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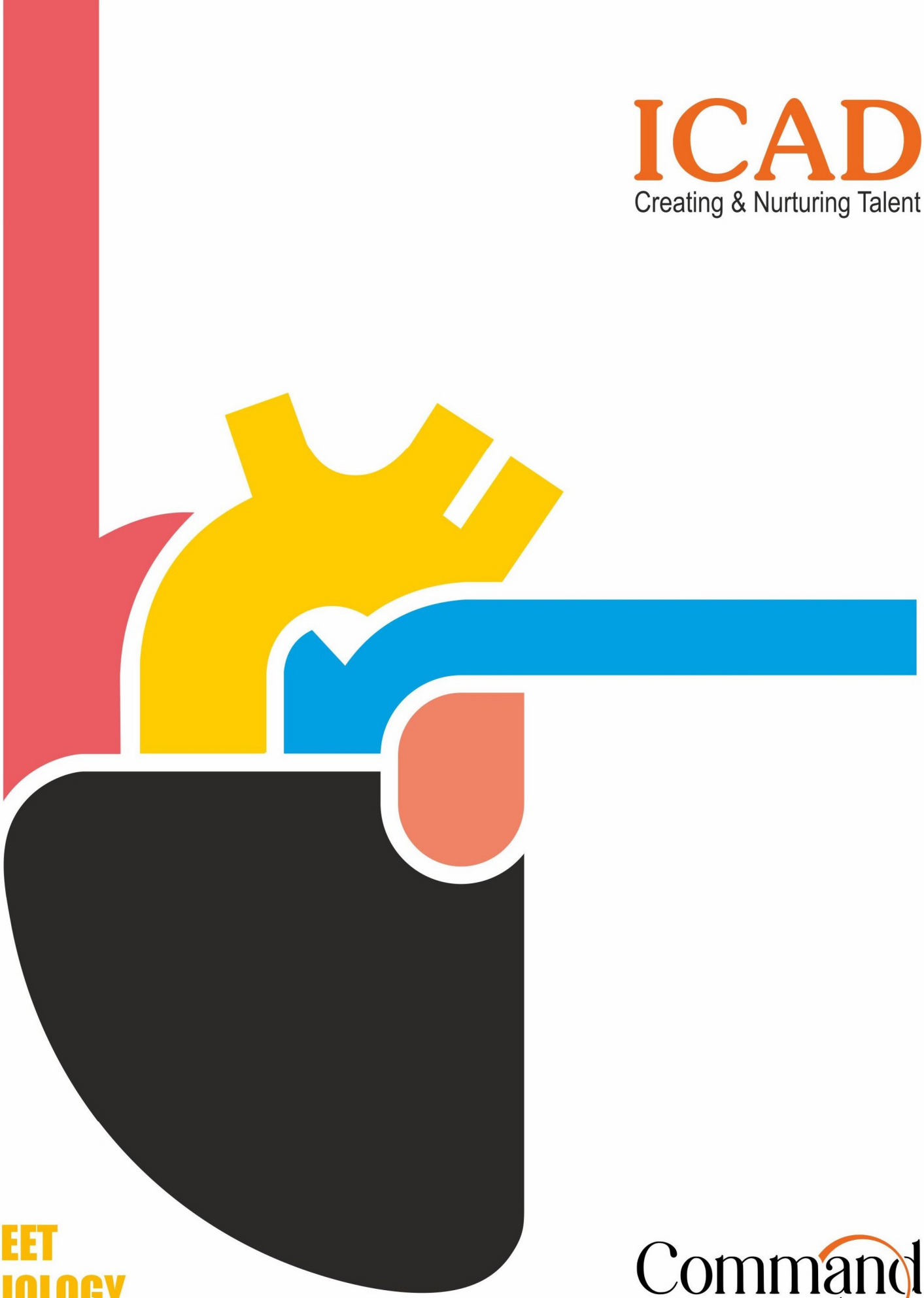
Creating & Nurturing Talent



NEET
BIOLOGY

[B43] : Frog, Family Brassicaceae (Cruciferae) Family Malvaceae, Family Asteraceae (Cruciferae) Family Poaceae (Graminae)

Command Capsule
MODULE SIMPLIFIED

CONTENTS

B-43 : FROG

General Features and Morphology:

Frogs can live both on land and in freshwater and belong to class Amphibia of phylum Chordata. The most common species of frog found in India is *Rana tigrina*. They 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. You might have also noticed changes in the colour of the frogs while they are in grasses and on dry land. They have the ability to change the colour to hide them from their enemies (camouflage). This protective coloration is called mimicry. You may also know that frogs are not seen during peak summer and winter. During this period they take shelter in deep burrows to protect them from extreme heat and cold. This is known as summer sleep (aestivation) and winter sleep (hibernation) respectively.

Rana tigrina is the most widely distributed species in Northern India. Generally frogs are found in ponds, tanks, pools, ditches, etc. However, they may leave their aquatic habitat to come on land to hunt for their prey, which are mostly insects. The frog is called an amphibious animal because it lives both in water and on land.

The frog is very well adapted both for jumping and leaping on the land and swimming or floating in water. Normally frog can jump up to three feet. When a frog jumps to a shorter distance, it is known as leaping. The alternate kicks of the hind-limbs push the webbed toes against water, thereby providing the force for swimming. The boat-shaped body of the frog, mainly due to the absence of neck, is helpful in swimming.

The adult frog is carnivorous and mostly feeds on insects and their larvae, spiders, earthworms and in some cases evens their own larvae. It will capture only a moving prey and swallow it as a whole.

During the rainy season, which is also the breeding season of the frog, the frogs make peculiar sounds with the help of their vocal cords, known as croaking. The male frogs croak louder than the females, because in them the pitch of croaking is increased due to the presence of two vocal sacs situated one on each side of the floor of the throat. The vocal sacs act as resonators. The croaking is a mating call to attract the females.

The body of frog is divisible into two parts only: the head and the trunk. The neck and tail are not present. The ante-riorly placed mouth is a wide transverse opening. A pair of external nares (nos-trils) is present at a short distance above the mouth. There is present a pair of dorsolaterally placed prominently bulg-ing out eyes on the head. The eyes are protected by upper and lower eye-lids.

The upper eye-lid is prominent, thick and slightly movable, while the lower eye-lid is vestigial and immovable. A little above the lower eye-lid, a transparent nictitating membrane, mistakenly referred to as the third eye-lid, is present.

This membrane is with-drawn and unfolds itself with the help of certain eye muscles to protect the eye from water and any other damaging matter by covering the eye ball. Just behind the eyes on each side a pigmented tympanum (ear covering) is present.

Between the two eyes on the mid-dorsal line is present a small circular and lightly coloured, but a conspicuous patch, known as brow spot which represents vestigial pineal eye. Only in the male frogs, there is situated on the posterior part of the throat a pair of somewhat bluish and wrinkled vocal sacs. The vocal sacs help in increasing the croaking which is referred to by some people as the “mating call”.

The neck being absent in frog, the head is directly continued into the trunk. The trunk comprises an anterior portion known as thorax and a posterior larger portion called abdomen. A pair of fore-limb and hind-limb is appended to the trunk.

Sexual Dimorphism:

This phenomenon means that the male and female animals can be distinguished by their external features.
In case of frog the male and female can be differentiated from each other due to the following facts:
(i) The male frog possesses vocal sacs, which are most developed during the breeding season,
(ii) During the breeding season an amplexusory or copulatory/nuptial pad is developed on inner finger of each hand of the male frog.

Digestive System of Frog:

It consists of the alimentary canal and the associated digestive glands.

Alimentary canal:

The alimentary canal consists of the following parts:

1. Mouth:

It is bounded by immovable upper jaw and movable lower jaw.

2. Buccopharyngeal cavity:

It is so-called because the buccal cavity and pharynx have been merged into one cavity.

3. Oesophagus:

Because of the absence of neck in frog, the oesophagus is only a short tube. The oesophagus leads to the stomach.

4. Stomach:

It is divisible into two parts:

(i) Cardiac stomach, the anterior larger part is present near the heart. The opening of the oesophagus into the cardiac stomach is guarded by a cardiac sphincter, a powerful ring of circular muscles, which prevents the backward flow of food,

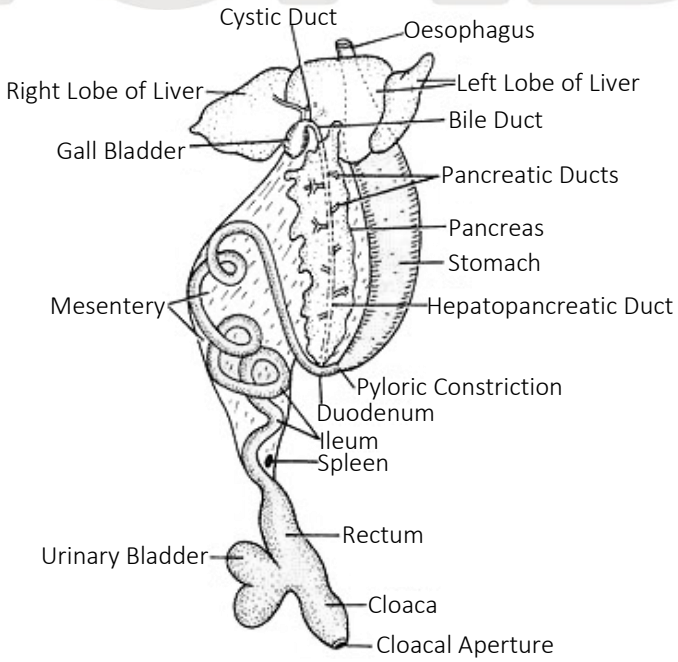
(ii) Pyloric stomach is a posterior narrow tapering part, which is separated from the duodenum by a muscular constriction, the pyloric constriction externally, which indicates the position of pyloric sphincter and controls the entry of food into duodenum.

5. Small Intestine:

It is the long-est part of the alimentary canal suspended by mesentery, and is divisible into duode-num and ileum. They have large number of finger like branched projections known as villi which increase the absorptive surface area.

6. Rectum (Large Intestine):

The ileum leads into the rectum. Posteri-orly, it opens into the cloaca through an aperture known as anus which is guarded by an anal-sphincter. The rectum stores the faecal matter and water is absorbed by its wall.



7. Cloaca:

It receives the rectum in both the sexes, but in female frog, the cloaca also receives the ureters and oviducts, while in male the urinogenital ducts are received in addition to the rec-tum. The urinary bladder also opens into the cloaca. The cloaca opens out through a cloacal aperture, situated at the posterior-most end of the abdomen.

Digestive Glands of Frog:

In frog, the digestive glands are as follows:

(i) Liver:

The liver is the largest gland of the body. It is composed of two lobes, the left and the right joined with each other. The left lobe is larger and divided into two smaller lobes. In between the two main lobes of the liver, a muscular, rounded, dark bluish green bag like structure, the gall bladder, is situated.

The liver secretes a liquid, which is called bile. The bile is transferred to the gall bladder for storage through many hepatic ducts. The bill contains organic and inorganic salts. The sodium carbonate salt of bile makes it alkaline. The bile as such does not contain any digestive enzyme.

The gall bladder gives rise to a duct, the cystic duct, which also receives a few hepatic ducts from the liver directly. The cystic duct proceeds towards the duodenum as the bile duct. When the bile duct passes through pancreas, it receives some pancreatic ducts from the pancreas and opens into the duodenum as a common hepatopancreatic duct.

(ii) Pancreas:

It is a branched flat elongated pale yellow gland lying in mesentery extended in the loop between stomach and duodenum. The pancreas is made up of lobules, connective tissue and inner core of islets of Langerhans. The lobules produce pancreatic juice which is poured into the bile duct through many pancreatic ducts and finally reaches the duodenum via common hepatopancreatic duct.

The islets of Langerhans secrete a hor-mone known as insulin which converts glucose into glycogen in the liver. The enzymes present in the pancreatic juice are trypsinogen (pro-enzyme), chymotrypsinogen (pro-enzyme), peptidase, amylase, maltase and lipase.

(iii) Gastric glands:

The glands are present in the stomach.
The gastric glands secrete gastric juice and are made up of two types of cells:
(a) Peptic cells secreting pro-enzyme, pepsinogen,
(b) Oxyntic cells producing hydrochloric acid. In addition there are also present many mucus secreting cells.

(iv) Intestinal glands:

These glands are present in the small intestine which secretes the intestinal juice. Intestinal juice contains several peptidases such as tri and dipeptidases, maltase, lipase and activator enterokinese enzyme.

Food:

The adult frog is carnivorous, eating insects, spiders, earthworms etc. However, its larva is strictly herbivorous feeding on water plants.

Ingestion:

The act of taking the food material into the buccopharyngeal cavity is called ingestion. During ingestion the mouth is opened and the muscular sticky tongue is shot out with much speed to catch the prey. The prey gets adhered to the sticky tongue. The tongue along with the prey is withdrawn with great rapidity into the buccopharyngeal cavity and the mouth is firmly closed.

The prey is held, injured or killed by the teeth. The bulging of eye balls and raising up the throat help in pushing down the food towards the oesophagus. The movement of the epithelial cilia of the buccopharyngeal cavity and peristalsis further aid in the downward movement of the food into the oesophagus.

The peristalsis is due to the alternate constrictions and relaxations of longitudinal and circular muscles present in tubular muscular organs like alimentary canal, bile duct, ureter, reproduc-tive ducts, etc., passing from one end of the tubular organ to the other end. During this, the contents of the tube are pushed onwards.

Digestion:

Digestion is a process by which the non-diffusible food material is converted into diffusible form by the action of various digestive enzymes. The buccopharyngeal cavity and the oesophagus do not secrete any enzymes.

Digestion that takes place in the stomach is known as gastric digestion. The walls of the stomach secrete a hormone, the gastrin, which stimulates the gastric glands to release the gastric juice. The gastric juice contains hydrochloric acid and a pro-enzyme pepsinogen and mucus.

Hydrochloric acid converts inactive pepsinogen into active pepsin. The acid also provides the acidic medium, which is essential for the action of pepsin. The pepsin converts proteins into proteoses and peptones. The carbohydrates and fats remain unaffected by the proteolytic enzymes.

