

MOOSAD GUIDE
For
BIOLOGY

KERALA PRE-UNIVERSITY

Rs. 1-50

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Part I ZOOLOGY.

1. What are the differences between living and non-living things?

The different objects which we see around us can be divided into two classes, the living and the non-living. There are certain distinct characteristics for the living things which help us to distinguish them from the non-living.

(a) All living things are fundamentally made up of a chemically complex material called Protoplasm. This can be considered as the Physical Basis of life. This will not be seen in the structure of a non-living thing.

(b) Every living Organism will be exhibiting metabolic activities. These activities involve different chemical changes going on in the body material. Some chemical changes are constructive and some destructive. The transformation of the digested food materials into protoplasm is an example for the former. During physiological activities like respiration and excretion we spend some part of the energy already manufactured; Protoplasm is broken down into simpler compounds. They represent the destructive part. The constructive phase of metabolism is called Anabolism and the destructive phase Katabolism. Metabolism, the highly complex chemical activity, will not be seen in the non-living things.

(c) Living things usually have a life-cycle consisting of embryonic stage, development,

growth and death. Such cyclic changes will not be seen in the case of non-living things.

(d) Living things reproduce. The process reproduction means the ability to give rise to offsprings resembling the parents. Non-living things do not reproduce.

(e) Living things grow in size whereas non-living things do not. (The growth of the rock and the increase in size of a crystal dipped in its saturated solution are exceptions. Their growths are superficial. Contrary to this, the growth of a living thing is effected by converting the digested food materials into protoplasm and hence is internal.)

(f) All living things respond to stimuli. Even the primitive unicellular animals can be seen responding to mechanical, chemical, electrical and thermal stimuli. Botanical experiments of modern times have proved the sensitiveness and reactions of plants to external stimuli. Non-living things have no such characteristics.

(g) Movement is another characteristic of living things. But there are certain non-living things also which can move. Eg: Sodium put in water. They can be considered as exceptions.

2. Show in what respects plants and animals differ.

We have already made a classification of the different objects around us as living and non-living things. Living things can be further divided into two classes—the plants and the

animals. They agree in certain fundamental features, but differ widely when we come to details.

(a) Animals are able to move from one place to another. Locomotion may be in search of food, mate or shelter. Plants are static. Of course some of the lower plants are exceptions to this rule.

(b) Plants manufacture starch, their food material, directly from the elements by a synthetic process. Animals cannot manufacture their food in this way. They have to depend upon the food materials prepared and kept by plants directly or indirectly.

(c) Animals have a compact shape. Plants have uncouth shape because of their branches and wide irregular areas of leaves.

(d) Animals grow only upto a certain age but plants grow till the very end of their lives.

(e) The growth of an animal is different from that of a plant. Animal grows from all the internal parts. But in plants only the tips of roots and stem take part in growth.

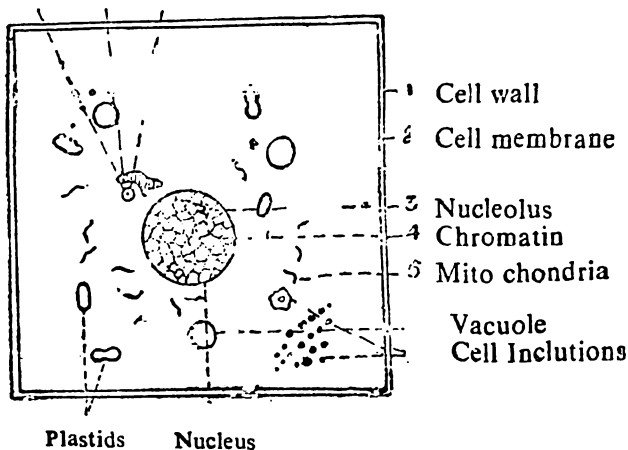
(f) Animals have special organs for respiration, excretion and digestion. No such organs can be seen in plants.

(g) Cells of plants are limited by walls made up of cellulose. Cell walls are absent in animals.

3. Describe the structure of an Animal cell.

The fundamental unit of all living things is called the cell. A typical animal cell is represented in the diagram given below. The cell is a small three-dimensional mass of protoplasm. The outermost layer of protoplasm is modified as a membrane. This cell membrane functions as a covering. Situated in the protoplasm there is a spherical nucleus. Protoplasm minus the nucleus is called cytoplasm.

Centro Golgi
Sphere Body Centrosome



Cytoplasm is a jelly like colourless material. It is a composition of many chemical substances. Nearly 90% of cytoplasm is water and the remaining part is constituted by solid substances of organic and inorganic nature. The main elements by which cytoplasm is made up of

are Hydrogen, Nitrogen, Oxygen, Carbon and Potassium.

Nucleus governs the major life-activities. Every living cell will be having a nucleus. It is externally covered by a nuclear membrane. Inside this a net work of chromatin can be seen. A small spherical mass of chromatin is situated inside the nucleus. This is called nucleolus.

Close to the nucleus a spherical mass is usually seen. This is the Central Body containing a Centriole. The Centriole, a minute granule like structure, plays an important part in the process of cell division. Some rodlike structures called Mitochondria also are seen in the Cytoplasm.

There are certain vacant places in the cytoplasm. They are the Vacuoles. In addition to these, a number of fat globules, yolk granules, starch grains and Plastids are usually identified among the cell inclusions.

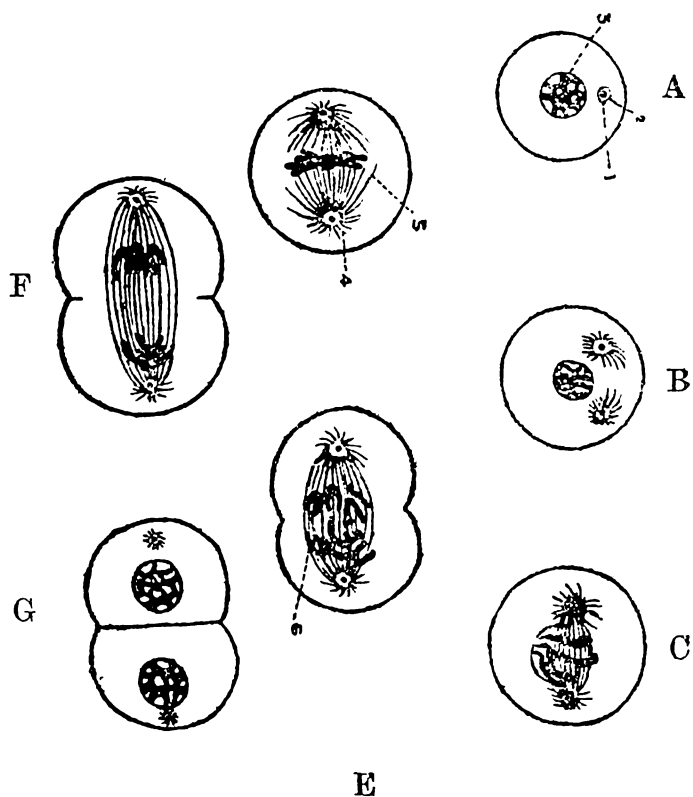
4. What is Mitosis, the Ordinary cell division?

