ZOOLOGY

MATRICULATION

STANDARD

X

Untouchability is a sin
Untouchability is a crime
Untouchability is inhuman

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PREFACE

This book is intended for students appearing for their first Board Examination in Biological Science. The materials included are relevant to the revised syllabus in Matriculation Zoology (in Biology).

Changing trends in science education have made it imperative to re-evaluate what the student should be taught when student, are going to enter the higher secondary level in their academic career.

Importance is given to the new topics like Biotechnology, Biomedical Instrumentation, Diseases and Immunology, Applied Biology along with Anatomy and Physiology, so that, the biology students are introduced into new fields of research and development in biological science.

Some salient features of this book :

- Simple language
- Important definitions, concepts and illustrations.
- Interesting extra informations
- Self Evaluation Exercises

While preparing for the examination, students should not restrict themselves, only to the questions at the end of each unit. They must be prepared to answer the questions from the text.

Some facts of biological interest have been given in boxes in the text to trigger curiosity and to give current information to students. These are not to be counted as contents for examination.

I thank everyone who has been a source of inspiration in bringing out this book for the students of Standard X Matriculation Board. Suggestions for further improvement of this book are welcome.

Mrs. V. SUNDARAM
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CONTENTS

UNIT 1

LEVELS OF ORGANISATION

The variety in the nature and habits of animals in this biosphere is quite amazing and interesting. What we see around us may be just a few, but there are innumerable species of animals which are interdependent. Some have already become extinct and some are on the verge of extinction.

1.1. Multicellular - Vertebrate - Frog

You have learnt in lower classes how these animals are broadly classified into unicellular and multicellular organisms and the multicellular organisms in turn are grouped under invertebrates and vertebrates. Taking frog as an example for a lower vertebrate animal, let us learn the external structure and its internal organisation.

Frog ***(Rana hexadactyla)*** is an animal that leads an amphibious mode of life i.e. it is adapted to live on land and in water. The frog is placed under phylum **Chordata** and class **Amphibia**. Its systematic position is given below.

Kingdom	:	**Animalia**
Phylum	:	**Chordata**
Sub-phylum	:	**Vertebrata**
Class	:	**Amphibia**
Order	:	**Anura**
Family	:	**Ranidae**
Genus	:	***Rana***
Species	:	***hexadactyla***

1.2. External Morphology

The body of a frog is streamlined to help in swimming. It is dorso-ventrally flattened and is divisible into the head and trunk. The neck and tail

are absent. The dorsal surface is dark green in colour while the ventral surface is pale yellow.

The head which is triangular in shape, has a blunt apex. The head bears a wide mouth, a pair of prominent eyes, a pair of external nostrils and a pair of tympanic membrane. Lying inside the mouth is a long, sticky, ***bifid tongue***. Eyes are large and project above the general surface of the body. The eyes are laterally placed and are protected by an upper and lower eyelid. The upper eyelid is thick and immovable while the lower eyelid is thin and movable. A protective membrane called nictitating membrane is seen covering the surface of the eyes when the animal is under water. A pair of small, circular, external nostrils are located dorsally at the tip of the snout.

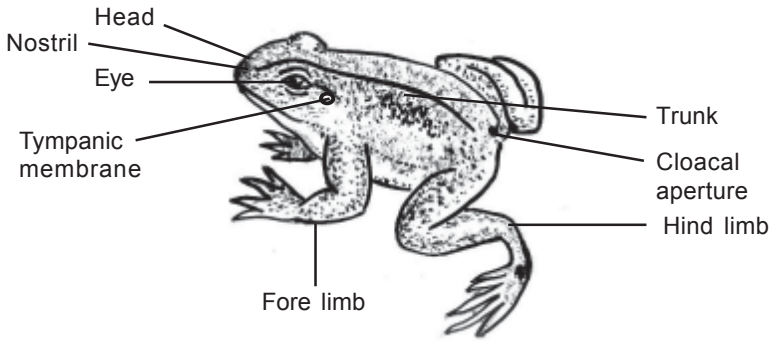


Fig. 1.1. Frog - External features

The ***tympanic membranes*** (ear drums) are circular patches of skin found behind the eyes on either side. These are connected to the internal ears. Frogs have no external ears.

The trunk is wider at the front and tapers behind. It bears two pairs of limbs. These limbs are useful for locomotion. Fore limbs are short and stumpy and consist of an upper arm *(brachium),* fore arm *(ante brachium)* and a hand *(manus).* The hand bears only four digits. Fore limbs help to bear the weight of the body. They are also useful for the landing of the animal after leaping.

The hind limbs are long and consist of a thigh, a shank *(crus)* and a foot *(pes)*. The foot bears five toes. The toes are joined by thin folds of skin called "web" which is an adaptation for leaping and swimming. When the animal is at rest, the hind limbs are kept folded in the form of letter ***"Z"***.

The cloacal aperture is present at the posterior end on the dorsal side between the two hind limbs. It is a common opening for discharging the undigested food, urine and reproductive products.

FIRST LAND INVADER

Frog, Toad, Salamander, Newts, Necturus (Mudpuppy) and Ichthyophis (limbless) **are the few members of class Amphibia. Amphibians are the first land vertebrates, evolved from fish like ancestors which successfully made their transition from aquatic to terrestrial life.**

The skin of a frog is soft, loose and smooth. It is kept moist and slimy by the mucous secreted by the ***cutaneous glands***.

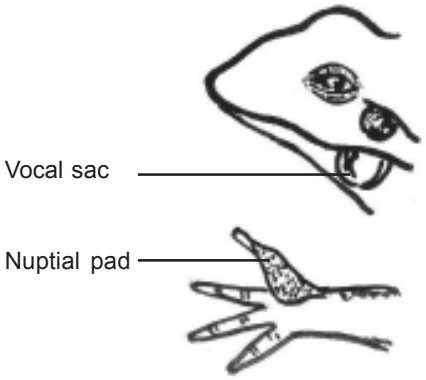


Fig. 1.2. Head and Hand of a male Frog

Sexual dimorphism is observed in frogs i.e. the male and female frogs show differences in their external appearance which become prominent during breeding season. Male frogs are larger in size. They possess a pair of pouch - like sacs called ***vocal sacs,*** a little behind the

mouth. It becomes large during breeding season. The male frogs produce a croaking sound and the vocal sacs help to increase the pitch. Vocal sacs are absent in the female frogs. The male frogs possess a special pad called ***copulatory*** or ***nuptial pad*** on the ventral side of the first finger in the fore limbs. During breeding season this becomes thick and sticky.

1.3. Digestive system of Frog

The alimentary canal is a long and coiled tube extending from mouth to anus and consists of the pharynx, oesophagus *(food pipe)*, stomach and intestine.

Mouth : The wide mouth leads into the buccal cavity. A large, thick tongue is attached to the lower jaw at front, while its free anterior end which is bifid is kept folded within the buccal cavity. When the frog sights an insect, it shoots out the tongue and the insect gets glued to the sticky tongue. The tongue is immediately withdrawn and the mouth closes.

A row of small, pointed maxillary teeth is found on the inner region of the upper jaw. The lower jaw is devoid of teeth. In addition to this, ***vomerine teeth*** are also found. Buccal cavity leads to the pharynx.

Pharynx : The pharynx serves as a common pathway for both nutrition and respiration and there are separate openings for the same. The pharynx leads into the oesophagus.

Oesophagus : The oesophagus is a short, wide tube. It leads to the stomach through a small opening.

Stomach : The stomach located towards the left side has a wider, anterior part *(cardiac part)* and a posterior, narrow part *(pyloric part)*. The wall of the stomach has many inner foldings and hence is quite thick. The stomach leads to the intestine.

Intestine : The long, narrow anterior part is the small intestine about 20 cms long. The wider, posterior part is the large intentine about 4 to 5 cms long. The small intestine is thin walled and is divisible into the duodenum and ileum. Ileum is coiled. The large intestine is short and straight and is divided into colon and rectum. The rectum leads to the cloaca. ***Liver*** and ***pancreas*** are the glands associated with the digestive system.

Cloaca : Cloaca is the region into which the ureters also open. The cloaca opens out by the cloacal aperture which serves both as anus and urino-genital aperture.

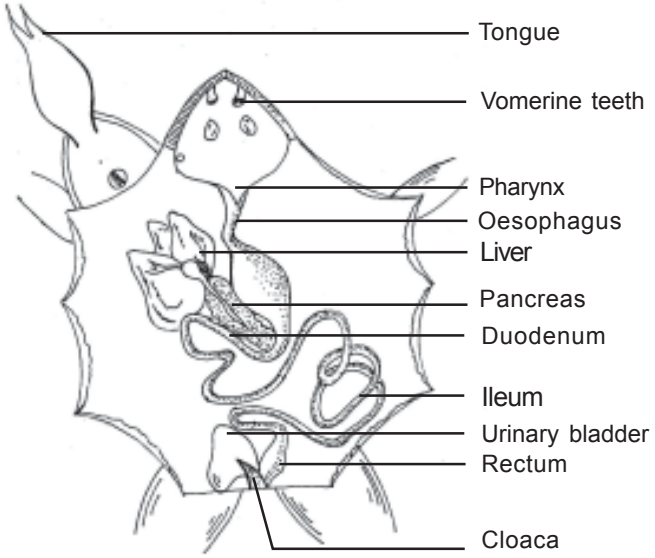


Fig. 1.3. Frog - Digestive system

1.4 Respiratory system of Frog

The adult frogs use their lungs for their respiration. They also use their skin and the buccal cavity for the respiration. During the developmental stages the tadpole larva of frogs respire through gills as they are purely aquatic.

Cutaneous respiration

The skin of frog is richly supplied with blood capillaries. The skin contains glands known as cutaneous glands which secrete mucous and keep the skin surface always moist and retain a thin film of water under the surface of the skin. This condition enables the gaseous exchange between the blood vessels in the skin and the outside environment. Frogs resort to cutaneous respiration while under water or when they undergo either ***hibernation*** *(winter sleep)* or ***aestivation*** *(summer sleep)*.

Buccal respiration

When frogs float on the surface of water or while resting on land, they respire through their buccal cavity. Atmospheric air is sucked through the nasal openings when the floor of the cavity is lowered and the air is sent out when the floor rises. Thus by the alternate lowering and rising of the floor of the buccal cavity, buccal respiration is brought about which accounts for **5%** of total oxygen intake.

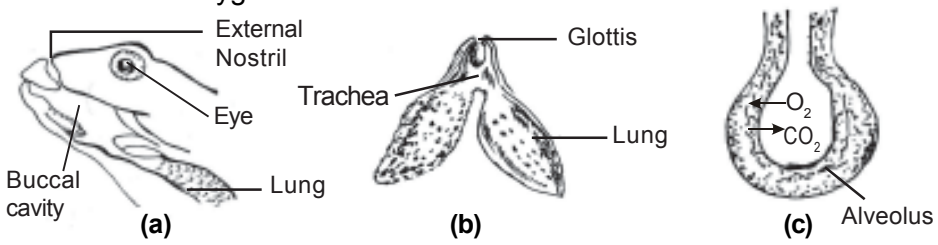


Fig : 1.4. Respiratory system in Frog

(a) Position of Lungs (b) Structure of Lungs (c) alveolus

Pulmonary respiration

The respiratory system comprises the nasal cavities, the buccal cavity, larynx, trachea, a pair of lungs and the alveoli inside them.

The lungs are anteriorly placed, pinkish, sac-like organs which are highly distensible. There are numerous small sacs called ***air sacs or alveoli***. The thin walls of the alveoli are richly supplied with a network of blood capillaries. Gaseous exchange occurs between the atmospheric air and blood through the thin walls of the alveoli. Pulmonary respiration accounts for about **65%** of the total oxygen intake.

1.5 Circulatory system of Frog

A pipeline system is useful in vertebrate animals for transporting materials between various parts of the body. The digested food from the alimentary canal which is absorbed has to be taken to different parts of the body. Similarly, the atmospheric oxygen which is taken into the lungs has to reach all the cells for respiration. The pipeline system, called circulatory system carries out these functions. It also helps to remove the metabolic wastes produced in different organs to be sent out to the exterior.

This system consists of a heart with three chambers, blood vessels, blood and lymph.

In frog, the heart is covered by a membrane called ***Pericardium***. The thin walled anterior part of the heart is called the ***auricle or atrium*** and the thick-walled posterior part is called the ventricle. Auricle is divided into two chambers, the right and the left. A large, triangular, thin-walled chamber viz. ***Sinus venosus*** is found on the dorsal surface of the heart, while a small, thick-walled and cylindrical ***Truncus arteriosus*** (also known as ***Conus arteriosus***) lies obliquely on the ventral surface. Truncus arteriosus arises from the ventricle and divides into the right and left branches. Each of this,

POISON FROM FROGS

- **Venom from the skin of certain Arrow - poison tree frogs of tropical America has long been used by natives to anoint dart tips.**
- **The most powerful known frog venom is *BATRACHOTOXIN* from the Kokoi frog of Columbia which can kill a person.**

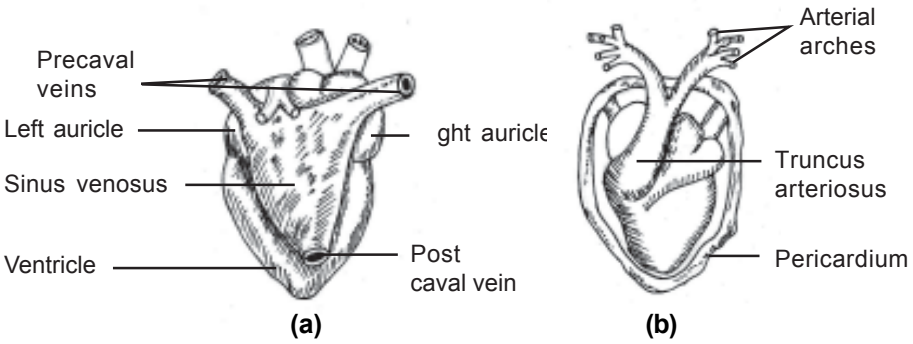


Fig. 1.5. Heart of Frog - a) Dorsal view, b) Ventral view

branches off into three vessels known as arterial arches. They are, the ***Carotid trunk***, the ***Systemic trunk*** and the ***Pulmocutaneous trunk***. These vessels supply the organs in the anterior region. Systemic trunks of both sides join posteriorly to form the dorsal aorta. Dorsal aorta is an important vessel which supplies the organs in the posterior part of the body.

Three, thick veins viz. the ***right and the left precaval veins*** and a post caval vein open into the Sinus venosus at its three corners. The Sinus venosus in turn opens into the right auricle. The blood from the anterior part of the body is collected by the pre caval veins and is emptied into the Sinus venosus. Blood from the posterior part of the body is collected by the ***post caval vein***. This also is emptied into the Sinus venosus.

1.6. Nervous system and Sense organs of Frog

The life of an organism is dependent on its environment which always keep changing. All organisms are capable of interacting with the environment which regularly fluctuates. This characteristic behaviour of responding to the external stimulus is due to the complicated system (Nervous system) of the body which consists of an extensive network of thread called nerves connected to the brain and spinal cord.

Brain of Frog

The brain of frog is covered by membranes called ***meninges***. The brain is divisible into three main parts - the fore brain, the mid-brain and the hind brain.

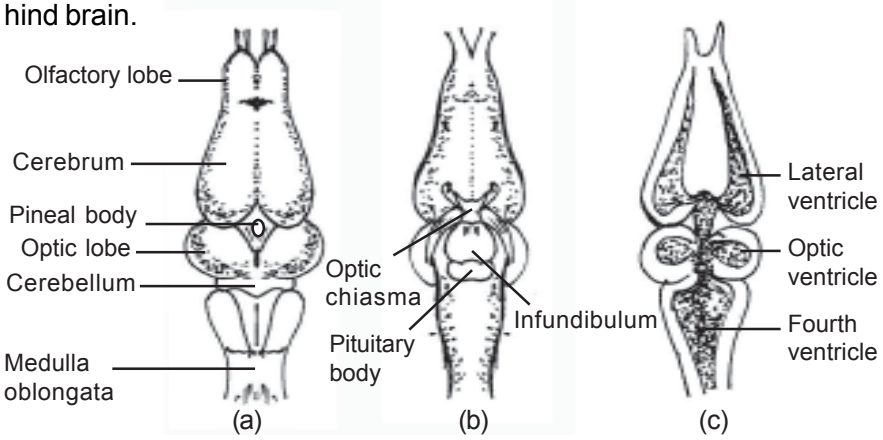


Fig. 1.6. Brain of Frog - (a) Dorsal view, (b) Ventral view, (c) Ventricles

Fore Brain

It is the anterior, largest part that consists of the olfactory lobes, the cerebral lobes and the ***diencephalon.*** The ***olfactory lobes*** are oval in shape, they are narrow and free anteriorly and fused posteriorly. Olfactory

nerves arise from its anterior end. The cavity inside the olfactory lobes are called ***ventricles***. The cerebral lobes which lie posterior to the olfactory lobes are longer and thicker and form the major part of the brain. A mid-dorsal groove separates the lobe into two lobes. The cerebral lobes also have cavities inside them called ***lateral ventricles***.

Diencephalon : It is a small, median part located between the cerebral hemispheres and mid-brain. The roof of the diencephalon is called ***anterior choroid plexus***. A knob-like, glandular structure called pineal body is found in the mid-dorsal line of diencephalon. The ventral wall of diencephalon is the hypothalamus which has an outgrowth called **infundibulum**. The pituitary gland is another small outgrowth found next to it.

Mid-brain

The mid brain consists of two large, oval optic lobes. They have cavities inside called ***optic ventricles***.

Hind brain

The hind brain consists of the cerebellum in front and medulla oblongata behind. ***Cerebellum*** is a thin narrow, transverse band behind the optic lobes. Medulla oblongata, the posterior part of the brain, is the most important region of the brain stem. It is some what conical and has a large cavity inside called the ***fourth ventricle***.

The spinal cord is the continuation of the ***medulla oblongata*** running upto the posterior end of the body. There are ten pairs of spinal nerves arising from the spinal cord. There are free sensory nerve terminals which are tactile, but they also receive stimuli like pressure, pain, temperature, light and chemical changes.

Sense Organs

Skin, Eyes, Ears and olfactory organs are the sense organs of frog. Taste buds are not very well developed.

Eyes (Photo receptors)

The eye ball which is spherical in shape is made up of three coats - the outer most protective, ***sclerotic*** coat, middle vascular, ***choroid*** coat which is pigmented and the inner sensory ***retina***.

The choroid coat forms iris at its anterior region with an opening in the centre called ***pupil***. Behind the iris, a large, spherical lens is held in position by suspensory ligaments.

The retinal layer consists of the ***rods*** and ***cones***. These are the sensory cells from which nerve fibres arise, pierce through the three coats and form the ***optic nerve.***

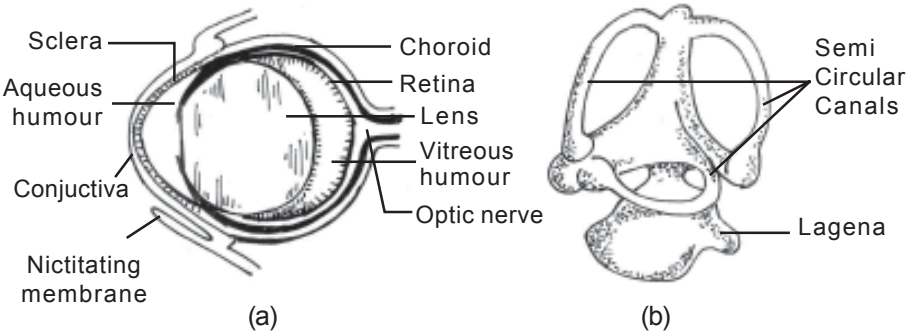


Fig. 1.7. Sense organs of Frog

a) Vertical section of the eye, b) Ear of Frog

Ears (Stato-acoustic receptors)

This organ is concerned with balancing and hearing. These two functions are performed by a delicate structure called ***membranous labyrinth***. This membranous labyrinth is situated on either side of the hind brain accommodated in the auditory capsule of the skull.

Skin (Tango receptors)

The skin of frog is supplied with abundant nerves which make it highly sensitive. There are tactile patches in the skin, that make it sensitive to chemical agents, intensity of light, humidity in air and touch of warmth.

Organ of smell (Olfactory receptors)

Though the olfactory receptors are situated in the olfactory chambers of the skull supplied with olfactory nerves, the sense of smell is not well developed.

Organ of Taste : (Gusto receptors)

Taste buds are located on the tongue and the roof of the mouth cavity. Taste buds contain sensory cells with sensory hairs. Sensations are received by the sensory hairs and passed on to the nerves.

1.7. Urino-genital system of Frog

The urino-genital system comprises the urinary system and the reproductive system which are closely associated.

Urinogenital system of a male Frog

In the male, a pair of testes, oval in shape are attached to the anterior region of the kidneys lying ventrally attached to them by ***peritoneum***. The testes are made up of ***seminiferous tubules*** which are lined with germinal epithelium. The germinal epithelial cells produce sperms which are

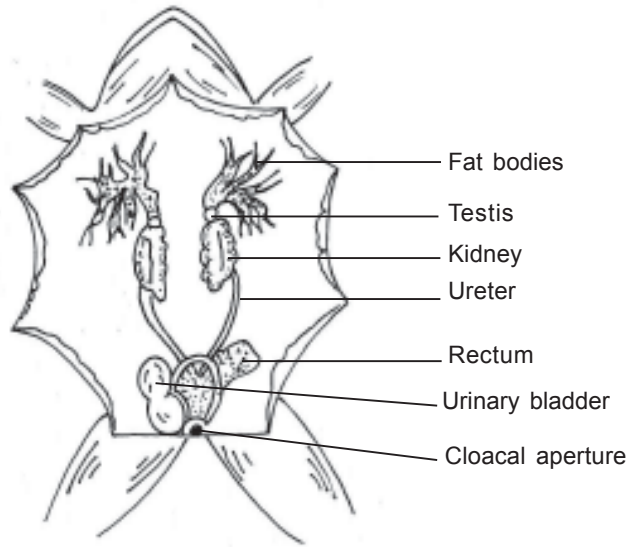


Fig 1.8 Urinogenital System of Frog - Male

collected by seminiferous tubules. These seminiferous tubules join to form ***vasa deferentia*** which open into the ureters. Ureters are swollen at their posterior ends to store the sperms temporarily. Sperms are given out through ***cloaca***.

Urinogenital system of a female Frog

In the female, a pair of ovaries are found in the anterior region of the kidneys lying ventrally attached to them by ***peritoneum***. They get enlarged during breeding season.

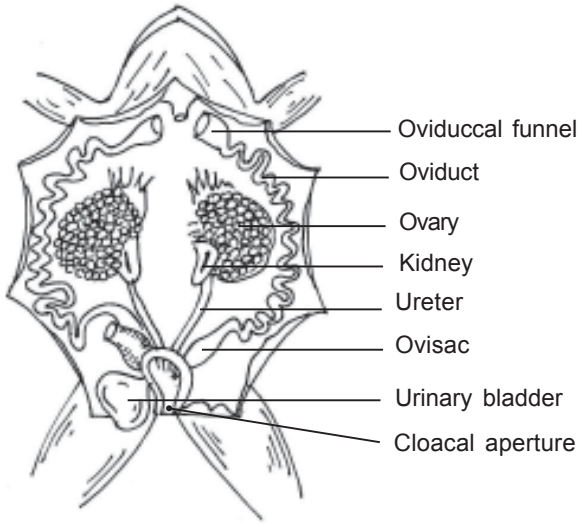


Fig 1.9 Urinogenital System of Frog - Female

Two coiled oviducts are present lying on the two sides of the body cavity, each oviduct opens into the body cavity in front by an oviducal funnel. Towards the lower end, the oviducts are dilated to form the ***ovisacs***. Ovisacs store the eggs temporarily. Ova or eggs are sent out through the cloaca.

Fat bodies are finger-like structure attached to the outer ends of the kidneys, in male and female frogs. They store the reserve food.

Factfile :

★ The study of frog is called **BATRECOLOGY**

POINTS TO REMEMBER

1. Frog is a vertebrate animal adapted for an amphibious life.
2. Body is divisible into the head and trunk.
3. Two pairs of limbs are present.
4. Sexual dimorphism is seen.
5. The digestive system consists of a alimentary canal - mouth, pharynx, oesophagus, stomach and intestine are seen communicates to the exterior by the cloacal aperture.
6. Cutaneous respiration, Buccal respiration and Pulmonary respiration take place in a frog .
7. Three chambered heart with blood vessels enables function of the circulatory system.
8. Brain of frog consists of olfactory lobes, cerebrum, optic lobes, cerebellum and medulla oblongata.
9. Spinal cord extends from medulla oblongata.
10. The male reproductive system consists of a pair of testes, seminiferous tubules, vasa deferentia and the cloaca.
11. The female reproductive system consists of a pair of ovaries, oviducts and ovisacs which open to the cloaca.

Activity :

1. Observe the dissections of frog in the computer and draw diagrams of the same. Get familiarised with the different parts.
2. Observe the external features of a frog in your Biology lab.

SELF EVALUATION

I. Choose and write the correct answers :

1. Which of the following is not a part of the digestive system?
   a. Pharynx b. Oesophagus
   c. Sinus venosus d. Intestine
2. The percentage of Oxygen intake during pulmonary respiration in a frog is around
   a. 5% b. 25% c. 65% d. 85%
3. The posterior, thick-walled chamber of a frog's heart is the
   a. Auricle b. Ventricle
   c. Conus arteriosus d. Sinus venosus
4. Olfactory lobes, cerebral lobes and diencephalon are parts of the
   a. forebrain b. mid-brain
   c. hind brain d. spinal cord
5. Internal cavity called ventricle is not present in
   a. olfactory lobes b. cerebral lobes
   c. cerebellum d. medulla oblongata

II. Fill in the blanks with suitable terms :

6. The circular patches of skin found behind the eyes in a frog are called _____
7. In a frog, the common opening for discharging the undigested food, urine and reproductive products is called _____
8. The skin of frog contains glands called _____ that secrete mucous and keep the skin surface always moist.
9. The Truncus arteriosus arises from the _____
10. The brain of frog is covered by membranes called _____
11. In the brain of frog, the roof of the diencephalon is called _____
12. Taste buds are not very well developed in a _____
13. The seminiferous tubules join to form _____ which open into the ureters.

III. Answer the following questions in one or two sentences.

14. How are the fore limbs and hind limbs useful to the frog ?

15. What are vocal sacs ?
16. What is cutaneous respiration ?
17. What are the parts of the hind brain in frog ?
18. What are ovisacs ? Where are they found ? Mention its function.

IV. Write short answers for each of the following questions in 100 words. Draw diagrams wherever necessary.

19. The head of a frog.
20. Sexual dimorphism in frog.
21. Pulmonary respiration in frog.
22. Male urinogenital system of frog.
23. Draw the vertical section of the eye of frog.
24. Draw the dorsal and ventral views of the brain of frog.

V. Write detailed answers for each of the following questions in 200 words. Draw diagrams wherever necessary.

25. Digestive system of frog.
26. Sense organs of frog.
27. Brain of frog.
28. Circulatory system of frog.

UNIT 2

HUMAN PHYSIOLOGY

Physiology is the branch of biology that deals with the ***vital functions*** of a body. It is a fascinating branch of science which unfolds the most intricate and marvellous designing of the complex systems of the animal body.

It reveals the functions of the various systems formed by different parts and organs of the human body. The basic physiological functions include provision of oxygen and nutrients, breaking of food substances to simpler forms, transport of hormones by blood to target organs, reproduction and the higher intellectual function such as memory and learning. The functions mentioned above are studied under the following units such as digestive system, respiratory system, circulatory system and Endocrine system.

2.1 Digestive System

Introduction : Food contains a variety of nutrient molecules needed for building up of new body tissues, repairing damaged tissues and sustaining needed chemical reactions. Food must be broken down to be used as a source of energy. The process of converting the complex food into simple chemical substances that can be absorbed and assimilated by the body is called ***digestion*****.** The medical speciality that deals with the structure, function, diagnosis and treatment of diseases of the stomach and intestine is called ***gasteroenterology***.

The digestive system is composed of two groups of organs. (1) The gastrointestinal tract and the (2) accessory digestive organs. Digestion is brought about in a step by step manner with the help of enzymes which are also called as ***biocatalysts***.

The gastrointestinal tract (alimentary canal) is a long muscular tube, about 8 meters in length. It commences from the mouth and ends in the anus. The mouth, buccal cavity, pharynx, oesophagus, stomach, small

intestine, large intestine, rectum and anus are all parts of the alimentary canal.

Factfile :

★ For the first time the term physiology was introduced by **Jean Fernel** in 1542

The Mouth

The mouth is guarded by lips. Inside the mouth lie the teeth, the tongue and the buccal cavity. The teeth are borne in sockets in the upper and the lower jaws. The teeth break and grind the food and masticate it into pieces.

The teeth in man are produced twice in his life span so termed ***diphyodont*.** First the milk teeth that come up between the sixth and the eleventh month are temporary, the second, the permanent teeth come up replacing the milk teeth from the sixth year and it is completed by the thirteenth year. The teeth are embedded in sockets so termed as the ***thecodont***. There are four kinds of teeth the Incisors, the Canines or the tearing teeth, the Premolars and Molars.

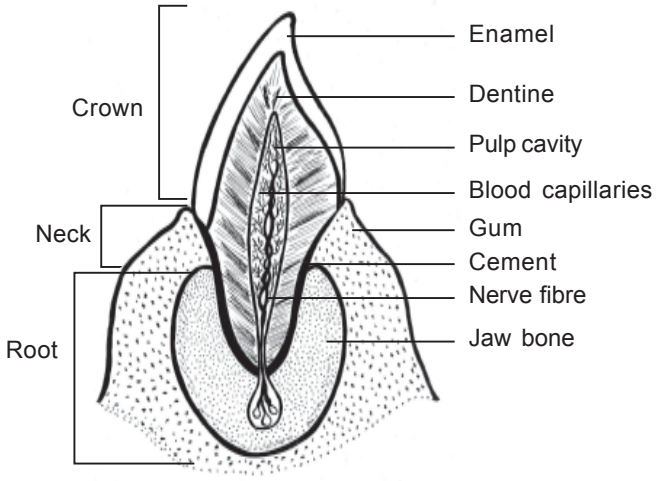


Fig 2.1 - Structure of a tooth

In an adult there will be 32 teeth sixteen in each jaw. The arrangement of the teeth or dentition is expressed in a dental formula

I 2/2 ; C 1/1 ; P 2/2 ; M 3/3

Structure of the tooth

A tooth is formed of a substance called dentine which is harder than bone. It has three parts. The upper part-the Crown, the middle neck and lower portion the root. The tooth is fixed in the socket by means of the cement which is in the region of the neck and the root. The Crown is covered with a very shining and strong substance called the enamel. This ***enamel*** is the hardest substance in the body and it is made of calcium phosphate and calcium carbonate. Inside the tooth is the pulp cavity which contains blood capillaries and lymph vessels and nerves.

The tongue is muscular and it lies attached to the floor of the buccal cavity. It rotates the food well in the mouth and mixes it with the saliva. There are three pairs of salivary glands, the ***parotid*** in the cheek, the ***sub lingual*** beneath the tongue, the ***sub maxillary*** below the angles of the jaw. The saliva secreted by the glands help the food to form into a ball termed bolus. From the buccal cavity food is swallowed as bolus in to the oesophagus. When the food is swallowed, the epiglottis at the pharynx closes the opening of the winid pipe or trachea.

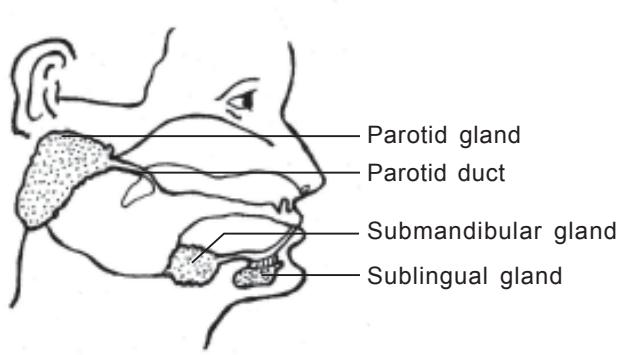


Fig 2.2 - Position of salivary glands

The food , in the form of bolus, glides down the oesophagus. The inside of the oesophagus is lined with mucous. The oesophagus contracts and expands alternately and the bolus is pushed down the oesophagus by the alternate contraction and expansion of the muscles of the oesophagus. This type of movement is termed as ***peristaltic movement.***

The oesophagus brings the food as bolus down to the stomach. The stomach is a **"J"** – shaped muscular sac. The oesophagus opens into the

stomach at its cardiac end. It is guarded by sphincter muscles which act as a valve. Similarly the stomach opens into the small intestine at the Pylorus, and this pyloric end of the stomach is also guarded by the ***sphincter muscles***.

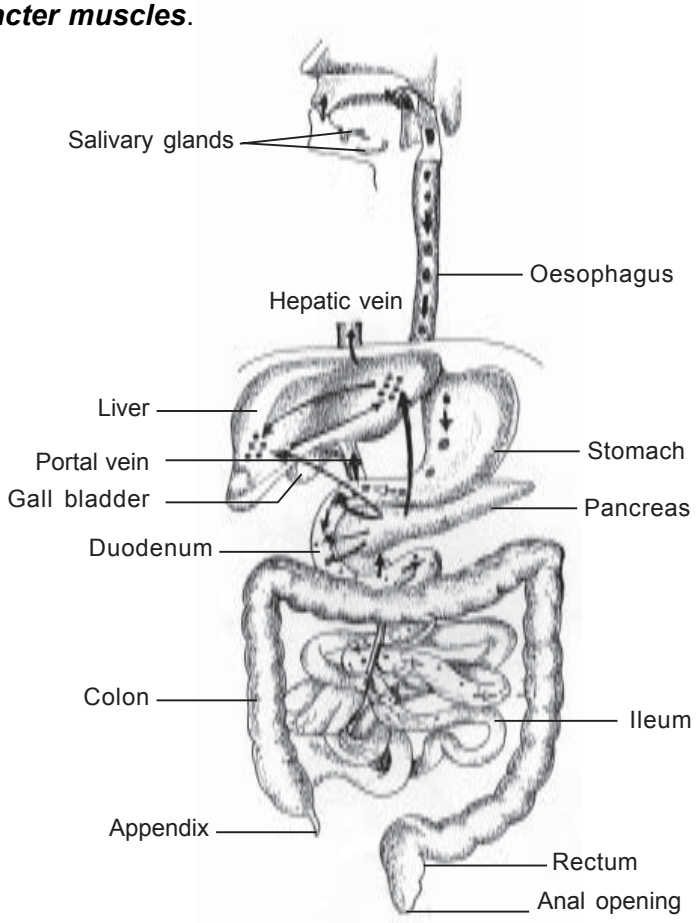


Fig 2.3 - Digestive system of man

The stomach opens into the small intestine which is divisible into a 'u' shaped ***duodenum***, a longer ***jejunum*** and ***ileum***. A common duct carrying the digestive fluids from the liver and the pancreas opens into the duodenum. The small intestine is about 7 metres long.

The inner wall of the small intestine has numerous finger like projections called ***villi*** (Singular-villus), which are the organs that absorbs the digested food passing through the small intestine.

The small intestine joins the large intestine at a dilated pouch called caecum. Here there is a slender, blind tube called the ***vermiform appendix***. This is a vestigial organ. But when this appendix becomes inflammed, it causes acute pain in the abdomen and this condition is known as ***appendicitis***. Then the appendix has to be removed by surgical operation.

The large intestine is about 1.5 metres long. It consists of colon, rectum and anus. The colon occurs as the ascending colon, the transverse colon and the descending colon. The rectum opens out through the anus.