In the stomach the food is stored for quite a long time. Due to the massive peristalsis of the stomach wall, the food is broken into smaller pieces and thoroughly mixed with the gastric secretions including the mucus. The food is now in a semi-liquid state known as chyme. The latter passes into the duodenum through pyloric sphincter at regular intervals.

Digestion that takes place in the intestine is called intestinal digestion. In the duodenum, the acidity of the chyme is neutralized by the salts of bile and now the chyme becomes alkaline in nature. With the entry of bile, pancreatic juice, the intestinal juice and more of mucus, the food is now in a more liquid form and is called chyle.

A hormone, the cholecystokinin, produced by the duodenum reaches the gall bladder through blood circulation where it stimulates the gall bladder to release the bile. The bill contains no enzymes, but its salts provide the alkaline medium necessary for the action of the pancreatic and intestinal enzymes.

The bile salts lower down the surface tension of fat material, which is then broken into fine fat droplets/globules and this process is called emulsification. The duodenum also secretes secretin hormone which reaches the pancreas through blood circulation, where it stimulates the pancreas to release the pancreatic juice.

The pancreatic juice contains pro-enzymes trypsinogen, chymotrypsinogen and enzymes peptidase, amylase, maltase and lipase. The inactive trypsinogen is converted into trypsin by the action of an activator enzyme, the enterokinase of the intestinal juice. The trypsin converts inactive chymotrypsinogen into chymotrypsin.

All these three enzymes— trypsin, chymotrypsin and peptidase change proteoses and peptones into peptides. Amylase converts starch into maltose. Maltase converts some maltose into glucose. Lipase changes fat into fatty acid and glycerol.

Intestinal juice contains peptidases, maltase and lipase enzymes. The enzyme enterokinase present in this juice converts inactive trypsinogen of pancreatic juice into trypsin. Many peptidases (tri and dipeptidases), change peptides into amino acids. Maltase changes the rest of the maltose into glucose and the lipase converts the remaining fat in fatty acids and glycerol.

Absorption:

It is a process by which the digested food diffuses into the circulatory system (blood and lymph) through the wall of the alimentary canal. The absorption starts from the stomach. Most of the absorption is done by small intestine.

The wall of the alimentary canal is richly traversed by blood and lymph capillaries. The lymph capillaries of the intestine are known as lacteals. Amino acids, glucose, vitamins and water are absorbed into blood capillaries, while fatty acids and glycerol enter the lymph-capillaries (lacteals).

Egestion:

The indigestible food comes to rectum by peristaltic action, where water is mainly absorbed. After that, the faecal matters are transferred to the cloaca and from there they are egested via cloacal aperture.

Respiratory Organs of Frogs:

The adult frog respires in three different manners:
(i) Cutaneous or skin respiration;
(ii) Buccopharyngeal respiration;
(iii) Pulmonary or lung respiration.

1. Cutaneous Respiration:

The skin of frog provides an extensive surface for the exchange of gases. It is thin, richly supplied with blood and kept moist by the mucus and water. The cutaneous respiration is always carried out. During hibernation (winter sleep) and aestivation (summer sleep), it is the only method of respiration in frog.

2. Buccopharyngeal Respiration:

It occurs when the animal is on the land or partially immersed in water. There are present two external nares situated at the tip of the snout. Each external naris (nostril) leads into a nasal chamber which opens into the buccopharyngeal cavity by an internal naris.

During this mode of respiration, the mouth and glottis are tightly closed while the nares are kept open.

3. Pulmonary Respiration:

It is less frequent than the cutaneous and buccopharyngeal respiration. It occurs when need for oxygen is increased. Respiratory path includes external nares, nasal chambers, internal nares, buccopharyngeal cavity and glottis. The glot-tis opens into the laryngotracheal chamber.

This chamber leads posteriorly to the lungs through a pair of apertures. The lungs are two delicate, elastic, pinkish, ovoid, thin walled hollow sacs lying on either side of the oesophagus. Each lung looks like a honey-comb.

The inner surface of the lungs is divided by a series of partitions, the septa into many small cavities known as alveoli. The wall of the alveoli is richly supplied with blood cap-illaries. Exchange of gases takes place through alveoli. During pulmonary respiration, the mouth is tightly closed.

Circulatory System of Frog:

The circulatory system of frog consists of blood vascular system and lymphatic system. Blood Vascular System. It is of closed type as the blood flows in the blood vessels. It represents single circulation. It means both the oxygenated and the deoxygenated blood enters the heart and get mixed in the ventricle. Blood vascular system comprises blood, heart and blood vessels.

Blood:

The blood is a mobile connective tissue, composed of a fluid, the plasma and the cells, the blood corpuscles.

Plasma:

It is the non-cellular alkaline, almost colourless fluid.

Blood Corpuscles:

There are present three types of cells in the blood plasma:

1. Erythrocytes (Red blood corpuscles):

These are large, oval and biconvex nucleated cells. The cytoplasm contains a respiratory red pigment, known as haemoglobin, which is made up of a blood protein, the globin and haematin.

2. Leucocytes (White blood corpuscles):

Their number is also numerous but less than erythrocytes.

The leucocytes are of two types:

Blood Corpuscles of Frog
(i) Granulocytes:
They are of three types:
(a) Neutrophils,
(b) Basophils,
(c) Eosinophil's.

(ii) Agranulocytes:
The agranulocytes are of two types:
(a) Lymphocytes,
(b) Monocytes.

3. Thrombocytes (Spindle-shaped cells):

They are small, numerous and spindle shaped nucleated cells. They are produced by the bone marrow. They help in the clotting of blood, by producing the thrombin enzyme.

Heart of Frog:

The heart is a modified blood vessel to receive and distribute the blood.

Location:

The heart is situated mid-ventrally in the thorax in between the two lungs, just anterior to the liver. The heart is protected by the pectoral girdle ventrolaterally and by vertebral column dorsally.

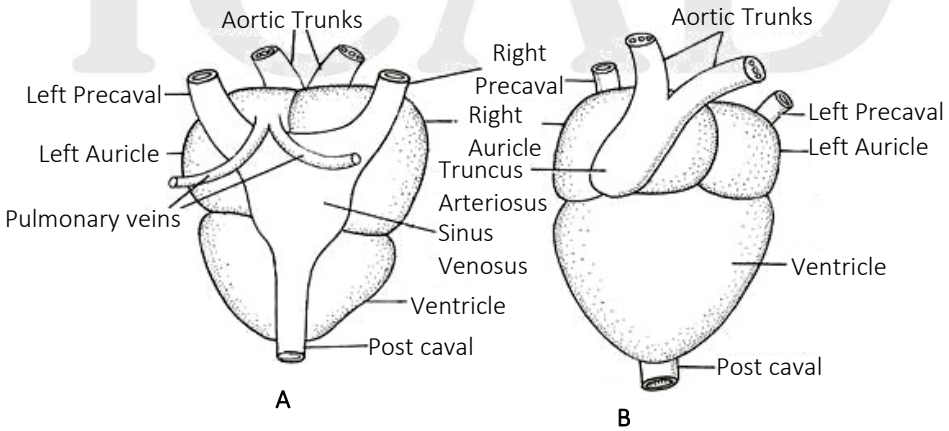
Pericardium:

The heart is enclosed in a delicate transparent two layered sac, the peri-cardium. The outer layer of the sac is called parietal pericardium and inner layer is known as visceral pericardium. In between the two layers, a space, the pericardial cavity is present, which is filled with a pericardial fluid. The pericardium protects the heart from the shocks, and mechanical injuries and also allows its free movements.

Structure of Heart:

After removing the pericardium, the external characters of the heart are clearly seen. The heart of frog is three chambered, viz., two auricles and a single ventricle. In addition to the auricles and ventricle, there are also two other associated structures, known as sinus venosus and truncus arteriosus (= conus arteriosus).

The two thin walled auricles are separated from each other by the inter auricular septum. The sinus venosus opens into right larger auricle through sinoauricular aperture which is guarded by a pair of sinoauricular valves. It only allows the blood to flow towards the right auricle. The common opening of pulmonary veins is present in the smaller left auricle. The opening is not guarded by any valve.



Both the auricles open into a single ventricle by a common wide auriculo-ventricular aperture, which is guarded by a valve, the auriculoventricular valve bearing four flaps— one dorsal, one ventral and two lateral in position. The free edges of these flaps project into the ventricle and are connected to the wall of the ventricle with fine contractile but tough thread-like structures known as chordae tendineae.

The chordae tendineae regulate the movement of the auriculo-ventricular valve so as to allow the blood to pass from the auricles into the ventricle and further prevent the backward flow of the blood into the auricles.

The ventricle is a muscular and thick walled chamber, the inner surface of which is projected into ridges, the columnae carneae. The latter divide the cavity of the ventricle into smaller spaces, known as fissures.

The right side of the ventricle opens into truncus arteriosus on the ventral side. At the place from where the truncus arteriosus arises from the ventricle, a row of three pocket shaped semilunar valves is present.

These valves allow blood flow from the ventricle to the truncus arteriosus.

Working of Heart:

Heart of frog is myogenic (heart beat originates from a muscle, however, it is regulated by the nerves). Wave of contraction originates from the sinus venosus and spreads over the wall of the sinus venosus and both the auricles. It compels the heart to beat. The contraction of the heart is termed as systole while its expansion is called diastole and both constitute one heart beat.

The sinus venosus contracts, whose contraction drives the mixed blood from the sinus venosus to the right auricle. At the same time, the left auricle receives oxygenated blood through the opening of the pulmonary veins from the lungs. When the two auricles are full of blood, they contract simultaneously. The backward flow of the blood into the sinus venosus is prevented by the sinuauricular valves.

The blood cannot go back into pulmonary veins as the openings of the pulmonary veins are small and oblique which are closed auto-matically by the contraction of the left auricle.

Thus, the blood from both the auricles is forced into the single ventricle through auriculoventricular aperture. The auriculoventricular node is stimulated by the auricular contraction and passes a fresh wave of the contraction over the wall of the ventricle.

Thus both oxygenated and deoxygenated bloods are mixed in the ventricle. Now the ventricle contracts and the backward flow of blood into auricles are prevented by the auricu-loventricular valve. The mixed blood of the ventricle enters the truncus arteriosus. From the truncus arteriosus mixed blood goes to three arches (carotid, systemic and pulmocutaneous) and ultimately reaches all the parts of the body.

Control of Heart Beat:

The contraction of heart (systole) and the relaxation of heart (diastole) constitute the heart beat. The rate of heart beat is controlled by the medulla oblongata of the brain and by certain hormones such as adrenalin and thyroxine.

Increase in carbon dioxide and temperature also affects the sinus venosus and thereby it increases the rate of heart beat. In frog cardiac cycle is completed in about 0.9 seconds. This means that frog's heart beats about 64 times per minute.

Renal Portal System:

The renal portal system collects the blood from the hind parts on the body from which the urea and uric acid present in the blood are first got filtered in the kidneys before the blood goes into postcaval and then to the heart. Thus, the blood going to the heart contains comparatively less impurities after passing through the renal portal system.

Nervous System of Frog:

The nervous system of frog is divisible into three parts:
(i) Central nervous system:
It comprises the brain and spinal cord.

(ii) Peripheral nervous system:
The nerves arising from the central nervous system constitute the peripheral nervous system.

(iii) Autonomic nervous system:
It includes the nerves and ganglia that control and coordinate such organs which are not under voluntary control. It comprises sympathetic nervous system and parasympathetic nervous system.

Brain:

It is lodged in the cranial cavity of the skull. The brain is covered by two membranes or meanings (sing meninx). The outer tough, thick membrane is duramater, and the inner thin, more delicate and vascular membrane is pia arachnoid membrane. The brain is divisible into three parts: Fore brain, mid brain and Hind brain.

Fore Brain:

It comprises two olfactory lobes, two cerebral hemispheres and a diencephalon. Dorsal surface of the diencephalon has anterior choroid plexus to supply nourishment to the anterior parts of the brain.

From the dorsal side of the diencephalon also arises a short cylindrical pineal stalk, which carries knob like pineal body. The pineal body is an endocrine gland. The position of pineal body is indicated externally by the brow spot.

A pair of thick optic nerves crosses and forms optic chiasma on the ventral side of the diencephalon. Just behind the optic chiasma, a small outgrowth is formed by the diencepha-lon, which is termed as infundibulum.

Further, behind the infundibulum and attached to it a flattened ovoid sac, the hypophysis (pituitary gland) is present. It is an important endo-crine gland (ductless gland). It produces very important hormones.

Mid Brain:

It consists of optic lobes and crura cerebri. Behind the diencephalon two ovals, large slightly pressed to the outside, optic lobes are present. These are well seen in dorsal view. On the ventral side, the brain is thickened to form two fibrous strands of nervous tissue, the crura cerebri (sing, crus cerebrum), which carry the stimuli between the cerebral hemispheres and medulla oblongata.

Hind Brain:

It comprises cerebellum and medulla oblongata. Immediately behind the optic lobes, there is present a sort of transverse ridge on the dorsal surface known as cerebellum, which is poorly developed in frog. It maintains balance of the body.

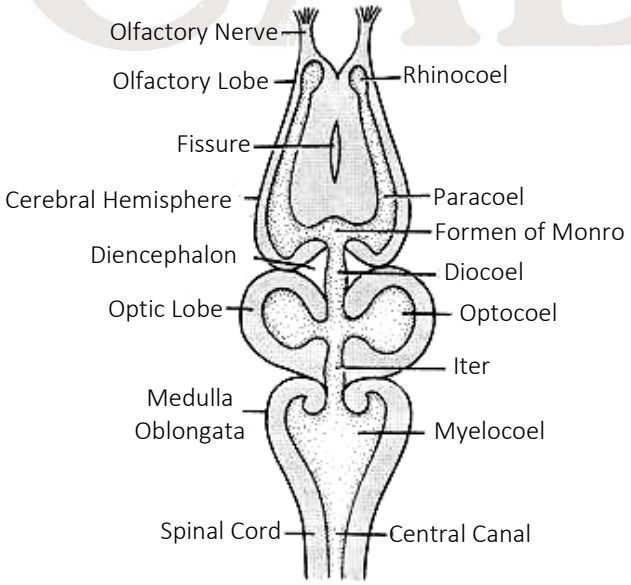
The last part of the brain is medulla oblongata, which is stout and somewhat triangular in shape and continues as spinal cord posteriorly. The medulla oblongata controls involuntary activi-ties of the body. The dorsal side of the medulla oblongata is non-nervous but highly vascular and forms posterior choroid plexus. The cranial nerves from 5th to 10th are connected with the medulla oblongata.

