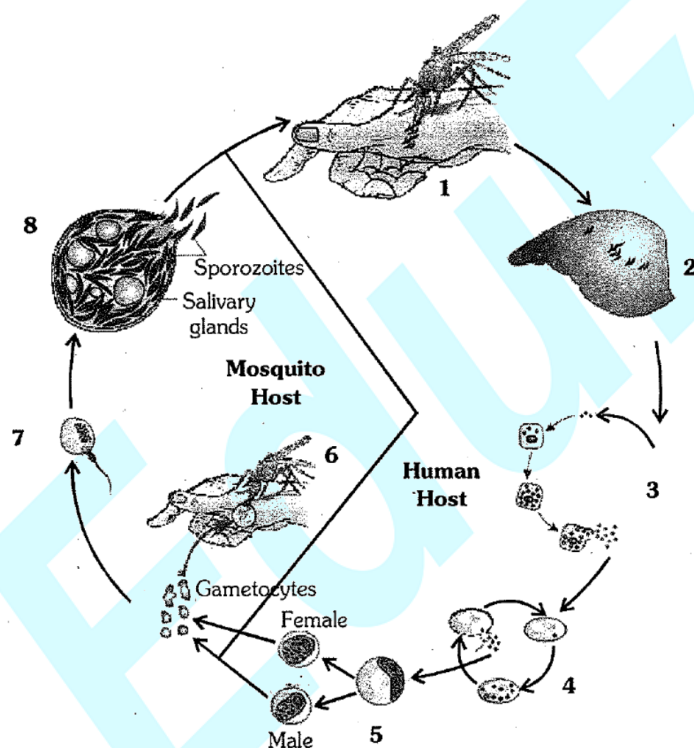


PLASMODIUM AND FROG

PLASMODIUM

- ♦ Plasmodium, a tiny protozoan is responsible for Malaria disease. Different species of Plasmodium (*P. vivax*, *P. malaria* and *P. falciparum*) are responsible for different types of malaria. Of these, malignant malaria caused by *Plasmodium falciparum* is the most serious one and can even be fatal.
- ♦ Plasmodium enters the human body as sporozoites (infectious form) through the bite of infected female *Anopheles* mosquito.
- ♦ The parasites initially multiply within the liver cells and then attack the red blood cells (RBCs) resulting in their rupture. The rupture of RBCs is associated with release of a toxic substance, haemozoin, which is responsible for the chill and high fever recurring every three to four days.
- ♦ When a female *Anopheles* mosquito bites an infected person, these parasites enter the mosquito's body and undergo further development. The parasites multiply within them to form sporozoites that are stored in their salivary glands.
- ♦ When these mosquitoes bite a human, the sporozoites are introduced into his/her body.
- ♦ Malarial parasite requires two hosts - human and mosquitoes - to complete its life cycle; the female *Anopheles* mosquito is the vector (transmitting agent) too.



Stages in the life cycle of Plasmodium :-

1. When the mosquito bites another human, sporozoites are injected with bite.
2. Parasites (sporozoites) reach the liver through blood.
3. The parasite reproduces asexually in liver cells, bursting the cell and releasing into the blood.
4. Parasites reproduce asexually in red blood cells, bursting the red blood cells and causing cycles of fever and other symptoms. Released parasites infect new red blood cells.
5. Sexual stages (gametocytes) develop in red blood cells.

6. Female mosquito takes up gametocytes with blood meal
7. Fertilisation and development take place in the mosquito's intestine.
8. Mature infective stages (sporozoites) escape from intestine and migrate to the mosquito salivary glands

FROG (RANA TIGRINA)

Classification :

Phylum	-	Chordata
Sub-phylum	-	Vertebrata
Super class	-	Tetrapoda
Class	-	Amphibia
Genus	-	Rana
Species	-	Tigrina

- Rana tigrina is the most common species of frog.
- Most common species of toad is Bufo malenostictus
- Toad have the poisonous gland in its skin but it is absent in frog.
- Frogs do not have constant body temperature i.e., their body temperature varies with the temperature of the environment. Such animals are called cold blooded or poikilotherms.
- They have ability to change the colour to hide them from their enemies (camouflage). This protective coloration is called mimicry.
- We also know that the frogs are not seen during winter. During this period they take shelter in deep burrows to protect them from extreme heat and cold. This is called as summer sleep (aestivation) and winter sleep (hibernation).

