Theories of Organic Evolution (Surendra Sharma)

1. Lamarckism (Theory of Inheritence of Acquired characters)

→ Postulated by Jean Baptiste De Lamarck (French Biologist)

→ based on the idea that; changes acquired or developed by the individuals during their life-time are transmitted to their offspring and environment plays an important role in formation of new organs.

* Postulates:-

i. Tendency to Grow: Lamark said that every organism have tendency to grow upto a certain limit due to internal forces of life. The limit of growth of organisms is determined by themselves.

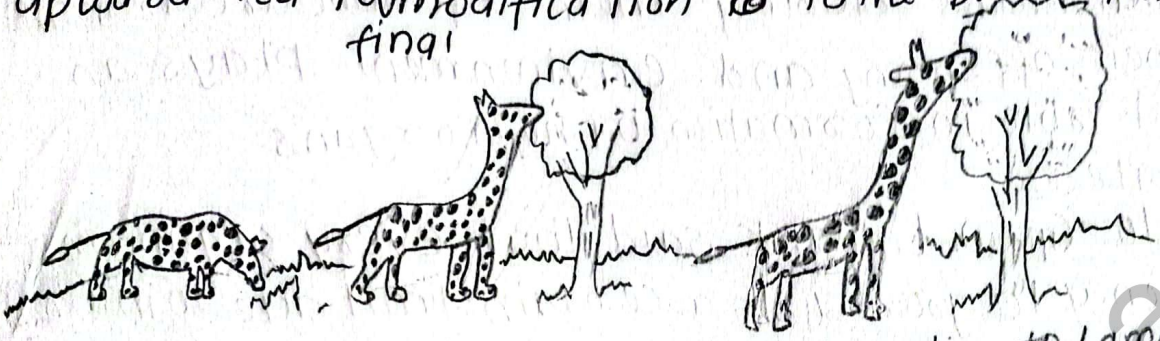
ii. Environmental effect and formation of new organs:-
The environment in which living organisms reside influence them very much, which leads to the change in their habits, which results structural modification or ~~evolution of~~ evolve new organ. to meet the new needs.

iii. Effect of use and disuse of organs:-
The efficiency and development of an organ or system is directly related to its use. It states that a continuous use of an organ by organisms makes it strong, large and functional, while disuse of organ leads into reduction in size and finally total disappearance in upcoming generations.

iv. Inheritance of acquired characters:
All the changes that have been acquired by an organism during its life time by use and disuse of it is known as acquired characters and according to Lamarck such modifications become pronounced, depending upon continuous use and disuse of organs in the offsprings.
These acquired characters goon accumulating in offspring generations after generations and finally in long course of time a new type of organism is evolved which is totally different from the original parents.

Examples:-

1. Long Necked Giraffe: According to Lamarck theory the present long-necked giraffes have evolved from short necked giraffe. When grasses became scarce the original giraffes began to eat the leaves of trees. The constant stretching of the neck and forelimbs upward led to modification in to the present long-necked giraffes.



Evolution of Giraffe According to Lamarck

2. Aquatic birds like ducks have been evolved from the terrestrial ancestors. They moved in water to get best food. Some structures like webs evolved between toes to adapt in water and lose the flying power because they had no need of flying.

Criticisms of Lamarkism:-

(1) Mutilation (removal of part of the body) is not inherited. If limb or finger is mutilated or cut it does not disappear in offspring.

(2) Eyes that are used continuously and constantly develop defects instead of being improved.

(3) Weishmann practically showed that cutting of tails in newly born rats upto 20 successive generations did not bring any change in size of tail in offspring.

(4) Chinese woman use iron shoes to keep their feet short but young ones at birth have normal sized.

(5) Boring of nose and ears in women practised for centuries is not inherited to offsprings.

(6) Circumcision of genetalia in Muslim and Jewish boys is not inherited to next generation.

(7) Wrestler's powerful muscles are not transmitted to the next generation.

(8) Organism not always evolve towards greater complexity as highly developed flowering plants are usually very small in size.

Darwinism (Theory of Natural selection)

~~Given by Charles Robert Darwin and Sir Alfred Wallace~~

→ Darwin made worldwide journey at the age of 22 and studied/collected several species of plants and animals. After researches, Darwin and Sir Alfred Wallace combinedly published a book named 'Origin of species'. Later Darwin wrote a famous book origin of species by natural selection in 1859 AD in which he explained his theory of evolution. which is popularly known as Darwinism.

* Postulates

1. Over production of offsprings:-

→ Every organisms can produce much more number of offsprings than possibly can survive. Foreg:- ① a single salmon produces 28,000,000 eggs in a season. ① Even the slowest breeder elephant can produce 19 million descendents in 750 years. ① a single housefly lays ~~8 batches~~ about 120-150 eggs in one time and six times in a summer. Such eggs hatch in 10 days and become sexually mature in 14 days.

2. Struggle for existence: It is found that population of the individuals tends to increase in geometric ratios, but the food and other resources multiply in arithmetic ratios. If all the reproduced offsprings survive, there would be an acute shortage of food and shelter leading to struggle for existence. The struggle may be:-

(i) Intraspecific struggle: Struggle between the members of same species e.g. two dogs struggle for food or mate.

(ii) Interspecific struggle: struggle between members of different species. e.g. struggle between predator and prey.

(iii) Environmental struggle: struggle between living organisms and adverse environmental condition like extreme hot, extreme cold, drought, calamities, etc.

Due to the result of above-mentioned struggle survival number remains fairly constant on earth.

3. Variation and heridity: The everlasting competition among the living organisms has compelled them to change themselves according to needs to utilize natural resources and survive successfully. such changes are called variations.

variation may be useful or harmful. Useful variations makes the organism stronger and harmful variation makes them weaker. Such variations are trasmitted to the next generations so that offspring are better suited for their environment.

4. Natural selection/survival of fittest: Those organisms which have useful variations will lead a more successful life and can survive and reproduce while the weaker forms are rooted out. Darwin → Natural selection
Wallace → survival of fittest.

5. Origin of new species: Useful variations goes on accumulating in naturally selected organisms and after a long course of time variations become so prominent that the organisms become quite different from the ancestors and give rise to a new species. This is called speciation.

Examples on support of Darwinism:-

(i) DDT resistant Mosquito:- After the use of DDT at the initial times, a few number of mosquitos survived as they could able to develop resistance power as per the needs of surroundings. Soon, on account of reproduction DDT resistive species outnumbered DDT sensitive mosquitoes. Finally, DDT brought genetic change and DDT resistant mosquitoes was evolved.

(ii) Industrial melanism: ~~Before~~ In the city of England, before industrialization, light coloured moths (Biston carbonaria) were predominant as they could camouflage on the background of tree trunk. But black coloured moths could be easily detected by predatory birds. But, due to deposition of smoke and dust during industration tree trunk became dark and black coloured moth became predominant. It means ~~the~~ light coloured moths changed their colour as per the need of environment.

* Criticisms:-

(i) Natural selection doesnot explain about the presence of the rudimentary structures.
(ii) The theory only explains about the survival of the fittest but not about the arrival of the fittest.
(iii) Darwin kept Pangenesis hypothesis in dark.
(iv) The theory did not take into account mutation, which is considered as chief source for formation of new species.
(v) His theory does not difference between somatic and germinal variations.

(VI) Natural selection does not ~~ep~~ explain about the power of regeneration.

(VII) Darwinism could not explain about over specialization of certain characters in organisms. Eg:- tusks of elephant, antlers of deer, etc.

Neo-Darwinism (Modern Synthetic Theory of Evolution)

→ modified version of Darwinism
→ contributed by J.S. Huxley, J. B.S Haldane, E. Haeckel, etc.
→ According to NEO-Darwinism, natural selection is not a single factor for evolution, rather there are multiple causes of organic evolution which are given below:-

1. Genetic Variations:- variations in genetic makeup or gene pool of organisms. The various sources for it are:-

(i) Gene recombination:- → recombination means production of new genotypes due to crossing over during meiosis cell-division
→ new genotype totally vary from parental ones.

(ii) Mutation:- Sudden discontinuous and changes in genotype of organism that alter their phenotypes. They may be caused by change in structure of chromosomes (chromosomal aberrations) or genes (gene mutation). (Hugo de Vries)

(iii) Genetic Drift: It involves the elimination of genes of some original characteristics of a species by extreme reduction in a population due to migration or epidemics.

(iv) Hybridization: It is the interbreeding between two genetically different individuals to produce hybrids.

2. Natural selection:-
→ occurs through 'differential reproduction'.
→ Differential reproduction states that those individuals, which are best adapted to their environment produce offsprings at a higher rate than those which are less adapted. If differential reproduction continues for many generations, then the genes of best adapted individuals become predominant in the gene pool of the population.

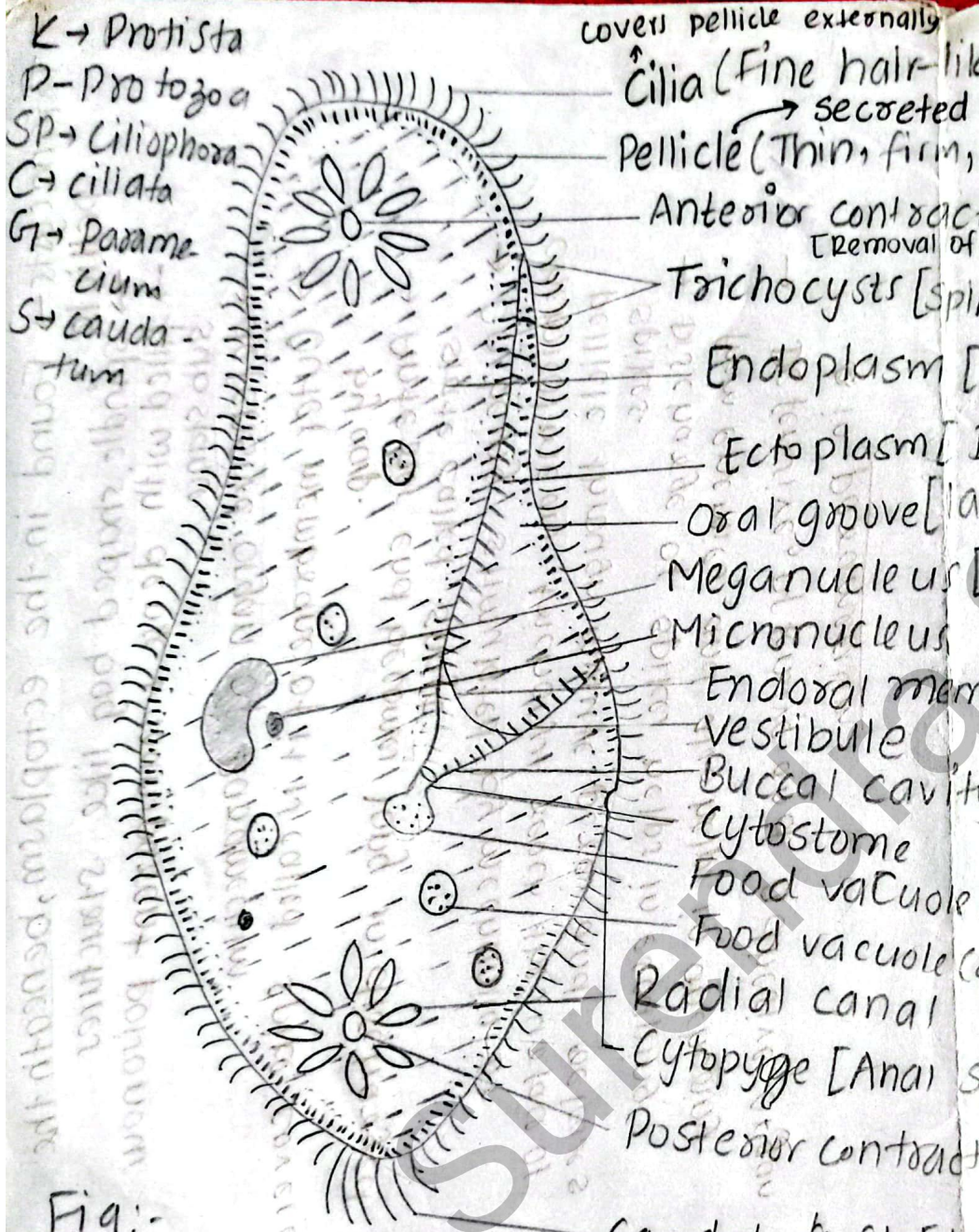
3. Reproduction isolation:- The phenomenon which prevents mating among potentially interbreeding groups due to physical or biological barrier is called reproduction isolation.
Biological barrier: different morphology of reproductive organs.
Physical barrier: sea, mountains, deserts, etc.

4. Speciation: It is the origin of new species from existing one due to modification with time. According to the concept of isolation, if the population is broken down into two units and prevented from interbreeding with each other for a long time, they adapt differently and develop themselves into different evolutionary lines i.e. evolution of new species.

	Body	Coelom	Symmetry	Germinal layer	Respiration	Excreation	Unique
Protozoa (Primitive animal)	Naked or covered with pellicle	-	Asymmetrical (some radial or bilateral)	-	General body surface	General body surface & contractile vacuole	→ unicellular → Locomotion by cilia, flagella or pseudopodia → cytoplasm - outer ectoplasm, inner - endoplasm
Porifera Eg:- Sycon, Spongilla, etc.	bears numerous pores called ostia	Acoelomate (but has central cavity called Spongocoel)	Asymmetry (some, radial)	Diploblastic (Between two layers Mesogleea)	General body surface (canal system)	General body surface (Canal system	→ body supported by spicules (made up of $CaCO_3$, Silica or Spongin fibre) → Cellular grade of body organization)
Coelentrata Eg: Hydra, Sea anemone, Obilia, etc	Posseses hollow gastro-vascular cavity called Coelentron	Acoelomate i.e coelom is absent	Radial Symmetry	Diploblastic (Between two layers gelatinous mass called mesoglea)	General body surface	General body surface	→ possess stinging cells called cnidoblast, which form nematocysts for paralyzing preys. → Alternation of generation betw. sexual medusoid and asexual polypoid.
Platyhelminthes Eg: Liverfluke, Tape worm, etc.	Dorso-ventrally flattened	Acoelomate	Bilaterally Symmetrical	Triploblastic	Respiratory, circulatory system is absent	Flamecells or protonephridia	→ Alimentary canal is absent or incomplete (without anus). → Organ grade → Mostly hermaphrodite
Nemathelminthes/Aschelminthis ~~→ Locomotory organ are setae or chaetae~~	Elongated, unsegmented & Round; covered by cuticle	Pseudocoelom (having false coelem)	Bilaterally symmetrical	Triploblastic	Respiratory and circulatory system are absent	Excretory glands; protonephridia for osmoregulation	→ Complete alimentary canal Eg:- Round worm, Hookworm, Wuchereia bancrofti (Filarial worm), etc.

	Body	Coelom	Symmetry	Germinal layer	Respiration	Excretion	Unique
Annelida → Locomotory organ are setae or chaetae	Elongated and vermiform, Metamerically segmented i.e. external segmentation is corresponds to internal segment.	True coelomate	Bilateral	Triploblastic	General body surface [Respiratory pigment; haemoglobin]	Nephridia	→ Moist cuticle as body covering → Straight and complete alimentary canal → Closed type circulatory system Eg:- Earthworm, Leech, etc.
Arthropoda	Covered by chitinious exoskeleton	True coelomate [Haemocoel; filled with blood]	Billateral	Triploblastic	Gills, trachae, or book lungs	Malphigian tubules (Terrestrial), coxal gland or green gland (aquatic)	→ largest phylum → body divided into head, thorax and abdomen → jointed appendages Eg:- Prawn, Spider, etc
Mollusca → body usually covered by shell made up of $CaCO_3$	divided into head, foot, mantle and visceral mass	True	Bilateral Eg: Slug, Snail, Pila, Octopus, etc.	Triploblast	Gills, pulmonary sacs	Kidneys	→ Circulatory system is open with blue blood due to copper containing pigment; haemocyanin → soft bodied, unsegmented
Echinodermata Eg:- Starfish, Sea urchin, etc.	Supported by calcareous exoskeleton bearing protective spines	True Locomotion- tube feet	Radially	Triploblastic	Gills, Tube feet, Papulae, Cloacal respiratory trees	Excretory organs are absent	→ Exclusively marine → pentamerous arrangement of body → developed water vascular system which help in feeding, respiration, locomotion

K → Protista
P - Protozoa
SP → Ciliophora
C → ciliata
G → Paramecium
S → caudatum

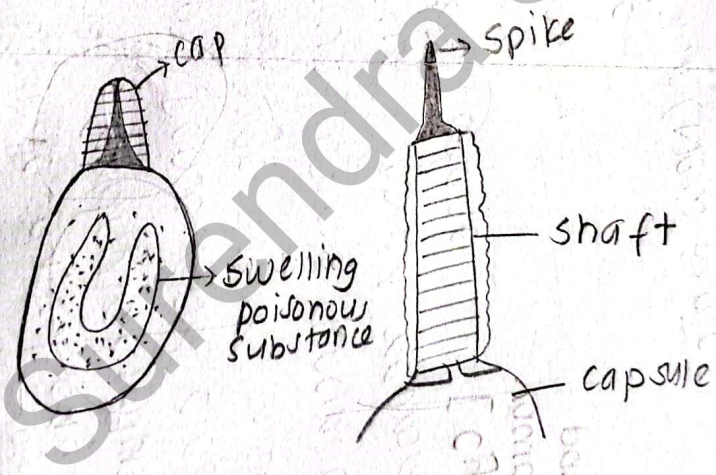


covers pellicle externally
↑
Cilia (Fine hair-like protoplasmic structures → locomotion + food capture)
ciliary movement
Pellicle (Thin, firm, elastic & colourless membrane → maintains shape)
→ secreted by ectoplasm
Anterior contractile vacuole [Fixed shape → removal of CO_2 and excretory (osmoregu...)
[Removal of excess water by osmosis → osmoregulation]
Trichocysts [spindle shaped bag like → Offense and defense)
Endoplasm [Granular, fluid like]
Ectoplasm [Dense and clear outer part)
Oral groove [large depression on ventral surface → makes food vacuole)
Meganucleus [controls general cellular activities res., dig., ...
Micronucleus [control reproductive activities)
Endoral membrane
Vestibule
Buccal cavity
Cytostome
[Cytopharynx forms new food vacuole packing ingested food particles inside it]
Food vacuole (New formed)
Food vacuole (detached) [Always moves in clockwise direction for digestion, absorption and elimination called cyclosis)
Radial canal
Cytopyge [Anal spot], behind cytopharynx, Undigested food is egested out]
Posterior contractile vacuole
Caudal tuft [lengthy cilia on posterior end)
↳ change of direction during swimming

Fig:-

...ramecium caudatum

Trichocysts → Found in the ectoplasm, beneath the pellicle
- → spindle shaped bag like structures
- → filled with dense & transparent poisonous substance.
- → defensive organ of Paramecium
- → Outer membrane of it is called spike covered by cap.
- → Anterior end becomes long in discharged state called shaft.
- → On being stimulated by mechanical or chemical means trichocyst reach the surface of pellicle through minute pores and releases spikes.
- → Discharge of spikes helps in escaping from enemies and also helps in anchoring
- → Defensive, offensive and adhesive organ in Paramecium



Trichocyst of Paramecium

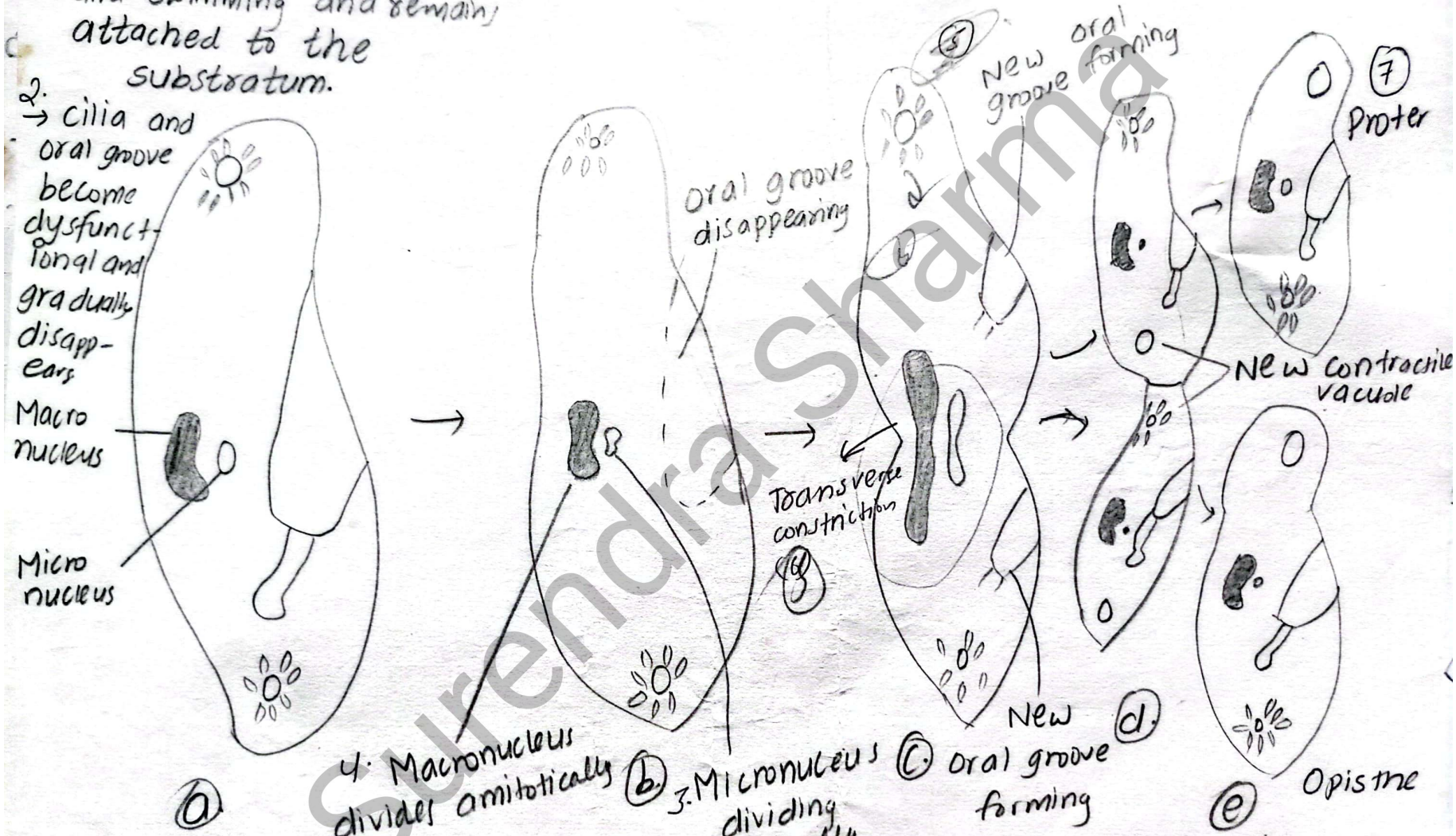
Asexual Reproduction (Transverse binary fission)

1. → Paramecium stops feeding and swimming and remains attached to the substratum.