Ventricles:

The brain is hollow containing cavities, which are filled with the cerebro spinal fluid secreted by anterior and posterior-choroid plexuses. The cavities of the brain are known as ventricles.

Each olfactory lobe encloses a ventricle termed as rhinocoel which leads into the ventricles of the cerebral hemisphere, the lateral ventricles or paracoels or first and second ventricles. Two lateral ventricles open into the ventricles of the diencephalon, the diocoel or third ventricle through an aperture, the foramen of Monro.

Each optic lobe con-tains a cavity which is called optocoel. The two optocoels open into a narrow tubular cavity, the iter which connects the diocoel with the myelocoel or fourth venticle (a triangular ven-tricle of the medulla oblongata). The ventricle of the cerebellum is called the metacoel. The myelocoel communicates with the central canal of spinal cord.



Functions of Brain:

(1) The olfactory lobes control the sense of smell.

(2) The cerebral hemispheres are the seat of intelligence, memory, will and emotions, but these qualities are poor in frogs, because cerebral hemispheres are not very well formed. They also control the voluntary activities of the animals.

(3) The diencephalon acts as a relay centre, because it conveys the impulses to cerebral hemispheres. It also regulates the autonomic nervous system. Diencephalon also controls the metabolism of fat, water and carbohydrates. The secretion of pituitary body influences a number of activities of the animal.

(4) Since optic lobes receive impulses from the eyes, they control the sense of sight.

(5) The crura cerebri serve to communicate impulses from the fore-brain to the hind-brain or vice versa.
(6) Cerebellum controls and coordinates muscular movements, thus it mainly controls equilib-rium and locomotion of the animal. It is a reduced structure in frog.
(7) Medulla oblongata controls and regulates the various involuntary activities, such as heart beat, respiration, nutrition, sound production and metabolism in general.

Spinal Cord (= Myelon):

It lies in the neural canal of vertebral column and extends from the medulla oblongata of the brain to almost the end of back-bone. The spinal cord is surrounded by the same two protective membranes; the meanings, as in the brain viz., a thick outer diameter and a thin inner vascular pia-arachnoid membrane.

In frog, it is short, somewhat flattened structure which widens anteriorly and tapers towards the posterior end into the urostyle, where it is called filum terminate. The spinal cord shows two swollen parts, one near the arms and the other near the hind limbs known as brachial and sciatic enlargements respectively. These enlargements supply large nerves to the arms and legs.

All along its length, spinal cord has two median longitudinal grooves, the dorsal fissure on the dorsal side and ventral fissure on the ventral side while the latter is more grooved.

Spinal cord serves two main functions:

(i) The stimuli are passed from and to the brain through spinal cord. (ii) It is the centre of spinal reflex action.

Cranial Nerves:

The nerves which connect the brain and leave the brain box (cranium) are known as cranial nerves. The number of cranial nerves is definite in a particular group of animals. In frog, the number is ten pairs. The serial number of a nerve is also definite.

Spinal Nerves:

These nerves arise from the spinal cord and are normally nine pairs, sometimes 10th unpaired nerve is also seen. Rarely 10 pairs of spinal nerves are found.

Autonomic Nervous System:

It is a system of nerve fibres and ganglia which control and coordinate the involuntary activities of the visceral organs, such as secretion of digestive fluid, action of heart, etc.

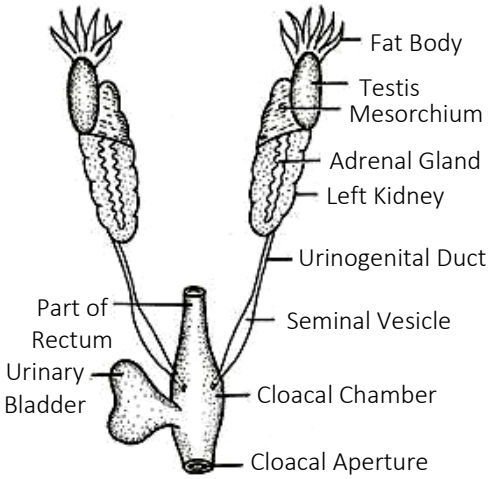
This system is autonomic in the sense that it regulates such activities of the body in which the will power of the animal is not involved, for example, the secretion of the digestive fluid is always under the control of autonomic nervous system, but the animal is not aware of it.

The autonomic nervous system is divisible into:

(i) Sympathetic nervous system, (ii) Para-sympathetic nervous system.

Urinogenital System of Frog:

Since the urinogenital system comprises two closely associated urinary (excretory) and the genital (reproductive) system, it is collectively called as the urinogenital system.



Excretory System of Frog:

The excretory system in both male and female frogs is similar except a few minor differences.

It comprises the following organs:

1. Kidneys:

There are two kidneys, situ-ated one on either side of the vertebral column in the posterior part of the body cavity. The kidneys are the chief excretory organs which are oval, dorsoventrally flattened, dark, red bod-ies. Peritoneum covers each kidney only on its ventral surface.

An elongated irregular yellow structure, the adrenal gland is present on the ventral surface of each kidney, which produces hormones. The fat bodies are attached anteri-orly. Renal arteries and veins are associated with the kidneys.

Internally, each kidney is made up of a large number of minute (microscopic) tubes (about 2,000), known as uriniferous tubules or nephrons bound together by connective tissue. Each uriniferous tubule is the structural and functional unit of the kidney.

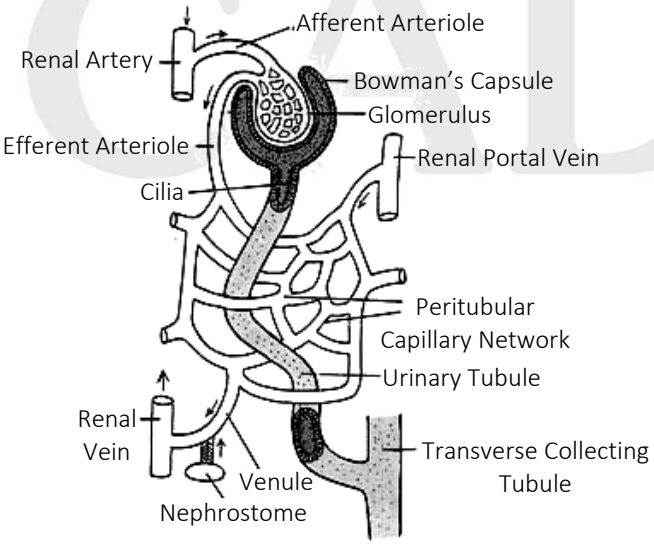
Thin walled expanded cup shaped blind end of each tubule, is called 'Bowman's capsule. The Bowman's capsule leads into a long coiled ciliated urinary tubule. The urinary tubule opens into trans-verse collecting tubules which ultimately communicate with the ureterurinogenital duct (to be described ahead).

The kidneys receive renal arteries and each artery divides into arterioles, one arteriole goes to each Bowman's capsule known as afferent arteriole. This breaks up into smaller branches (not capillaries) to form a network, termed as glomerulus.

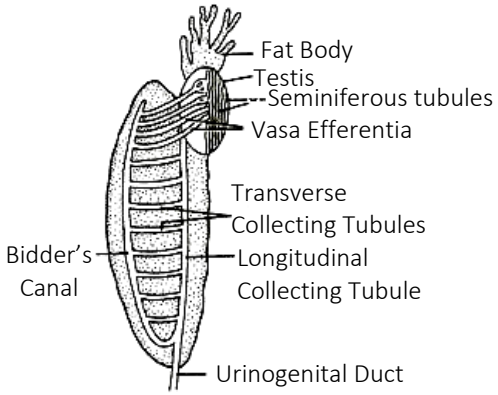
From the glomerulus, an efferent arteriole emerges out of the capsule and proceeds towards the urinary tubule, where efferent arteriole breaks up into peritubular capillaries network. The latter unite to form venules which join to form renal vein.

The renal portal vein after entering the kidney also breaks up into capillaries, which unites with the capillaries and finally connect the renal veins. A few ciliated funnels, the nephrostomes, are situated on the ventral surface of the kidney to collect the excretory matter from the coelom and pour it into the renal vein.

Thus, Bowman's capsule receives only the arterial blood supply, while the renal tubules get arterial as well as the venous blood supply.



Each kidney contains a longitudinal Bidder's canal to which the transverse collecting tubules are connected. All the transverse collecting tubules lead into the ureter urinogenital duct.



2. Ureters Urinogenital ducts:

From the outer border of each kidney a fine trans-parent duct arises, which is known as ureter in the female and urinogenital duct in the male. They run backwards from the kidneys and open into the cloaca, and carry urine from the kidneys to cloacal chamber.

In female ureters carry urine alone, while in male both sperms and urine are carried from kidney to cloacal chamber, hence called urinogenital ducts. In some species of frog the posterior part of each urinogenital duct dilates to form a seminal vesicle. The latter stores the sperms temporarily. Seminal vesicles are not well-developed in Rana tigrina.

3. Cloaca:

The terminal portion of the alimentary canal is known as cloaca which receives faecal matter, genital products and urine. It opens outside through an opening, the cloacal aperture provided with a sphincter.

4. Urinary bladder:

It is a transparent, highly distensible bilobed sac, attached to the ventral side of the cloaca, below the opening of the ureters urinogenital ducts. When it is completely empty, it shrinks.

It can undergo periodic contractions due to the presence of un-striped muscles. It does not have direct connection with ureters urinogenital ducts. The opening of the urinary bladder into the cloaca has a sphincter to regulate its passage. It can store the urine for some time.

Essay # 17. Reproductive System of Frog:

Reproductive system is meant for the production of sex cells (sperms or eggs) and transporting the same through certain ducts to outside. The sexes are separate. The male and female can be distinguished by their external features. This phenomenon is known as sexual dimorphism.

The vocal sacs are present only in male, and during the breeding season, a nuptial pad is developed at the base of the first finger of the male frog. The vocal sacs increase the pitch of the sound, while the nuptial pads help in grasping the female during amplexus. As already mentioned in the excretory system, the two systems (excretory and repro-ductive) are closely associated with each other and form urinogenital system.

Male Reproductive System:

It comprises the following parts:

1. Testes:

These are two, oval yellow coloured structures. Each is lying attached on the outer side of the anterior most part of each kidney on the ventral side. With the help of a thin peritoneum, the mesorchium, each testis remains attached with the dorsal wall of the abdomen and kidney. Testis is composed of a large number of small tubes, the seminiferous tubules, which look rounded in section.

The wall of the seminiferous tubules is made up of germinal epithelium, which forms sperms by spermatogenesis. The space between the seminiferous tubules is filled with the connec-tive tissue, blood capillaries, nerve fibres and interstitial cells. The interstitial cells secrete a male sex hormone, which produces the secondary sexual characters in male viz., nuptial pads during breeding season, etc.

There are present some finger like outgrowths, yellowish in colour attached to the anterior end of each testis which are collectively known as fat-body. The fat bodies store the food material specially for hibernation period. They increase in size during summer.

2. Vasa efferentia:

There are 10-12 very fine tubes connecting the testes to kidneys on each side. The vasa efferentia run transversely through the mesorchium. They open into the anterior part of Bidder's canal.

The sperms produced by the germinal epithelium of seminiferous tubules are passed into Bidder's canal via vasa efferentia and thence carried to the transverse collecting tubules and then to the urinogenital duct via longitudinal collecting tubule.

3. Urinogenital ducts:

Each kidney gives rise to a muscular urinogenital duct at its outer border, which carries urine as well as sperms. Each urinogenital duct runs posteriorly, and before opening into cloaca, it dilates to form a seminal vesicle to store the sperms temporarily. In some frogs the seminal vesicles are not found.

4. Cloaca:

It is a common chamber for receiving faecal matter, urine and sperms. All these products are passed out through cloacal aperture. Copulatory organ present in higher animals, is absent in frog. During amplexus, the male frog sheds his sperms on the female's ova. It happens in the surrounding water where external fertilization takes place.

Germinal epitheliums of seminiferous tubules produce sperms which are transferred to the Bidder's canal via vasa efferentia. From the Bidder's canal, the sperms are carried to the transverse collecting tubules, longitudinal collecting tubule and then to the urinogenital duct.

The latter carries the sperms to the seminal vesicle where they are stored temporarily. From the seminal vesicles, the sperms are transferred to the cloaca and then they are shed into water through cloacal aperture. Male frog sheds its sperms on the female's ova during amplexus.

Female Reproductive System:

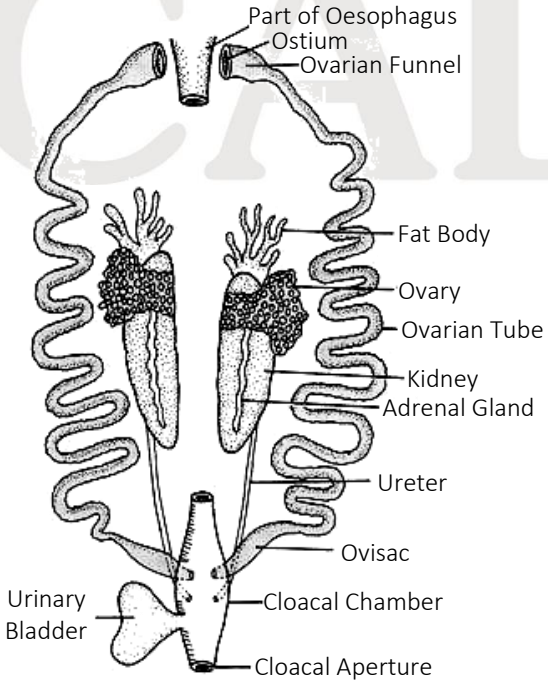
The female reproductive system comprises the following parts:

1. Ovaries:

These irregular shaped, lobulated structures, occupying the same position as the testes in male frog. The ovaries are attached to the dorsal wall of abdomen, and kidneys with the help of thin membrane, known as mesovarium. The ovaries have no internal connections with the kidneys. During the breeding season, the wall of the ovary ruptures to release the ova into the coelom.

