

Frog

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Systematic Position

Phylum :- Chordata

Sub-phylum :- Vertebrata

Division :- Gnathostomata

Super class :- Tetrapoda

Class :- Amphibia

Genus :- Rana

Species :- Ligonia

Distribution :-

They are cosmopolitan in distribution.

Habitat :- They lead amphibious mode of life. They are usually found in fresh water, rivers, ditches, damp places except in arid part of country.

Habit :- They have smooth skin, strong hindlimbs for leaping and webbed feet for swimming. It shows following habits.

- ① Resting :- Frogs rest in land within a squatting position. They keep their short forelimbs upright and long hindlimbs folded inside the body.

② Feeding: - It is a Carnivorous animal and feeds on earthworm, insects, spiders etc. The tadpoles feeds on aquatic plants that is they are herbivorous.

③ Hibernation: - During winter, the frogs bury themselves inside the soil and take rest this is called winter sleep or Hibernation. In winter, the Metabolism is slow and its temperature falls down. Therefore the frogs become inactive. They do not take any food but consume energy which is stored in their body in the form of glycogen.

④ Aestivation: - Similarly in summer, when the environment becomes dry, frog is threatened of having its skin dry hindering the Cutaneous respiration and also other metabolic activities being hampered. Thus during summer days, frogs hardly live in dry land and it goes underground in the mud. This type of summer sleep is called aestivation.

⑤ Croaking: - The characteristic sound made by male frog during breeding season is called croaking. It is a mating call, male frog croaks

to attract the female frog for copulation.

⑥ Breeding: - Frogs breed during rainy season from the end of June to September. During rainy season male frog croaks to attract the female for copulation. Copulation takes place in shallow water, where they lay down eggs for fertilization.

External features of frog

① Shape and size: - It is spindle shaped and bilaterally symmetrical. It is somewhat dorsoventrally flattened and streamlined which offer least resistance during swimming.

② The size of the bull frog varies according to age from 10 to 15 cm in length.

③ Skin: - It is smooth, moist, glandular and highly vascular (rich with blood vessels) without any derivatives like scales, feathers and hairs. It is loosely attached with their bodies. It provides covering and protection.

and also helps in respiration, excretion etc.

③ Colouration: The dorsal surface of the body is green with black patches but the ventral surface is white or pale yellow in colour. The colouration helps them to save from their enemies.

④ Body division: The body is divided into head and trunk. Head and trunk are not separated due to the absence of neck.

① Head: It is triangular in outline with point snout in front. Mouth is located ventrally almost at the tip of the snout as a wide slit like aperture which helps in ~~ingestion~~ ingestion of food. Two small openings called external nares or nostrils are present at the tip of snout. Above the mouth. They have bulging eye ball and the eyes are covered by nictitating membrane.

② Trunk: The head is broadly joined with the trunk due to the absence of neck. It is short and flattened, above to downward.

The posterior end of the trunk is round. Cloaca is present at the posterior end which helps to discharge the faeces, urine and reproductive bodies (sperm & egg). The pairs of limbs arise from the trunk - one pair of forelimbs and one pair of hindlimbs. The hindlimbs are longer, stronger and highly muscular than the forelimbs.