MAGIC MOVEMENTS

Movement of bolus from buccal cavity to the stomach through the oesophagus by a progressive wave of muscle contractions called peristaltic waves. In the oesophagus one peristaltic wave takes about 9 seconds to reach the stomach. Due to this magic waves, swallowing can occur even while a person is upside down.

PROCESS OF DIGESTION

The term nutrition includes the processes of (a) Ingestion (b) Digestion (c) Absorption (d) Assimilation and (e) Egestion

(I) Ingestion – The process of intake of food is known as ingestion.

(II) Digestion – Carbohydrates, fats and proteins are the major constituents of our food. These are complex insoluble molecules. These are broken down into simpler molecules by enzymes. These enzymes are present in the digestive juices. Eventually carbohydrates are broken down by enzymes into glucose molecules, fat is broken down into fatly acids and glycerol and proteins are broken into amino acids.

Digestion in the Buccal Cavity : Saliva is secreted into the buccal cavity. Saliva mixes with the food in the mouth and it contains the enzyme Ptyalin or salivary amylase. Ptyalin acts on starch and breaks it into maltose.

Digestion in the stomach : Food from the oesophagus enters the stomach through its cardiac end by opening the sphincter muscles there. Stomach is an elastic muscular bag, and it can keep the food for some

time. During this period food is acted upon by the gastric juice and hydrochloric acid. Hydrochloric acid is secreted by the ***oxyntic cells*** in the inner walls of the stomach. This ***Hcl*** in the stomach provides an acidic medium and kills the harmful bacteria in the food. The gastric juice contains the enzymes (a) ***Pepsin*** (b) ***Renin*** (c) ***Gastric lipase***. Pepsin acts on proteins and breaks them into peptones. Renin converts milk proteins into caesin. Gastric lipase acts on fats. The food stays in the stomach for about 3 to 4 hours and gets well churned into a milky liquid called the ***chyme.*** From the stomach, chyme is pushed into the duodenum through the pylorus as and when the pyloric sphincter muscle relax and open periodically.

Digestion in the Duodenum

The duodenum is the **'U'** shaped first portion of the small intestine. Here the common duct from the gall bladder in the liver and the pancreas open and pour their contents. Besides these, the intestinal juice is also secreted by the small intestine.

Activity :

a. Clean your mouth thoroughly with water. Put a small marble in your mouth. Saliva will start secreting in your mouth. Collect some saliva in a clean test tube.

b. Take 5ml of soluble starch solution in a clean test tube. Add some saliva to this starch solution. Mix the contents and keep it at normal room temperature.

c. Pour a portion of the mixture in a clean test tube and add iodine solution to this. Note your observations.

d. To the remaining portion of the mixture, add 2 to 3ml of **Benedict's solution** and warm it in a hot water bath.

e. Note your observations

   1. Benedicts solution turns sugar solution into green, brown or red colour.
   2. **Iodine solution** turns starch to blue black colour.
   3. Have a class discussion based on your observations.

Bile : It is yellowish green fluid. It is secreted by the liver and stored in the gall bladder. Bile neutralises the acidity in the food. Bile has no enzyme

as such but it breaks the fat globules and ***emulsifies*** them. The emulsified fat are then easily acted upon by the enzyme lipase in the pancreatic and intestinal juices.

Pancreas

Pancreas is a long, narrow leaf like digestive gland. It is both exocrine and endocrine (Islets of Langerhans is seen as patches on the pancreas which is endocrine in function)

Pancreatic juice contains sodium bi-carbonate which neutralizes Hcl and the enzymes ***Trypsin, Chymotrypsinogen, Carboxypeptidase, Pancreatic Amylase and Pancreatic Lipase.***

a. Trypsin – reduces proteins and peptones to polypeptides.

b. Chymotrypsinogen – It is activated by trypsin to form active enzyme. It digests milk protein.

c. Carboxypeptidase – It acts on polypeptides and converts into amino acids.

d. Pancreatic amylase – It hydrolyses starch into maltose and glucose.

e. Pancreatic lipase – It breaks down fats into fatty acids and glycerol.

Factfile :

★ In humans, daily secretion of saliva is more than one litre.

★ Each day, the stomach wall secretes about 3 litres of gastric juice.

★ About every 20 seconds, the stomach contents are mixed by the charming action of smooth muscles. When an empty stomach churns, **hunger pangs** are left

Intestinal Juice

The intestinal juice contains the enzymes

a) Enterokinase b) Erypsin c) Maltase d) Sucrase e) lactase f) intestinal lipase.

a) Enterokinase - acts on peptones and breaks them into polypeptides.

b) Erypsin - acts on proteins and breaks them into amino acids.

c) Maltase - converts maltose into glucose

d) Sucrase - converts sucrose into glucose and fructose

e) Lactase - breaks lactose into glucose and galactose

f) Intestinal lipase - completes the digestion of fats breaking them into fattyacids and glycerol.

III Absorption – As the digested food passes through the small intestine the end products of digestion are taken up into the blood and the lymph and this process is termed absorption.

The ileum part of the small intestine is long and it has on its inner wall thousands of finger-like processes called villi.

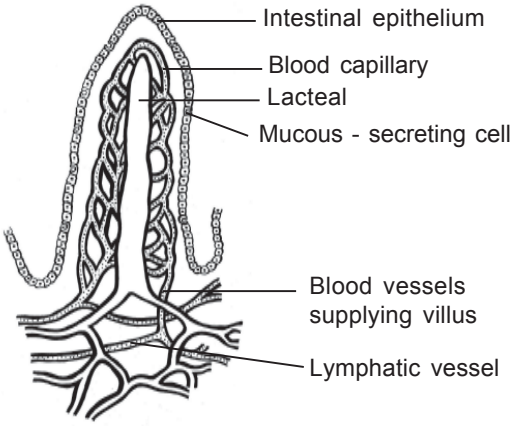


Fig 2.4 - Vertical section through a villus

Each villus has a thin single layered wall. It has a network of capillaries in the center that surround a central lymph vessel called the ***lacteal***. Glucose and amino acids are absorbed into the blood in the capillaries while fatty acids and glycerol are absorbed by the lymph in the lacteal. Water and mineral salts are absorbed in the large intestine.

IV Assimilation – The process by which the absorbed food are taken to various parts of the body where they are resynthesised to form Proteins, Carbohydrates and fats. This results in the replacement of the protoplasm. This process is termed ***assimilation***. This results in the building of body tissues leading to growth.

V Egestion – In the large intestine excess water is absorbed, while the undigested matter in the food is kept in the rectum. There are some beneficial bacteria in the rectum which act upon the undigested food while doing so they synthesise some vitamins and they are taken by the body. The remaining solid waste is sent out through the anus as faeces and this process is termed as ***egestion*** or ***defaecation***.

Table 2.1 : Action of digestive enzymes

Organ	Secretion	Enzyme	Substance acted upon	Products formed
Salivary gland	Saliva	Ptyalin or Salivary amylase	Starch	Maltose
Stomach	Gastric Juice	a) Pepsin b) Renin	Proteins Milk proteins	Peptones Caesin
Pancreas	Pancreatic Juice	a) Trypsin	Proteins and peptones	Polypeptides and dipeptides
		b) Chymotrypsin	Milk proteins	Large peptides
		c) Carboxypeptidase	Polypeptides	Aminoacids
		d) Pancreatic amylase	Starch	Maltose and Glucose
		e) Pancreatic lipase	Fat	Fatty acids and glycerols

Small intestine	Intestinal Juice	a) Enterokinase	Trypsinogen	Trypsin
		b) Maltase	Maltose	Glucose
		c) Sucrase	Sucrose	Glucose and fructose
		d) Lactase	Lactose	Glucose and galactose
		e) Intestinal lipase	Fat	Fatty acids and glycerols

2.2 RESPIRATORY SYSTEM

Living organisms are sustained with the continuous supply of oxygen during the basic metabolic process of respiration. The supplied oxygen oxidises food substances to release energy. This energy is utilized for various activities such as movement, working of the muscles, conduction of impulses etc.

Respiration is a term used for the process of gaseous exchange where oxygen is taken in from the surrounding medium and carbon – dioxide is removed as a product of oxidation. Gaseous exchange occurs at the level of the lungs and at cellular level. The organs that are involved in gaseous exchange are called respiratory organs.

Respiratory organs in man

The respiratory system consists of the nose, pharynx, larynx ***(voice box)***, trachea ***(windpipe)***, bronchi and bronchioles within the lungs. The bronchioles open into the airsacs or alveoli.

Nose : The nose can be divided into external and internal portions. The external nostrils or nares leads into the nasal cavity. This cavity open into the pharynx through openings called internal nares or nostrils. The nasal cavity is lined with fine hairs which helps to remove dust and impurities.

Pharynx : The pharynx is a funnel shaped tube about 13 cm long that starts at the internal nares. The pharynx functions as a passage for air and provides a resonating chamber for speech sounds.

Larynx : The larynx or voice box is a short passage that connects pharynx with the trachea. It contains vocal cords which produce the different kinds of sounds. The opening into the trachea (wind pipe) is a narrow slit, the ***glottis*** through which the air pases into the trachea. A cartilage flap called the ***epiglottis*** covers the glottis which prevents entry of food particles into the respiratory system.

Activity 1 : 1) What peculiar noises people often make?

2) Explain Cough and Hiccupping as reflex actions. What is the difference between these two actions.

Trachea : The trachea or windpipe is a tubular passage way for air that is about 12cm long. It is located anterior to the oesophagus. The trachea is supported by C-shaped cartilage rings without it the tube would collapse.

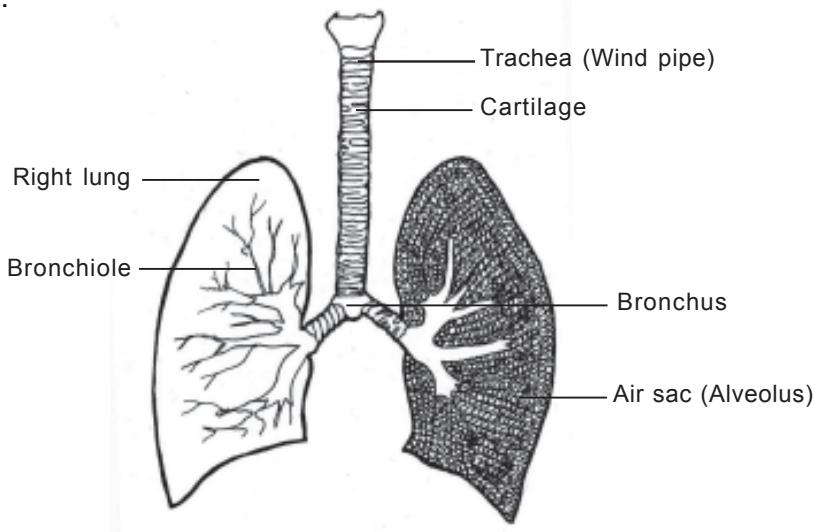


Fig 2.5 - Structure of human lungs

Bronchi and Bronchioles : The trachea divides about the level of fifth thoracic vertebrae into two, the right and left bronchi. Each bronchus enters the lung and divides further into bronchioles.

The bronchioles branch into many short tubes called alveolar ducts which end in tiny hollow bags called air sacs or alveoli. There are about ***300 million alveoli*** in the human lung.

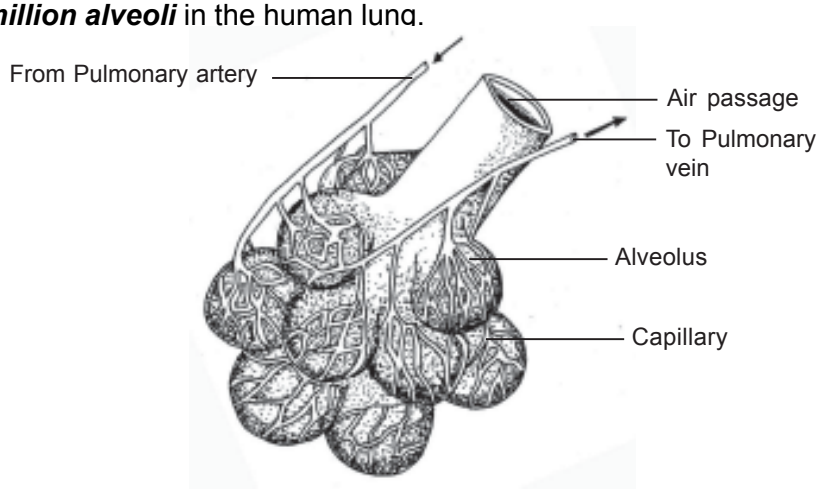


Fig 2.6 - Structure of alveoli

Lungs : A pair of cone-shaped organs lying in the thoracic cavity are the lungs. The right lung is larger than the left lung. The right lung has three lobes while the left has only two.

The lower surfaces of the lungs are concave to accommodate the diaphragm. The lungs are protected by a double layered membrane called the ***pleura***. The pleural fluid fills the space within the membranes and it helps in lubrication. The space between the two lungs is called ***mediastinum*** where the heart is situated.

Activity 2 : 1) What is Cardiac notch?

2) Make a model of the bronchial tree in man.

3) Breathing through mouth is not advisable why?

Factfile :

★ We take 600 million breathe during our life time.

★ Opened out and laid flat, the lungs would cover an area of the size of a tennis court.

★ On an average, we breathe roughly a litre of air every ten seconds.

MECHANISM OF RESPIRATION

The lungs are enclosed within the pleural cavities in the thoracic region. The rib cage protecting the lungs has the sternum in front, the vertebral column at the back and the ribs on the sides. In between successive ribs, two sets of intercostal muscles – the external and internal intercostal muscles are present. The floor of thoracic cavity is covered by the diaphragm. Breathing is brought about by the alternate expansion and contraction of the thoracic cavity where the lungs are present.

The process of respiration occurs in two stages, inspiration and expiration referred as respiratory movements.

Inspiration : Inspiration or inhalation is an active process when fresh air is drawn into the lungs. It is brought by the diaphragm and the external intercostal muscles present between the ribs. During this process, the external intercostal muscles contract and pull the ribs upwards and outwards. The diaphragm becomes flattened due to contraction and pulls the lungs downward, thus increasing the volume of the thoracic cavity and decreasing the pressure. When the air pressure in the lungs fall, atmospheric air from the outside enters the respiratory system into the lungs causing inspiration.

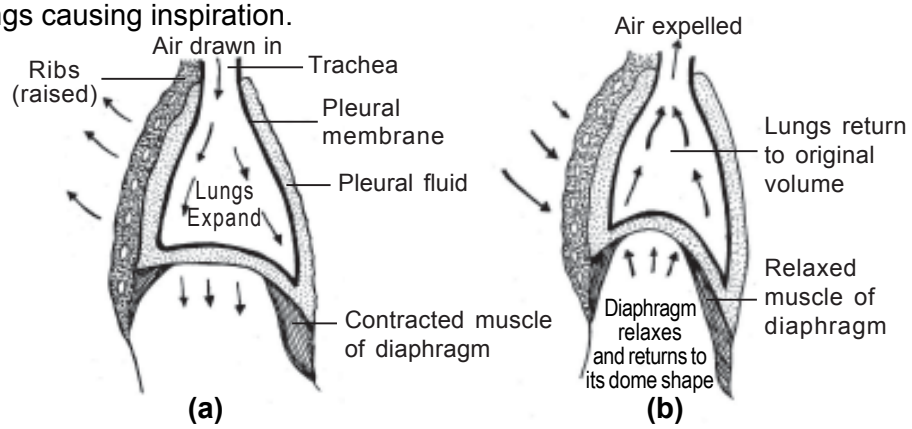


Fig 2.7 - Mechanism of respiration
a. Inspiration, b. Expiration

Expiration : Expiration as exhalation is a passive process which follows inspiration. The expulsion of air from the lungs is called expiration. This process involves the contraction of the internal intercostal muscles

which bring the ribs into their original position. The diaphragm relaxes and becomes dome shaped. When these movements occur, the volume of thoracic cavity reduced and the pressure in the lungs increased, causing the expulsion of air to the outside. A person breathes about 12 to 14 times per minute at rest.

Exchange of gases in the lungs – There are thousands of air sacs, alveoli in the lungs. These have thin and moist walls on which is present an extensive network of blood capillaries. These bring in deoxygenated blood through the pulmonary arteries from the heart. In the air sacs, gaseous exchange takes place. Oxygen from the air sac enters into blood in the capillaries while Carbon dioxide from the blood enters into the air sac by a process of simple diffusion.

The capillaries now with the oxygenated blood in them form the pulmonary vein which carry it to the heart for circulation to all the parts of the body.

Oxygen combines with the haemoglobin in the blood forming the unstable oxyhaemoglobin. In the tissues the concentration of oxygen is low and the unstable oxyhaemoglobin releases the oxygen there and becomes haemoglobin again.

$$\text{Haemoglobin} + \text{Oxygen} \rightleftharpoons \text{Oxyhaemoglobin}$$

Thus oxygen from the lungs is transported to the tissues by the blood.

Exchange and transport of Co_2 in Tissues

In the tissues Co_2 concentration is higher and hence it enters the blood and is carried to the lungs.

Besides this process of diffusion, Co_2 is also transported by other methods.

a) Co_2 is released in the cells during various metabolic activities. Co_2 dissolves in water and forms an unstable Carbonic acid.

$$Co_2 + H_2O \rightleftharpoons H_2CO_3 \text{ (Carbonic acid)}$$

This carbonic acid enters the plasma of the blood and is transported. However, it is only a negligible amount of Co_2 that is transported as carbonic acid. An enzyme called carbonic anhydrase plays an important role in this. Again this same enzyme converts the carbonic acid back into water and Co_2 which diffuses out in the lungs.

b) There is also another method by which about 20% of Co_2 is transported. Here Co_2 combines with the globin (protein) part of the haemoglobin to form an unstable compound Carbamino haemoglobin which releases Co_2 later.

Co_2 + Globin part of Haemoglobin $\rightleftharpoons$ Carbamino haemoglobin

The Important role played by Haemoglobin are

a) Haemoglobin transports oxygen.

b) It transports Co_2 and

c) It acts so effectively that the acid / alkaline nature (pH) of the blood is maintained almost constant throughout the process of transportation of respiratory gases.

Activity 3 :

1. Demonstrate that the air you breathe out contains a large amount of water vapour.
2. Polish a piece of glass so that it is really clear and then breathe on it several times. Notice that is becomes misty, showing that tiny droplets of water in your breathe have settled on it. You can actually see these droplets on a very cold morning because the water vapour in your breath turns into drops of water as soon as it meets the cold air.

2.3. CIRCULATORY SYSTEM

The system of transport in the Human body which meets every requirements is called the circulatory system. Different materials such as the nutrients, respiratory gases and metabolic wastes are transported from one part of the body to another.

This system concerned with carrying substances to and from the different parts of the body was first discovered by ***William Harvey*** in the year **1628**.

The circulatory system consists of

1. The blood and the lymph
2. The network of vessels, or branching tubes called the blood vessels (arteries, veins, capillaries) and the lymph vessels. They are found everywhere in the body and contain the blood and lymph.
3. Lymph glands - These are arranged in groups at various parts of the body.
4. The heart – It pumps blood into the blood vessels.
5. The spleen – This lies high up in the left side of the abdominal cavity.

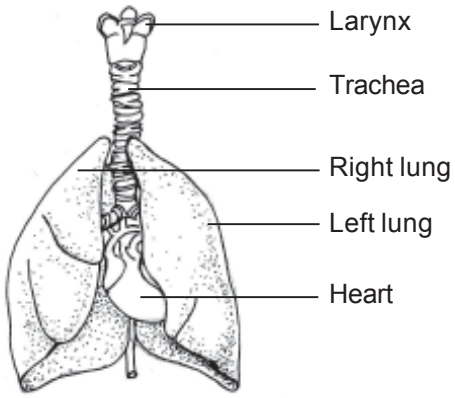


Fig. 2.8 Position of human heart

Structure of the Heart

The human heart is a conical muscular organ situated in the middle mediastinum in between the two lungs. The base of the heart lies upwards while the apex lies downwards and tilted towards the left. The heart is covered by a double walled membranous sac known as the ***pericardium.*** Pericardial fluid, present inside the membrane, protects the heart from shock and lubricates its movements.

Internally the heart is divided into 4 chambers namely two auricles or atria and two ventricles. The auricles are separated by an inter auricular septum and the ventricles by an inter ventricular septum. The right auricle and right ventricle are separated by an aperture guarded by a valve with 3 flaps called ***Tricuspid valve***. The free ends of these flaps are connected to the ***Papillary muscles*** on the inner wall of the ventricle by ***Chordae tendinae***. The left auricle and the left ventricle are guarded by a valve called ***Bicuspid*** or ***'Mitral valve'*** which has two flaps.

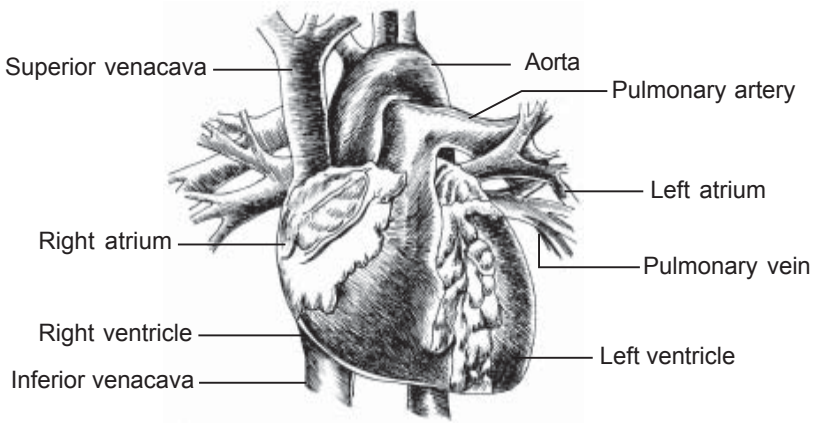


Fig 2.9 Heart of man - External structure

Blood vessels connected with the heart

Superior venacava : It brings deoxygenated blood from the anterior parts of the body and opens into the right auricle at the anterior end.

Inferior venacava : It brings deoxygenated blood from posterior parts of the body and opens into the right auricle.

Pulmonary veins : They bring oxygenated blood from lungs and open into the left auricle.

Pulmonary artery : It arises from the right ventricle. It takes deoxygenated blood to the lungs for purification.

THE LIVING PUMP

The total amount of blood pumped by the human heart each day is about 8000 litres. Since the entire blood volume of an average sized man is only 5 litres, the blood must be recirculated 1600 times a day.

Aorta : It is the largest blood vessel and arises from the left ventricle. It takes oxygenated blood from the heart to all the parts of the body.

The openings of pulmonary artery and the aorta are guarded by semilunar valves.

Coronary artery and coronary sinus : The coronary artery supplies oxygenated blood to the wall of the heart and the coronary sinus or coronary vein receives the blood from the wall of the heart.

Working of the Heart

When the auricles or atria are relaxed (Diastole) the right auricle receives deoxygenated blood from the superior and inferior vena cava. At the same time the left atrium is filled with oxygenated blood brought from the lungs through four pulmonary veins. When the atrium is filled with blood they are in a relaxed condition. This relaxtion phase is called ***diastole***.

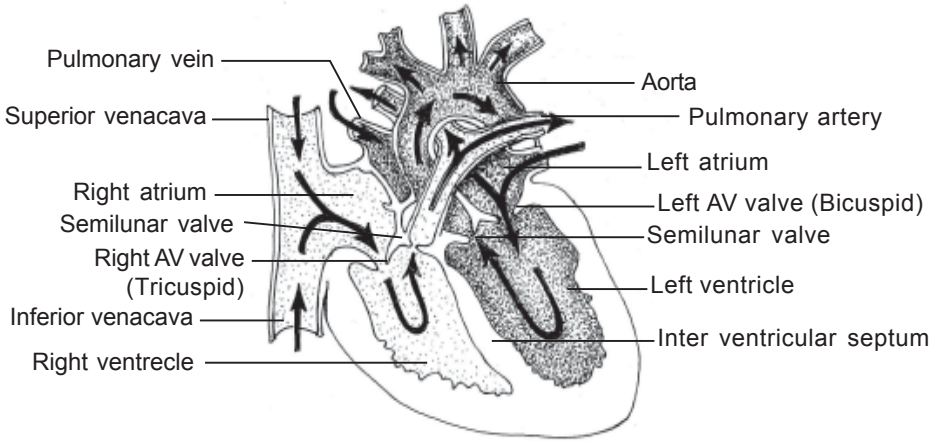


Fig 2.10 - Diagrammatic section of the human heart
(The arrows indicate the direction of blood flow)

The atrium contract from the top and this contraction is termed as ***systole***. Now the blood in both atrium is pushed through the Tricuspid and Bicuspid valves into their ventricles. The right ventricle receives deoxygenated blood and the left ventricle receives oxygenated blood. Then there is ventricular systole. During this systole the right ventricle pushes impure blood into the pulmonary artery the opening is guarded by semilunar

valves. The left ventricle pumps the oxygenated blood into the thick aorta. The opening is guarded by ***aortic valves (semilunar valves)***. The rhythmicity of heart is due to the inherent power of muscles. This is termed as a ***Myogenic heart.*** The human heart is a myogenic heart.

Origin and conduction of Heart beat

A heart beat comprises of one atrial systole and a ventricular systole and a short pause. When one listens with a ***Stethoscope*** to the beating of the heart he normally hears two sounds. The first sound ***'lub'*** a long and dull sound is caused by the closure of tricuspid and bicuspid valves. When the ventricles contract the second sound ***'dub'*** a short and sharp sound is caused by the closure of semilunar valves during the ventricular diastole.

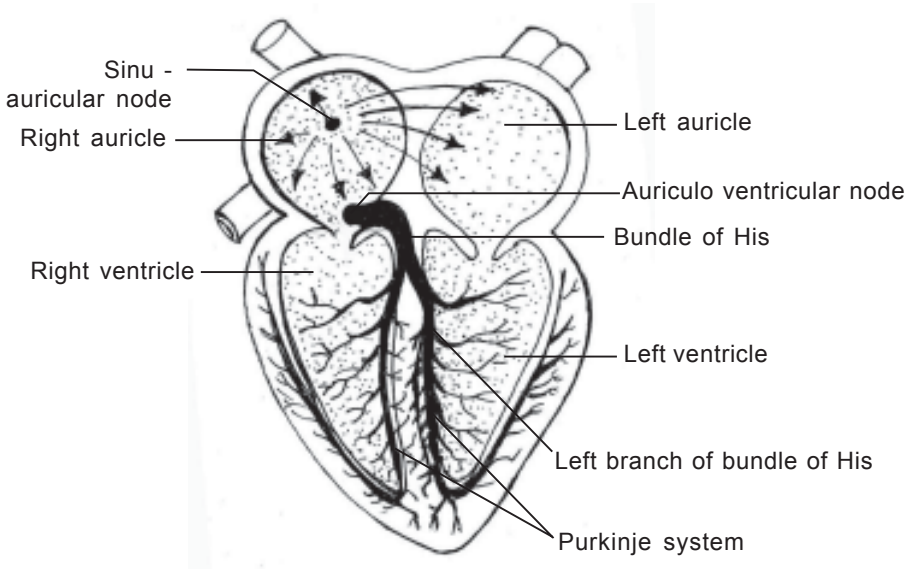


Fig 2.11 - Origin and conduction of heart beat

Heart beat in man starts in a tiny island of tissue present in the upper region of the right auricle called ***"Sinu Auricular Node" (S.A. Node).*** This node initiates the heart beat. So it is described as the 'Heart of Hearts'. This Sinu auricular node acts as a ***'Pace maker'*** of the heart. The heart beat originates here. The impulses sent out by the sinu auricular node are picked up by the second node of tissue called the ***"auriculo ventricular***

node" (A.V. Node) located at the posterior right border of the inter-auricular septum. From this node a bundle of tissue known as ***"Bundle of His"*** takes its origin. It divides into two branches – one to each ventricle. These branches divide again and again to form a net work of filaments called the ***"Purkinje system".*** Through this Purkinje system the wave of excitation is transmitted to the ventricles which contract simultaneously.

Factfile :

- ★ The heart beats rhythemically 72 times per minute in adult man at rest and a single heart beat lasts for 0.8 of a second.
- ★ Average heart beat rate in new born is about 130 times per minutes.
- ★ In an average life time of 70 years, the human heart beats about 2.5 billion times, pumping about 180 million litres of blood.

Activity 4 :

Get a sheep's heart from the butcher, asking him to leave part of the arteries and veins attached to the heart.

Identify the parts

1. The fat protecting the outside of the heart.
2. The skin covering the heart (Pericardium)
3. The blood vessels which spread out over the surface of the heart and supply it with blood.
4. The auricles and ventricles (chambers of the heart)
5. The vessels entering and leaving the heart. Here you will find that our diagrams were a little more simple than the real heart. There are, in fact four pulmonary veins and not two. The aorta and pulmonary artery cross over as they leave the ventricles.

Blood Pressure

Systolic blood pressure

This is the maximum pressure extended in the arteries during the systole of heart. The normal systolic blood pressure is 120 mm Hg. It ranges between 110 and 140 mm Hg.

Diastolic blood pressure

This is the minimum pressure in the arteries during the diastole of the heart. The normal diastolic blood pressure is 80mm Hg. It varies between 60 and 80mm Hg.

Pulse pressure

This is the difference between the systolic pressure and diastolic pressure. Normally it is 40mm Hg.

Blood pressure is measured by an instrument called ***Sphygmomanometer***.

Blood vessels

The blood is distributed round the body in vessels, most of them are tubular, and varying in size from about 1cm to 0.001mm in diameter. They form a continuous system communicating with every living part of the body. There are three types of blood vessels, arteries, veins and capillaries connected to form a continuous system.

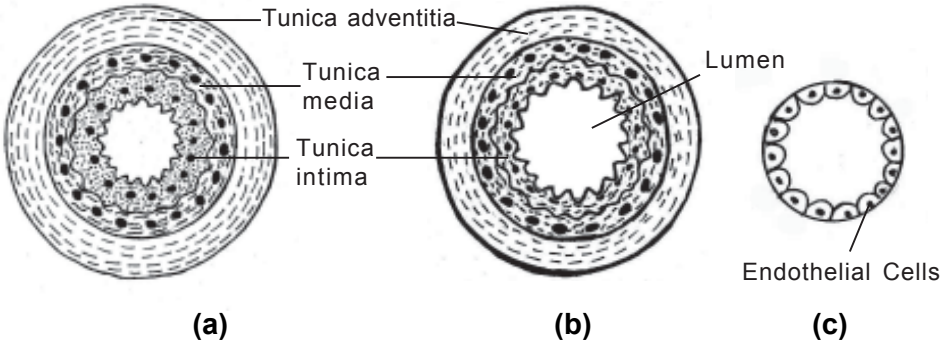


Fig 2.12 Blood vessels a) artery, b) vein, c) capillary

Arteries

They are thick – walled, muscular and elastic and they carry the pure blood from the heart. There is an exception to this generalisation namely the pulmonary artery carries impure blood. They are covered by three coats namely ***Tunica adventitia, Tunica media*** *and* ***Tunica intima***. The arteries divide into thinner arterioles which branch into extremely thin and small

meta – arterioles which themselves divided repeatedly until they form a dense network of microscopic vessels penetrating between the cells of every living tissue. These final branches are called capillaries.

Veins

These are thin walled muscular less elastic vessels, that collect the blood from the tissues and empty into the heart. There is an exception to this, namely the ***pulmonary vein*** which carry pure blood from the lungs to the heart.

Factfile :

Blood raises through the arteries upto 1 metre (3 feet) per second. There are over 60,000 Kilometres 37,000 miles of capillaries in the human body.

Capillaries are tiny vessels with walls often only one cell thick. The capillary walls are extremely permeable so that water and dissolved substances diffuse freely in and out. Through these thin walls, oxygen, Co_2, dissolved food and excretory products are exchanged with the tissues round the capillary. Finally the capillaries unite into large vessels which join to form veins and return blood to the heart.

COMPOSITION OF BLOOD

Blood is the chief circulating medium. It consists of corpuscles floating in the complete fluid called plasma.

Plasma : It forms **55% of the total volume of blood.** It contains proteins as well as organic and inorganic substances in solution. Besides it also contains nutritive and waste materials, antibodies, enzymes and hormones.

Plasma contains 91.5% water and 8.5% solutes. The solutes include plasma proteins namely,

1. Serum albumin, 2. Serum globulin, 3. Fibrinogen

Serum albumin – smallest and most numerous plasma proteins; produced by liver, controls osmotic pressure.

Serum globulins – Protein group to which antibodies belong. Produced by plasma cells. Alpha and beta globulins transport iron, lipids and fat – soluble vitamins.

Fibrinogen – Produced by liver, plays essential role in blood clotting.

Blood Corpuscles : There are three types. They are R.B.C., W.B.C. and platelets.

Red blood corpuscles or Erythrocytes

They are circular, biconcave cells without nucleus in man. They are arranged like a pile of coins such arrangement of RBC is called ***'Rouleaux'***. RBC contain a spongy elastic substance called 'Stroma' inside the meshes of stroma is present the iron pigment called Haemoglobin which gives red colour to the blood. Hb consists of a protein part called 'Globin' and a non-protein pigment called ***Haem***. Haemoglobin has the property of combining with oxygen to form Oxyhaemoglobin. The RBC's are produced in the bone marrow and are released into the blood stream. After the life span of 90-120 days they are destroyed in the spleen and liver.

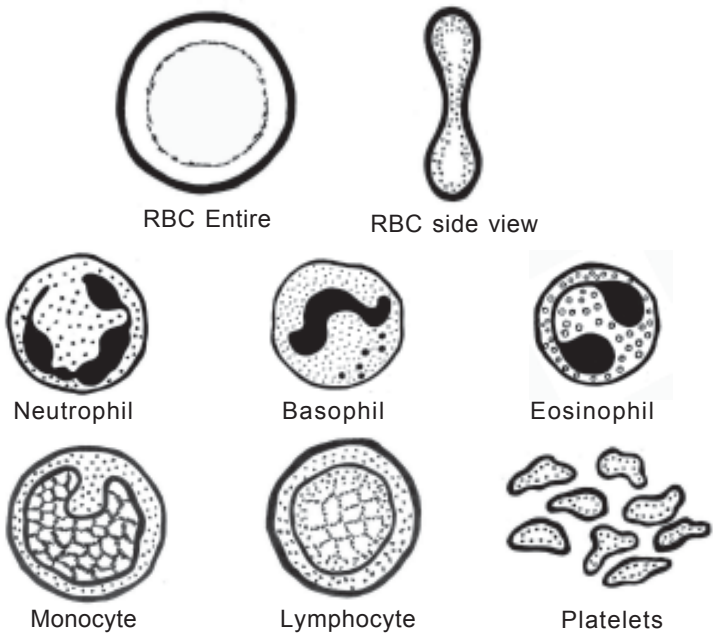


Fig 2.13 - Blood cells

White blood corpuscles or Leucocytes

The leucocytes are nucleated. They are capable of amoeboid movement and hence are referred as amoebocytes. They are also called

'Phagocytes' for they attack the invading micro-organisms and devour them. They are classified into Agranulocytes and Granulocytes.

Agranulocytes : These cells are with simple nucleus and the cytoplasm is without granules. Eg. Lymphocytes and Monocytes.

Granulocytes : In these cells, the nucleus is lobed and the cytoplasm is filled with granules.

Eg. Neutrophil, Eosinophil and Basophil. The leucocytes are produced in the lymph nodes, reticulo epithelial cells in the liver, spleen and in red bone marrow. They live for about 2-3 weeks.

Blood Platelets or Thrombocytes

These are small bodies either disc-shaped or irregular in form. They are without nucleus and cytoplasm is granular. They play a very important role in the coagulation of blood.