2. → Cilia and oral groove become dysfunctional and gradually disappears

Macro nucleus

Micro nucleus



4. Macronucleus divides amitotically

3. Micronucleus dividing mitotically

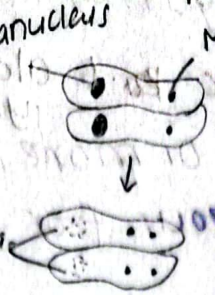
→ During favourable condition.

(8) completes in 30-120 min

→ After continuous binary fission upto 300 generations it losses it vigour. So, to gain new vigour they reproduce sexually to gain

Conjugation in Paramecium:-

Temporary union of two individual of same sp. but dif mating types for nuclei exchange of nuclear material.
→ unfavorable condition.



① 2 Paramecia fused (conjugants) of different mating type.
② stop feeding: bucal st. disappear.. Meganucleus disappers and micronucleus divides twice

3 of 4 micro nuclei in each conjugant disappear

Remaining one nucleus divides meiotically and unequally into two gamete nuclei

Female pronuclei (migratory)

Male pronuclei (migratory)

Smaller pronuclei (males) are exchanged through protoplasmic bridge

2 pronuclei in each conjugant unite to form zygote nucleus (synkaryon)

Synkaryon

exconjugant

Paramecia separate as exconjugants

Zygote nucleus in each divides 3 times and 8 nuclei are formed (4 micro and 4 macro)

Macronuclei

Micronuclei

3 out of 4 micronuclei disappears

Each exconjugant divides into two with the division of micronucleus (Each new 1 mega and 1 micro nucleus)

4 daughter paramecia from 1st exconjugant

4 paramecia from 2nd exconjugant

Significance of conjugation:

(1) Rejuvenation ↳ wear & old Paramecium becomes young, viable and energetic.
→ look younger or more lively
→ revive lost vigour for asexual reproduction.

(2) Nuclear organization:
(6) One pair of Paramecia produces eight daughter Paramecia at a time ie. a rapid multiplication process.
→ old macronucleus: unable to control metabolic activities.
→ replaced by new which brings renewed vigour and accelerate metabolic activities

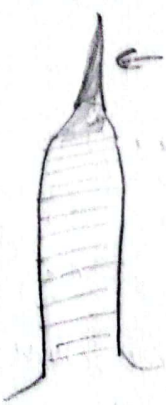
(3) Hereditary variation: exchange of nuclear material

(4) Formation of new strains/evolution: conjugation of two opposite mating types.

(5) Immortality: Due to conjugation, there is no natural death of Paramecium for ever.

Trichocysts
→ In the ectoplasm beneath the pellicle
→ numerous, small spindle shape bag like structure.
→ defensive organnels of Paramecium.
→ On being stimulated by mechanical or chemical mean, it reach the surface of pellicle through minute pore, and release the thread like st called spike
→ Discharge of spike helps in escaping from enemies, and it also help in anchoring
→ Trichocyst → offensive, defensive & adhesive organ.

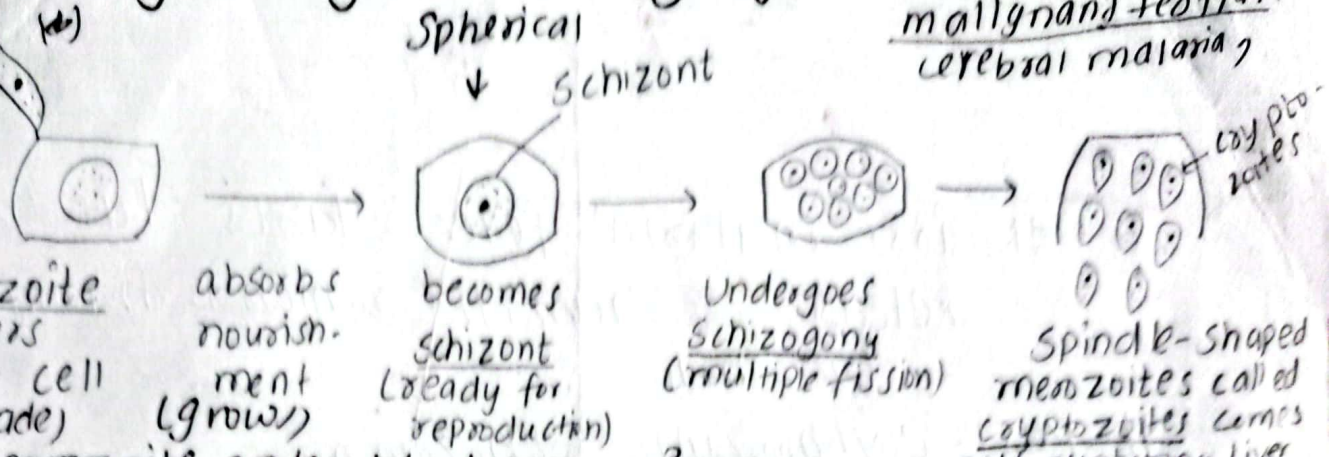
Trichocyst



Discharged trichocyst

Pre-Erythrocytic Schizogony:-

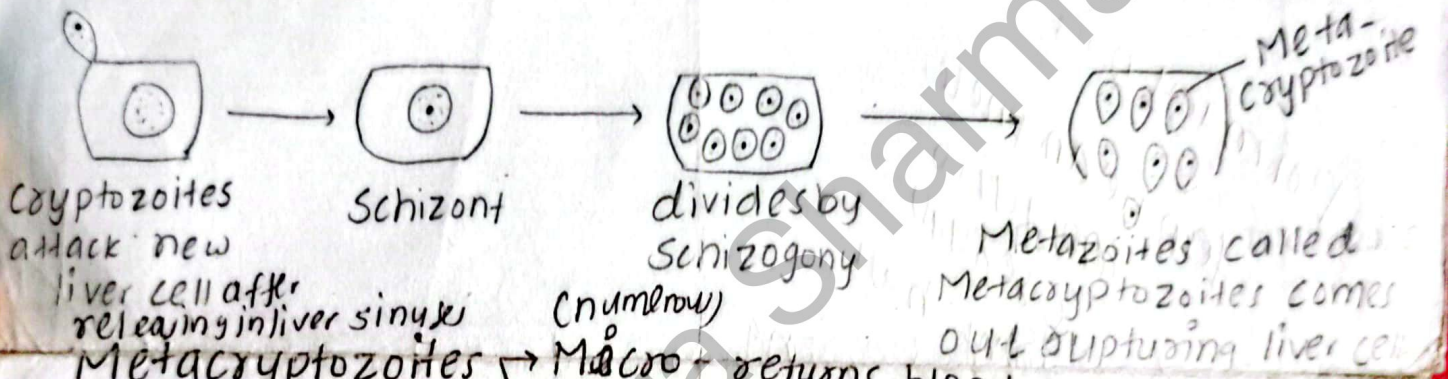
P. falciparum → malignant tertian / cerebral malaria



(2) Sporozoite enters liver cell (invade) → absorbs nourishment (grows) → becomes schizont (ready for reproduction) → Undergoes Schizogony (multiple fission) → Spindle-shaped merozoites called cryptozoites comes out rupturing liver cell

(1) Sporozoite enter bloodstream, circulate passively along blood circulation for 30 min, reach liver.

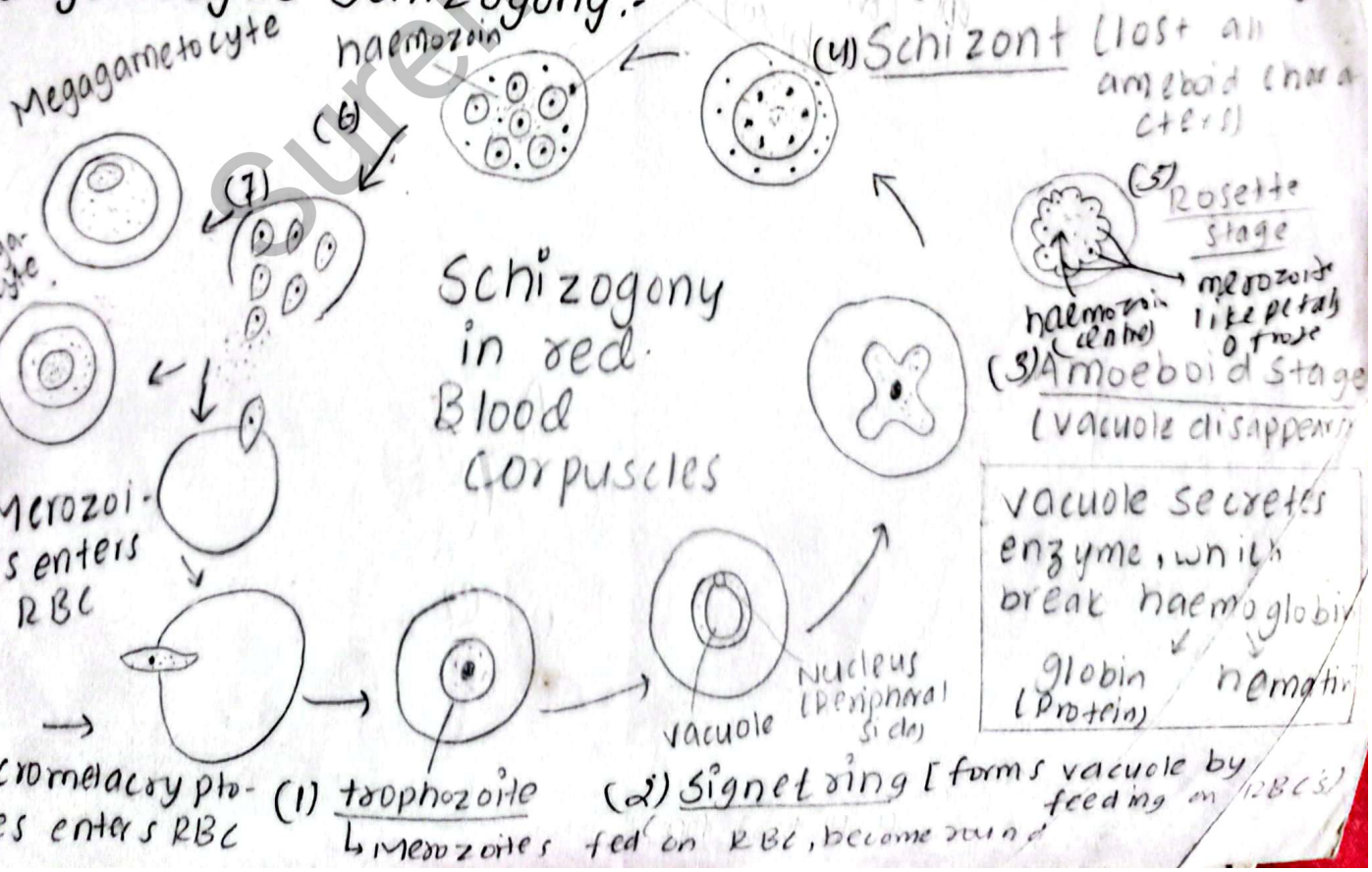
Exo-erythrocytic schizogony:-



Cryptozoites attack new liver cell after releasing in liver sinuses → Schizont → divides by Schizogony → Metazoites called Metacryptozoites comes out rupturing liver cell

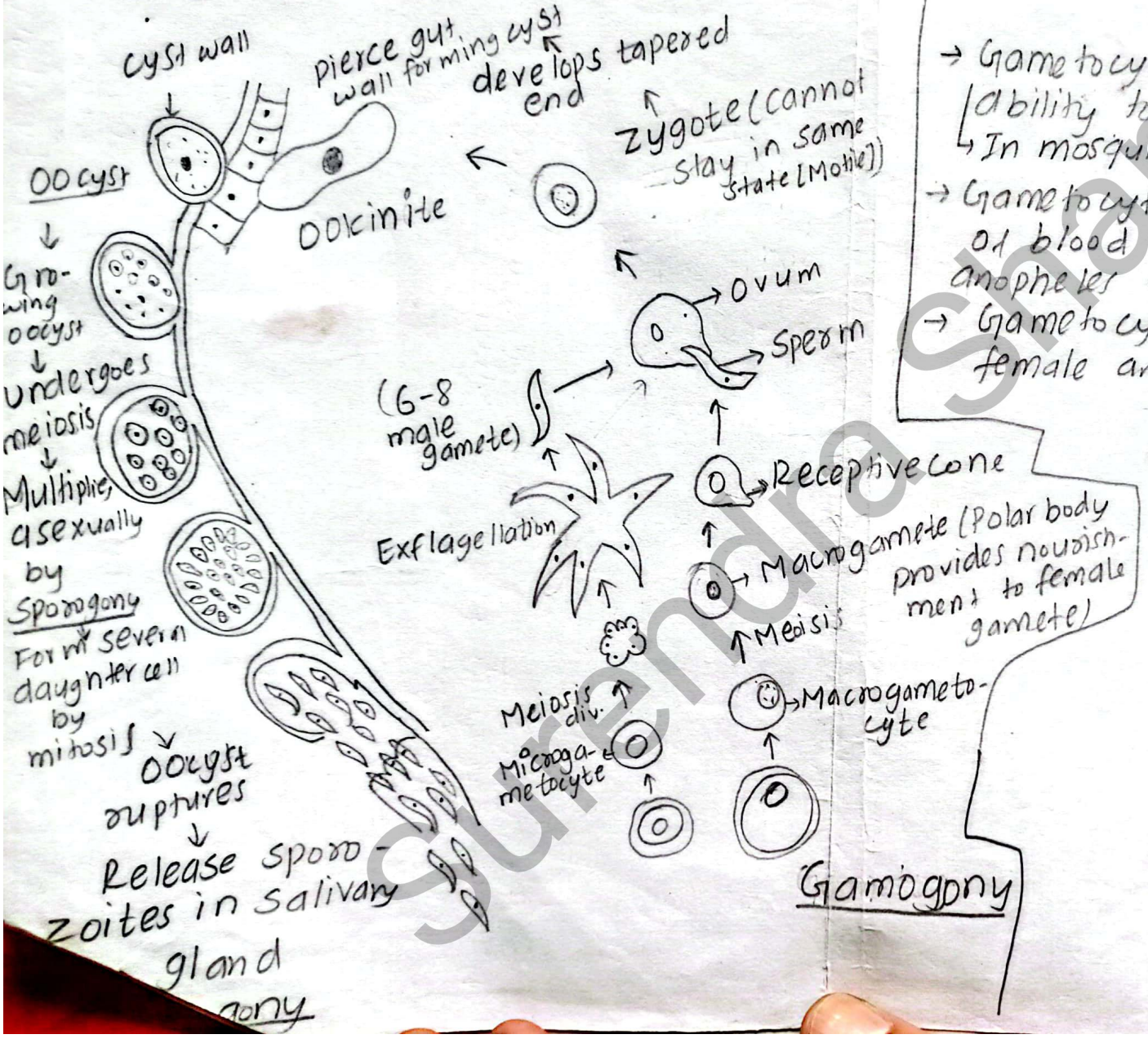
Metacryptozoites → Macro (numerous) - returns blood stream
→ Megal (Macro) (less-number) - continues feeding liver cell.

Erythrocytic schizogony:-



Sexual Cycle in mosquito:

(I) Gamogony (Gametogenesis + Fertilization)
(II) Sporogony (Formation of sporozoites)



Merozoites

Some return to liver cell (Post-erythrocytic schizogony)

Some form gametocytes (low)

Micro (Male) (less)

Macro (Female) (more)

→ Gametocyte: Those cell which has ability to form gamete by meiosis.
↳ In mosquito? → primary host → cold temp.

→ Gametocyte goes to peripheral side of blood vessel and when female anopheles bites us it sucks gametocyte.

→ Gametocyte goes to stomach of female anopheles → Gametogony starts.

↓

1st cycle in Mosquito (Process of forming gametes from gametocyte)

Classification of Frog:-

Kingdom: Animalia
Phylum: Vertebrata
Division: Gnathostomata
Super class: Tetrapoda
Class: Amphibia
Genus: Rana
Species: tigrina

Hibernation and Aestivation in frog:-

Since frog is cold blooded or poikilothermic animal i.e. body temperature fluctuates according to surrounding environment.

During winter, temperature becomes very low. So, to get protection from extreme cold it undergoes winter sleep under the soil, which is termed as hibernation.

Similarly during summer, temperature becomes very high. So, to get protection from extreme heat it undergoes summer sleep in the mud called aestivation.

During hibernation and aestivation, it respires through skin (cutaneous respiration) and get energy from the stored fat bodies.

Colouration of frog:-

Dorsal surface of frog is green with black spot so that it is not noticed easily by prey.

Frog produces croacking sound during mating season (rainy season) with the help of vocal sac in order to attract female frog for mating.

Endocrine part of pancreas → Islets of Langerhans produce insulin and glucagon.
Exocrine part of pancreas → Pancreatic juice

Glycogenis → process of formation of glycogen (insulin) from glucose
Glycogenolysis → process of formation of glucose from glycogen (Glucagon)

Acrodont: directly attached to jaw bone
Polyphyodont: replaced periodically

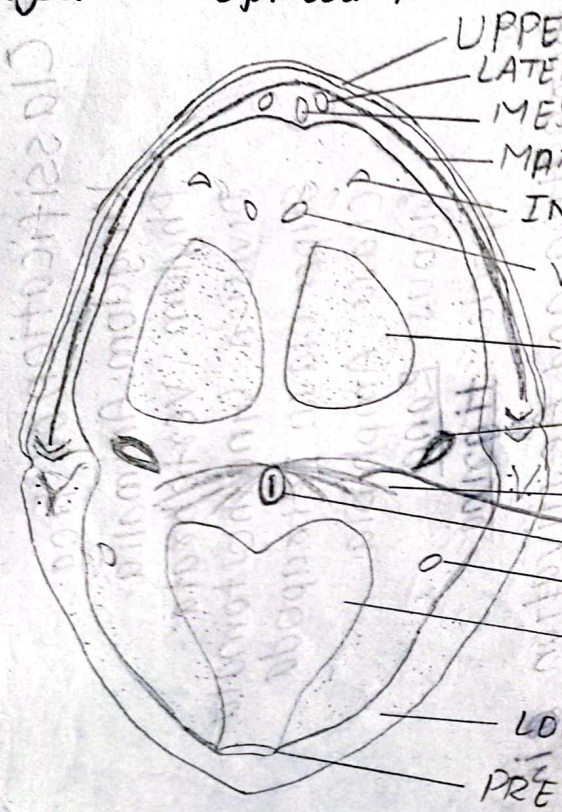
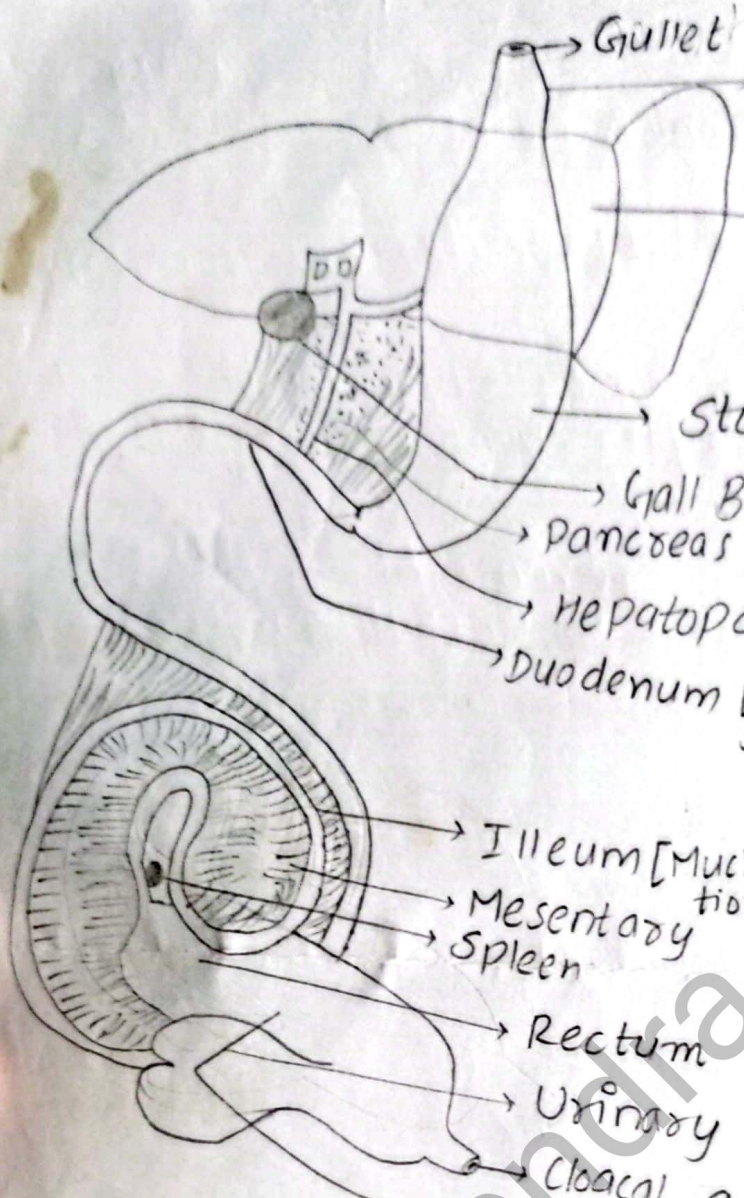


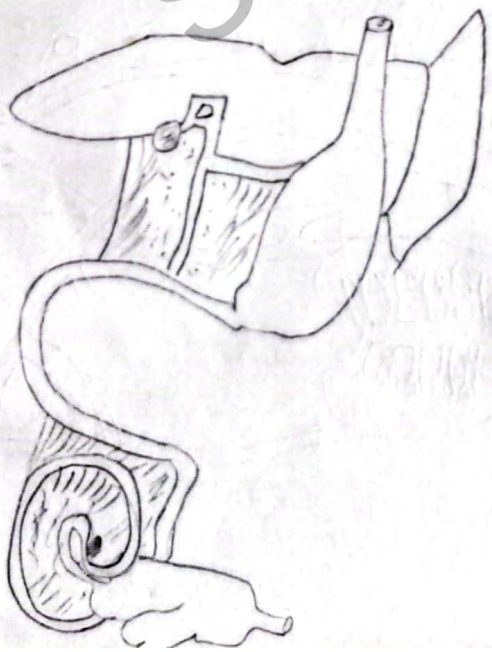
Fig: Bucco-Pharyngeal cavity of male frog

