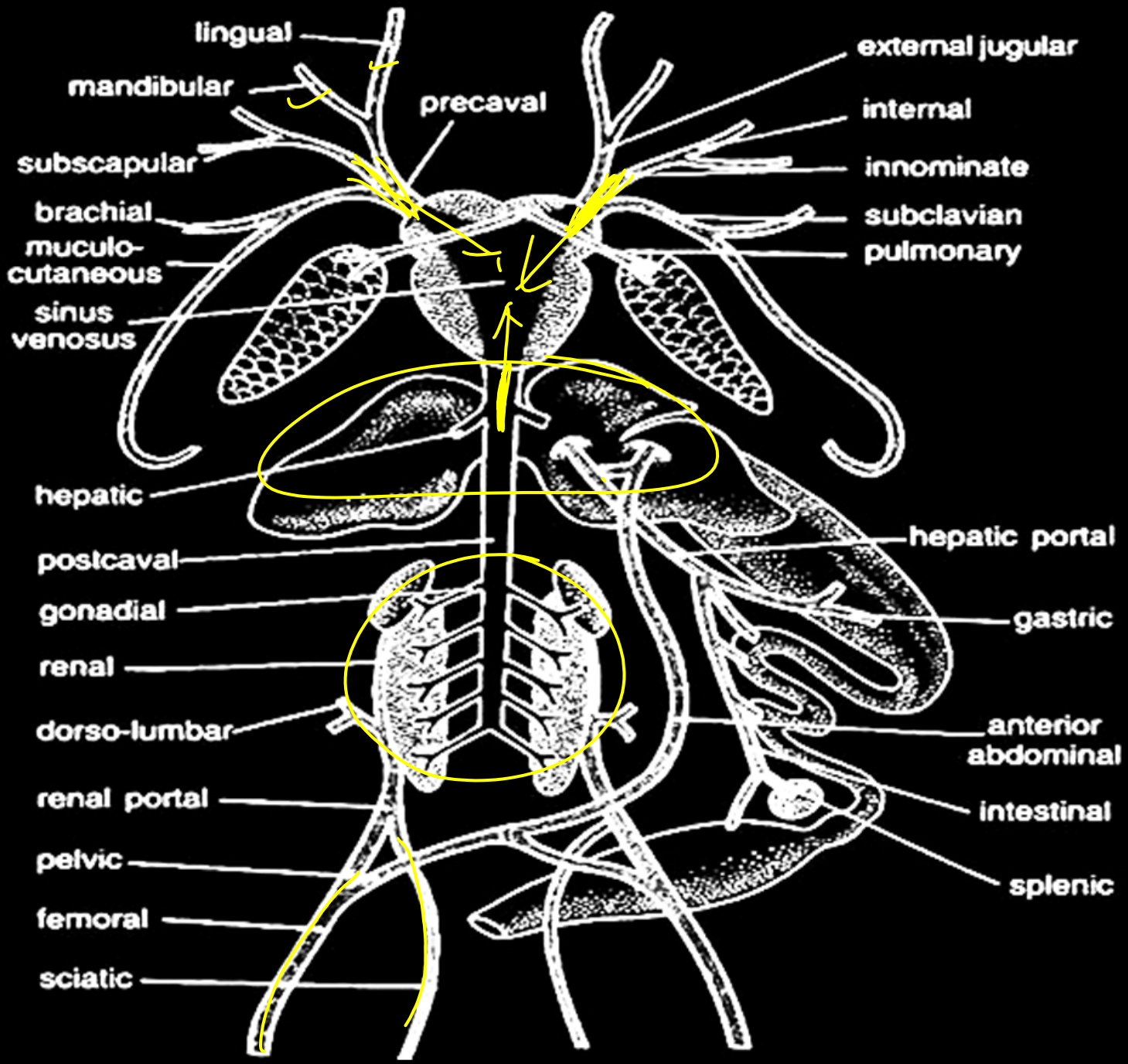
Arterial system



Venous System of Frog

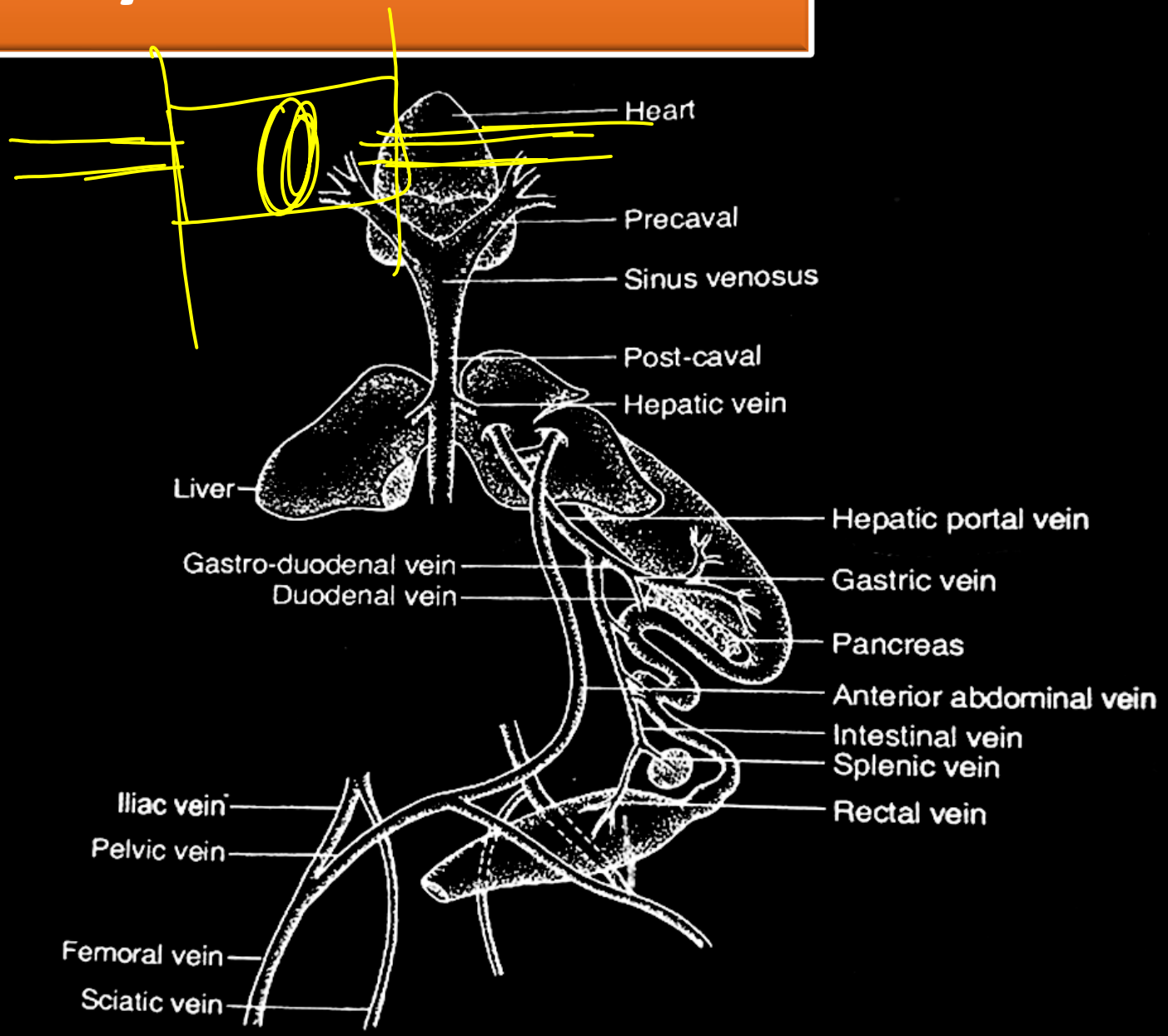
- The venous system includes veins or those blood vessels in which blood of the body returns to the heart.
- **Comprised of :**
- Pulmonary veins
- Caval veins
- Renal portal veins
- Hepatic portal veins