Digestive System of Frog

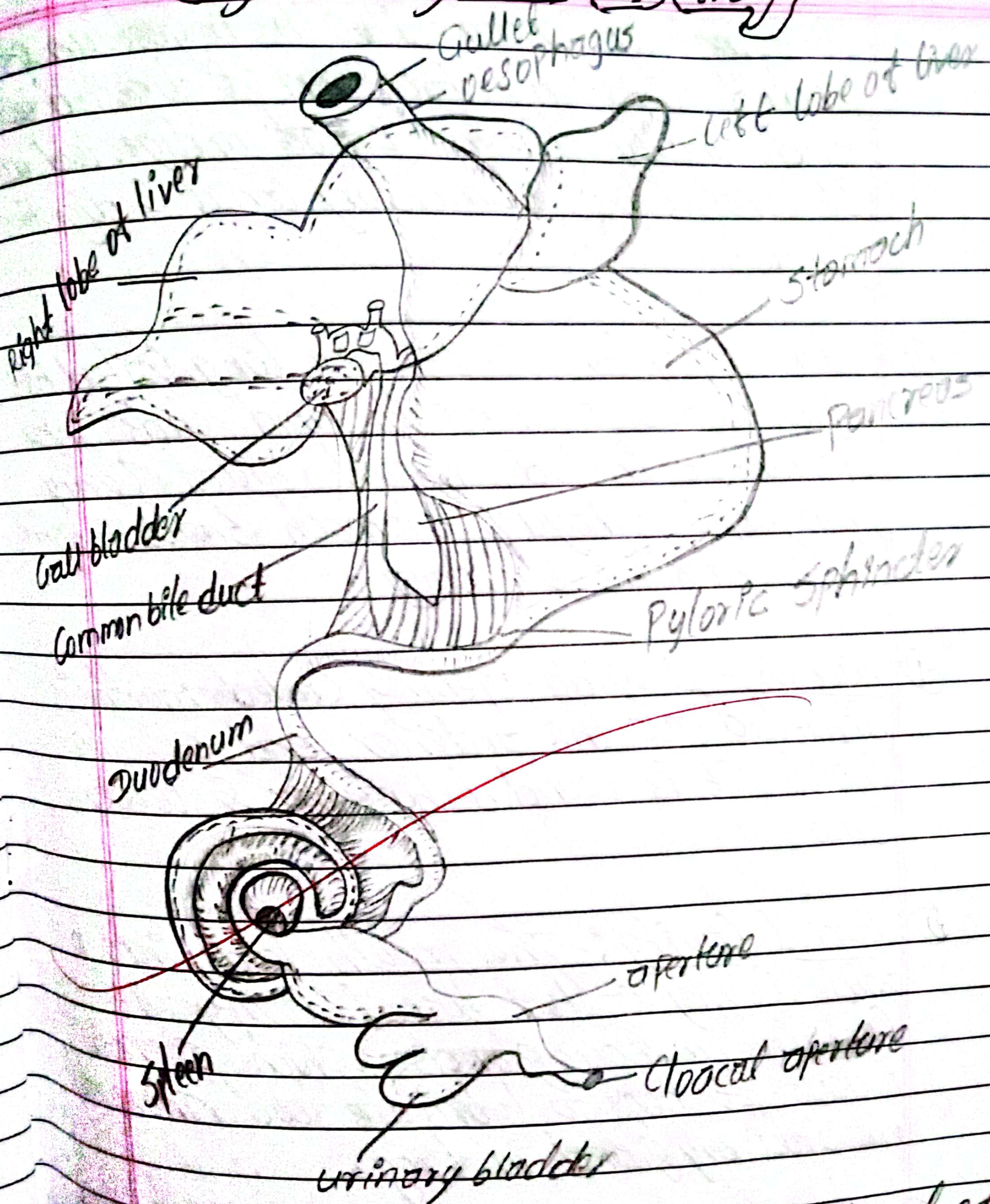


fig:- Alimentary Canal of frog

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It is mainly concerned with ingestion of food, its digestion, absorption of digested food and finally elimination of undigested food. It consists of alimentary canal & digestive glands.

① Alimentary Canal:- It is a long, coiled tube which begins from mouth and ends into cloaca. It includes mouth, buccal cavity, pharynx, oesophagus, stomach, small intestine, large intestine & cloaca.

② Mouth:- A wide opening called mouth is situated at the anterior end of the snout. It is bounded by upper & lower jaw.

③ Buccal Cavity:- The mouth leads into a wide cavity called buccal cavity. It contains mucous glands which secrete mucus. It helps to lubricate food, there are no salivary gland in frog.

④ Pharynx:- The buccal cavity narrows behind to form pharynx. They are considered together

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and known as Bucco-pharyngeal Cavity. There is a large transverse opening called gullet which leads into oesophagus.

① Oesophagus:- It is a short and wide tubular structure which runs from the gullet of bucco-pharynx to the stomach. It opens into stomach.

② Stomach:- The oesophagus opens into a large thick walled tubular sac known as stomach. It lies on the left side of the body cavity. It takes part in storage and digestion of food. It opens into small intestine.

③ Small intestine:- It is a long, coiled and narrow tube and measures about 30cm long. It is made up of two parts.

④ Duodenum:- It is a small anterior part of small intestine. It is a narrow tube which turns forward parallel to stomach forming a 'U' shaped structure. It receives a common hepato-pancreatic duct from liver and pancreas.

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(ii) Ileum:- It is the longest part of alimentary canal. It is coiled tube like structure which makes several loops.

(iii) Large intestine:- The ileum opens behind into the large intestine or rectum. It is a wide tube which measures about 4cm long. In the rectum, the undigested food material is stored and converted into faecal matter. It opens into cloaca.

(iv) Cloaca:- It is a small sac like structure. The anus and urino-genital aperture open into it. It is used as common passage for the removal of undigested food or faeces, urine and reproductive bodies i.e. sperms and ova are released out.

(v) Digestive Glands:- It consists of two glands:

(a) Liver:- It is the largest digestive gland and is reddish brown in colour. It is composed of two main lobes i.e. the right and the left lobes. Between the two main lobes, there is a thin walled, round, greenish sac called gall

bladder. The gall bladder stores bile secreted by the liver. The duct which arise from different liver lobes are called hepatic duct and the duct which arise from the gall bladder is called cystic duct. The hepatic and cystic duct joint to form common bile duct. It runs through from pancreas and joins the pancreatic duct to form hepato-pancreatic duct which ultimately opens into duodenum.

function of Liver

- It neutralizes the acidity of the chyme.
- It stores excess sugar as glycogen.
- It maintain the concentration of protein in blood.
- It stores Copper and Iron and forms Vitamin A.
- It destroys the injured RBC.

(b) Pancreas:- It is a long, flattened irregularly lobed gland of yellowish colour. Its secretion is known as pancreatic juice. It also contains compact group of cells distributed in its connective tissue which are called Islet of Langerhans. These cells are endocrine in nature and produce hormones called insulin & glucagon.

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Glucose $\xrightarrow{\text{Insulin}}$ Glycogen
Glycogen $\xrightarrow{\text{Glucagon}}$ Glucose

Functions of Pancreas

- The insulin causes conversion of excess glucose into glycogen which is stored in liver.
- The glucagon hormone converts glycogen into glucose. Thus the combined action of glucagon and insulin in the body regulates the blood sugar level.

Physiology of Digestion in frog

The process in which complex organic foods are converted into simple soluble & diffusible forms is known as digestion. As the food is directly swallowed into the pharynx, it is not affected by any enzymatic action in the mouth. Then the muscular walls of oesophagus perform peristalsis movement and transport the food stuffs to the stomach. Here, the digestion of food actually starts.

It is broken down by the mechanical action of the muscular action of the muscular wall of stomach. The gastric juice which is secreted by gastric gland contains HCl & inactive pepsinogen changes into active pepsin in the presence of HCl. The pepsin converts proteins into peptones and proteases. HCl also kills bacteria and fungi present in food & makes it soft. The food is gradually digested and changes into semi-solid state called chyme. Then the food passes into duodenum through pyloric valve. In duodenum, the chyme is affected by bile, pancreatic juice & intestinal juice. Bile neutralizes the acidity of the chyme and help in emulsification of fat. The pancreatic juice contains important enzymes which are as follows:

Trypsinogen + Enterokinase \rightarrow Trypsin

Proteases, peptones + Trypsin \rightarrow Amino acids.

starch + Amylopsin \rightarrow Maltose

Emulsified fats + Lipase \rightarrow fatty acids + glycerol

Maltose + Maltase \rightarrow glucose.