Cells divide and produce more cells. The growth of animals depends on this natural phenomenon. The ordinary cell division is called Mitosis. This happens in four continuous stages.

The first stage is called Prophase. During this nucleus undergoes some changes. The chromatin material is modified into thick short threads called chromosomes. The nuclear membrane and nucleolus disappear by this time.

MITOSIS

D



A, B & C - Prophase
 D Metaphase
 E & F Anaphase
 G Telophase

1. Centrosome
2. Centriole
3. Nucleus
4. Astral fibres
5. Spindle fibres
6. Chromosomes

The central body of the cell divides into two and moves to the opposite poles. They are then connected by radiating fibres and the whole thing becomes spindle shaped. The chromosomes migrate towards the middle of the cell and form an equatorial plate.

The second stage is Metaphase. The chromosomes get themselves arranged in the centre of the spindle. Each chromosome is split into two longitudinal halves. Each half produced thus are identical in structure.

During the third stage Anaphase half of the chromosomes move to one pole and the other half to the opposite pole. Each pole will be having the original number of chromosomes. Each set of chromosome, get associated with the centrosome of that side.

In the last stage Telophase the chromosomes diffuse and become the Original chromatin network. A constriction starts at the middle region of the spindle. When this constriction deepens the whole cytoplasm gets separated into two halves. Each half develops as a daughter cell with a nucleus and a central body. The daughter cells produced by Mitosis possess the same number of chromosomes of the mother cell.

5. Give an account of the Classification of animals

Animals are divided into two sections Protozoa and Metazoa. Protozoa consists of unicellular animals and metazoa multicellular animals. Metazoa can be further divided into two, Invertebrates and chordates. In the former, there are no internal axial skeletons to support the body. The latter possess such a structure. This may be in the form of an undifferentiated rod or a chain of Vertebrae. Those animals which possess a vertebral column are called Vertebrates. Animals with rod shaped structures are called Protochordates.

Protochordata includes cephalochorda, Urochorda and Hemichorda. Vertebrata include Pisces, Amphibia, Reptilia, aves and mammalia.

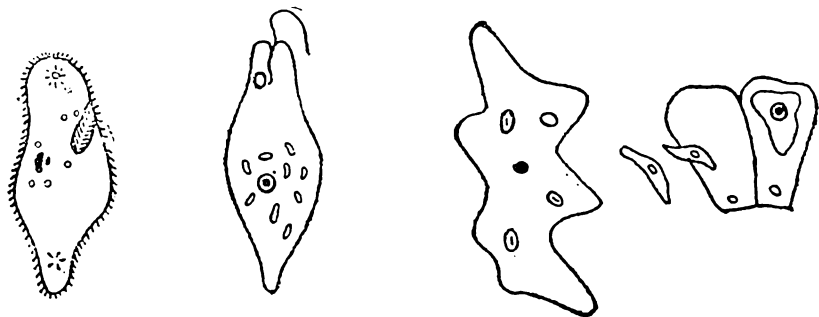
Invertebrates are divided into eight Phyla or groups (they are Protozoa, coelenterata, Platy-helminthes, nemathelminthes, Annelida, Arthropoda, Mollusca and Echinodermata.)

Totally there are eleven phyla in the animal kingdom. Each phylum is again divided into classes. Classes are divided into orders, orders into families, families into Genera and Genera into species.

6. What are the general characteristics of Phylum Protozoa.

This is the first and the most primitive phylum of the animal kingdom. This includes

unicellular animals. They are generally microscopic.



L. to R: Paramecium, Euglena, Amoeba, Plasmodium.

All the life activities are performed by the single cell of the animal. The outer layer of the body is called Ectoplasm and the inner material is called Endoplasm. There will be a nucleus situated in the Endoplasm governing the life activities of the animal. In some cases the number of nucleus will be more than one.

Protozoans have different methods of locomotion. Amoeba is capable of projecting the cytoplasm and thus producing some temporary false feet called 'Pseudopodia—Paramecium' Another member of the phylum has a number of protoplasmic hair like structures covering the body. They are called cilia. The animal moves by the lashing of these specialised structures. In Euglena a whip or flagellum can be seen. By the sudden lashing of this whip the animal is able to move.

Some of the protozoans have a parasitic existence. Independent animals of the phylum develop different methods of capturing the food. Amoeba produces pseudopodia on either side of the prey and it is enclosed within the endoplasm. Paramecium drives a current in water by the lashing of cilia and the prey is swept down the peristomial groove. Digestive system is not well developed in protozoans.

All protozoans respire by the most primitive method Diffusion. Oxygen dissolved in water enters the body through the ectoplasm. Carbon-di-oxide produced during the physiological activities goes out through the same.

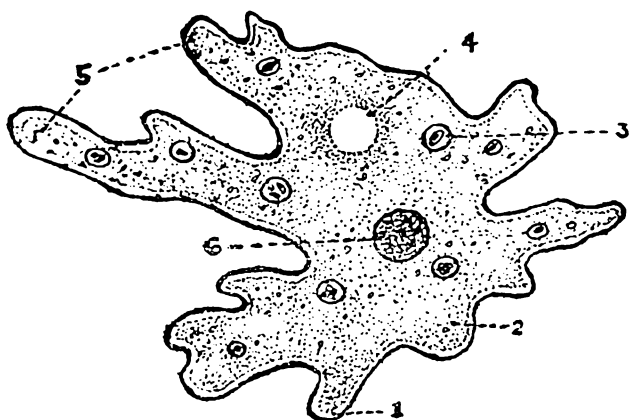
Excretory system cannot be seen in the protozoans. The contractile vacuoles work as excretory organs.

During their pulsating movement they attract and collect nitrogenous waste products from the surrounding Endoplasm. They throw out the impurities by a sudden out burst after coming close to the outer surface of the body.

Nervous system is not at all developed in the protozoans though they exhibit response to stimuli.

Reproduction is done either by Binary fission or by multiple fission. During the Binary fission a mother animal splits into two halves, each sharing a half of the nucleus. During the multiple fission animals develop spores.

Example:—AMOEBA



- | | |
|-----------------|------------------------|
| 1. Ectoplasm | 4. Contractile Vacuole |
| 2. Endoplasm | 5. Pseudopodia |
| 3. Food Vacuole | 6. Nucleus |

This is a fresh water organism with a microscopic, irregular, transparent jellylike body. Due to the absence of a limiting outer cuticle the animal can change its shape at any time. The fleshy projections of the body are the pseudopodia intended for locomotion. They help in capturing the food also. Embedded in the Endoplasm Food Vacuoles can be seen. They are the storages of food.

This is a representative of Rhizopoda, a class under phylum protozoa.