Venous system



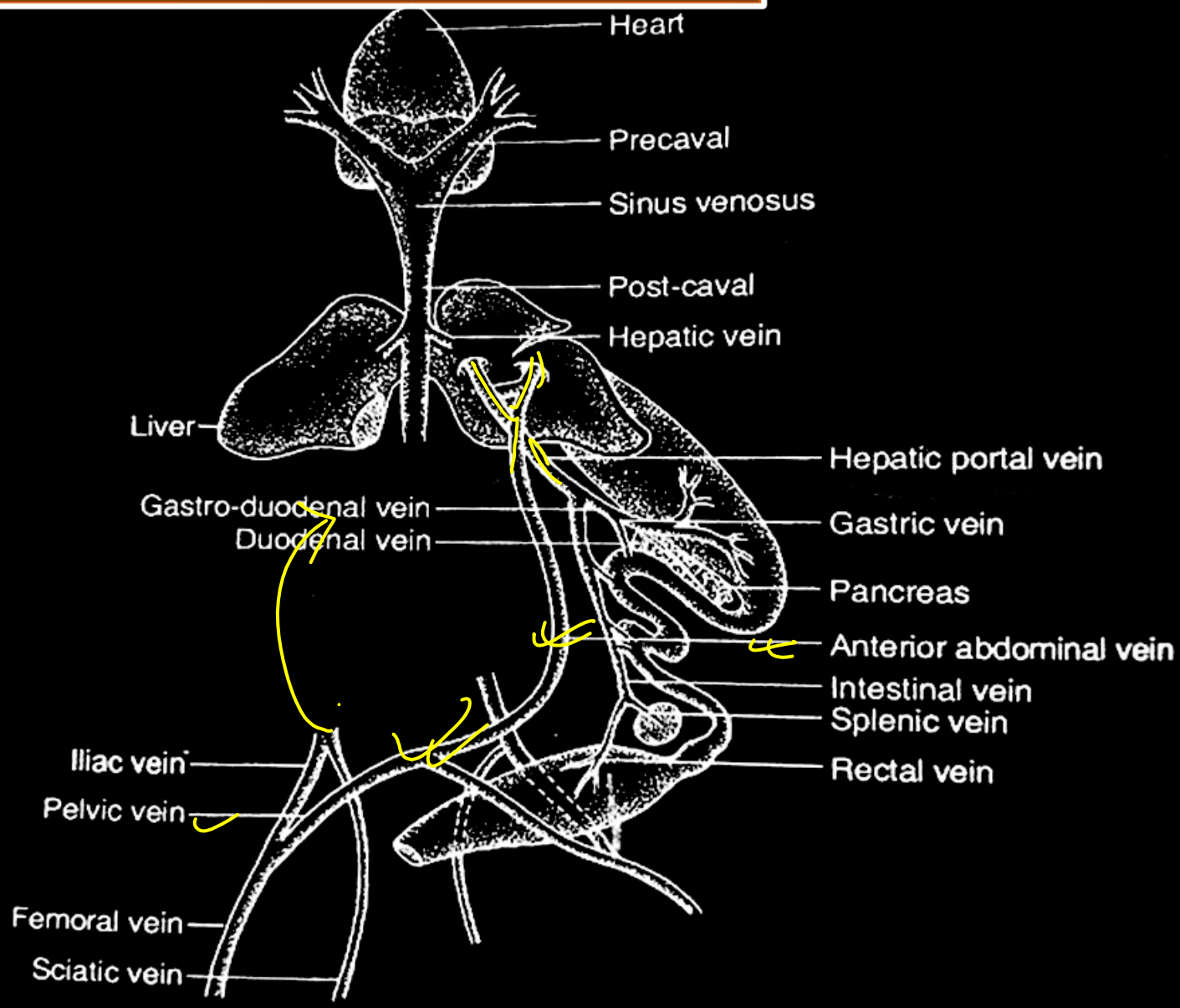
Hepatic portal system

- A large hepatic portal vein is formed by the union of several branches from stomach, intestine, spleen and pancreas.
- Gastric
- Duodenopancreatic
- Intestinal or mesenteric
- Splenic
- Rectal/ Hemorrhoidal



Hepatic portal system

- It carries blood of alimentary canal, heavily loaded with digested food stuffs, to the **liver** into which it breaks up into capillaries.
- The anterior abdominal vein is connected with hepatic portal vein, in the region of liver.
- Formed by two pelvic and vesicular
- Anterior end bifurcates and enters left and right lobe of liver