Thus, the process of digestion is completed & the absorption of digested food mainly occur

in small intestine. The removal of undigested food material as faeces is known as egestion. The undigested material is passed onto the rectum & egested out through cloacal aperture.

Respiratory system of frog

• It is the process of oxidation of food to release energy in the form of ATP.

Types of respiration: - It is an amphibious animal so it can respire by many ways to make itself to live in water and on the land.

① Cutaneous respiration: - It is a form of respiration in which gases exchange occurs across the skin of an organism. Skin is the chief respiratory organ in frog. During aestivation and hibernation, the frog totally depends on the skin for taking in oxygen. It takes place all the time whether the adult frog is on land or in water. A frog's moist skin is thin, moist with blood vessels & capillaries close to the surface. This moisture on the skin dissolves oxygen from the air & water surrounding the frog and transmit into the blood. This type of respiration is more active & important than pulmonary respiration in frog.

Carbon dioxide diffuses out in opposite direction.

② Buccopharyngeal respiration: - This is the respiration through mucous membrane of buccopharynx. The inner upper lining of the buccopharyngeal cavity is thin, moist & highly vascular. The regular and alternate lowering & raising of buccal floor bring the buccal respiration. The movement of buccal floor is controlled by the sternohyal and pterohyal muscles. The contraction of sternohyal muscles brings about the lowering of floor and the air enters the buccal cavity through nostrils. The oxygen of air dissolves in the layer of mucus and then into blood by simple diffusion method. The pterohyal muscles contract to raise the buccal floor, so the foul air expelled out through the nostrils.

③ Pulmonary respiration: - The respiration which takes place with the help of lungs is called pulmonary respiration. Usually, frog respire through skin or buccopharyngeal cavity but when it needs more oxygen, it respire through lungs as well.

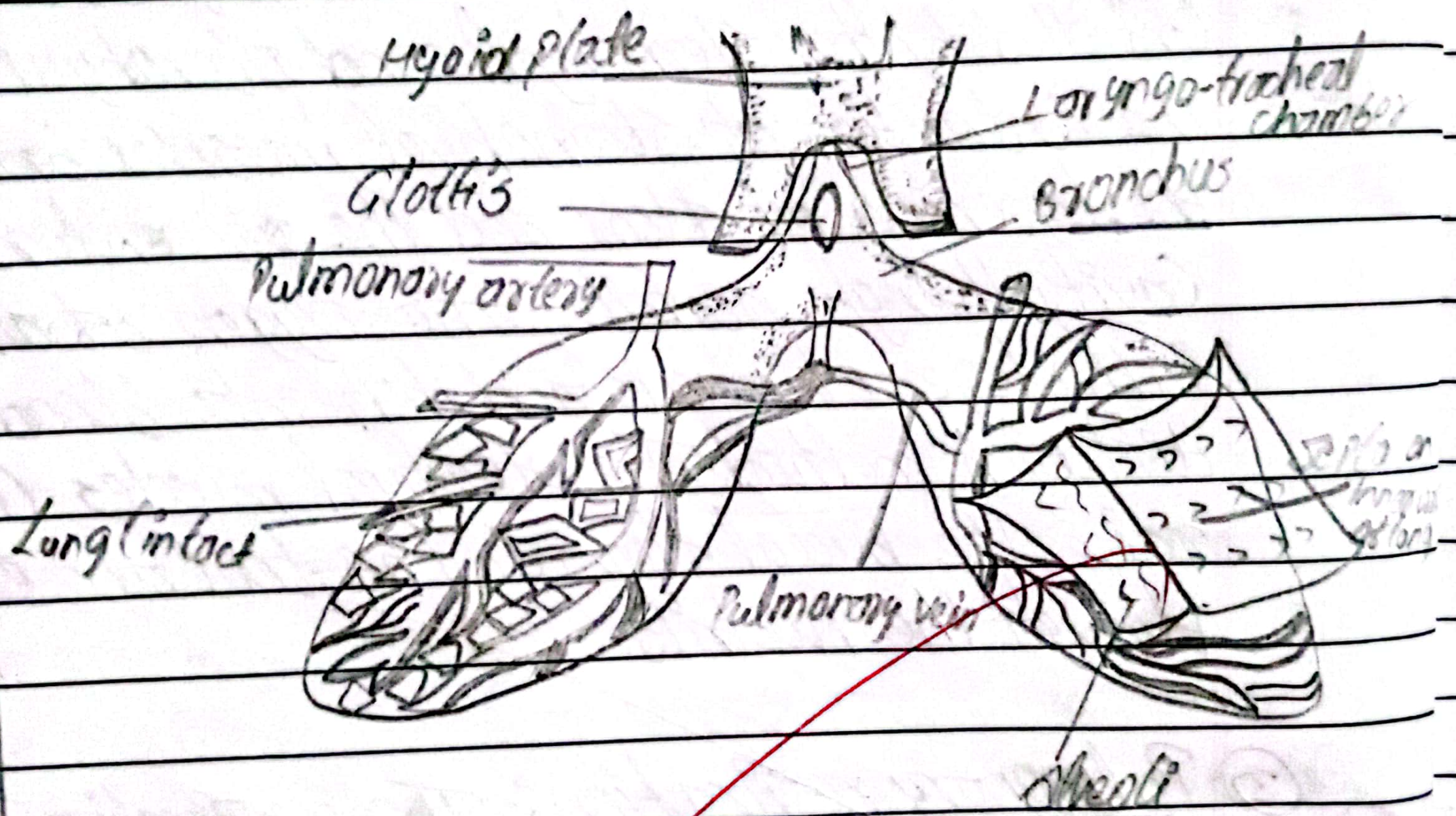


fig:- Pulmonary respiratory organs of frog.