Blood Coagulation

The coagulation of blood is the property of plasma alone, the red and white blood cells do not take part in it. The blood cells become caught up in the meshes of the clot giving the characteristic appearance of the clot. Coagulation of blood helps to stop further haemorrhage. When the blood is shed the platelets disintegrate and liberate ***thromboplastin*****.** The thromboplastin is derived from damaged tissues disintegrating platelets and also plasma.

Thromboplastin converts prothrombin into thrombin with the help of ***calcium ions.*** Prothrombin is a plasma protein. ***Ionic calcium*** greatly helps in the formation of active thromboplastin. Prothrombin is a plasma protein and is manufactured in the liver. ***Vitamin K*** is required by the liver for normal formation of prothombin.

Thrombin is an active enzyme which converts soluble protein fibrinogen into insoluble fibrin. The fibrin forms fine threads that adhere to damaged surface of blood vessels and thereby prevent blood loss. The normal coagulation time is about ***5 to 8 minutes.***

$$\text{Prothrombin} + Ca^{++} \text{ Thromboplastin} \rightarrow \text{Thrombin (active enzyme)}$$

Thrombin	+	Fibrinogen (Soluble Protein)	➔	Fibrin (insoluble protein)

Thrombosis : Sometimes a clot is formed inside intact vessel. Such a clot is known as ***thrombosis***. If a part of thrombus circulates in the blood vessels, it is called an ***embolus***.

Functions of the blood

The blood plays a vital vole in the body and is often called the ***"river of life"*** Each one of its constituents is important. Plasma – The plasma serves the following functions.

1. **Transport of Food :** Food materials such as glucose, amino acids, fatty acids and triglycerides, vitamins and mineral salts are carried by plasma from the alimentary canal and liver to all the tissues of the body for growth, repair and energy.
2. **Transport of waste products :** Waste products as urea are being constantly produced by catabolism. Blood transports them from the place of their origin to the excretory organs.
3. **Gaseous transport :** Blood conveys oxygen from the lungs to the tissue for the oxidation of food and production of energy. The carbon – dioxide formed in the tissues as a result of this process is carried to the lungs, where it is exhaled.
4. **Transport of hormones :** The endocrine glands secrete their hormones directly into the blood, which carries them to their target organs.
5. **Regulation of body temperature :** Plasma carries heat from the heat – producing tissues (muscles, glands) to others where no or little heat is produced.
6. **Regulation of pH :** Plasma helps to regulate the pH of the body fluids. It contains buffer materials, such as proteins and salts, which can neutralize the acids and bases entering the blood.
7. **Immunity :** Antibodies present in the plasma promote immunity against certain diseases.
8. **The white blood cells :** The WBC cells acts as the soldiers to defend the body against the attack of microbes. Neutrophils and Monocytes also phagocytise the dead cells to clean the body.

Lymphatic System

Lymph is a colourless, mobile fluid, which is present inside a system of branching tubes called lymph vessels. The composition of lymph is similar to the blood plasma. The lymph contains lymphocytes and granulocytes. The lymph oozes out of the vessel and bathes the cell. The exchange of gases between the tissue and the blood takes place through the lymph.

The lymph glands such as Tonsils, Thymus and Spleen are responsible to destroy the invading microbes and foreign particles. These also make new white blood cells to replace those that get killed so that the number present in the blood always remains constant.

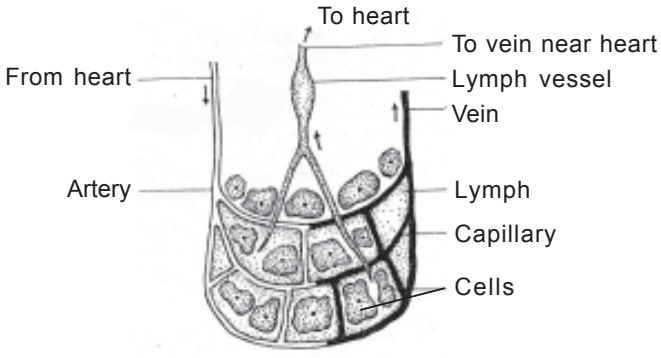


Fig 2.14 Lymph

Activity : 5

Find your pulse : Lay your hand flat on the desk. Palm upwards, place two fingers of the other hand on the pulse and then count how many times the artery pulses in one minute. Record your heart beat under normal conditions.

Normal pulse rate is _____ beats/minute. Then jump up and down several times on the same spot. Sit down and take your pulse rate as before. Record your result.

Pulse rate after exercise is _____ beats/minute. Compare the two results.

2.4 RELATED DISEASES

A physical or functional change from the normal state that causes discomfort or disability is called a disease. The term ***"disease"*** literally means ***"without ease"***. Diseases may be caused due to varying environmental factors, malnutrition, pollution of the environment and microbes that surround the body. Diseases are a result of improper functioning of certain organ or organ systems, while others are caused by Pathogens.

Diseases that are not caused by organisms are studied under three categories (i.e) Metabolic or functional, deficiency and hereditary diseases. In this chapter we shall learn about metabolic diseases related to digestive, circulatory and respiratory systems.

DISEASES RELATED TO DIGESTIVE SYSTEM

HERNIA

A Hernia is a weakness or split in the muscle wall of the abdomen which allows the abdominal contents (usually some part of the intestine) to bulge out. The bulge is particularly due to tension in the abdominal wall muscles that occurs when coughing, sneezing, straining or simply standing.

Types of Hernia

Umbilical hernia

These common hernias are often noted at birth as a protrusion at the belly button (the umbilicus). This is caused when an opening in the abdominal wall, does not close completely (which normally closes after birth) leading to hernia.

Incisional hernia

Abdominal surgery causes a flaw in the abdominal wall that must heal on its own. This flaw can create an area of weakness where a hernia may develop.

Obturator hernia

This extremely rare abdominal hernia happens mostly in women. This hernia protrudes from the pelvic cavity through an opening in your pelvic bone.

Symptoms

Any condition that increases the pressure of the abdominal cavity may contribute to the worsening of a hernia. Such as obesity, heavylifting, coughing, fluid in the abdominal cavity.

Treatment

For hernia often a simple surgery is done.

ULCER

Ulcers are non healing wounds develops on the skin and mucous membranes. It is marked by loss of integrity of the area and secondary infection of the site by bacteria, fungus or virus.

Types of Ulcer – Peptic ulcer and Gastric ulcer

Peptic ulcer : It is an erosion in the lining of the stomach or duodenum. The word peptic refers to pepsin, a stomach enzyme that breaks down proteins. If a peptic ulcer is located in the stomach it is called a ***gastic ulcer***.

Symptoms

Normally the lining of the stomach and small intestines have protein against the irritating acids produced in stomach. For various reasons there is breakdown of the lining. This results in inflammation or an ulcer. The most common cause of such damage is infection of the stomach with a bacterium called ***Helicobacter pylori.***

Other factors include using Aspirin, Ibuprofen, drinking alcohol excessively and smoking cigarettes.

Treatment

Treatment often involves a combination of medications to kill the ***Helicobacter pylori*** bacteria, reduce acid levels, and protect the gastro intestinal tract.

CIRRHOSIS OF LIVER

The inflammation and damage of parenchyma of liver is known as Cirrhosis of liver. This may result in degeneration of hepatic cells.

Causes

Infection, Retention of bile in liver due to obstruction of ducts of biliary system. Enlargement of liver, inflammation around liver these may lead to symptoms such as fever, nausea, vomitting, increased hear beat, muscular weakness and drowsiness.

Treatment

Diagnosis is made through blood sampling. The treatment depends on the degree of liver damage.

PILES (HAEMORRHOIDS)

Piles are small, blood filled swellings, caused by dilated veins of the rectum or anus, that cause anal bleeding, itching and discomfort. They may be located at the beginning of the anal canal (Internal piles) or at the anal opening (external piles) and may be present for years, but go undetected until bleeding occurs. Haemorrhoids are most common in adult men and women.

Causes

Constipation and straining during bowel movements may cause haemorrhoids by increasing the pressure in the anal or rectal veins. Other factors that may contribute to haemorrhoids include a low fibre diet. Prolonged sitting or standing, obesity, pregnancy and loss of muscle tone due to old age or rectal surgery.

Treatment

In many cases haemorrhoids can be controlled by simple measures.

Change of diet – Doctors may recommend a high fibre diet and more green vegetables, fruits, whole grain cereals, and to increase the amount of fluids you drink each day.

Creams are available and will relieve discomfort and itching and reduce swelling.

Laxative drugs may be prescribed to prevent constipation and soften the stools.

DISEASES OF THE CIRCULATORY SYSTEM

MYOCARDIAL INFARCTION (HEART ATTACK)

Myocardial Infarction (Heart attack) is a serious result of Coronary artery disease. Coronary artery disease occurs from atherosclerosis when arteries become narrow or hardened due to cholestol plague built-up. Further narrowing may occur from thrombus (blood clot) that form on the surfaces of plaques. It occurs when a coronary artery is so severely blocked that there is a significant reduction or break in the blood supply. Causing damage or death to a portion of the heart muscle. Depending on the extent of the heart muscle damage, the patient may experience significant disability.

Causes

The following risk factors have been associated with a higher incidence of myocardial infarction. Some of these factors are controllable (such as smoking) while others are uncontrollable such as age, genetics, family history.)

Treatment

Myocardial infarction include medications such as antiplatelets (aspirin) beta blockers, Calcium channel blockers. Coronary angioplasty and coronary artery bypass graft may be performed.

VALVE STENOSIS

Your heart is a muscular pump in your chest has four valves which open and close to keep blood flowing in the right direction through your heart. The aortic valve is seen at the origin of the aorta from the left ventricle. Aorta is the largest artery in the body.

Stenosis is a condition in which the aortic valve narrows. This narrowing prevents the valve from opening fully, which obstructs blood flow from your heart into the aorta and onwards to the rest of your body. The condition usually results in an abnormal heart sound (heart murmur or cardiac murmur).

Symptoms

Aortic stenosis ranges from mild to severe Chest pain, feeling faint with exertion, dizziness, shortness of breath, Heart murmur.

Treatment

Medications sometimes can cause symptoms of aortic stenosis. The only way to eliminate stenosis is surgery to repair or replace the valve.

HYPERTENSION OR HIGH BLOOD PRESSURE

A persistent rise in the pressure of blood or blood pressure due to narrowing of arterial lumen and reduced elasticity is called ***Hypertension***. Frequent tension or stress force and rate of heart beat, viscosity of blood, ***artherosclerosis*** (hardening and thickening of artery walls) and atheroma (deposition of yellow plaques of lipid material in the inner wall of the artery) that often occur in old age. This disease is known as the ***"Silent Killer"***. Manifestations of hypertension are ***Renal failure***, ***Cerebral haemorrage***.

Treatment

Different types of drugs (Beta blockers, Vasodilators) are given to reduce this disease.

THROMBOSIS

The formation of a Thrombus or blood clot within an intact blood vessel is called thrombosis. A Thrombus that forms within one of the coronary arteries supplying heart muscle is known as ***Coronary thrombosis***. This results in ***heart attack***.

A Thrombus within arteries supplying the brain is known as ***Cerebral thrombosis*** or ***stroke***.

DISEASES OF THE RESPIRATORY SYSTEM

BRONCHITIS

Inflammation of the Bronchi or bronchioles is called Bronchitis. The trachea may or may not be infected. Weakness of the chest, a common hereditary problem in families, fatigue, exposure to cold, cigarette smoking is the leading cause of chronic bronchitis.

Symptoms

Aching in the limbs, Congestion in the chest, temperature rises from 100^0 F to 103^0 F. The sputum becomes mucoid and frothy.

Treatment

Cessation of smoking and removal of environmental irritants can reduce the intensity of the disease. Use of broncho dilators and oxygen therapy controls the disease.

EMPHYSEMA

It is a disorder of the lung characterised by destruction of the walls of the alveoli, producing abnormally large air spaces that remain filled with air during expiration with less area for gas exchange. O_2 diffusion is reduced. It is caused due to air pollutants, exposure to industrial dust, cigarette smoking, destruction of alveoli may be caused due to enzyme imbalance.

Symptoms

Dyspnea (difficulty in breathing), cough and wheezing.

Treatment

To advice patients to exercise regularly under medical supervision. To avoid smoking.

PLEURISY

It is a term which describes the result of any disease process involving the pleura of the lungs. Collection of serous fluid in the pleural cavity is called hydrothorax rise in the intrapleural pressure.

Symptoms – Dyspnea – difficult in breathing.

Treatment – Patients are treated with pethidine or morphine by intravenous injection.

LUNG CANCER

Lung Cancer or Carcinoma of the lung may be caused due to pollution of the environment. Smoking is the main cause of bronchial carcinoma.

Symptoms

Chronic cough, Spitting blood from the respiratory tract, shortness of breath, Chest pain, weight loss, pain in the bones.

Treatment

i) Radiation therapy or Chemotherapy

ii) Laser treatment is used to destroy the tumour in the lungs.

iii) Partial or complete surgical removal of diseased lung may be done to control the disease.

2.5 ENDOCRINE SYSTEM

The group of ductless glands in the human body which controls and co-ordinates the body functions and maintains a homeostasis are called endocrine glands. These glands are organs located at different regions of the body but still form an organ system called endocrine system. The endocrine glands produce chemical substances called **hormones** which are transported to target organs through blood. These hormones do not show any catalytic action like enzymes. They differ from each other for the following reasons.

Table 2.1 Differences between the enzymes and hormones

	Enzymes	Hormones
1.	They are produced by exocrine glands which have ducts.	They are produced by endocrine glands which do not have ducts.
2.	They are proteinaceous in origin.	Hormones are either made up of protein, steroids, polypeptides or amino acid derivatives.
3.	They act as catalyst and remain unchanged at the end of reaction.	They are used up during a metabolic reaction.
4.	Enzymes produced by various glands perform their function in that organ or gland.	Hormones secreted have target organs to reach through blood and perform their function there.
5.	They have high molecular weight and are not diffusible.	They have low molecular weight and can diffuse through cell membranes.

We have learnt in the earlier chapter that enzymes are produced by glands like liver, pancreas, salivary, gastric etc. These glands are called ***exocrine glands***. They secrete enzymes to help in digestion. But the hormones promote entire growth of living organism.

Factfile :

The name ***hormone*** was first used by the English physiologists ***W.M. Bayliss*** and ***E.H. Starling*** in 1909.

The endocrine glands of the human body are Pituitary. Thyroid, Parathyroid, Adrenals, Islets of Langerhans, Thymus, Pineal body and gonads (Testes and Ovaries)

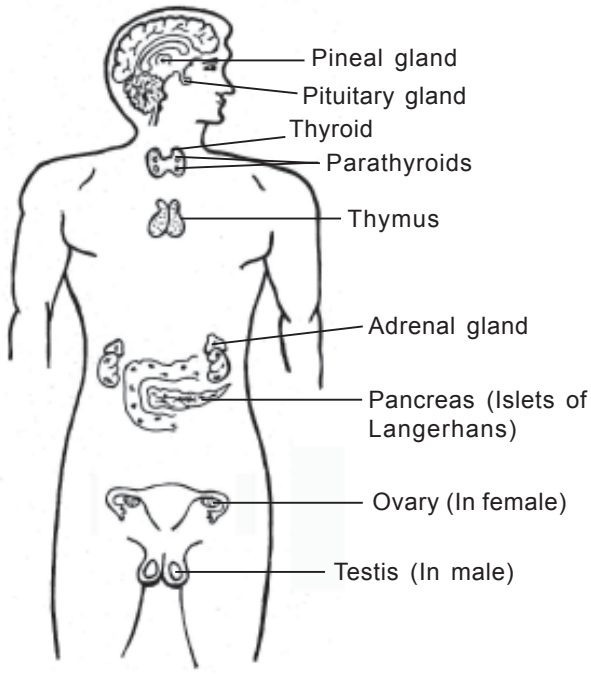


Fig 2.15 - Position of Endocrine glands in man

PITUITARY GLAND

It is a small, red-grey, pea shaped gland located on the ventral side of the diencephalon and attached to the hypothalamus of the brain by a stalk called ***infundibulum***.

Structure and Function

The Pituitary gland consists of three lobes – Anterior lobe or Adenohypophysis, Intermediate lobe and Posterior lobe or Neurohypophysis.

The Anterior lobe or Adenohypophysis secrete six hormones with varied functions. They are

1. Somatotrophic hormone or Growth hormone **(STH or GH)**
2. Thyroid stimulating hormone (or) Thyrotrophic hormone **(TSH)**
3. Adrenocorticotrophic hormone **(ACTH)**
4. Follicle stimulating hormone **(FSH)**
5. Luteinising hormone in female and Interstitial cells stimulating hormone in male **(LH or ICSH)**
6. Lactogenic hormone or Luteotrophic hormone **(LTH).**

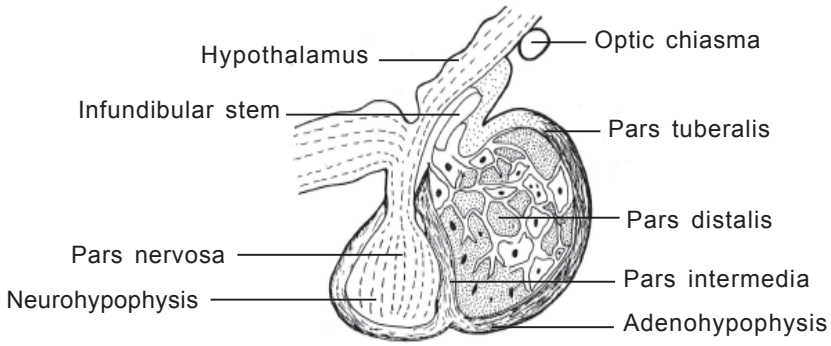


Fig. 2.16 - L.S. of Pituitary gland

Somatotrophic Hormone

This Hormone stimulates the growth and development of all tissues. It increases the length of cartilage bones and controls metabolism of carbohydrates, protein and fat. Improper secretion of this hormone produces three important disorders.

Dwarfism

It is caused by deficiency of growth hormone from early age. Characteristic features of dwarfism are 1. stunted growth 2. delicate

extremities 3. delayed skeletal and dental development. These dwarfs have normal intelligence.

Gigantism

Excess of growth hormone results in ***gigantism***. Individuals grow to a height of ***7 to 8*** feet. Bones are long with large hands and feet.

Acromegaly

Secretion of growth hormone in excess during adolescence causes ***Acromegaly***. The bones of the lower jaw and limbs become abnormally large but the body does not attain a giant stature.

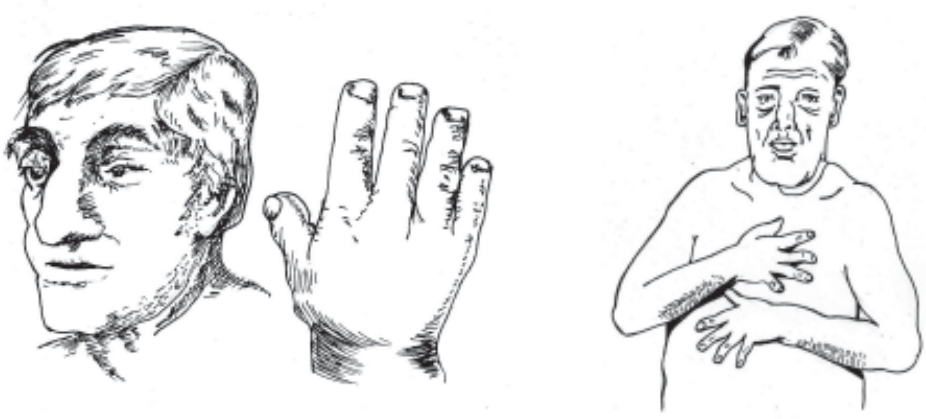


Fig 2.17 - Acromegaly

Thyrotrophic Hormone

It stimulates the growth and activity of the thyroid gland and production of its hormone thyroxine.

Adreno Corticotrophic Hormone

It controls the growth and activity of adrenal cortex to secrete ***aldosterone*** and ***cortisone***.

Follicle Stimulating Hormone

It stimulates the maturation of the Graffian follicles in the ovary to sperm formation in males.

Luteinising hormone of Interstitial cell stimulating hormone

In males the ICSH induces the interstitial cells of the testes to produce male sex hormones called ***androgens***. In females, the LH causes ovulation along with FSH and secretion of females hormones, estrogen and progesterone.

Lactogenic Hormone

It helps in the growth of mammary glands and milk secretion after child birth.

Neurohypophysis (Posterior Lobe)

This stores two hormones, Oxytocin and Vasopressin which are produced by the cells in the hypothalamus of the brain.

Oxytocin

This hormone helps in contraction of the uterus at the time of child birth. It also helps in release of milk after Child birth.

Vasopressin

It is also called Antidiuretric hormone (ADH). It helps in reabsorption of water in the distal convoluted tubule, collecting tubules of the kidneys. It also stimulates the contraction of smooth muscles of the arterioles, thereby enhancing the blood pressure and hence the name vasopressin.

Deficiency of ADH reduces reabsorption of water and increases urine output, causing excessive thirst ***(polydipsia)***. This deficiency disorder is called ***Diabetes insipidus***. No glucose is lost in the urine of such patients.

Master gland

The Pituitary gland plays a very important role in controlling the activities of the thyroid, adrenal and gonads and hence described as the ***"Master gland"*** of the endocrine system.

THYROID GLAND

It is the largest endocrine gland and is highly vascular. It lies on the ventral and lateral sides of the upper part of the trachea and neck.

Structure and Function

It is brownish red, shield shaped, bilobed gland. The two lobes are connected by a bridge of tissues calle ***isthmus***. The lobes of the gland are made up of follicles or acini. They secrete a hormone called ***thyroxine*** derived from ***tyrosine***, an iodinated amino acid.

Functions of Thyroxine

1. They control the rate of oxidation and production of energy by maintaining the ***Basal Metabolic Rate (BMR)*** of the body.
2. They control growth of physical, mental and sexual growth of the body. Growth of central nervous system and bones is regulated by thyroxine.
3. Regulates Iodine and sugar level in blood.
4. Control the working of kidneys and urine output.
5. Regulates carbohydrate and fat metabolism.

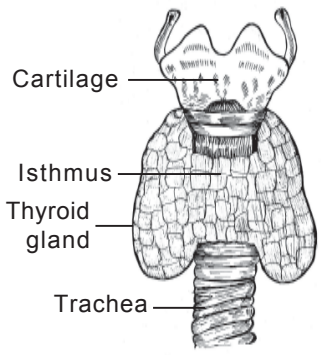


Fig 2.18
Position of Thyroid gland

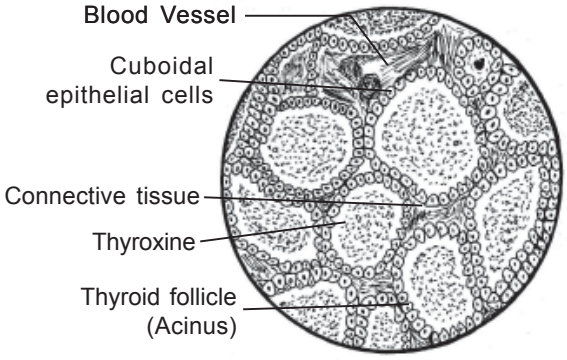


Fig 2.19
L.S. of Thyroid gland

Improper secretion of the thyroxine hormones results in the following diseases. Increased secretion results in Hyperthyroidism and less secretion in Hypothyroidism.

Factfile :

The thyroid is the largest of the endocrine glands, weighing about 20-25 g.

Hyperthyroidism

Excessive secretion of thyroxine results in **exophthalmic goiter** also called **Graves disease**. The symptoms of the disease are

1. Enlargement of the gland.
2. Increased metabolic rate results in quick consumption of food without anything left for storage and causing emaciation. (leaness of body)
3. Heart beat and blood pressure rises.
4. Nervousness, initability, tremor and bulging of eye balls (exophthalmos)

This disease can be rectified by removal of a part of the gland termed ***thyrectomy***.

Fig 2.20 - Simple goiter

Fig 2.21 - Exophthalmic goiter

Effects of thyroid gland malfunction

Hypothyroidism

Under activity of the thyroid gland with decreased secretion of thyroxine results in Cretinism, Myxoedema and Simple goiter.

Cretinism

It is a disease of infants where under secretion of thyroxine is common. The child grows to be a ***Cretin*** or ***Dwarf***. The characteristics of this disorder are

1. Decreased BMR (50% than normal) which results in slow heart beat, lower blood pressure and stunted growth.

2. Retarded mental development and delayed puberty.
3. Decreased Iodine and Sugar level.
4. Disproportionate body with pot belly and pigeons chest.

This disease can be treated by an early administration of thyroxine.

Myxoedema

It occurs due to deficiency of thyroxine in adults. It is more common in women than in man. This disease is also called ***Gull's disease*** and is characterised by

1. Low metabolic rate with accumulation of fat in the subcutaneous tissue resulting in puffy appearance.
2. Individual suffers from lack of intelligence, alertness and initiative.
3. Decreased cardiac output, low blood pressure and low sugar and iodine in blood.

This disease can also be treated by administrating thyroxine.

Simple Goiter : It is caused by deficiency of iodine in drinking water mostly in hilly areas where iodine is deficient in diet. It is characterised by enlargement of thyroid gland. Addition of iodine to table salt can prevent the disease.

Activity 6 :
1. Collect tadpoles from a fresh water pond. Remove the thyroid gland and study the activity of the organism and observe its growth.
2. Add iodine to water where tadpoles are kept and study their growth.

PARATHYROID

They are four in number and embedded on the dorsal surface of the thyroid gland, two glands in each lobe of thyroid gland.

Structure and Function

The glands are small flat and oval in shape and yellow coloured. This gland secrete a hormone called ***Parathormone*** which is a polypeptide.

Functions

It regulates calcium - phosphorous balance in the blood. Normal calcium and phosphorus balance helps in growth of bones and teeth, blood clotting, muscle contraction and nerve impulse conduction.

Hyposecretion of parathormone results in **Hypoparathyroidism**. This disease is characterised by low concentration of calcium in blood. It causes painful spasmodic contraction of muscles of face, hand, feet and larynx.

Hyperparathyroidism : Over secretion of parathormone results in this disease.

1. It increases separation of calcium from bones causing it to soften and bend called **osteoporosis**.
2. Calcium level increases in blood and there is loss of calcium in urine. Sometimes calcium is deposited in kidney tubules resulting in kidney stones.

ADRENAL GLAND

Adrenal glands are paired and placed on the top of the kidneys and are also known as **Supra renal glands**.

Structure and Function

Adrenal glands are conical, yellowish and small sized. Each gland has two distinct parts, outer adrenal cortex and inner adrenal medulla.

Adrenal Cortex

It produces two hormones, Aldosterone and Cortisone.

Aldosterone helps to maintain sodium and potassium ratio in the extra cellular and intra cellular fluids. It also balances the water and salt content and blood volume in the body.

PHOBIAS

The hormone adrenalin is excessively secreted into blood stream at the time of frightened state or panic state to keep the body in steady state. So it is called as *emergency hormone* or hormone of fear.

Types of fear (phobias)

Hydrophobia	- Fear of water
Eremiophobia	- Fear of silence
Phonophobia	- Fear of noise
Acrophobia	- Fear of heights
Cynophobia	- Fear of dogs
Nyctophobia	- Fear of the dark
Ophidiophobia	- Fear of snakes
Pyrophobia	- Fear of fire

Deficiency of this hormone results in **Addison's disease.** It is characterised by 1. loss of appetite, 2. weakness, nausea, vomiting and diarrhoea 3. bronze like skin colouration and finally death.

Hyperactivity of aldosterone causes abnormal development of the sex organs in the foetus. Virilism in women results in development of male characters.

Adrenal Medulla

This inner part of the adrenals secretes two hormones, adrenaline and noradrenaline. Both the hormones have the same basic effect.

Adrenalin is produced at the time of stress or danger and is called as an emergency hormone the effect of this hormone is

1. Increased heart beat, blood pressure and respiration rate.
2. Basic metabolic rate increases with an increase in blood glucose.
3. Increases blood flow to heart and skeletal muscles and decreases it to skin, intestine and kidneys.
4. Increase in sweating, dilation of the pupil and contraction of the muscles of skin resulting in goose flesh.

Since the adrenal glands prepare the body to face stress or danger they are called ***"glands of flight, fright or fight"*.** Hyperactivity of adrenalin causes hypertension which may lead to death.

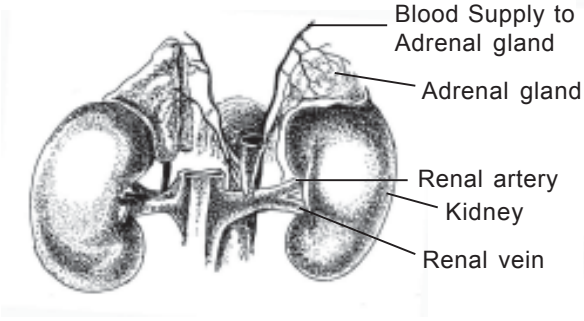


Fig 2.22 -
Position of Adrenal Glands

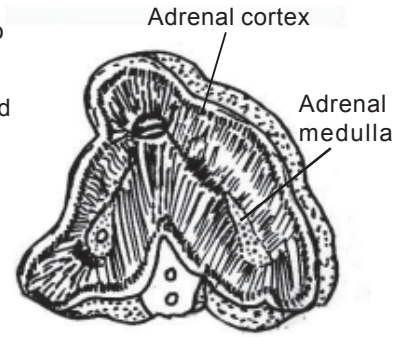


Fig 2.23 -
L.S. of Adrenal Glands

Nor-adrenalin resembles adrenalin but it operates during normal state at a milder rate.

ISLET OF LANGERHANS

Pancreas is an elongated, yellowish exocrine gland located in the loop of the duodenum. It secretes enzymes which are digestive in nature. Groups of cells lie within this gland which are endocrine in nature. These interspersed cells are called Islet of Langerhans.

Structure and Function : Groups of epithelial cells called Alpha cells and Beta cells are found within the pancreas. The Alpha cells produce a hormone called ***Glucagon*** and the Beta cells secrete ***Insulin***. Insulin maintains blood glucose level in the human body. It was first extracted by **Best and Banting in 1922**.

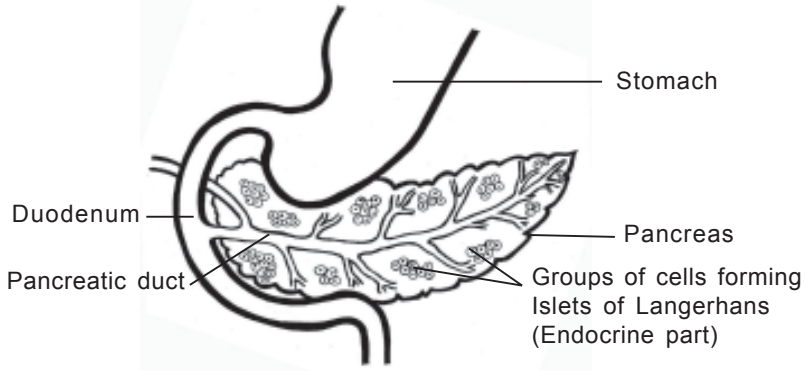


Fig 2.24 - Pancreas showing islets of langerhans

Functions

1. It enables the muscles and liver to store glucose as glycogen.
2. It enables cells to utilise glucose for respiration.
3. It reduces breakdown of protein and fats to be used as respiratory substrates.

Deficiency of insulin causes **Diabetes mellitus.** This disease is characterised by

1. Blood glucose level increase and glucose is eliminated through urine by the kidneys.
2. Urine output increases which results in excessive thirst.
3. Delayed healing of wounds and injuries may change into gangrenes.

Activity 7 :

Visit a hospital/clinic to meet a Diabetologist and collect information on the following a. Polydipsia b. Polyphagia c. Polyurea

Factfile :

Controlled dose of insulin and sugar free diet are best preventive measures for diabetes mellitus. Glucagon is secreted to increase sugar level in blood by breaking down the glycogen in the liver into glucose. It's action is opposite to that of insulin. Glucagon starts functioning when blood glucose level falls in blood.

THYMUS

It is bilobed mass of lymphoid tissues present above the heart.

Structure and Function

It is a soft, pinkish, bilobed gland which is prominent at birth and gradually atrophies in adult. This gland secretes a hormone called **Thymosine**. It's function are

1. Influences rate of growth during early stage of life.
2. It stimulates the differentiation of ***T-lymphocytes*** which increases resistance to infection.
3. It hastens sexual maturity.

PINEAL BODY

It is a small gland which lies under the ***Corpus callosum*** between the two cerebral hemispheres.

Structure and Function

It is a small, reddish grey vascular conical organ. It secretes a hormone called ***melatonin***. This hormone causes concentration of pigment granules and working of gonads.

GONADS

The male and female reproductive organs are the gonads. They secrete different hormones from puberty to control the reproductive organs and the process of reproduction.

Testes

The testes have groups of cells called interstitial cells or ***Leydigs cells***. They secrete hormones called androgens such as testosterone. The functions of this hormone are

1. It stimulates the reproductive organs to form sperms.
2. It determines secondary sexual character such as growth of facial hair, hoarse voice, broadening of shoulders etc.
3. It maintains normal functioning of the male reproductive system.

Ovaries

A pair of ovaries in the female produce three hormones. They are ***oestrogen, progesterone*** and ***relaxin***.

Oestrogen

It is responsible for the growth of female reproductive organs and the apperance of secondary sexual characters.

Progesterone

It is responsible for the maintenance of pregnancy, regulation of the menstrual cycle and development of the mammary glands.

Relaxin

It relaxes the muscles of the pelvic region at the time of child birth.

POINTS TO REMEMBER

1. The process of converting the complex food into simple chemical substances that can be absorbed and assimilated by the body is called ***digestion***
2. The food constituents are classified as – Proteins, Carbohydrates, fats, vitamins and mineral salts.
3. **Inspiration** – Intake of fresh air with the help of diaphragm and intercoastal muscles.

   Expiration – The expulsion of air from the lungs is called expiration.
4. Oxygen molecules combines with the haem (Iron) protein of the **haemoglobin**.
5. The globin part of haemoglobin directly combines with carbon-dioxide and forms carbamino compounds.
6. ***William Harvey*** was the first to discovers the circulation of the blood.
7. Blood components are classified as liquid component – Plasma and solid component – corpuscles
8. The normal blood pressure of man is **120/80 mm Hg**.
9. The hormones are the main chemicals co-ordinators secreted by the endocrine glands.
10. Different types of endocrine glands are found in our body. They are Pituitary gland, Thyroid gland, Parathyroid gland. Islets of langerhans (Pancreas), Adrenal glands, Gonads, Thymus and others.
11. The pituitary gland is the **master gland** of the body.
12. A physical or functional change from the normal state causes discomfort or disability is called a disease.
13. Hernia, ulcer, Liver cirrhosis and piles are the related diseases of the digestive system.
14. Myocardial infarction, valve stenosis, hypertension and thrombosis are the related diseases of the circulatory system.
15. Bronchitis, emphysema, pleurisy and lung cancer or the related diseases of the respiratory system.