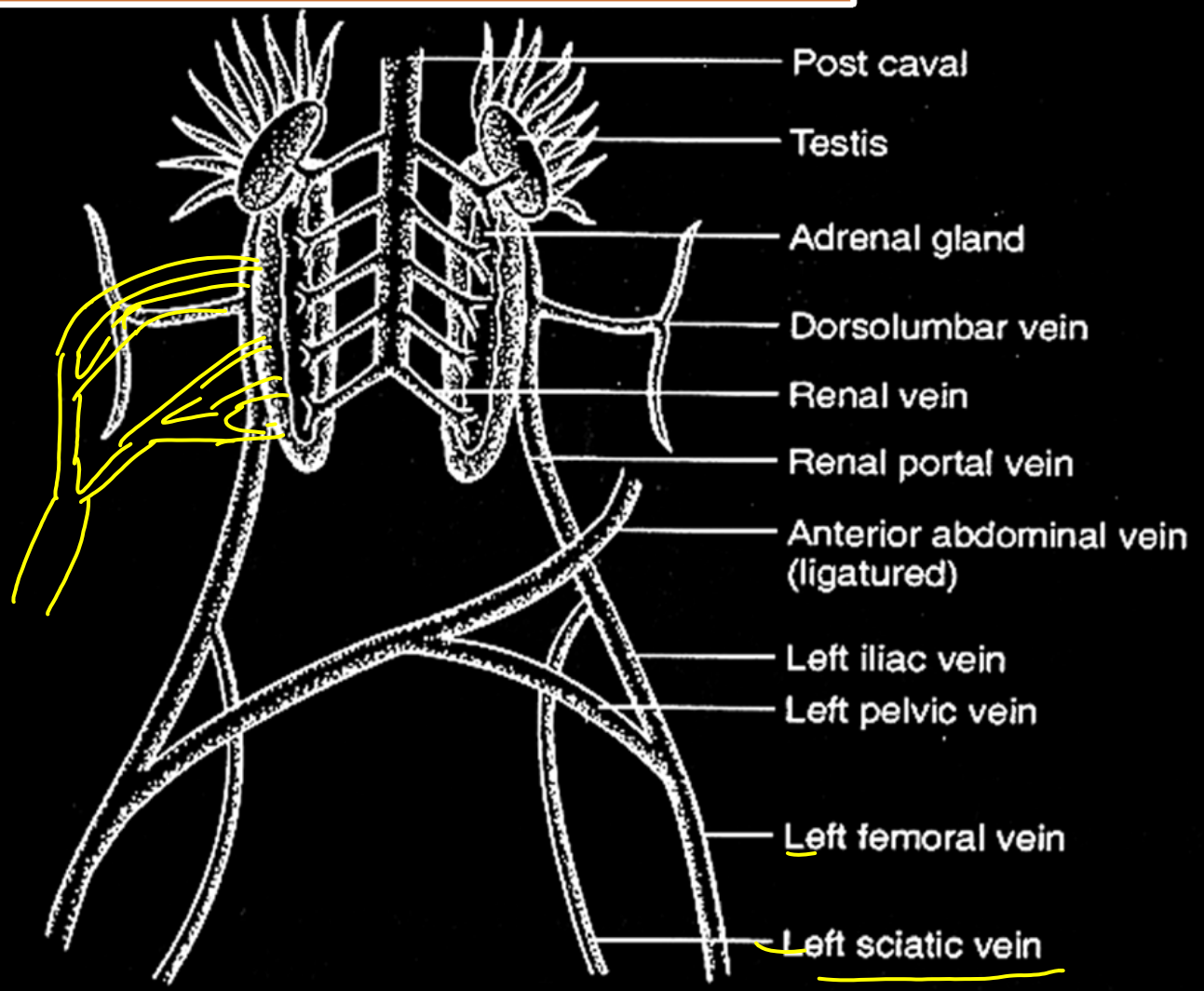


Hepatic portal system

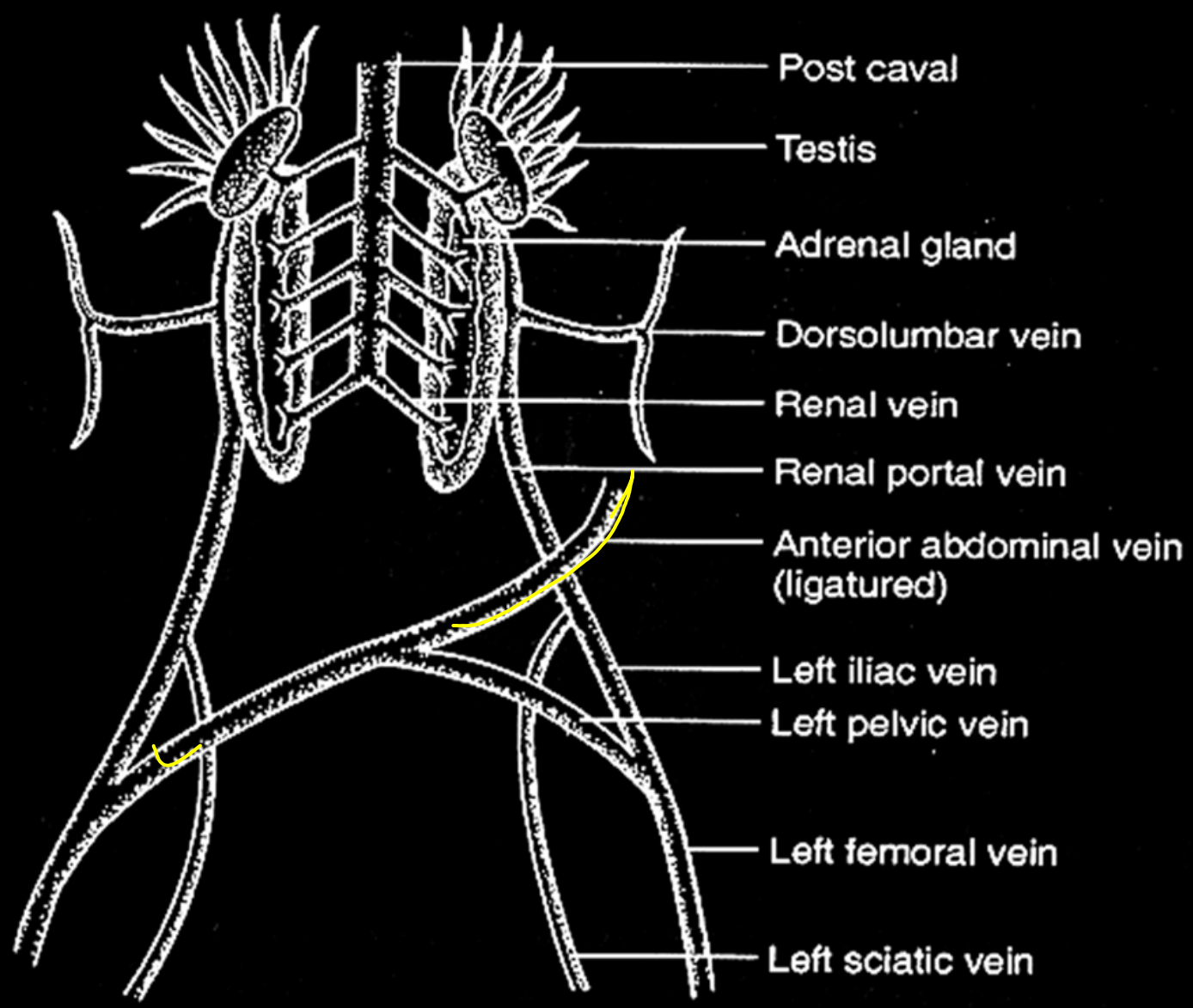
- Significance
- Blood rich in glucose and amino acid
- Excess glucose and amino acid is stored by liver
- Deamination amino acid to ammonia to urea or uric acid
- Detoxification

Renal portal system

- The veins which carry blood to a capillary system in kidneys forms the renal portal system.
- Blood of each hindleg is collected by two veins: an outer femoral and an inner sciatic.
- Renal portal vein enters the kidney by various branches which break up into capillaries.



- The pelvic veins of both sides are united to form a median ventral or anterior abdominal vein.
- It receives blood from urinary bladder and ventral abdominal wall.
- Then, it runs towards to enter liver into which it breaks up into capillaries.
- Both renal and hepatic system are interconnected by a small loop.



- Significance
- High level of urea,Co2 and others
- Kidney separates harmful substance from blood
- Substance are removed in the form of urine.

- Lymphatic system : Group of tissue and organ related to production, development and circulation of lymph.
- Include primary and secondary lymphoid organ and lymph.

1. lymph: colorless fluid without RBC along with blood proteins that bathes tissue and lubricates internal organs.

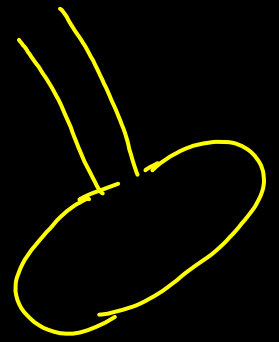
   Mainly WBC Lymphocytes (antibodies) and Monocytes(phagocytic)

2. Lymph vessels/lymphatics: thin walled vessels

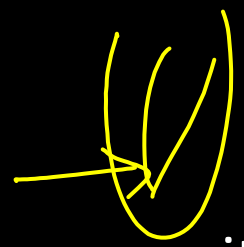
3. Lymph hearts: 2 pairs, at the opening of lymph vessel.

4.Lymph space: below skin 20 sinuses.

5.Spleen: contains lymphatic tissue helps in phagocytosis, pinocytosis, destruction and production of RBC, lymphocytes and antibodies.



Function

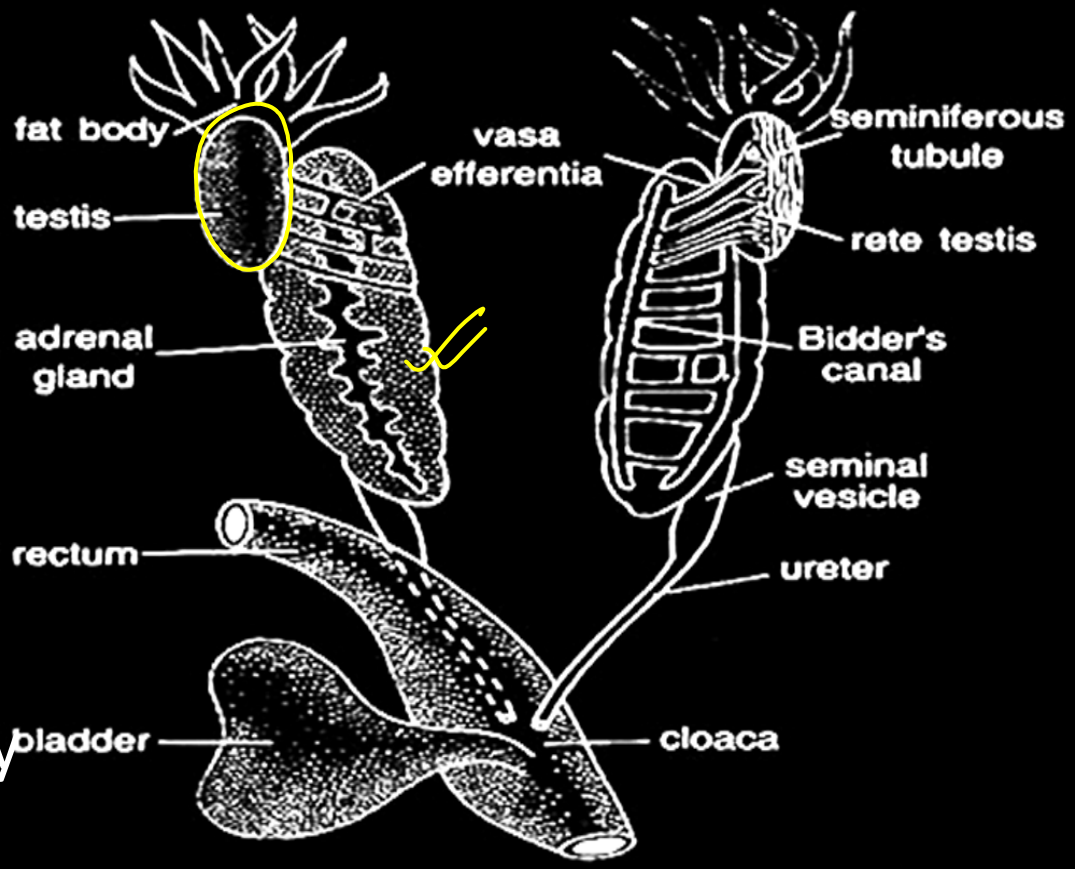


- Maintains volume and composition of blood by returning tissue fluid back into the blood.
- Supplies oxygen and nutrition to the parts where blood cannot reach.
- Collects absorbed fatty materials from lacteals in the villi of small intestine and to the blood.
- Plasma proteins made in liver enter blood through it.
- Picks hormones from endocrine gland to blood .
- Waste materials from cell to blood.
- Destroys invading pathogens