2. Oviducts:

These are paired, white, glandular, long, coiled tubes lying one on either side of the body cavity. Each oviduct consists of ovarian funnel, ovarian tubule and ovisac.



By the rupturing of the ovary wall, the ova are released into body cavity and reach the ovarian fun-nels, through ostia, where they find their way to the ovarian tubule, from where they pass to the ovisac, cloaca and then outside.

This all happens due to the pressure exerted by the fore-limbs of male on the body of the female frog during amplexus (the clasping of the female frog by the male frog before discharging sexual products in water is called amplexus, and by the beating of cilia present in the internal epithelial lining of the oviduct.

A mature female frog can lay 2500 to 3000 ova at a time fertilization is external. Development is indirect involving a larval stage called tadpole.

Interaction of Frog with Mankind:

Frog is useful animal for human being because it eats up insects which are harmful for the crops. Thus the frog saves expenditure on insecticides. Frog also eats mosquitoes which act as vectors for parasites (e.g., malarial parasite) of man. Frog has been used as an experimental material for teaching and researches. It was ideal animal for dissections.

The muscles of the legs are used as food by man in some parts of India and many other countries. Frogs were exported in large quantities but it is now legally banned. Frog-lets (very small frogs) are used as fish bait.

Due to habitat loss and large scale use of this animal, it has become a threatened species. Since frog is important animal in the food chain, it helps to maintain our ecosystem. So it should be protected. Use of frogs for dissection purpose should also be discouraged as far as possible.

PRACTICE QUESTIONS

1. Frogs belong to which class?
(a) Reptilia (b) Mammalia
(c) Amphibia (d) Aves

2. Which of the following terms describes animals whose body temperature varies with the environment?
(a) Homeotherms (b) Endotherms
(c) Ectotherms (d) Poikilotherms

3. What ability allows frogs to hide from their enemies?
(a) Amphibious nature (b) Vocal cords
(c) Mimicry (d) Webbed feet

4. During peak summer and winter, frogs undergo:
(a) Metamorphosis
(b) Aestivation and Hibernation
(c) Regeneration
(d) None of the above

5. The frog is adapted for:
(a) Flying and swimming
(b) Jumping and leaping
(c) Climbing and burrowing
(d) Hunting and hiding

6. What is the primary diet of adult frogs?
(a) Plants and algae
(b) Fish and amphibians
(c) Insects and their larvae
(d) Birds and mammals

7. Why do male frogs croak louder than females?
(a) To warn other males
(b) To mark their territory
(c) To attract females
(d) To communicate with offspring

8. Which of the following is NOT present in frogs?
(a) Neck (b) Head (c) Trunk (d) Legs

9. The transparent membrane that protects a frog's eye is known as:
(a) Upper eyelid
(b) Lower eyelid
(c) Nictitating membrane
(d) Tympanum

10. The tympanum in a frog is associated with which sense?
(a) Sight (b) Taste (c) Hearing (d) Touch

11. What is the function of the vocal sacs in male frogs?
(a) Breathing
(b) Swallowing food
(c) Increasing the croaking sound
(d) Storing food

12. What does the brow spot represent in frogs?
(a) A third eye
(b) A type of gland
(c) Vestigial pineal eye
(d) A sensory organ for taste

13. The anterior portion of a frog's trunk is known as:
(a) Abdomen (b) Thorax
(c) Pelvis (d) Tail

14. What is sexual dimorphism?
(a) Change in color during mating
(b) Ability to reproduce both sexually and asexually
(c) Difference in appearance between males and females
(d) Changing gender during a lifespan

15. Which feature is present only in male frogs during the breeding season?
(a) Nictitating membrane
(b) Brow spot
(c) Copulatory pad
(d) Tympanum

16. Frogs are not usually seen during:
(a) Rainy season
(b) Breeding season
(c) Peak summer and winter
(d) Nighttime

17. How far can a frog usually jump?
(a) Six feet (b) One foot
(c) Three feet (d) Ten feet

18. What is the primary habitat of frogs?
(a) Forests (b) Deserts
(c) Ponds and ditches (d) Mountains

19. Frogs capture their prey based on:
(a) Smell (b) Size
(c) Movement (d) Color

20. What do male frogs use to increase the pitch of their croaking?
(a) Lung capacity (b) Webbed feet
(c) Vocal sacs (d) Brow spot

Assertion-Reason Questions:

21. **Assertion:** Frogs belong to the class Amphibia of the phylum Chordata.
Reason: They have a constant body temperature.
(a) Both assertion and reason are true, and the reason is a correct explanation of the assertion.
(b) Both assertion and reason are true, but the reason is not a correct explanation of the assertion.
(c) Assertion is true, but the reason is false.
(d) Assertion is false, but the reason is true.

22. **Assertion:** Frogs change their color to hide from predators, a phenomenon known as mimicry.
Reason: This color-changing ability helps them regulate their body temperature.
(a) Both assertion and reason are true, and the reason is a correct explanation of the assertion.
(b) Both assertion and reason are true, but the reason is not a correct explanation of the assertion.
(c) Assertion is true, but the reason is false.
(d) Assertion is false, but the reason is true.

23. **Assertion:** Frogs are often not seen during peak summer and winter.
Reason: During these periods, frogs go into a state of summer sleep (aestivation) and winter sleep (hibernation) to protect themselves from extreme temperatures.
(a) Both assertion and reason are true, and the reason is a correct explanation of the assertion.
(b) Both assertion and reason are true, but the reason is not a correct explanation of the assertion.
(c) Assertion is true, but the reason is false.
(d) Assertion is false, but the reason is true.

24. **Assertion:** Rana tigrina is the most widely distributed frog species in Northern India.
Reason: Frogs are generally found in oceans and seas.
(a) Both assertion and reason are true, and the reason is a correct explanation of the assertion.
(b) Both assertion and reason are true, but the reason is not a correct explanation of the assertion.
(c) Assertion is true, but the reason is false.
(d) Assertion is false, but the reason is true.

25. **Assertion:** Frogs are called amphibious animals because they can live both in water and on land.
Reason: They can jump up to three feet in the air.
(a) Both assertion and reason are true, and the reason is a correct explanation of the assertion.
(b) Both assertion and reason are true, but the reason is not a correct explanation of the assertion.
(c) Assertion is true, but the reason is false.
(d) Assertion is false, but the reason is true.

26. **Assertion:** The boat-shaped body of the frog is mainly due to the presence of a neck.
Reason: Frogs have a long neck that helps them swim.
(a) Both assertion and reason are true, and the reason is a correct explanation of the assertion.
(b) Both assertion and reason are true, but the reason is not a correct explanation of the assertion.
(c) Both Assertion and reason are false.
(d) Assertion is false, but the reason is true.

27. **Assertion:** Adult frogs are herbivorous and primarily feed on plants.
Reason: They capture and eat moving prey such as insects and their larvae.
(a) Both assertion and reason are true, and the reason is a correct explanation of the assertion.
(b) Both assertion and reason are true, but the reason is not a correct explanation of the assertion.
(c) Assertion is true, but the reason is false.
(d) Assertion is false, but the reason is true.

28. **Assertion:** Frogs make croaking sounds during the rainy season to attract females for mating.
Reason: Females croak louder than males to signal their readiness to mate.
(a) Both assertion and reason are true, and the reason is a correct explanation of the assertion.
(b) Both assertion and reason are true, but the reason is not a correct explanation of the assertion.
(c) Assertion is true, but the reason is false.
(d) Assertion is false, but the reason is true.

29. **Assertion:** The neck is a distinct body part in frogs.
Reason: Frogs have a well-developed neck that separates the head from the trunk.
(a) Both assertion and reason are true, and the reason is a correct explanation of the assertion.
(b) Both assertion and reason are true, but the reason is not a correct explanation of the assertion.
(c) Assertion is true, but the reason is false.
(d) Both assertion & reason are false.

30. **Assertion:** Sexual dimorphism in frogs can be observed through the development of vocal sacs in males.
Reason: Female frogs have copulatory pads on their inner fingers.
(a) Both assertion and reason are true, and the reason is a correct explanation of the assertion.
(b) Both assertion and reason are true, but the reason is not a correct explanation of the assertion.
(c) Assertion is true, but the reason is false.
(d) Assertion is false, but the reason is true.

31. What is the primary function of the alimentary canal in a frog?
(a) Respiration (b) Digestion
(c) Circulation (d) Excretion

32. Which part of the frog's digestive system is responsible for preventing the backward flow of food into the esophagus?
(a) Pyloric sphincter (b) Cardiac sphincter
(c) Duodenum (d) Ileum

33. What is the primary role of the pyloric constriction in the frog's stomach?
(a) Mixing gastric secretions
(b) Storing food
(c) Absorbing nutrients
(d) Preventing entry into the duodenum

34. In the frog's small intestine, what increases the absorptive surface area?
(a) Circular muscles (b) Villi
(c) Peristalsis (d) Mucus secretion

35. Which part of the frog's digestive system stores fecal matter and absorbs water?
(a) Stomach (b) Duodenum
(c) Rectum (d) Cloaca

36. In the frog's digestive system, what is the role of the cloaca?
(a) Digestion of food
(b) Absorption of nutrients
(c) Egestion of waste
(d) Storage of bile

37. What is the function of the gall bladder in the frog's digestive system?
(a) Production of bile
(b) Storage of bile
(c) Absorption of nutrients
(d) Emulsification of fats

38. Which gland in the frog's digestive system secretes insulin?
(a) Gastric gland (b) Pancreas
(c) Liver (d) Intestinal gland

39. Which enzyme is responsible for converting glucose into glycogen in the frog's liver?
(a) Maltase (b) Lipase (c) Insulin (d) Amylase

40. What is the primary role of gastric glands in the frog's stomach?
(a) Producing mucus (b) Digesting proteins
(c) Neutralizing acidity (d) Storing food

41. Which part of the frog's digestive system is responsible for emulsifying fats?
(a) Small intestine (b) Liver
(c) Stomach (d) Pancreas

42. Where does the absorption of most nutrients occur in the frog's digestive system?
(a) Mouth (b) Stomach
(c) Small intestine (d) Large intestine

43. Which type of respiration is the primary method used by a frog during hibernation and aestivation?
(a) Cutaneous respiration
(b) Buccopharyngeal respiration
(c) Pulmonary respiration
(d) Gaseous respiration

44. Where are the external nares (nostrils) located in a frog's respiratory system?
(a) On the tongue (b) In the lungs
(c) At the tip of the snout (d) In the stomach

45. During which type of respiration is the mouth tightly closed in a frog?
(a) Cutaneous respiration
(b) Buccopharyngeal respiration
(c) Pulmonary respiration
(d) Gaseous respiration

46. Which part of the frog's respiratory system is responsible for exchanging gases through alveoli?
(a) Lungs (b) Stomach
(c) Small intestine (d) Liver

47. When is pulmonary respiration in a frog less frequent?
(a) During hibernation
(b) During aestivation
(c) When oxygen demand is increased
(d) When the mouth is open

48. What is the role of the lacteals in the frog's respiratory system?
(a) Emulsifying fats
(b) Absorbing water
(c) Absorbing fatty acids and glycerol
(d) Exchanging gases

49. What is the primary function of the glottis in the frog's respiratory system?
(a) Exchanging gases (b) Absorbing nutrients
(c) Preventing food entry (d) Storing oxygen

50. During which type of respiration does the frog keep its mouth tightly closed?
(a) Cutaneous respiration
(b) Buccopharyngeal respiration
(c) Pulmonary respiration
(d) Gaseous respiration

51. What is the circulatory system of a frog composed of?
(a) Lungs and gills
(b) Blood vessels and the heart
(c) Kidneys and bladder
(d) Stomach and intestines

52. Which type of circulation does the frog's circulatory system represent?
(a) Single circulation (b) Double circulation
(c) Triple circulation (d) Closed circulation

53. What is the primary function of plasma in the blood?
(a) Transporting oxygen
(b) Carrying nutrients
(c) Providing mechanical support
(d) Being a non-cellular fluid

54. Which type of blood cell contains the respiratory red pigment called hemoglobin?
(a) Erythrocytes (Red blood corpuscles)
(b) Leucocytes (White blood corpuscles)
(c) Thrombocytes (Spindle-shaped cells)
(d) Plasma

55. What is the role of thrombocytes in the blood?
(a) Carrying oxygen (b) Clotting of blood
(c) Fighting infections (d) Transporting nutrients

56. Where is the heart of a frog located?
(a) In the head (b) In the abdomen
(c) In the thorax (d) In the limbs

57. What is the function of the pericardium in the frog's circulatory system?
(a) Pumping blood (b) Producing blood cells
(c) Protecting the heart (d) Filtration of blood

58. How many chambers does the heart of a frog have?
(a) One (b) Two (c) Three (d) Four

59. What separates the two thin-walled auricles in the frog's heart?
(a) Interventricular septum
(b) Interauricular septum
(c) Sinuauricular valves
(d) Auriculoventricular aperture

60. What prevents the backward flow of blood from the ventricle into the auricles in a frog's heart?
(a) Semilunar valves
(b) Auriculoventricular valve
(c) Sinuauricular valves
(d) Chordae tendineae

61. Which part of the frog's heart drives the mixed blood from the sinus venosus to the right auricle?
(a) Sinuauricular valves
(b) Ventricle
(c) Sinus venosus
(d) Left auricle

62. What controls the rate of heart beat in a frog?
(a) Kidneys (b) Lungs
(c) Brain (d) Spleen

63. What is the role of the renal portal system in a frog's circulatory system?
(a) Pumping oxygenated blood
(b) Filtering impurities from the blood
(c) Directing blood to the lungs
(d) Providing nutrients to the heart

64. What substances are first filtered in the kidneys through the renal portal system in a frog?
(a) Oxygen and nutrients
(b) Urea and uric acid
(c) Hemoglobin and plasma
(d) Red blood cells and white blood cells

65. What is the advantage of the blood passing through the renal portal system before reaching the heart in a frog?
(a) It provides oxygen to the heart
(b) It reduces the blood's volume
(c) It increases the heart rate
(d) It removes impurities from the blood

66. Assertion: The frog's circulatory system represents single circulation.
Reason: Both oxygenated and deoxygenated blood enter the heart and get mixed in the ventricle.
(a) Both assertion and reason are true, and the reason is a correct explanation of the assertion.
(b) Both assertion and reason are true, but the reason is not a correct explanation of the assertion.
(c) Assertion is true, but the reason is false.
(d) Assertion is false, but the reason is true.