(1) SIZE OF FROG -

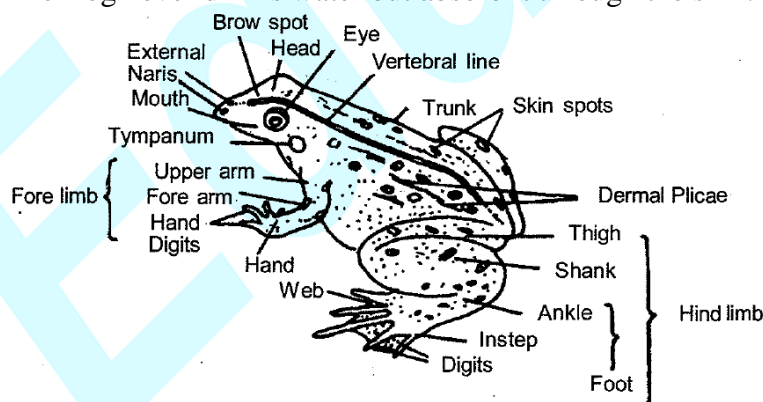
Length	-	18-20 cm
Width	-	5-8 cm

The skin is smooth and slippery due to the presence of mucus.

Colour of frog → Dorsal part is olive green and ventral part is uniformly pale yellow.

Body of frog is adapted for burrowing, jumping and swimming.

The frog never drinks water but absorb it through the skin.

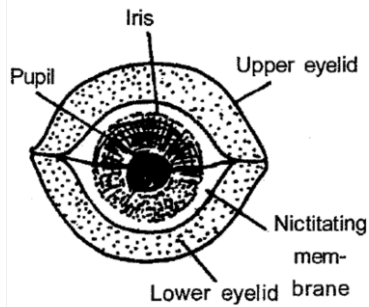


Frog in sitting position

(2) BODY OF FROG IS DIVIDED INTO 2 PARTS

- (i) Head (ii) Trunk

Neck and tail are absent in it.



**Eye of Frog showing
different eye lids.**

(I) HEAD

Head is triangular & its anterior conical part is called snout.

Head bears the following structures

- (i) Mouth
- (ii) Nostrils - 1 pair
- (iii) Eyes - 1 pair
- (iv) Tympanic membrane- 1 pair
- (v) Vocal sac - 1 pair
- (vi) Brow spot- 1 at mid dorsal region

(a) Eyes : Each eye has 3 eyelids

- (i) Upper eye lid - It is immovable
- (ii) Lower eye lid - It is movable
- (iii) Third eye lid - It is thin, transparent, freely movable membrane also called nictitating membrane. It protect the cornea from mud & dust.

(b) Brow Spot : It is small, Circular light coloured spot located mid-dorsal side in between the 2 eyes. It represents vestigial third eye or pineal eye.

(c) Tympanic membrane/Eardrum : It is small, circular membranous fold located just behind each eye. It receives the sound waves so it is related with hearing.

(d) Vocal sac : It is a pair of balloon like elastic structures in throat of male frog. It acts as a resonator. It increases the pitch of croaking of male frog. At the time of breeding season, it is used to attract the female.