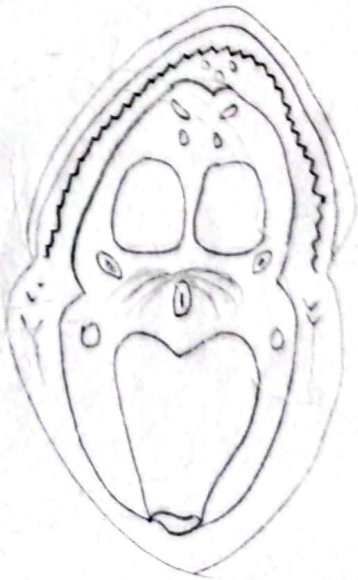
Homodont → similar in structure
Mouth → wide slit opening/aperture
→ extends from tympanum of one side to other]
[gets attached to pre-lingual elevations and compulsory close mouth]
[Prevent escape of prey]; attached to maxillae bone.
homodont; acrodont; polyphyodont]
[Inner hole of nasal cavity] nostrils]; Communicate external nares]
[attached to vomer bone]
[Help push food inside; swallowing]
[Communicate with middle ear]
Gullet +
[Follows bucco-pharyngeal cavity]
[Amplify sound that come from vocal cord]
[Prostusible; attached to anterior portion; capture. preys; bifid; sticky]

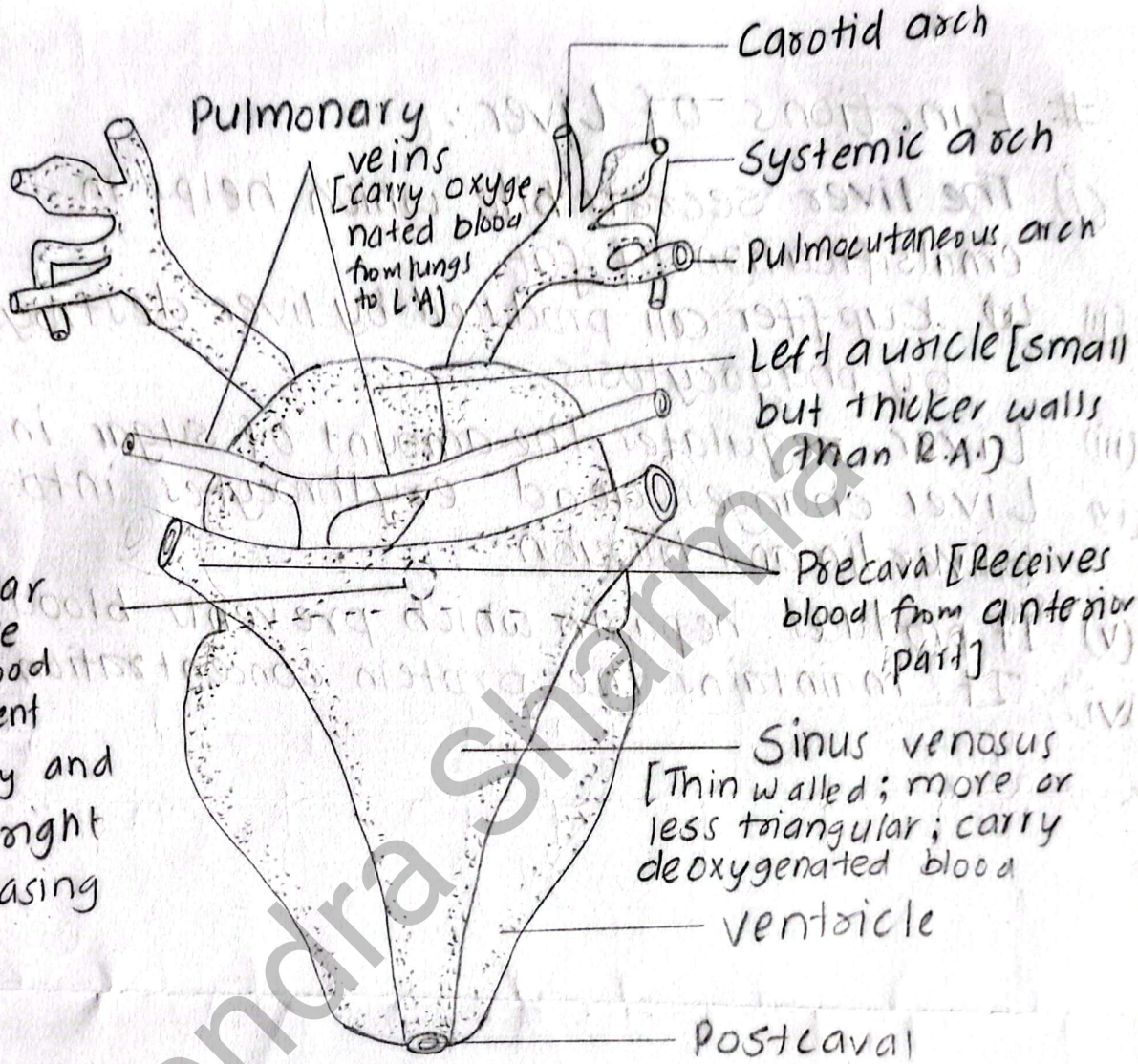
Large cavity followed by mouth - Buccal cavity.
↓
internally lined by thin ciliated columner epithelium containing mucous secreting cell. (keeps buccal cavity moist; lubricate food)



→ Gullet
→ Oesophagus [Connects gullet to stomach; mucous membrane help to pass down food (bolus) makes food slippery]
→ Liver
→ Stomach [sac like; C-shaped; store food; gastric gland - digestion; two part]
→ Gall Bladder
→ Pancreas
→ Hepatopancreatic duct
→ Duodenum [receives hepatopancreatic duct; U shaped, separated from stomach by pyloric constriction]
→ Ileum [Much-coiled; inner lining → villi: help in absorption and mucous lining secrete intestinal juice]
→ Mesentary
→ Spleen
→ Rectum
→ Urinary bladder
→ Cloacal aperture [Discharges temp. stored things in cloaca]
→ Cloaca [common room for temp. storage of urine, faeces and reproductive bodies]







Dorsal view

Functions of Liver :-

P → 16
C → 17
B → 18

(i) The liver secrets bile which helps in emulsification of fat.

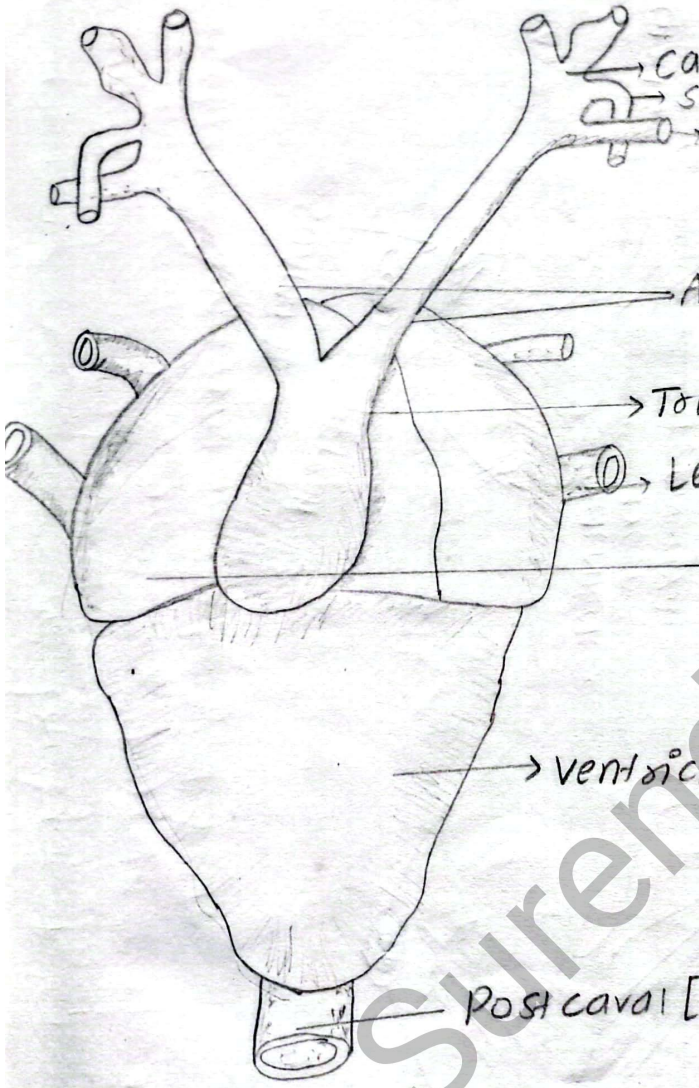
(ii) Kupffer cell produced by liver destroys bacteria by phagocytosis.

(iii) Liver regulates the amount of sugar in the blood.

(iv) Liver changes dead erythrocytes into bile pigments biliverdin and bilirubin.

(v) It produces heparin which prevents blood clotting.

(vi) It maintains the protein concentration in the blood.



→ Carotid arch [carries blood to brain and skull portion]
→ Systemic arch [carries blood to limbs and other parts]
→ Pulmocutaneous arch [TO lungs and skin]

→ Aortic trunks

→ Truncus arteriosus (thick walled chamber: collects blood from ventricle and distributes it;

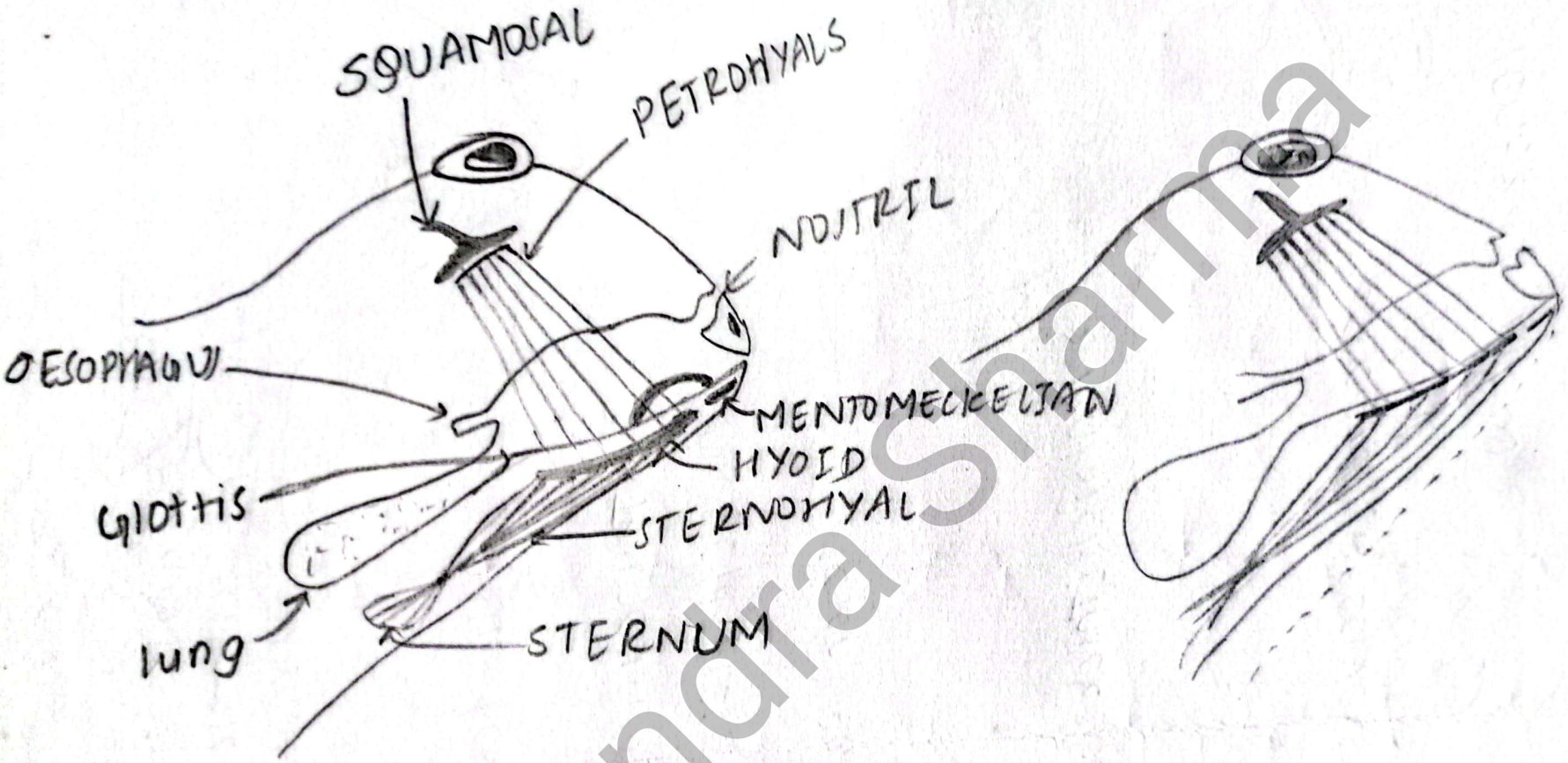
→ Left Precaval

→ Right Auricle [Larger than left auricle; thin walled]

→ Ventricle [Thick walled; need pressure to pump blood

→ Post caval [Receives blood from lower portion of the body]

Ventral view



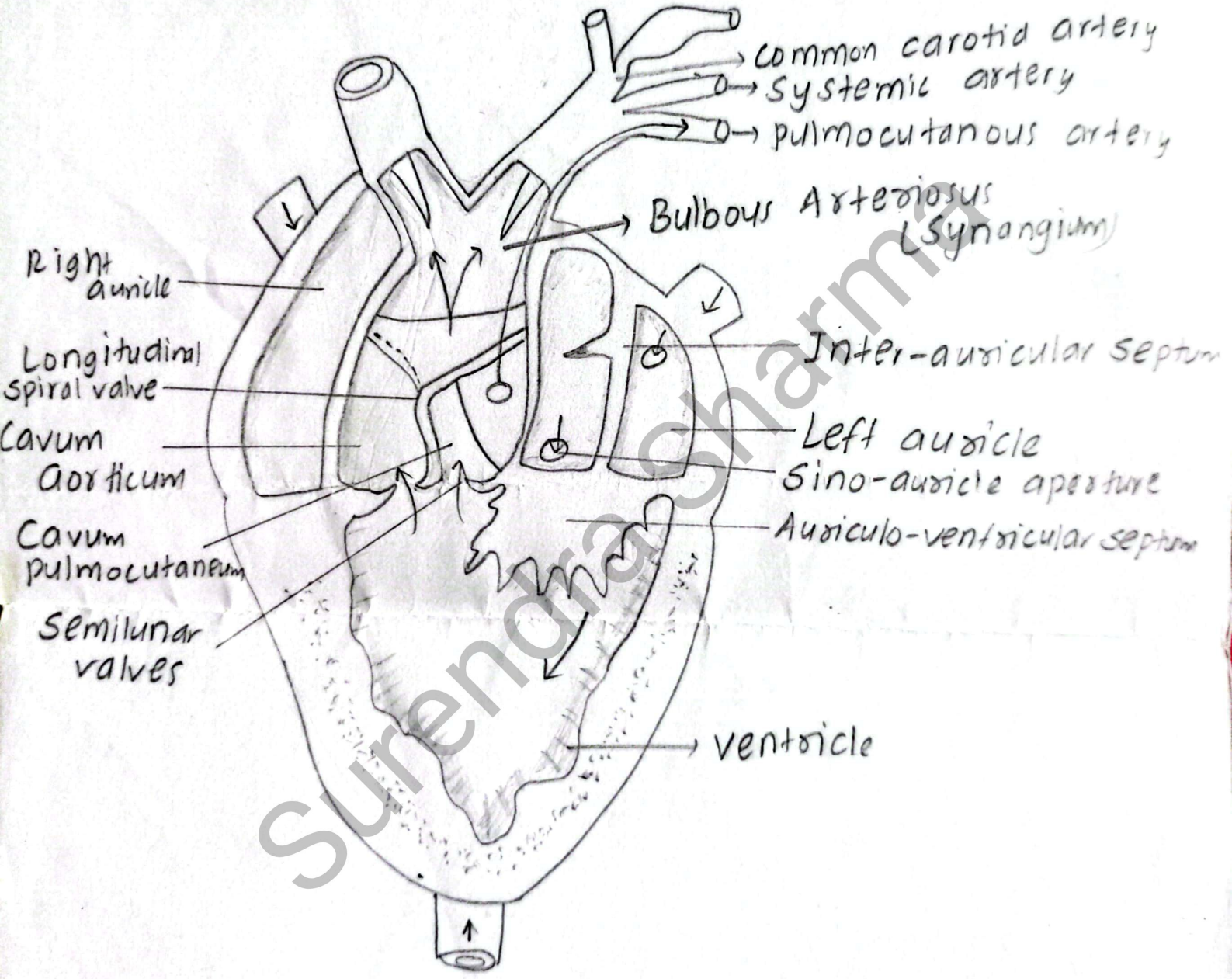


Fig: Internal Structure of Frog's heart.

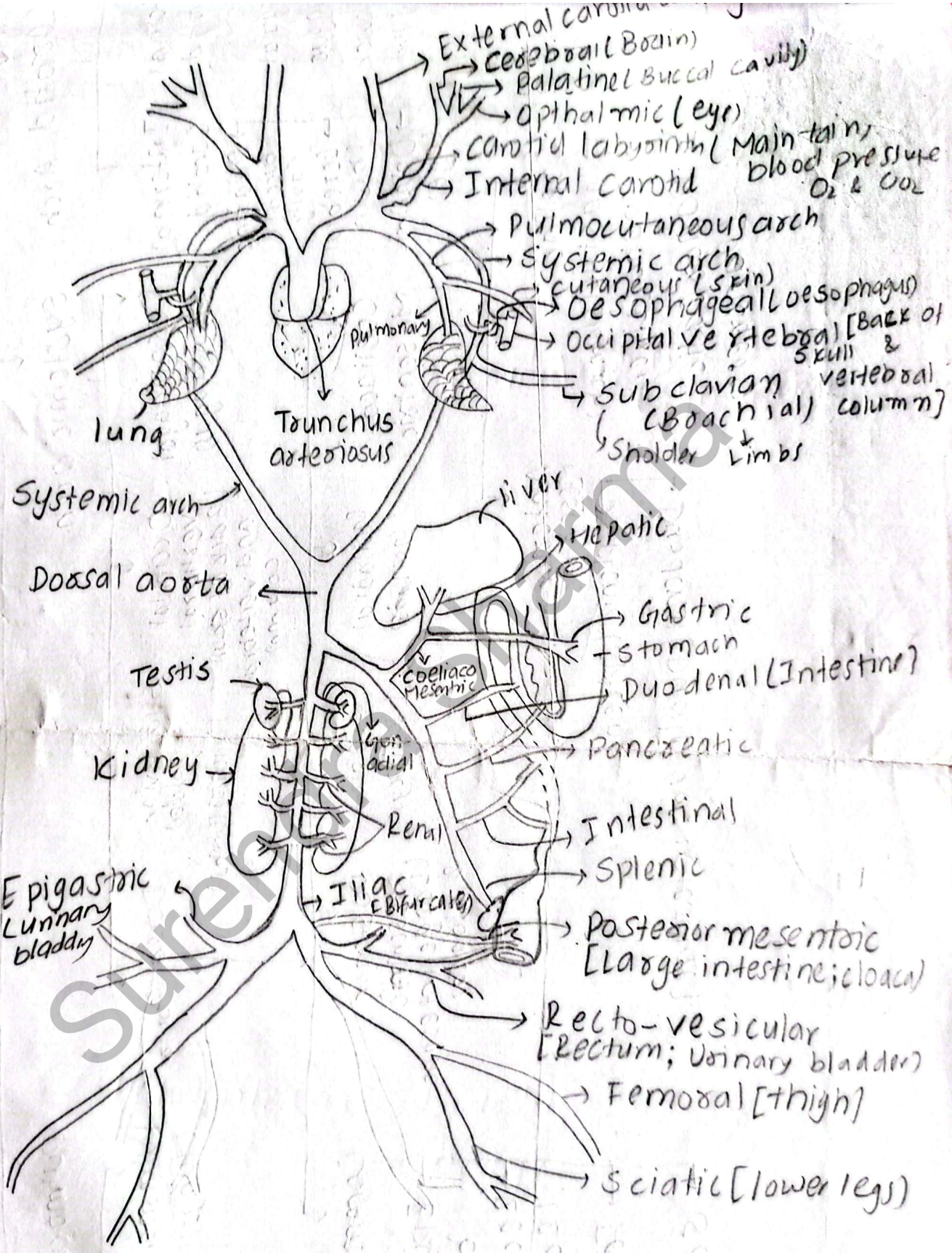
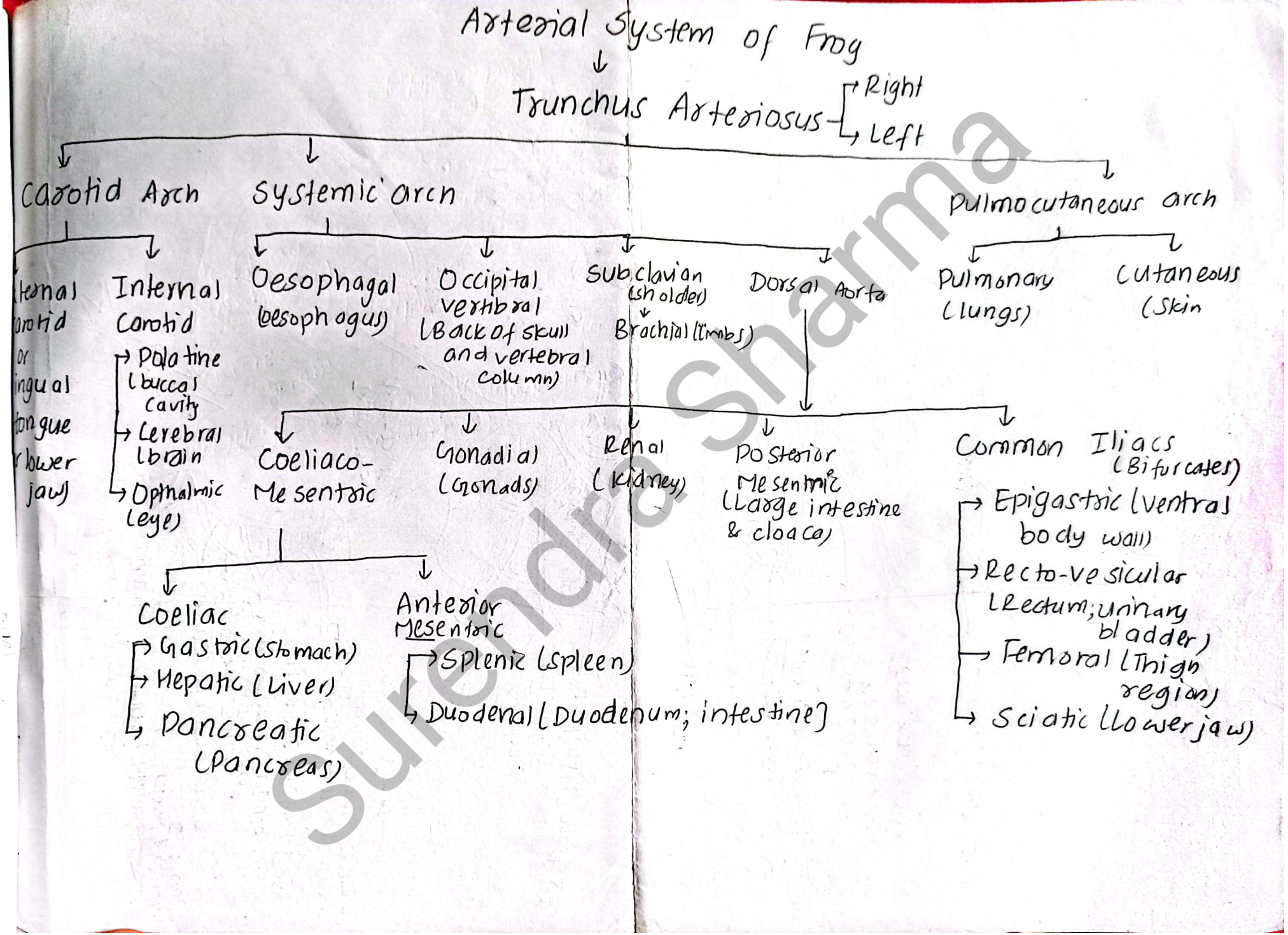