① Respiratory organs :- They are as follows :-

① External nares :- On the tip of the snout, there is a pair of openings through which air gets in and out during breathing are called external nares.

② Internal nares :- There is a pair of small openings lies on the roof of buccal cavity. Just in front of the wall of laryngo-tracheal box.

③ Laryngo-tracheal chamber :- It comprises a pair of elastic horizontal bands, between the arytenoids & Cricoid. These bands are called Vocal Cords which help in sound production. During sound production, the vocal cords come closer and size of glottis is decreased. Now, the air is expelled under pressure which increases the pressure behind the vocal cords & thus makes it vibrating due to which a sound is produced. In male frogs, there is a pair of Vocal Sacs under the head, which amplify the sound.

④ Bronchi :- The laryngotracheal box communicates with the lungs through a pair of small tubes called bronchi.

⑤ Lungs:- There are a pair of lungs situated in the anterior part of the body cavity, one on either side of heart. Each lung is an oval, spongy, elastic & pink coloured structure. Histologically, the lungs are externally covered by a thin layer of peritoneum, internal to this, is a layer of unstripped muscles. Internally, the wall is produced into numerous ridges or septa which divides the lungs into many small chambers called air sacs or alveoli. The alveolar epithelium is moist & supplied with network of blood capillaries which carry out exchange of O_2 & CO_2 .

Physiology of Respiration

① Breathing:- It is a process by which the oxygen is taken into respiratory organs and carbon dioxide is removed from the body. In frog, breathing occurs into two stages i.e. inspiration & expiration.

② Inspiration:- It is the process of taking in oxygen from the atmosphere into the lungs for the gaseous exchange. Due to pressure differences, air is drawn through the nostrils into the mouth cavity. The pressure in the cavity increases and air is forced into the lungs.

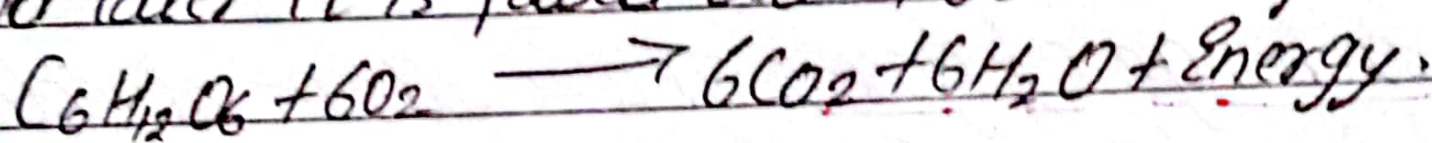
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① Expiration: - During expiration the elastic walls of the lungs and the abdominal muscles contract. This results in the decrease of the lung volume and the pressure in the lungs increases. The volume of the mouth cavity is decreased and the pressure is increased. The air is then pushed outside through the opened external nares.

② Exchange of gases: - The walls of alveoli are very thin and poorly supplied with blood capillaries. They are always moist due to secretion of mucus. In between the expiration & inspiration, the exchange of gases takes place in the lungs by simple diffusion method i.e. from high partial pressure to low partial pressure. Thus the O_2 of lungs diffuses into blood & CO_2 diffuses out of blood to the lumen of lungs. The haemoglobin of blood temporarily combines with O_2 to form oxyhaemoglobin. The oxidized blood is transported to various parts of body & supplies O_2 to various tissues. On reaching the tissues, the haemoglobin dissociates due to less conc. of O_2 in the tissues and thus gives up its O_2 content to the tissues. On contrary, the partial pressure of CO_2 is high in tissues, it combines with blood & carried to the lungs.

③ Oxidation of food :- In the tissues, O_2 combines with glucose. The oxidation process finally releases energy in the form of ATP which is stored in the mitochondria. The CO_2 formed is a byproduct due to the oxidation of glucose.

The CO_2 formed is first diffused into the blood and later it is passed out into the lungs.



Circulatory System of Frog

The system which distributes nutrients and oxygen to all parts of the body and also helps in removal of metabolic wastes from different parts of body is called Circulatory system. It is two types.

a. Blood Vascular system.

b. Lymphatic system.

④ Blood Vascular System :- The circulation of blood through out the body via blood vessels is called blood vascular system. The blood vessels which carry blood away from the heart are called arteries. The blood vessels which collect blood from different parts of body & carry it into heart are called

Veins. It is made up of 3 principal components i.e. Heart, blood vessels & blood.