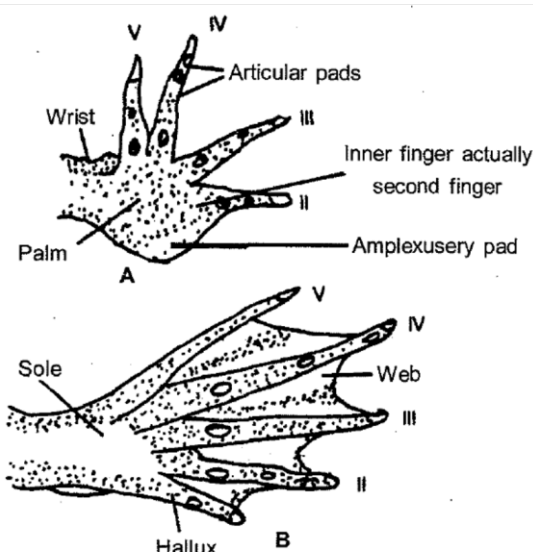
(II) TRUNK

Frog is a tetrapod. Four limbs are attached to its trunk. Longitudinal folds are present on the dorsal part of trunk that is called dermal fold or dermal plicae.

The forelimbs and hind limbs help in swimming, walking, leaping and burrowing. Fore limbs have four digits. Thumb is absent in fore limb.

The hind limbs are larger and muscular than fore limb and have five digits.

Feet have webbed digits that help in swimming.



A, hand of male frog during breeding season.

B, distal part of foot showing digits and web.

Hind Limb : One pair each limb is divided into 3 parts.

- (i) Upper part : It is thigh or femur
- (ii) Middle part : It is shank or chrus
- (iii) Distal part is foot or pes.

- Pes bears 5 toes but no nails or claws (exoskeleton is absent).
- In between the toes, skin folds are present that is called web which help in swimming.
- These three parts of hind limb folded in the form of 'Z'. It help in jumping movement and act as a shock absorber.

Male frogs can be distinguished by the presence of sound producing vocal sacs and also a copulatory pad on the first digit of the fore limbs which are absent in female frogs.

Cloacal aperture : It is a common outlet for faeces, urine and sex cells (sperm & ova). Frogs exhibit sexual dimorphism.

FROG SYSTEM OR INTERNAL MORPHOLOGY

- Following systems are present in frog.

(3) RESPIRATORY SYSTEM

- Exchange of gases from the environment is the function of its respiratory system. Frog respire on land and in water by different methods in water skin act as respiratory organ and on land the buccal cavity, skin and lungs act as the respiratory organ.
- 3 types of respiration are present in frog.
 - (a) **Cutaneous Respiration :** 35% cutaneous respiration is present in it. Skin contains the mucous gland which secretes the mucous on the surface to moisten the skin that causes exchange of gases from the environment by diffusion. During aestivation and hibernation gaseous exchange takes place through skin.
 - (b) **Pulmonary respiration :** 56% pulmonary respiration is present in it. Two pear-shaped lungs are present in the anterior part of the trunk which are responsible for pulmonary respiration. The lungs are a pair of elongated, pink-colored sac-like structures present in the upper part of the trunk region (thorax). Air enters through the nostrils into the buccal cavity and then to the lungs.
 - (c) **Buccal cavity respiration :** 9% buccal respiration is present in it. Large network of capillaries is present in its oral cavity that causes exchange of gases through diffusion.

(4) DIGESTIVE SYSTEM :

Function of digestive system is ingestion of food, digestion & egestion of undigested food.

Digestive system is divided into 2 parts.

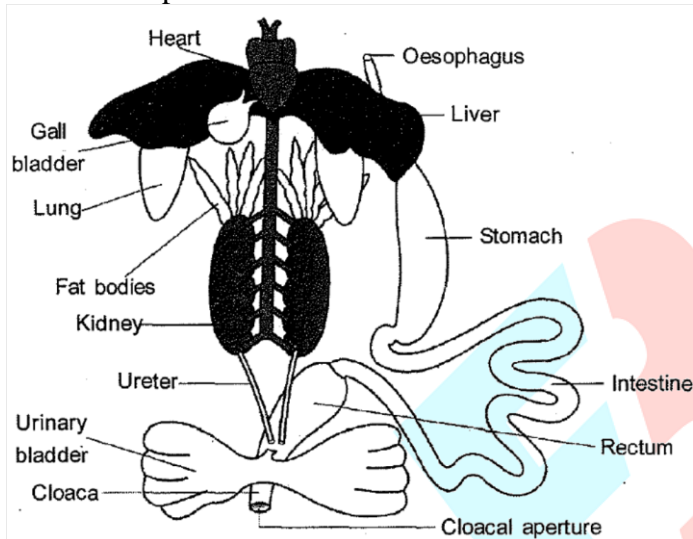
The digestive system consists of alimentary canal and digestive glands.