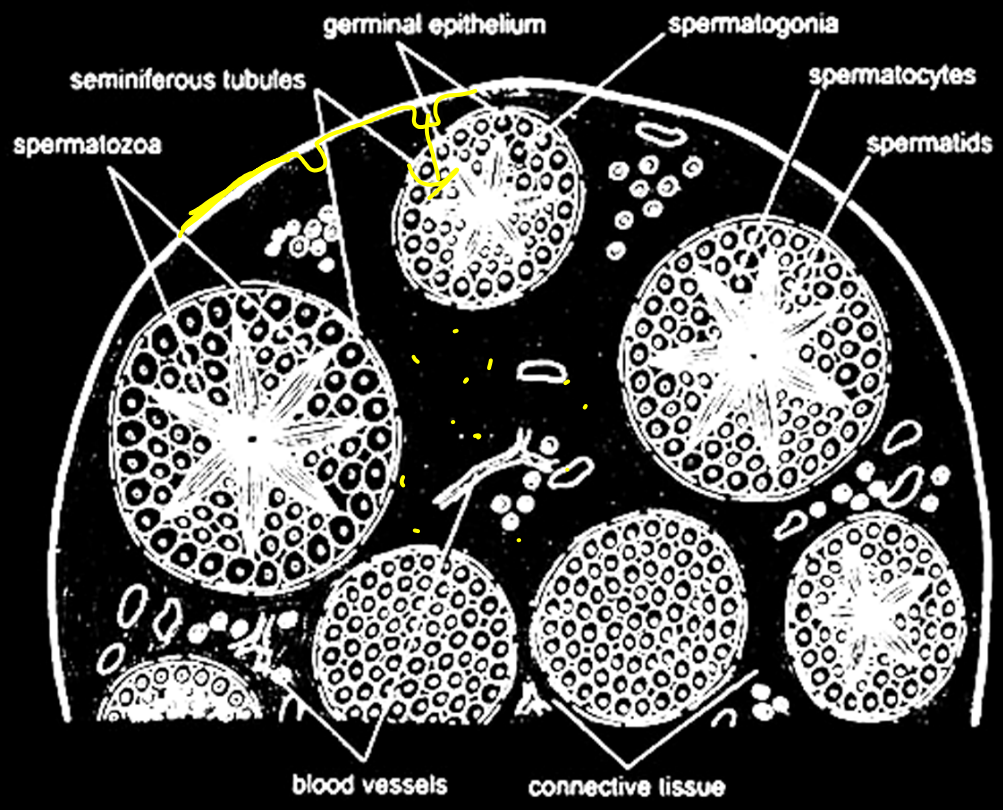
Reproductive System of Frog

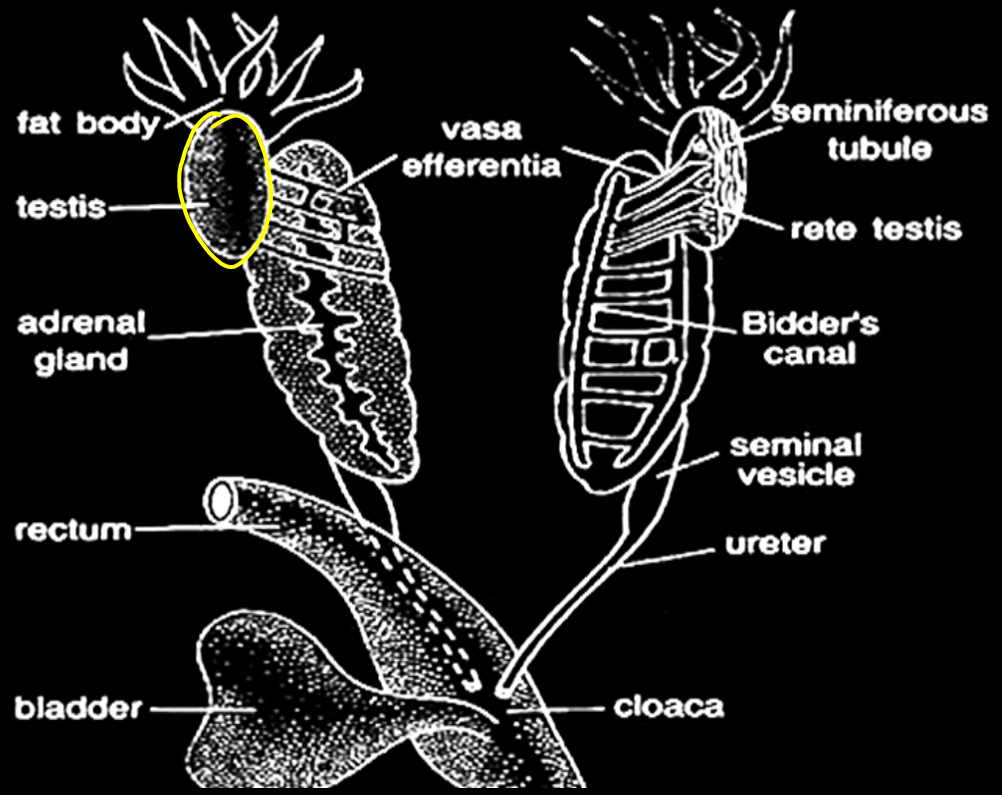
- The process by which the offsprings of its own kind are produced.
- Frog exhibits sexual dimorphism.
- In the breeding season, the male and the female frogs enter into a process of temporary union called amplexus.
- Vocal sacs
- Ampuloxary or copulatory pads(-subarticular)
- Male smaller Female larger
- Color: lemon yellow(M) dull green (F)

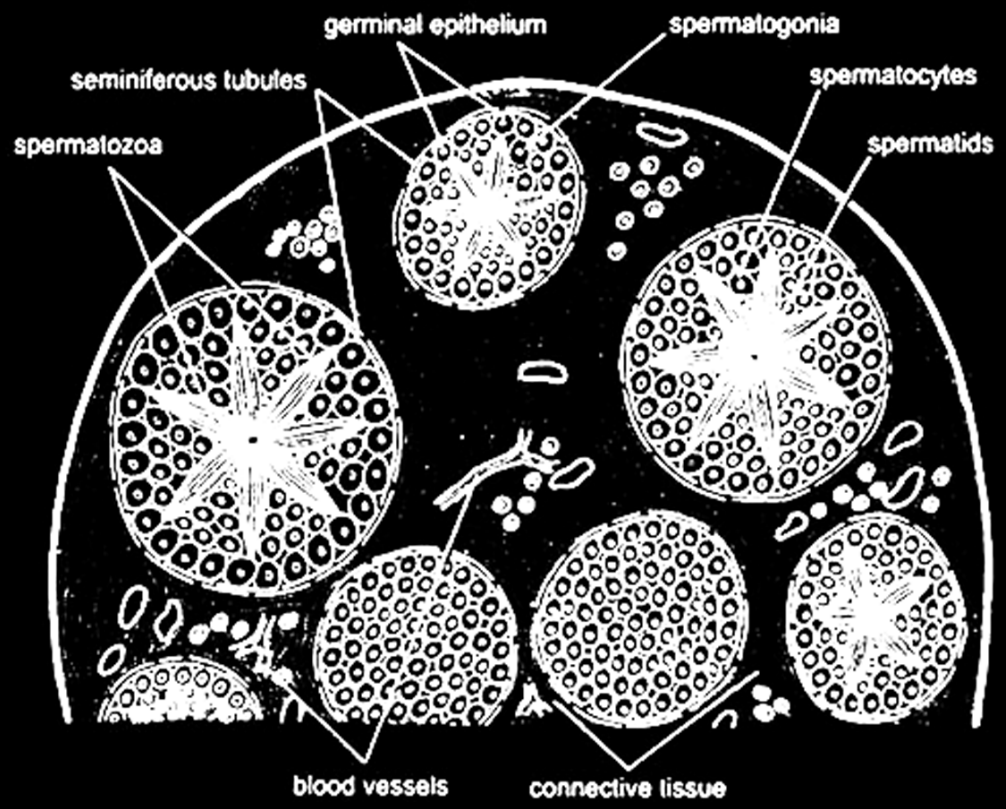
- **Male reproductive system**
- Male reproductive system consists of a pair of **testes**, **vasa efferentia** and **urinogenital ducts cloacal chamber/cloaca.**
- Copulatory organs absent.
- **Testes:**
- Testes are yellowish, elongated or oval structures surrounded by tunica albuginea.
- **Mesorchium** is a double fold of peritoneum connecting testis with kidney anteriorly.
- Each testes consists coiled structures called seminiferous tubules or crypts surrounded by membrana propria.