2. Paramecium.

phyl: protozoa.

class: ciliata.

Paramecium is comparatively better organised than amoeba. It has a regular structure. Though microscopic it is bigger than amoeba. It lives in ditches and fresh water areas.

Paramecium has a spindle shaped body with one end blunt. The outer surface of the body is covered by hair-like structures, cilia. They are the locomotor organs of the animal.

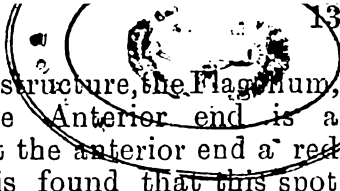
The body is limited by a cuticle. There are two nuclei for this animal, the small micro-nucleus and the big macronucleus. Similarly there are two contractile vacuoles, one on the anterior ventral side and the other on the posterior dorsal side.

Within the body a streaming movement of the protoplasm can be seen. Unlike Amoeba, Paramecium has a mouth and a gullet.

Paramecium reproduces by Binary fission and conjugation. The fact that Paramecium has adopted the method of conjugation which is usually seen only in the case of higher animals is significant.

3. Euglena.

This is a type of Mastigophora, a class under Protozoa. This lives in dirty water containing decayed organic matter. This also is microscopic.



The presence of a whiplike structure, the Flagellum, which springs from the Anterior end is a characteristic feature. At the anterior end a red eyespot can be seen. It is found that this spot shows definite reactions to light.

In respect of nutrition Euglena is more plant like. There are chloroplasts in the body and with the help of this the animal manufactures starch when there is sunlight. It is also able to absorb decayed organic matter from the surrounding water through the outer surface of the body. Reproduction is done by Binary fission.

4. Plasmodium.

Plasmodium belongs to the class sporozoa which includes the parasites of protozoa. Plasmodium is the malarial parasite. The life cycle is completed in two hosts, man and Anopheles mosquito. They attack the red corpuscles of man. They multiply within the corpuscles and invade fresh cells. Plasmodium assumes the shape of a minute Amoeba, with a disc of protoplasm and a nucleus.

7 Describe the general characteristics of phylum Coelenterata

Animals belonging to this phylum have only one cavity within their body. This cavity represents both coelom and Enteron. The name coelenterata suggests this peculiarity.

Coelenterates are multicellular animals which can be seen without the help of a microscope. They are better organised than the protozoans.

Coelenterates are called Diploblastic because they have only two layers for the body wall, the Ectoderm and the Endoderm. In higher animals a third layer Mesoderm also can be seen. Instead of Mesoderm we find an undifferentiated mass of jelly called Mesoglea, situated in between the ectoderm and the endoderm.

Generally the body of coelenterates has a long and cylindrical structure. The gastrovascular cavity or the coelenteron has only one opening. This acts as mouth and anal opening as well (eg: hydra). Radial symmetry is another typical characteristic of coelenterates.

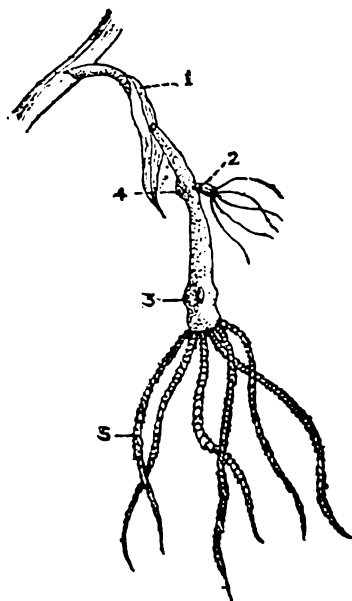
The larva of coelenterates is called planula. In the life history of coelenterates alternation of generation can be seen. There will be a sexual generation represented by the Medusa which produces gametes and an asexual generation represented by the polyps.

Coelenterates develop some specialised organs called cnidoblasts. They are the modifications of interstitial cells and they function as weapons of offence and defence. In colonial coelenterates a distinct division of labour can be seen. Some are allotted the work of capturing food and some reproductive activities.

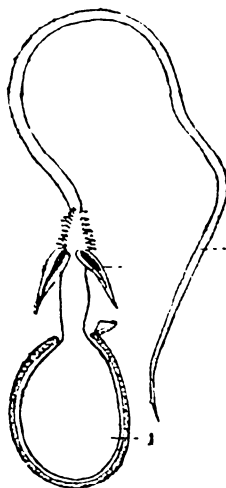
Generally coelenterates possess finger shaped structures called tentacles. These help the animal in locomotion and food capture. Tentacles in animals like hydra will be loaded with a number of cnidoblasts.

Example: Hydra.

Hydra is a multicellular fresh water animal. It has a long and cylindrical body. The Basal

HYDRA

1. Hydrilla plant
2. Bud
3. Testis
4. Ovary
5. Tentacle

NEMATOCYST CAPSULE

1. Capsule
2. Proks
3. Nematocyst

Disc will be fixed to a substratum. The anterior-most end of the body is a conical prominence

called hypostome. The mouth opening is situated at the summit of this prominence. The hypostome is surrounded by many finger shaped tentacles. All the major characteristics of the phylum are applicable to hydra. It is diploblastic. The interstitial cells especially of the tentacular region get modified as cnidoblasts.

Hydra moves by the muscular activity of the body wall. It can bring about locomotion by making a series of somersaults and also by adopting the method of the caterpillar. In both the cases the movement is controlled by the contraction and relaxation of the musculo epithelial cells. The bending, stretching and contracting of the body are done by them.

Hydra reproduces by producing buds in the asexual way and gametes in the sexual way. Being a hermaphrodite both the male and female sex organs are produced by one and the same animal.

8. What are the general characteristics of Phylum Annelida ?

Metamerism or Segmentation is the most important general characteristic of this phylum. The body of the animal will be divided into segments or metameres both externally and internally. The external division can be seen marked by transverse grooves. Internally there will be partitions or Septa. All the physiological systems pass through the Septa piercing them.

As these systems run longitudinally, from end to end each compartment will be sharing a part of each.

Annelids have three layers for the body wall. Hence they are described as triploblastic. The outermost cuticle is formed by the secretion of the epidermis.

The coelom is spacious. This is in communication with the exterior by excretory ducts as well as reproductive ducts.

There are certain characteristic paired excretory organs in Annelids called Nephridia.

The circulatory system is present in Annelids. Blood is red in colour due to the presence of haemoglobin.



A. Neries—(Class chaetopoda)

B. Leach—(Class Hirudinea)

The Nervous System also is developed. This consists of a ventral nerve cord with segmental Ganglia and a brain.

Respiration is by the primitive method diffusion.

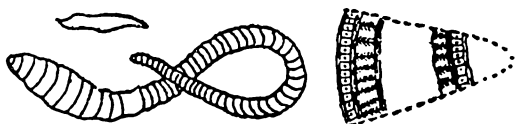
Many of the Annelids are Hermaphrodites.