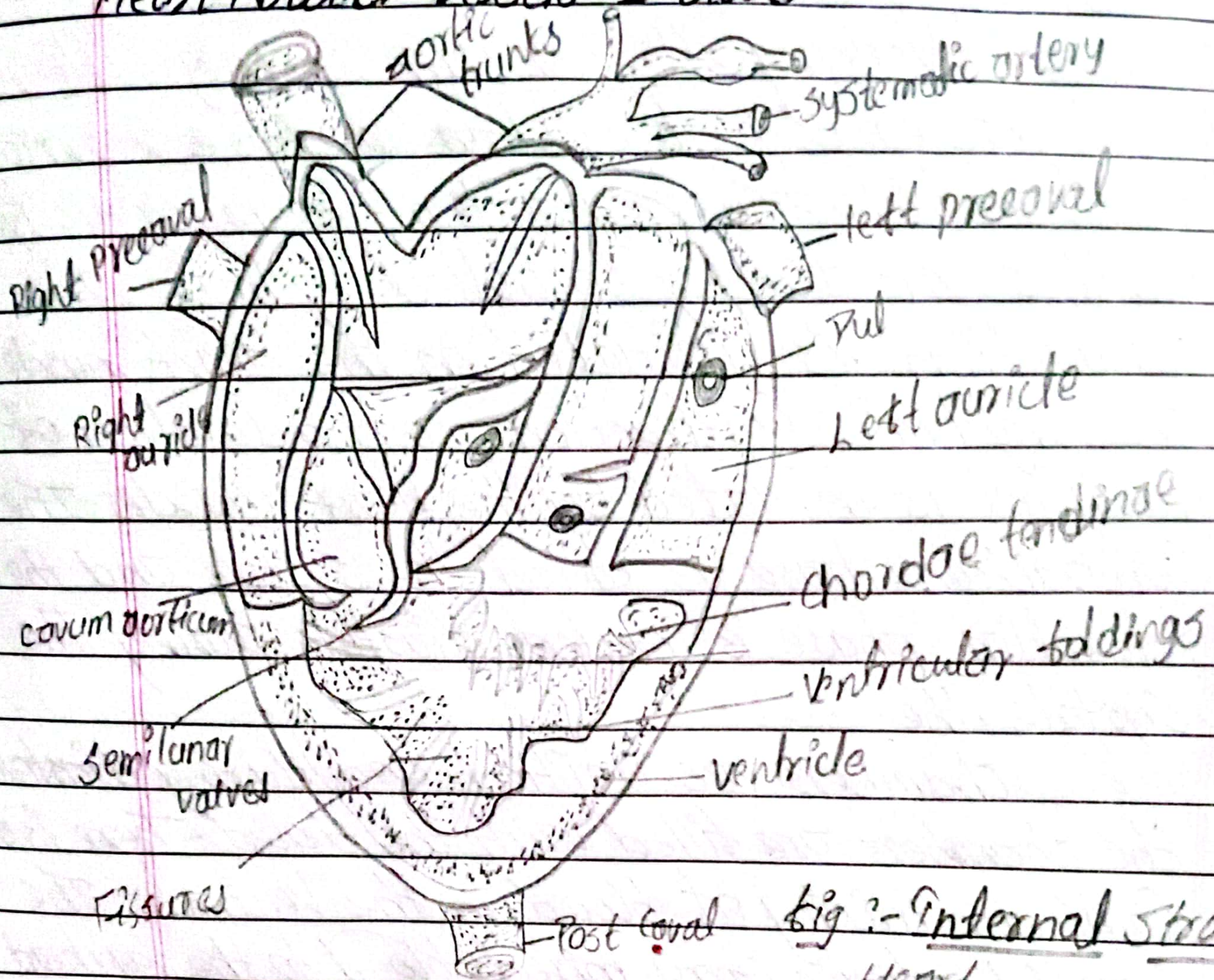


Fig :- Internal Structure of Heart

① Heart :- It is a muscular organ which is situated in the anterior part of the thoracic cavity at the level of forelimbs. It is reddish in colour and protected by a double-layered membrane called pericardial membrane. The space between the peritoneal wall & the heart wall is filled with a viscous fluid called pericardial fluid which protects the heart from mechanical injury. It is conical in shape & is 3

chambered i.e. 2 auricles & 1 Ventricle.

Working Mechanism of Frog's Heart.

Frog's Heart is three chambered i.e. 2 auricles and 1 ventricle. The frog's Heart is myogenic type i.e. it is not directly controlled by brain. The contraction is initiated in the Heart muscle. The rhythmic contraction and relaxation of the Heart is initiated by the Heart muscles. The contraction phase is called the systole and the relaxation phase is called diastole. During the systole, the

chambers are emptied and during diastole the chambers are filled with the blood. There is a complete mixing of blood in the ventricle. The carotid arteries carry mixed blood to the leg, head & brain. The pulmo-cutaneous arteries carry mixed blood to the lungs & skin whereas the systemic arteries carry mixed blood to all parts of the body. Frog is a sluggish animal so it can survive with the mixed blood.

② Blood Vessels :- There are two principal types of blood vessels, these are arteries & veins.

Difference between Arteries & Veins

Arteries

- ① They are tough, thick & deep seated.
- ② They carry the blood away from the heart for distribution & purification.
- ③ They are thick walled, muscular & elastic.
- ④ Their lumens are narrower in diameter.
- ⑤ Big artery is called aorta.
- ⑥ It carry pure pure blood.

Vein

- ① They are delicate thin, non-elastic & superficially situated.
- ② Except pulmo-cutaneous vein, others bring back the impure blood back to the heart.
- ③ They are thin walled, fibrous & non-elastic.
- ④ Their lumens are larger in diameter.
- ⑤ Big vein is called vena cava.
- ⑥ It carry impure blood.

③ Blood:- It is a red coloured fluid vascular connective tissue. It is a viscous fluid formed of blood plasma and cells called blood corpuscles.

④ Plasma:- It is non-living, viscous, colourless fluid. It forms 55-60% of blood by volume. It is slightly alkaline.

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and contains many inorganic and organic substances but the major part is formed by water (About 90 l. water). The inorganic substances include chloride, sulphates, bicarbonates & phosphates of sodium. The organic substances of plasma are proteins, food waste products, hormones etc.

(ii) Blood Corpuscles:- They are floated freely in the plasma & are made up of 40-50% of blood. They are of three kinds:-

- Erythrocytes (RBC):- The erythrocytes are oval, biconvex, nucleated cells about 15 to 20 micron in size. It has a round nucleus in the center & the cytoplasm contains a colour pigment, Haemoglobin. The haemoglobin has a remarkable affinity and is useful in transportation of oxygen gas during respiration. RBCs are formed in the liver & spleen. They have life span of about 100 days.

- Leucocytes (WBC):- The leucocytes are small, nucleated, colourless cell which are less in number than erythrocytes. They are about 4 to 5 thousands per cubic mm of blood are capable to change their body shapes like an amoeba. They may creep out

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through the thin walled, porous, capillaries to engulf and remove foreign harmful bodies from the tissues fluid. This process is called phagocytosis.