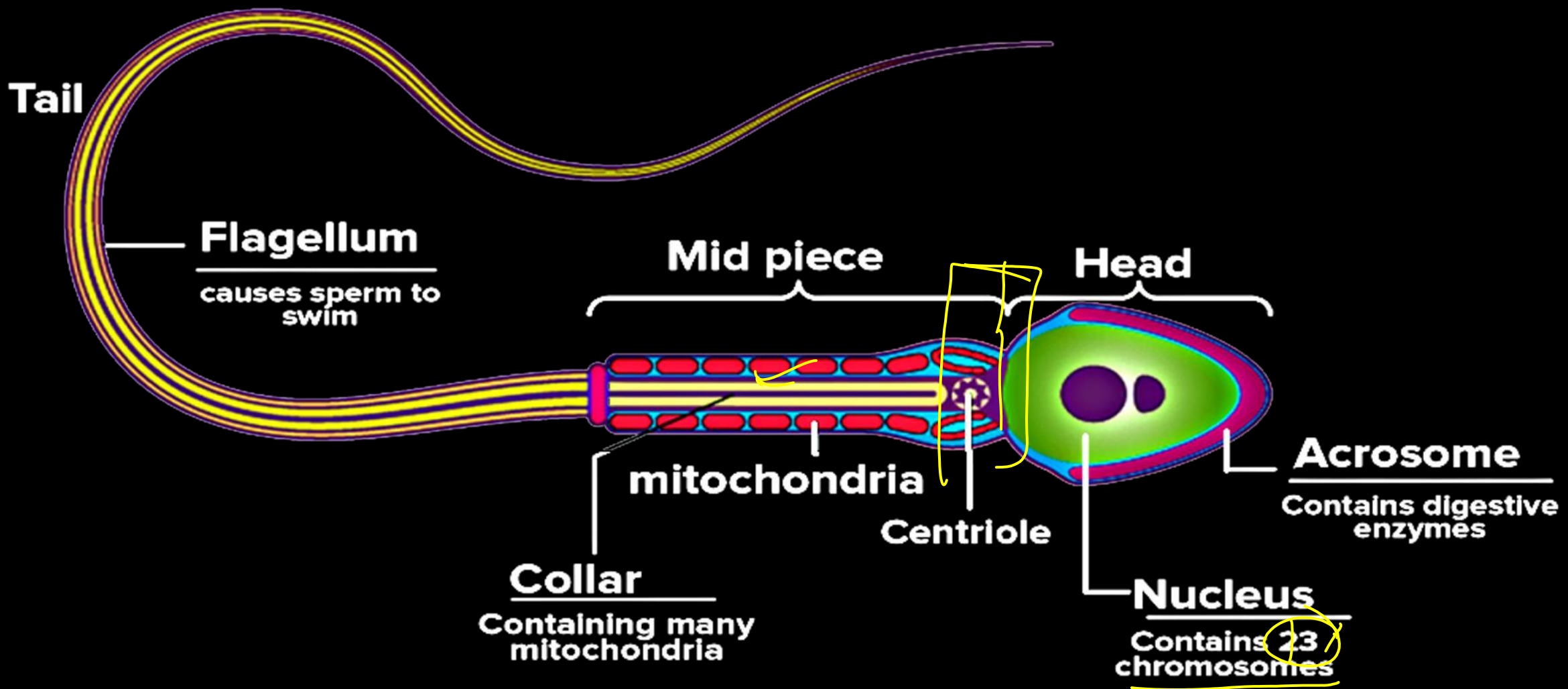


- The epithelial lining of seminiferous tubules consists of **germinal cells**, produces **spermatozoa** through **spermatogenesis.**
- In between seminiferous tubules, connective tissues are present that contain blood vessels, nerve fibers and **interstitial cells (Leydig cells**).
- Interstitial cells produce hormones called **Testosterone** that stimulate the development of **secondary sexual characteristics** (**vocal sac, copulatory pad**) in males.

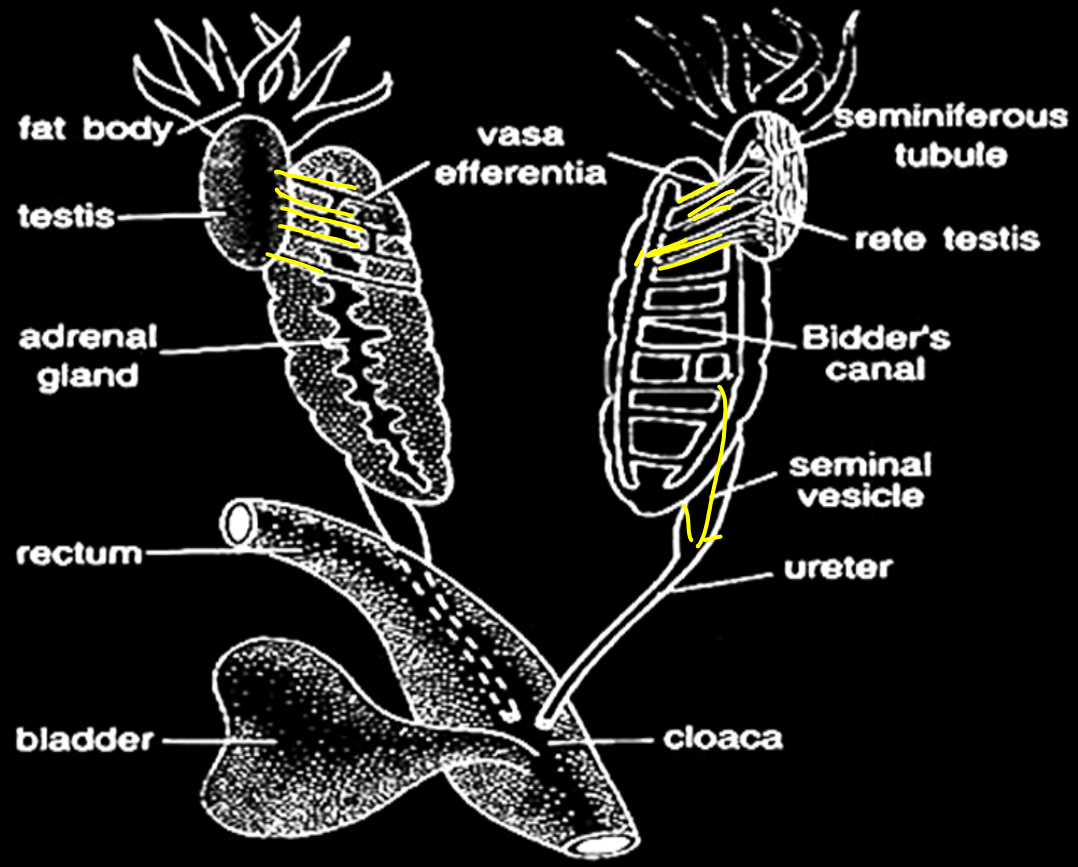



fat body
testis
adrenal gland
rectum
bladder
vasa efferentia
seminiferous tubule
rete testis
Bidder's canal
seminal vesicle
ureter
cloaca


germinal epithelium
spermatogonia
seminiferous tubules
spermatocytes
spermatozoa
spermatids
blood vessels
connective tissue


Tail
Flagellum
causes sperm to swim
Mid piece
Head
mitochondria
Centriole
Acrosome
Contains digestive enzymes
Collar
Containing many mitochondria
Nucleus
Contains 23 chromosomes

- **Vasa efferentia:**
- Many seminiferous tubules unite to form a narrow tube, vasa efferentia,(10-12) enter into the kidney.
- In kidney, it opens into the Bidder’s canal, longitudinal tube connected to the ureter. Bider's canal serve as the passage of sperm.
- The vasa efferentia conduct mature sperms from testis to the ureter.