Locomotion is a muscular process. Alternate contraction and expansion of the muscular layers of the body wall help the animals to move.

Regeneration is a characteristic phenomenon exhibited by many of the Annelids. Regeneration means the ability of developing lost parts.

Example—Earthworm.

This is found in moist soil. The decayed organic matter contained in the soil is the food of the earthworm. They burrow into the soil with the help of the protruded muscular pharynx. When doing this, the soil containing food materials is taken in. Within the alimentary



Earth worm, Seta and a Section of Body wall

canal organic matter is absorbed and the remaining soil is thrown out as wormcast.

Body segments have small bristles around. These hard chitinous structures called Setae, help the animal in locomotion securing a grip on the ground.

Fertilisation is by copulation. The earth worm is considered as the 'friend of the farmer.' During their feeding they rake the soil and bring

the lower layers up. Air gets access to the soil and the nitrogenous wormcasts add to the fertility.

9. Give a general description of Phylum Arthropoda

Arthropoda is the biggest Phylum in Zoology. Body is segmented. But the segmentation is only external. Bilateral symmetry and the presence of biramous appendages are distinguishing characteristics.

The presence of an exoskeleton is another typical feature. Chitinous tergal plates cover the dorsal sides of the body. The ventral sides are covered by sternal plates. Laterally a thin layer of cuticle connects the Tergum and the Sternum.

Body is triploblastic. A distinct division of head, thorax and abdomen can be seen.

Blood which is white in colour due to the absence of Haemoglobin is not kept in closed vessels. The body cavity is filled with blood and hence it is called Haemocoel.

Terrestrial Arthropods have tracheal tubes for their respiration. The circulation and respiration are not connected as in other animals.

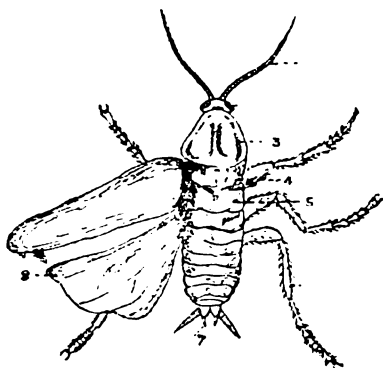
Arthropods exhibit sexual dimorphism. The development is a metamorphosis. During the growth of the young one moulting takes place a number of times.

Many of the Arthropods are useful to man. Prawns, lobsters and crabs provide food. Silk

moth and honey bee are very useful to the mankind. But there are dangerous enemies also in this phylum. Mosquitoes and house flies are carriers of diseases.

Example—Cockroach

Cockroach is an omnivorous nocturnal animal. The body consists of a head, thorax and an



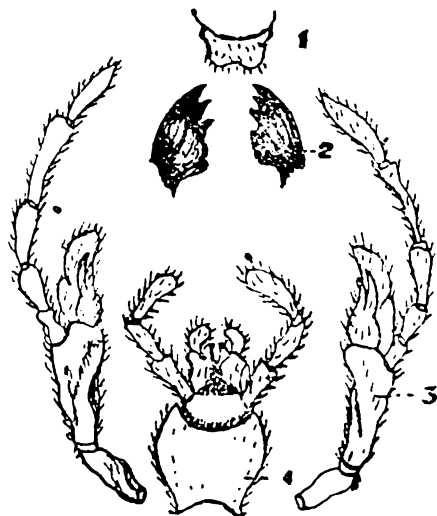
1. Antenna
2. Compound eye
3. Prothorax
4. Mesothorax
5. Metathorax
6. Jointed leg
7. Anal style
8. Wings

abdomen. Head bears a pair of *Antennae*. The eyes are compound being made up of many units. The thorax consists of three segments. Prothorax, mesothorax and metathorax. Abdomen is divided into ten segments. There are two pairs of thoracic wings which are the extensions of the cuticle.

Body is protected by exoskeletal structures.

Heart is a long tube divided into thirteen compartments and enclosed within a pericardium.

MOUTH PARTS OF COCKROACH



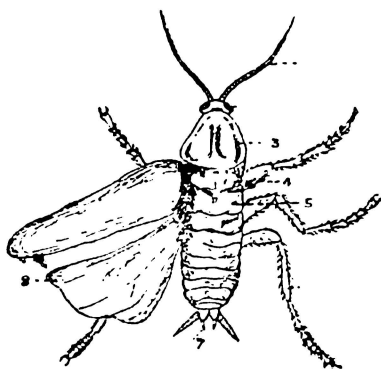
1. Labrum. 2. Mandible. 3. Maxilla. 4. Labium.

Mouth parts are modified to suit the omnivorous feeding habit. The mouth consists of an upper lip labrum, a pair of mandibles forming the chief jaws, a pair of maxillæ which serve as accessory jaws, and a lower lip called labium. Sexes are separate. Male can be identified by the presence of Anal styles in the last abdominal segment. The abdomen of the female cockroach will be bigger than that of the male. Being a typical arthropod, all the major characteristics of the phylum are applicable to cockroach.

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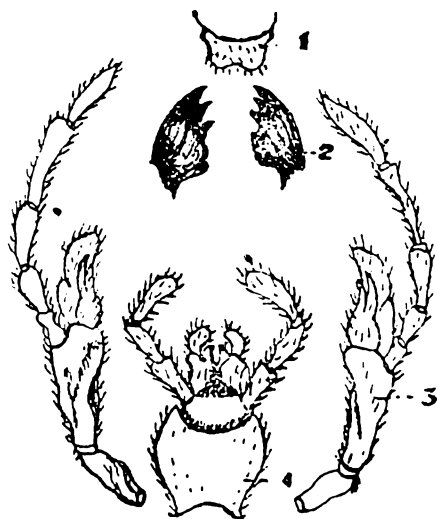
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10. Describe the general characteristics of phylum Amphibia ?

Animals having an aquatic and a terrestria stage in their life history are called amphibious.

Frog is an example of Amphibia. Amphibians are generally lungbreathing unisexual, cold-blooded animals. There will be external and internal nostrils. The outer skin is loose and slimy. The skin also helps in the process of respiration. (Eg. Cutaneous respiration of frog.) Skin will be supplied with capillaries. Two pairs of limbs with five digits help the locomotion.

Circulatory system is well developed. The heart is externally covered by pericardium and internally divided into three compartments, two auricles and a ventricle.

Fertilisation is external. The female throws the eggs into water. During copulation the male sheds the sperms on it. Fertilisation takes place in water and so it is said to be external.

Example—FROG

The frog is an amphibian as it has two stages in its life history, aquatic and terrestrial. It is a Vertebrate.

The body is bilaterally symmetrical and it consists of a head and trunk. The head which is flat and triangular, contains besides the brain, paired sense organs like nose, ears and eyes. Limbs, which are paired organs, are attached to the trunk and they are used in locomotion. They

do not enclose cavities. The trunk has two cavities, a large ventrally situated body cavity and a narrow dorsally placed neural canal. The hollow neural canal continues into the head. The heart, lungs, liver, alimentary canal, kidneys and gonads are situated in the body cavity. The alimentary canal opens out at both ends. The ventral heart is enclosed in the pericardial cavity, a separate part of the body cavity.