67. Assertion: The auriculoventricular valve in the frog's heart prevents the backward flow of blood into the auricles.
Reason: The auriculoventricular valve has chordae tendineae that connect to the wall of the ventricle.
(a) Both assertion and reason are true, and the reason is a correct explanation of the assertion.
(b) Both assertion and reason are true, but the reason is not a correct explanation of the assertion.
(c) Assertion is true, but the reason is false.
(d) Assertion is false, but the reason is true.

68. Assertion: The heart of a frog is myogenic.
Reason: The heart beat originates from a muscle in the heart.
(a) Both assertion and reason are true, and the reason is a correct explanation of the assertion.
(b) Both assertion and reason are true, but the reason is not a correct explanation of the assertion.
(c) Assertion is true, but the reason is false.
(d) Assertion is false, but the reason is true.

69. Assertion: Increase in carbon dioxide and temperature affects the rate of heart beat in a frog.
Reason: The medulla oblongata of the brain and certain hormones control the heart rate.
(a) Both assertion and reason are true, and the reason is a correct explanation of the assertion.
(b) Both assertion and reason are true, but the reason is not a correct explanation of the assertion.
(c) Assertion is true, but the reason is false.
(d) Assertion is false, but the reason is true.

70. **Assertion:** The renal portal system in a frog filters impurities from the blood.
Reason: The renal portal system collects blood from the hind parts of the body before it reaches the heart.
(a) Both assertion and reason are true, and the reason is a correct explanation of the assertion.
(b) Both assertion and reason are true, but the reason is not a correct explanation of the assertion.
(c) Assertion is true, but the reason is false.
(d) Assertion is false, but the reason is true.

71. What are the three main parts of the frog's nervous system?
(a) Brain, spinal cord, and nerves
(b) Fore brain, mid brain, and hind brain
(c) Central, peripheral, and autonomic nervous systems
(d) Sympathetic, parasympathetic, and enteric nervous systems

72. Where is the brain of a frog located?
(a) In the abdomen
(b) In the thorax
(c) In the cranial cavity of the skull
(d) In the limbs

73. What are the two membranes that cover the frog's brain?
(a) Pia arachnoid and optic lobes
(b) Dura mater and crura cerebri
(c) Dura mater and pia arachnoid
(d) Optic lobes and hypophysis

74. Which part of the frog's brain is an endocrine gland?
(a) Cerebral hemispheres (b) Infundibulum
(c) Pineal body (d) Crura cerebri

75. What is the primary function of the optic lobes in a frog's brain?
(a) Control of the sense of smell
(b) Coordination of muscular movements
(c) Regulation of the autonomic nervous system
(d) Control of the sense of sight

76. What connects the forebrain to the hindbrain in a frog's brain?
(a) Cerebral hemispheres (b) Infundibulum
(c) Optic lobes (d) Crura cerebri

77. What is the main function of the cerebellum in a frog's brain?
(a) Control of the sense of smell
(b) Coordination of muscular movements
(c) Regulation of the autonomic nervous system
(d) Control of the sense of taste

78. Which part of the nervous system controls involuntary activities like heart rate and respiration in a frog?
(a) Central nervous system
(b) Peripheral nervous system
(c) Sympathetic nervous system
(d) Autonomic nervous system

79. What is the purpose of the spinal cord in a frog's nervous system?
(a) To control voluntary activities
(b) To serve as a relay center
(c) To maintain balance
(d) To regulate endocrine functions

80. How many pairs of cranial nerves are found in a frog?
(a) 5 pairs (b) 7 pairs (c) 9 pairs (d) 10 pairs

81. What are the two divisions of the autonomic nervous system in a frog?
(a) Sympathetic and enteric nervous systems
(b) Central and peripheral nervous systems
(c) Parasympathetic and somatic nervous systems
(d) Sympathetic and parasympathetic nervous systems

82. **Assertion:** The brain of a frog is divided into fore brain, mid brain, and hind brain.
Reason: The fore brain controls the sense of smell, while the mid brain controls the sense of sight.
(a) Both assertion and reason are true, and the reason is a correct explanation of the assertion.
(b) Both assertion and reason are true, but the reason is not a correct explanation of the assertion.
(c) Assertion is true, but the reason is false.
(d) Assertion is false, but the reason is true.

83. **Assertion:** The cerebellum in a frog's brain is well-developed.
Reason: The cerebellum controls the sense of smell.
(a) Both assertion and reason are true, and the reason is a correct explanation of the assertion.
(b) Both assertion and reason are true, but the reason is not a correct explanation of the assertion.
(c) Assertion is true, but the reason is false.
(d) Assertion is false, but the reason is true.

84. **Assertion:** The spinal cord in a frog tapers towards the posterior end.
Reason: The spinal cord in a frog extends from the medulla oblongata to the urostyle.
(a) Both assertion and reason are true, and the reason is a correct explanation of the assertion.
(b) Both assertion and reason are true, but the reason is not a correct explanation of the assertion.
(c) Assertion is true, but the reason is false.
(d) Assertion is false, but the reason is true.

85. **Assertion:** Spinal cord serves as the center of spinal reflex action.
Reason: Spinal cord is responsible for controlling voluntary muscle movements.
(a) Both assertion and reason are true, and the reason is a correct explanation of the assertion.
(b) Both assertion and reason are true, but the reason is not a correct explanation of the assertion.
(c) Assertion is true, but the reason is false.
(d) Assertion is false, but the reason is true.

86. **Assertion:** Cranial nerves connect the brain and leave the cranium.
Reason: The number of cranial nerves in a frog is variable.
(a) Both assertion and reason are true, and the reason is a correct explanation of the assertion.
(b) Both assertion and reason are true, but the reason is not a correct explanation of the assertion.
(c) Assertion is true, but the reason is false.
(d) Assertion is false, but the reason is true.

87. **Assertion:** The autonomic nervous system in a frog regulates activities under voluntary control.
Reason: The autonomic nervous system is aware of the body's actions.
(a) Both assertion and reason are true, and the reason is a correct explanation of the assertion.
(b) Both assertion and reason are true, but the reason is not a correct explanation of the assertion.
(c) Assertion is true, but the reason is false.
(d) Assertion is false, but the reason is true.

88. **Assertion:** The autonomic nervous system includes the enteric nervous system.
Reason: The enteric nervous system controls involuntary activities of the visceral organs.
(a) Both assertion and reason are true, and the reason is a correct explanation of the assertion.
(b) Both assertion and reason are true, but the reason is not a correct explanation of the assertion.
(c) Assertion is true, but the reason is false.
(d) Assertion is false, but the reason is true.

89. **Assertion:** The autonomic nervous system comprises the sympathetic and parasympathetic nervous systems.
Reason: The sympathetic nervous system controls rest and digest functions, while the parasympathetic nervous system controls fight or flight responses.
(a) Both assertion and reason are true, and the reason is a correct explanation of the assertion.
(b) Both assertion and reason are true, but the reason is not a correct explanation of the assertion.
(c) Assertion is true, but the reason is false.
(d) Assertion is false, but the reason is true.

90. **Assertion:** The autonomic nervous system regulates voluntary muscle movements.
Reason: The autonomic nervous system is consciously controlled by the frog.
(a) Both assertion and reason are true, and the reason is a correct explanation of the assertion.
(b) Both assertion and reason are true, but the reason is not a correct explanation of the assertion.
(c) Assertion is true, but the reason is false.
(d) Assertion is false, but the reason is true.

91. What is the collective name for the closely associated urinary and genital systems in frogs?
(a) Urinary-genital system
(b) Genito-urinary system
(c) Urinogenital system
(d) Excretory-reproductive system

92. How many kidneys are present in a frog?
(a) One (b) Two (c) Three (d) Four

93. What is the function of the adrenal gland in a frog's kidney?
(a) Production of urine
(b) Storage of urine
(c) Production of hormones
(d) Filtration of blood

94. Which structure in the frog kidney serves as the structural and functional unit of the organ?
(a) Bowman's capsule (b) Uriniferous tubule
(c) Renal artery (d) Adrenal gland

95. What is the function of the glomerulus in the frog kidney?
(a) Production of hormones
(b) Filtration of blood
(c) Storage of urine
(d) Transport of sperms

96. How do the nephrostomes in a frog's kidney collect excretory matter?
(a) Through Bowman's capsule
(b) Through peritubular capillaries
(c) Through the cloaca
(d) From the coelom

97. Which duct carries urine and sperms from the kidneys to the cloaca in a male frog?
(a) Ureter (b) Urinogenital duct
(c) Seminal vesicle (d) Oviduct

98. What is the function of the urinary bladder in a frog's urinogenital system?
(a) Filtration of blood
(b) Storage of urine
(c) Production of hormones
(d) Collection of excretory matter

99. What is the common chamber for receiving faecal matter, urine, and genital products in a frog's urinogenital system?
(a) Ureter (b) Cloaca
(c) Ovaries (d) Testes

100. What is the primary role of the reproductive system in frogs?
(a) Filtration of blood
(b) Production of hormones
(c) Transporting sex cells
(d) Digesting food

101. What are the secondary sexual characteristics in male frogs?
(a) Ovaries and vocal sacs
(b) Testes and vocal sacs
(c) Nuptial pads and ovaries
(d) Nuptial pads and vocal sacs

102. Where are the testes located in a male frog?
(a) Attached to the dorsal wall of the abdomen
(b) Attached to the dorsal side of the cloaca
(c) Attached to the ventral side of the kidneys
(d) Attached to the ventral side of the cloaca

103. What is the role of the interstitial cells in the male frog's testes?
(a) Production of hormones
(b) Production of sperms
(c) Storage of food material
(d) Filtration of blood

104. What is the function of the vasa efferentia in the male frog's reproductive system?
(a) Filtration of blood
(b) Production of sperms
(c) Carrying urine to the bladder
(d) Connecting testes to kidneys

105. What is the function of the urinogenital ducts in male frogs?
(a) Storage of urine
(b) Carrying urine to cloaca
(c) Carrying sperms to cloaca
(d) Production of hormones

106. In female frogs, what is the structure that temporarily stores ova before they are released into the cloaca?
(a) Ovary (b) Oviduct
(c) Ovarian funnel (d) Seminal vesicle

107. During which process do male frogs shed their sperms on the female's ova in the surrounding water?
(a) Ovulation (b) Fertilization
(c) Amplexus (d) Osmoregulation

108. Where are the ovaries located in female frogs?
(a) Attached to the dorsal wall of the abdomen
(b) Attached to the dorsal side of the cloaca
(c) Attached to the ventral side of the kidneys
(d) Attached to the ventral side of the cloaca

109. What is the function of the oviducts in female frogs?
(a) Production of ova
(b) Carrying ova to the cloaca
(c) Filtration of blood
(d) Storage of urine

110. How are the ova released from the ovaries in female frogs?
(a) Through urine (b) Through the cloaca
(c) Through the skin (d) Through the mouth

Assertion-Reason Questions:

111. **Assertion:** The urinogenital system in frogs comprises two closely associated urinary and genital systems.
Reason: The urinary and genital systems in frogs are completely separate and do not share any organs.
(a) Both assertion and reason are true, and the reason is a correct explanation of the assertion.
(b) Both assertion and reason are true, but the reason is not a correct explanation of the assertion.
(c) Assertion is true, but the reason is false.
(d) Assertion is false, but the reason is true.

112. **Assertion:** In female frogs, the urinogenital ducts carry both urine and sperms.
Reason: Female frogs have a single urinogenital duct for excretion and reproduction.
(a) Both assertion and reason are true, and the reason is a correct explanation of the assertion.
(b) Both assertion and reason are true, but the reason is not a correct explanation of the assertion.
(c) Assertion is true, but the reason is false.
(d) Assertion is false, but the reason is true.

113. **Assertion:** The seminal vesicles in male frogs store urine.
Reason: Seminal vesicles play a crucial role in the male reproductive system.
(a) Both assertion and reason are true, and the reason is a correct explanation of the assertion.
(b) Both assertion and reason are true, but the reason is not a correct explanation of the assertion.
(c) Assertion is true, but the reason is false.
(d) Assertion is false, but the reason is true.

114. **Assertion:** The cloaca in frogs is responsible for digesting food.
Reason: The cloaca is a common chamber for receiving faecal matter, urine, and genital products.
(a) Both assertion and reason are true, and the reason is a correct explanation of the assertion.
(b) Both assertion and reason are true, but the reason is not a correct explanation of the assertion.
(c) Assertion is true, but the reason is false.
(d) Assertion is false, but the reason is true.

115. **Assertion:** The primary function of the reproductive system in frogs is to filter blood.
Reason: The reproductive system in frogs is closely associated with the excretory system.
(a) Both assertion and reason are true, and the reason is a correct explanation of the assertion.
(b) Both assertion and reason are true, but the reason is not a correct explanation of the assertion.
(c) Assertion is true, but the reason is false.
(d) Assertion is false, but the reason is true.

B-43 : FAMILY BRASSICACEAE (CRUCIFERAE)

Flowers actinomorphic rarely zygomorphic, hermaphrodite; sepals four in two whorls of two each, petals four, diagonally arranged-cruciform; stamens six, tetradynamous; gynoecium bicarpellary, syncarpous, parietal placentation, bilocular due to the formation of flase septum (replum); fruit siliqua or silicula.

A. Vegetative characters:

Habit: Generally herbs, annual or biennial or shrubs.

Roots: Tap root, swollen on account of stored food materials. It may be conical (Radish), fusiform or napiform (Turnip).