Fig:- Arterial System of frog. (Away

Arterial System of Frog



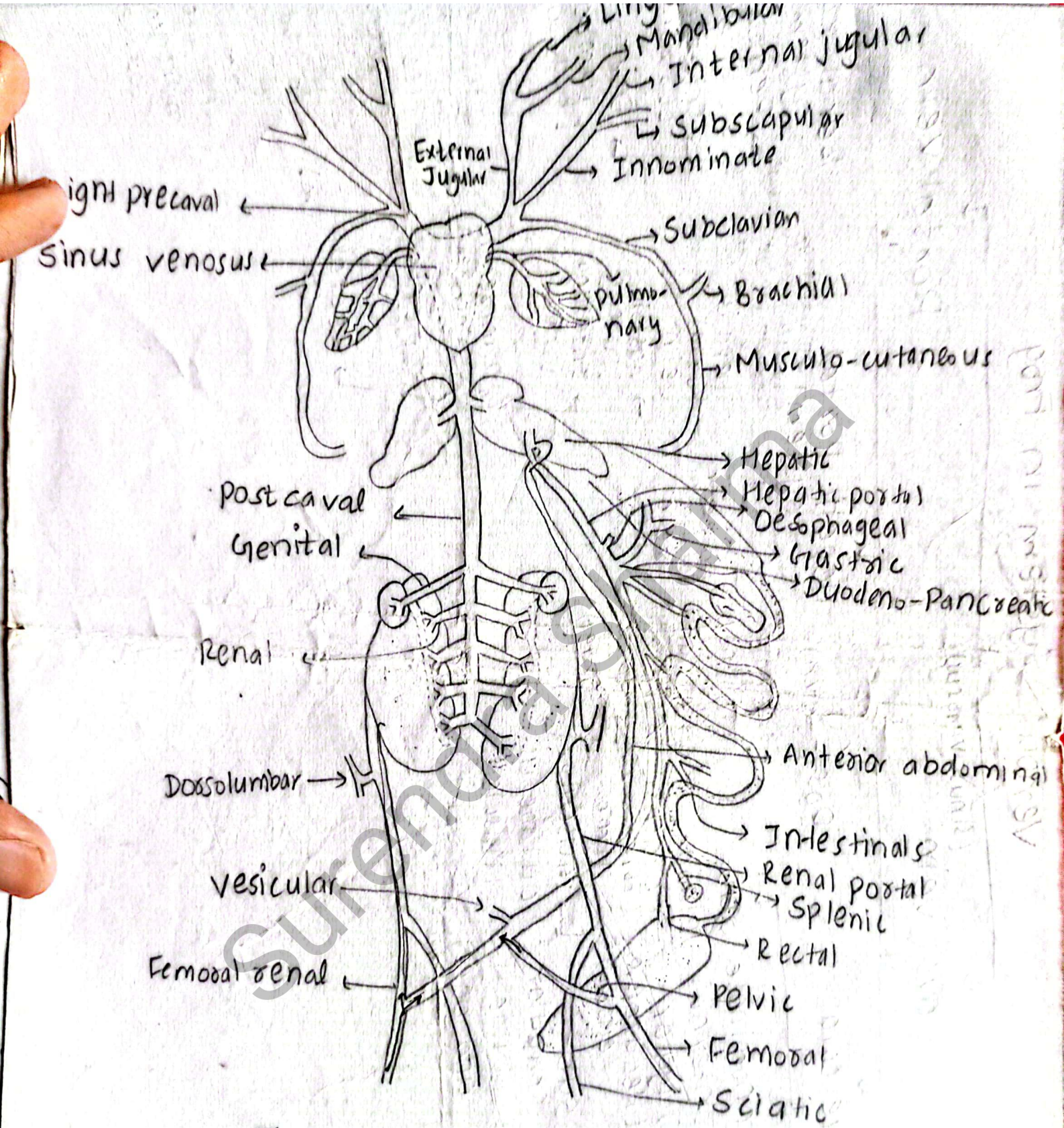


Fig:- Venous System of frog

Venous System in Frog

- Pulmonary vein (on left auricle from lungs)
- Caval vein (Sinus venosus)
  - Pre-caval
    - External Jugular
      - lingual (tongue)
      - mandibular (lower jaw)
    - Innominate
      - Internal Jugular (Head, brain, eyeball)
      - Sub-scapular (shoulder and back) (scapula)
    - Sub-clavian
      - brachial (Fore-limb)
      - musculo-cutaneous (Muscle & skin)
  - Post-caval
    - Renal (kidney)
    - Gonadial (Gonads)
    - Hepatic (liver)
- Portal vein
  - Hepatic Portal system [Detoxification, Storage of excess, conversion product: glucose, ~~fat~~ ammino acid, fat]
    - Anterior abdominal vein [Joins Femoral vein]
    - Hepatic Portal vein
      - Gastric [Stomach]
      - Intestinal [Intestines]
      - Pancreatic [Pancreas]
      - Splenic [Spleen]
      - Rectal [Rectum]
  - Renal Por... system
    - Femora... (thigh)
    - Sciatic (lower li...
    - Dorso-lumbar [Body wa...

[Blood is ultrafilter... and gets free fro... excretory matter... dissolved... blood ... is colle... from low... parts, ma... nitrogene... wastes

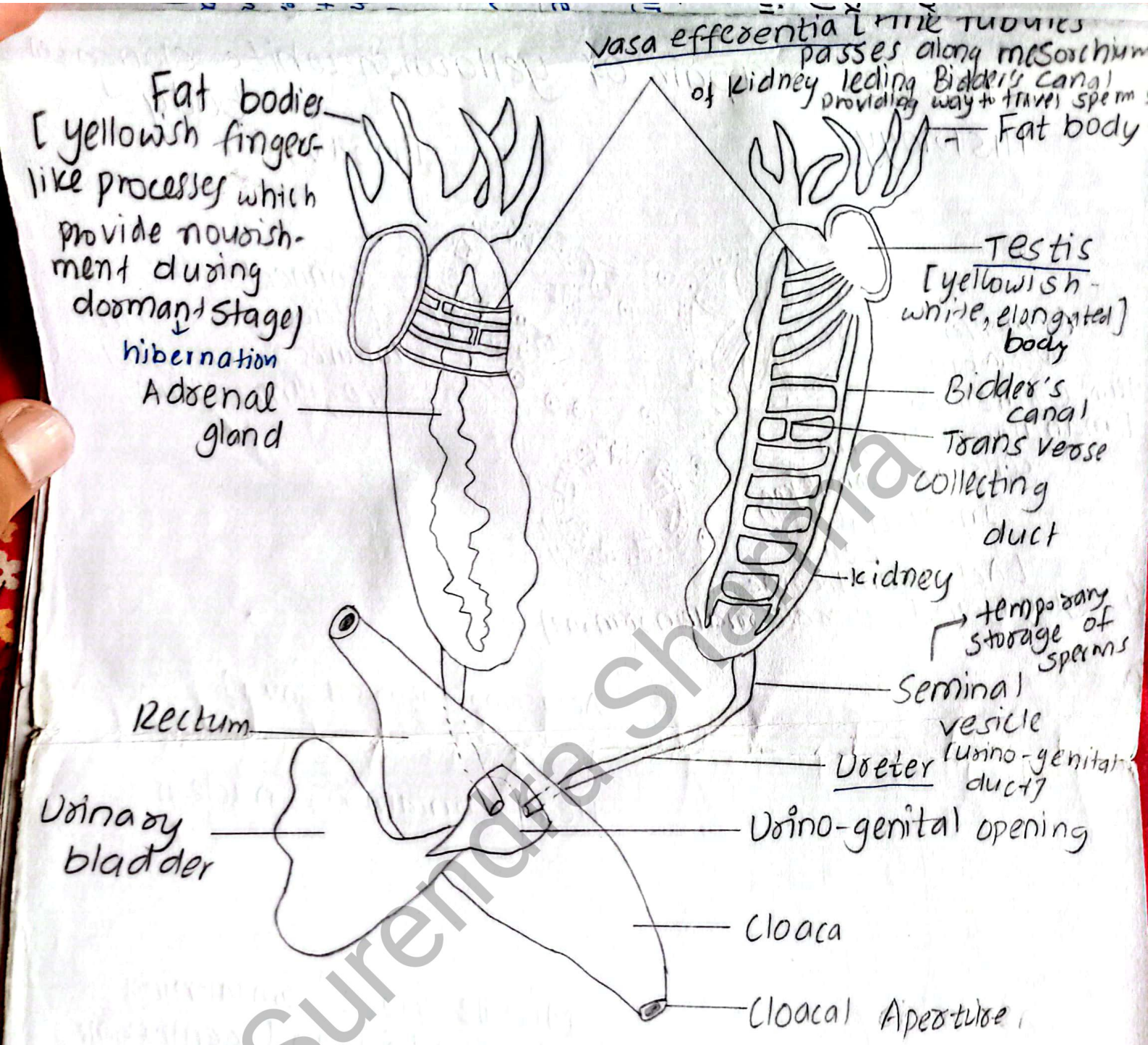
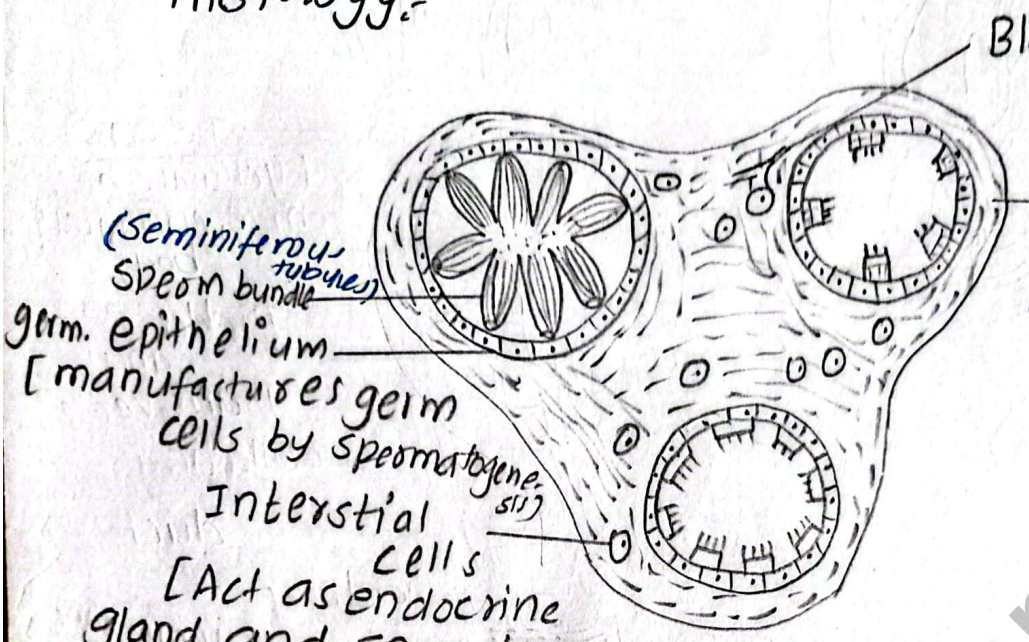


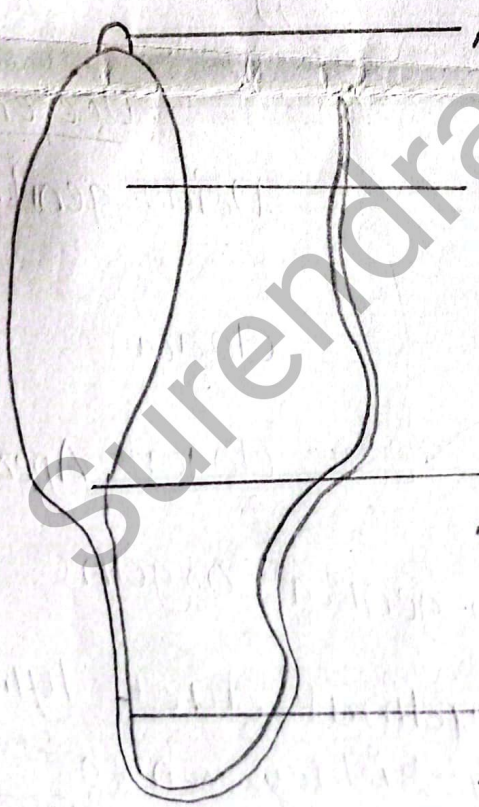
Fig: Frog: male urino-genital organs

Bidder's canal → longitudinal duct lying on inner margin of kidney which carry sperms to urinogenital duct through transverse collecting tubules.

Testes → a pair of yellowish-white elongated body

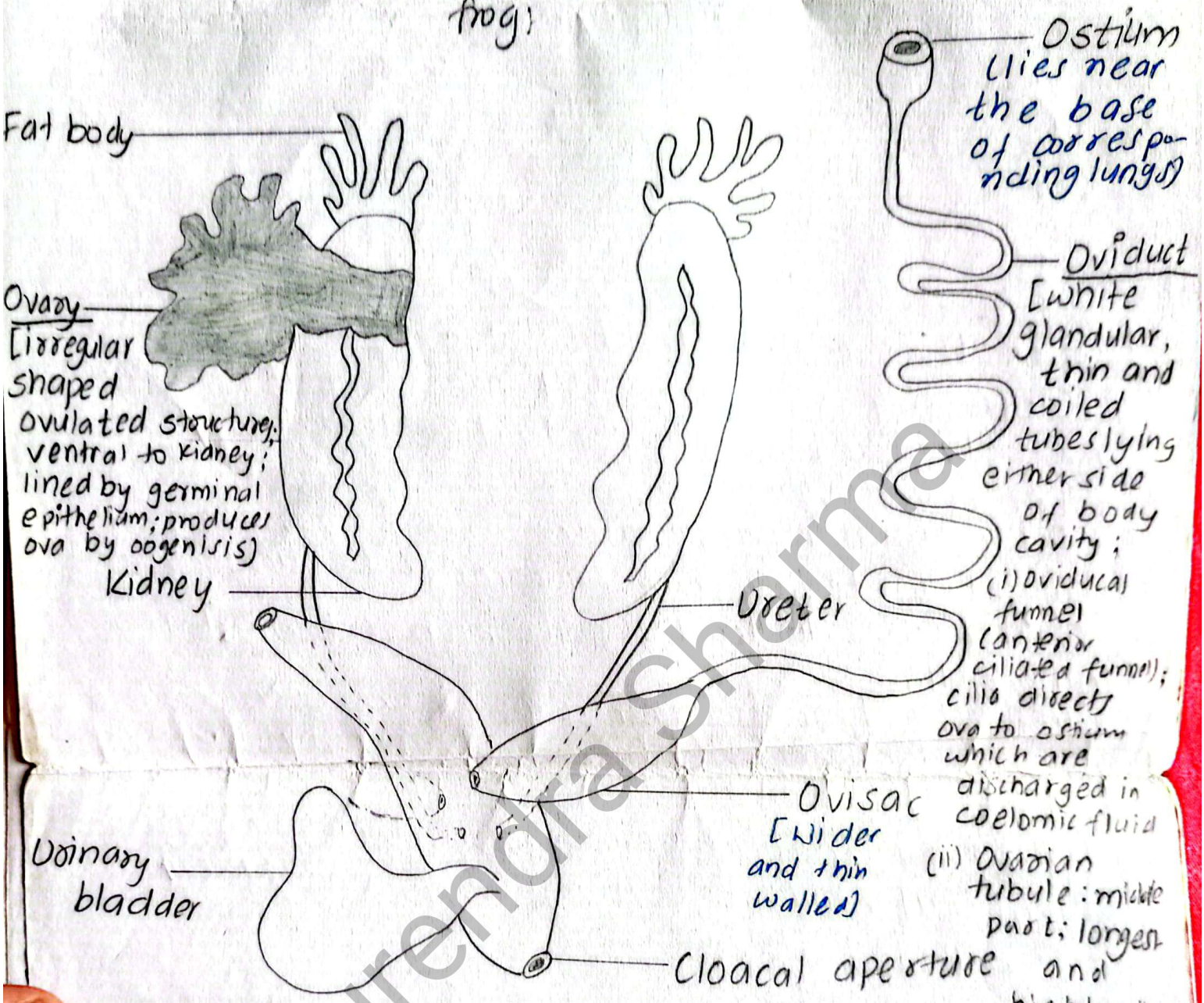
Histology:-

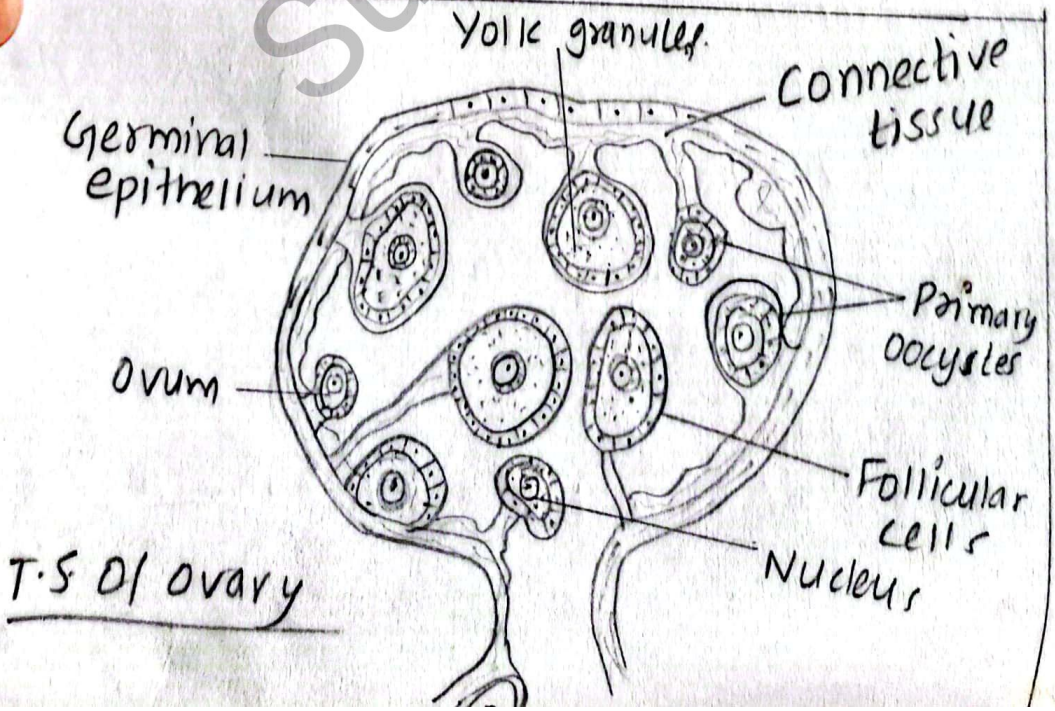




Sperm

Female Reproductive organs in frog:





T.S of ovary

Female Reproductive System

→ associated with production and maturation of ova (female gametes).