The body is covered by a smooth, loosely attached slimy skin. The male can be identified from the female by the presence of a pair of vocal sacs and the padlike swelling on the index.

Copulation is said to be external. The development of the young one, i.e., the tadpole into the adult frog is a metamorphosis.

11. What are vertebrates? What are their distinguishing characters?

Animals which possess a vertebral column are called vertebrates. It will be dorsally placed inside the body, and usually it consists of a number of vertebræ linked to one another.

The distinguishing characters of vertebrates are given as under.

Vertebrates possess a central nervous system, which is placed dorsal to the alimentary canal, and which has an anterior enlarged part, the brain and a posterior narrow part, the spinal cord. The body is bilaterally symmetrical. A head with paired sense-organs like eyes and ears, a heart

with distinct chambers lying ventral to the alimentary canal, pharyngeal gill-slits which exist either in the embryonic stage or throughout life, and paired appendages are other distinguishing characters. The blood is red in colour due to the presence of hæmoglobin. Hæmoglobin is contained in the red corpuscles and not dissolved in plasma. A hepatic portal circulation is also a characteristic feature.

Vertebrata are divided into five classes. They are Pisces, amphibia, Reptilia, aves and mammalia.

12. Short notes on some phyla.

1. Mollusca

The body of the mollusc will be soft and it will be kept within a shell case.

Their locomotion will be very slow with the help of specialised structure 'foot'.

There are no appendages for the body. Coelom is present. The pericardial space will be a part of the coelom. A Heart with three divisions, two auricles and a ventricle, can be seen. Molluscs respire through gills.

They may be bisexual or unisexual. The veliger larva is a typical characteristic of this phylum.

2. (a) Platy helminthes

Platy helminthes are flat triploblastic animals. The body has bilateral symmetry. Digestive system is developed. Mouth serves as

both the entrance and exit of the alimentary canal. This includes free living forms as well as parasites. In the parasites the alimentary canal will not be so developed as in the free living members.

1. Liverfluke



2. Planarian



2. Tape worm



4. Roundworm

Platy helminthes are bisexual. Reproductive system is well developed. The parasites have segmented body and every segment is having male and female gametes.

(b) Nemat helminthes

These are long round triploblastic animals with bilateral symmetry. The body cavity is well developed. Mouth and Anus are different openings. Sexes are separate. There are dissi-

ilarities in the morphological structures of the male and the female.

Body wall is externally covered by a well developed cuticle.

Many of the nemathelminthes are free living. There are of course some harmful parasites in this phylum like *Trichinella*, *Ascaris*, *Wucheraria*, etc.

13. What is Organic Evolution?

Before the advancement of science, it was believed that the earth and the living beings were created as such by the Almighty. This idea was a part of the religious faith of the people and nobody dared to reason. Along with the growth of scientific knowledge 'How's and 'why's were raised by free thinking intellectuals. There was no basis for the theory of Divine creation.

Scientific knowledge explained, the development of different kinds of animals and plants. These modern ideas form the theory of Organic evolution. Many scientists contributed to the establishment of this theory.

According to the Organic Evolution theory, higher forms of life are evolved from smaller ones after undergoing a series of very slow changes. The history of life is a record of gradual changes, from the primitive unicellular animals to the highly complicated big mammals. Each individual animal has a background of this long chain of evolutionary changes.

These are some of the important theories involved in the idea of organic evolution.

LAMARCKISM

According to Lamarck new characters are developed to meet the necessities by the influence of environment. Lamarck's classical example is the long necked Giraffe. Giraffes are evolved from horses. Some horses entered the forests leaving the plains and they found it difficult to get on. The foliage was the only food available. But they were too high to reach. A long neck was an absolute necessity. They tried to reach the higher branches and gradually the neck began to lengthen. This struggle went on for generations and a class of horses with very long necks was formed.

Lamarck put forth the theory of use and disuse. If a particular organ is frequently used, it will, according to him, become strong and prominent. If a particular organ is kept in disuse it will diminish and after some generations become a relic.

Lamarck's idea about the inheritance of acquired characters was thoroughly disproved later.

DARWINISM

Charles Darwin's theory of natural selection is explained in his immortal work 'Origin of Species.' These are the points of his theory.

(1) If all the seeds germinate or if all the embryos developed into young ones the earth will be overcrowded.

(2) But nature will not allow over production. Among the offsprings there will be a keen *struggle for existence*.

(3) In this struggle only the *fittest will survive*.

(4) Nature will make its own selection. By the favour and influence of Nature some offsprings develop new characters and they can adapt to their environment.

(5) Man also decides which should be allowed to grow and which should not be. This is called artificial selection.

Darwin says that the development of new characters is a very slow process.

HUGO-DE-VRIES

De-Vries, the Dutch botanist suggested another theory on the development of new characters. According to him the organic evolution is not a slow and even process as Charles Darwin imagined. He says that there are leaps and jumps in the process and that new characters may develop all on a sudden. This phenomenon is called *mutation*.

14. What are the evidences of Organic Evolution ?

(1) Morphological evidences

Morphology is the study of external organs. While studying the structure, origin and functions of Morphological structures in different animals much similarity can be traced. When we compare the skeleton of the forelimbs of a frog, a bird, a lizard and a man we will find the fundamental plan is more or less the same. There may be differences in details. When we study different plants we can find that all of them are built in the same morphological pattern. These things show that higher forms of life are evolved from primitive smaller ones. Homological and Analogical studies will throw much light on the development of the respective species.

(2) Entomological evidence

Entomology is the study of internal organs. When we compare the anatomical structure of different animals we will find distinct similarity. This will prove that they have a common origin. The arterial system of a frog and the arterial system of a rabbit have the same fundamental structure.

Along with entomological studies the Vestigial organs of man also were considered. Within the human body we find many vestigial structures like the appendix. The appendix is quite useless to man and it is very small and insignificant. But in the early mammals like the rabbits we find a well developed appendix playing an

important part in the digestion. We can assume that man in whom we find the vestigial appendix has evolved from mammals in which the appendix was functioning well. The coccyx (tail of man) is another vestigial organ.

(3) Palæontological Evidences

Palæontology is the study of Fossils. Fossils are got from ice and lower strata of earth. In fossils nature preserves the form of the animal without any damage for millions and millions of years. By studying such fossils we get an idea about the different types of animals that existed in the past. Geologists can ascertain the age in which they were formed. The ideas about the pre-historic animals are mainly based on fossils. Many missing links in the chain of evolution were got in this way. The study of fossils helped to prove the Organic Evolution theory considerably.