- **Thrombocytes (Platelets):** These are smallest corpuscles in the blood. They are nucleated & spindle shaped. They break down when the blood is shed, and released an enzyme, thromboplastin that helps in the clotting of blood. In the frog, the thrombocytes have life span of about 2-3 days & present one-two lakhs per cubic mm.

Functions of blood

The primary function of blood in frog are as follows:

① **Transportation of respiratory pigment:** - The respiratory pigment Haemoglobin present in the blood act as a carrier of O_2 from respiratory organs to the tissues. Similarly, the blood plasma carry CO_2 formed in tissue to the respiratory organs.

② **Defense against diseases:** - The circulating fluid contains WBCs which engulf bacteria and play an important role in defending the body against diseases. They also defend body through antigen antibody.

reaction.

- ③ Transportation of nutrients :- Blood transport all the soluble food compounds which are absorbed through the intestinal wall to be transported to different parts of the body for storage and assimilation.
- ④ Transportation of waste products :- Blood transports excretory products from all over the body & they excreted out through kidneys.
- ⑤ Transportation of Various chemicals :- Inorganic ions, Hormones etc. are also transported by circulatory fluid to maintain a uniform distribution.
- ⑥ Uniform distribution of Heat :- Due to metabolism, Heat is continuously produced in the tissues; from where it is passed to circulatory fluid & then it is evenly distributed through out the body during the course of blood circulation.

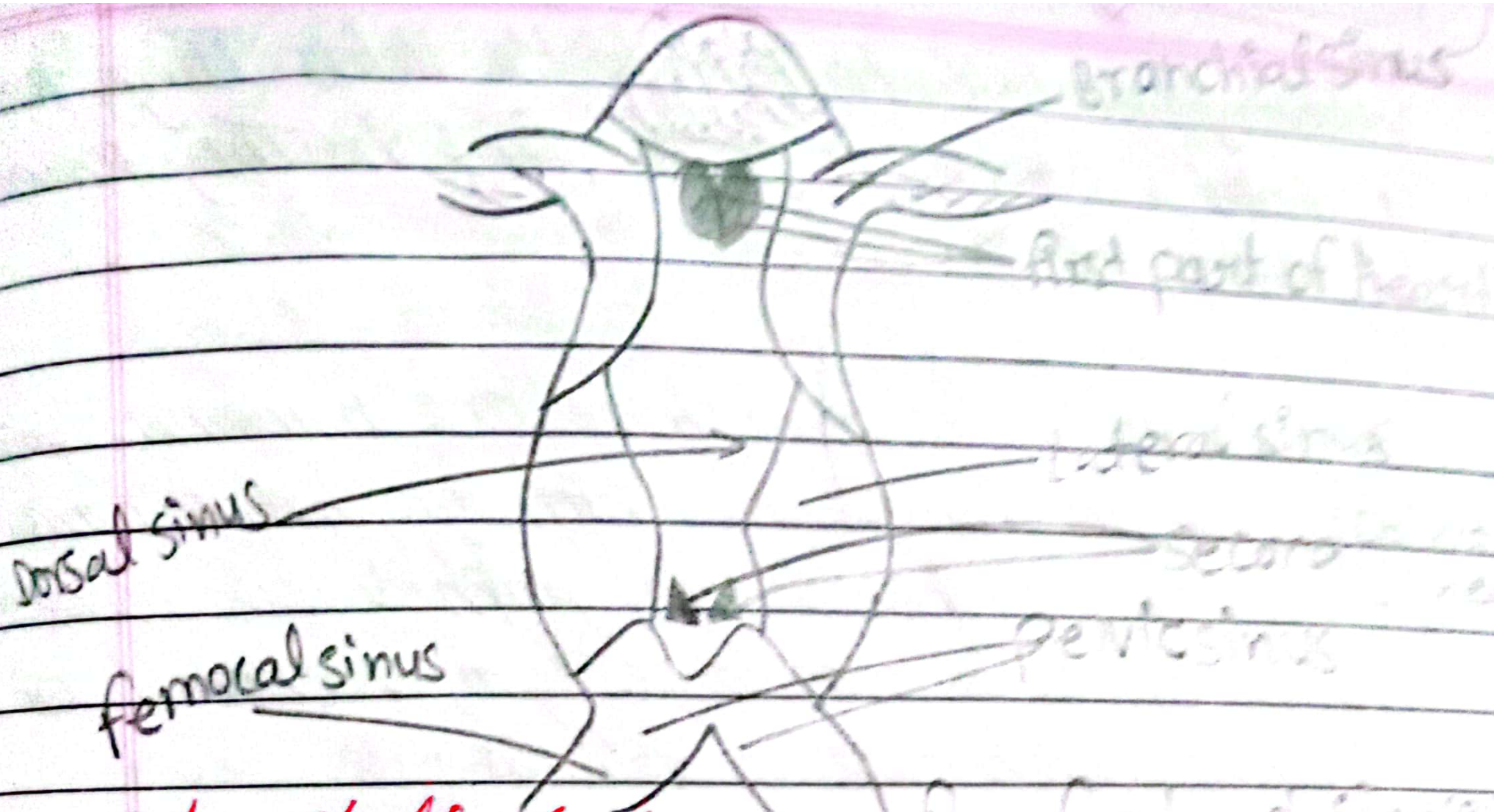


Fig - Frog Lymphatic System

(3) Lymphatic System

It consists of lymph, a colourless fluid instead of blood as a circulatory medium. Its main component are :-

(1) Lymph :- It is a colourless fluid which is actually filtered out part of blood. Lymph :- Blood - RBC - Plasma proteins.

It is a medium of exchange between the blood & the tissue cells. It carries food and oxygen to the cells & takes away water & other waste substances from the cells.

(2) Lymph Vessels :- The lymph capillaries found between the tissue cells have small swollen knobs which help in collecting lymph from tissue. They unite to form larger lymph vessels or lymphatics which finally

discharge their contents into the veins. They are provided with valves present in pairs. They prevent backflow of lymph.