→ It includes:-

1. **Ovaries**: In female frog, the gonads are the two ovaries. Each ovary is much-folded sac of irregular shape and blackish or grayish in colour, attached to the ventral surface of the corresponding kidney by a peritoneal fold called **mesovarium**. Internally, each ovary is externally covered by a layer of germinal epithelium cells. The germinal cells divide to form many small follicles. One of the follicular cells forms ova by process of oogenesis. Remaining follicular cells provide nourishment to the developing ovum.
→ Due to accumulation of nourishment, oocyte enlarges whereas follicular cells decrease in size. Ultimately, it forms a protective layer around the oocyte called external vitalline membrane. [Ovaries are much enlarged during breeding season]
2. **Oviducts**: They are a pair of long, coiled tubes lying on either side of body cavity. Each oviduct can be divisible into three parts:-

Ostium: anterior ciliated funnel lying near the base of corresponding lung, Ovarian tubule: middle part; longest and highly coiled part which opens posteriorly into enlarged ovisac. [When matured, the eggs escape into body cavity by rupturing ovarian wall, which are directed towards ostium by beating of cilia. As they pass down the coiled oviduct, they are covered by albuminous coat and finally stored temporarily in ovisac and voided through vent during mating]

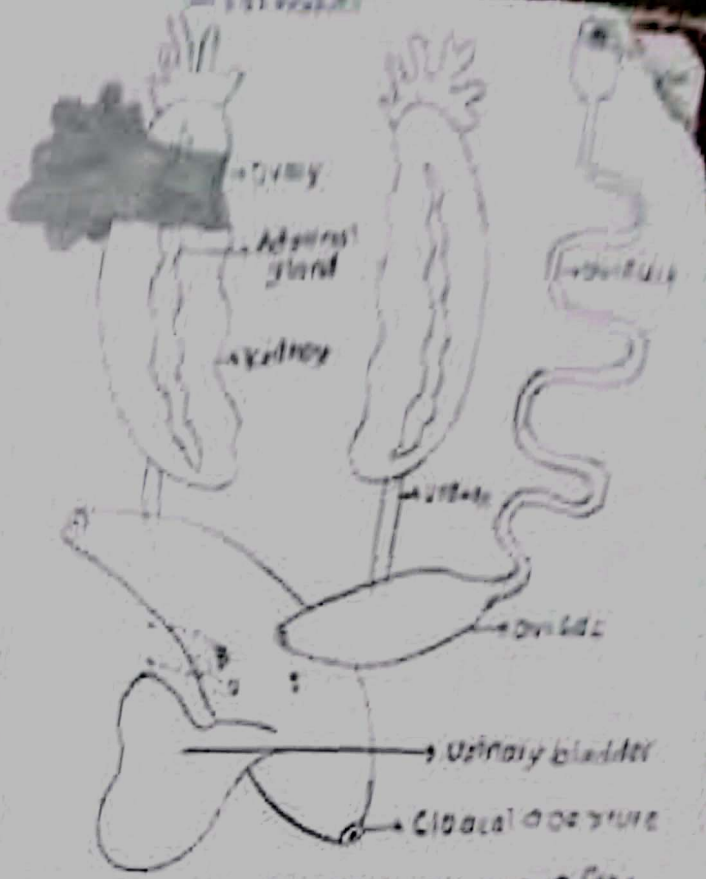


Fig: Female Reproductive organs in frog

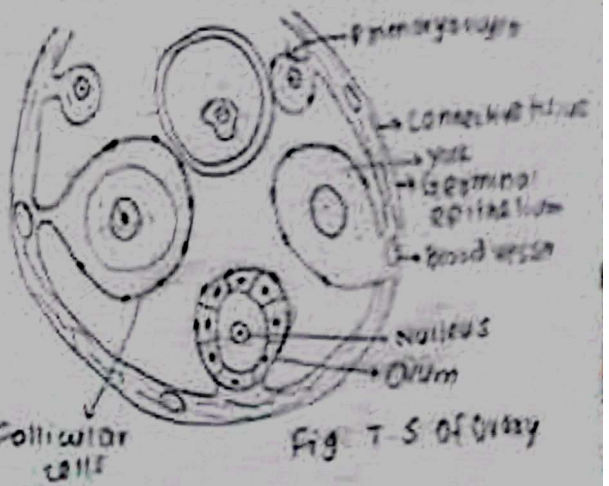


Fig: T.S of Ovary

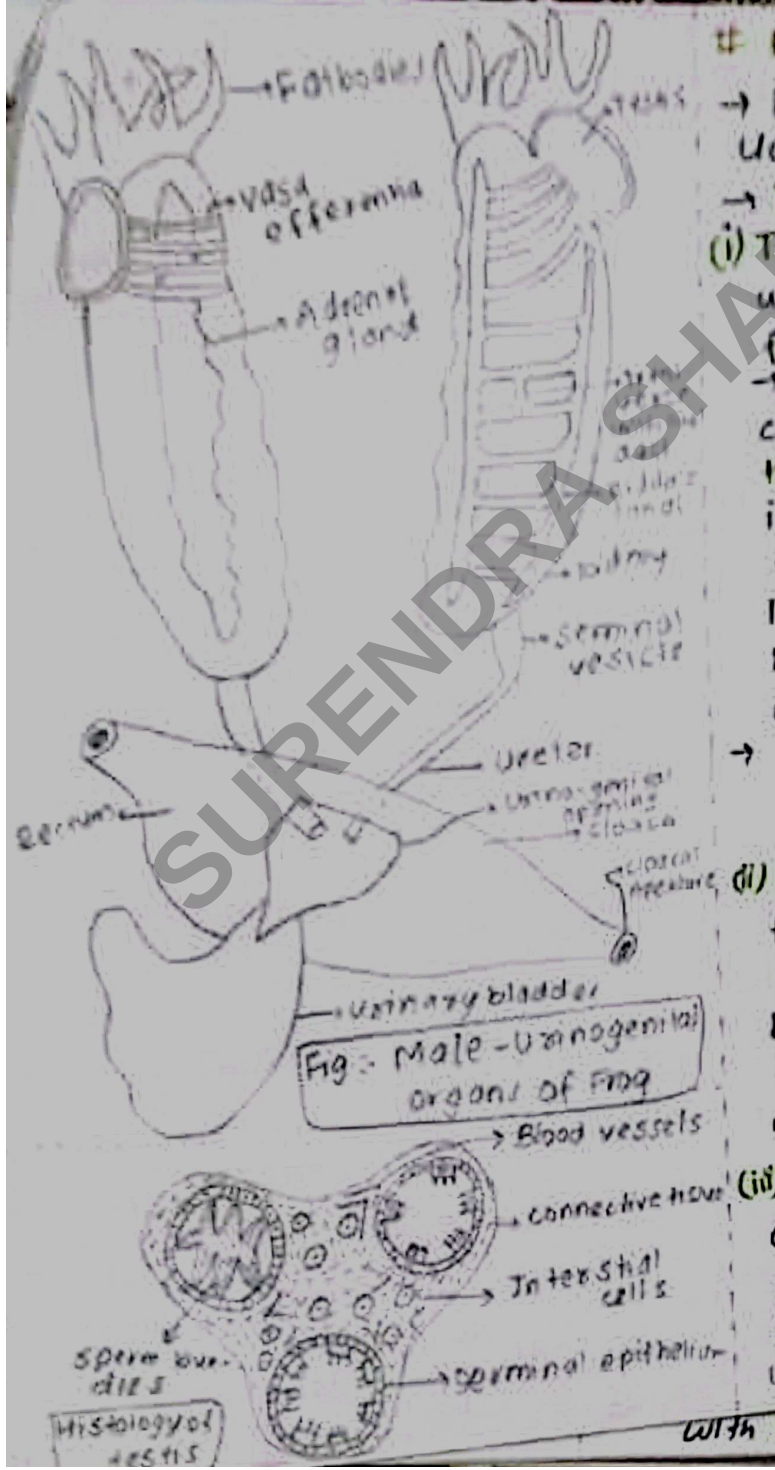


Fig:- Male-Urinogenital organs of Frog

Histology of testis

Male Reproductive organs

→ Male reproductive system is concerned with production and maturation of sperms (male gametes)

→ It involves following organs:

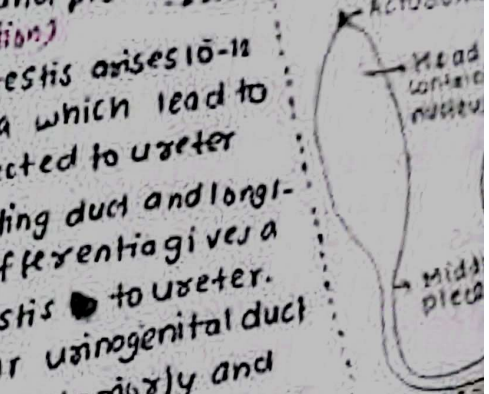
(i) Testis:- a pair of yellowish-white, elongated body attached with ventral surface of the corresponding kidney by a fold of peritoneum called mesorchium.

→ Histology: Each testis is formed of numerous, very fine, coiled tube called seminiferous tubules bounded by connective tissues supplied with blood vessels, nerve fibres and interstitial cells. Interstitial cells secrete male sex hormone testosterone which stimulates secondary sexual characters like development of nuptial pad. Seminiferous tubules are lined by germinal epithelium which produce sperm by the process of spermatogenesis.

→ In front of testis, there are finger like yellowish outgrowth called fat bodies which stores food and provide nourishment to developing spermatozoa (during hibernation)

(ii) Vasa efferentia: From each testis arises 10-12 fine tubelle called vasa efferentia which lead to Bidder's canal, which are connected to ureter by series of transverse collecting duct and longitudinal collecting ducts. Vasa efferentia gives a way to travel sperms from testis to ureter.

(iii) Urino-genital duct: Muscular urinogenital duct arises from each kidney, runs posteriorly and opens into cloaca. At the base, it swells to form a seminal vesicle which store sperms temporarily. Ureter serves for the passage of both sperm and urine material. So, it is called urinogenital duct.



covered with enamel; has pulp cavity lined with odontoblast cell that produce new tooth

filled with blood vessel

Respiration in Frog

By gills (in tadpoles) → Brachial respiration

a. Cutaneous respiration

→ Skin of frog: richly supplied with blood capillaries and always moist due to slimy secretion of mucous glands → makes skin efficient respiratory organ.

→ Spends most of the time in water (skin only as organ of respiration)

→ During hibernation & aestivation.

→ Atmospheric air dissolved in moisture present over body diffuses to blood capillaries

→ haemoglobin + oxyhaemoglobin

→ Oxyhaemoglobin carried to different parts of body by blood is converted into oxygen and haemoglobin.

→ CO_2 produced as waste product + haemoglobin → carboxyhaemoglobin

later diffused outside the body as CO_2.

b. Bucco-pharyngeal respiration:

→ Inner lining of bucco-pharyngeal cavity → thin, moist & vascular

→ Regular lowering and raising of buccal floor bring buccal respiration

→ Movement of buccal floor is controlled by sternohyal and petrohyal muscle.

→ Sternohyal muscle contract → Buccal floor lowered → air enters inside buccal cavity through nostril → O_2 passes into blood by simple diffusion

→ petrohyal muscle contracts → buccal floor rises → forces air to expelled out through nostril

c. Pulmonary respiration

→ When frog needs more oxygen, it respires through lungs.

Organs concerned with pulmonary respiration

(i) External nares: On tip of snout; pair of openings through which air gets in and out

(ii) Internal nares: pairs of opening at top roof of buccal cavity in front of vomerine teeth

(iii) Laryngotracheal chamber: Trachea of frog is separated by laryngotracheal chamber (formed by fusion of larynx & tracheal). It comprises pair of elastic horizontal bands, between arytenoids and cricoid which help in sound production, so the box is called vocal box.

(When air is expelled out under pressure, it increases pressure behind vocal cords and makes it vibrating and producing sound. In male frog there is a pair of vocal sac under the head to amplify the sound)

(iv) Lungs:- A pair of lungs is situated in the anterior part of the body one either side of heart.

→ Each lung is an oval, spongy, elastic & pink coloured structure

→ Each lung is covered by peritoneum whereas internally the lung is divided into series of irregular septa into a large number of tiny small air sacs called alveoli. The walls of alveoli are richly supplied with blood vessels.

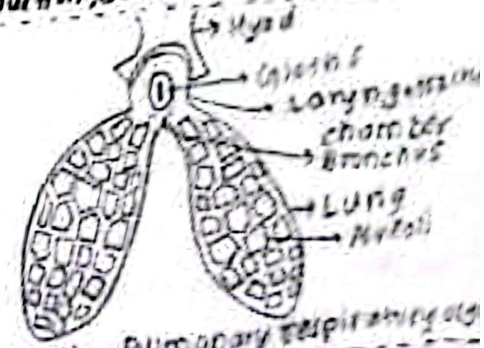


Fig:- Pulmonary respiratory organ

Fig 7.5 of Lung

Fig ... of Frog

(lower jaw oesophagus) of veins; collect blood from liver lobes)

...tory system of Earthworm:

...e prosidium → (highly coiled structure) → they control the composition and volume of body fluid.

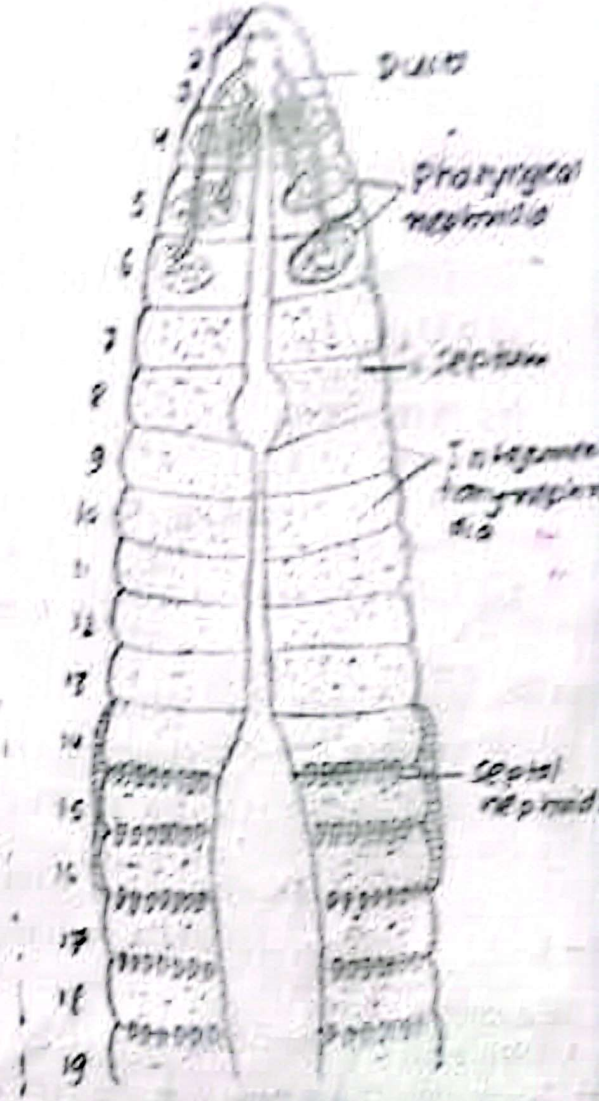
Types

Integumentary

→ attached to skin/integument from 3rd segment
→ ~~maximum in number~~ (200-250).
→ maximum in clitellar region 2000-2500 (14, 15 & 16th segment)
→ Clitellum - Forest of integumentary nephridia
→ Nephridia:- **Lacks Nephrostome**
→ Collect waste from blood & excrete outside the body by tiny pores called nephridiopore
→ Exonephric Nephridia

Pharyngeal

→ present near pharynx in 4, 5, 6 segment
→ One pair of tuft/bunch per segment
→ 100 nephridia in each tuft.
→ Least in number
→ Lack nephrostome
Simple nephridia
→ Collect excretory matter from blood & pour into pharynx through nephridial duct
→ Endonephric nephridia



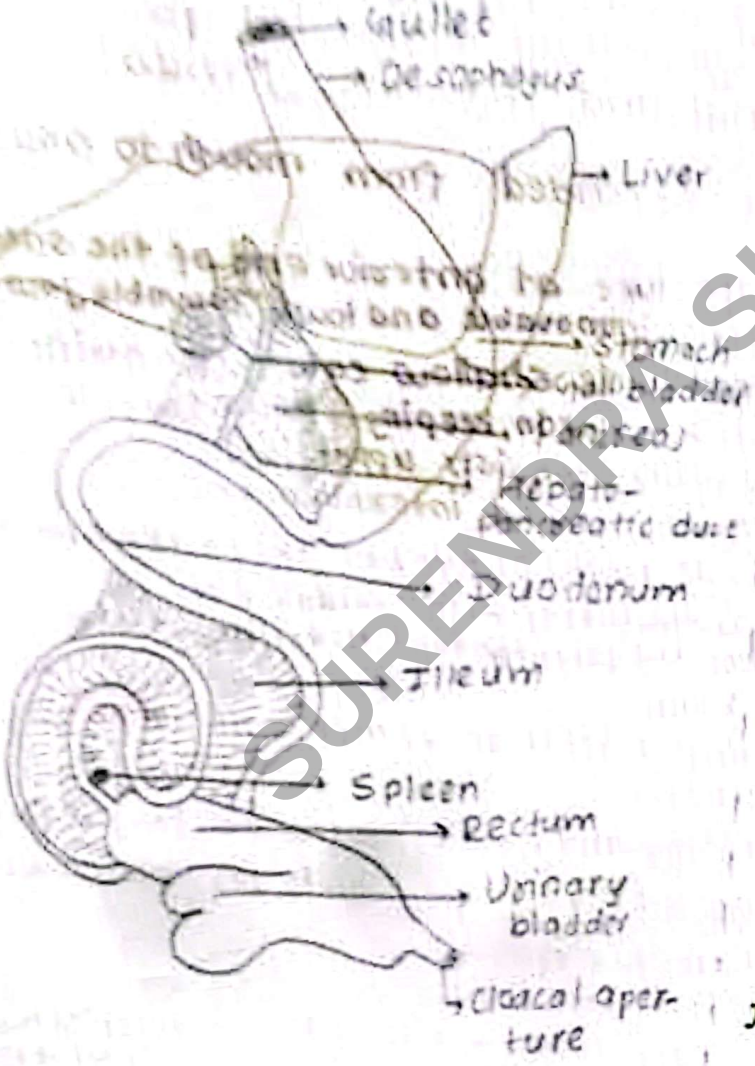


Fig: Alimentary canal of frog

Buccal cavity and pharynx are not differentiated.

c. Oesophagus: short, wide tube running from gullet to the stomach; highly muscular; mucus glands secrete mucus which keeps oesophagus slimy and allow to pass bolus. (Bolus → small lumps of food mixed with mucous)

d. Stomach: widest part of alimentary canal; thick walled, slightly bent part; situated left side of body cavity. Broader anterior part - cardiac part (near) posterior narrower part - Pyloric part. Pyloric constriction separates stomach from duodenum. Gastric glands secretes pepsinogen enzyme, hydrochloric acid and mucus.

e. Small Intestine → longest part of alimentary canal → Attached to body wall by mesenteries → divided into two parts: Duodenum & Ileum

Duodenum → short; U-shaped; receives hepato-pancreatic duct from liver and pancreas; inner mucosal lining is thrown into longitudinal folds.

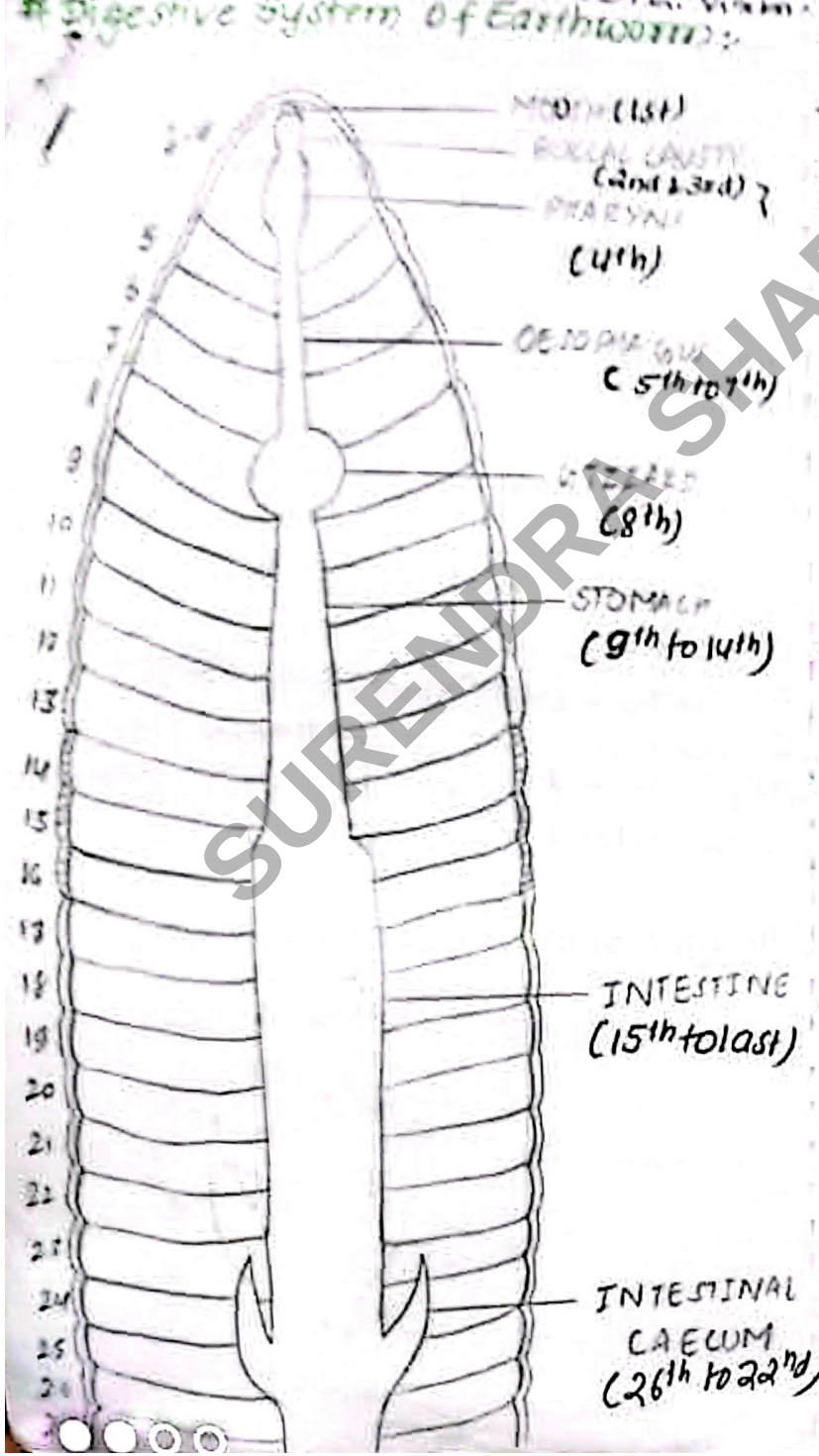
Ileum → much-coiled part; inner lining consists of longitudinal folds called villi which increases absorptive areas.

→ Mucous lining of intestine consist intestinal gland that secrete intestinal juice.

f. Large intestine → small intestine enlarged to form large intestine. It consists rectum: wide, thick-walled chamber; inner lining produced into longitudinal folds → (absorb water from unaigested food). Rectum temporarily stores undigested food.

Rectum joined posteriorly with cloacal chamber that receives ducts from kidneys, urinary bladder & reproductive organs. Cloaca opens outside by cloacal aperture.

Digestive system of Earthworm:



- Physio-chemical process of breaking down of large food into simple and absorbable form (digestion)
- Consist of: alimentary canal & digestive glands.

1. Alimentary canal: complete, straight tubular, mouth to anus
   a. Mouth: Semi-circular, ventral side of 1st segment peristomium just below prostomium, ingests food
   b. Buccal cavity: Short; thin walled tube; highly folded muscular walls having protractor muscle & retractor muscle which helps to protrude and retract buccal cavity during ingestion & locomotion.
   c. Pharynx: buccal cavity opens; highly vascular and glandular mass; pharyngeal mass (mass of glandular cells) produces mucous and digestive enzymes; pharynx divided into two chambers due to inward pushed lateral walls; dorsal salivary chamber and ventral conducting chamber; contracting activities of pharyngeal walls helps in ingestion of food.
   d. Oesophagus:- narrow tube; No digestion; gives way to constant food
   e. Gizzard: Prominent; oval, hard, thick walled and highly muscular organ; internally lined by tough cuticle; grinds food into fine particles
   f. Stomach: Short, narrow, highly vascular and glandular region; sphincter muscles at anterior and posterior ends; walls thrown into internal transverse folds; gland cell secrete proteolytic enzyme; wall possess calciferous gland which produce caco3 (lime) to neutralize humic acid & remove excess calcium and carbonate.
   g. Intestine: long, wide and thin walled tube; ciliated and glandular lining; intestinal lining folded to form villi which increase absorptive area; 26th to before last 25 segments intestinal lining is highly infolded and richly supplied with blood capillaries called Typhlosole
   So intestine divided into three segments:-
   (i) Pre typhlosolar region: 15th to 26th, In 26th two lateral finger-like outgrowths called intestinal caeca or caecum extending upto 22nd, secrete amylase enzyme
   (ii) Typhlosolar region: 26th to last except last 25; finger like intestinal folds on dorsal side wall of intestine called typhlosole; increase digestive and absorptive surface; digestion almost completed.
   (iii) Post-typhlosolar region: last 25; rectum, no villi and typhlosole, opens outside by terminal opening called anus.
   h. Anus: circular opening at terminal end

Venous System of Frog

- The blood vessels, which collect blood from various parts of the body and carry into heart collectively form venous system
- These blood vessels are called veins.