SELF EVALUATION

I. Choose and write the correct answers :

1) The space between the two lungs is termed as
   a) Pericardium b) Mediastinum
   c) Mucous membrane d) Larynx

2) The organ which separates the thorax and abdomen
   a) Inter coastal muscles b) Diaphragm
   c) Lungs d) Stomach

3) Expired air contains _____ percentage of Nitrogen
   a) 78.6% b) 62.8%
   c) 75% d) 80%

4) The protein part of Hb is termed as
   a) Haem b) Globin
   c) Pectin d) Stroma

5) Carbon combines with reduced Hb to form
   a) Oxyhaemoglobin b) Oxygen
   c) Carbaminohaemoglobin d) Glucose

6) The hardest substance in the body is the
   a) dentine b) enamel
   c) cartilage d) skin

7) Diabetes mellitus is caused due to malfunctioning of
   a) Alpha cells b) Adrenals
   c) Beta cells d) somatic cells

8) The pace maker of the body is
   a) Auriculo ventricular node b) Sinu auricular node
   c) Bundle of this d) Purkinje system

9) Fibrinogen is produced in the
   a) Liver b) Pancreas
   c) Pituitary d) Blood

10) The plasma proteins that control osmotic pressure is
   a) Albumin b) Globulin
   c) Fibrin d) Protein

11. High fibre diet is a treatment for
    a) Hernia b) Piles
    c) Ulcer d) Cancer

12. Thrombus leads to
    a) Cirrhosis b) Obesity
    c) Pleurisy d) Heart attack

13. Morphine is used to cure
    a) Pleurisy b) Cancer
    c) Stenosis d) Haemorrhoids

II. Fill in the blanks with suitable terms

14) Teeth embedded in sockets is termed _____
15) Fats and glycerol are absorbed in the _____
16) The gland which is both Exocrine and Endocrine _____
17) Hydrochloric acid is secreted by _____ cells.
18) Pepsin acts on _____
19) Saliva contains an enzyme _____
20) B.P is measured by an instrument called _____
21) The circulation of blood first described by _____
22) Adrenalin is termed _____ hormone.
23) Hyperthyroidism leads to _____ disease.
24) Protrusion at the umbilicus causes _____
25) Non healing wounds are termed _____
26) Difficulty in breathing is _____
27) Smoking is the main cause of _____ carcinoma.
28) Laser treatment is used to destroy the _____ in the lungs.

III. Answer the following questions in one or two sentences

29) Physiology
30) Peristalsis
31) Assimilation
32) Heterodont
33) Bronchi

34) Trachea
35) Lymph
36) Artery
37) Clotting of blood
38) Simple goiter
39) Haemoglobin
40) Diabetes insipidus
41) Stroke
42) Stenosis
43) Cirrhosis
44) Incisional Hernia

IV. Write short answers for each of the following questions in 100 words. Draw diagrams wherever necessary :

45) Explain how bile helps in the process of digestion.
46) Explain the structure of the tooth.
47) Describe the process of digestion in the mouth.
48) Explain transport of carbon dioxide
49) Describe how the capillaries help in the process of circulation?
50) Explain the structure of Adenohypophysis
51) Explain the role of insulin in the body.
52) Explain hypothyroidism
53) Explain the hormones secreted by Neurohypophysis
54) List the symptoms of Addison's disease
55) Explain ulcer? Write note on symptoms and treatment?
56) Explain Hypertension?

V. Write detailed answers for each of the following questions in 200 words. Draw diagrams wherever necessary.

57) Explain composition of blood.
58) Explain the structure and function of the pituitary gland.

59) Explain the Mechanism of respiration?

60) Explain the structure and function of the Thyroid gland.

61) Explain digestion in the mouth and stomach?

62) Explain the respiratory passage in the respiratory system.

63) Explain the structure of the heart with a labelled sketch.

64) Explain the following terms.
    a) Gigantism
    b) Myxoedema
    c) Diabetes insipidus
    d) Addison's disease
    e) Acromegaly

65) Explain in detail the diseases related to circulatory system?

66) Explain in detail the diseases related to digestive system?

UNIT 3

ANIMAL REPRODUCTION

Reproduction is the capacity of an organism to produce young ones of their own kind. Reproduction is the only means by which the continuity of a species is maintained. In Amoeba, reproduction can be divided into two types namely 1. Asexual reproduction, 2. Sexual reproduction.

3.1. Asexual and Sexual Reproduction

Asexual Reproduction

When an amoeba has fully grown. it reproduces by a process of division of the nucleus into two followed by the division of the cytoplasm. This mode of reproduction is known as ***binary fission***. In this process, the nucleus first divides mitotically, and it is followed by a constriction of the cytoplasm across the middle line between the nuclei. The constriction deepens dividing the organism into two individuals. Thus one amoeba becomes two with a newly formed nucleus and protoplasm. As the parent becomes merged in the offspring, it will appear that amoebae are immortal.

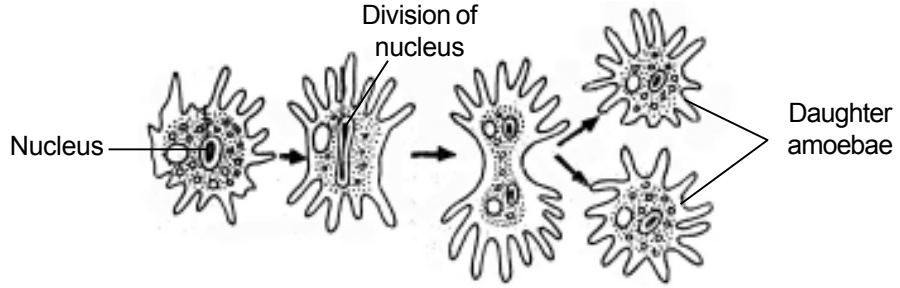


Fig 3.1 Binary fission in amoeba

Multiple Fission

Multiple fission occurs during unfavourable conditions. The conditions may be a decrease in temperature, scarcity of food or drying up of the pond. The animal forms a cyst wall around the nucleus, divides into many

bits. Each nucleus is surrounded by cytoplasm and they form uninucleate cells. When the cyst wall ruptures, many daughter amoebae are released.

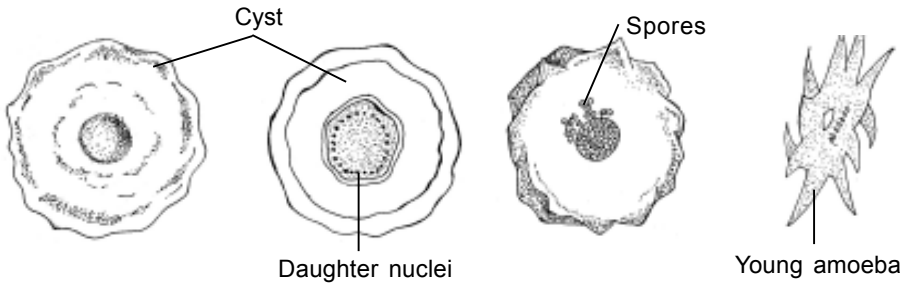


Fig 3.2 Multiple fission in amoeba

REPRODUCTION IN HYDRA

In Hydra, both asexual and sexual reproduction takes place.

Asexual Reproduction

Reproduction in Hydra takes place when food is available in plenty. It takes place by budding and fission. In this process, the body develops a small projection on the body wall containing the ectoderm, mesoglea and endoderm. When the bud gradually develops, the gastrovascular cavity of the parent Hydra extends into the bud. This bud lengthens, grows tentacles and a mouth. Later, when the individual is fully formed it gets detached from the parent hydra by constriction and floats freely in the water. When it finds a suitable substratum it attaches itself and lives an independent life.

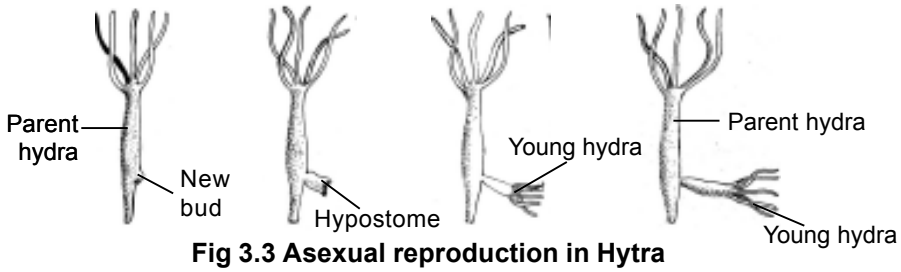


Fig 3.3 Asexual reproduction in Hytra

Sexual Reproduction

This method occurs during unfavourable conditions. Both the testis and ovary develop as a temporary structures on the same individual but at

different seasons. Hence Hydra is said to be a ***hermaphrodite***. The testis is generally found developing on the upper half as a small elevation on the body wall. Sperms develop within the testis. When these sperms are fully mature, they escape from the testis and swim about actively in water.

Ovaries develop near the basal end. The cells inside the ovary undergo division and multiply but only one cell develops into an ovum. This ovum is first covered by ectoderm. Later, when these cells break, the single large ovum alone remains attached to the Hydra by an epidermal cup.

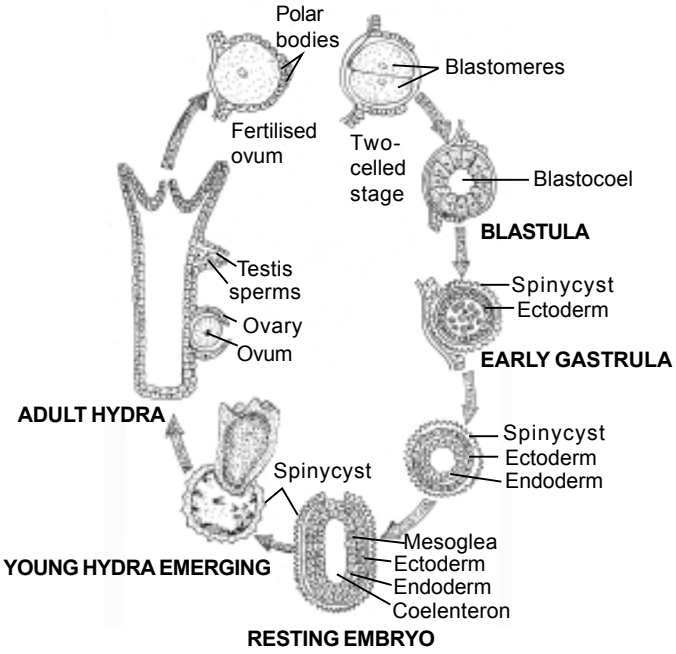


Fig 3.4 Sexual reproduction in Hydra

Development

Many sperms actively swim in water, but only one enters the ovum. The nucleus of the sperm unites with the nucleus of the ovum. Simultaneous maturation of the sperm and ovum of a particular Hydra is prevented to avoid self fertilization and to enhance cross fertilization. The nucleus which is formed is called the **fusion nucleus** and the fusion product is called the **zygote**. It undergoes repeated division and reaches the next stage, when it becomes a spherical ball of cells with a hollow cavity called **blastula**.

When more cells are formed, the cells get differentiated into two layers and a new cavity called **gastrula** is formed . The gastrula usually gets cut off from the parent. The embryo remains inside the cyst. Under suitable conditions the embryo starts developing inside. When the embryo grows longer, the cyst breaks. The Hydra then emerges, fixes itself to a substratum and leads an independent life.

3.2 REPRODUCTION IN HUMAN

Sexual Reproduction

In higher group of organisms the only method of reproduction is sexual. In this method, two individuals (Male and Female) are involved. The male reproductive organs are the testes and the female reproductive organs are the ovaries. The testis produce male reproductive cells called Sperms. The ovaries produce female reproductive cells called the ovum (egg). The gametes i.e. the Sperm (Male gamete) and Ovum (Female gamete) fuse to form the Zygote.

Organs of Male Reproductive System

Male reproductive system includes the primary sex organs and accessory organs. Primary organs are the testis and the accessory organs are seminal vesicles, prostate glands, urethra and penis.

Testis

Testis is the primary male sex organ or male gonad. It is ovoid or walnut shaped. There are two testes in almost all species. Each testis contains about 900 coiled tubules known as **Seminiferous tubules**. These tubules produce sperms. The sperms enter the Vas deferens, which form the **epididymis** which is the **"store house of sperms"**. The epididymis continues as Vas deferens.

Seminal Vesicles

They are the accessory sex organs situated on either side of prostate. Secretions of seminal vesicles are emptied into ampulla of vas deferens. The Vas deferens is continued as ejaculatory duct.

Prostate Gland

Prostate gland is constituted by many secretary glands. Secretion from these glands is emptied into urethra.

Urethra

Urethra has two parts namely internal and external urethra. Internal urethra is the continuation of ejaculatory duct. The bulbo urethral glands also open into the urethra.

Penis

Penis is the male genital organ. Urethra passes through the Penis and opens to the exterior.

Female Reproductive System

Female reproductive system contains the primary sex organs and accessory sex organs. The primary organs are a pair of ovaries which produce egg or ova and secrete female sex hormones, oestrogen and progesterone. The accessory sex organs of females are fallopian tubes, uterus, cervix and vagina. The external genitalia which consists of Labia majora, Labia minora and Clitoris. The mammary glands are not the female genital organs, these are important glands of female reproductive system.

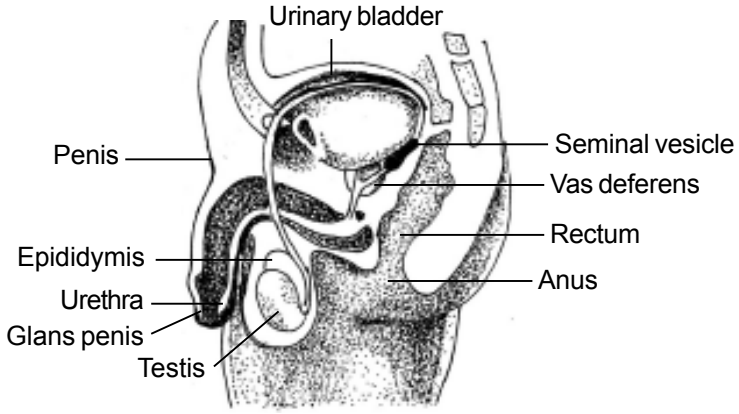


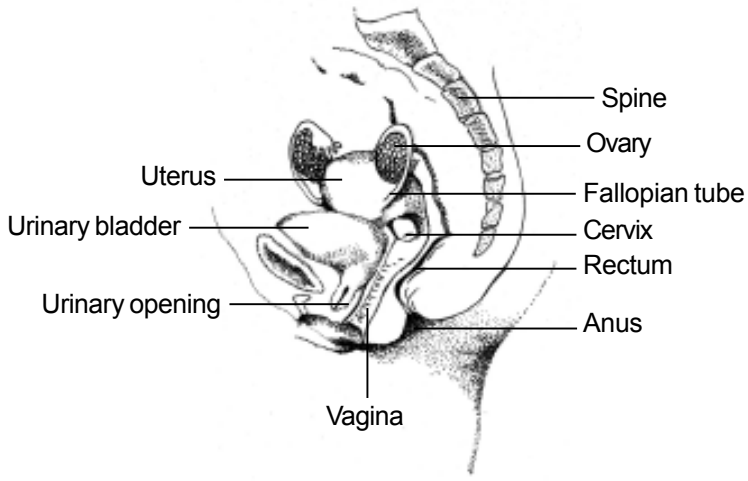
Fig 3.5 Human - male reproductive system

Ovaries

Ovaries are flattened ovoid bodies located in the abdominal cavity attached to the dorsal body. Each ovary consists of several thousands of rounded bodies called follicles. Each mature follicles produces the female gamete or ovum. Development of the ovum within the ovarian follicles is called ***oogenesis***.

Uterus

The Uterus is a hollow thick walled muscular organ situated in the Pelvic cavity between the bladder and rectum. The uterus is formed of three layers namely outer serous, thick muscular and inner mucous membrane called ***endometrium.*** The fertilized ovum is embedded in the uterine cavity where it develops and nourished.



3.6 Human - female reproductive system

Vagina

Vagina is a muscular tube lined with mucous membrane. Vagina connects the cervix at the upper end and genitatia at the lower end. Vagina serves to receive the sperms and serves as a **birth canal**.

3.3. GAMETOGENESIS

Spermatogenesis

Spermatogenesis is the process by which spermatozoa are developed from the primitive germ cells in the testis known as spermatogonia. Spermatogenesis occurs in four stages.

1. Stage of Proliferation
2. Stage of Growth
3. Stage of Maturation
4. Stage of Transformation

1. Stage of proliferation

The spermatogonia near the basement membrane of semiferous tubule are larger. Each one contains diploid number of chromosomes (23 pairs in men). During the proliferative stage, the spermetogonia divide by mitosis without any change in chromosomal number in man. At the end of division, the cells are termed primary spermetocytes which enter into a period of growth.

2. Stage of growth

During this phase, limited growth occurs, so that the volume of the primary spermatocyte is doubled. This growth phase is insignificant.

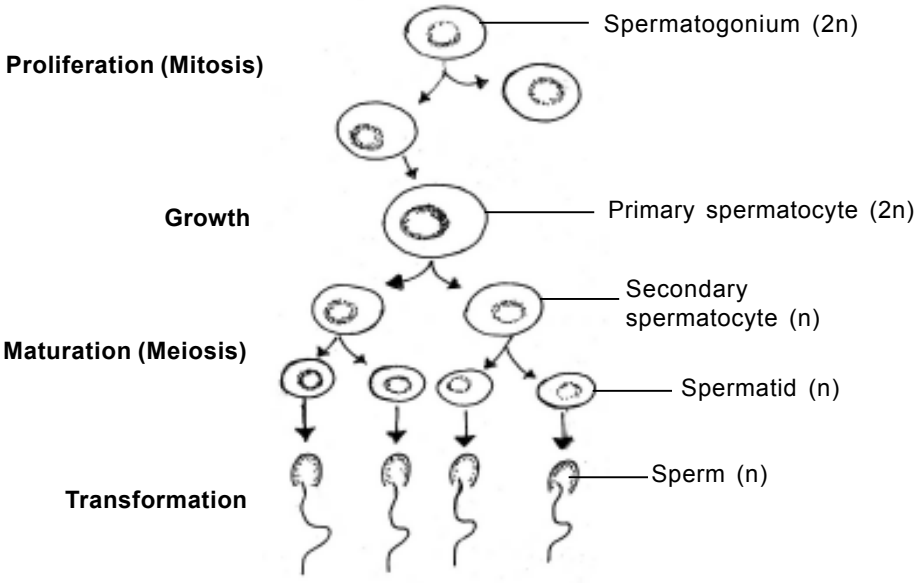


Fig 3.7 Stages in spermatogenesis

3. Stage of maturation

After reaching the full size each primary spermatocyte quickly undergoes meiotic or reduction division, which occurs in two stages. In the first stage, two secondary spermatocytes are formed. In the second stage, each secondary spermatocyte divides into two spermatids. The significance of the two stages of maturation division is that, each spermatid receives only the haploid or half the number of chromosomes.

4. Stage of transformation

The spermatids do not divide further but transform into spermatozoa by a process called **spermiogenesis**. Spermatogenesis is regulated by ***sertoli cells or nurse cells*** which nuture the developing sperms and also by hormones.

SPERM BANK

Sperms **or** ***spermatozoa*** **are collected in the form of** ***semen*** **and can be stored in sperm bank kept viable for several years in frozen state at about temperature below -100^{O}C. This is useful for** ***artificial insemination*** **and** ***invitro fertilization*** **techniques.**

Structure of a mature sperm

Spermatozoan is the male gemete developed in the testis. The matured spermatozoan is 60μ long. It consists of four parts - head, neck, body and tail.

Head

Head is oval shaped with a length of 3 to 5μ and width of 3μ. The head is formed by a condensed nucleus, a thin cytoplasm and a thin cell membrane. The anterior two thirds of the head is like a thick cap called acrosome formed from Golgi apparatus. The acrosome is made up of mucopolysaccharide and acid phosphate. It also contains ***hyaluronidase*** and proteolytic enzymes. These enzymes are essential for the sperm to fertilise the ovum.

Neck

The head is connected to the body by a short neck. It contains two centrioles. The disc shaped anterior end knob is called proximal centriole. The distal end is formed by the posterior centriole. The distal centriole is continuous with an axial filament which continues into the tail.

Body

It is cylindrical with a length of 5 to 9μ and thickness of 1μ. The body of the sperm consists of a central core called axial filament which continues in the tail as axial thread. In the body the axial filament is surrounded by a closely wound spiral filament consisting of mitochondria.

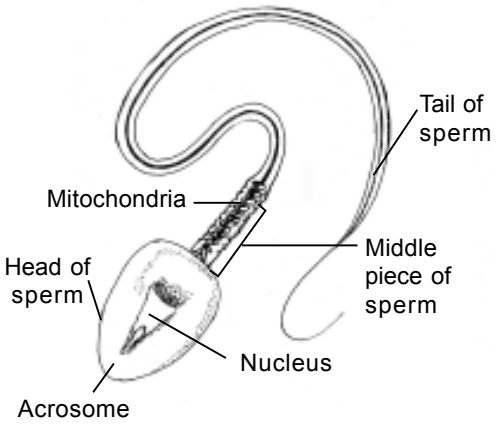


Fig 3.8 (a)
Structure of a mature human sperm

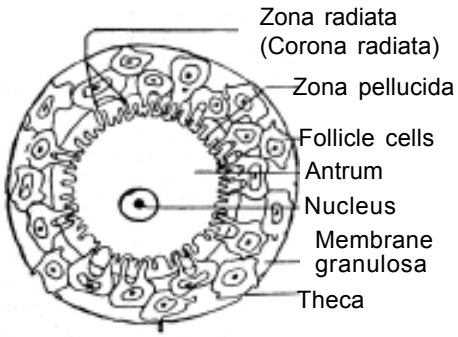


Fig 3.8 (b)
Structure of mammalian egg (Egg or ovum of human)

Tail

The tail represents the remnents of the cell cytoplasm. Lashing from side to side, it propels the sperm in the liquid medium through which it has to swim before reaching the egg.

Oogenesis

The cells of the germinal epithelium lining the ovarian wall are called primordial germ cells. These germ cells group to form the Graafian follicle which give rise to the development of the egg or ovum. Oogenesis is a complicated process and can be studied as the following stages :

a. **Multiplication Phase :** The primordial germ cells divide mitotically and form oogonia or egg mother cells. These divide further and form cells called Primary oocytes.

b. **Growth Phase :** This is an important phase when the cell division stops and accumulation of nutrients and yolk makes the primary oocyte increase in size.

c. **Maturation Phase :** During this stage, the Primary oocyte undergoes first meiotic division and produces a large secondary oocyte and a small first polar body. The secondary oocyte will

now divide meiotically to form a large cell, ovum and a small second polar body. The first polar body also divides simultaneously into two polar bodies. At the end of oogenesis, a single ovum and three polar bodies are formed.

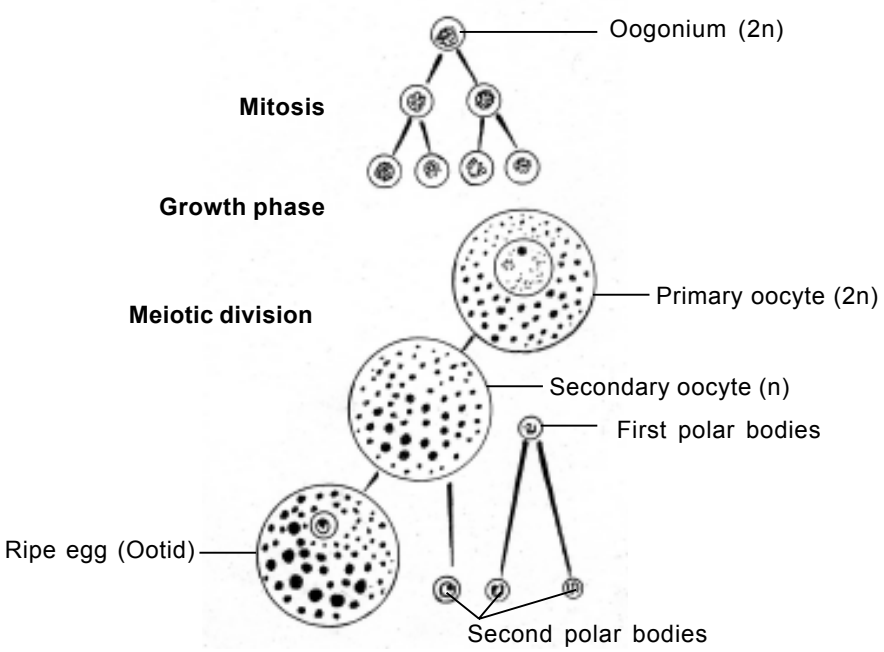


Fig 3.9 Oogenesis

Table 3.1 Differences between Spermatogenesis and Oogenesis

	Spermatogenesis	Oogenesis
1.	Meiotic divisions are equal	Meiotic divisions are unequal
2.	At the end of second meiotic division four spermatids are formed	At the end of second meiotic division only one ootid is formed
3.	Growth phase is insignificant	Growth phase is significant
4.	Spermatids undergoes spermiogenesis	No such changes are seen in the ootid.
5.	The functional system is motile.	The ovum is non-motile

Structure of the egg or ovum

The femal gamete or ovum is spherical, non motile and 0.1mm in diameter. Each ovum has a nucleus surrounded by dense cytoplasm with the living organelles. The egg is free of yolk and is said to be alecithal. In the cytoplasm are two specialised inclusions, the cortical granules and yolk platelets. The egg is surrounded by a number of egg membranes.

1. **Vitelline membrane :** It is a primary egg membrane secreted by the ovum. The ovum is surrounded immediately by this thin and transparent membrane.
2. **Zona pellucida :** It is thick, transparent and non cellular and is a primary membrane between the vitelline membrane and Zona pellucida lies the perivitelline space.
3. **Corona radiata :** The outer most thick membrane formed by the follicular cells is called corona radiata. It is a secondary egg membrane. It is not smooth and radially elongated cells form this membrane.
4. **Ovulation :** When the ovum is mature it is released from the Graafian follicle into the abdominal cavity. This is called ovulation.

The ovum reaches the fallopian tube and it may get fertilized. Ovulation generally occurs on the 14^{th} day after the onset of the Menstrual cycle.

MENSTRUAL CYCLE

The series of changes that occur in the ovary and uterus of a mature female is cyclic and helps in the functioning of the reproductive system. This rhythmic activity occurs for about 28 days and it starts at puberty (12-14 yrs) and lasts till menopause (40-45 yrs). When the ovum is mature and is brought to the fallopian tube it gets fertilised and continues development. When the ovum is not fertilised, the ovum along with the uterine wall is ruptured and discharge with blood and uterine tissue to the outside called the Menstrual cycle.

The menstrual cycle in man consists of three phases 1. Follicular or Proliferative phase 2. Luteal or secretory phase 3. The Menstural phase.

1. **Follicular or Proliferative phase (From 5th – 14th day of the menstrual cycle)** – This phase is initiated by the secretion of FSH of the pituitary and last for about 10-12 days.

    i. The primary ovarian follicles begin to grow and mature.

    ii. The mature Graafian follicles burst and release the ovum into the fallopian tube. This is called ovulation and occurs after 14 days.

2. **Luteal or Secretory phase** – (15th – 28th days) this phase starts at day 14. The Leutinizing hormone or LH influences this stage.

    i. When the ***Graafian follicles*** have released the ovum, they become empty and grow into a partial endocrine gland called Corpus luteum.

    ii. The ***Corpus luteum*** secretes a hormone called ***Progesterone***. This hormone acts on the wall of the uterus ***(endometrium)*** and prepares it to receive the fertilized ovum.

    iii. The growing foetus gets implanted in the uterus and continues development.

    iv. The endometrial glands secrete nutrients for the foetus and hence this stage is called secretory phase.

    v. If the ovum is not fertilized, the ovum and uterine wall are ruptured and discharged during the menstrual phase.

3. **Menstrual phase** – This phase lasts from the 1st to the 4th day and the events are –

    i. There is a fall in the level of Progesterone and oestrogen, if the ovum is not fertilized.

    ii. The endometrium (uterine wall) ruptures and bleeding occurs called ***menstruation.*** The unfertilized egg, ruptured blood vessels and tissues are discharged through the vagina called the menstrual flow.

    iii. The Corpus luteum is converted into a scar tissue called ***Corpus albicans***.

iv. The FSH is released from the pituitary at the end of menstrual phase to start the new cycle again.

3.4. FERTILISATION

The fusion of the male and female gamete to form a diploid zygote is called fertilization.

Significance of fertilization

i) It stimulates the egg to complete maturation
ii) It restores the diploid number of chromosomes in the zygote.
iii) It makes the egg more active metabolically.
iv) It activates the fertilized ovum to divide and grow into a new individual.
v) It brings the combination of the characters and results in variation.
vi) During fertilization, the mixing of the paternal and maternal chromosomes in the offspring is called ***Amphimixis***.

Types of Fertilization

Two types of fertilization are common among animals. They are external fertilization and internal fertilization.

External Fertilization – The fusion of the gametes occurs outside the body of the animal and is common in aquatic animals. In ***bony fishes***, ***frogs, echinoderms*** the sperms and ova are released into the water and their union occurs by chance. Since fertilization occurs outside the body of the animal externally, this method is called external fertilization.

Internal fertilization – When the fusion of the male and female

CHROMOSOME NUMBERS

★ Chromosome numbers are very specific for each species of an animal in ***diploid state (2n).***

★ Each gamete is with single set of cromosome called ***haploid set (n) or genome.***

★ ***Fertilisation*** maintains the diploid state of chromosomes.

Chromosome number of few animals species are :

Man	- **46**	Cat	- **38**
Gorilla	- **48**	Rat	- **42**
Frog	- **26**	Fruit fly	- **8**
Dog, Hen	- **78**	Hydra	- **32**
Cockroach	- **34**	Pigeon	- **80**

gamete occurs within the female genital tract it is called internal fertilization. This type of fertilization occurs in all terrestrial animals both oviparous and viviparous. ***Reptiles, Birds and mammals*** show internal fertilization.

Mechanism of Fertilization

The process of fertilization in animals involves four stages.

a) The meeting or approach of gametes

The gametes are brought into contact by chance or by physico – chemical events. In amphibia the movement of sperm is random and they collide with the eggs by chance. But the eggs of some species like man secrete a chemical substance called ***fertilizin.*** This substance attracts the sperms towards the egg. Fertilizin causes the sperms to clump together and stick to the surface of the egg. The sperms produces a substance ***antifertilizin*** in response to the fertilization phenomenon. It dissolves the egg membranes and penetrates into it causing fertilization. The fertilizin - antifertilizin is a highly species specific reaction.

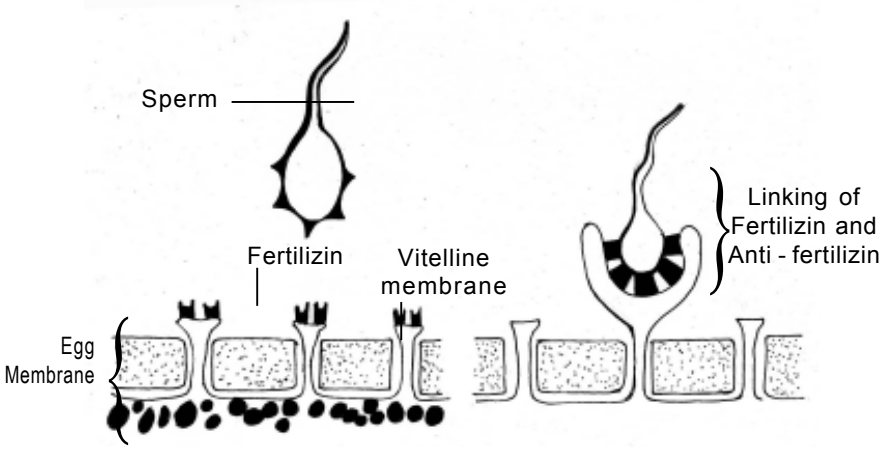


Fig 3.10 Fertilizin - antifertilizin reaction

b) Penetration of the sperm into the egg

The acrosome of the sperm helps in penetration of the sperm and is purely chemical. In mammals, the follicular cells are held by a cementing substance called ***hyaluronic acid***. When the sperm reaches the egg

surface, the acrosome secretes an enzyme called ***hyaluronidase*** which dissolves the follicle cells and gains entry.

c) Activation of the egg

When the sperm reaches the inner membrane of the egg, the cytoplasm projects outside forming the fertilization cone. The cone engulfs the sperm and only the middle piece and the nucleus enter the egg. These changes are collectively known as ***activation***. A fertilisation membrane is formed immediately to avoid ***polyspermy***.

d) Fusion of male and female nuclei

The fusion of the male and female nuclei is called ***Amphimixis***. The sperm head and middle piece move inward and rotates so that the mitochondria and middle piece are in front with the centrioles forming a spindle. The nuclear membrane of the gamete degenerates resulting in the union of the two sets of chromosomes. The fused product is called zygote.

The zygote undergoes rapid division and enters the next stage of development called cleavage.

Factfile :

★ In humans, spermatogenesis takes about 74 days.

★ The average volume of semen for each ejaculation is about 2.5 to 5 ml and the average of spermatozoa ejaculated is about 50 to 150 million / ml. When the number of spermotozoa falls below 20 million / ml, the male is likely to be infertile.

3.5. EMBRYOLOGY – EGG TYPES

The most important characteristic feature of every living organism is the capacity to reproduce its kind to perpetuate the species. The reproductive process includes a wide range of phenomenon from simple types in unicellular organisms to a highly complex type in higher animals.

Embryology is the study of the development of animals and plants. It deals with different phases of development such as gametogenesis, fertilization, cleavage, gastrulation, organogenesis, growth and maturity.

The fully formed female sex cell is termed ovum. They are large in size compared to the sperm. The egg contains almost all the materials which are essential for the entire process of development. It has three important functions.

They are

1. It supplies haploid (n) number of chromosomes to the future embryo.
2. It supplies almost all the cytoplasm of the egg to the embryo.
3. It supplies nutrients to the developing embryo.

Size and shape

Eggs are spherical in shape but in few animals the eggs are elongated, In cartilagenous fishes the egg are covered with a soft shell, and in insects the eggs are round. In vertebrates the size of the egg may vary from 0.07mm in mouse to 3.5 inches diameter in Ostrich. The eggs of mammals are minute almost yolkless and measure about 100μ in diameter.

Disposition of Eggs

Oviparity	-	Eggs are shed into the environment.
Viviparity	-	Eggs are retained internally and living young delivered.
Ovoviviparous	-	Young nourished by yolk.
Euviviparous	-	Young nourished by maternal tissues. (Placenta)

Types of Animal Eggs

The animal eggs are classified on the basis of (1) amount of yolk (2) distribution of yolk (3) presence or absence of shell and (4) Types of development.

Amount of yolk

(i) **Alecithal :** When the egg contains no yolk it is called Alecithal egg. Eg. Eggs of eutherian mammals.

(ii) **Microlecithal :** When the egg contains a small or negligible amount of yolk, Eg. ***Amphioxus***.

(iii) **Macrolecithal :** When the egg contains enormous amount of yolk. Yolk interferes with cleavage Eg. Birds.

Distribution of Yolk

(i) **Isolecithal :** An even distribution of yolk throughout the cytoplasm. Eg. ***Amphioxus***.

(ii) **Telolecithal :** Yolk concentrated at one pole, most vertebrate eggs are telolecithal. The presence of yolk at one end of the egg imposes polarity on the egg. The pole with the yolk is the vegetal pole, opposite hemisphere has the nucleus but little yolk and is the animal hemisphere eg. Frog.

(iii) **Centrolecithal :** Yolk is concentrated at the center of the egg. Cytoplasm forms a superficial cortex around the surface. Eg. Arthropods.

Presence or absence of shell

Cleidoic eggs : Fully laden with yolk and surrounded by albumen and a water proof shell, made up of calcium eg. ***Reptiles*** and ***Birds***.

Non cleidoic eggs : Non cleidoic eggs are not protected by shells. Eg. ***Frog***.