③ Lymph spaces:- In frog, there are numerous lymph spaces in the tissue from which lymph capillaries arise. They unite to form lymph vessels, some of which dilate to form large lymph channels or sinuses which are as follows.

④ Subcutaneous lymph sinuses:- They are large spaces found on dorsal, ventral & lateral sides between the skin & muscles.

⑤ Sub-vertebral sinuses:- They are found around the dorsal aorta & also enclose the kidney.

⑥ Pericardial sinuses:- They enclose the heart, their lymph is called pericardial fluid.

⑦ Coelom:- It is a body cavity containing lymph which is commonly known as coelomic fluid.

④ Lymph Hearts:- Lymph Heart is a small rhythmically contractile sac which slowly drives lymph into vein from the diffuse lymphatic system lymph is pumped back into veins by 2 pairs of lymph hearts.

④ Spleen:- It lies near the rectum in the mesentery & is a dark & coloured body. It acts as a reservoir of blood. It destroys the worn out RBCs & produce antibodies, new RBCs & WBCs.

Reproductive System of Frog

Frog shows sexual dimorphism that is male and female frog can easily distinguish. The male frog is slightly smaller than female frog. During breeding season male frog produce special sound known as croaking, by the help of vocal sac. The croaking is the invitation for the the copulation.

Male reproductive system

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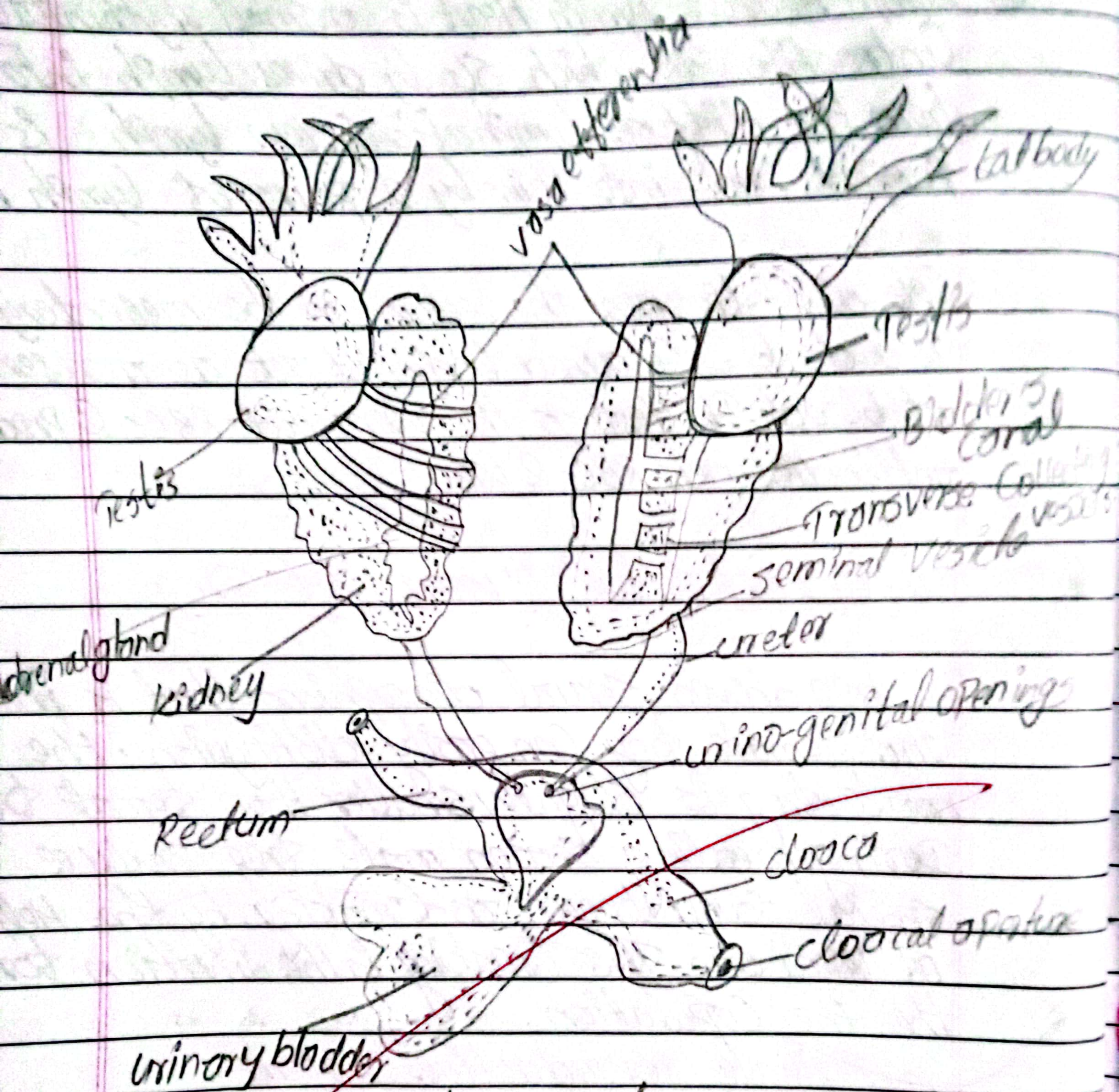


Fig.:- Male urino-genital organ of Inq.

It consists of a pair of testes, Vasa efferentia, urino-genital duct and Seminal Vesicle.

① **Testes**:- They are yellow in colour elongated or oval in shape and found attached to the anterior ventral side of each kidney. They are surrounded by a double fold of peritoneum called mesorchium. Each testis consists of coiled structure called seminiferous tubules or crypts. The epithelial lining of seminiferous tubules consists of germinal cells which produce spermatozoa.

② **Vasa efferentia**:- Many seminiferous tubules unite to form vasa efferentia which is narrow tube like structure. They enter into the kidney. The kidney opens into Bidder's canal. It is long tube which is then connected to the Ureter.