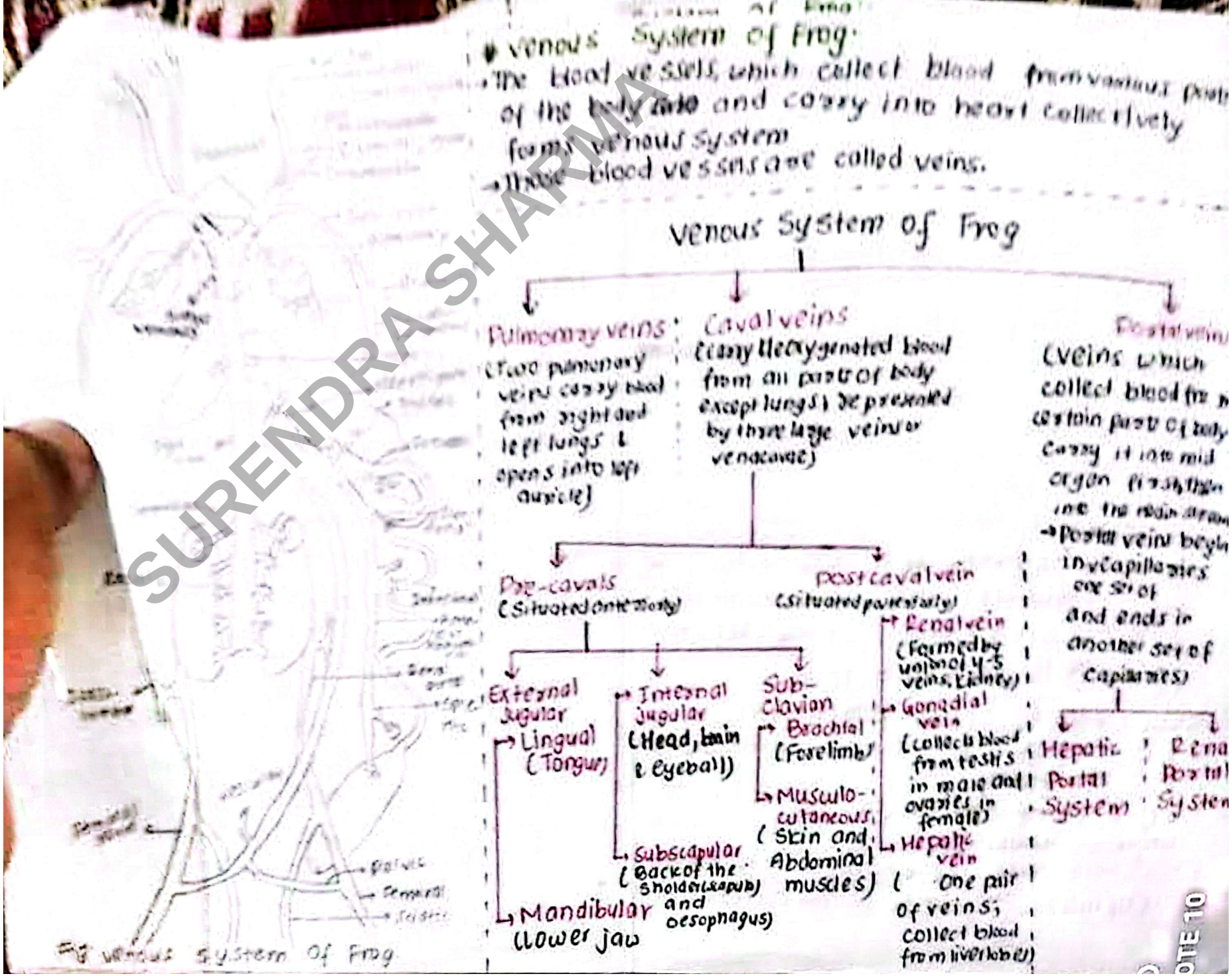


Fig Venous System of Frog

B. Digestive glands

B. Physiology of Respiration.

→ The lowering and raising of buccal floor brought about by sternohyal and petrohyal muscle play an important role in pumping air in and out of the lungs.

(iii) Internal structure of heart

→ Interauricular septum divides upper broader part into two anterior chambers: right and left auricles.

→ Right auricle is longer than left auricle.

→ From sinuauricular aperture in thicker right auricle sinus venosus communicates into it guarded by sinuauricular valves.

→ Opening is prevent backflow of blood to sinus venosus

→ Left auricle receives blood through aperture of the common pulmonary vein.

→ Lower conical part consist of single thick ventricle. resist blood pressure.

→ Auricles communicate with ventricle by auriculo-ventricular aperture, guarded by auriculoventricular valves.

→ Ventricle: rough walled; has ridges and grooves developed from inner lining; columnae carnae (prevent mixing of blood) spongy

→ ventricle leads into truncus arteriosus through an opening.

→ Truncus arteriosus: ⇒ proximal part (conus arteriosus or pylangium)
↘ distal part synangium or bulbous arteriosus.

→ Spiral valve divides cavity into cavum aorticum & cavum pulmo-cutaneous.
↓ pumps oxygenated blood
↓ pumps deoxygenated blood.

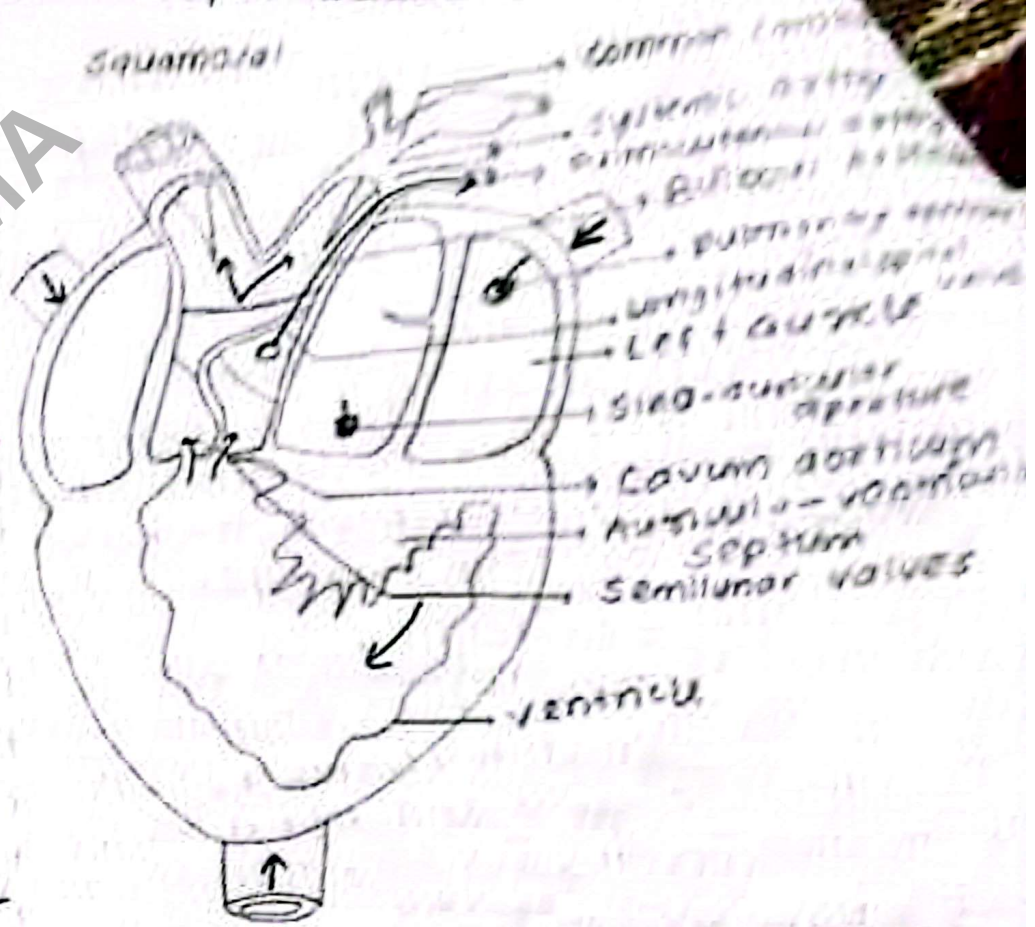
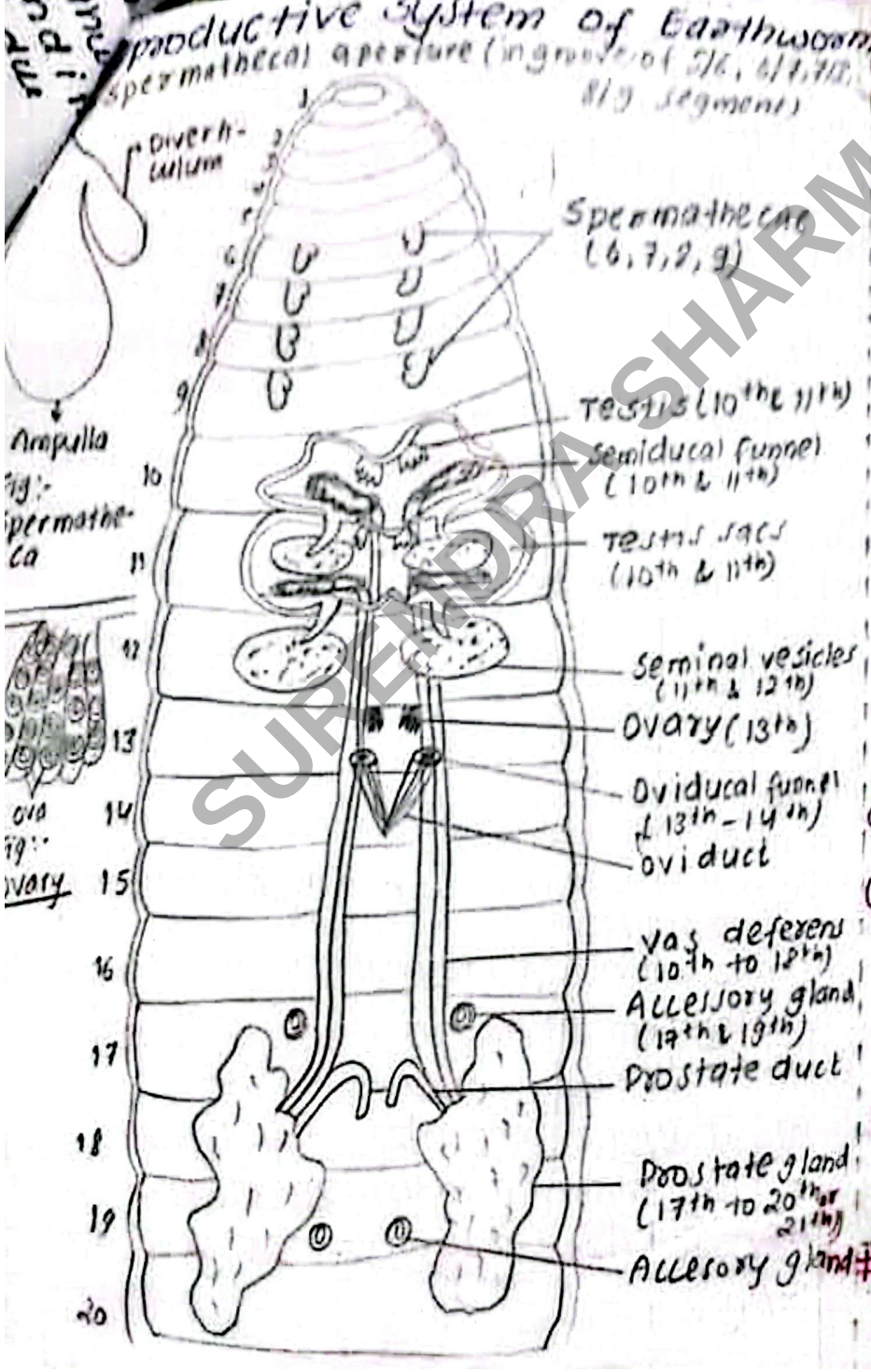


Fig. Internal structure of Frog's heart.



Earthworm: Hermaphrodite, protandrous, cross-fertilization.

* Male Reproductive organs:

(1) **Testes** → Two pairs each in 10th, 11th; Anterior tube attached to septa; finger like sac; Spermatogonia in it produce sperm.

(2) **Testes sacs** → whitish sac that enclose testes; communicate with seminal vesicle

(3) **Seminal vesicle** → nourishes spermatogia; whitish pouch like

(4) **Vas deferentia** → long, delicate, ciliated tubular structure; join prostatic duct in 18th; open ventrally into male genital opening in 18th segment

(5) **Prostate gland** → irregular shape; dirty-white; consist glandular & non-glandular part; glandular part filled with prostatic fluid; non-glandular part forms prostatic duct

(6) Accessory glands → Two paired; situated ventrally and opens into over genital papillae

* Female Reproductive organs:-

(1) Ovaries → white; attached to septa; hanged in cavity of 13th segment; finger like processes contain egg or ova in dif. stages of development

(2) Oviduct → funnel shaped; ciliated; communicate with female genital opening of 14th

(3) Spermathecae → four paired; bag like; basal swollen part: ampulla; upper short tube part: spermathecal duct or neck; small sac found at junction of ampulla & neck: diverticulum Stores sperm; open outside by spermathecal pore

(4) Female gonopore → median aperture at 14th segment through which ~~which~~ mature ova is discharged during fertilization

Spermatogonia formed at testes → seminal vesicle → testis sac → converted to sperm → again come in vasa differentia through spermatic funnel → come out through male genital opening (male gonopore)

...ning of Heart:-

Heart of frog is myogenic i.e heart beat is originated by special cardiac muscles.

→ Heart continues to beat, taking short rest between successive contractions. Each period of contraction is called systole and shorter period of relaxation is called diastole.

→ A special bundle of nodal tissue called sinu-auricular node (SA node) is situated in the wall of sinus venosus which initiates the wave of contractions. The wave of contraction passes from sinus venosus to auricles and then to the ventricle and ends at truncus arteriosus.

→ Sinus venusus collect the deoxygenated blood from different parts of body by two precavals and one postcaval veins. When sinus venosus is filled with blood it contracts forcing the blood into into right auricle through sinus auricular aperture mean while oxygenated blood from the lungs enters into the left auricle by a pair of pulmonary veins. Now, both auricles contract simultaneously forcing blood in the ventricle through common auriculo ventricular aperture. All valves prevent the back flow of blood.

For further circulation of blood there are two theories

1. Old view (Proposed by Brucke)

According to this view, the oxygenated and deoxygenated blood do not mix. The blood coming from right auricle remains on right side, and from left auricle on left side and little blood get mixed in middle portion. The further pumping of blood is directed by spiral valve. First, deoxygenated blood enters lungs and skin for purification through pulmocutaneous arch. On further contraction, ventricle enables mixed blood to pump into systemic arches and distributes to trunk and limbs. Finally, oxygenated blood is forced into carotid arches through cavum aorticum to be distributed to head regions.

2. Modern View (Vandervael and Foxon)

According to this view, completely mixed blood is ~~mixed~~ pumped by ventricle to truncus arteriosus and simultaneously to different parts of body through respective arches. Spiral valve do not play any major role. They said mostly blood received by heart is oxygenated because blood received from skin and buccal cavity is more oxygenated than that received from lungs in LA.

Physiology of Digestion:

→ frog is carnivorous or insectivorous animal feeding on worms, insects, snails, tadpoles, etc.

Physiology of digestion consists of:

a. Ingestion: During ingestion mouth is opened and the sticky tongue is flicked out to catch the prey. The preys are killed by vomerine teeth. Maxillary teeth prevent the captured prey from escaping out. Bulging of eye balls and throat helps in pushing down of the food towards the oesophagus.

b. Digestion:
→ catabolic process in which large complex and inabsorbable food molecules are hydrolysed into simple and absorbable form.
→ occurs in presence of digestive enzymes.
→ No salivary glands → no chemical action in buccopharyngeal cavity

→ Digestion in Stomach: Digestion of food begins in stomach. Gastric glands secrete gastric juice which possess HCl and a pro-enzyme pepsinogen.
HCl → kills the bacteria present in food & activate pro-enzyme pepsinogen into active pepsin which act on protein to convert it into peptones & proteoses.
Pepsinogen (inactive) —HCl→ pepsin (active)
pepsin + protein → peptones and proteoses.
→ Food is temporarily stored in stomach which is partially digested to form acidic paste called Chyme.
→ Foods passed to duodenum by peristaltic movements.

Digestion in Intestine: Chyme entered into the intestine stimulate endocrine cell of small intestine to produce secretin, cholecystokinin and enterokinin hormones.
→ Secretin activates pancreas to secrete pancreatic juice.
→ Cholecystokinin activates gall bladder to release stored bile (Both reach duodenum through hepatopancreatic duct)
→ Enterokinin stimulates intestinal gland to secrete intestinal juice (succus entericus)
(In intestine chyme mixes with bile juice, pancreatic juice and intestinal juice)
Bile - emulsify fat, activates lipase, neutralizes acidic chyme
Pancreatic juice → contains Trypsinogen, amylase & lipase enzymes.
(i) Trypsinogen (inactive) —enterokinase→ Trypsin (active)
peptones/proteoses —Trypsin→ Amino acids.
(ii) Starch —amylase→ Maltose
(iii) Fat —lipase→ Fatty acid + Glycerol
(iv) DNA & RNA —DNAase & RNAase→ Nucleotides

Intestinal juice → has enzymes like ..., maltase, sucrase, lactase and lipase
Maltose —Maltase→ Glucose
Sucrose —sucrase→ Glucose
Lactose —lactase→ Glucose
Fat (remaining) —lipase→ Fatty acid + Glycerol

(c) Absorption:- Digested food molecules from intestine are absorbed by wall of ileum which are provided with many longitudinal folds called villi that has blood capillaries → absorb glucose, amino acid, water

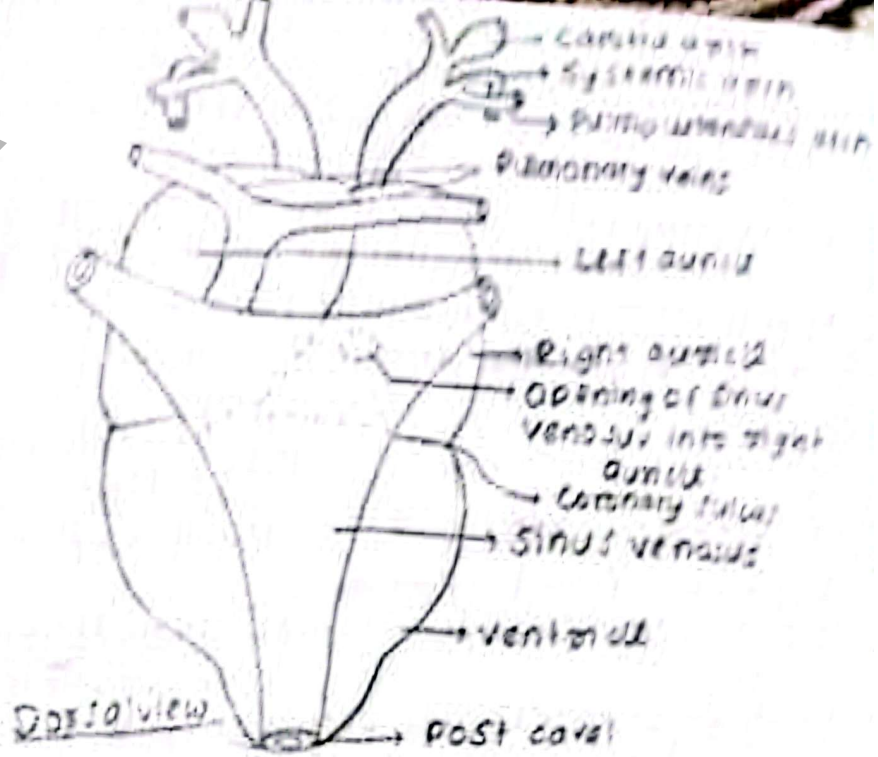
Circulatory system of frog:-

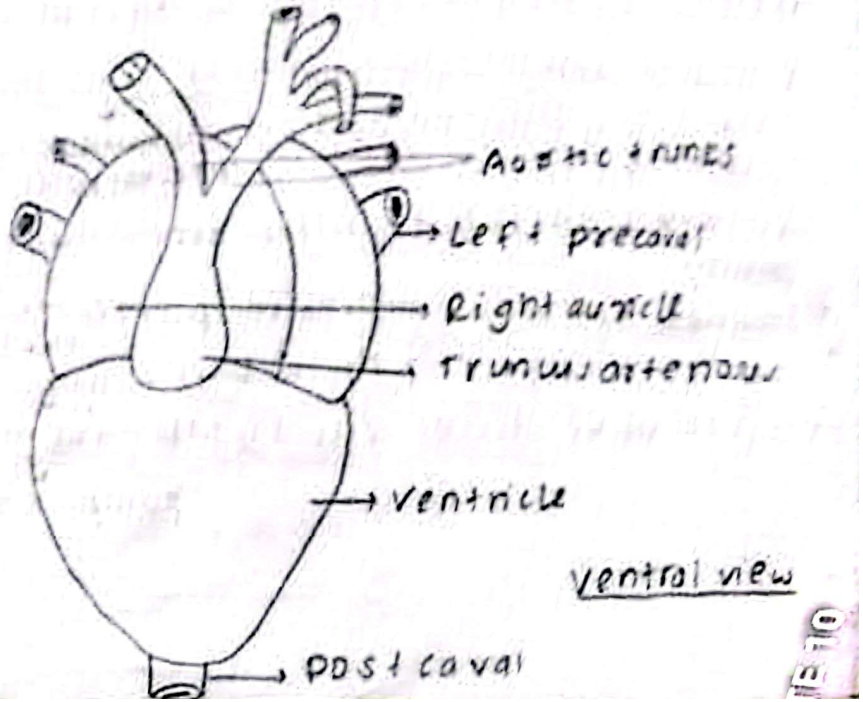
. System which distributes the nutrient and oxygen to all parts of the body and also help in removal of metabolic wastes from different parts of the body.