(4) Embryological Evidence

This is by a comparative study of embryos. In the early stages embryos of different Vertebrates show surprising similarity in structure. Further the theory of recapitulation also is of much importance. This theory states that Ontogeny (development of the individual) is a repetition of Phylogeny (development of Class). To put it in other words, the stages which we find in the development of the individual show the stages through which the class has evolved. Frog can be taken as an example. The adult frog is developed from the larva tadpole. Tadpole is

exactly like a fish in structure and habitat. From this fact it is assumed that the class of frogs (amphibia) has developed fish like ancestors.

(5) Physiological Evidence

In all animals the Physical Basis of life is the same, Protoplasm. It has the same chemical composition in all cell tissues. Hormones, digestive juices etc. show similar structure and functions in different animals. Blood tests also help to prove the relation between classes. Closely allied classes show the same type of blood reactions.

15 What are the general characteristics of Aquatic Animals

All aquatic animals have a characteristic structure. The body will be spindle shaped tapering at both ends. This is to minimise resistance to water in swimming.

Locomotion is effected by the contraction of the muscles of the bodywall. Aquatic animals keep their balance by their fins and tails during locomotion. In fishes there will be an air bladder which functions as a hydrostatic organ.

Some of the aquatic animals are gillbreathing and some lungbreathing.

The body will be divided into head, trunk and tail. But the three regions will not be clearly marked off by constrictions. Body will be streamlined so that they can easily cleave through water.

In the aquatic mammals (eg: whale) the limbs get modified as propellers.

The skeletal structure will be spongy so that the body weight is reduced to the minimum. The outer surface will be smooth and slimy so that there will be no friction. In the aquatic animals fat bodies are deposited below the outer skin in order to maintain the temperature of the body.

16 What are the general characteristics of terrestrial animals.

Terrestrial animals or animals living on land show different varieties according to their geographic distribution, climatic difference and dissimilar environments. All of them maintain a level of body temperature. There may be difference between body temperature and atmospheric temperature. To protect the body temperature from the influence of atmospheric temperature they have outer coverings. In man and other mammals there is the outer skin. In lower animals there is the exoskeleton.

Compared to aquatic animals terrestrial animals are smaller in size. They have well developed limbs for their locomotion.

The respiratory organs of land animals are situated internally.

They depend on the vegetable kingdom directly or indirectly for their food materials.

Usually the larva stage is absent in the life history of terrestrial animals. Their eggs are covered by shells and richly supplied with yolk.

In structure and habits terrestrial animals vary according to their natural surroundings. Subterranean animals have slender cylindrical body to suit their burrowing habit. With the help of the sharp snout they pierce and dig through the soil. Limbs, if present will be highly reduced. They live in darkness almost all the time. So eyesight will be very little. Animals which dwell in dark caves permanently will not be having eyes at all.

Animals living on the surface of the earth are able to withstand the variations of atmospheric temperature. Their physical capacities differ so as to adapt to their environments. Some have protective colouration. Some are very strong and agile. Beasts of prey can run fast and leap very broad. Some develop very sharp senses.

The struggle for existence is seen to the maximum among terrestrial animals. To get their food and to protect themselves they have so many ingenious methods.

17. Give an account of animals that are harmful to man.

There are two types of animals which can be generally considered as harmful to man. One type is actually responsible for diseases and the other helps to spread them among men. The

former type, described as pathogenic, includes protozoans, Helminths etc. Bacteria are the most important pathogenic forms. But they are included under plants (Many of the major diseases like Tuberculosis, Typhoid, Plague, Cholera etc. are caused by bacteria).

Some species of amoeba (coming under the phylum protozoa) have parasitic existence. *Entamoeba histolytica* is one example. It attacks the inner walls of our intestine and we are affected by the disease Amoebic dysentery.

Trypanosoma which causes the African Sleeping sickness and *Leishmania* which causes tropical diseases like Kala Azar and Oriental sore belong to the flagellate class of phylum protozoa.

Plasmodium (Class: Sporozoa) is the parasite which causes Malarial fever. This parasite attacks the red corpuscles of man and multiply within the body. They soon enter a number of red corpuscles and destroy them. At this stage the man becomes a victim to shivering malarial fever. In acute stages the disease is fatal.

Tape-worm (belonging to Phylum Platyhelminthes) is infected through pork. This parasite is not very dangerous as it causes only Anæmia. *Ascaris*, the round worm is a dangerous parasite. This attacks the intestinal wall. In the later stages Round Worms infect the lungs and heart even. This causes fatal diseases like pneumonia.

Ancylostoma or the hookworm enters the skin and causes ulcers.

Filarial parasite (*Wucheraria Bancrofti*) causes serious diseases like elephantiasis. They enter the blood circulation and from there they will pass on the lymphatic vessels. When they remain in groups in the lymphatic system lymph circulation will be blocked. This causes the swelling of different parts.

Pathogenic forms are helped by their agents to spread the diseases far and wide.

So many animals play the part of intermediate host in the life cycle of parasites. But the most harmful of them all are the insects. They visit all sorts of dirt and filth containing pathogenic forms and when they sit on food substances next, germs of diseases are transmitted. Cholera, Tuberculosis, Typhoid etc. are spread by them in this way. A number of diseases are transmitted by the housefly.

Mosquitos of the *Anopheles* type are responsible for the spread of Malaria. When a mosquito sucks blood from a Malaria victim the parasite enters the insect. Within the intestine it multiplies and then those germs pass on to the salivary glands. When the mosquito next sucks the blood of another individual the germs enter his blood from the salivary glands. There they attack healthy red corpuscles and multiply. Mosquitos of *Culex* type spread filarial parasites.

Plague, a dangerous epidemic is spread by fleas. But this disease spreads among rats usually. Sometimes man also is infected when the flea which has already visited a disease carrying rat bites him.

Cockroaches, lice, black flies and so many other insects spread diseases by transmitting pathogenic forms.

18. Write an essay on animals useful to man.

Many animals are of immense use to man. They give us food, clothing, labour and help us in our struggle for existence against our natural enemies.

Certain molluscs (oysters and fresh water mussels), arthropods (prawns and crabs), Fishes (sharks, sardines and mullets), birds (ducks and poultry) and animals (deer, swine and cattle) are used for food. Eggs of some birds, milk from cattle and honey from honey-bees are also parts of human diet. It is to serve these purposes that man has domesticated many such animals.

Skins and hides, wool and furs, silk and ornamental feathers are all outcomes of the animal world. Oils and fats are extracted from aquatic and terrestrial animals. The shells of certain molluscs provide material for the manufacture of lime, mortar and cement. Even the precious pearls and ivory of commerce are taken from animals. Biological products like Hormones and antibiotics are immensely used in the treatment of diseases.

Domestic animals like dogs and cats are kept as pets and companions. Adding to man's joy and pastime cage birds and aquarium fishes are useful.

Dogs are trained to-day for detecting criminals in murder cases. Horse, ass and ox are made to work for man. Certain insects help pollination in flowers, and birds, animals etc. disperse seeds far and wide. Parasites, which are often doing harm to mankind, oblige by keeping down pests injurious to man's interests. For example, the tiny wasp *Trichospilus* destroys another serious pest of the Coconut palm, the *Nephantis*. Man has harnessed a number of animals for his well-being.