③ **Urino-genital duct**:- It is a tubular duct where the urine and sperm pass through Ureter. So that it is also called as Urino-genital duct.

④ **Seminal Vesicle**:- Each urino-genital duct expands to form seminal vesicle where the sperm are stored until they are ejected out during copulation.

Female Reproductive System

It consists of ovaries, oviducts, ovisacs.

Ovary: They are paired much folded sac. They are lies on Ventral to the kidneys and hang in loops of peritoneum called mesovarium. It is sac like structure composed of ovarian follicles consists of countless ova group of germ remaining cells from ovarian follicles and one of them undergoes Oogenesis to form ova. The mature ova are shed into the abdominal cavity and reach to the oestium by pressure of fore arms of clasping of male.

Oviduct: They are long coiled tubes one on either side of abdominal cavity. Anterior of oviduct funnel called ostium is present. At maturity the eggs are shed & ultimately find their way into the oviduct.

Ovisacs: The coiled part of the oviduct posteriorly dilates to form a thin-walled ciliated ovisacs. They opens by a narrow aperture in the cloaca.

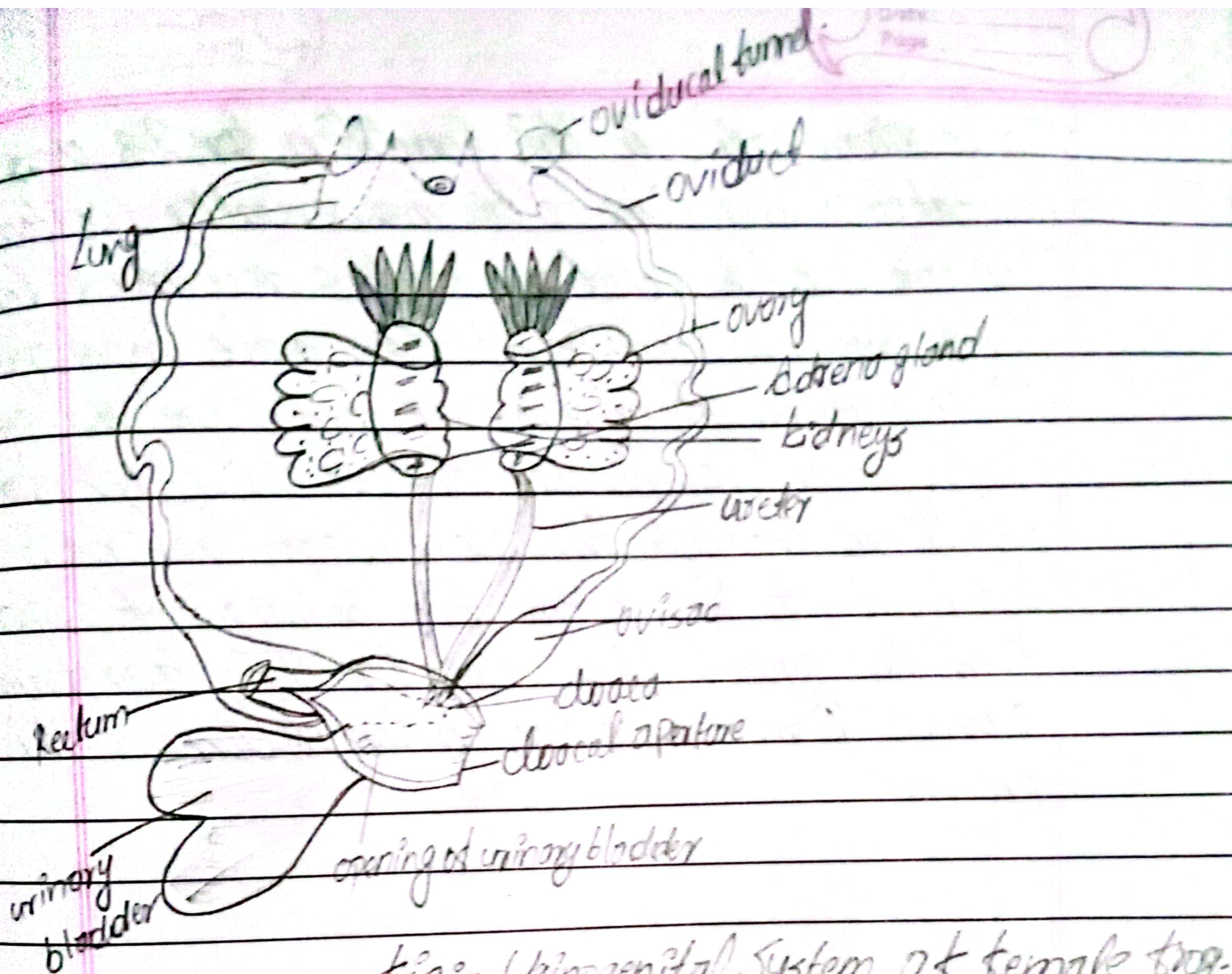


Fig:- Urogenital System of female frog.

Copulation:-

Copulation takes place in water during season. They produce ~~croaking~~ croaking sound with the help of ~~vocal sacs~~ vocal sacs. The vocal sacs ~~act~~ act as amplifiers. The ~~croaking~~ croaking is a mating call for the female frogs. The female frogs getting attached approach the male frogs. The male frog rides over the female frog and embraces. It the male frog holds the female frog firmly by its forelimbs and nuptial pads.

The couple remains in this condition for 2-3 days. The frog takes a long time to become sexually excited, as they are cold-blooded animals & devoid of copulatory organs. The male holds the female more tightly at the state of orgasm. At this stage the female discharges a large number of eggs in water from its ovisac through the cloacal aperture. The male frog right at same moment discharges its sperms over the eggs falling in water. The two animals separate from each other on completion of this process.