Stem: Herbaceous, erect, cylindrical (Iberis, Brassica) rarely woody or some times reduced (Raphanus & Brassica species), glabrous or hairy, solid and branched.

Leaves: Alternate or sub-opposite, simple, exstipulate (Brassica campestris). May be cauline or radical (Raphanus), generally sessile, hairy, entire and with unicostate reticulate venation.

B. Floral characters:

Inflorescence: Raceme, corymbose raceme or corymb.

Flower: Pedicellate, ebracteate, hermaphrodite, actinomorphic, hypogynous, complete and tetramerous.

Calyx: Sepals 4 arranged in two whorls of two each, polysepalous (2 antero-posterior and 2 lateral).

Corolla: Petals 4, alternate with sepals, polypetalous, petals arranged in the form of across known as cruciform. This arrangement is characteristic of the family.

Androecium: Stamens 6, arranged in two whorls, outer two stamens short and inner four long (2+4), tetradynamous, polyandrous, anthers dithecous.

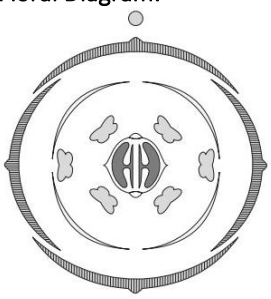
Gynoecium: Bicarpellary, syncarpous, ovary superior, unilocular, becomes bilocular due to the development of false septum called replum: parietal placentation, ovules many, style short, stigma simple or bifid.

Fruit: Siliqua or silicula, sometimes lomentum (Raphanus); when the valves separate in a siliqua the seeds remain attached to the replum.

Seed: Ex-albuminous. The germination of seed is epigeal.

Floral formula: Ebr, Ebrl, $\oplus \, ♂♀ \, K_{2+2} C_4 A_{2+4} \underline{G}_{(2)}$

Floral Diagram:



Economic Importance of Brassicaceae:

This family is of considerable economic importance.

1. Food:

The plants of this family which are cultivated as vegetable crops are:

Brassica oleracea var. botrytis (H. Phul gobhi), B. oleracea var. capitata (H. Band gobhi), B. oleracea var. caulorapa (H. Gand-gobhi), Brassica campestris var. sarson (white mustard), Brassica rapa (H. Shalgam), Raphanus satiuus (H. Muli), are edible and cooked as vegetables.

2. Oil:

The seed of B. campestris (or white mustard) yield mustard oil or Karwa-tel which is widely used as a cooking medium. B. nigra (H. Kalirai) and B. juncea (H. rai) also produce oil.

After extracting oil the cake is left behind which is highly nutritious as a cattle feed; the oil cake is also used as soil fertilizer. Raphanus seeds also produce a pungent oil which is often used in adulteration of sarson oil; this oil has digestive properties.

3. Medicines:

The leaves and tender shoots of Lepidium sativum are used in liver complaints, asthma, cough and bleeding piles.

4. Ornamentals:

Some plants are grown in gardens for their beautiful flowers.

Primitive characters:

1. Leaves simple and alternate.
2. Flowers hermaphrodite, hypogynous and actinomorphic.
3. Calyx and corolla free.
4. Stamens polyandrous.
5. Ovules anatropous.

Advanced characters:

1. Plants are generally herbs-annual or biennials.
2. Leaves exstipulate.
3. Flowers ebracteate.
4. Gynoecium bicarpellary and syncarpous.
5. Fruit simple.

PRACTICE QUESTIONS

1. Which family does the text describe?
(a) Rosaceae (b) Brassicaceae (Cruciferae)
(c) Solanaceae (d) Fabaceae

2. What type of flowers are typically found in the Brassicaceae family?
(a) Zygomorphic (b) Actinomorphic
(c) Monocotyledonous (d) Polypetalous

3. How many sepals are present in the Brassicaceae family?
(a) Two (b) Four (c) Five (d) Six

4. What is the arrangement of petals in Brassicaceae flowers?
(a) Alternate (b) Whorled
(c) Spiral (d) Cruciform

5. How many stamens are there in Brassicaceae flowers, and how are they arranged?
(a) Four, tetradynamous (b) Six, tetradynamous
(c) Four, polyandrous (d) Six, polyandrous

6. What is the gynoecium like in Brassicaceae plants?
(a) Multicarpellary
(b) Apocarpous
(c) Syncarpous with parietal placentation
(d) Bilocular with true septum

7. Which of the following is NOT a type of fruit found in the Brassicaceae family?
(a) Capsule (b) Drupe (c) Siliqua (d) Silicula

8. What type of root is commonly found in Brassicaceae plants, such as Radish and Turnip?
(a) Fibrous root (b) Adventitious root
(c) Tap root (d) Tuberous root

9. What is the typical habit of plants in the Brassicaceae family?
(a) Trees (b) Shrubs (c) Herbs (d) Vines

10. What is the primary use of mustard oil produced from Brassica campestris (white mustard)?
(a) Cooking medium (b) Lubricant
(c) Perfume (d) Medicine

11. Which plant's leaves and tender shoots are used in liver complaints, asthma, cough, and bleeding piles?
(a) Brassica oleracea (b) Brassica campestris
(c) Raphanus sativus (d) Lepidium sativum

12. What type of venation is typically found in the leaves of Brassicaceae plants?
(a) Reticulate venation (b) Parallel venation
(c) Palmate venation (d) Pinnate venation

13. What is the mode of germination of Brassicaceae seeds?
(a) Epigeal germination
(b) Hypogeal germination
(c) Cryptogamic germination
(d) Viviparous germination

14. What is the characteristic arrangement of petals in Brassicaceae flowers?
(a) Valvate (b) Twisted
(c) Imbricate (d) Cruciform

15. Which part of the Brassicaceae flower is hypogynous?
(a) Sepals (b) Petals (c) Stamens (d) Gynoecium

16. What type of inflorescence is commonly found in Brassicaceae plants?
(a) Umbel (b) Spike
(c) Raceme (d) Capitulum

17. What is the type of placentation found in the gynoecium of Brassicaceae plants?
(a) Axile placentation
(b) Free central placentation
(c) Parietal placentation
(d) Basal placentation

18. Which part of the Brassicaceae fruit remains attached to the seeds when the valves separate?
(a) Ovary (b) Placenta
(c) Replum (d) Sepal

19. What type of root is commonly found in Brassicaceae plants?
(a) Fibrous root
(b) Adventitious root
(c) Tap root
(d) Tuberous root

20. Which family is known for its economic importance due to the production of mustard oil?
(a) Solanaceae (b) Rosaceae
(c) Brassicaceae (d) Fabaceae

Assertion-Reason Questions:

21. **Assertion:** The Brassicaceae family is characterized by zygomorphic flowers.
Reason: Zygomorphic flowers are common in many plant families within the Brassicaceae family.
(a) Both assertion and reason are true, and the reason is a correct explanation of the assertion.
(b) Both assertion and reason are true, but the reason is not a correct explanation of the assertion.
(c) Assertion is true, but the reason is false.
(d) Assertion is false, but the reason is true.

22. **Assertion:** The Brassicaceae family includes both herbaceous and woody plants.
Reason: Some members of the Brassicaceae family have woody stems.
(a) Both assertion and reason are true, and the reason is a correct explanation of the assertion.
(b) Both assertion and reason are true, but the reason is not a correct explanation of the assertion.
(c) Assertion is true, but the reason is false.
(d) Assertion is false, but the reason is true.

23. **Assertion:** Brassicaceae flowers have petals arranged in a cruciform pattern.
Reason: This cruciform arrangement of petals is a unique characteristic of the Brassicaceae family.
(a) Both assertion and reason are true, and the reason is a correct explanation of the assertion.
(b) Both assertion and reason are true, but the reason is not a correct explanation of the assertion.
(c) Assertion is true, but the reason is false.
(d) Assertion is false, but the reason is true.

24. **Assertion:** Brassicaceae fruits are typically capsules.
Reason: Capsules are the most common type of fruit in the Brassicaceae family.
(a) Both assertion and reason are true, and the reason is a correct explanation of the assertion.
(b) Both assertion and reason are true, but the reason is not a correct explanation of the assertion.
(c) Assertion is true, but the reason is false.
(d) Assertion is false, but the reason is true.

25. **Assertion:** Mustard oil from Brassica campestris is used primarily for medicinal purposes.
Reason: Brassica campestris produces a pungent oil with medicinal properties.
(a) Both assertion and reason are true, and the reason is a correct explanation of the assertion.
(b) Both assertion and reason are true, but the reason is not a correct explanation of the assertion.
(c) Assertion is true, but the reason is false.
(d) Assertion is false, but the reason is true.

26. **Assertion:** Brassicaceae plants have a fibrous root system.
Reason: Fibrous roots are common in plants of the Brassicaceae family.
(a) Both assertion and reason are true, and the reason is a correct explanation of the assertion.
(b) Both assertion and reason are true, but the reason is not a correct explanation of the assertion.
(c) Assertion is true, but the reason is false.
(d) Assertion is false, but the reason is true.

27. **Assertion:** The gynoecium in Brassicaceae plants is unilocular.
Reason: The development of a false septum called replum makes the gynoecium unilocular.
(a) Both assertion and reason are true, and the reason is a correct explanation of the assertion.
(b) Both assertion and reason are true, but the reason is not a correct explanation of the assertion.
(c) Assertion is true, but the reason is false.
(d) Assertion is false, but the reason is true.

B-43 : FAMILY MALVACEAE

Characters of Malvaceae:

Stellate hairs on the young parts, mucilaginous juice present, leaves alternate, stipulate, multicostate reticulate; inflorescence solitary or cyme; flower actinomorphic, hermaphrodite, hypogynous, pentamerous, with epicalyx, calyx free or united, corolla free; stamens indefinite, monadelphous; anthers monothecous, stamens united to form a tube; gynoecium many often five, syncarpous, ovary multilocular, superior, axile placentation; fruit schizocarpic carcerulus or capsule.

A. Vegetative characters:

Habit: The plant are generally herbs, shrubs (Hibiscus, Gossypium), and a few trees (Gossypium arboreum) with a mucilaginous sap in all parts. Usually young parts of the plants are covered with stellate hairs.
Root: Tap, root, branched.

Stem: Herbaceous (Malva) or woody (Hibiscus), branched, erect or spreading (Sida, Malva parviflora) pubescent with stellate hairs.

Leaves: Alternate, petiolate, stipulate, stipules deciduous (Malva), simple, entire or palmately divided or lobed, margin wavy or serrate, apex acute, multicostate reticulate venation.

B. Floral characters:

Inflorescence: Solitary axillary (Hibiscus, Urena), solitary terminal (Abutilon), raceme (Althaea).

Flower: Pedicellate, bracteate, bracteolate in the form of epicalyx, hermaphrodite, complete, actinomorphic, pentamerous, hypogynous.

Epicalyx: Epicalyx 3 (Gossypium), 7 to 9 (Althaea) and in a few totally absent (Abutilon, Sida).

Calyx: Sepals five, connate at the base, persistent.

Corolla: Petals 5, polypetalous sometimes slightly connate at the base with the staminal tube-thus epipetalous, large showy, twisted. Prominent veins can be observed on the petals.

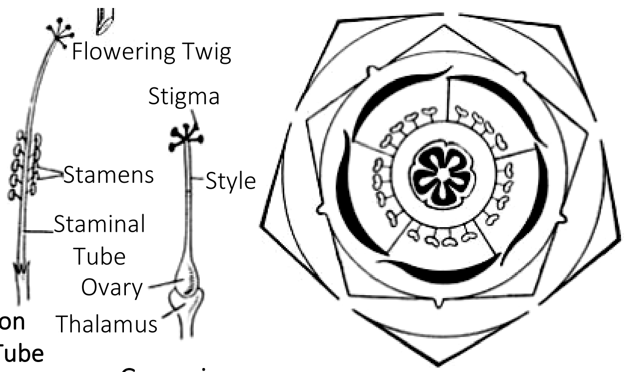
Androecium: Stamens indefinite, monadelphous, forming a staminal tube; epipetalous staminal tube united with the corolla, anthers monothecous, reniform, basifixed, filament short, introse.

Gynoecium: Multicarpellary usually five (Hibiscus) or ten (Althaea); syncarpous, ovary superior, penta or multilocular with axile placentation, ovules one to many in each loculus.

Fruit: Capsule (Hibiscus, Gossypium), berry (Malvaviscus).

Seed: Non-endospermic.

Floral formula and Floral Diagram:



Stamen on Staminal Tube **Gynoecium** **Floral Diagram**

$\oplus$ ⚥ $Epi_{3 \rightarrow 8}\ K_{(5)}\ C_{(5)}\ A_{\infty}\ G_{(2-\infty)}$

Economic Importance of Malvaceae:

Economically this family is of much importance because there are a number of fibre yielding plants. According to certain authorities nearly all genera can produce some or other kinds of fibres.

A. Fibre yielding plants:

1. Cotton is perhaps the most important fibre inspite of many synthetic textile fibres. The seed coat of *Gossypium* produce epidermal hairs which is cellulosic in nature. This is cotton wool. These hairs are flattened, twisted and from the staple. Cotton plant grows best in the sandy damp soil of humid regions. Cotton seed is further important for it produces an edible oil.
2. *Abelmoschus esculentus* (Hindi-Bhindi, Eng.-Lady's finger) fruits are used as a vegetable.
3. *Hibiscus rosa-sinensis* or shoe flower is widely cultivated as an ornamental plant and also used in the worship of God and Godess Kali. Althea rosea is also a garden plant with its lovely pinkish flowers.