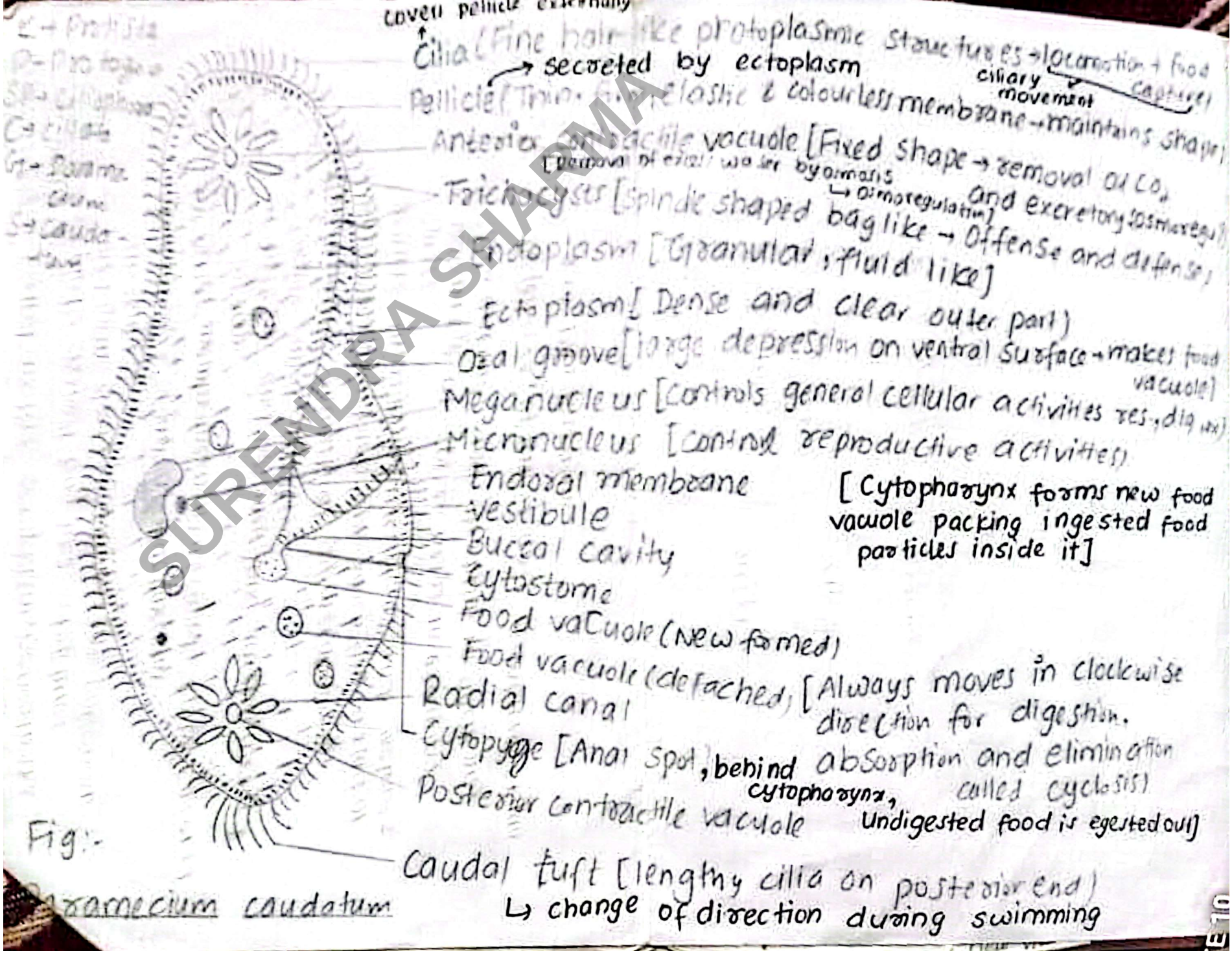
The Heart:-

(i) External structure of heart

→ hollow, conical and muscular organ
→ myogenic: not directly controlled by brain
→ Reddish color and protected by double-layered membrane called pericardial membrane.
→ pericardial space is filled with pericardial fluid which protects the heart from mechanical injury
→ It consists of three chambers: Upper broader part include right and left auricles & posterior conical part include a thick walled ventricle.
→ Coronary sinus: groove that separate ventricle from auricle
→ There are other smaller chambers:-
→ Sinus venosus: thin-walled, situated on dorsal side of heart; more or less triangular with three caval veins which carry deoxygenated blood from dif. parts of body to sinuvenosus
→ Truncus arteriosus:- thick walled; collects blood from ventricle and distributes it to various body parts.
→ Two pulmonary veins from each lung carrying oxygenated blood from lungs to left auricle.







[Cytopharynx forms new food vacuole packing ingested food particles inside it]

[Always moves in clockwise direction for digestion.]

[absorption and elimination called cyclosis]

[Undigested food is egested out]

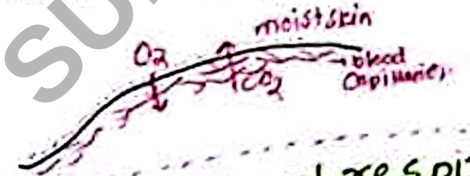
↳ change of direction during swimming

Fig:-

Paramecium caudatum

Respiration in frog
By gills (in tadpoles) → Brachial respiration

a. Cutaneous respiration
→ Skin of frog: richly supplied with blood capillaries and always moist due to slimy secretion of mucous glands → makes skin efficient respiratory organ.
→ Spends most of the time in water (skin only site of respiration)
→ During hibernation & aestivation.
→ Atmospheric air dissolved in moisture present over body diffuses to blood capillaries
↓ haemoglobin
oxyhaemoglobin
→ Oxyhaemoglobin carried to different parts of body by blood is converted into oxygen and haemoglobin.
→ CO_2 produced as waste product + haemoglobin
↙ carboxyhaemoglobin
later diffused outside the body as CO_2.



b. Bucco-pharyngeal respiration:-
→ Inner lining of bucco-pharyngeal cavity → thin, moist & vascular
→ Regular lowering and raising of buccal floor bring buccal respiration
→ Movement of buccal floor is controlled by sternohyal and petrohyal muscle.
→ Sternohyal muscle contract → buccal floor lowered → air enter inside buccal cavity through nostril → O_2 passes into blood by simple diff. → Also
foul air expelled out from nostril ← buccal floor raise ← petrohyal muscle contract ←

Fig

C. Pulmonary respiration
→ When frog needs more oxygen, it respires through lungs
Organs concerned with pulmonary respiration
(i) External nares - On tip of snout, pair of openings through which air get in and out
(ii) Internal nares: pairs of opening at the roof of buccal cavity in front of vomerine teeth
(iii) Laryngotracheal chamber - Trachea of frog is replaced by laryngotracheal chamber (formed by fusion of larynx & trachea). It comprises pair of elastic horizontal bands, between arytenoids and cricoid which help in sound production, so the box is called vocal c...

(When air is expelled out under pressure, it increases pressure behind vocal cords and makes it vibrating and producing sound. In male frog there is a pair of vocal sacs under the head to amplify the sound)

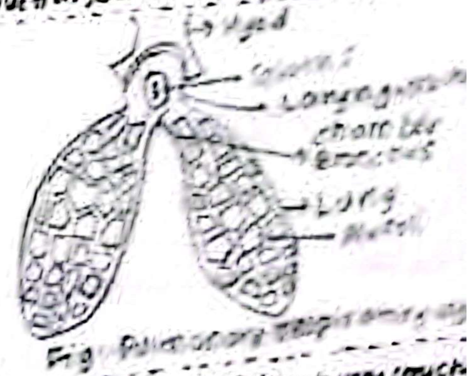


Fig. Pulmonary respiratory ...

(iv) Lungs:- A pair of lung is situated in the anterior part of the body one either side of heart.
→ Each lung is an oval, spongy, elastic & pink coloured structure
→ Each lung is covered by peritoneum whereas internally the lung is divided into series of irregular septa into a large number of small air sacs called alveoli. The walls of alveoli are richly supplied with blood vessels.

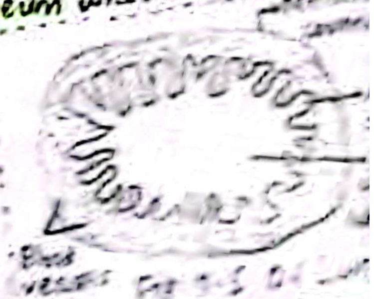


Fig ... of ...

B. Physiology of Respiration.

→ The lowering and raising of buccal floor brought about by sternohyal and petrohyal muscle play an important role in passage of air in and out of the lungs. These both structures are attached to hyoid apparatus situated on the floor of buccal cavity.

Respiratory mechanism involves following steps:-

(i) Inspiration:- → entering of fresh air into lungs.

→ During this sternohyal muscle contract, due to which buccal floor is pulled downward that results the enlargement of buccal cavity; the air enters into buccal cavity through nostrils.

→ Meanwhile, muscles of lower jaw contract and mentomeckelian bone is raised which pushes pre-maxillae bone upward and nostrils are closed tightly.

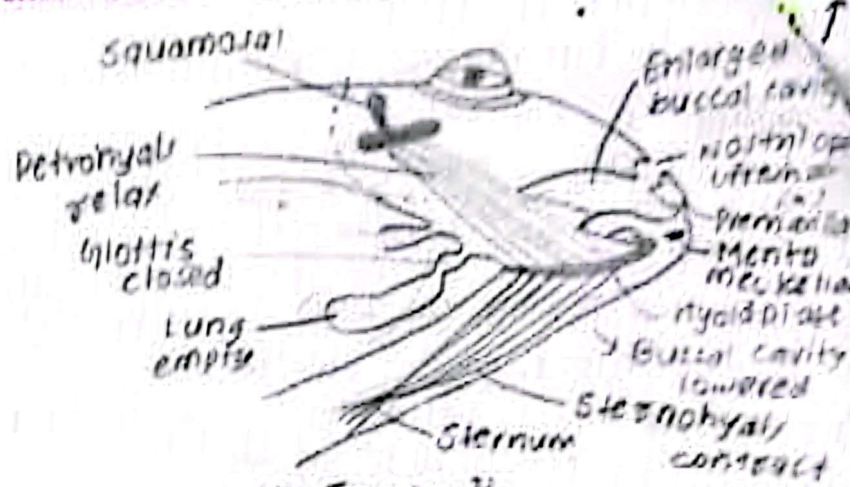
→ Now the petrohyal muscle contract due to which volume of buccal cavity is decreased and pressure increases; the air is pumped into lungs through the glottis.

(ii) Expiration:-

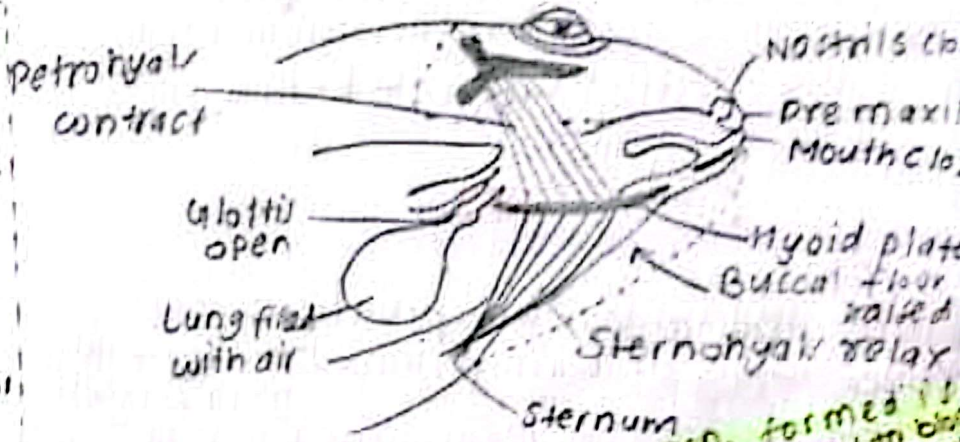
→ Removal of air out of lungs → In this lungs along with abdominal muscles contract, soon the glottis is opened and deoxygenated air is expelled into buccal cavity.

→ Finally glottis is closed and pre-maxillae come back into its original position, due to which external nares open. Now, petrohyal muscle contract, buccal floor is raised again to force the air to go out through external nares.

Haemoglobin of blood + O_2 → Oxyhaemoglobin → Oxidized blood → various parts of body → tissues (supply O_2)



(a) Inspiration



(b) Expiration

Exchange of gases. → In between respiration and inspiration → exchange of gases takes place by simple diffusion. → O_2 of lungs differs into blood and CO_2 differs from blood to lungs through thin alveolar wall of alveoli.

- Beating of heart:-

→ Beat of frog is myogenic i.e heart beat is originated by special cardiac muscles.

→ Heart continues to beat, having short rest between successive contractions. Each period of contraction is called systole and shorter period of relaxation is called diastole.

→ A special bundle of neural tissue called Sino-auricular node (SA node) is situated in the wall of sinus venosus which initiates the wave of contraction. The wave of contraction passes from sinus venosus to auricles and then to the ventricle and ends at truncus arteriosus.

→ Sinus venosus collect the deoxygenated blood from different parts of body by two precavals and one postcaval veins. When sinus venosus is filled with blood it contracts forcing the blood into into right auricle through sinus auricular aperture meanwhile oxygenated blood from the lungs enters into the left auricle by a pair of pulmonary veins. Now both auricles contract simultaneously forcing blood in the ventricle through common auriculo ventricular aperture. All valves prevent the back flow of blood.

For further circulation of blood there are two views

1. Old view (Proposed by Bruce)

According to this view, the oxygenated and de-oxygenated blood do not mix. The blood coming from right auricle remains on right side, and from left auricle on left side and little blood get mixed in middle portion. The further pumping of blood is directed by spiral valve.

First, deoxygenated blood enters lungs and skin for purification through pulmocutaneous arch. On further contraction, ventricle enables mixed blood to pump into systemic arches and distributes to trunk and limbs.

Finally, oxygenated blood is forced into carotid arches through cavum aorticum to be distributed to head regions.

2. Modern view (Vandervael and Foxon)

According to this view, completely mixed blood is ~~mixed~~ pumped by ventricle to truncus arteriosus and simultaneously to different parts of body through respective arches. Spiral valve do not play any major role. They said mostly blood received by heart is oxygenated because blood in RA received from skin and buccal cavity is more oxygenated than that received from lungs in LA.

Hepatic portal system:-

→ The deoxygenated blood collected from alimentary canal discharges into liver and then carry to heart.

→ It consists of anterior abdominal vein and hepatic portal vein.

(i) Hepatic portal vein: Collects blood from different parts of alimentary canal through several small veins. They are:-

- Gastric vein: It collects blood from stomach.
- Duodenal vein: duodenum
- Pancreatic vein: pancreas
- Intestinal vein: Ileum
- Splenic vein: spleen
- Rectal vein: Rectum

(ii) Anterior abdominal vein: formed by union of right and left pelvic veins. It collects blood from bladder and passes upwards and enters the liver, where it joins to hepatic portal vein.

Importance of hepatic portal vein:-

→ excess of glucose is converted into glycogen by glycogenesis.

→ Kupffer cells of liver destroy the bacteria by phagocytic action.

→ Toxic substances are changed into non-toxic substances by detoxification process.

Renal Portal System:-

Deoxygenated blood from hind limbs

Renal portal vein is made by vein from outer part of thigh, sciatic vein from internal part of thigh. On entering the cavity, femoral gives off the median pelvic vein, which joins with its fellow of opposite side to form the anterior abdominal vein. The renal portal vein is again joined before entering kidney, by dorso lumber veins bringing blood from the body wall on outer margin of the kidney.

Importance of Renal Portal vein:-

→ It helps in the removal of nitrogenous waste products like urea, uric acid, ammonia, etc. present in the blood coming from hind limbs.

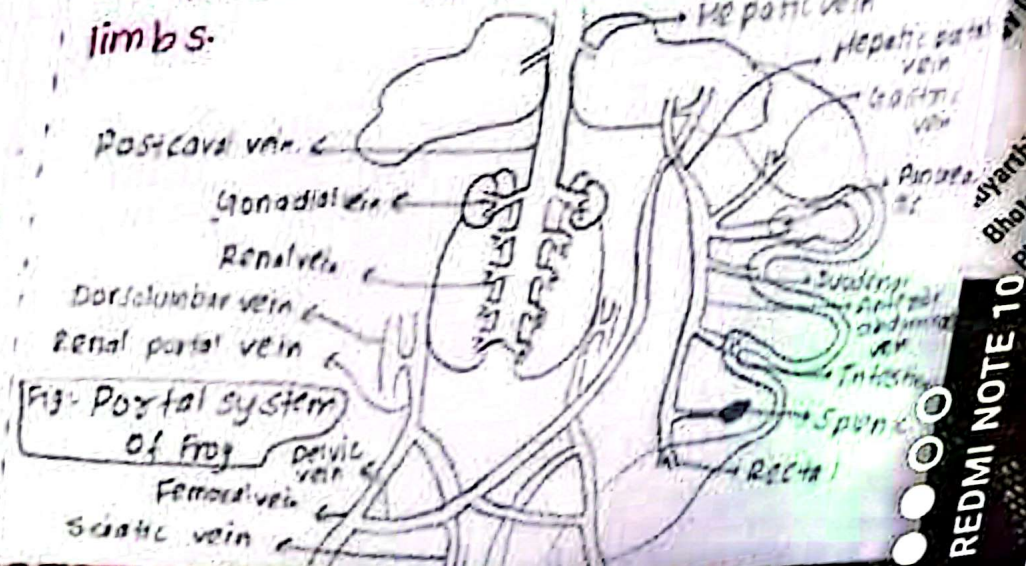


Fig:- Portal system of frog

* Arterial System

→ Blood vessels which carry blood away from the heart to various parts of the body, is collectively called arterial system.

→ begins with truncus arteriosus

Truncus arteriosus → Right innominate, Left innominate

- Carotid Arch
  - External carotid (lingual) (Tongue) → hyoid muscles
  - Internal carotid → Palatine (Buccal cavity), Carotid (Brain), Opthalmic (Eye)
- Systemic arch
  - Oesophagal (Oesophagus)
  - Occipito vertebral (Back of skull & vertebral column)
  - Subclavian (Clavicle) (Enters into forelimb as brachial)
  - Dorsal aorta (Formed in mid-dorsal line by union of right & left systemic arches)
    - Coeliaco-Mesentric (Given out from meeting of two systemic)
      - Coeliac artery
        - Gastric (Stomach)
        - Hepatic (Liver)
      - Anterior-Mesentric
        - Duodenal (Duodenum)
        - Pancreatic (Pancreas)
        - Intestinal (Ileum)
        - Splenic (Spleen)
    - Genadial (Gonads) Male: Testicular, Female: ovarian
    - Renal (Kidneys)
    - Posterior-mesentric (Large-intestine)
    - Common Iliacs (Dorsal aorta bifurcates)
      - Epigastric (Ventral body wall & Urinary bladder)
      - Recto-vesicular (Rectum)
      - Femoral (Thigh region)
      - Sciatic (Lowerleg)
- Pulmocutaneous arch
  - Pulmonary (Lungs)
  - Cutaneous (Skin)

Carotid labyrinth → detects the pressure changes of oxygen in blood.

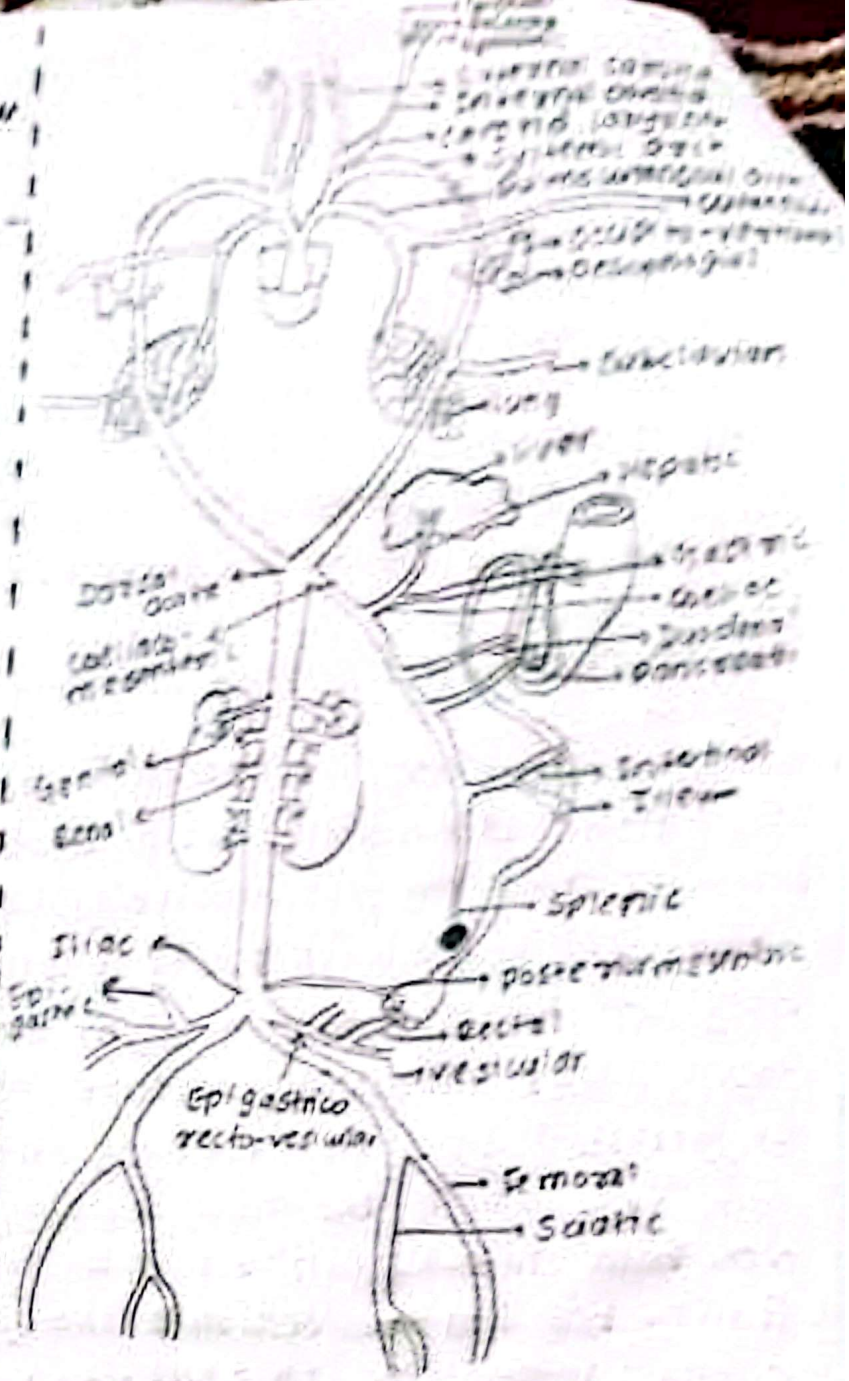


Fig: Arterial System of frog.