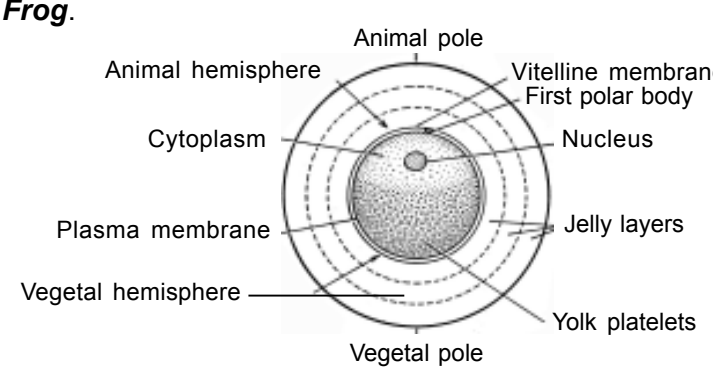


Fig 3.11 *Amphibian* egg - Frog

Basis of development

Determinate or Mosaic eggs : Definite fate of every part of egg is predetermined. If a particular portion of the egg is removed the developing embryo will be lacking in a particular organ. Eg. ***Annelids*** and ***Arthropods***.

Indeterminate or Regulative eggs : In majority of animals, there is no pre-determination. If a particular portion of the egg is removed it can

develop into a normal embryo without any defect. This type of egg is called regulative egg. Eg. ***Amphioxus***.

Amphibian egg

The fully matured egg of a frog is a large, spherical cell. As it contains moderate amount of yolk it is said to be ***mesolecithal.*** The yolk is in the form of small platelets and they are distributed unequally so it is ***telolecithal***. The egg is covered by thin, transparent, vitelline membrane and the nucleus is located in the animal pole. The opposite side is the vegetal pole. The egg of the frog is surrounded by a layer of jelly which protects the egg and adheres the other eggs. The cytoplasm is differentiated into two parts i.e. cortex and endoplasm. The cortex contains ***cortical granules***.

Hen's Egg

Hen's egg is a cleidoic egg with a water proof calcareous shell. It is elliptical in shape with one end broader than the other. It contains enormous amount of yolk so it is classified as ***macrolecithal*** or ***megalecithal***. A disc shaped ***blastodisc*** is present in a small area and the rest of the egg is covered with yolk. So this type of egg is termed ***discoidal***. The egg is surrounded by a membrane called vitelline membrane. In the center there is a mass of white yolk called ***latebra***. The latebra is surrounded by many concentric layers of white and yellow yolk. A strand of white yolk runs upwards from the latebra. It is called the neck of latebra.

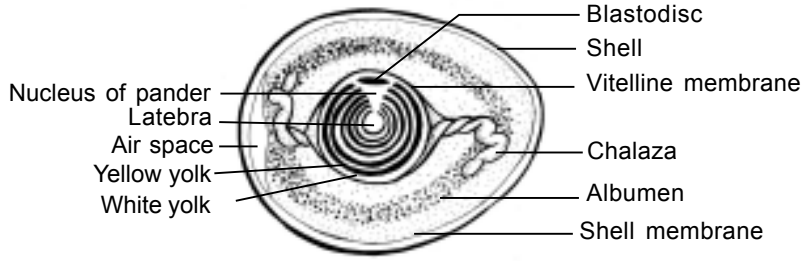


Fig 3.12 Structure of a Hen's egg

It spreads on the upper surface of the ovum as a plate called ***nucleus of Pander***. On the nucleus of Pander rests a mass of disc shaped cytoplasm with a nucleus. This is called the ***blastodisc***. The vitelline membrane is surrounded by the albumen or the white of the egg. Between the albumen and the vitelline membrane there is another membrane called

chalaziferous membrane. At each end of the egg, this membrane is twisted into cords called ***chalaza***. The albumen is surrounded by a double - shell membrane. The two membranes are separated by an air space at the broad end of the egg.

3.6 CLEAVAGE AND GASTRULATION

Cleavage : A series of mitotic cell divisions that transform the fertilized egg into a multicellular body is called segmentation or cleavage.

Planes of cleavage

Meridional : When the cleavage is passing through the animal - vegetal axis, it is termed meridional.

Vertical : When the cleavage furrow passes from animal pole to vegetal pole but not through the median axis.

Equatorial : When the cleavage is at the right angles to the median axis, half way between the animal and vegetal pole. Transverse, latitudinal or horizontal plane – similar to equatorial plane but it passes either above or below the equator of the egg.

Types of Cleavage

There are two main types of cleavage.

1. **Total or Holoblastic cleavage :** The entire egg divides by each Cleavage furrow.
    i. **Equal holoblasic cleavage :** When the blastromeres are of the same size. It mainly occurs in Microlecithal or Isolecithal eg. ***Amphioxus***.
    ii. **Unequal holoblastic cleavage :** If the blastomeres are unequal in size, the complete divisions of the egg is referred to as unequal holoblastic cleavage. It occurs in mesolecithal and telolecithal egg. Eg. Frog
2. **Partial or Meroblastic cleavage :** The division furrows divide only small amount of cytoplasm while yolky portion of egg remains undivided.

a. **Discoidal cleavage :** It occurs in fishes, reptiles and birds. Here the cytoplasm is placed at the animal pole as a disc called blastodisc, and this disc alone divides. Hence it is said to be discoidial.

b. **Superficial cleavage :** Superficial cleavage is characteristic of Centrolecithal eggs. (Insects)

Here the segmentation occurs only in the surface layer of the egg and does not extend into the central yolk.

The zygote undergoes Cleavage and divides into 2, 4, 8, 16 cells and so on. At the end of division it forms a spherical ball of cells called ***morula***.

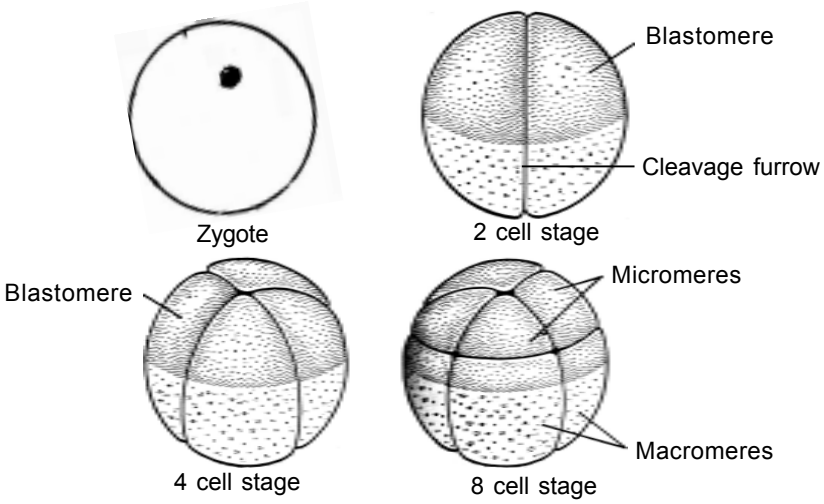


Fig 3.13 Stages during Cleavage in a Fertilized Frog egg

Morula Stage

This is a solid mass of ***blastomeres***. The morula is followed by the next phase of development called ***blastulation***.

Blastula Stage

When the cleavage is completed the morula develops into a hollow ball of cells called ***blastula***. The layer of cells is known as blastoderm and each is a blastomere and the fluid filled cavity is called blastocoel. The process of formation of blastula is known as ***blastulation***. In frog because of unequal holoblastic cleavage the blastomeres are divided into smaller micromeres and larger macromeres.

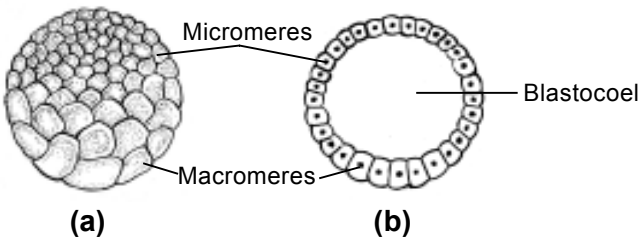


Fig 3.14 Structure of Blastula of an Amphioxus - a) Entire, b) L.S. of Blastula

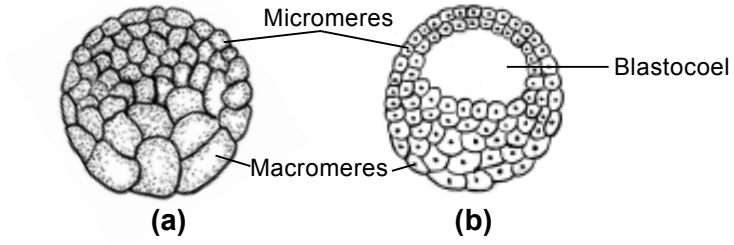


Fig 3.15 Structure of Blastula of an Amphibian - Frog a) Entire, b) L.S. of Blastula

Gastrulation

It is a dynamic process of cellular movements which form the three primordial germ layers, ectoderm, mesoderm, endoderm and the coelom. This involves the displacements of parts of the early embryo, the single layer of cells giving rise to three germinal layers. These germinal layers by a process called ***Organogensis*** result in the formation of various systems which constitutes the body of animal.

Table 3.2 Development of organs from three germinal layers.

Germ Layer	Derivatives
Ectoderm	Outer layers of integument and nervous system. Internal Ear Enamel of Teeth
Mesoderm	Muscles, Bones and Connective Tissues Excretory organs Reproductive organs
Endoderm	Lining of the gut, Primordial germ cells, Lungs and gills.

POINTS TO REMEMBER

1. **Reproduction** is the only means by which the continuity of a species is maintained.
2. In animals the gametes develop in the gonads by an elaborate process called **gametogenesis**
3. Sperm is the male gamete. It is highly specialized morphologically as well as physiologically for active motility.
4. Egg is the female gamete. It contains almost all the materials which is essential for the entire process of development.
5. **Fertilization** is the union of sperm and egg resulting in the formation of **zygote**.
6. Fertilization maintains the diploid number of chromosomes.
7. **Cleavage** is the segmentation of the zygote into blastomeres.
8. **Gastrulation** is the transformation of blastula into gastrula.

Activity :

1. Observe a slide of hydra with bud in the laboratory
2. Observe cleavage of Frog - 2 cell, 4 cell and 8 cell stages.
3. Open the shell of a Hen's egg. Transfer the contents in to a saucer and observe the parts.

SELF EVALUATION

I. Choose and write the correct answer

1. The fertilized egg divides by the process of
   a. Regeneration b. Cleavage
   c. Oogenesis d. Invagination
2. The eggs of insects is termed
   a. Isolecithal b. Centrolecithal
   c. Telolecithal d. Mesolecithal
3. Equal holoblastic Cleavage is found in
   a. Man b. Insect
   c. Amphioxus d. Frog
4. Spermatids contains
   a. Diploid number of Chromosomes
   b. Triploid number of Chromosomes
   c. Haploid number of Chromosomes
   d. Monoploid number of charomosomes
5. Spermiogenesis is the
   a. Conversion of ootid into ovum
   b. Conversion of spermatid into sperm
   c. Growth phase into maturation phase
   d. Conversion of spermetogonia into spermatid
6. Nurse cells is also called
   a. Sperm Cells b. Leydig cells
   c. Gamete Cells d. Sertoli cells
7. The spirally twisted cord like strands arise from the two ends of the egg are known as
   a. latebra b. Nucleus
   c. Chalaza d. blastodisc
8. The sperm produce substance of enzymatic nature called sperm lysin. In mammals it is called
   a. Hyaluronic acid b. Hyaluronidase
   c. Oestrogen d. Androgen

9. The cavity of gastrula is called

a. Blastocoel b. Archenteron
c. Coelom d. Haemocoel

10. Kidney is formed from

a. Ectoderm b. Mesoderm
c. Endoderm d. Coelom

II. Fill in the blanks with suitable terms

11. The central space present in blastula is known as _____
12. The cells which are formed as a result of cleavage are termed as _____
13. Asexual reproduction in Hydra is by _____
14. The hormone which maintains pregnancy is termed as _____
15. Polar body is formed during _____
16. Cleavage in telolecithal egg is holoblastic and _____
17. The birth canal is also called _____
18. The tail of sperm is formed by the _____ of the _____
19. Development of ovum in the follicles is called _____
20. Testis is _____ shaped.

III. Answer the following questions in one or two sentences

21. Define gametogenesis.
22. Define Cleavage.
23. What are called sertoli cells ?
24. Define regulative eggs. Give an example.
25. Define Telolecithal egg.
26. Define cledoic and non cledoic eggs.
27. Define Oogenesis.
28. What is called Morula?
29. Define Cyst in Amoeba.
30. What is meant by latebra ?
31. Explain blastula and blastulation
32. List the organs derived from ectoderm and mesoderm ?

IV. Write short answer for each of the following question in 100 words. Draw diagrams wherever necessary.

33. Write about Sexual reproduction in hydra?
34. Tabulate the differences between spermatogenesis and oogenesis.
35. Draw a labelled structure of a mature sperm.
36. Draw a neat labelled sketch of Hen's egg.

V. Write detailed answers for each of the following questions in 200 words. Draw diagrams wherever necessary

37 Explain in detail the process of fertilisation.
38. Explain the process of spermatogenesis.
39. Describe the menstrual cycle and structure of the uterus.

UNIT 4

OUR ENVIRONMENT

We know that the innumerable species of plants and animals found in this world are interdependent and are greatly influenced by their environment. The environment consists of both living organisms and the non-living substances (biotic and abiotic environment)

"A fish out of water" is a popular proverb which is used when some one feels uncomfortable. A fish is comfortable only in its surrounding i.e. water. We know that a fish dies when it is taken out of water. The same concept is applicable to many other organisms. A few organisms of course adapt themselves to a new environment.

4.1 WILD LIFE CONSERVATION

Our environment consists of forests, deserts, hills, rivers, oceans, ponds, lakes etc. All non-domesticated and non-cultivated biota found in natural habitat are termed ***'wildlife'***. Wildlife is an asset to be protected and preserved to our own advantage and to the benefit of future generations.

In our environment there has been drastic changes due to human intervention, ***industrialization*** and ***deforestation*** leading to large-scale killing of endangered species of animals and birds, felling of trees for timber and fuel etc. If there is no check, the entire species will become extinct. Hence the wildlife has to be conserved.

Indian Wildlife :

India has a rich bio-diversity. We have tropical, sub-tropical and temperate forests scattered all over the country. In the ***lofty Himalayas***, animals like musk deer, bears, snow-leopard, red panda are found. Eagles and snow patridges are the birds found here. At ***the slopes of***

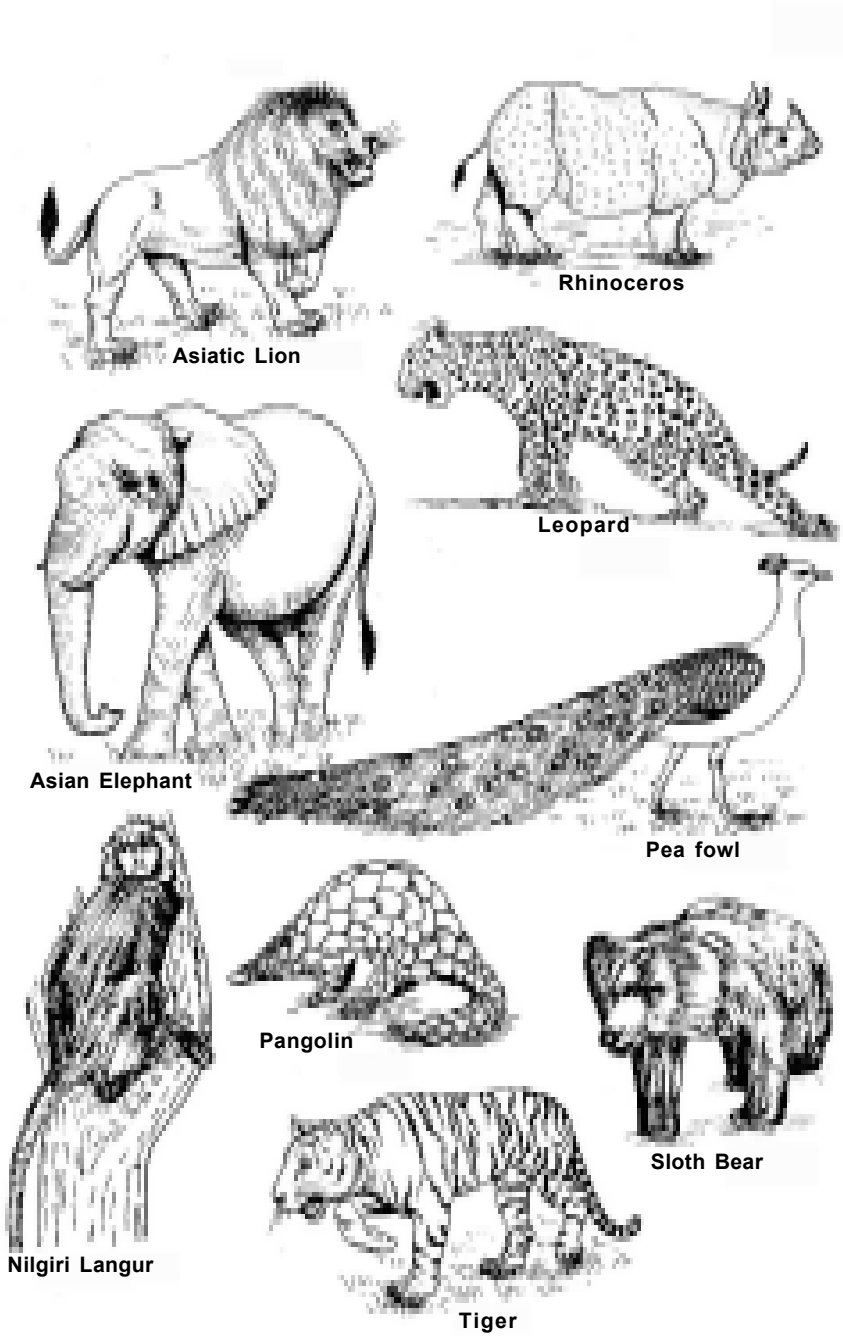


Fig 4.1 Some vanishing wild animals of India

Himalayas are found antelopes, deer, wolves, moles, mongooses, foxes etc.

The Terai belt has elephants, one horned rhino, tigers, panthers, hyaenas, jackals, buffaloes, antelopes and a variety of birds.

Indo-gangetic plain has a rich wildlife. Elephants, Sambhars, Tigers, Leopards, Panthers, Wild dogs etc. are found here.

Thar desert has different species of rodents, lizards and birds like peacock, bustard and pigeon.

Deccan Plateau also has a rich fauna. In the forests of western ghats, monkeys, mongooses, elephants, tigers and snakes are found.

The wild life which had a rich flora and fauna centuries ago had depleted at an alarming rate.

Animals like the lion, tiger, jackal, scaly ant-eater, snow leopard, rhinoceros, black buck, porcupine, gaur, gibbon and many more are on the ***verge of extinction***. Birds like horn bill, bustard, pheasant, sauras crane are also becoming extinct.

4.2 WILD LIFE MANAGEMENT – GOVERNMENTAL AND NGO ORGANISATION

To conserve wild life, many governmental and non-governmental organizations are actively involved in wild life conservation schemes.

The ***Bombay Natural History Society (BNHS), started in 1883,*** had been actively involved in wild life conservation.

In ***1952,*** Central Government of India Constituted the ***Indian Board for Wild Life (IBWL)*** for conserving the wildlife. Following this, many Indian states have setup wild life boards.

In ***1972, "Wild Life Protection Act"*** was enacted by the Central Government of India for setting up National Parks and Sanctuaries enabling special legal protection to endangered species of flora and fauna.

In ***1980, Forest Conservation Bill*** was passed which forbade deforestation of the forests without the permission of the Central Government.

In ***1982, Wild Life Institute of India*** was set up by the Ministry of Environment and Forest, Government of India.

Project Tiger :

In the year ***1973,*** Indian Government launched a special scheme, ***"Project Tiger"*** in collaboration with ***World Wide fund for nature (WWF)*** to save the tigers from extinction.

There are about 27 Tiger reserves in our country under "Project Tiger" to look after tiger population and the environment.

In our country, there are about 89 National Parks, about 500 wild life sanctuaries and about 13 Biosphere reserves maintained by the government.

GOVERNMENTAL AND NGO ORGANISATION

Some other Governmental and Non-Governmental Organisations (NGO) which are actively involved in wild life conservation are

1. World Wide Fund for Nature **(WWF)**, India.
2. Zoological Survey of India **(ZSI)**
3. The Biodiversity Support Program **(BSP)**
4. International Science Foundation **(ISF)**
5. Genetic Resource Action International **(GRAIN)**
6. International Union for Conservation of Nature and Natural Resources **(IUCN)**
7. Centre for Ecological Sciences, Bangalore
8. The Union Ministry of Environment and Forests
9. C.P.R. Environmental Education Centre, Chennai

IMPORTANT NATIONAL PARKS AND WILDLIFE SANCTUARIES IN INDIA :

Some important Sanctuaries and National Park which protect animals and birds in India are

1. Corbett National Park, Uttranchal (India's first National Park)
2. Sunderbans National Park, West Bengal
3. Manas Wildlife Sanctuary, Rajasthan
4. Bharatpur Bird Sanctuary, Rajasthan
5. Kaziranga National Park, Assam
6. Kanha National Park, Madhya Pradesh
7. Gir National Park, Gujarat
8. Bandhipur National Park, Karnataka

SOME IMPORTANT SANCTUARIES IN TAMIL NADU ARE

1. Mudumalai Wildlife Sanctuary, Nilgiri Hills
2. Aringnar Anna Zoological Park, Vandalur
3. Vedanthangal Birds Sanctuary, Kancheepuram District
4. Indira Gandhi Wildlife Sanctuary, Western Ghats
5. Gulf of Mannar Marine National Park, Coast of Ramnad and Tuticorin District
6. Kalakkadu Wildlife Sanctuary, Tirunelveli District.

IMPORTANT DAYS

- **World Forest Day** - **March 21st**
- **World Water Day** - **March 22nd**
- **Earth Day** - **April 22nd**
- **World Environment Day** - **June 5th**
- **World Ozone Day** - **September 16th**
- **World Wildlife Protection Week** - **October 2nd to 9th**

MAN AND BIOSPHERE :

Due to over population, man's interference with nature is on the increase as he upsets the biosphere by clearing the forests and killing the animals. The consequences are many – ***Ozone depletion, global warming, biological imbalance, depletion of natural resources, extinction of some species of animals*** etc. Man has to understand that the ecological balance is possible only if he changes some of the agricultural and industrial practices.

RED DATA BOOK

- ★ **This book contains a record of animals which are identified as *endangered species* or animals which are in imminent danger of extinction.**
- ★ **This book is maintained by the International Union for Conservation of Nature and Natural Resources *(IUCN)***

1. To prevent soil erosion, organic matter should be returned to the soil after each harvest, instead of the inorganic fertilizers which is normally used.
2. If possible, chemical controls should be replaced by biological controls.
3. Recycling of Industrial pollutants and wastes have to be made possible.
4. All necessary steps have to be taken to preserve rare plants and animals in their natural habitats.
5. Conservation of energy and water should be strictly followed.
6. People should be properly educated and guided for the conservation of nature's gifts.

RESTORING BALANCE IN ECOSYSTEM :

1. Control methods have to be adopted to check spoilage of landscapes.
2. There is a need for conservation and management of water. Hence water shed management and rain water harvesting is mandatory.

3. Forests, grasslands and semi-arid ecosystems are to be conserved and managed efficiently.
4. Ocean resources have to be conserved and marine life has to be preserved.
5. Wild life has to be conserved by enforcing legal procedures against poaching, hunting and bio-piracy.
6. Tribal culture and its linkage with forest resources should be encouraged.
7. Application of bio-technology should be made possible.
8. Public awareness programmes concerning conservation of water, soil, air, forests and other resources should be organised.

Wild life is considered to be of great importance for its ecological, commercial, scientific, aesthetic and medicinal value. Hence it is absolutely necessary to restore balance in ecosystem, check pollution and strive for a better environment.

POINTS TO REMEMBER

1. Wild life is to be protected and preserved.
2. India has a rich bio-diversity.
3. Many animals are on the verge of extinction.
4. To preserve the wild life many governmental and non-governmental organizations have introduced many wild-life conservation schemes.
5. Man's interference with nature has upset the biosphere.
6. Man has to bring in certain changes in the agricultural and industrial field to restore balance in the ecosystem.

SELF EVALUATION

I. Choose and write the correct answers

1. Bombay Natural History Society was started in _____
   a. 1888 b. 1880 c. 1883 d. 1989
2. In the year _____ Wild Life Protection Act was enacted.
   a. 1770 b. 1885 c. 1872 d. 1972
3. There are _____ Tiger resources in India
   a. 27 b. 29 c. 40 d. 50

II. Fill in the blanks

4. _____ is the first National Park in India.
5. Vedanthangal Birds Sanctuary is in _____ district.
6. _____ Act was enacted in 1972 to Protect Wild Life and endangered species.
7. Indian government had launched a special scheme called _____ to save the tigers from extinction.
8. In the year _____ wild life Institute of India (WII) was set up.
9. The black buck is at the verge of _____

III. Answer the following questions in one or two sentences.

10. Write a note on “Project Tiger”
11. What is Wild life ?
12. Name any two important sanctuaries located in Tamilnadu.
13. Expand IUCN
14. Name the few fauna found in Thar Desert.

IV. Write short answers for each of the following questions in 100 words. Draw diagrams wherever necessary.

15. Write a note on importance of Wild life. Write a brief account on Indian Wild life.

16. Write a brief account on Indian Wild life.
17. Write a short note on wild life management.
18. Write a short note on Man in the Biosphere.

V. Write detailed answers for each of the following questions in 200 words. Draw diagrams wherever necessary.

19. Write an essay on wild life conservation.
20. Write about the role of Government and NGO Organisation in Wild life management.
21. Enumerate the methods by which we can restore balance in Ecosystem.

MAATHAI !
A FRIEND OF OUR EARTH

★ ***Wangari Maathai*** **was the first woman from Africa honoured with the Nobel Peace Prize for the year 2004 by the Norwegian Nobel Committee for her contribution to sustainable ecological and environmental development.**

★ **On 5th June, 1977 World Environment day she planted nine trees in her backyard and founded the *GREEN BELT MOVEMENT*.**

★ **Over a period of nearly thirty years she has mobilized poor women to plant *thirty million trees* in protecting the existing environment for ecologically sustainable development, which plays a vital role in afforestation.**

UNIT 5

APPLIED EMBRYOLOGY

Embryology is the branch in biology which deals with the development of embryo into the youngone. Since the zygote develops into a complete organism through various embryonic stages, it is also called ***Developmental Biology***. The higher animals show ***sexual dimorphism*** i.e. the male and female organisms are separately seen in the population of a particular species. The sexually dimorphic animals reproduce by sexual method. During sexual reproduction the male individuals produce male gametes called sperms by a process called ***spermatogenesis*** and the female individuals produce female gametes called ova by a process called ***oogenesis***. One sperm fuses with one ovum and form a fertilized egg called ***zygote***. This process of fusion of a sperm and ovum is called ***fertilization***. The zygote develops into an young one.

The embryonic development includes the stages like gametogenesis, fertilization, cleavage, gastrulation, organogenesis, differentiation and growth.

1. Gamatogenesis :

It is the process of development of gametes (sex cells) in the gonads (reproductive organs). The process of development of sperms in the testis of males is called spermatogenesis. The process of development of ova in the ovary of females is called oogenesis.

2. Fertilization :

It is the process of fusion of male and female gamates (a sperm and ovum respectively) and form a zygote.

3. Cleavage :

It is the process of conversion of the zygote into a multicellular, single layered, spherical hollow structure called ***blastula*** by repeated mitotic division.

4. Gastrulation :

It is the process of conversion of a single layered blastula into a three layered hollow gastrula by specific movements of cells of blastula.

5. Organogenesis :

It is the process of development of various organs from the three primitive layers of gastrula.

6. Differentiation :

It is the process of formation of various tissues, organs and systems by the modifications of cells.

7. Growth :

It is increase in the size of the embryo and also increase in the body mass.

Applied Embryology

Applied embryology deals with the application of various techniques in the field of embryology. By applying various techniques in the reproduction process, scientists produce varieties of genetically modified animals with better qualities such as more yield, disease resistance, stronger and large sized animals etc. It also plays vital role in the field of genetics, microbiology, horticulture etc. It also enhances our understanding on the human reproductive process such as ***artificial insemination, invitro fertilization, hormonal replacement*** etc. There are many techniques applied in embryology. In this unit we will discuss about a few techniques.

5.1. TISSUE CULTURE

Tissue culture is a technique applied to grow the tissues of plants and animals by in vitro culture. ***'In vitro'*** culture means culturing the tissues outside the body of living organisms i.e. in the laboratory.

Plant tissue culture is developed based on a principle called ***'totipotency'***. Totipotency is the inherent capacity of a living plant cell to develop into a complete plant of the same variety. It is a peculiar character of plants. According to this technique, if a living plant cell is isolated from a

plant and introduced in the standard culture medium, it grows into a mass of undifferentiated cells called ***'callus'***. When the callus is introduced into another culture medium with plant growth hormones such as ***auxins*** and ***cytotkinins,*** it grows into a complete plant with root and shoot systems. This plant is genetically same to the plant from which the cell is taken.

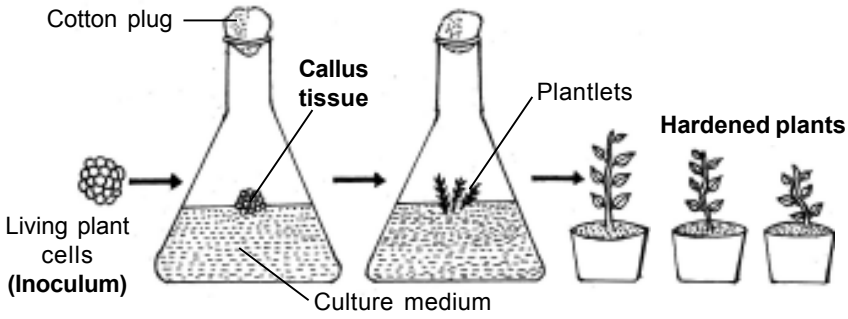


Fig 5.1 Digramatic representation of plant tissue culture

Significance of plant tissue culture

1. It is useful to produce genetically identical plants called ***clones***.
2. It is useful to perpetuate the rare species of plants
3. Genetically modified hybrids and their clones could be made by transgenesis (introduction of a new gene).
4. More healthier and disease resisting plants could be made.

Animal tissue culture

The cells of a tissue is isolated from an animal organ. These cells are allowed to grow and multiply in the laboratory in suitable conditions. The following steps are involved in animal tissue culture method.

- A block of tissue from an animal is isolated.
- The isolated tissue is kept in an isotonic medium. The isotonic medium keeps the tissue intact and alive condition.
- The tissue is transferred into a culture medium taken in a petridish. The culture medium supplies all essential nutrients to the tissue.

- The culture medium contains glucose, aminoacid, vitamins, minerals, oxygen suppliments etc.
- The culture medium and the tissue are kept in the optimum temperature of 37^{O}C.
- The pH range of the culture medium should be 7.2 to 7.4.
- The petridish, culture medium and tissue are maintained in aseptic condition.
- The cells of the tissue grow and multiply until the petridish is filled.
- A portion of the grown up tissue is isolated and introduced into another petridish containing culture medium. This is called ***sub culturing.***
- The culture medium should be changed once in fifteen days.
- The waste products produced by the tissue should be removed periodically.
- The multiplication of cells in the petridish should observed carefully.

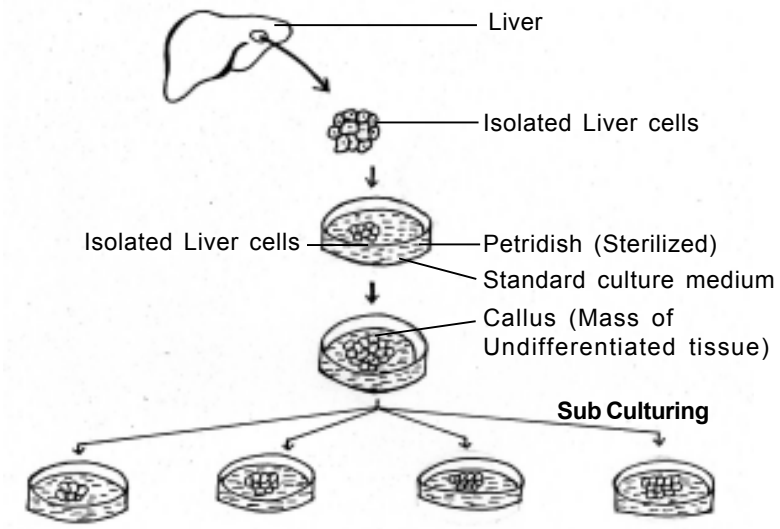


Fig 5.2 Animal tissue culture

Significance of animal tissue culture

1. Cultured tissue becomes the host for viruses. This helps to do research in viruses.
2. The cells of the tissue culture become identical genetically.

3. By introducing new genes into the cells, genetically modified cell clones are produced.
4. It is helpful in the identification of different cell types involved in immune system.
5. It is useful to detect the cancerous growth in blood and in the lymph glands.

5.2. CLONED ANIMALS

Animal cloning is a technique by which genetically identical individuals are raised. Animal clones are of two types. They are natural clones and induced clones. The natural clones include identical twins. But the induced (artificial) clones are developed by the nuclear transfer into the other host cell.

Induced cloning procedure

The procedure of induced cloning in mammals has the following steps.

1. A ***somatic cell (body cell)*** of an animal for which the clones are to be raised is isolated. This cell is called ***donor cell***.
2. The diploid nucleus (2n) of the donor cell is isolated. This diploid nucleus retains all the genetic informations for the all the genetic informations for the development of a complete and genetically identical individual.
3. The ovum from the reproductive tract of female animal of the same species is isolated.
4. The haploid nucleus (n) of the ovum is removed because it has no capacity to develop into an adult. (only diploid ***zygote*** can develop into an adult)
5. The diploid nucleus of the somatic donor cell is transplanted into the cytoplasm of the ovum.
6. The ovum with transplanted diploid nucleus is implanted into the ***uterus*** (natural environmental condition for embryonic development) of the female animal of the same species.

7. The ovum develops into an young one which is ***genetically***, ***morphologically, anatomically*** and ***physiologically*** similar to that of the animal from which the somatic nucleus is taken. This identical young one is called the clone.

Development of Dolly (a kind of sheep) :

Dolly was a cloned sheep developed by **Dr. Ian Wilmut** and his colleagues in Roslind Institute in Scotland in ***July 1996***. To produce Dolly, the scientists used the nucleus of udder cell (somatic cell taken from the mammary gland) from a six year old Finn Dorset White sheep. The nucleus of the udder cell contains diploid number of chromosomes with all the genes. They preserved the diploid nucleus in a suitable preservative. Then they took an ovum from the uterus of an another sheep. The haploid nucleus (n) in the ovum is removed. The diploid nucleus of the udder cell was injected into the cytoplasm of the enucleated ovum. Then the ovum with diploid nucleus was implanted into the uterus of surrogate mother sheep. Since the ovum had the diploid nucleus, it developed into an young clone called ***'Dolly'.***

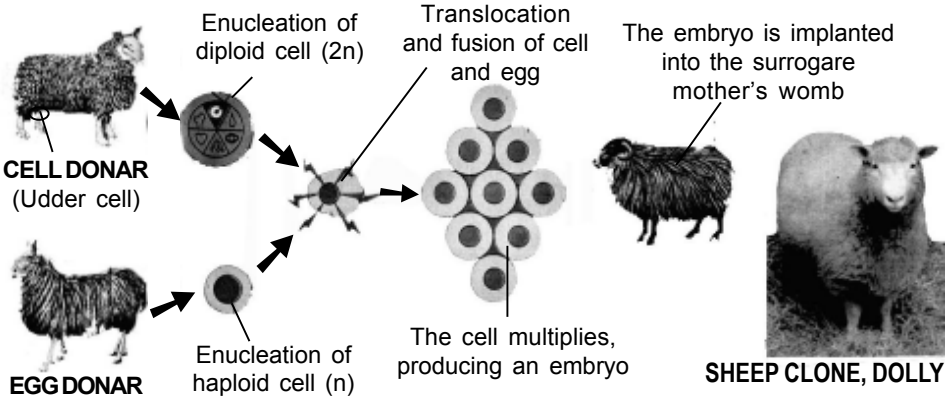


Fig 5.3 Mechanism of cloning of sheep

Significance of cloning in animals :

1. The main aim of cloning is the production of medicines in the milk secreted by mammary glands of mammals. These medicines can prevent ***Haemophilia or bleeder's disease*** (lack of blood clot – a genetic problem), Cystic fibrosis and the lung problems.