PRACTICE QUESTIONS

1. What type of hairs are found on young parts of plants in the Malvaceae family?
(a) Simple hairs (b) Branched hairs
(c) Stellate hairs (d) Glandular hairs

2. What is the primary habit of plants in the Malvaceae family?
(a) Trees (b) Shrubs (c) Herbs (d) Vines

3. Which part of Malvaceae plants contains mucilaginous sap?
(a) Leaves (b) Flowers (c) Roots (d) All parts

4. What type of root is typically found in Malvaceae plants?
(a) Fibrous root (b) Adventitious root
(c) Taproot (d) Rhizome

5. Which of the following is a floral character of Malvaceae?
(a) Bifurcated leaves (b) Whorled arrangement
(c) Unisexual flowers (d) Actinomorphic flowers

6. How many sepals are typically found in the calyx of Malvaceae flowers?
(a) Three (b) Four (c) Five (d) Six

7. What is the number of petals in the corolla of Malvaceae flowers?
(a) Three (b) Four (c) Five (d) Six

8. In the androecium of Malvaceae flowers, the stamens are:
(a) Free and distinct (b) Fused to form a tube
(c) Adnate to the petals (d) None of these

9. What is the typical number of carpels in the gynoecium of Malvaceae flowers?
(a) One (b) Two (c) Five (d) Ten

10. Which economic plant in the Malvaceae family is known for its cotton production?
(a) Hibiscus (b) Abelmoschus esculentus
(c) Gossypium (d) Althaea rosea

11. Which Malvaceae plant is used for its fruits as a vegetable and is known as "Lady's finger"?
(a) Hibiscus rosa-sinensis (b) Althaea rosea
(c) Abelmoschus esculentus (d) Malva parviflora

12. Which part of the flower is known as "epicalyx" in Malvaceae?
(a) Sepals
(b) Petals
(c) Bracts outside the calyx
(d) Stamens

13. Which type of placentation is typically found in the ovary of Malvaceae flowers?
(a) Axile placentation
(b) Basal placentation
(c) Free central placentation
(d) Parietal placentation

14. Which Malvaceae plant is cultivated as an ornamental plant and used in the worship of deities?
(a) Althaea rosea (b) Gossypium arboreum
(c) Sida (d) Malva parviflora

15. What type of seed does Malvaceae typically have?
(a) Endospermic (b) Non-endospermic
(c) Cotyledonary (d) Arillate

16. In Malvaceae, which part of the flower is fused with the corolla?
(a) Sepals (b) Stamens
(c) Epicalyx (d) Ovary

17. Which part of the plant is used to produce cotton fiber?
(a) Leaves (b) Flowers (c) Stem (d) Seeds

18. How many petals are typically found in the corolla of Malvaceae flowers?
(a) 3 (b) 4 (c) 5 (d) 6

19. What is the economic importance of Malvaceae?
(a) It is a source of medicinal herbs
(b) It is a source of edible fruits
(c) It is a source of fiber-yielding plants
(d) It is a source of ornamental flowers

20. Which Malvaceae plant is known as "shoe flower" and is used in the worship of deities?
(a) Gossypium arboretum
(b) Abelmoschus esculentus
(c) Hibiscus rosa-sinensis
(d) Malva parviflora

Assertion-Reason Type Questions:

21. **Assertion:** Malvaceae plants typically have stellate hairs on their young parts.
Reason: Stellate hairs provide protection against herbivores.
(a) Both Assertion and Reason are true, and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are true, but Reason is not the correct explanation of Assertion.
(c) Assertion is true, but Reason is false.
(d) Both Assertion and Reason are false.

22. **Assertion:** Malvaceae flowers have actinomorphic symmetry.
Reason: Actinomorphic symmetry is advantageous for attracting pollinators.
(a) Both Assertion and Reason are true, and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are true, but Reason is not the correct explanation of Assertion.
(c) Assertion is true, but Reason is false.
(d) Both Assertion and Reason are false.

23. **Assertion:** The epicalyx in Malvaceae may have 7 to 9 bracts.
Reason: Epicalyx bracts protect the flower bud.
(a) Both Assertion and Reason are true, and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are true, but Reason is not the correct explanation of Assertion.
(c) Assertion is true, but Reason is false.
(d) Both Assertion and Reason are false.

24. **Assertion:** Malvaceae flowers have monadelphous stamens.
Reason: Monadelphous stamens enhance pollen transfer efficiency.
(a) Both Assertion and Reason are true, and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are true, but Reason is not the correct explanation of Assertion.
(c) Assertion is true, but Reason is false.
(d) Both Assertion and Reason are false.

25. **Assertion:** Malvaceae fruits are typically berries.
Reason: Berries are advantageous for seed dispersal by animals.
(a) Both Assertion and Reason are true, and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are true, but Reason is not the correct explanation of Assertion.
(c) Assertion is true, but Reason is false.
(d) Both Assertion and Reason are false.

26. **Assertion:** Cotton is the primary fiber-yielding plant in the Malvaceae family.
Reason: Cotton fibers are derived from the seeds of Gossypium plants.
(a) Both Assertion and Reason are true, and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are true, but Reason is not the correct explanation of Assertion.
(c) Assertion is true, but Reason is false.
(d) Both Assertion and Reason are false.

27. **Assertion:** Hibiscus rosa-sinensis is used in the worship of deities.
Reason: Hibiscus flowers are considered sacred in certain cultures.
(a) Both Assertion and Reason are true, and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are true, but Reason is not the correct explanation of Assertion.
(c) Assertion is true, but Reason is false.
(d) Both Assertion and Reason are false.

28. **Assertion:** Malvaceae seeds are endospermic.
Reason: Endosperm in seeds provides nourishment to the developing embryo.
(a) Both Assertion and Reason are true, and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are true, but Reason is not the correct explanation of Assertion.
(c) Assertion is true, but Reason is false.
(d) Both Assertion and Reason are false.

B-43 : FAMILY ASTERACEAE (COMPOSITAE)

Characters of Asteraceae:

Mostly herbs or shrubs or rarely trees; leaves alternate rarely opposite, exstipulate rarely stipulate; inflorescence capitulum or head surrounded by involucre of bracts; ray and disc florets, flower tubular or ligulate, flowers bi- or unisexual or outer male or female, pentamerous, actinomorphic or zygomorphic, caryxpappus, corolla gamopetalous, petal lobes 5, stamens 5, epipetalous, usually dithecous, filament free and anthers united i.e. syngenesious, introrse, ovary unilocular, inferior, with basal placentation, style slender stigma bifid; fruit cypsela.

A. Vegetative characters:

Habit: Herbs, shrubs, rarely trees. Many of the plants are xerophytes, hydrophytes some are semiaquatic.

Root: Tap root, sometimes modified into tubers (Dahlia).

Stem: Erect, or prostrate, herbaceous or woody (Artemisia), hairy, sometimes with latex. Stem tubers are also present (Helianthus); tubers are edible (H. tuberosus); cylindrical; glabrous, solid or fistular, stem may be leaf-like (Baccharis).

Leaf: Alternate rarely opposite (Zinnia, Dahlia) or whorled; leaves may be radical, petiolate or sessile, exstipulate, mostly simple sometimes scale-like (Senecio), unicostate or multicostate reticulate venation.

B. Floral characters:

Inflorescence: A head or capitulum, consisting of a few or large number of flowers or florets closely arranged on an axis surrounded by involucral bracts. The whole head or capitulum is apparently similar to a single flower because the involucral bracts perform the function of protection.

In Helianthus the outer or peripheral, ligulate and zygomorphic florets are called ray-florets; whereas inner or central, tubular and actinomorphic ones are called disc-florets.

In capitulum or head the form of flowers and distribution of sex also varies.

Distribution of sex: The flowers of a head may be all hermaphrodite (Ageratum), or ray-florets are female or neuter and inner ones hermaphrodite, or male; rarely the complete head bears unisexual flowers.

Flower: Bracteate, sessile, complete or incomplete, hermaphrodite or unisexual, pentamerous, tubular (actinomorphic) or ligulate (zygomorphic), epigynous and inconspicious.

Ray-florets: Zygomorphic, ligulate, pistillate, or neuter or sometimes also bisexual, epigynous.

Calyx: Modified into pappus or absent or scale-like.

Corolla: Petals 5, gamopetalous, highly coloured, ligulate, strap-shaped, valvate.

Androecium: Absent.

Gynoecium: Either absent or if present then bicarpellary, syncarpous, inferior, unilocular with basal placentation, one anatropous ovule; style one; stigma bifid.

Fruit: Absent; if present cypsela.

Seed: Non-endospermic.

Floral formula: Br. % ☿ or neuter K pappus C (5) A0 $G\overline{(2)}$ or 0.

Disc florets:

Flower: Bracteate, sessile, complete, hermaphrodite, actinomorphic, pentamerous, epigynous and tubular.

Calyx: Modified into pappus or scale, persistent.

Corolla: Petals 5, gamopetalous, tubular, coloured.

Androecium: Stamens 5, epipetalous, syngenesious, dithecous, introrse, dehiscing longitudinally.

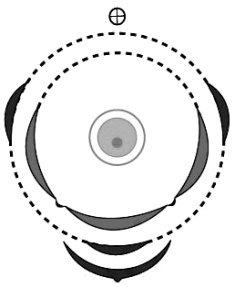
Gynoecium: Bicarpellary, syncarpous, inferior, unilocular with single anatropous ovule, basal placentation; style simple, long, stigma bifid.

Fruit: Cypsela.

Seed: Non-endospermic.

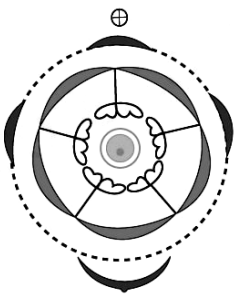
Pollination: Entomophilous.

Floral formula: Br. $\oplus$ ☿ K pappus $C_{(5)}$ $A_{(5)}G_{\overline{(2)}}$.



Floral Diagram of Ray floret

Floral formula: Br % ♀ $K_{(2–3)(pappus)}C_{(3–5)}A_0\bar{G}_{(2)}$



Floral Diagram of Disc floret

Floral formula: Br $\oplus$ ♂ ♀ $K_{2–3(pappus)}C_{(5)}A_5\bar{G}_{(2)}$

Economic Importance of Asteraceae:

1. Food: Leaves of Lactuca sativa are used as salad. The roots of Helianthus tuberosus are edible.

2. Oil: The seeds of Helianthus and Artemisia yield oil.

3. Medicinal: Solidago used in dropsy. Artemisia yields santonin which is used as vermifuge. The roots of Taraxacum used in bowel disorders. The juice of Emillia sonchifolia leaves has cooling effect and is used in eye inflammation and also for night blindness. Eclipta alba used as tonic in spleen enlargement. Centipeda orbicularis is used in cold and toothache.

4. Rubber: It is obtained from Solidago laevenworthii and Taraxacum.

5. Insecticide: The capitula of Chrysanthemum roseum and C. cinerriefolium are dried, powdered and used as insecticide.

6. Ornamental: Zinnia, Dahila, Cosmos, Chrysanthemum, Calendula, Helichrysium, Aster Helianthus etc. are well known garden plants.

7. Weeds: Xanthium, Blumea, Sonchus, Vernonia are the common weeds.

PRACTICE QUESTIONS

1. Which family do the plants with the following characteristics belong to: herbs, shrubs, or rarely trees; inflorescence in the form of a head surrounded by involucre of bracts; flowers with tubular or ligulate corollas; leaves that are alternate or rarely opposite?
(a) Rosaceae (b) Asteraceae (Compositae)
(c) Solanaceae (d) Fabaceae

2. What is the typical root structure found in Asteraceae plants?
(a) Fibrous root (b) Adventitious root
(c) Tap root (d) Tuber

3. Which part of some Asteraceae plants is edible and modified into tubers?
(a) Leaves (b) Stem (c) Flowers (d) Roots

4. What type of inflorescence is characteristic of Asteraceae?
(a) Raceme (b) Umbel
(c) Capitulum or head (d) Spike

5. What is the function of the involucral bracts in Asteraceae inflorescence?
(a) Photosynthesis (b) Protection
(c) Attraction of pollinators (d) Storage of nutrients

6. In Asteraceae, what are the two types of florets found in the capitulum or head inflorescence?
(a) Tubular and actinomorphic florets
(b) Ray-florets and disc-florets
(c) Hermaphrodite and unisexual florets
(d) Zygomorphic and bisexual florets

7. What is the distribution of sex in Asteraceae flowers within a head?
(a) All hermaphrodite
(b) All male
(c) Ray-florets male, disc-florets hermaphrodite
(d) Ray-florets female, disc-florets male

8. What type of corolla is typically found in ray-florets of Asteraceae?
(a) Tubular (b) Ligulate
(c) Actinomorphic (d) Zygomorphic

9. How many petals are typically found in the corolla of Asteraceae flowers?
(a) 3 (b) 4 (c) 5 (d) 6

10. In Asteraceae, what is the structure formed by the fusion of stamens?
(a) Androgynophore (b) Gynoecium
(c) Staminode (d) Syngenesious tube

11. What type of placentation is found in the ovary of Asteraceae flowers?
(a) Axile placentation
(b) Basal placentation
(c) Free central placentation
(d) Parietal placentation

12. What is the typical fruit type in Asteraceae?
(a) Berry (b) Capsule (c) Nut (d) Cypsela

13. What is the nature of the seed in Asteraceae?
(a) Endospermic (b) Non-endospermic
(c) Cotyledonary (d) Arillate

14. Which type of pollination is characteristic of Asteraceae flowers?
(a) Wind pollination
(b) Entomophilous pollination
(c) Self-pollination
(d) Hydrophilous pollination

15. What is the economic importance of Artemisia?
(a) Edible leaves (b) Medicinal properties
(c) Rubber production (d) Ornamental value

16. Which part of Asteraceae is used as an insecticide?
(a) Leaves (b) Flowers (c) Stems (d) Capitula

17. Which of the following is NOT mentioned as an economic use of Asteraceae plants in the text?
(a) Food (b) Oil (c) Rubber (d) Timber

18. Which type of inflorescence does Zinnia belong to?
(a) Raceme (b) Umbel
(c) Capitulum (d) Spike

19. What is the common habitat type mentioned for many Asteraceae plants?
(a) Desert
(b) Rainforest
(c) Alpine meadows
(d) Xerophytes and hydrophytes

20. Which part of Helianthus is edible and sometimes referred to as "Jerusalem artichoke"?
(a) Leaves (b) Flowers (c) Roots (d) Stem

Assertion-Reason Type Questions:

21. **Assertion:** Asteraceae plants typically have taproots.
Reason: Taproots provide better anchorage and storage of nutrients.
(a) Both Assertion and Reason are true, and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are true, but Reason is not the correct explanation of Assertion.
(c) Assertion is true, but Reason is false.
(d) Both Assertion and Reason are false.