The alimentary canal is short because frogs are carnivores and hence the length of intestine is reduced.

(a) Digestive tract or food passage:

In frog, passage of food is through Alimentary canal of Frog and its associated organs.

Mouth → oral cavity → pharynx → Oesophagus → stomach → intestine → rectum → Cloaca → Cloacal aperture



Alimentary canal of Frog and its associated organs.

Tongue : Tongue of frog is long, folded, sticky & bilobed at its anterior end. It is adapted for capturing the prey (insect).

Stomach:

- It is a muscular bag. It contains HCl & proteolytic enzyme. HCl makes the acidic pH of food & it is bacteriolytic.
- Digestion is completed in intestine.
- Food is captured by the bilobed tongue. Digestion of food takes place by the action of HCl and gastric juices secreted from the walls of the stomach. Partially digested food called chyme is passed from stomach to the first part of the intestine, the duodenum. The duodenum receives bile from gall bladder and pancreatic juices from the pancreas through a common bile duct. Bile emulsifies fat and pancreatic juices digest carbohydrates and proteins. Final digestion takes place in the intestine. Digested food is absorbed by the numerous finger-like folds in the inner wall of intestine called villi and microvilli. The undigested solid waste moves into the rectum and passes out through cloaca.

Digestive glands :

Two digestive glands are present in it.

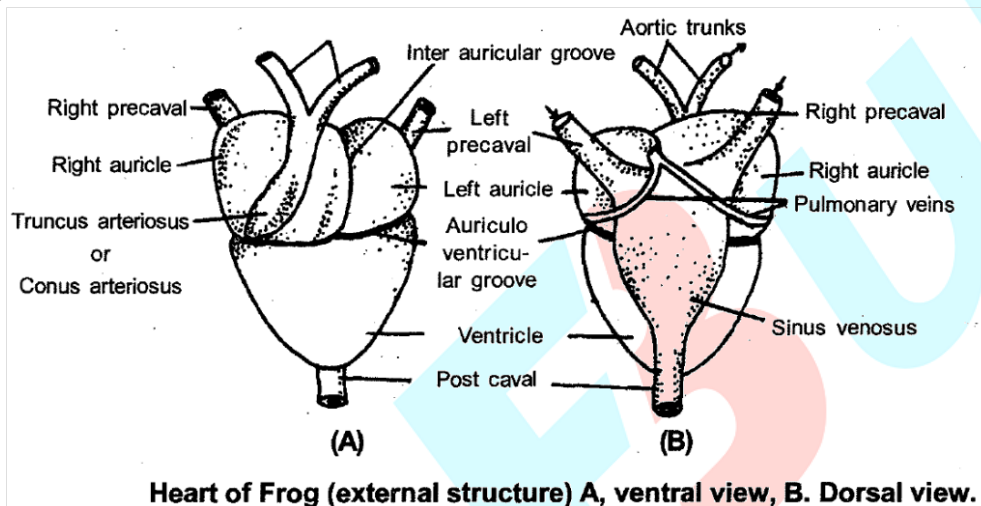
- (i) **Liver** : It forms bile. Bile is stored in gall-bladder. Bile is secreted in Intestine. Bile juice is an alkaline solution. It changes the pH of food from acidic to alkaline. It also causes emulsification of fat.
- (ii) **Pancreas** : It secretes pancreatic juice in intestine. Pancreatic juice is called digestive juice as it is complete digestive juice.

(5) **CIRCULATORY SYSTEM :**

Closed & incomplete double circulation is present in frog.

Function of circulatory system is to transport food, gases and hormones to various parts of the body. It consists of following structures.