SHORT NOTES

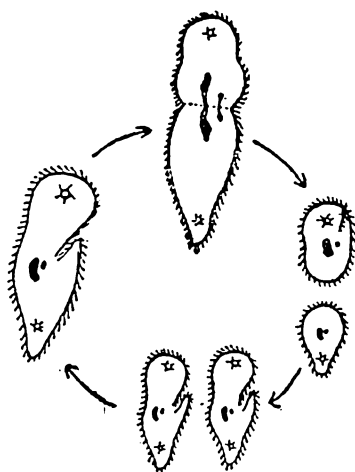
1. Chromosomes

Chromosomes govern the inheritance of parental characters. They constitute the most important part of the nuclear material. The chromatin net work which we find in the nucleus is the diffused form of chromosomes. This net work gets modified as ribbon-shaped chromosome threads during the cell division. The number of chromosomes in the cell will be limited in every species. A change in the number of chromosomes will bring out much differences in the character of the offspring. Each chromosome contains a number of small beads called genes. These genes are representing the different characters of the individual. During cell division the chromosomes split longitudinally so that identical halves are

shared by the daughter cells. The daughter cells inherit all the characters of the mother cell in this way.

2. Binary fission.

This is the most primitive method of reproduction. One animal splits up into two halves and each half begins to live independently.

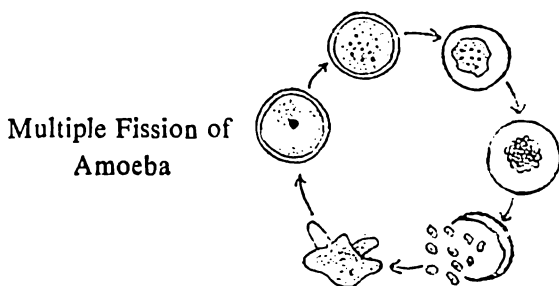


Binary Fission of
Paramecium

Unicellular animals like the amoeba, paramecium etc. adapt this method. Binary fission is effected mainly during favourable seasons when there is an abundant supply of food and water. During this the nucleus as well as the body material divide.

3. Multiple fission

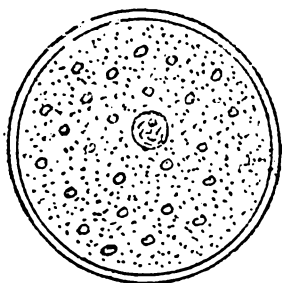
Some of the protozoans reproduce by the method spore formation or Multiple Fission. The class sporozoa includes Parasites producing spores. The free living Amoeba also reproduces by multiple fission during unfavourable conditions. The animal withdraws all the pseudopodia and becomes spherical in shape. The protoplasm secretes a fluid which forms a thick outer covering called the cyst. The nucleus divides repeatedly



and corresponding to this division the protoplasm also divides. Each fragment of the nucleus will be taken up by a bit of protoplasm. When once again the season is favourable the outer cyst ruptures and the small daughter individuals inside it come out.

4. Ovum

Ovum is the female sexual gamete. It is spherical in structure. It has an outer egg membrane. Within this there is a mass of



Above: Ovum

Below: Sperm

1 Head

2 Neck

3 Tail



protoplasm and a prominent nucleus. The protoplasm is richly supplied with yolk. Yolk is the reserve food material. The growing embryo makes use of this.

5. Sperm

Sperm is the male sexual gamete. The male Reproductive System produces sperms in large numbers. It has a small head, a long tail and a neck connecting the two. The sperm moves by the lashing of tail. The nucleus is situated in the head.

42011

6. Fertilisation

During the sexual reproduction the male sperm and female ovum fuse together. This fusion is called fertilisation. The sperm enters the ovum through the micropyle, if it is protected by the egg-membrane. The fusion is complete, nucleus with nucleus and protoplasm with protoplasm. The fertilised egg is called zygote. The zygote develops as the embryo.

7. Asexual Reproduction

Reproduction is in two ways in the animal kingdom—sexual and asexual. All higher animals reproduce by the sexual method where the male and female gametes take part. But in the asexual reproduction which is seen in the lower members of the animal kingdom, gametes are not produced. Binary fission and multiple fission are asexual methods where there is no fusion between the male gamete and the female gamete (For a description of binary and multiple fissions see notes 2 & 3).

8. Metamorphosis

The transformation of the larva into the adult individual is called metamorphosis. In some cases the larva will not be having any resem.

blance whatso ever with the adult. It undergoes a thorough change during the development. Eg: tadpole to frog, caterpillar to butterfly. Such transformation involving fundamental changes is called a complete metamorphosis. The direct development of a young one into the adult after a series of gradual changes is said to be incomplete metamorphosis. (Eg: nymph of cockroach develops into the adult).

9. Commensalism

Commensalism is the union of two individuals. This union will be helpful to each other in many respects. They work with a perfect mutual understanding.

Commensalism of Sea Anemone and Hermit crab is the most outstanding example. The Hermit crab manages to get the food materials and a part of which is supplied to the Sea Anemone. The Anemone in its turn protects its commensal from the attack of its enemies. The crab helps its partner in the matter of locomotion also. Other examples of commensalism are crab and Mytilus, Prawn and Anemone, Ants and Aphids and Echene and Shark.

The partners of commensalism can be separated without any harm to either of them.

10. Parasites

Parasites are animals which do not lead an independent life. They depend upon other animals for their food. They are harmful to the hosts in many cases.

Parasites which attack the outer surface of the host's body are called Ectoparasites (Eg. Leech.) They will be having suckers or hooks.

Parasites seen inside the body are called Endoparasites. They do not require sense organs unlike the Ectoparasites. They multiply rapidly inside the body of the host.

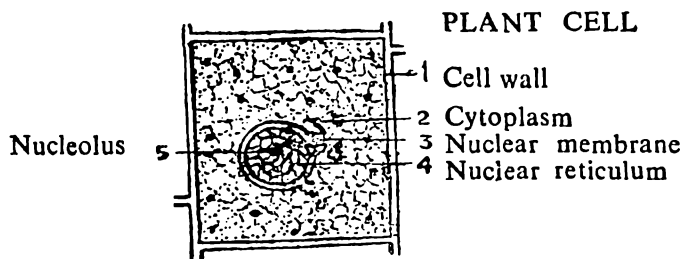
Some parasites complete their life history in one host and some in more than one.

Some absorb the food materials of the host, some attack and damage the tissues and some produce poisonous substances. In certain cases the parasites even make the host sterile by their activities (eg. Sacculina on female crab).

BOTANY.

Describe the Structure of a Plant Cell.

As all living things the fundamental unit of a plant is the cell. The cell has an outer *Cell wall* made up of a substance called the *Cellulose*.