22. **Assertion:** In Asteraceae, the inflorescence is in the form of a head surrounded by involucral bracts.
Reason: The involucral bracts protect the individual flowers within the head.
(a) Both Assertion and Reason are true, and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are true, but Reason is not the correct explanation of Assertion.
(c) Assertion is true, but Reason is false.
(d) Both Assertion and Reason are false.

23. **Assertion:** In Asteraceae, ray-florets are typically zygomorphic, while disc-florets are actinomorphic.
Reason: This floral variation helps attract different pollinators to the ray-florets and disc-florets.
(a) Both Assertion and Reason are true, and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are true, but Reason is not the correct explanation of Assertion.
(c) Assertion is true, but Reason is false.
(d) Both Assertion and Reason are false.

24. **Assertion:** Asteraceae flowers typically have five petals in their corolla.
Reason: A pentamerous corolla is advantageous for attracting a wide range of pollinators.
(a) Both Assertion and Reason are true, and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are true, but Reason is not the correct explanation of Assertion.
(c) Assertion is true, but Reason is false.
(d) Both Assertion and Reason are false.

25. **Assertion:** In Asteraceae, stamens are epipetalous and form a syngenesious tube.
Reason: The fusion of stamens enhances pollen transfer efficiency.
(a) Both Assertion and Reason are true, and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are true, but Reason is not the correct explanation of Assertion.
(c) Assertion is true, but Reason is false.
(d) Both Assertion and Reason are false.

26. **Assertion:** Asteraceae flowers have superior ovaries with basal placentation.
Reason: Superior ovaries provide better access to pollinators, and basal placentation ensures efficient seed development.
(a) Both Assertion and Reason are true, and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are true, but Reason is not the correct explanation of Assertion.
(c) Assertion is true, but Reason is false.
(d) Both Assertion and Reason are false.

B-43 : FAMILY POACEAE (GRAMINAE)

Characters of Poaceae:
Mostly herbs, stem jointed, fistular, cylindrical; leaves simple, alternate, sheathing, sheath open, ligulate; inflorescence compound spike; flowers zygomorphic, hypogynous, protected by palea; perianth represented by 2 or 3 minute scales (lodicules); stamens 3, versatile; carpel one, style 2 or 3, stigmas feathery, basal placentation; fruit caryopsis; testa fused with pericarp.

A. Vegetative characters:

Habit:
Herbs, annuals or perennials or shrubs, sometimes tree like (*Bambusa, Dendrocalamus*).

Root:
Adventitious, fibrous, branched, fascicled or stilt (*Zea mays*).

Stem:
Underground rhizome in all perennial grasses, cylindrical, culm with conspicuous nodes and internodes, internodes hollow, herbaceous or woody, glabrous or glaucous, vegetative shoots are arising from the base of aerial stem or from underground stems are called tillers.

Leaves:
Alternate, simple, distichous, exstipulate, sessile, ligulate (absent in Echinochloa), leaf base forming tubular sheath, sheath open, surrounding internode incompletely, ligule is present at the junction of the lamina and sheath, entire, hairy or rough, linear, parallel venation.

B. Floral characters:

Inflorescence:
Compound spike which may be sessile or stalked. Each unit of inflorescence is spikelet. The spikelets are arranged in various ways on the main axis called rachilla. A compound inflorescence may be spike of spikelets (Triticum), panicle of spikelets (Avena).

The spikelet consists of a short axis called rachilla on which 1 to many sessile or short stalked flowers are borne. The florets may be arranged in alternate or opposite manner on the central axis.

At the base of rachilla two sterile scales, called glumes, are present. The glumes are placed one above the other on opposite sides. The lower one is called first glume and the upper is called second glume. Both the glumes are boat shaped and sterile. Above the glumes a series of florets are present.

Flower:
Bracteate and bracteolate, sessile, incomplete, hermaphrodite, or unisexual (Zea mays), irregular, zygomorphic, hypogynous, cyclic.

Perianth:
Represented by membranous scales called the lodicules. The lodicules are situated above and opposite the superior palea or may be absent, or many (Ochlandra), or 2 or 3.

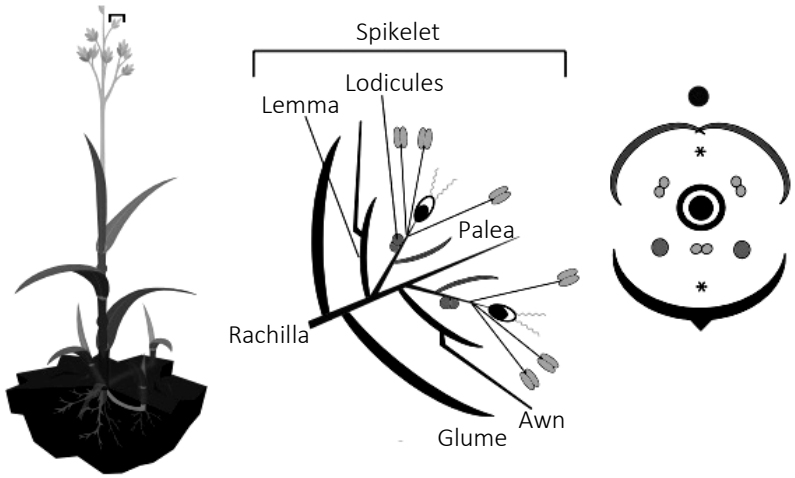
Androecium:
Usually stamens 3, rarely 6 (Bambusa, Oryza); polyandrous, filaments long, anthers dithecous, versatile, linear, extrorse; pollen grains dry.

Gynoecium:
Monocarpellary, according to some authors carpels 3, of which 2 are abortive, ovary superior, unilocular with single ovule, basal placentation, style short or absent; stigmas two feathery or papillate and branched.

Fruit:
Caryopsis (achene with pericarp completely united or adherent with the seed coat) or rarely nut (Dendrocalamus) or berry (Bambusa).

Seed:
Endospermic and containing a single cotyledon called scutellum, which is shield shaped and pressed against the endosperm.

Floral formula:



Floral formula: Br.% ○ P2 (Iodicules) or absent A3 or 3 + 3 G (3) or (2) or 1

Economic Importance of Poaceae:

The family stands first and foremost in respect of economic importance in whole of Angiosperms. The staple food grains of the population of world is derived from Oryza sativa (Rice) and Triticum aestivum (Wheat). They are cultivated from time immemorial.

The family has been divided on economic basis as follows:

Food:

Triticum aestivum, Oryza sativa, Zea mays (Maize), Hordeum vulgare (Jaw), Sorghum vulgare (Jowar), Avena sativa (Oats), Pennisetum typhoides (Bajra) are cultivated for cereals and food grains.

Fooder:

Many grasses as Cynodon dactylon, Panicum, Cymbopogon, Agrostis, Poa are grown for fodder.

Sugar:

Saccharum officinarum (Sugarcane; H. Ganna) is cultivated for gur and sugar.

Building material:

Some species of Bambusa e.g. B. tulda, B. vulgaris are used for scaffolding, thatching huts etc.

Furniture:

Species of Dendrocalamus (H. Bent), Arundinaria, Melocalamus are used in manufacture of furniture.

Aromatic grasses:

Many grasses yield scented oils which are used in perfumery viz. Vetiveria zizanioides (H. Khus khus) yields vetiver oil from the roots. The roots are also woven into curtains. Andropogon odoratus (Ginger grass), Cymbopogon citratus (Lemon grass), Cymbopogon martini (Geranium grass), Cymbopogon jawarancusa etc. also yield oil.

Medicinal:

Phragmites karka, Cymbopogon schoenanthus etc. are medicinal.

Secale cereale is cultivated for infection of its inflorescence by Claviceps purpurea for production of Ergot and for extraction of ergotine. Ergotine is an excellent remedy for uterine contraction.

Paper:

It is manufactured from certain species of grasses and bamboos.

Ornamental:

Rhynchelytrum repens, Cortaderia selloana and some species of the tribe Bambusoideae are ornamentals.

Besides these a number of grasses are grown to form fine lawns, play grounds etc.

PRACTICE QUESTIONS

1. What is the primary vegetative character of plants in the Poaceae family?
(a) Compound leaves (b) Simple leaves
(c) Branched stems (d) Woody stems

2. Which part of the plant is represented by the lodicules in the Poaceae family?
(a) Perianth (b) Stamens (c) Carpels (d) Roots

3. How many stamens are typically found in the flowers of Poaceae?
(a) 2 (b) 4 (c) 3 (d) 6

4. What is the fruit type in most plants of the Poaceae family?
(a) Berry (b) Nut (c) Caryopsis (d) Achene

5. Which of the following grasses is used for the production of sugar?
(a) Vetiveria zizanioides
(b) Cymbopogon citratus
(c) Saccharum officinarum
(d) Phragmites karka

6. What is the economic importance of Secale cereale in the Poaceae family?
(a) Furniture production (b) Perfumery
(c) Medicinal use (d) Ergot production

7. Which grass family provides the staple food grains for a significant portion of the world's population?
(a) Liliaceae (b) Rosaceae
(c) Poaceae (d) Fabaceae

8. What type of inflorescence is typically found in Poaceae?
(a) Compound spike (b) Raceme
(c) Umbel (d) Capitulum

9. Which part of the plant is modified to form a tubular sheath in Poaceae?
(a) Stem (b) Leaf (c) Flower (d) Root

10. Which of the following is NOT an economic use of grasses in the Poaceae family?
(a) Furniture production (b) Perfumery
(c) Medicinal use (d) Fuel production

Assertion Reason Type Questions:

11. **Assertion:** The primary vegetative character of Poaceae is simple leaves.
Reason: Simple leaves have a complex, lobed structure in Poaceae.
(a) Both assertion and reason are true, and the reason is the correct explanation of the assertion.
(b) Both assertion and reason are true, but the reason is not the correct explanation of the assertion.
(c) The assertion is true, but the reason is false.
(d) Both assertion and reason are false.

12. **Assertion:** Poaceae is economically important due to its role in furniture production.
Reason: Species of Dendrocalamus and Arundinaria are commonly used for making furniture.
(a) Both assertion and reason are true, and the reason is the correct explanation of the assertion.
(b) Both assertion and reason are true, but the reason is not the correct explanation of the assertion.
(c) The assertion is true, but the reason is false.
(d) Both assertion and reason are false.

13. **Assertion:** The inflorescence in Poaceae is typically a compound spike.
Reason: The spikelets in Poaceae are arranged in various ways on the main axis called rachilla.
(a) Both assertion and reason are true, and the reason is the correct explanation of the assertion.
(b) Both assertion and reason are true, but the reason is not the correct explanation of the assertion.
(c) The assertion is true, but the reason is false.
(d) Both assertion and reason are false.

14. **Assertion:** The floral characters of Poaceae include zygomorphic flowers.
Reason: Zygomorphic flowers have radial symmetry.
(a) Both assertion and reason are true, and the reason is the correct explanation of the assertion.
(b) Both assertion and reason are true, but the reason is not the correct explanation of the assertion.
(c) The assertion is true, but the reason is false.
(d) Both assertion and reason are false.

15. **Assertion:** The economic importance of Saccharum officinarum includes the production of gur and sugar.
Reason: Saccharum officinarum is a common source of aromatic oils used in perfumery.
(a) Both assertion and reason are true, and the reason is the correct explanation of the assertion.
(b) Both assertion and reason are true, but the reason is not the correct explanation of the assertion.
(c) The assertion is true, but the reason is false.
(d) Both assertion and reason are false.

Topic: Frog (B-43)

PRACTICE QUESTIONS

1. c	2. d	3. c	4. b	5. b	6. c	7. c
8. a	9. c	10. c	11. c	12. c	13. b	14. c
15. c	16. c	17. c	18. c	19. c	20. c	21. c
22. c	23. a	24. c	25. a	26. c	27. d	28. c
29. d	30. a	31. b	32. b	33. d	34. b	35. c
36. c	37. b	38. b	39. c	40. b	41. a	42. c
43. a	44. c	45. b	46. a	47. a	48. c	49. c
50. c	51. b	52. a	53. d	54. a	55. b	56. c
57. c	58. c	59. b	60. b	61. c	62. c	63. b
64. b	65. d	66. a	67. a	68. a	69. a	70. a
71. c	72. c	73. c	74. c	75. d	76. d	77. b
78. d	79. b	80. d	81. d	82. a	83. b	84. a
85. a	86. c	87. b	88. a	89. b	90. c	91. c
92. b	93. c	94. b	95. b	96. d	97. b	98. b
99. b	100. c	101. d	102. c	103. a	104. d	105. c
106. d	107. c	108. c	109. b	110. b	111. a	112. b
113. b	114. b	115. b				

Topic: Family Brassicaceae (Cruciferae) (B-43)

PRACTICE QUESTIONS

1. b	2. b	3. b	4. d	5. b	6. c	7. b
8. c	9. c	10. a	11. d	12. a	13. a	14. d
15. c	16. c	17. c	18. c	19. c	20. c	21. b
22. b	23. a	24. b	25. b	26. d	27. a	

Topic: Family Malvaceae (B-43)

PRACTICE QUESTIONS

1. c	2. c	3. d	4. c	5. d	6. c	7. c
8. b	9. c	10. c	11. c	12. c	13. a	14. a
15. b	16. b	17. d	18. c	19. c	20. c	21. a
22. a	23. a	24. a	25. b	26. a	27. a	28. c

Topic: Family Asteraceae (Compositae)(B-43)

PRACTICE QUESTIONS

1. b	2. c	3. d	4. c	5. b	6. b	7. c
8. b	9. c	10. d	11. b	12. d	13. b	14. b
15. b	16. d	17. d	18. c	19. d	20. c	21. a
22. a	23. a	24. a	25. a	26. a		

Topic: Family Poaceae (Graminae) (B-43)

PRACTICE QUESTIONS

1. b	2. a	3. c	4. c	5. c	6. d	7. c
8. a	9. b	10. d	11. a	12. b	13. a	14. c
15. b						

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