Heart :



Three chambered, muscular myogenic heart is present in it which have 2 Auricles & 1 ventricle. Auricles receive the blood. Ventricle pumps the blood to the various parts of the body. Its heart rate is 64/min.

Blood vessel : These are contractile tubes which distribute blood from the heart to the various parts of the body.

Blood : Three type of blood cells are present in it

- (1) RBC- RBC are oval or biconvex in shape and nucleated. It contains haemoglobin which carry the oxygen.
- (2) WBC - This cell provide protection or immunity.
- (3) Thrombocytes : This cell prevent loss of blood by forming thrombus or clots on the bleeding site.

Special venous connection between liver and intestine as well as the kidney and lower parts of the body are present in frogs. The former is called hepatic portal system and the latter is called renal portal system.

The lymphatic system consists of lymph, lymph channels and lymph nodes.

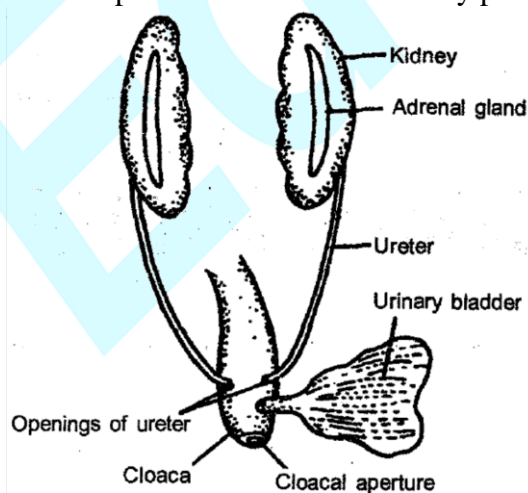
The lymph is different from blood. It lacks few proteins and RBCs.

(6) **NERVOUS SYSTEM :**

Function of nervous system is perception of sense & analysis of sense, reaction according to a sense & control and coordination of various parts of body.

It is divided into 3 parts

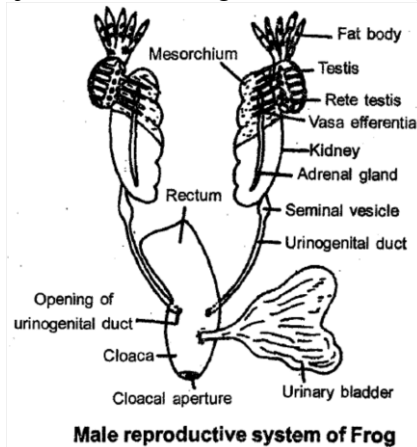
- (a) **Central Nervous System** : Central nervous system is made up of brain & spinal cord. It is involved in analysis of sense. Brain is enclosed in a bony structure called brain box (cranium). The brain is divided into fore-brain, mid-brain and hind-brain. Forebrain includes olfactory lobes, paired cerebral hemispheres and unpaired diencephalon. The midbrain is characterised by a pair of optic lobes. Hind-brain consists of cerebellum and medulla oblongata. The medulla oblongata passes out through the foramen magnum and continues into spinal cord, which is enclosed in the vertebral column.
- (b) **Peripheral Nervous System** : It is made up of cranial nerves and spinal nerves. 10 pairs of cranial & 10 pairs of spinal nerves are present in frog.
- (In *Rana tigrina*, 9 pairs spinal nerves are present) 12 pairs cranial nerves & 31 pairs spinal nerves are present in human.
 - 12 pairs cranial nerves & 33 pairs spinal nerves are present in rat.
- (c) **Autonomous Nervous System** : This controls the autonomous parts (automatic) of the body. This system controls the autonomic parts of the body like heart, lungs & intestine. Two types of nerves are present in it.
- (1) **Sympathetic Nerve** : It increases the rate of autonomous organs.
 - (2) **Parasympathetic nerve** : It decreases the rate of autonomous organs.
- (7) **SENSE ORGANS IN FROG** :
1. Organ of touch called sensory papillae.
 2. Organ of taste called taste buds.
 3. Organ of smell called nasal epithelium.
 4. Organ of vision called eyes (Possessing only one unit)
 5. Organ of hearing called tympanum with internal ears.
 6. Eyes and internal ears are well-organised structures and the rest are cellular aggregations around nerve endings.
- (8) **EXCRETORY SYSTEM** :
- One pair of kidneys are present in it. Each kidney is made up of 2000 uriniferous tubules or nephrons. Kidneys form urine which is stored in urinary bladder & excreted through cloacal aperture. The main excretory product in frog is urea, so it is a ureotelic animal.