The urinary bladder of frog opens into

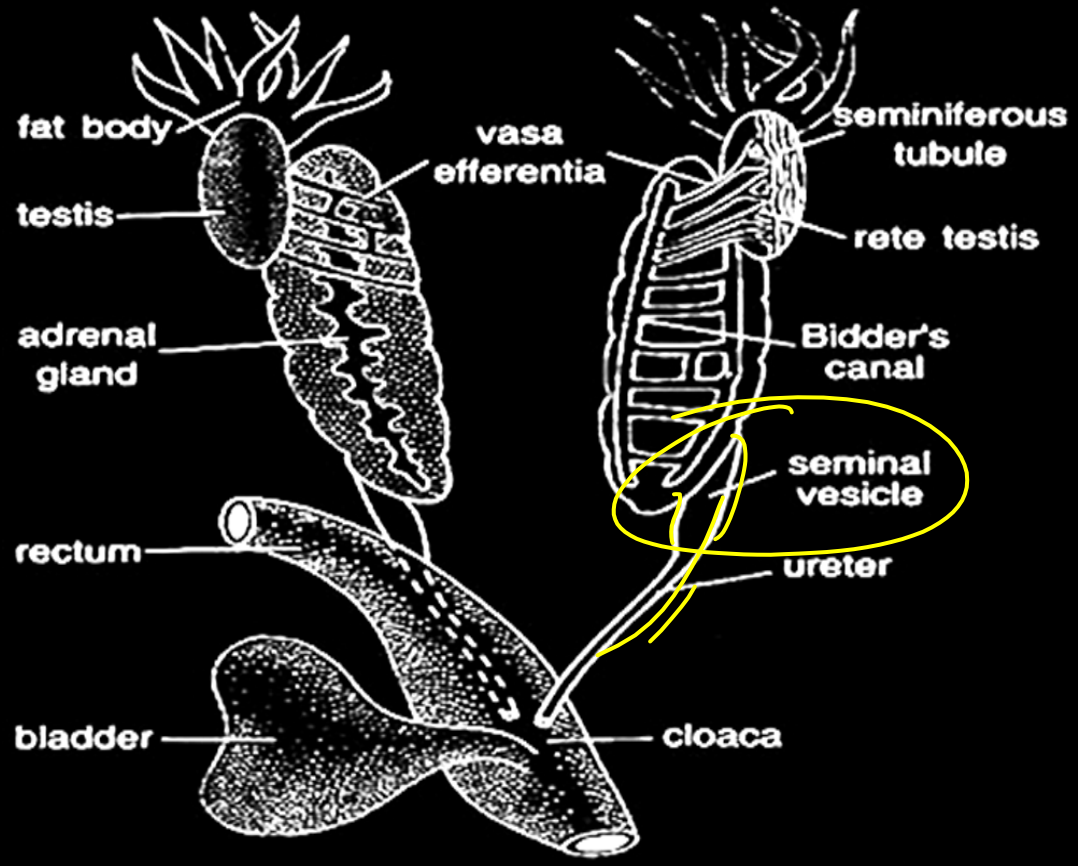
A. Ureter

B. Uterus

C. Urethra

D. Cloaca

- **Urinogenital Duct:**
- A tubular duct where the urine and sperms pass through ureter is called as urinogenital duct.
- Proximal part of urinogenital duct expands to form **seminal vesicle** where the sperms are stored until they are ejected out during copulation.
- Sperms from seminiferous tubules pass into rete testis, vasa efferentia, Bider's canal (present in kidney) and then to urinogenital duct.
- Sperms are released out through cloacal aperture.