2. The combined application of genetic engineering and cloning technique on pig make the development of suitable organs in the pig which could be transplanted into human body. This kind of transplantation of organs from pig to man is called ***Xenotransplantation***. Example : heart valve transplantation from pig to man.
3. The cloning technology makes the scientists to understand the process of development of embryo, ageing and age related problems.
4. The study of animal cloning used to create better animals with disease resistance.
5. It also leads to the understanding and treating the diseases.
6. It can enhance the biodiversity by ensuring the continuation of rare breeds and endangered species.

History of Cloning	
Year	Cloned Animals
1952	*Rana pipiens*
1956	Toads
1989-90	Rabbit, Sheep and Cow
1996	Megan Sheep and Morag Sheep
1996	The sheep **'Dolly'**
1998	Mice, Cow, Pig and Goats
2000	Monkey
2001	Gene knock in sheep

5.3. STEM CELLS (ORGAN REPAIR) :

One of the most fascinating branches in applied embryology is the ***stem cell culture***. The stem cells are the most unspecialised mass of cells. They are derived from animals and plants. They have two important characteristic features. They are

1. Stem cells are unspecialized cells which have the potentiality of growing and multiplying into enormous number of same type a cells by repeated mitosis.

2. They can be induced to become any other type of tissues with specific functions. i.e. they can be induced to become cardiac muscles, beta cells of pancreas, special neurons in the brain etc.

There are two kinds of stem cells. They are

1. Embryonic stem cells, 2. Somatic or adult stem cells.

1. EMBRYONIC STEM CELLS :

The embryonic stem cells can be derived from early embryo which is developed by an ***"in vitro fertilization"*** (fertilization made artificially in the laboratory). After fertilization the zygote develops into a hollow blastula by cell division. The inner mass of undifferentiated cells are isolated and they are considered as embryonic stem cells.

Growing embryonic stem cells in the laboratory :

A few skin cells of a mouse embryo is isolated. These cells are treated with special chemicals so that these cells do not divide. The mouse embryonic skin cells are spreaded on the inner surface of the sterile culture dish. This layer of ***mouse embryonic skin cells*** is called ***feeder layer*** because it is the source of nutrients to the stem cells. Some amount of culture medium is taken in the culture dish on the feeder layer. The embryonic stem cells which are derived from the blastula is introduced into the culture medium. The stem cells absorb the nutrients from the feeder layer and from the culture medium. They grow and multiply into undifferentiated huge mass of cells. Some of these cells are isolated gently in groups and are transferred into several fresh culture dishes. This is called ***sub-culturing.*** This process of sub-culturing is repeated for several times. After six months millions of genetically identical embryonic stem cells are produced. These embryonic stem cells have the potentiality to differentiate into about two hundred different types of cells. This potentiality of the embryonic stem cells into different types of cells is called ***pleuripotent***.

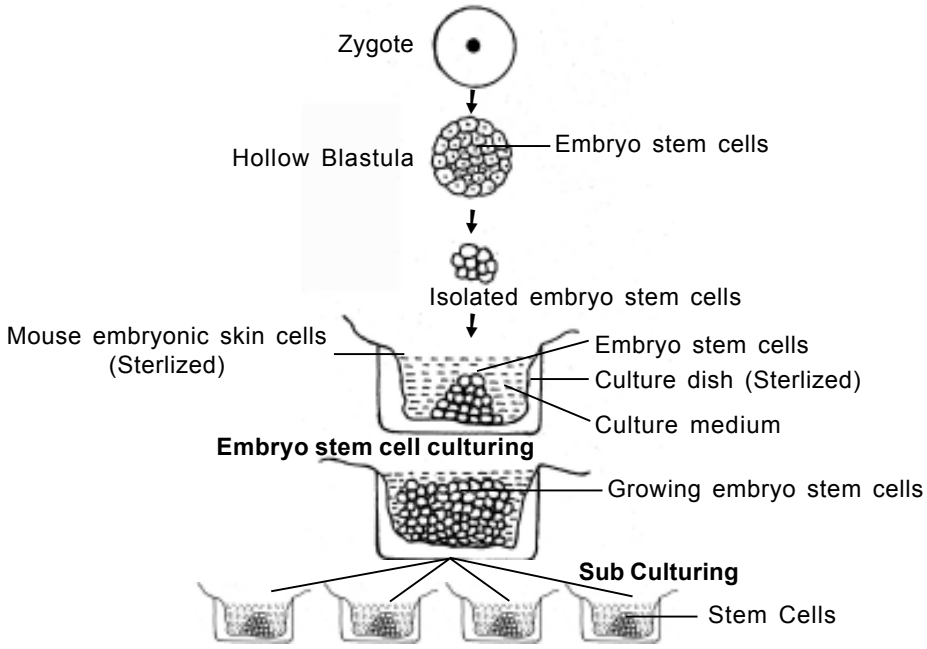


Fig 5.4 Isolation and culturing of embryonic stem cells

2. Adult or somatic stem cells :

The body of higher animals and human beings have many well differentiated tissues like epithelial, connective, muscular, vascular, supporting, nervous and reproductive tissues. They are also called ***permanent tissues.*** In these tissues, there are some undifferentiated cells. These undifferentiated cells are considered as the ***adult or somatic stem cells.*** They can grow, multiply and can be differentiated into same type of tissue in which they are implanted. The mechanism of adult or somatic stem cell culture is similar to that of embryonic stem cell culture.

Applications of stem cell technique :

If any organ in our body shows some defects due to damage or degeneration of cells, they are rectified by implanting a stem cell in the organ. With the help of some stimulant, the stem cells proliferate and differentiate into healthy cells of the organ. Thus the defect of the organ is rectified. It is also called organ repair. The following are some of the applications of stem cells.

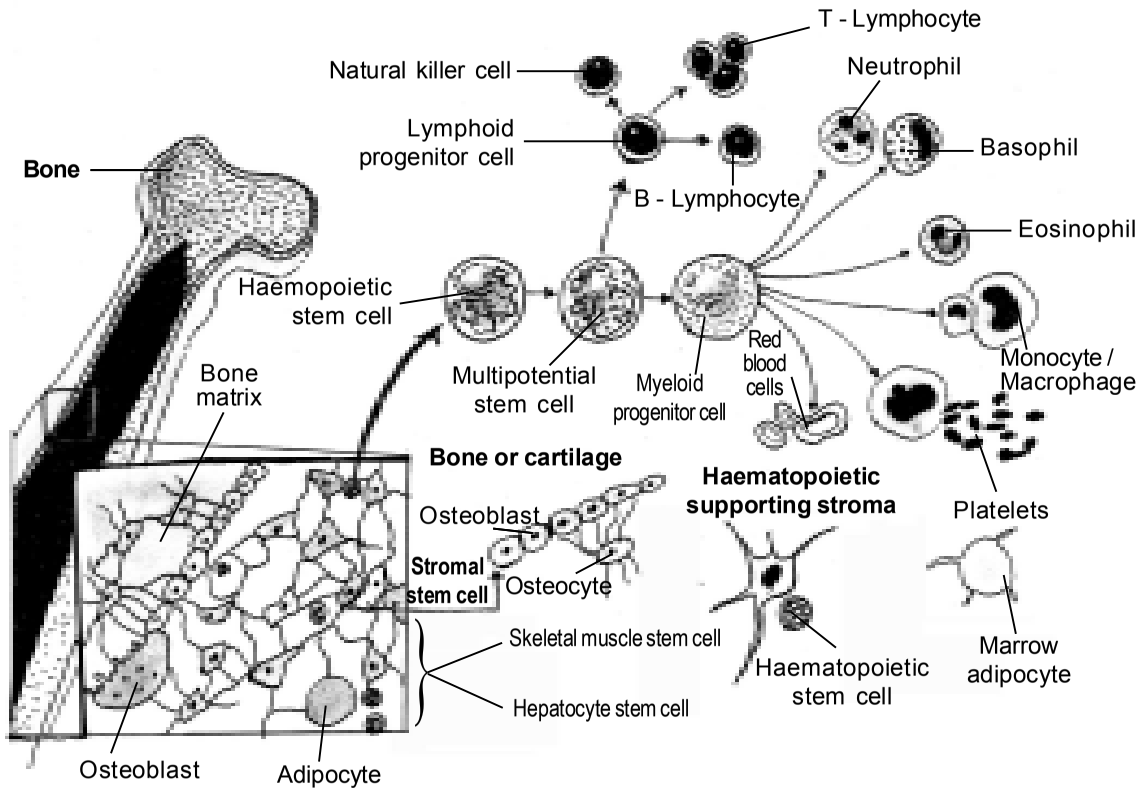


Fig 5.5 Adult somatic stem cell culture

1. ***Haematopoietic stem cells*** taken from bone marrow can give rise to all the types of blood cells such as erythrocytes, leucocytes and thrombocytes.
2. Bone marrow stromal stem cells can develop into bone cells, cartiliage cells, fat cells etc.
3. Neural stem cells can develop into special neurons that rectify the brain defects.
4. Epithelial stem cells of digestive system give rise to absorptive cells, goblet cells, endocrine cells etc.

EXCITING CELL CULTURE

★ ***James Thomson*** **of the University of Wisconsin in *1998* first isolated the human embryonic stem cells, which explored the possibility of using stem cells to restore damaged or lost tissue.**

★ **In embryonic stem cell culture, researchers can only use embryos that are upto 14 days old, which cells are still living.**

5. Skin stem cells develop into dead cells on the surface of the skin.
6. Skin follicular stem cells give rise to follicle and epidermis of the skin.
7. Glandular stem cells from pancreas give rise to beta cells to secrete more insulin.

POINTS TO REMEMBER

1. Embryology is also called developmental biology.
2. Higher animals show sexual dimorphism.
3. Spermatogenesis is the formation of sperms in the testis.
4. Oogenesis is the formation of ova in the oovary.
5. ***Fertilized egg*** is the zygote.
6. Fertilization is the fusion of male and female gametes i.e. sperm and ovum.
7. Cleavage is the repeated mitotic division.
8. Blastula is a hollow spherical, multicellular ball like structure.
9. Organogenesis is the development of various organs.
10. ***Applied embryology*** is the application of various techniques in the field of embryology.

11. ***Invitro fertilization*** means fertilization outside the body i.e. in the laboratory.
12. Invitro tissue culture means culturing tissue in the laboratory.
13. Plant tissue culture is based on a principle called ***"totipotency"***.
14. The mass of undifferentiated cells formed in tissue culture technique is called ***callus***.
15. In tissue culture the ***auxin*** and ***cytokinin*** are essential for differentiation of tissues.
16. ***Transgenesis*** means introduction of a new gene into the cell.
17. The optimum temperature for animal tissue culture is ***37^{o}C***.
18. Repeated culturing of tissue is called ***sub-culturing***.
19. Cultured tissue is the host for viruses.
20. Tissue culture is used to detect cancer.
21. Identical twins are natural clones.
22. Haploid nucleus has no capacity to develop into a complete organism.
23. ***'Dolly'*** was developed by ***Dr. Ian Wilmut*** and his colleagues.
24. ***Udder cell*** is the cell taken from the mammary gland.
25. ***Haemophilia*** is a genetic problem.
26. Haemophilia is lack of blood clot.
27. ***Gene knock*** in sheep was made in 2001.
28. The stem cells are the most unspecialized mass of cells.
29. ***Embryonic stem cells*** and ***somatic stem cells*** are the two types of stem cells.
30. ***The mouse embryo stem cells*** is the feeder layer of stem cells.
31. Haematopoietic stem cells can give rise to blood cells.
32. Glandular stem cells from pancreas give rise to beta cells to produce more ***insulin***.

SELF EVALUATION

I. Choose and write the correct answers

1. Which is also called developmental biology ?
   a. Embryology b. Cleavage
   c. Gastrulation d. All of these
2. The process of formation of sperms in called
   a. Gametogenesis b. Oogenesis
   c. Spermatogenesis d. Cleavage
3. The repeated mitotic division takes place during
   a. Gametogenesis b. Fertilization
   c. Cleavage d. Gastrulation
4. Artificial insemination is understood by the study of
   a. Fertilisation b. Developmental biology
   c. Embryology d. Applied embryology
5. Identical twins belong to
   a. Natural clones b. Induced clones
   c. Invitro fertilization d. Embryology
6. Which of the following retains all the genetic informations?
   a. Haploid nucleus b. Diploid nucleus
   c. Unfertilised egg cell d. All of these
7. Megan and Morag sheep were developed in the year
   a. 1952 b. 1990 c. 1996 d. 2000
8. Stem cells can be induced to become
   a. Cardiac muscle b. Beta cells of Pancreas
   c. Neurons in the brain d. All of these
9. Hematopoietic stem cells give rise to
   a. Erythrocytes b. Leucocytes
   c. Thrombocytes d. All of these
10. Goblet cells are derived from _____ stem cells.
    a. Hematopoietic b. Bone marrow stromal
    c. Neural d. Epithelial

II. Fill in the blanks with suitable terms.

11. Ovum is produced by the process called _____
12. _____ is the process of formation of sperms.
13. _____ is the process of fusion of male and female gametes.
14. The somatic cell of an animal to which the clones are to be made is called _____ cell.
15. _____ from the egg has no capacity to develop into an adult.
16. Dolly was developed in _____ institute in Scotland.
17. In the history of cloning toads were cloned in the year _____
18. In the history of cloning _____ in sheep was done in 2001.
19. _____ stem cells can be derived from early embryo.
20. In the embryonic stem cell culture, the mouse embryonic skin cells are called _____ layer.

III. Answer the following questions in one or two sentences.

21. Define embryology.
22. What is developmental biology?
23. Define gametogenesis.
24. Define fertilization.
25. Define cleavage
26. Define gastrulation
27. Define organogenesis.
28. What is applied embryology?
29. What is the significance of applied embryology?
30. What is tissue culture?
31. Mention the conditions necessary for tissue culture
32. What is meant by induced cloning?
33. What is clone?
34. What are udder cells?
35. What is meant by embryonic stem cells?
36. What is meant by somatic stem cells?
37. What is meant by Sub culturing?

IV. Write short answers for each of the following questions in 100 words. Draw diagrams wherever necessary.

38. Give an account of the significance of animal cloning.
39. Give an account of the application of stem cells
40. Give an account of the application of tissue culture.

V. Write detailed answers for each of the following questions in 200 words. Draw diagrams wherever necessary.

41. Describe the steps involved in the process of cloning mammals.
42. Describe the development of “Dolly”
43. Describe the process of Culture of embryonic stem cells in the laboratory.
44. Explain the process involved in tissue culture in animals.

UNIT 6

DISEASES AND IMMUNOLOGY

Human body has many systems. All the systems perform their own common functions. When all the systems perform their functions in a coordinated manner, then the body is said to be in good condition. Keeping the body in good condition is called ***Homoeostasis.*** This also indicates that the person is healthy in physical, mental and social dimensions.

The word ***"disease"*** means ***"without ease"*** (uneasiness). Disease is the condition in the body in which the function of a system or an organ is disturbed or abnormal. Diseases are caused due to various factors such as environmental factors, nutritional factors, genetic factors, metabolic factors etc. Based on these factors, the diseases are classified into three types. They are communicable diseases, hereditary diseases and non communicable diseases. Communicable diseases are caused by the ***pathogens*** which can spread from one person to another either directly or through some agents. Hereditary or genetic diseases are caused due to some genetic defects and can be inherited by subsequent generation. The non communicable diseases are caused due to metabolic disorders, nutritional deficiencies, hormonal and enzymatic abnormalities etc. These diseases do not spread to others.

In this unit, let us discuss some of the non communicable diseases in man and some immunological aspects.

6.1 NON COMMUNICABLE DISEASES

A. DIABETES MELLITUS

The normal glucose level in human blood is ranging between 80mg and 120mg/100ml. This level is perfectly maintained by a hormone called ***insulin*** secreted by the ***beta cells of Islets of langerhans*** in pancreas (refer endocrine system in human physiology). Whenever the

glucose level in the blood is increased, sufficient amount of insulin is secreted by beta cells. This insulin is responsible for removing the excess of glucose from the blood and storing it in the liver in the form of ***glycogen***. By doing this, it helps to maintain the glucose level in the blood.

Diabetes mellitus is caused due to the deficiency of insulin. Insufficient quantity of insulin can take only a part of excess of glucose to the liver for storage and the rest of excess of glucose is left in the blood. Thus the glucose level in the blood is always high. This condition is called ***hyperglycemia.*** When the blood with excess of glucose enters into the kidneys, the excess of glucose is excreted along with urine. This elimination of excess of glucose along with urine is called diabetes mellitus. When the kidneys receive the blood with lot of glucose, the tissues in the kidneys are destroyed which leads to ***renal failure.*** Ultimately this leads to the death of the individual.

Causes of Diabetes mellitus

1. The gene responsible for insulin production is defective.
2. Viral infection in the beta cells.
3. Bovine serum albumen (a type of protein) found in cow's milk can damage the beta cells in early infancy.
4. Mental stress can suppress the beta cells from the production of insulin.
5. Mechanical damage in the pancreas.

Symptoms

The diabetic patients show the following symptoms :

a. Polyurea : It is the frequent excretion of excessive quantity of urine.

b. Polydipsia : It is the development of excessive thirst and increased consumption of water.

c. Polyphagia : It is the excessive appetite and the consumption of excessive food.

Loss of body weight, weakness, body ache, skin boils, loss of skin texture, cracked lips etc. are other symptoms.

Control and Prevention

1. Less intake of high energy carbohydrates.
2. Consumption of low energy and weight reducing diet like vegetables and fruits.
3. Reducing Obesity
4. Avoiding alcohol and smoking
5. Controlling blood pressure and cholesterol
6. Consumption of controlled diet with oral hypoglycemic drugs
7. Treatment with insulin

B. DIABETES INSIPIDUS

It is an uncommon disease in man, characterised by the persistant excretion of excessive quantity of dilute urine. It results in frequent thirst. It is caused due to the deficiency of a hormone called ***Anti diuretic hormone*** (ADH) secreted by the neurohypophysis of pituitary gland. Deficiency of ADH makes the wall of the renal tubule of nephron impermeable to water. So the wall of the renal tubule reabsorbs very less amount of water. The remaining water is excreted by the kidneys along with urine. This elimination of excess of water along with urine is called ***diuresis*** which is also termed as ***diabetes insipidus***.

Symptoms

1. Frequent and excessive excretion of dilute urine.
2. Excessive thirst
3. Loss of body weight
4. Retarded growth in young individuals

Treatment

The problem of diabetes insipidus is rectified by administering sufficient amount of anti diuretic hormone.

C. Coronary Heart Disease (CHD)

Coronary heart disease is defined as an impairment of heart functions due to inadequate blood supply to the heart. The wall of the heart gets blood supply from the aorta through a pair of small coronary arteries. Due to some risk factors there may be blockage or narrowing of the coronary arteries which results in inadequate blood supply to the heart muscles. It is one of the biggest health problems in the world.

Risk factors

The risk factors causing CHD are classified into non-modifiable and modifiable risk factors. The non-modifiable risk factors are the age, male sex and family history. The modifiable risk factors are smoking, hypertension, cholesterol, diabetes mellitus, sedentary life style (physical inactivity), obesity, deficiency of vitamins. alcoholism, mental stress etc.

Symptoms

1. Chest Pain
2. Dizziness
3. Dyspnoea (Shortness of breath)
4. Swelling of legs and ankles

Control and Prevention

1. Abstinence from smoking
2. Regular physical exercise
3. Maintaining Ideal body weight
4. Regular consumptions of fruits and green vegetables

D. RHEUMATIC HEART DISEASE (RHD)

It is a common disease affecting children and young adults all over the world. It is a crippling disease, caused by a specific group of ***Streptococci bacteria*** which infect the throat of the children. The ***Streptococci*** bacteria secrete a specific antigen (poison). This antigen circulates through blood and attack the connective tissues, heart wall and

the heart valves. It leads to the death of the individual if prompt treatment is not given.

Symptoms

1. Rheumatic fever
2. Anorexia
3. Polyarthritis (Swelling of joints with pain)
4. Difficulty in breathing
5. Palpitation and Chest pain
6. Cardiac enlargement and cardiac murmur
7. Skin rashes
8. Enlarged nodules below the skin

Prevention and Cure

Eradication of Streptococcal infection and prevention of recurrence are essential. The Streptococcal bacteria are eradicated by giving anti-streptococcal drugs such as ***Benzathine Penicillin*** and ***Phenoxymethyl Penicillin.*** For the prevention of recurrence, the anit-streptococcal drugs should be given to the patient upto the age of 30. Cleanliness and better housing can prevent the entry of streptococci into the body of children.

E. RENAL FAILURE

The term renal failure is used to denote the failure of excretory functions of the kidneys. It leads to the accumulation of nitrogenous wastes in the blood and tissues ***(uraemia),*** imbalance of water and electrolytes in the body, variation in blood pressure etc. The renal failures are of two types. They are

1. Acute renal failure
2. Chronic renal failure

The ***acute renal failure*** refers to sudden and reversible loss of renal function. It is developed over a period of a few days or a few weeks. It is mainly caused due to heart failure, narrowing of renal arteries, toxic drugs and renal infections. If proper treatment is given at an early stage, the normal renal function will be resumed quickly.

The ***Chronic renal failure*** is an irreversible deterioration in the renal function. It is developed over a period of few years. It is caused mainly due to disturbance in water balance, electrolytic balance and acid-base balance in the blood. It is also caused due to the accumulation of various toxic substances in the blood and kidney tissues. Early detection and prompt treatment may bring the kidney back to normal condition.

F. OBESITY

Obesity is defined as an abnormal growth of the adipose tissues. Adipose tissue is the fat storing tissue beneath the skin. It consists of a few layers of fat storing cells. When these cells store excessive fat they become very thick and cause obesity. It leads to over weight where the body weight is greater than normal according to the height, sex and age.

Factors causing obesity

It is caused due to the following factors.

1. Genetic factor
2. Physical inactivity
2. Consumption of diet containing more fat
4. Endocrine abnormalities
5. Consumption of some steroid drugs etc.

Consequences of Obesity

Obesity develops some serious consequences such as hypertension, stroke, CHD, cancer, gall stone formation, diabetes mellitus, arthritis and psychological depression.

Prevention and control

Obesity is prevented and controlled by diet restriction, body weight reduction, increased physical activities etc.

G. HYPERTENSION

Hypertension is high blood pressure. The normal systolic and diastolic blood pressure is **120mm/Hg** and **80mm/Hg** respectively. If the systolic pressure is greater than 160mm/Hg and the diastolic pressure is greater than 95mm/Hg, then it is called hypertension.

Risk factors

The risk factors causing hypertension are classified into two groups. They are

1. Non modifiable risk factors
2. Modifiable risk facors

1. Non Modifiable risk factors

i. Age : Blood Pressure is increased according to the age in both males and females.

ii. Genetic factors : The defective genes can raise the blood pressure.

2. Modifiable risk factors

i. Obesity
ii. Salt intake
iii. Excess of serum cholesterol
iv. Hormonal imbalance

Prevention and Control

Hypertension can be prevented and controlled by diet control, physical exercise, mental relaxation by meditation and by drug therapy.

6.2 ADDICTION

There are certain drugs and alcohol which are useful to cure certain diseases. When these drugs are consumed with the advice of medical practitioners in prescribed dosages, they cure the diseases and the systems in our body are not affected. For example, sleeping pills are prescribed by medical practitioners when the patients suffer by severe pain, high blood pressure and psychological problems. The minimum dosage of alcohol is a good appetizer and also cures the cough.

When these drugs and alcohol are misused and consumed in large quantities by the individuals without the consultation of medical practitioners, they affect the central nervous system, liver, spleen, kidneys, heart etc. Slowly the individual becomes addict to these drugs and alcohol. This addiction leads to personal problems, social problems etc. Let us learn more about the addiction to alcohol and narcotic durgs and their consequences.

6.3 ALCOHOLISM

Alcoholism is a ***killer disease.*** The term “alcoholism” means a pattern of drinking alcoholic drinks which is harmful to the individual and also to the family members. It leads to severe physical, psychological and social problems. Alcohol has empty calories. It has no nutritive value. The people become addict to alcohol because of the following reasons.

- Curiosity to taste
- Motivated by their companions (of same age group)
- Social status of the individual
- Noise pollution in the factories
- Relaxation after heavy physical work etc.

Physical problems due to alcoholism

Addiction to alcohol leads to the following physical problems in the individuals.

- Oropharyngeal cancer

- Oesophageal cancer
- Gastritis
- Pancreatic malfunctioning
- Swelling of Joints
- Liver cancer, Hepatitis and Liver cirrhosis
- Pneumonia and tuberculosis
- Cerebral haemorrhage
- Dementia (mental abnormalities)
- Cerebellar degeneration
- Heart wall damage
- Hypertension etc.

Psychological problems

Addiction to alcohol leads to the following psychological problems in the individuals.

- Mental depression
- Impaired consciousness
- Visual hallucination
- Lack of memory and grasping ability

Social problems

Addiction to alcohol leads to the following social problems in the individuals.

- Absenteeism from their profession
- Loss of employment
- Tension and loss of peace in the family
- Neglect by family members
- Child abuse
- Financial problem
- Violation of law and traffic rules etc.

Prevention of Alcoholism
(in general and at school level)

Addiction to alcohol can be prevented at early stage by taking following steps.

- The harmful effects of alcohol must be explained to the people.
- If the addiction is developed due to leisure activities and by the job, both the leisure activities and the nature of job should be changed.
- Psychotherapy helps the patient in changing their life style.
- By educating the parents and teachers to help the patients to recover from alcoholic addiction.
- Drug therapy is also a valuable treatment. Medicines like ***Benzodiazepines,*** high dose of vitamin - B_1 and anti depressant like ***Phenothiazines*** are effective in the recovery of alcoholic addiction.
- Ill effects of alcoholism could be published through mass media very strongly.
- A number of voluntary organizations are financially assisting to undertake the educative work in various community and target groups.

NARCOTIC DRUGS

Drug Abuse

In the study of addiction, the term ***"drug"*** means unauthorised and improportionate chemical which are injurious to health. Sometimes the authorised drugs are consumed in large quantities without doctor's advice. It also leads to drug addiction. Consumption of such drugs for a long period of time have direct effect on the central nervous system (CNS) and its related problems. Following are some of the drugs that are injurious to health. These drugs are also called ***narcotics.***

1. Benzadiazipine (Sleeping pills)

It is a drug given to patients with specific sufferings such as accidental injuries, post operational conditions, cardio vascular problems, blood pressure etc. It is to be given to patients for a specific period of time. If the patients consume the pills for a long time by misusing the doctor's prescription, then the individuals become addict to this drug.

2. Cannabis

It is an illegal drug derived from ***Cannabis sativa.*** It is usually mixed with tobacco and inhaled. It suppresses the central nervous system and keeps the individual in a confused state. It leads to cerebral damages and psychological complications.

3. Barbitrates

These drugs are now rarely prescribed by doctors. If the drug is consumed in an illegal way, it leads to serious consequences like CNS depression and respiratory depression.

4. Opiates

Marphines, heroin, codeine, opium etc. are the main drugs that come under a group called opiates. These drugs are taken orally, intravenously or by inhalation with tobacco. The intra venous users are prone to get bacterial infections, Hepatitis-B and HIV by sharing the syringes and needles.

5. Amphetamines

These drugs when consumed in prescribed doses stimulate the CNS, more energy production and greater concentration of mind in the professions of the individuals. They are taken orally and intravenously. Excessive consumption of these drugs leads to loss of appetite, mental depression, anxiety and fatigue.

6. Cocaine

It is taken intravenously or be sniffing through the nostrils. Its harmful effects are similar to that of the effects of amphetamines. Chronic cocaine sniffing leads to ulceration in the nasal mucosa.

7. Hallucinogenic drugs

LSD (Lysergic acid Diethylamide) and ***Psilocybin*** (magic mushroom) are the most common hallucinogenic drugs. Heavy consumption of these drugs leads to loss of vision, psychological abnormalities, loss of sensory perception of skin, hyperthermia (increased body heat), intravascular blood clot, acute mental failure and cerebral haemorrhage.

Prevention and control of drug abuse

The first step in controlling drug abuse is usually aimed at helping the patient withdraw from the drugs. The following steps could be taken to withdraw the patient from drug addiction.

- Reducing the dosage of drug once in every fortnight until the consumption of drug is completely stopped.
- Providing regular counselling
- Avoiding the usage of any other drugs
- Providing more vitamins
- Long term medical support is necessary if the patients are to remain drug free.

6.4 DEADDICTION – REHABILITATION

Deaddiction Methods

Deaddiction is the management of alcoholism and drug abuse. There are a few government and non government organisations in our country which serve as rehabilitation centres to treat and counsel the drug addicts and alcoholics by means of medical and psychological approaches. The following are the steps taken in rehabilitation centres to deaddict the individuals.

- This management includes the identification of addiction, i.e. alcoholic addiction or drug addiction.
- If the addiction is for the drugs, the composition of the drug is analysed.

- The addicted individual is identified to find out whether the dependency is physical or psychological .
- A suitable chemotherapy is given to the addicts to detoxify the drugs consumed.
- The treatment to the addiction disorders is a long term treatment.
- The treatment is mainly based on the behavioural changes that take place during the treatment. So there is constant observation of addicts on the improvement a physical, mental, social and occupational status of the patients.

Alcoholism and drug addiction are mainly due to lack of awareness about their ill effects. Government and non government organisations have taken necessary steps to create awareness among all the people through mass media. Televisions, radios and news magazines contribute major role in launching the awareness programmes. Exhibitions, debates, competitions and project works at school and college level also influence the awareness to a greater extent among youngsters.

IMMUNOLOGY

Immunology is the study of immunity. Immunity is a part of complex system of defence reactions in the body. Historically immunity means the defence against or the specific resistance exhibited towards infectious organisms and their products. The infectious organisms that invade the body and the toxins produced by these organisms are called ***"foreign substances"*** or ***"antigens"***. The immune system which includes blood plasma, lymph and lymphocytes analyse the chemical nature of antigen and secrete a suitable ***"antibody"*** to detoxify the antigen. This response of immune system of our body against foreign substance is called ***immune response***.

The immunity is of two types. They are natural or innate immunity and acquired or specific immunity.

Natural or innate immunity

Natural immunity is developed in an individual right from birth without having any disease or immunization. The antibodies for certain diseases are present in the new born baby which prevent the entry of microbes.

Acquired or Specific immunity

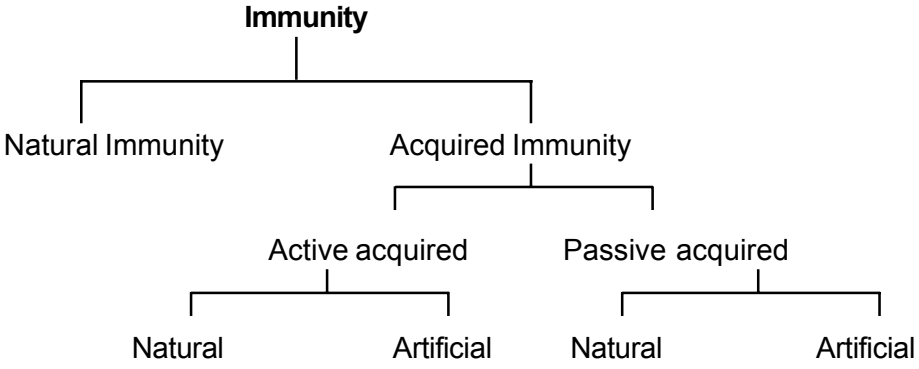
The resistance against certain infectious disease developed by an individual during life time is called ***acquired immunity***. The acquired immunity is of two types. They are active acquired and passive acquired immunity.

Active acquired immunity

This kind of immunity is developed by our body during first infection of any pathogen. The antibody produced in the blood stays for a long period and kills the pathogen when they enter the body. If the antibody production is stimulated naturally, then it is called ***natural active acquired immunity***. If the antibody synthesis is stimulated by vaccines or any other man made methods, then the immunity is ***artificial active acquired immunity***. Eg. **Typhoid Vaccine**

Passive acquired immunity

In this type of immunity, the antibody is not produced by the immune system of an individual. But it is taken as ready made antibody from outside. If the ready made antibody is taken from mother's blood to the foetus, it is called ***natural passive acquired immunity.*** If the ready made antibody is given to an individual artificially, it is called ***artificial passive acquired immunity***. This immunity is not a permanent immunity.



Immunization

Administering vaccines to prevent diseases is called ***immunization***. This process of immunization develops artificial active acquired immunity. Immunization through inoculation is a mass means of protecting the greatest number of people against the spread of diseases.

Development of Vaccine

Edward Jenner, the ***British Physician*** was the first one who developed the vaccine in ***1796***. He observed that the milkman and milkmaid in the cattle field were not suffering from small pox. But they were often exposed to ***cow pox viruses*** when the cows were suffering by cow pox. Jenner assumed that the milkman and milkmaid developed immunity for pox. To verify his assumption, he collected some substances from the cow pox sore and injected into the hand of his son. His son developed defence mechanism for small pox. This experiment made him develop the vaccine for various diseases.

Louis Pasteur discovered that all types of pox are caused by viruses. He prepared the vaccine in ***1865*** by introducing a few microorganisms into human blood. The immune system produced suitable antibody for the inoculated microbes and destroyed the microbes. This antibody stayed in the body throughout the life of the individual and provided life long immunity. Later, a number of techniques were applied to develop vaccines. Now we have two types of vaccines. They are ***live vaccines*** and ***Killed Vaccines.*** The live vaccines are prepared from living organisms. They produce immunity for a long period. Example : ***Oral polio vaccine, Measles vaccine and BCG vaccine.***

The killed vaccines are prepared form dead micro organisms which are killed by heating or chemicals. They are safe but less effective. They give only 50% protection to our body. Revaccination is required for these vaccines.

Immunization Schedule

The Immunization Schedule indicates the stages at which vaccinations and inoculations have to be given to guard themselves against different diseases.

The table given below lists the names of vaccines, their dosage and the stage at which it is to be administered.