Excretory system of Frog.

(9) REPRODUCTIVE SYSTEM :**I. Male Reproductive System :**

One pair of testis are attached to the upper part of kidney by the help of membrane mesorchium. Sperms are formed in testis by spermatogenesis. At the time of copulation. This sperm enter into bidder canal from the testis by 10 to 12 small ducts. These ducts are called Vasa efferentia. This bidder canal opens into cloaca through the urinogenital duct. Sperms are ejected out through the cloacal aperture.

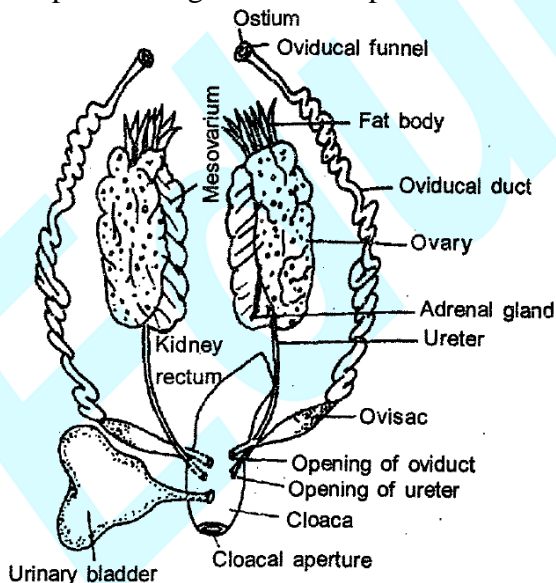
**II. Female Reproductive System :**

One pair of ovaries are present on the upper pole of kidney & it opens into cloaca by a separate duct that is called oviduct. so, there is no connection between the ovaries & kidney.

Mature female can lay 2500-3000 ova at a time.

At a time only one ovary eject ova. Fertilization is external. Its larva is called tadpole.

Tadpole undergoes metamorphosis to form the adult.



Female reproductive system of Frog

SPECIAL POINTS :

1. Sexual dimorphism is present in frog. Nuptial pad & vocal sac are present in male frog only.
2. 10 vertebrae are present in frog.

ECONOMICAL IMPORTANCE OF FROG :

Frogs are beneficial for mankind because they eat insects and protect the crop. Frogs maintain ecological balance because these serve as an important link of food chain and food web in the ecosystem. In some countries the muscular legs of frog are used as food by man.

GOLDEN KEY POINTS

- Frog belong to order - Anura.
- The capability of changing colour is known as metachrosis.
- The tadpole (larva) of frog- Herbivorous. So alimentary canal and intestine long.
- During tadpole kidney act as haemopoietic. Organ help in haemopoiesis process.
- The tadpole (larva) of frog respire with the help of gills.
- In frogs, teeth are absent on the lower jaw. While the upper jaw bears two type of teeth - maxillary and vomerine teeth.
- Teeth are homodont, polyphyodont and acrodont type.
- Sinus venosus of heart act as a pace maker in frog.
- In frog diaphragm absent.
- The digital formula for the fore limb of frog is 02233.
- The digital formula for the hind limb of frog is 22343.
- In frog kidney cortex, medulla and pyramid absent.
- Frog have anamniotes eggs.
- Neck is absent in frog. This helps frog in jumping on ground.
- Frog have single ear ossicle.
- Frog skull - dicondylic type.