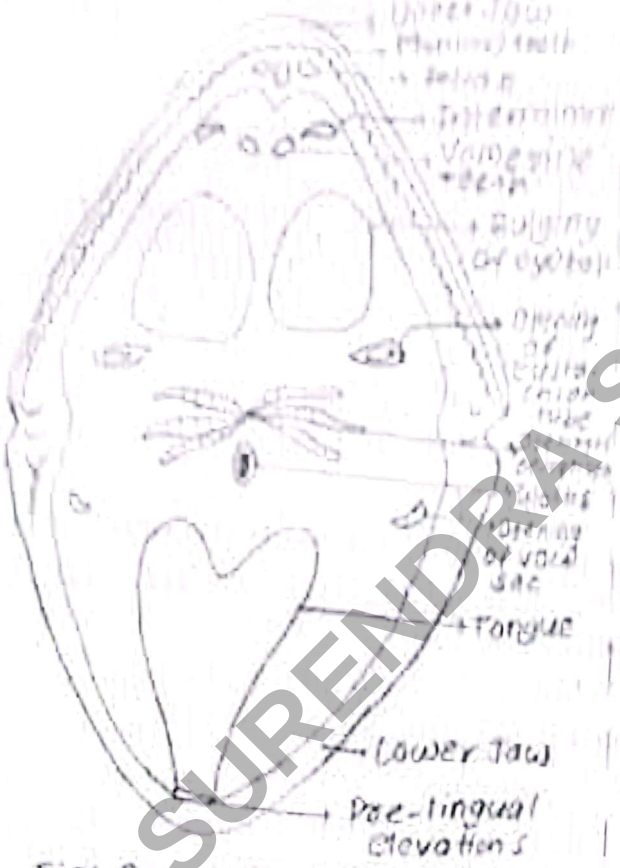


Fig: Buccopharyngeal cavity

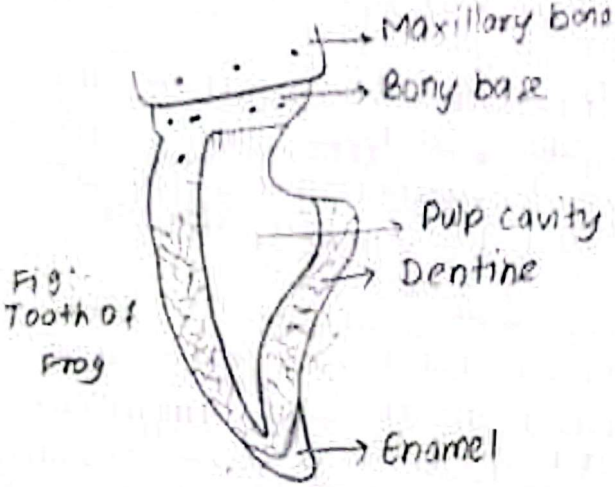


Fig: Tooth of Frog

If Digestive System of Frog:-

Digestive system of frog serves for the ingestion, digestion, absorption, and also the egestion of undigested food.

It consist Alimentary canal and digestive glands.

1. Alimentary Canal
→ long coiled structure extended from mouth to anus.

It consists:-

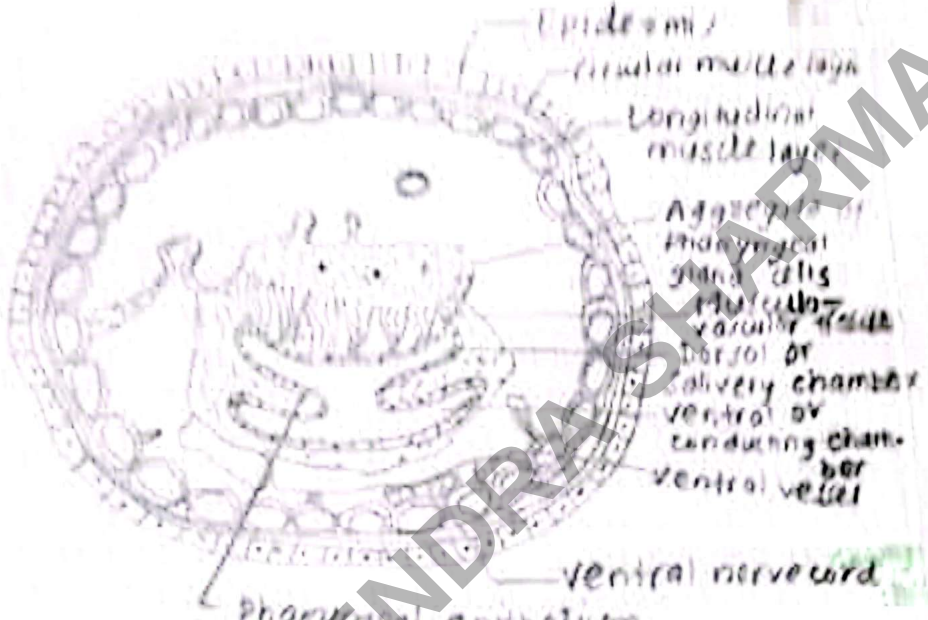
a. Mouth:- wide slit like aperture at anterior end of the snout.
→ bounded by two jaws - upper immovable and lower movable jaw.

b. Buccal cavity:→ wide shallow cavity; contains mucous-secreting cells which helps in keeping buccal cavity moist → Roof of buccal cavity consists upper jaw; consists two small anteriorly placed internal nares, two bulging of eye balls → beside bulging of eye ball there are opening of eustachian tube for communicating with middle ear
→ bears homodont, acrodont and polyphyodont maxillary teeth attached with maxillae bones
→ roof also bears vomerine teeth on vomer bone lying anterior to internal nares
→ lower jaw consist fleshy and elastic protrusible tongue for catching prey and opening of vocal sac which produces croaking sound
→ Glottis - leads to laryngotracheal chamber
→ Gullet - opening that leads to oesophagus.

Teeth:- Two types → maxillary (found on maxilla and premaxilla bones) → prevent captured prey from escaping
→ vomerine found on vomer bone → kill the prey.

Maxillary → sharp, pointed; all teeth look similar (homodont); remain directly attached to jaw bones (acrodont); If teeth are broken, they are replaced easily many times (polyphyodont)

Consists of two parts: (a) base with bone like material (b) Crown consists dentine covered with enamel; has pulp cavity lined with odontoblast cell that produce new tooth → filled with blood vessels, nerves



T.S of earthworm passing through pharynx.

Function of clitellum:-

(I) helps to detect the anterior position of the animals.

(II) helps in formation of cocoon which serves as the store house of eggs and sperms and site of fertillization.

(III) Secrete mucous; keeps clitellum moist.

(IV) helps in division of body into 3 regions pre clitellar region(1-13), clitellar(14-16) and post clitellar (17th to last)

(V) Secretes albumen for plastering the burrow wall to minimize the friction.

Economic importance of earthworm

→ The soil becomes porous and its humus contents are also increased due to egested faecal matter.

→ Worm-castings are rich in nitrogenous materials.

→ It makes soil soft by grinding soil in the gizzard. So, it is known as natural plough.

→ People in different parts of the world use it as food.

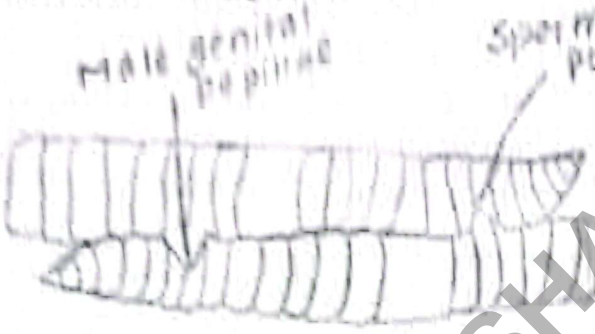
→ They are used as bait in fishing.

→ It is believed that it helps in curing bladder stones, piles, gout, arthritis, etc.

→ It is used for the dissection in the laboratory which gives basic idea of general body structure and anatomy of lower animal.

→ It damages roots of tender plants ↓ easily damaged.

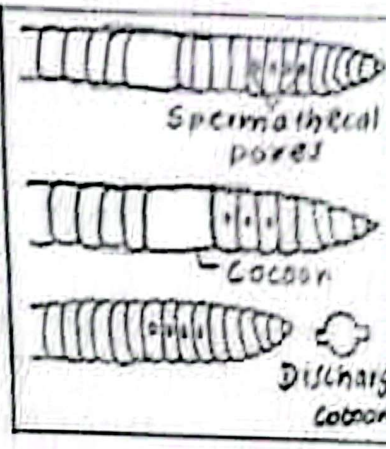
Copulation in earthworm



→ Copulation takes place in rainy season
→ During this process, two earthworms lie opposite to each other such the ventral surface remain in touch and male genital openings of one come opposite to the spermathecal opening of other.
→ At this time protuberence arise from male genital opening and acts as penis for piercing spermathecal opening.
→ In this way, both earthworms receive sperms and prostatic secretion in all their spermathecae one after another.
→ The copulants separate after copulation i.e. after sperms are stored in the spermathecae.

Cocoon formation and fertilization.

→ After copulation, gland cells of clitellum become active and secrete the substance which harden on exposure to air and form a hard covering known as girdle.
→ The worm now withdraws itself backwards from the girdle.
→ When girdle passes over female gonopore it receives egg and when it passes over spermathecal opening sperms are received (which fertilize the eggs to form the zygote)
→ When anterior end of animal comes out of girdle, both end of girdle are closed up and result in the formation of yellowish round cocoon.
→ Fertilization occurs in cocoon only. when cocoon has been deposited in a moist place.
→ Fertilization is external (occurs in cocoon).
→ Development of earthworm is direct without larval stage.
→ Only a single fertilized egg in each cocoon undergoes further development while other fertized nourishes the developing embryo.



...tory system of Earthworm:

...ephridium = (highly coiled structure) → They control the composition and volume of body fluids

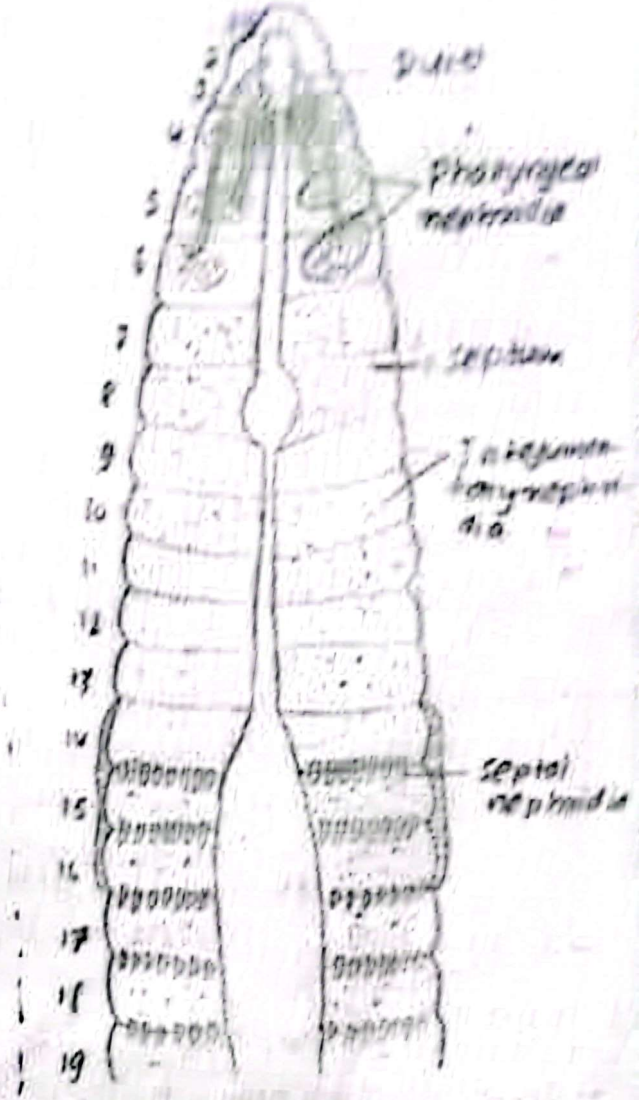
Types

Integumentary

- Attached to skin/integument from 3rd segment
- ~~Maximum in number (200-250)~~
- Maximum in clitellar region 2000-2500 (14, 15 & 16th segment)
- Clitellum - Forest of integumentary nephridia
- Nephridia:- **Lacks Nephrostome**
- Collect waste from blood & excrete outside the body by tiny pores called nephridiopore
- Exonephric Nephridia

Pharyngeal

- Present near pharynx in 4, 5, 6 segment
- One pair of tufts/tuft per segment
- 100 nephridia in each tuft.
- Least in number
- Lack nephrostome
  Simple nephridia
- Collect excretory matter from blood & pour into pharynx through nephridial duct
- Endonephric nephridia



B. Digestive glands

a. Gastric gland:
- goblet cell: produce mucus
- Peptic cell: produce protein digestive engymes
- Oxyntic cell: produce HCl

b. Intestinal gland found in mucosal lining of small intestine which produce intestinal juice having several enzymes for digestion of food in basic medium.

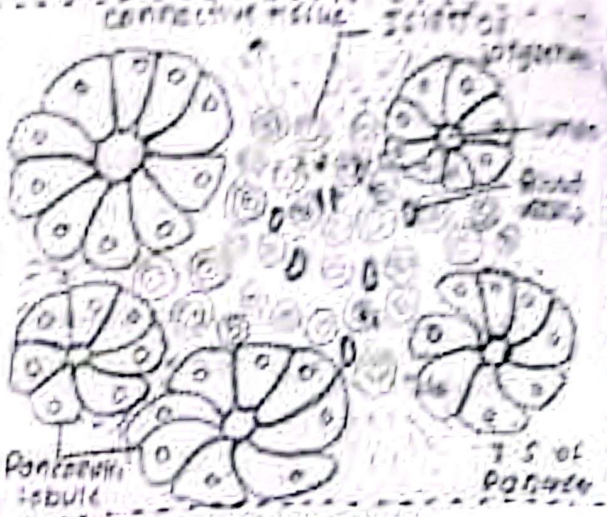
c. Liver: Largest gland; lies anterior part of body cavity near heart and lungs; hepatic duct arise from lobes of liver; hepatic duct and cystic duct (arising from gall bladder)

Absorption occurs either by simple diffusion and active transport method.

(d) Assimilation: Process of deposition of excess food molecules which are stored and incorporated as structural component of the body.
Eg: Deposition of hibernating fat in frog.

→ Functions of liver:
→ produces non-enzymatic digestive juice called bile.
Bile → (i) Neutralizes acidic food
(ii) kills bacteria present in the food
(iii) Bile salts like sodium bicarbonate, sodium glycocholate emulsify fats.
(iv) activates lipase to act on fat
→ maintains constant blood sugar by the process of glycogenesis and glycogenolysis
↓ excess glucose into glycogen in presence of insulin hormone
↓ Glycogen into glucose in presence of glucagon hormone
→ Produces prothrombin and fibrinogen that help in blood clotting
→ breaks haemaglobin of dead RBCs into bile pigments i.e. biliverdin and bilirubin.
→ produces heparin that prevent blood clotting inside blood vessels.
→ Kuffar cell of liver destroy harmful bacteria & dead RBCs.
→ detoxifies toxic substance.

d. Pancreas
→ Second largest gland
→ thin, elongated and irregular gland lying between duodenum and stomach
→ yellowish; produce pancreatic juice



→ Heterocrine gland

1. Exocrine part is pancreatic lobule that produce enzymes Trypsinogen, Amylase, and lypase that help in digestion of protein, carbohydrate and fat respectively.
2. Endocrine part is Islets of langerhans that produces two hormones Insulin and glucagon → Increase & decrease sugar level in blood.

K → Protista
P - Protozoa
Sp → Ciliophora
C → Ciliata
Cl → Paramecium
S → Caudatum

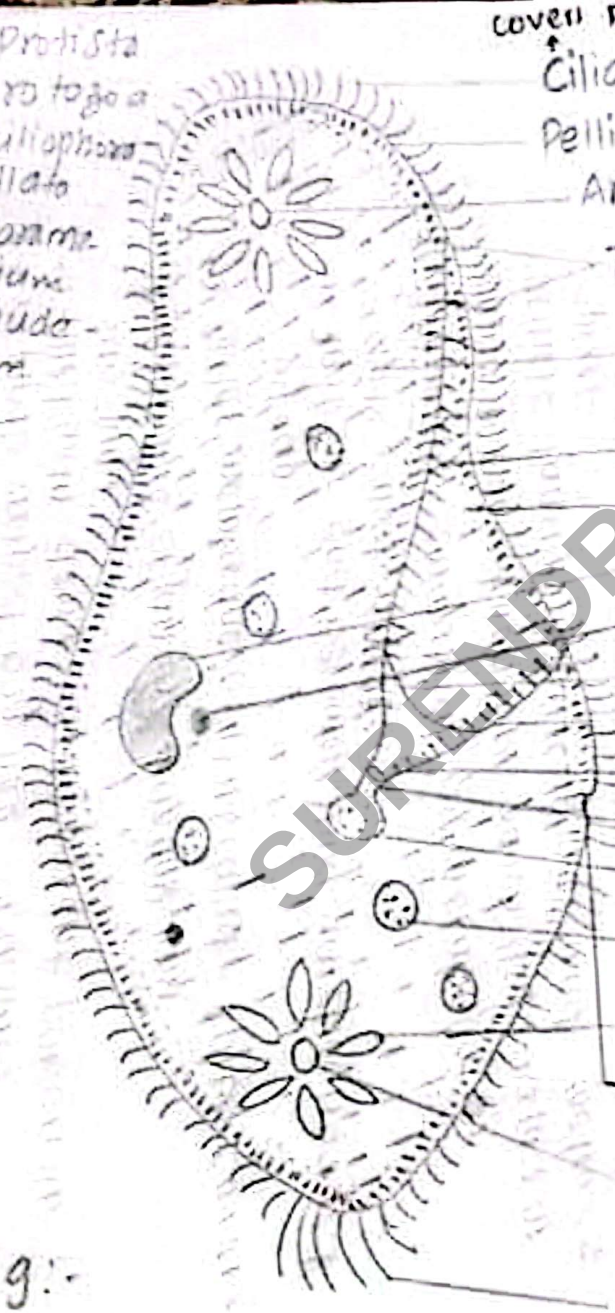


Fig:- Paramecium caudatum

Cilia (Fine hair-like protoplasmic structures → locomotion + food capture)
↑ covers pellicle externally
→ secreted by ectoplasm
ciliary movement
Pellicle (Thin, firm, elastic & colourless membrane → maintains shape)
Anterior contractile vacuole [Fixed shape → removal of CO_2 and excretory (osmoregul.)]
[Removal of excess water by osmosis → osmoregulation]
Trichocysts [Spindle shaped bag like → Offense and defense]
Endoplasm [Granular, fluid like]
Ectoplasm [Dense and clear outer part]
Oral groove [large depression on ventral surface → makes food vacuole]
Meganucleus [controls general cellular activities residing]
Micronucleus [control reproductive activities]
Endoral membrane
Vestibule
Buccal cavity
Cytostome
Food vacuole (New formed)
Food vacuole (detached)
Radial canal
Cytopyge [Anal spot], behind cytopharynx,
Posterior contractile vacuole
Caudal tuft [lengthy cilia on posterior end]
↳ change of direction during swimming

[Cytopharynx forms new food vacuole packing ingested food particles inside it]

[Always moves in clockwise direction for digestion, absorption and elimination called cyclosis)
Undigested food is egested out]

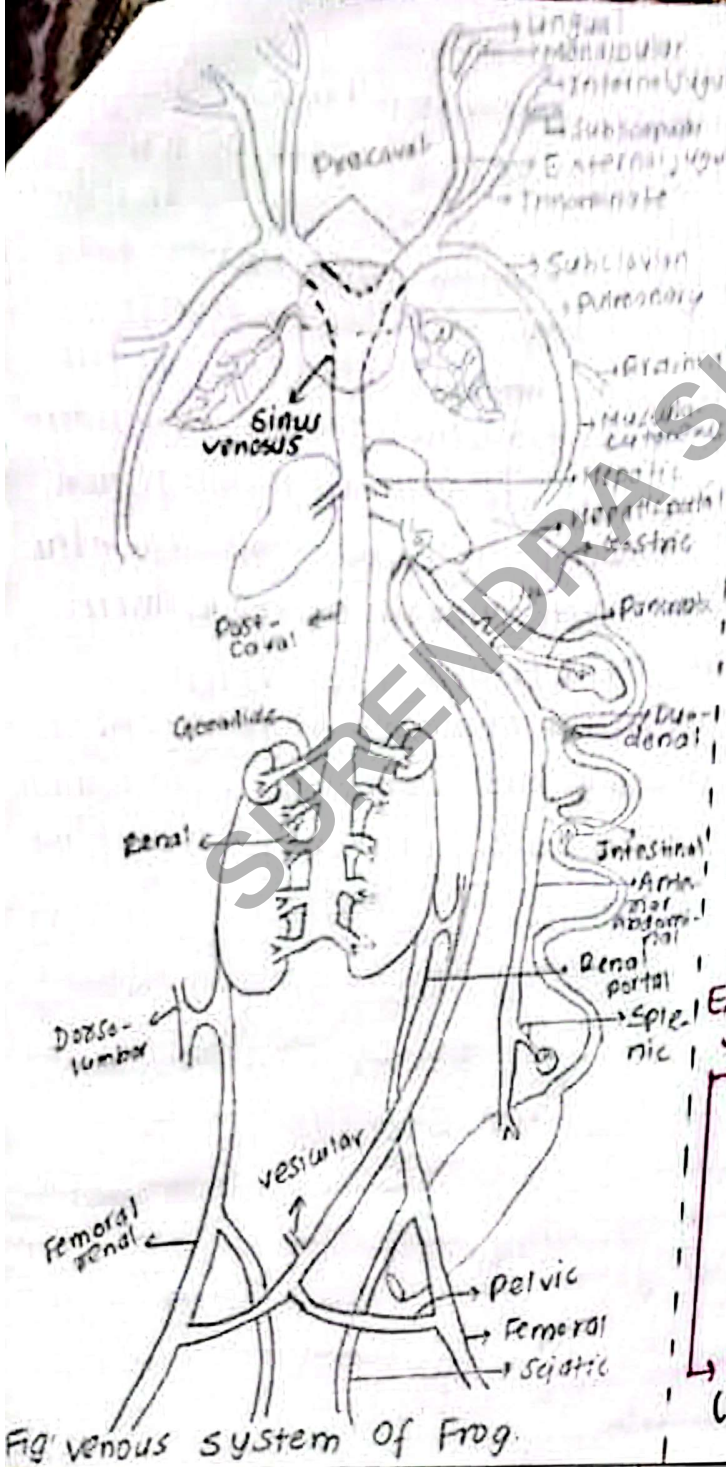


Fig: venous system of Frog.

venous System of Frog:

→ The blood vessels, which collect blood from various parts of the body and carry into heart collectively forms venous system.

→ Those blood vessels are called veins.

venous System of Frog

- **Pulmonary veins**
  (Two pulmonary veins carry blood from right and left lungs & opens into left auricle)
- **Caval veins**
  (carry deoxygenated blood from all parts of body except lungs; represented by three large veins or venacavae)
  - **Pre-cavals**
    (situated anteriorly)
    - External Jugular → Lingual (Tongue)
    - Internal jugular (Head, brain & eyeball)
      - Subscapular (Back of the shoulder (scapula) and oesophagus)
    - Sub-Clavian → Brachial (Forelimb)
      - Musculo-cutaneous, (Skin and Abdominal muscles)
    - Mandibular (lower jaw)
  - **post caval vein**
    (situated posteriorly)
    - Renal vein (Formed by union of 4-5 veins, kidney)
    - Gonadial vein (collects blood from testis in male and ovaries in female)
    - Hepatic vein (One pair of veins; collect blood from liver lobes)
- **Portal vein**
  (veins which collect blood from certain parts of body carry it into mid organ first, then into the main stem
  → Portal veins begin in capillaries one set of and ends in another set of capillaries)
  - Hepatic Portal System
  - Renal Portal System