Table : 6.1 Immunization Schedule followed in India

S.No.	Age	Vaccine	Dosage
1.	New Born	BCG	One dose
2.	15 days	Oral polio	First dose
3.	6th Week	DPT and Polio	First dose
4.	10th Week	DPT and Polio	Second dose
5.	14th Week	DPT and Polio	Third dose
6.	9-12 Months	Measles	One dose
7.	18-24 Months	DPT and Polio	First booster
8.	15 Months-2years	MMR vaccine	One dose
9.	2-3 years	Typhoid vaccine	Two doses at one month gap
10.	4-6 years	DT and Polio	Second booster
11.	10th year	TT and Typhoid	——
12.	16th year	TT and Typhoid	Second booster

BCG = Tuberculosis vaccine

DPT = Diphtheria, Pertussis, Tetanus vaccine (Trible antigen)

MMR = Mumps, Measles, Rubella

DT = Diphtheria, Tetanus (Dual antigen)

TT = Tetanus Toxoid

POINTS TO REMEMBER

1. Keeping the body in good condition is called ***Homoeostasis.***
2. Communicable diseases are caused by ***pathogens.***
3. Metabolic disorders, nutritional deficiencies, hormonal and enzymatic abnormalities cause non communicable diseases.
4. Beta cells of islets of Langerhans secrete insulin.
5. Alpha cells of islets of Langerhans secrete glucagon.
6. Increased glucose level in the blood is called ***hyperglycermia.***
7. Renal failure is destroyed tissues in the kidneys.
8. ***Polyurea, polydipsia and polyphagia*** are the symptoms of diabetes mellitus.
9. Diabetes mellitus is caused due to the deficiency of insulin.
10. Diabetes insipides is caused due to the deficiency of anti diuretic hormone.
11. Excretion of excessive water along with urine is called diuresis.
12. Impairment of heart functions due to inadequate blood supply to the heart is called CHD.
13. RHD is a crippling disease.
14. Uraemia is the accumulation of nitrogenous wastes in the blood.
15. Abnormal growth of adipose tissue leads to obesity.
16. Blood pressure greater than ***160/95 mm Hg*** is called ***hypertension.***
17. Alcoholism is a killer disease.
18. Drug means unauthorised and improportionate chemicals that are injurious to health.
19. Immunology is the study of immunity.
20. The foreign substance is called antigen.
21 The response of immune system against antigen is called immune response.
22. Immunization is the administration of vaccine.
23. ***Edward Jenner*** was the first one developed the vaccine.
24. ***Louis Pasteur*** discovered pox viruses.
25. ***Live and killed vaccines*** are the two types of vaccines.

SELF EVALUATION

I. Choose and write the correct answers

1. The diseases caused by pathogens are called _____ diseases.
   a. genetic b. communicable
   c. non communicable d. metabolic
2. Diabetes mellitus is caused due to the deficiency of
   a. adrenalin b. glucogon
   c. Insulin d. ADH
3. In diabetes, the excessive appetite and excessive consumption of food is called
   a. Polydipsia b. Polyphagia
   c. Polyurea d. Hyperglycemia
4. An impairment of heart functions due to inadequate blood supply to the heart is called
   a. CHD b. RHD
   c. Hypertension d. Dyspnoea
5. Anorexia is the symptom of
   a. CHD b. RHD
   c. Hypertension d. Renal Failure
6. CNS depression and respiratory depression are caused by excessive consumption of
   a. Benzadiazipines b. Cannabis
   c. Barbitrates d. Opiates
7. Ulceration in the nasal membrane is caused due to
   a. Opiates b. Amphetamines
   c. Cocaine d. Cannabis
8. Which one of the following is commonly called magic mushroom?
   a. Cocaine b. LSD
   c. Psilocybin d. Opiates
9. Immunity developed after first infection is called _____ immunity.
   a. natural b. artificial acquired
   c. natural active acquired d. passive

10. The immunity which is developed right from birth is called _____ immunity

    a. natural
    b. artificial acquired
    c. natural active acquired
    d. artificial passive acquired

II. Fill in the blanks with suitable terms

11. _____ is the complex system of defence reaction in the body.
12. Artificial active acquired immunity is developed by the administration of _____
13. Diabetes mellitus is caused due to the deficiency of _____
14. Cow's milk contains _____ which destroys the beta cells.
15. _____ is a crippling disease.
16. _____ and _____ are the two types of renal failures.
17. _____ is empty calories and has no nutritive value
18. Physical, psychological and social problems are developed due to _____
19. _____ can be taken by sniffing through external nostrils.
20. _____ is the study of immunity.

III. Answer the following questions in one or two sentences.

21. What is meant by homoeostasis ?
22. What is disease ?
23. Mention the factors causing diseases
24. What is meant by non communicable diseases ?
25. What is meant by diabetes mellitus ?
26. What is meant by diabetes insipidus ?
27. What is meant by Polydipsia ?
28. What is meant by Polyurea ?
29. What is Polyphagia ?
30. Define coronary heart disease.
31. What is meant by renal failure ?
32. What is meant by acute renal failure?
33. What is meant by chronic renal failure ?

34. Define obesity.
35. Define hypertension.
36. What are narcotic drugs ?
37. What is meant by de-addiction ?
38. Define immunology.
39. Define immunity.
40. What is meant by natural immunity?
41. What is acquired immunity?
42. What is meant by passive acquired immunity?
43. What is vaccine ?
44. What is antibody?

IV. Write short answers for each of the following questions in 100 words. Draw diagrams wherever necessary.

45. Write short notes on Diabetes insipidus.
46. Write short notes on CHD.
47. Write short notes on renal failure.
48. Write the schematic representation of immunity.
49. Write short notes on obesity.

V. Write detailed answers for each of the following questions in 200 words. Draw diagrams wherever necessary.

50. Give detailed account of diabetes insipidus.
51. Give an account of RHD.
52. Give an account of various types of immunity.
53. Give an account of the problems caused by alcoholism.
54. Give an account of the harmful effects of any five drugs.
55. Explain the steps that could be taken for deaddiction.

UNIT 7

APPLIED BIOLOGY

Application of biological principles for the betterment of Human welfare is called ***Applied Biology.*** It involves principles like, improvement in agriculture by using organic manure, (e.g. vermiculture), involving improvement in production in aquaculture following scientific methods, Bio-Medical instrumentation, principles used in Biotechnology, Genetic engineering, Tissue culture etc.,

7.1. AQUACULTURE : FISH, PRAWN, CRAB, ALGAE, PEARL OYSTER, MUSSELS

Aquaculture deals with the farming of economically important aquatic organisms, both plants and animals, under controlled conditions, in a confined environment. Aquaculture includes, culture of prawns and lobsters, fish, pearl oysters, mussels, crabs, etc.,

Major types of aquaculture involves development of fresh water culture, mariculture and brackish water culture.

Fresh Water Culture

Characteristics of Fresh Water

1. Salt content is about 0.5 ppt (parts per thousand).
2. Water current is less.
3. Temperature zonation is within limits.
4. Light penetration is better than marine environment.

FRESH WATER AQUACULTURE

Culturing of organisms in fresh water is called ***fresh water aquaculture***. There are many types in this. Description of various types will go beyond our syllabus, and hence let us mention only the types.

Various kinds of Fresh water aquaculture

1. **Earthen ponds**
2. **Temple tanks**
3. **Irrigation tanks**
4. **Race ways**
5. **Sewage ponds**
6. **Re-circulation system**
7. **Ornamental fish**
8. **Larvivorous fish**
9. **Food organism**
10. **Sports fish**
11. **Integrated aquaculture**

Culture of fish is called ***Pisciculture***. A typical fish farm has *1. Nursery ponds, 2. Rearing ponds, 3. Production ponds and 4. Breeding ponds.*

Nursery Ponds are used for nursing the fish eggs (hatchlings). These hatchlings are called ***'Fry'*** after two weeks of growth. Then they are transferred to rearing ponds. Here special food is given to 'fry' and they are allowed to grow for two months. When they reach a stage called ***'Fingerlings'*** they are taken to production ponds. This is the stocking area. Here, they grow to marketing size. Fishes for breeding will be selected from this stock and the rest are harvested to be sent to market.

In breeding ponds selected male fishes and female fishes are allowed to reproduce. Lot of research has been carried out in inbreeding experiments in utilizing ***carps*** in breeding ponds.

Before culturing the fish, the following factors are to be considered

1. Preparation of pond
2. Conditioning of pond
3. Manuring the pond

4. Management of fish farm
    i. Water quality management
    ii. Feeding
    iii. Disease management

Edible Fishes of Tamilnadu

1. Indian Major Carps *("Kendai")*

a. ***Catla catla* -** Fast growing species among the Indian major Carps.

b. ***Labeo rohita (Rohu)* -** This is considered as the tastiest of Carps.

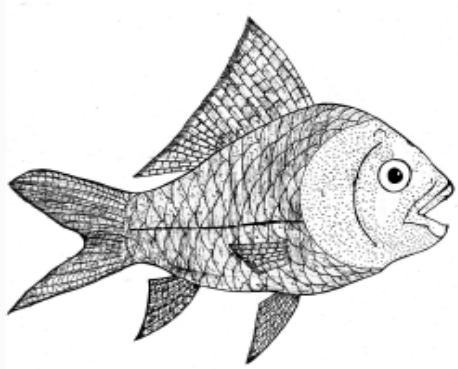


Fig 7.1 - *Catla catla*

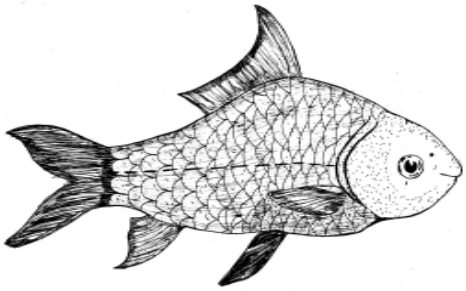


Fig 7.2 - *Labeo rohita*

2. Catfishes *("Keluthi")*

These are air breathing fishes and can be transported in fresh condition over long distances.

3. Murrels or Snakeheads *("Viral")*

These are also air breathing and have a good market value. They can be cultured in irrigation wells. e.g. : ***Channa marulius*** (Giant snake head)

4. Tilapia *("Jilabi-kendai")*

Introduced from East Coast of Africa. This is a good edible fish. e.g : ***Oreochromis mossambicus***

Marine edible fishes in Tamilnadu Coast include Sharks, which are Cartilagenous and Pomfrets ***('Vavval')***, Indian mackeral ***('Kanangeluthi')***, Seer fish ***('Vanjiram')***, Perches, Flat fishes ***('Naakku')***, Sardines and many more bony fishes.

PRAWN CULTURE

Prawn Culture fetches a lot of foreign exchange into Indian markets. They are the most sought after food among marine food items. There are different methods in Prawn culture to get the best harvest. The traditional method of Prawn culture is used in India and the intensive Prawn culture is used in other countries like USA, Japan and Taiwan.

The Cultivable Prawns include

Penaeus indicus, (Indian white shrimp)

Penaeus monodon, (Tiger shrimp)

Penaeus semisulcatus (Green tiger shrimp)

The three usual types of Prawn culture in ***traditional method.***

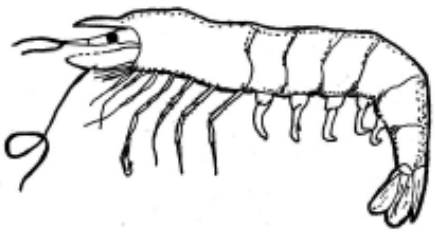


Fig 7.3 - *Penaeus indicus*

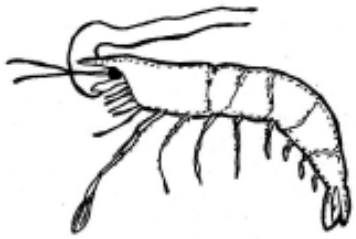


Fig 7.4 - *Penaeus monodon*

a. Juvenile holding method

The low lying fields near the Backwaters or Sea shore are used as culture farms. The larvae and juvenile Prawns are trapped here during high tides.

b. Seed collection method

Prawn larvae are naturally collected from estuaries and backwater and are allowed to grow.

c. Hatchery method

In this method, Prawns are allowed to grow and reproduce in controlled conditions. Here the Prawn larvae are given supplementary food.

CRAB CULTURE

There are nearly 600 Crab species occurring in the Indian Coast waters but only a few are used for edible purpose. Some edible Crabs are ***Matura lunaris***, ***Scylla serrata (mud crab)*** and ***Portunus sanguinolentus*** (Three-red spot swimming crab). Crab culture is not popular as Prawn or fish culture. Mud crabs are of export value. Lot of research is being done to improve Crab culture in India.

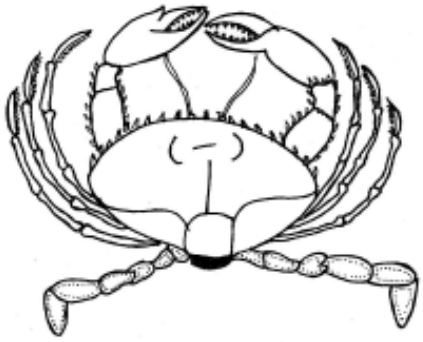


Fig 7.5 - ***Scylla serrata***

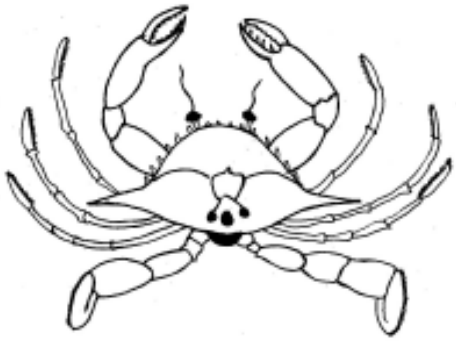


Fig 7.6 - ***Portunus sanguinolentus***

ALGAL CULTURE

Algae are the primary producers in marine environment. They start the aquatic food chains.

Some algae are important as a source of food for human beings, domestic animals and fishes.

Algae like ***Porphyra*** are eaten in Japan and England.

Ulva, Laminaria and ***Chlorella*** are used as food in many countries.

Ascophyllum and ***Fucus*** are used as fodder for domestic animals.

Spirulina is a blue green alga which has been cultured specially as a raw material for making many types of food items. Spirulina is cultured in CFTRI (Central Food Technological Research Institute, Mysore).

It is grown in fresh water. It is also filtered and dried and used as animal food. **60 to 70%** dry weight of Spirulina is Protein. It has high nutritional value. Spirulina is also called a ***Single Cell Protein*** (SCP). Apart from these, Red algae ***Gracilaria*** and ***Geladiella*** are cultured for the extraction of ***agar agar***.

PEARL OYSTER CULTURE

Pearls are the rarest of gems, and are produced by a particular variety of oysters called ***Pearl oysters***. The most important species is ***Pinctada fucata***. The pearl oysters occur on ridges of rocks or dead coral along the South Indian Coast and the Coast of Srilanka. These formations are called ***"Pearl banks"***. Best production in Pearls is recorded in Tuticorin.

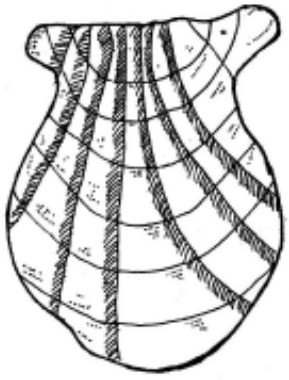


Fig 7.7 - Pearl oyster

The CMFRI in India (Central Marine Fisheries Research Institute) gives necessary training in the culture of Pearl Oysters.

In this type of Oyster culture ***shell beads*** are introduced into the soft tissues of the oyster along with a strip of the mantle so that the latter triggers the secretion of the pearly secretion around the bead.

At this stage Oysters are taken care in cages suspended from floating rafts in shallow waters of the sea.

The Shells are also used for making buttons and fancy articles .

MUSSEL CULTURE

Mussels are bivalves which are cultured for their food value. ***Perna indica*** and ***Perna viridis*** are cultured in India. The young ones of these

are called seeds. They are cultured by ***1. Raft culture, 2. Rack culture, 3. Pole culture, 4. Long Line culture and 5. Coir or Nylon rope culture.***

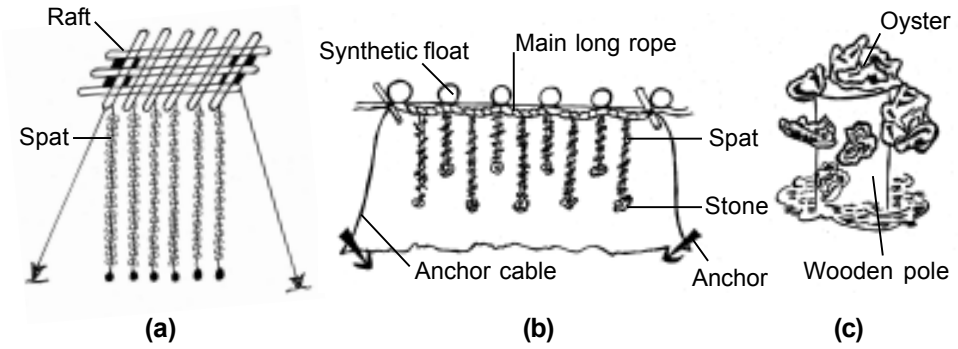


Fig 7.8 Mussel culture
a) Raft culture b) Long line culture c) Pole culture

Mussel harvest is done in five months from the foregoing types of culturing techniques & improvement with innovative scientific methods of Aquatic organisms like Fish, Prawns, Crabs, Oysters, Mussels and Algae, will definitely improve aquaculture development in India. Aquaculture will definitely play a significant role in Indian Economy and reduce food shortage which is a common problem in populous countries like India.

7.2 VERMICULTURE

In the past two decades, agricultural scientists in the world had realized the limitations of chemical fertilisers used for fertility management. Organic matter recycling has been in use for centuries. In ninetieth and twentieth centuries, scientific methods were invented and followed for converting low value organic matter into high value organic composts. The activities of earthworms in recycling organic matter drew attention in 1990s. ***Dr. Sultan Ismail*** of Tamilnadu is a pioneer in the field of ***vermiculture technique.***

The specially bred earthworms are used to convert organic matter into compost. Through the simple act of eating and digesting, earthworms promote enhancement of soil structure, bacterial growth and decompostition of organic matter. Not all earthworms are suitable for vermiculture.

Earthworms are of three types based on their action on humus.

Epigeic forms

These earthworms eat plant materials and are seen on the soil surface eg. ***Eisenia foetida, Eudrilcus eugeniae***. They are used in producing vermicast.

Aneic forms

These feed on leaf litter with soil and send out vermicastings eg. ***Lampito mauritii, Prionyx excavator.***

Endogeic forms

These feed on organic materials in the soil e.g. ***Octochaetona thurstoni.*** Of these three forms the first two are humus formers and are useful in vermiculture.

Vermicompost

The breakdown of organic materials by worm activity is called *"Vermicompost"*. It is a better source of organic manure.

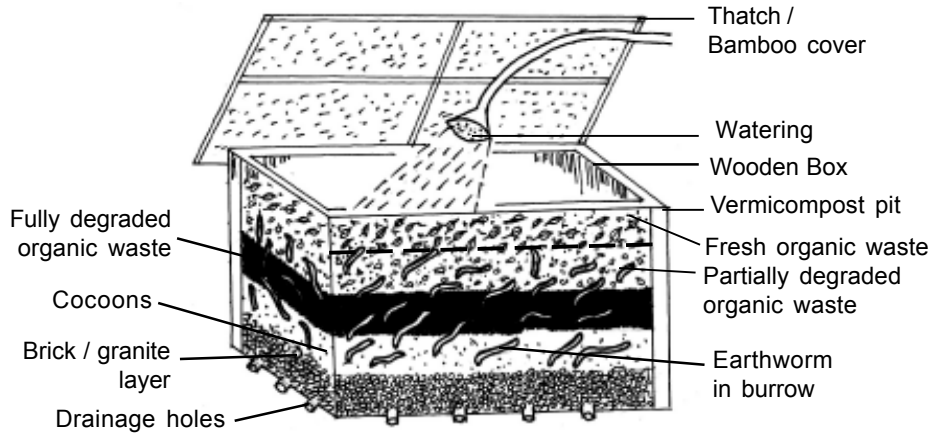


Fig 7.9 - Vermiculture

A simple method of vermiculture

Needed Materials

A wooden box, breeder worms, a wooden bed and organic wastes. The bed should be 2½ ft high x 4 ft wide x any length desired. A proper plan applying two parts worms for every part waste to be followed.

Sieving and Shredding

Decomposition can be accelerated by shredding raw materials into small pieces.

This procedure includes blending, digesting and formation of vermicost. In blending carbonaceous substances like saw dust, paper and straw can be mixed with nitrogen rich materials such as sewage sludge, biogas slurry and fish scraps. A varied mixture of substances produces good quality compost, rich in major and micronutrients.

The raw materials should be kept in piles and the temperature allowed to reach 50^{O} to 55^{O} C. The piles should remain at this temperature for 7 to 10 days. Moisture, temperature and pH play a major role in this process. The temperature of the piles at this stage should be within 28-30^{O} C. Higher or lower temperature will reduce the activity of microflora and earthworms.

After about a month the compost is ready. It will be black, granular, light weight and humus rich. To facilitate separating the worms from the compost, stop watering for two or three days before emptying the beds. This will force about 80% of the worms to the bottom of the bed. The rest of the worms can be removed by hand. The vermicompost is then ready for application.

7.3 BIOMEDICAL INSTRUMENTATION

Biomedical Instrumentation has evolved into a popular branch of science technology. It involves the study of the structure and working of various Biomedical Instruments and techniques used in ***clinical diagnosis***. A few of such instruments and diagnostic procedures are given below.

7.4 ECG (ELECTROCARDIOGRAM)

A graphic record of the electrical variations produced by the beating of the heart during its contraction and relaxation is called ***Electrocardiogram***.

An instrument used to observe the working of the heart is called ***Electrocardiograph***. Electrocardiograph was discovered by ***Einthoven*** in ***1906*** commonly called **"*Father of Electrocardiography*"**. ECG was first recorded by ***Waller (1887)*** by using capillary electrometer. Electrographic electrodes are flat, pliable and formed of corrosive resistant

metal. These are first coated with a paste or gelly and then applied to specific parts of the body with rubber straps.

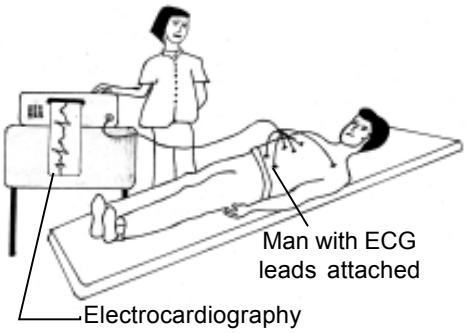


Fig 7.10 - Electrocardiogram

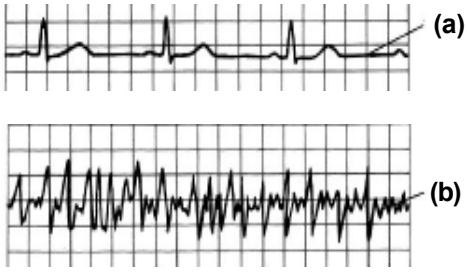
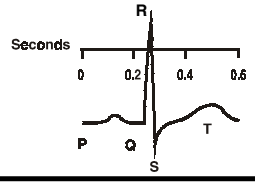


Fig 7.11 - ECG
a) Normal, b) Abnormal

A normal ECG is a series of ridges and furrows. Normal pattern of ECG for a healthy person is shown in the ECG graph.

1. In this P-wave indicates the impulse of contraction created by S.A node.
2. PQ represents - atrial contraction QRS wave indicates spreading of impulse of contraction from A.V. node to the wall of the ventricles
3. The RS of QRS wave and ST internal represents ventricular contraction.
4. T wave represents relaxation of ventricles.

THE ECG TRACE



On an ECG trace, which is called an ***electrocardiogram,*** a pen marks the line on a moving strip of paper. Each heartbeat shows as a ***pattern of spikes and dips called the P, Q, R, S, and T waves.*** In a normal resting adult the whole beat takes less than a second. The trace can also be displayed on a screen and recorded by photography or video.

Activity 1 :

Collect a normal ECG and abnormal ECG and compare. Have a discussion in class.

Sphygmomanometer

Sphygmomanometer is derived from the Greek word ***Sphygmus*** (Pulse) plus the scientific term ***manometer***.

A Sphygmomanometer is an instrument used to measure blood pressure. The instrument has an inflatable rubber bladder, the cuff, a rubber squeeze ball pump and valve assembly and manometer (Mercury).

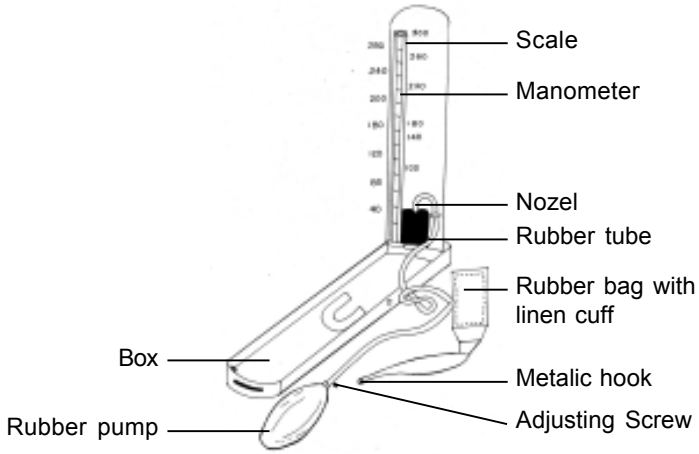


Fig 7.12 - Sphygmomanometer

The blood pressure in the artery changes during cardiac cycle. During ventricular systole, the pressure is maximum which is referred to as ***systolic pressure***. This is about ***120mm of Hg*** (Mercury). During diastole, the pressure falls and the lowest value is referred to as ***diastolic pressure***. This is about ***80 mm of Hg***.

If there is an increase in the systolic pressure for a prolonged period of time, the condition is called ***hypertension***. In normal person, Blood Pressure increase during physical exercise, anxiety etc., when there is decrease in the systolic pressure than normal for a prolonged period of time, the condition is called ***hypotension***. Both conditions of hypertension and hypotension need medical help.

CT SCAN (COMPUTED TOMOGRAPHY)

Computed Tomography combines the use of a digital computer with rotating X-ray device to create cross sectional slices of the different organs

and the body parts such as the lungs, liver, kidney, pancreas, brain, bone and blood vessels.

CT Scan helps in

1. cancer diagnosis
2. diagnosis of heart diseases
3. measurement of bone mineral density
4. diagnosis of internal bleeding etc.

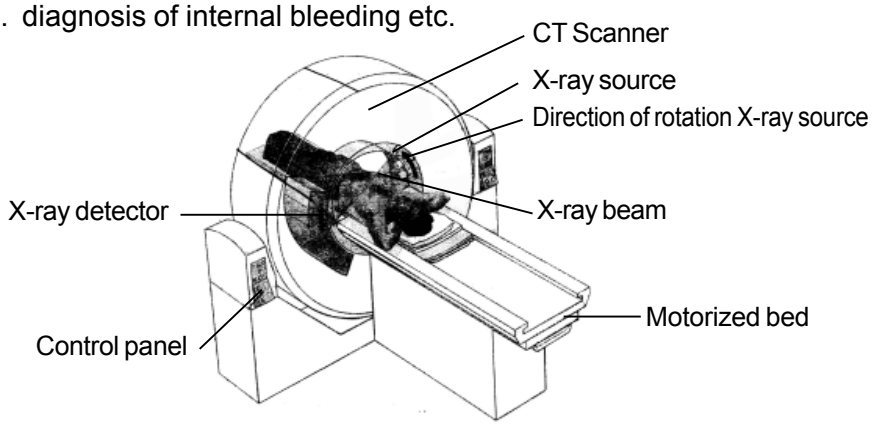


Fig 7.13 CT Scan

ANGIOGRAM

This is a special contrast X-ray and can be used to detect an abnormality in a blood vessel such as narrowing of the Coronary artery

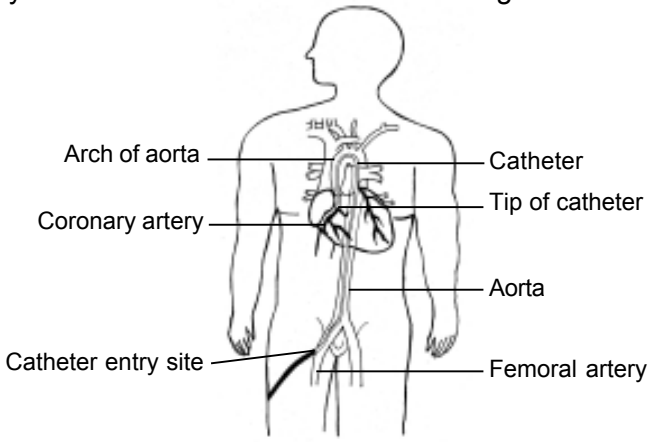


Fig 7.14 - Coronary Angiography

supplying the heart muscles or cerebral artery supplying the brain.

DIALYSIS

Dialysis is a clinical device involving a technique used for removing waste products from the blood and excess fluid from the body when kidneys fail to carry on their normal functions.

The dialysis machine is about the size of a large television. This machine has 3 main functions

i. pumps blood and monitor flow for safety
ii. removes wastes from the blood
iii. monitors Blood pressure and the rate of fluid removal from the body.

The dialysis is a large canister containing thousands of small fibres through which blood is passed. Dialysis solution, the cleaning fluid, is pumped around these fibres. The fibres allow wastes and extra fluids to pass from blood into the solution which carries them away. The dialysis is sometimes called as ***artificial kidney***.

There are two type of dialysis - Haemodialysis and Peritoneal dialysis.

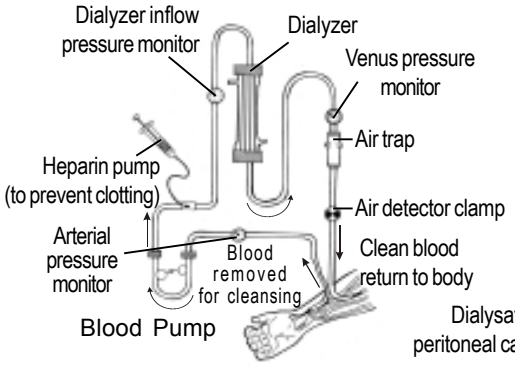


Fig 7.15 - Haemodialysis

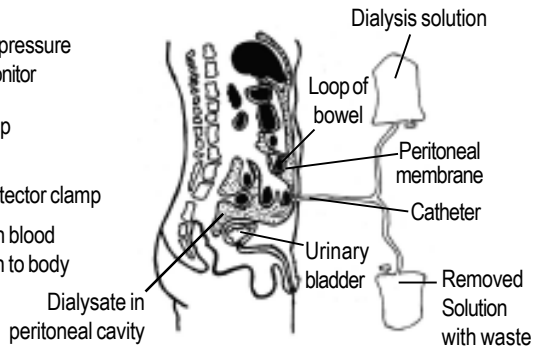


Fig 7.16 - Peritonealdialysis

LAPAROSCOPY

During Laparoscopy, an instrument called a Laparoscope is used to view the inside of the pelvis and the abdomen of a female to find out the disorders of the reproductive system ***(ovaries, fallopian tube, uterus).*** Laparoscopy is also used in the case of appendicitis. A very small incision

is made in the abdomen through which the laparoscope is inserted. It is done under general anaesthesia and recovery is faster than after normal surgery.

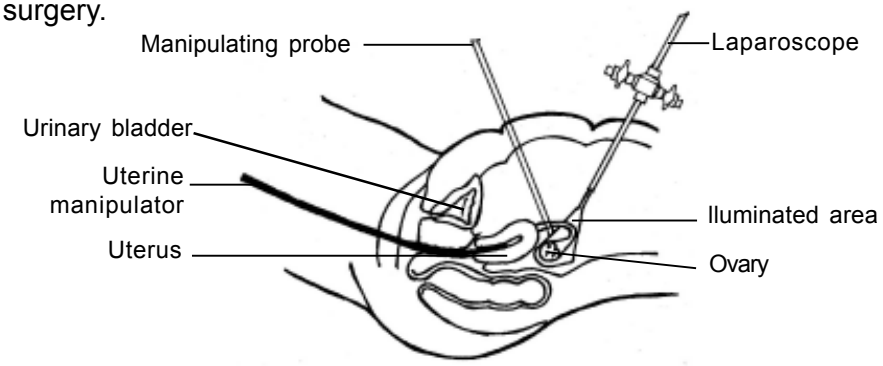


Fig 7.17 - Laparoscope

ENDOSCOPY

The use of tube like instruments to look at organ of structures deep within the body is called Endoscopy.

During endoscopy, a tube like optical instrument known as the endoscope is introduced deep into the body so that internal structures can be examined visually. Access into the body is usually through a natural opening, such as the mouth or anus, and in some endoscopes an incision can be made in the skin.

There are two main types of endoscopes - ***Flexible endoscopes*** and ***Rigid endoscopes***.

THE MICRO ENDOSCOPE

The part of this micro endoscope that is inserted into the body is ***less than 3 mm in diameter,*** yet houses six channels. The main working channel is 1.1 mm in diameter and can be used in various ways, for example, as a tunnel for a minute ***biopsy forceps*** to grab a sample of tissue. Two 0.45 mm working channels suck in air, ***flush fluid,*** or pump drug solutions. Two 0.5 mm channels ***carry light,*** and the fibre optic channel houses a 10,000-strand bundle to convey an image back out.

Factfile :

- ★ Arthroscopy is a kind of endoscope used to examine joints such as knee.
- ★ Gastroscopy is a kind of endoscope used to examine Oesophagus, stomach and intestine

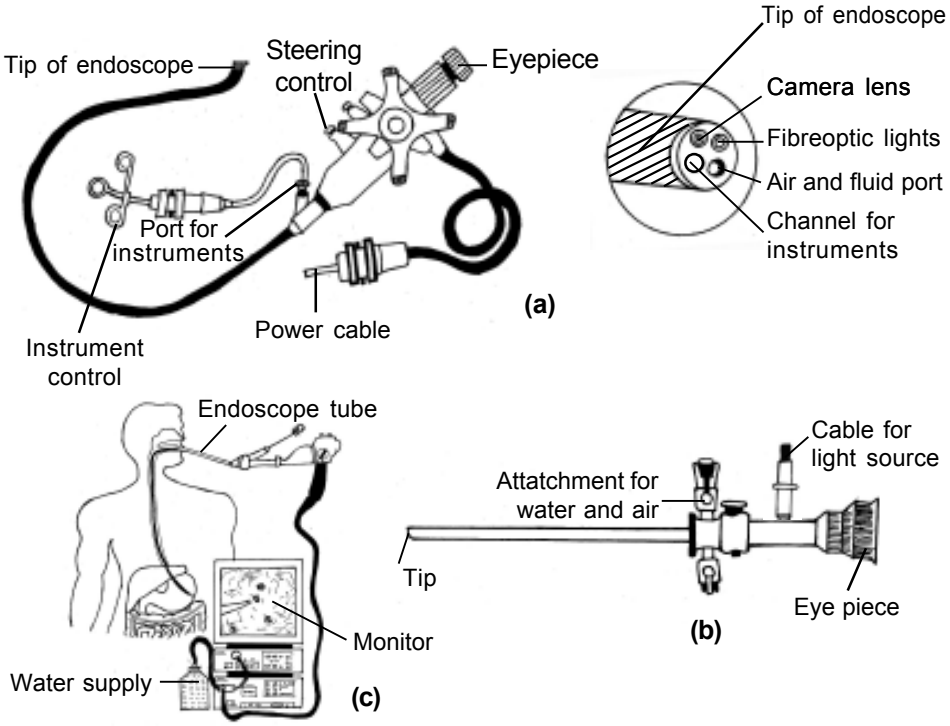


Fig 7.18 - Endoscope - a. Flexible endoscope, b. Rigid endoscope c. Endoscope examining the stomach for an ulcer

EYE LENS IMPLANTATION

This method is followed when the eye lens is removed in the case of cataract or injury and in refractive surgeries. Cataract is the opacity in the lens of the eye. Once the cataract is removed, the eye is unable to focus, as there is no lens.

One has to use artificial lens after cataract surgery. ***Intra ocular lenses*** (IOL) are implanted in these cases. These can restore 97% of vision after the surgery.

BLOOD TRANSFUSION

Replacement of lost or diseased blood using donor blood is called blood transfusion. ***ABO system*** of blood groups were discovered by ***K. Landsteiner in 1900***.