Bidder's canal in frog is found in

A. Liver

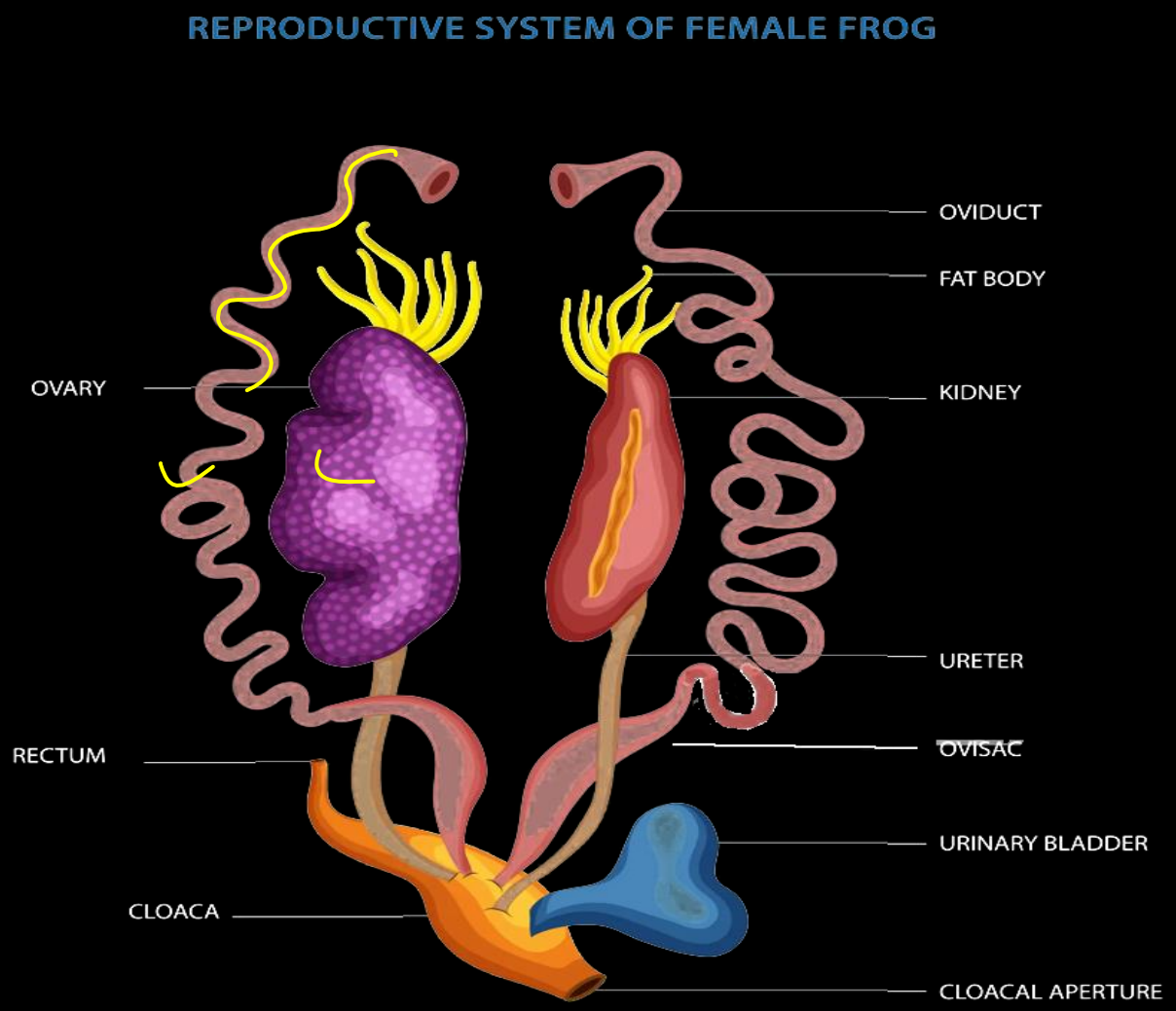
B. Testis

C. Ovary

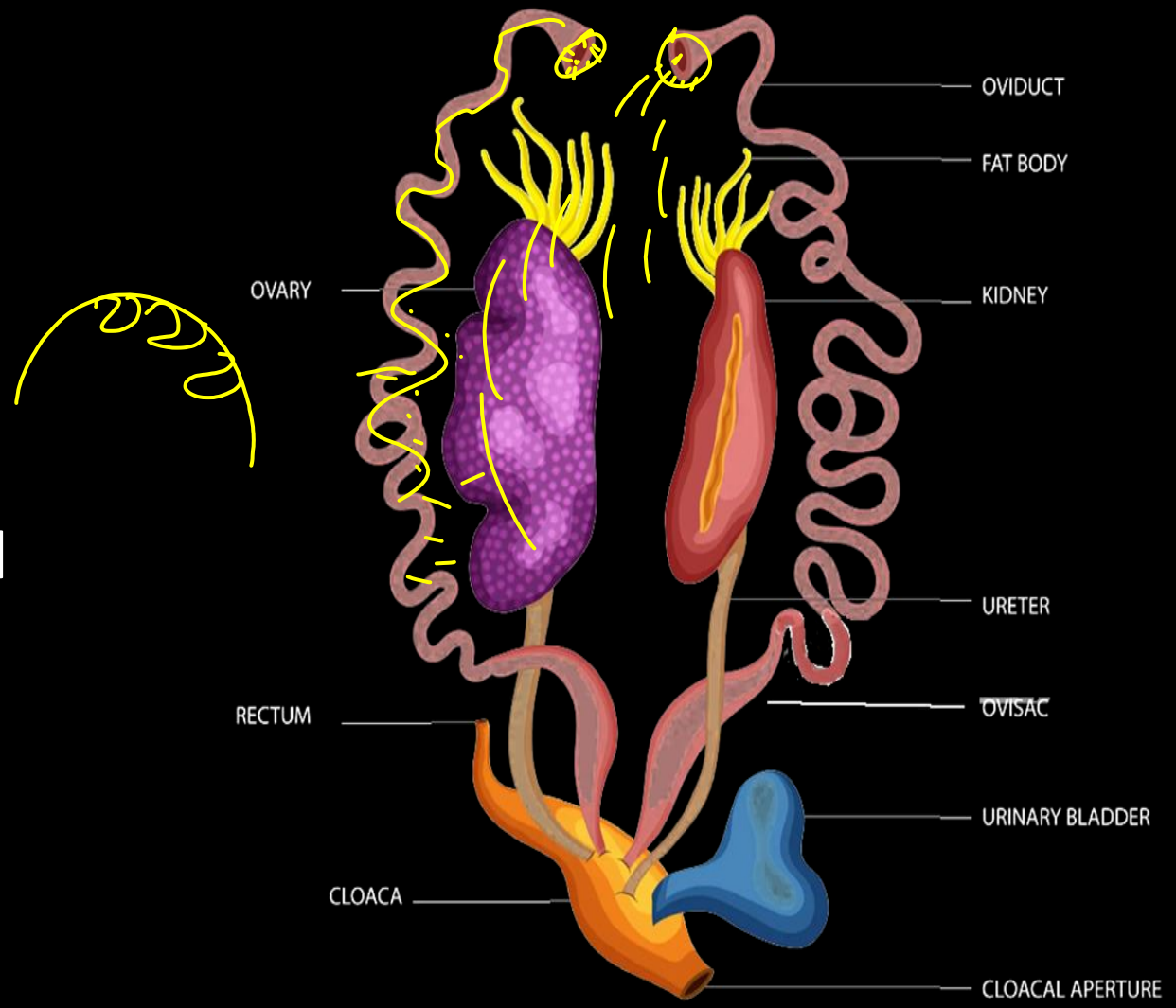
D. Kidney

Female reproductive system

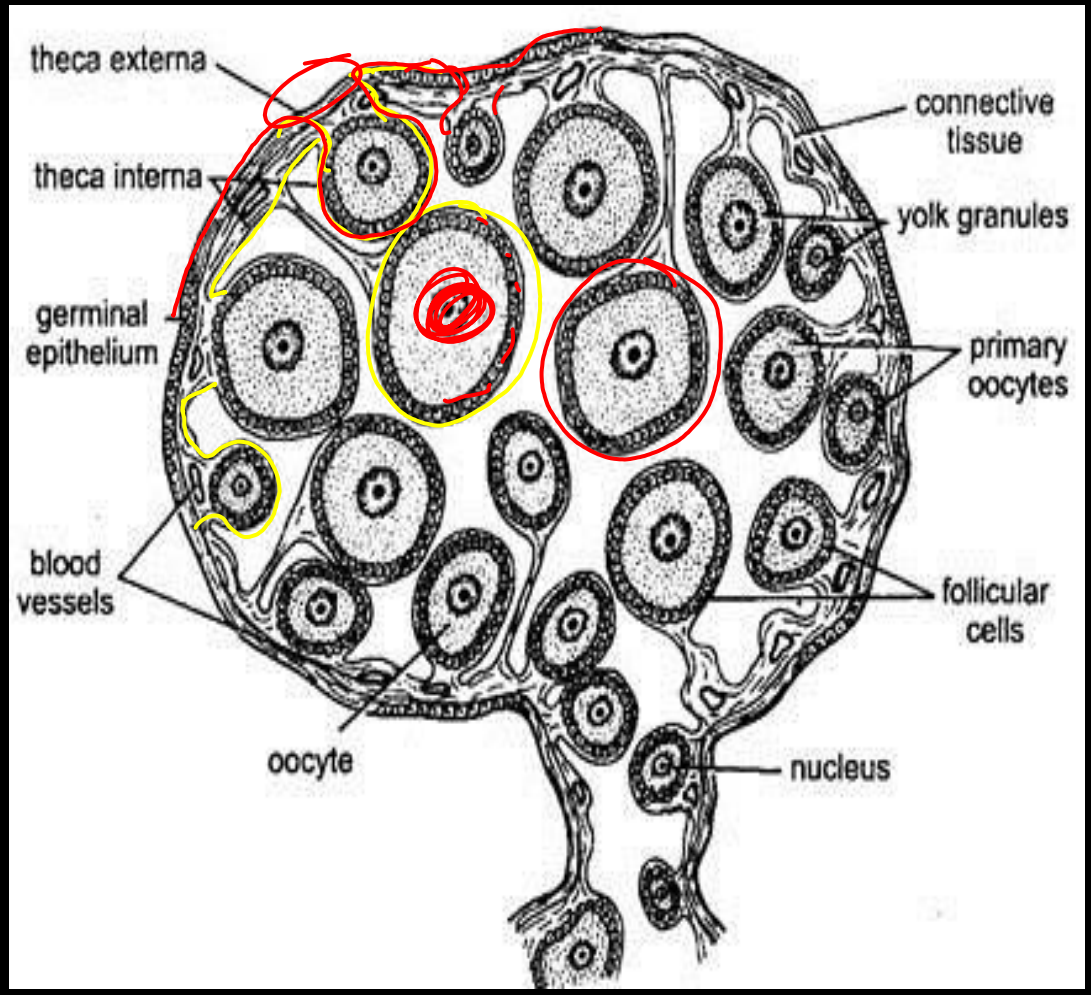
- Female reproductive system consists of **a pair of ovaries** and **oviducts.**



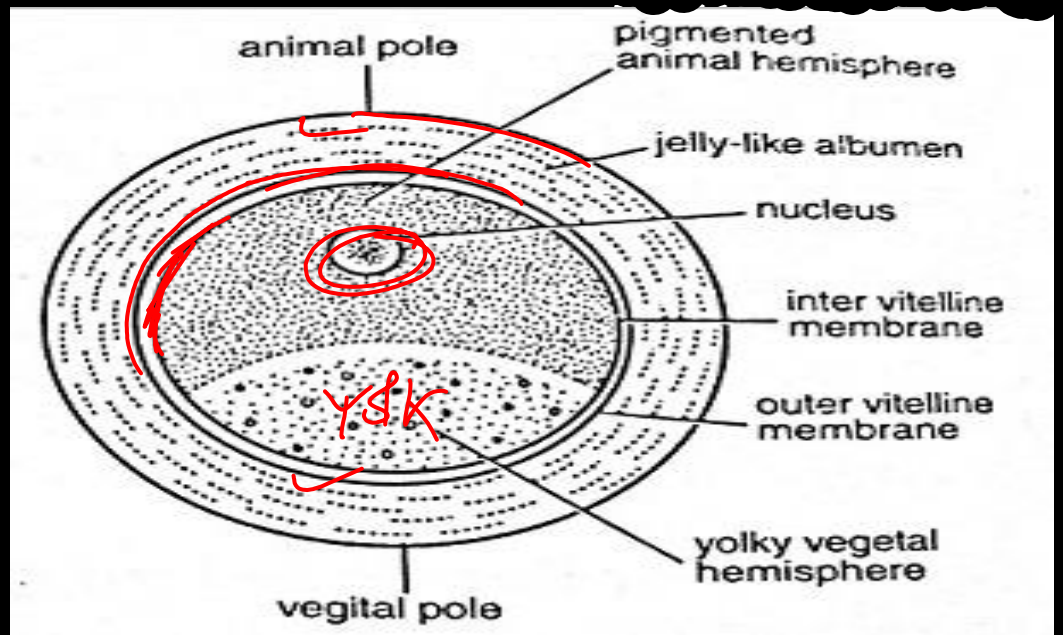
- **Ovary:**
- A pair of much folded sac lies on ventral to the kidneys and supported by peritoneum called **mesovarium.**
- It is sac like structures composed of ovarian follicles consists of countless ova.
- **Ova** arises from germinal epithelial lining by **oogenesis.**
- The mature ova are shed into the coelomic fluid of the body cavity and reach to the ostia by cilia of peritoneum.

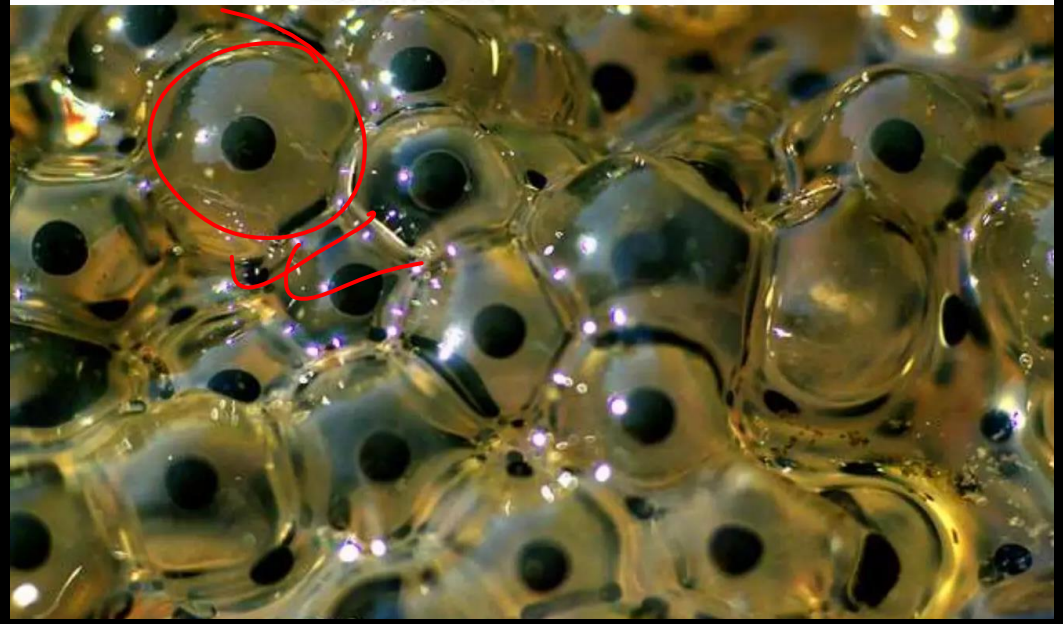


- **internal structure of Ovary:**
- Thin walled hollow sac containing many lobes where ova is formed.
- Lobes composed of outer theca externa and inner theca interna .
- Theca externa modified as germinal epithelium forming small groups of cells called ovarian follicles .
- One of the cell of the follicle enlarges and under go oogenesis to form ovum
- The remaining cells provide nourishment to the ovum.



- **Structure of mature Ovum:**
- Mature ovum is large rounded cell with prominent nucleus and yolk.
- Thin vitelline membrane surrounds the ovum.
- It is secreted by ovum itself.
- Ova come out of the ovary and floats in the coelomic fluid of body cavity.
- Albumen covers the vitelline membrane secreted by gland cells of the wall of the oviduct .





Jelly does not allow eggs to

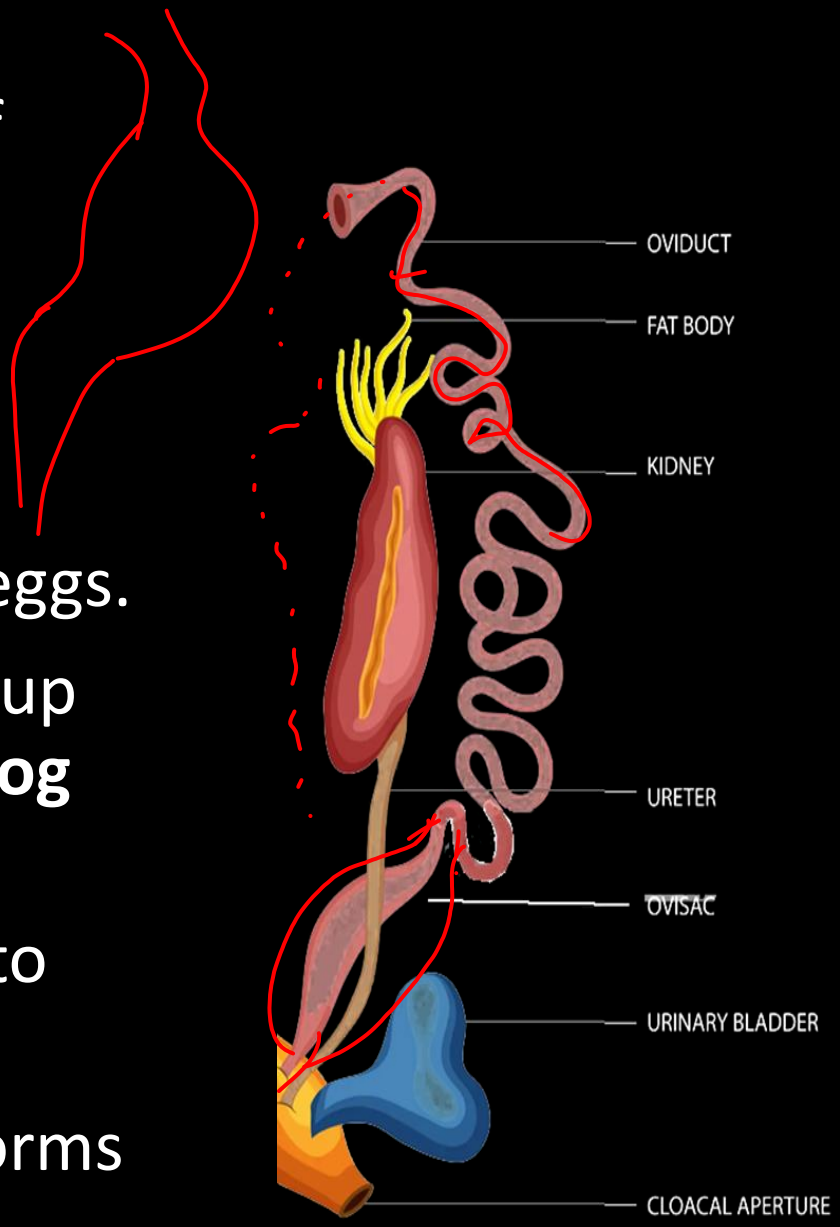
A. Float

B. Sink

C. Move

D. Fertilize

- **Oviduct:**
- Two long coiled tubes one on either side of abdominal cavity.
- Anterior ends of oviducts is **ostia.**
- The oviduct is lined with ciliated cells and glandular cells are scattered which secrete albuminous substance that surrounds the eggs.
- **Albumen** when contacts with water swells up enormously and forms the **egg spawn** or **frog spawn.**
- Posterior ends of oviducts open dorsally into cloaca.
- Just before entering cloaca, each oviduct forms a thin walled enlargement , called **ovisac.**



- **Extra information:**
- **Copulation: Pseudocopulation**
- Copulation takes place in water during breeding season.
- They produce croaking sound, a mating call for the female frogs.
- The female frogs getting attracted approach the male frogs.
- The male frog rides over the female frog and embraces it firmly by its forelimbs and nuptial pads.

- The couple remains in this condition for 2-3 days.
- The male holds the female more tightly at the state of orgasm, in turn the female discharges a large number of eggs in water from its ovisac through the cloacal aperture.
- The male frog right at the same moment discharges its sperms over the eggs falling in water.
- The two animals separate from each other on completion of this process.

Amplexus in frog is a process by which

A. Female carries a male from one place to another

B. Male carries female

C. Male mounts on the back of female to stimulate it for oviposition

D. Male call for mating