An antigen called ***"A" antigen*** is seen on the surface of RBCs and an antibody "b" is seen in the plasma in some people and they are said to be belonging to "A" blood group. If ***"B" antigen*** is seen on the surface of RBC's 'a' antibody is seen in plasma and these are said to be belonging to "B" blood group. If both "A and B" antigens are present on RBCs, no antibody is seen in plasma. These are said to be having "AB" blood group. In one group of people no antigen is seen on the surface of RBCs, but "a" and "b" antibodies are seen in the plasma. These group is said to be belonging to "O" blood group.

The inheritance of blood group is gene based. Read and understand the following table which gives you information about compatible blood groups for blood transfusion.

Table : 7.1 - Relationship between antigen, antibodies of ABO blood group system

Blood Group type	RBC antigen	Serum antibodies	Blood can be given to	Can receive blood from	Blood should not be given to
A group	A	anti - b	A, AB	O, A	O, B
B group	B	anti - a	B, AB	O, B	O, A
AB group	A and B	None	AB	O, A, B, AB	O, A, B
O group	None	anti - a and anti - b	O, A, B, AB	O	

Blood group ***"AB"*** is called ***"Universal recipient"*** since they can receive blood from any other group.

Blood group ***"O"*** is called ***"Universal donar"*** since they can donate blood to all the other groups.

A Blood transfusion is carried out to treat severe anaemia or to replace blood lost by bleeding. It may be done in the hospital or an out patient unit. Each bag of blood is usually given over a period of 3-4 hrs but can be given quickly if necessary. The blood sample is first checked for compatibility.

The donor's blood is screened for infectious organisms like HIV, Hepatitis virus and is stored in blood banks.

Activity 2 :

Visit a blood bank and observe how the blood is stored in fluid condition.

ORGAN TRANSPLANTATION

The replacement of an injured or diseased tissue or organ (*Skin, Cornea, Heart, Kidney* etc.) with another healthy tissue or organ is called transplantation. The success of organ transplants depends mainly on the compatibility of the recipient and donor tissues.

There are different types of transplantation depending on the recipient and donor.

i) ***Autograft*** - This is the most successful transplantation where one's own tissue is grafted to another part of the body.

ii) ***Isograft*** - In this type of transplantation, the donor and the recipient are genetically identical e.g. graft between identical twins.

iii) ***Allograft*** - In this type of transplantation, the grafting is done between two individuals of the same species (between two men who are not related). In this type, graft rejection is possible.

iv) ***Xenograft*** - In this type of transplantation, grafting is done between two different species (between man and animal). This type of transplantation is used only when human grafts are not available.

Factfile :

★ The first heart transplant operation was performed by Dr. Christian Barnard at Groofe Schwer hospital in Capetown in 1967.

★ Artificial heart is made for the first time by ***Alexis Coral***

POINTS TO REMEMBER

1. Application of biological principles for the betterment of human welfare in called ***Applied Biology***.
2. Major types of aquaculture involves development of freshwater culture, mariculture and brackish water culture.
3. Culture of fish is called ***pisciculture***.
4. Carps, Catfishes, Tilapia, Murrels are some of the edible fishes of Tamilnadu.
5. Marine edible fishes in Tamilnadu are sharks, pomfrets, Indian mackerel, Seerfish, Perches, Sardines and many bony fishes.
6. Prawn culture fetches a lot of foreign exchange into Indian markets.
7. Algae are the primary producers in marine environment. Algae like ***Porphyra*** are eaten in Japan, ***Spirulina*** is a blue green alga which is cultured in CFTRI, Mysore.
8. Pearl oysters produce the Pearls.
9. Mussels are bivalves cultured for their food value.
10. The specially bred earthworms are used to convert organic matter into ***compost***.
11. The breakdown of organic materials by worm activity is called ***'Vermicompost'***.
12. Biomedical instrumentation has evolved into a popular branch of science technology.
13. A graphic record of the electrical variations produced by the beating of heart during contraction relaxation is called ***Electrocardiogram***.
14. ***Sphygmomanometer*** is an instrument used to measure blood pressure.
15. CT scan is used to diagnose many diseases of the heart, cancer etc.

16. Dialysis is a clinical device involving a technique used for removing waste products from blood and excess fluids from the body when kidneys fail to do their function.
17. Laparoscopy, Endoscopy helps in the diagnosis of diseases inside the body.
18. Eye lens implantation is followed in the case of catract and in refractive surgeries.
19. The replacement of lost or diseased blood using donor blood is called ***blood transfusion***.
20. System of ABO blood groups is followed is Human beings.
21. The replacement of a lost organ or tissue with another organ or tissue from another person is called organ / tissue transplanation.

Activity 3:

1. Adopt ***vermiculture*** concept in your school garden, select a portion of your school garden, divide yourselves into groups. Assign duty to each group. One group would prepare the box in which vermiculture is going to work on the soil. When this group is successful in their attempt apply the same principle and prepare vermiculture pit in your school garden.
2. After you succeed in bringing the concept of vermiculture and vermicompost into your school garden, try to explain the usefulness of this principle to std VIII and IX students in the form of socially useful productive program.

SELF EVALUATION

I. Choose and write the correct answers

1. *Lampito mauritii* is an example for

   a. Epigeic type b. Aneic type
   c. Endogeic type d. All of these

2. Common name of carps is

   a. Keluthi b. Viral c. kendai d. vavval

3. The most important species of Pearl oyster is

   a. *Pinctada fucata* b. *Perna indica*
   c. *Perna viridis* d. *Penaeus indicus*

4. Among the different blood groups, the universal recipient is

   a. A b. B c. AB d. O

5. Among the different blood groups the universal donor is

   a. A b. B c. AB d. O

6. The use of tube like instruments to look at organs of structures deep into the body is called

   a. Laproscopy b. Endoscopy
   c. CT Scan d. ECG

II. Fill in the blanks with suitable terms

7. Culture of fish is called _____
8. Algae like _____are eaten as food in Japan and China.
9. _____ is an example of epigeic type of earthworm.
10. _____ is a blue green alga used specially as raw material for making food items.
11. _____ is an example for single cell protein.

III. Answer the following questions in one or two sentences.

12. What is Applied biology?
13. Define aquaculture.
14. Name any two cultivable prawns of Tamilnadu.
15. What is CFTRI?

16. What is Vermiculture?
17. What are the uses of CT Scan?
18. Define dialysis.
19. What is Xenograft?

IV. Write short answers for each of the following questions in 100 words. Draw diagrams wherever necessary.

20. Prawn Culture
21. Algal Culture
22. CT Scan
23. Laproscopy
24. Endoscopy
25. Organ transplantation

V. Write detailed answers for each of the following in 200 words. Draw diagram wherever necessary.

26. Write an essay on Pisciculture and mention about any two edible fishes.
27. Vermiculture and Vermicosting.
28. Procedures followed in ECG.
29. Write an essay on dialysis.
30. Write in detail an account on blood transfusion.

MATRICULATION
STANDARD - X BIOLOGICAL SCIENCE
ZOOLOGY PRACTICALS

I. MODELS

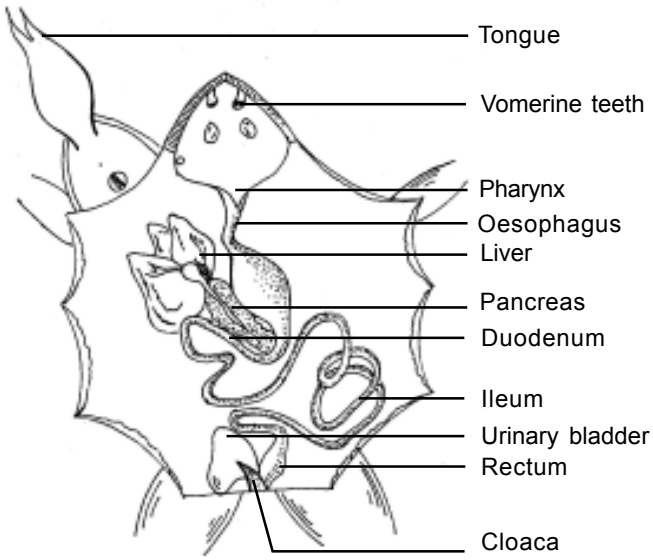
1.DIGESTIVE SYSTEM OF FROG

Two parts from the following list to be flag labelled

1. Buccal cavity 2. Pharynx 3. Stomach 4. Duodenum 5. Liver 6. Ileum 7. Rectum

Identification

The given model is identified as the digestive system of frog



Frog - Digestive system

Notes

1. Buccal Cavity

Location - Mouth leads to the buccal cavity bounded by upper and lower jaws.

Structure - the upper jaw bears teeth and lower jaw is devoid of teeth. A pair of vomerine teeth present, near internal nostrils. These teeth prevent the prey from escaping and not meant for mastication. A long muscular bifid tongue is present attached to the lower jaw.

Function - The teeth on the upper jaw and the vomerine teeth prevent the prey from escaping. The tongue is shot out when a prey is available and the prey gets attached to sticky tongue, the buccal cavity serves as the pathway for the food to enter the pharynx.

2. Pharynx

Location - The buccal cavity narrows down to form the pharynx.

Structure - It is a wide opening common for both air and food.

Function - Pharynx helps to swallow the food.

3. Oesophagus

Structure - This is a short wide tube connecting the pharynx with stomach.

4. Stomach

Location - The Oesophagus leads to the stomach.

Structure - Stomach is muscular with anterior broad cardiac stomach and a posterior narrow pyloric stomach.

Function - Stomach helps to grind the food. Protein digestion takes place here.

5. Duodenum

Location - The Stomach leads to the duodenum which lies parallel to the stomach. It is located at the anterior part of intestine.

Function - Digestion of starch, proteins and fats takes place.

6. Ileum or small intestine

Location - The duodenum leads to the small intestine or ileum

Structure - This the longest part of alimentary canal and is highly coiled.

Function - Digestion gets completed in the small intestine and digested food is absorbed by the villi.

7. Rectum

Location - Small intestine opens into the rectum

Structure - It is a short tube.

Function - It stores the undigested food temporarily and sends it out through cloaca.

2.a. FROG – URINOGENITAL SYSTEM (MALE)

Two parts from the following list to be flag labelled

1. Kidney 2. Ureter 3. Urinary bladder 4. Testis

Identification

The given model is identified as the Urinogenital system of male frog.

Notes

The Urinogenital system is a composite organ system formed of two district organ systems namely an excretory or urinary system and a reproductive or genital system.

1. Kidney

Location - A pair of kidneys are present in frog lying on either side o the vertebral column attached to the dorsal bodywall.

Structure - Kidney is reddish brown in colour and lobular in nature. It is covered by a capsule. The outer edge is convex.

Function - Helps in excretion in frog.

2. Ureter

Location - Ureters arise from the posterior outer margin of each kidney as white tubular ducts which leads into the cloaca.

Structure - Tubular, white in colour

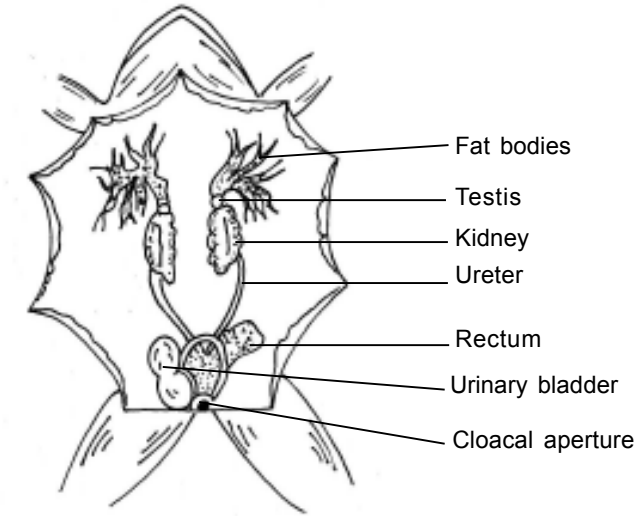
Function - Collects urine or sperm from the kidneys or testes respectively and transport them to the cloaca.

3. Urinary Bladder

Location - Just at the place where the ureters open into the cloaca there is and unpaired thin walled sac, the urinary bladder.

Structure - Thin walled sac.

Function - It stores urine for a short period of time.



Urinogenital System of Frog - Male

4. Testes

Location and Structure - Testes are the male reproductive organs. In frog they are seen as a pair of small yellowish elongated bodies, attached to the anteroventral surface of the kidney.

Function - Produces the male gametes (Sperms)

2.b. FROG - URINOGENITAL SYSTEM (FEMALE)

Two parts from the following list to be flag labeled

1. Kidney 2. Ureter 3. Urinary bladder 4. Ovary 5. Oviduct

Identification

The given model is identified as the Urinogenital system of a female frog.

Notes

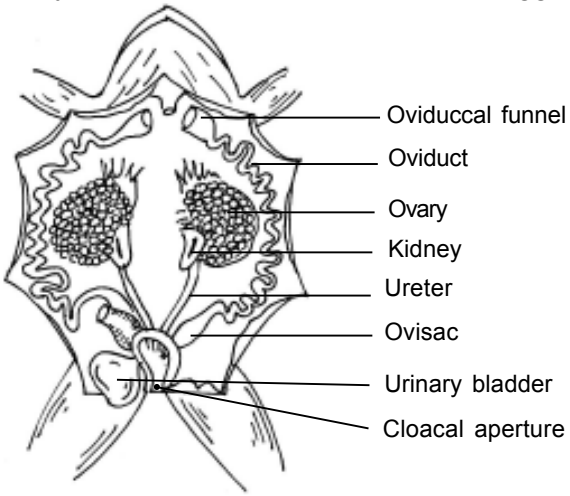
Kidney, Ureters, Urinary bladder – same as male

1. Ovary

Location - on the ventral side of each kidney an ovary is seen.

Structure - Each ovary is folded sac with numerous follicles. The ova (eggs) develop in these follicles, as round bodies with white and black surface.

Function - Ovary helps in the production of ova or eggs.



Urinogenital System of Frog - Female

2. Oviducts

Location and Structure - A coiled oviduct is present on the side of the kidney in the body cavity. Each oviduct open into the body cavity in front by a funnel like opening called oviducal funnel. The oviducts are slightly dilated to form the ovisacs near the cloaca.

Function - Oviducts help in the transportation of eggs from the body cavity to the cloaca.

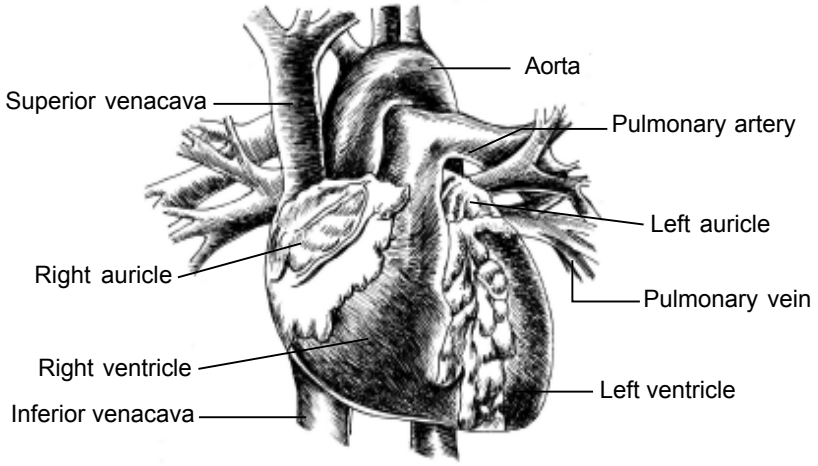
3. HEART OF MAN

Identification

The given model is identified as Heart of Man

Two of the following parts have to be flag labelled.

1. Right auricle 2. Left auricle 3. Right ventricle 4. Left ventricle 5. Aorta 6. Pulmonary artery 7. Pulmonary Vein 8. Superior venacava 9. Inferior venacava



External structure of human heart

Notes

1. Right auricle

Location - This is the upper chamber of the heart towards the right side.

Structure - Right auricle is thin walled and receives deoxygenated blood from vena cavae and coronary sinus. There is a tricuspid valve separating it from the right ventricle.

Function - When the right auricle contracts the deoxygenated blood goes to the right ventricle through the tricuspid valve.

2. Left auricle

Location - The upper chamber of the heart towards the left side.

Structure - left auricle is thin walled and receives oxygenated blood from four pulmonary veins.

Function - When the left auricle contracts the oxygenated blood goes to the left ventricle through the bicuspid valve.

3. Right Ventricle

Location - Right ventricle is the lower chamber of the heart situated towards the right side of the heart.

Structure - Right ventricle is thick walled and receives deoxygenated blood from the right auricle.

Function - When the right ventricle contracts the deoxygenated blood enters the pulmonary artery.

4. Left Ventricle

Location - Left ventricle is the lower chamber of the heart situated towards the left side of the heart

Structure - Left ventricle has very thick walls since it has to pump oxygenated blood into aorta under pressure.

Function - When the left ventricle contracts the oxygenated blood enters the aorta.

5. Aorta

Location - Aorta originates from the left ventricle

Structure - Aorta is the largest artery in the body. At the place of origin aortic valves or semilunar valves are present to prevent backflow of blood

Function - Aorta carries oxygenated blood to all the parts of the body through various arteries.

6. Pulmonary Artery

Location - Pulmonary artery originates from the right ventricle.

Structure - Pulmonary artery divides into two as right and left pulmonary arteries which go to the right and left lungs respectively. At its origin there are pulmonary valves or seminular valves to prevent the back flow of blood.

Function - Pulmonary arteries carry deoxygenated blood from the heart to the lungs for oxygenation.

7. Pulmonary Veins

Location - Two Pulmonary veins originates from right and left lungs and go to the heart.

Structure - Pumonary veins 2 from each lung (totally four) are thin walled blood vessels carrying oxygenated blood to the left auricle of the heart.

Function - Pulmonary veins carry oxygenated blood from the lungs to the left auricle of the heart.

8. Superior Venacava

Location - Superior venacava is the major vein formed from the veins of the anterior regions of the body and opens into the right amicle.

Structure - It is a thin walled vein formed by the union of many veins.

Functions - Superior venacava collects the deoxygenated blood from the anterior parts of the body and pours it into the right auricle of the heart.

9. Inferior Venacava

Location - Inferior venacava, is a vein formed by the veins of the posterior parts of the body and it opens into the right auricle.

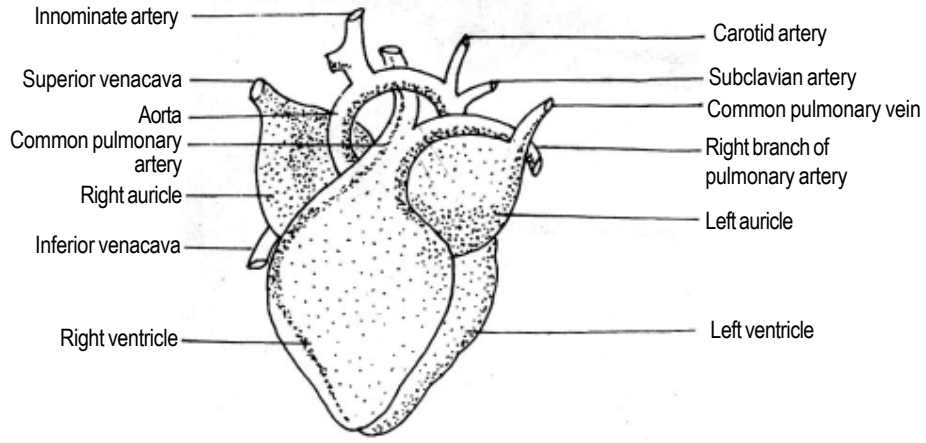
Structure - It is a thin walled vein formed by the union of many veins.

Function - Inferior venacava collects the deoxygenated blood from the posterior parts of the body and pours it to the right auricle.

II. PRESERVED SPECIMENS

1. Heart of Sheep

It is a conical muscular organ located in the thoracic cavity. It is covered by a double walled membrane called pericardium. The heart has four chambers. The two upper chambers are the auricles and the two lower ones are the ventricles. The right and left auricles open into their respective ventricles through auriculo-ventricular apertures. These allow the blood to flow only in one direction i.e. from auricles to ventricles. This is accomplished with the help of tricuspid and bicuspid valves respectively. Inter auricular and the inter ventricular septum divide the auricles and the ventricles, respectively.



The Heart of a Sheep

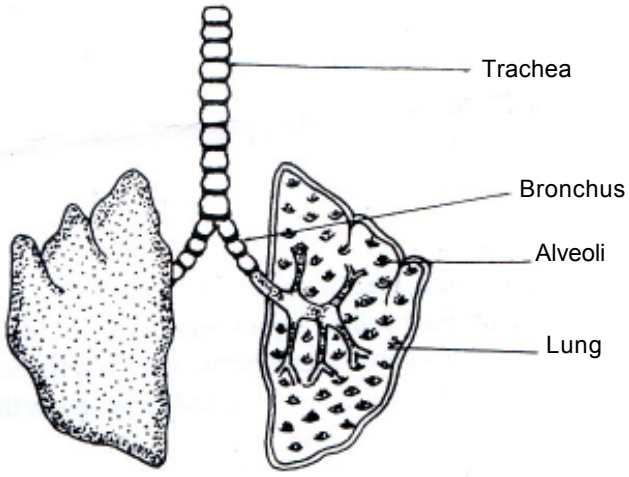
The left side of the heart (Left auricle and Left ventricle) contain the pure blood or oxygenated blood, while the right side of the heart has impure or deoxygenated blood. The superior and inferior venaecavae empty the deoxygenated blood into the right auricle.

Pulmonary artery arises from the right ventricle and divides into two branches, the right and the left and then reaches the lungs. Pulmonary

artery carries deoxygenated blood to the lungs. The deoxygenated blood is oxygenated in the lungs. The oxygenated blood is carried to right auricle by 2 pairs of pulmonary veins. The aorta arises from the left ventricle and supplies oxygenated blood to all parts of the body.

2. Lungs of sheep

The Lungs are located in the thoracic cavity and are the organs of respiration. Each lung is spongy and elastic in nature. Each lung is enclosed in a membranous covering called pleura. The trachea or the wind pipe divides into two bronchi and each one enters a lung. Inside the lung the bronchus divides into a number of bronchioles. The bronchioles divide further ending in tiny sacs called alveoli. The alveoli and the capillary network are separated only by thin walls enabling the easy exchange of gases.



The Lungs of a Sheep

III. APPARATUS

1. ECG : Electrocardiogram

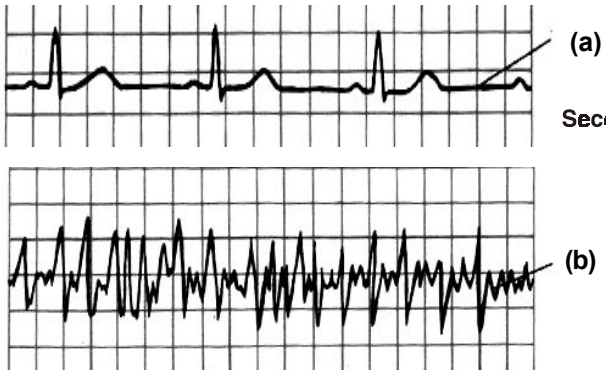
a. The electrocardiogram is a record of the electric potential changes that occur in the heart during cardiac cycle.

b. Einthoven was the one to work with a Capillary electrometer to find out the cardiogram for the first time in 1887, and he was awarded Nobel Prize in 1924.

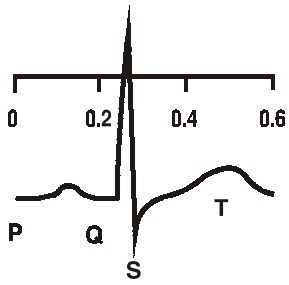
c. A normal ECG is composed of five waves designated from left to right with the letters P, Q, R, S and T. Refer to the diagram.

P	-	represent atrial activity
Q	-	insignificant wave
R	-	Prominent positive wave
S	-	small wave
T	-	Ventricular activity (broadwave)

Lot of diagnostic information can be gained from alteration in the QRS complex.



ECG (Electrocardiogram)
a) Normal curve, b) Abnormal curve



THE ECG TRACE

2. Glucometer

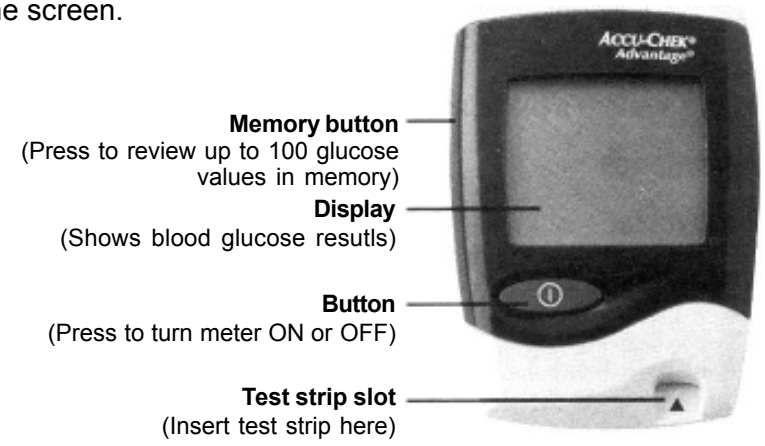
A glucometer is an electronic device to test the level of glucose (sugar) in your blood at a given time.

Normal blood sugar level in man is 80 to 120 mg/100ml. If the glucose level in the blood goes beyond 120mg/100ml, the condition is called diabetes mellitus.

Blood glucose level is controlled by a hormone called insulin secreted by the beta cells of islets of Langerhans.

Glucometer gives a digital reading of blood sugar when a drop of blood of the patient is kept on a sensitive “Strip” and then inserted into the

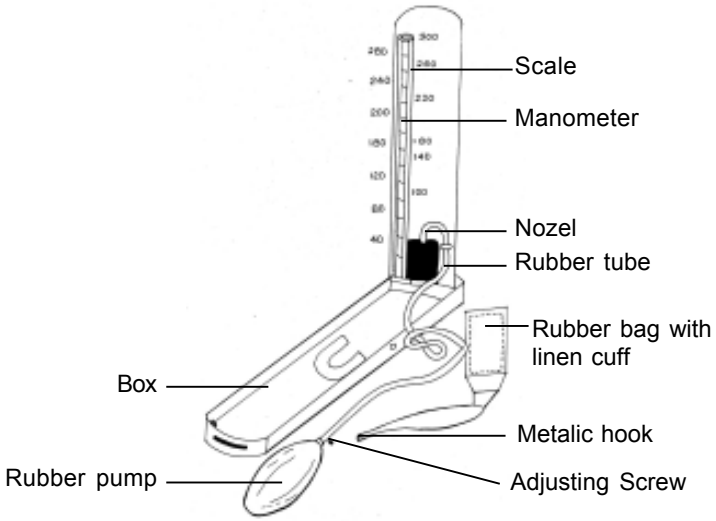
glucometer. Within a minute the reading (blood sugar level) is displayed on the screen.



Glucometer

3. Blood Pressure (B.P.) Apparatus - Sphygmomanometer

A Sphygmomanometer is an instrument used to measure blood pressure.



Sphygmomanometer

Arterial blood pressure is the force of pressure exerting on the walls of the blood vessels in which it flows. The blood pressure in the artery varies during the cardiac cycle.

During ventricular systole, when the left ventricle its forcing blood into the aorta the pressure rises to the peak which is referred to as systolic pressure. During diastole the pressure falls and the lowest value is recorded as the diastolic pressure.

Blood pressure changes during physical exercise, anxiety and emotion and in sleep etc. The normal blood pressure value is 120/80 mm of mercury in which 120 denotes the systolic pressure and 80 the diastolic pressure.

Sphygmomanometer helps to diagnose pathological conditions such as hypertension and hypotension.

IV. PROJECT (ANY TWO)

1. Diseases - Preventive measures
2. Biomedical Instrumentation - Visits to Hospitals / Scan Centres
3. Blood groups
4. Blood smear
5. CT scan

Note :

1. Project may be done with Computer Aided Technology.

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Model Question Paper
Zoology Practicals

Max. Marks : 25
Time : 1½ hrs

I. a. Identify the flag labelled parts (A) and (B) in the given dissection :
b. Write their location, structure and functions.
c. Draw a neat diagram and flag label only the indicated parts.

Identification of labelled parts	-	1 + 1 =	2 marks
Location	-	½ x2 =	1 mark
Structure	-	½ x 2 =	1 mark
Function	-	½ x 2 =	1 mark
Diagram	-		2 marks
Two labels	-		1 mark (8)

II. a. Identify the given preserved specimen (C)
b. Draw a neat labelled diagram.
c. Write notes on it.

Identification	-	1 mark
Diagram	-	2 marks
Labels	-	2 marks
Notes	-	2 marks (7)

III. a. Identify the given apparatus (D) (1mark)
b. Write a note on its use in the diagnosis of a pathological condition. (Diagram not needed) (4 marks) (5)

KEY

I - Digestive system of Frog (Model) A - Stomach B - Rectum
II - Heart of Sheep (Preserved specimen)
III - ECG apparatus (Either apparatus or diagram or photograph)

External (20marks)

Q I	8 marks
Q II	7 marks
Q III	5 marks

Internal (5marks)

Project	2 marks (Project can be done based on textual material)
Record	3 marks
Total	25 marks

X Std
Matriculation Examination
Model Question Paper (Theory)

Science II **Time : 1¼ hrs.**
Marks : 50

Biology - Zoology

Section - B

I. Choose the correct answer : **(5 x 1 = 5)**

1. Haemoglobin consists of a protein part called
   a. Haem b. Globin
   c. Iron d. Heparin

2. In Frog internal cavity called ventricle is not present in
   a. Olfactory lobes b. Cerebral lobes
   c. Cerebellum d. Medulla oblongata

3 If transplantation is done with one's own tissue grafted to another part of the body it is termed
   a. Allograft b. Autograft
   c. Xenograft d. Isograft

4. Segmentation of Zygote is also termed
   a. Gastrulation b. Cleavage
   c. Blastulation d. Fertilization

5. The vaccine given between 9-12 months is
   a. Typhoid b. Polio
   c. Measles d. BCG

II. Fill in the blanks with suitable terms. (5 x 1 = 5)

6. The largest blood vessel of the body is termed the _____

7. Genetically identical individuals are known as_____

8. An instrument used to study the internal organs of man is_____

9. First booster dose of polio is given at the age of _____

10. In the year 1973, Indian Government launched a special scheme _____

III. Answer any five of the following questions in one or two sentences (5 x 2 = 10)

11. Define the term peristalsis.

12. What are Sertoli cells?

13. Draw a labelled sketch of the lymph.

14. Mention any four National Parks in India.

15. What are antibodies?

16. Explain the term immunization.

17. Name few fauna found in the desert.

IV. Write short answers for any four of the following questions in 100 words. Draw diagrams wherever necessary. (4 x 5 = 20) (Question No. 20 is a compulsory question)

18. Describe the digestive system of Frog.

19. Explain the structure of a tooth.

20. Draw a neat labelled sketch of a Hen's egg.

21. Explain Man and Biosphere.

22. Write short notes on "ABO" Blood grouping.

23. Explain organ transplantation.

V. Write detailed answer for any one of the following in 200 words. Draw diagrams wherever necessary. (1 x 10 = 10)

24. Explain the structure of the human heart with a labelled sketch.

25. Describe the development of **"Dolly".**

X STANDARD MATRICULATION BOARD

QUESTION PAPER DESIGN AND BLUE PRINT

BIOLOGY

ZOOLOGY

Science II

Time :
(Zoology 1 hr and 15 minutes)

I. Weightage to learning outcome.

S.No.	Categories	Percentage (%)
1.	Knowledge	30
2.	Understanding	40
3.	Application	20
4.	Skill	10
	Total	100

NOTE :

1. Total Mark is inclusive of choice.
2. While preparing question paper, there may by variation in weightage of categories upto 5%

II. Weightage of various types of questions :

S. No.	Types of Questions	Marks for each Qns.	Total No. of Qns	No. of Qns to be answered	Total Marks
1.	Section – A (MCQ)	1	5	5	5 x 1 = 5
2.	Section – B (FIB)	1	5	5	5 x 1 = 5
3.	Section – C (VSA)	2	7	5	5 x 2 = 10
4.	Section – D (SA)	5	6	4	4 x 5 = 20
5.	Section – E(LA)	10	2	1	1 x 10 = 10
	Total		25	20	50

EXPANSIONS :

MCQ	:	Multiple Choice Questions
FIB	:	Fill in the Blank
VSA	:	Very Short Answer
SA	:	Short Answer
LA	:	Long Answer

NOTE :

1. While preparing multiple choice questions, the question paper setter should not give options like **"none of the above" and "both A and B".**
2. Options to be given are selected only from the text contents. Unfamiliar, irrelevant and non textual matter should be avoided.
3. There should not be any ambiguous options and there must be only one appropriate answer among the four alternatives.
4. Questions are to be framed in such a manner that the candidates should write the VSA in two minutes, SA in five or six minutes and LA in fifteen or sixteen minutes each.

III. Weightage of units.

S. No.	Units	Objective		VSA	SA	LA	Total Marks
		MCQ	FIB				
1.	Levels of Organisation	IMCQ	-	-	1	-	6
2.	Human Physiology	1MCQ	1 FIB	2	1	1	21
3.	Animal Reproduction	1MCQ	-	1	1 (One Diagram compulsory)	-	8
4.	Our environment	-	1 FIB	2	1	-	10
5.	Applied Embryology	1MCQ	1 FIB	-	-	1	12
6.	Diseases and Immunology	1MCQ	1 FIB	2	1	-	11
7.	Applied Biology	-	1 FIB	-	1	-	6
	Total	5	5	7(5)	6(4)	2(1)	74
	Marks to be obtained	5	5	10	20	10	50

IV. Levels of questions

S.No.	Level of questions	Percent
1.	Easy Type	50 %
2.	Average Level	40 %
3.	Difficult Level	10 %

Note :

The level of difficulty varies from individual to individual. The question paper should be a balanced one on the basis of general expectations from the group as a whole. The questions paper setter is strictly instructed to follow this design of question and there should not be any deviation.

X STANDARD MATRICULATION BOARD QUESTION PAPER DESIGN AND BLUE PRINT

UNITS	KNOWLEDGE					UNDERSTANDING					APPLICATION					SKILL					TOTAL
	MCQ	FIB	VSA	SA	LA	MCQ	FIB	VSA	SA	LA	MCQ	FIB	VSA	SA	LA	MCQ	FIB	VSA	SA	LA	
1. LEVELS OF ORGANISATION	1 (1)	-	-	-	-	-	-	-	1 (5)	-	-	-	-	-	-	-	-	-	-	-	6
2. HUMAN PHYSIOLOGY	1 (1)	-	-	1 (5)	-	-	1 (1)	1 (2)	-	1 (10)	-	-	-	-	-	-	-	1 (2)	-	-	21
3. ANIMAL REPRODUCTION	1 (1)	-	-	-	-	-	-	-	-	-	-	-	1 (2)	-	-	-	-		1* (5)	-	8
4. OUR ENVIRONMENT	-	-	1 (2)	1 (5)	-	-	-	-	-	-	-	1 (1)	1 (2)	-	-	-	-	-	-	-	10
5. APPLIED EMBRYOLOGY	1 (1)	-	-	-	-	-	1 (1)	-	-	-	-	-	-	-	1 (10)	-	-	-	-	-	12
6. DISEASES AND IMMUNOLOGY	-	1 (1)	-	1 (5)	-	-	-	2 (4)	-	-	1 (1)	-	-	-	-	-	-	-	-	-	11
7. APPLIED BIOLOGY	-	-	-	-	-	-	-	-	1 (5)	-	-	1 (1)	-	-	-	-	-	-	-	-	6
TOTAL MARKS	4	1	2	15	-	-	2	6	10	10	1	2	4	-	10			2	5		74

Note : * Skill (Diagram) - Compulsory Question