Inside the cell wall there is a semi solid substance called the *Cytoplasm*. Somewhere in the centre of cytoplasm a spherical structure *nucleus* can be seen. Nucleus is the centre of the life activities of the cell.

Nucleus is covered by a nuclear membrane. The material by which the nucleus is made up consists of chromatin and nuclear sap. A small spherical nucleolus (sometimes more than one) can be seen inside the nuclear sap.

Embedded in the cytoplasm a number of plastids can be seen.

In grown up cells the cytoplasm will not be filling the whole interior space of the cell. There will be empty spaces called vacuoles. In the older cells the cytoplasm will be merely a lining layer and the nucleus will be seen attached to the inner wall.

2 Describe the broad classification of plants giving one example of each major group.

Based upon evolution and the internal structures of plants, the plant kingdom, as a whole, is broadly divided into two distinct groups, cryptogams and spermatophyta. In cryptogams the reproductive organs are hidden, and they reproduce by means by spores. The root, stem and leaves are not properly developed in such plants. They are flowerless plants. Spermatophyta have well developed roots, stem and leaves. As they are flowering plants and have visible reproductive organs, they are also called Phanerogams.

Cryptogams are further divided into three major groups, Thallophyta, Bryophyta and Pteridophyta. Algæ, Fungi, Bacteria and Lichens belong to the group Thallophyta (Spirogyra is an alga). These plants are very primitive and their body is composed of a simple mass of cells

forming athallus. They do not have root, stem or leaves.

Mosses and their allies are Bryophytes (Eg: Funaria). They have root-like, stem-like and leaf-like structures and during their reproduction a regular alternation of two generations, a sporophyte and a gametophyte, could be seen.

Fern like plants (Eg. Nephrolepis) are Pteridophytes and they exhibit the highest organization among Cryptogams.

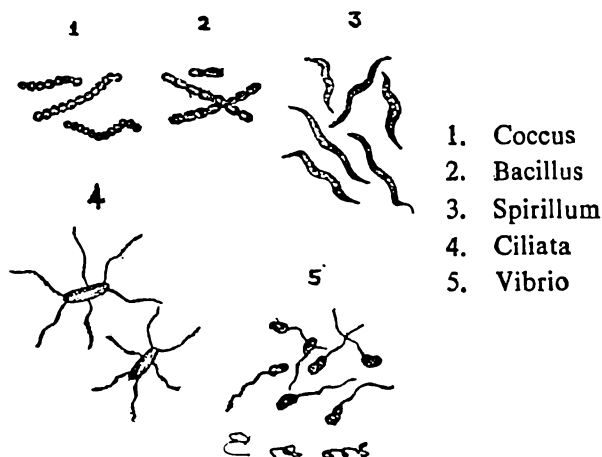
Phanerogams are divided into two major groups, Gymnosperms and Angiosperms. Cycas is a Gymnosperm. Hibiscus and Cocos (the Coconut palm) are typical examples of Angiosperms. The seeds are exposed in the former, but are enclosed in an ovary in the latter. There are further divisions among Angiosperms, the Monocotyledons and Dicotyledons. According to the similarity in structure and reproduction, each group is further subdivided into families.

3. Explain the structure and reproduction of Bacteria, bringing out their economic importance.

Bacteria are certain microscopic unicellular primitive plants, popularly known as germs or microbes. They are entirely devoid of chlorophyll and so they depend upon organic or inorganic matter for their food. They occur either as parasites or as saprophytes.

Bacteria vary very much in form and size. Four forms of Bacteria are easily recognized.

BACTERIA



They are, the spherical form called coccus, the rod-shaped form Bacillus, the spiral form spirillum and the comma shaped Vibrio.

The bacterial cell does not have a cellulose wall. There is only a limiting film around. The protoplasm is found 'enmasse' and it is not differentiated into nucleus and cytoplasm. Most of them move by the help of cilia or flagella. There are aerobic and anaerobic forms of Bacteria.

Under favourable conditions they multiply quickly by the simple reproductive method of

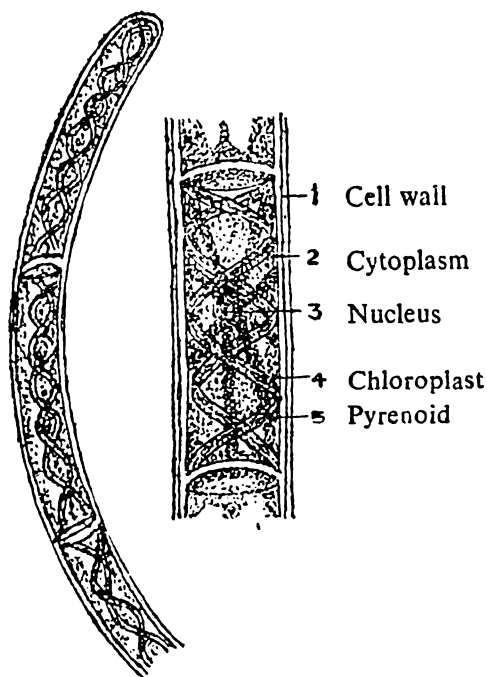
binary fission. During unfavourable seasons they develop spores. In this condition they are dispersed far and wide. When once again conditions are suitable, the spores develop into Bacteria.

Some forms of Bacteria are harmful to mankind, and they are responsible for the spread of diseases like plague, typhoid, cholera and tuberculosis. But some of them are highly beneficial to man. Many forms of bacteria act as scavengers during their consumption of decayed organic matter from their surface of the soil. The denitrifying bacteria help in sewage disposal, while the nitrifying bacteria render the soil fertile. Bacteria play an important role in wine-brewing and alcohol manufacture. Certain forms of the n are used in dairy industry, in the manufacture of butter and cheese. The extraction of fibres of coconut, jute etc. would have been impossible without their help. Hence their economic importance.

4. Describe the structure and reproduction of the spirogyra.

Spirogyra is a green filamentous alga. The filament consists of long cylindrical cells fused end to end. Each cell consists of an outer cell

wall, an inner lining layer of protoplasm and a prominent spirally coiled chloroplast. In the

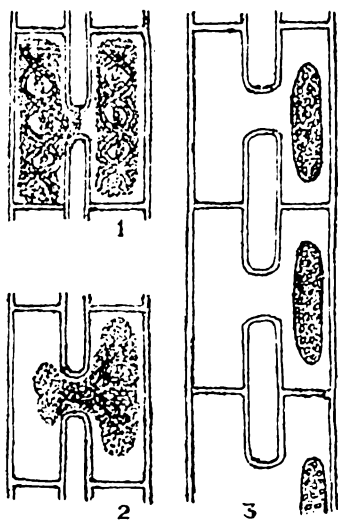


centre there is nucleus kept in position by thin threads of cytoplasm. The chloroplast is studded with pyrenoid bodies—which are storages of food materials.

Spirogyra reproduces by the vegetative method *Fragmentation*. One filament breaks down

into small fragments and each settles down on a suitable substratum and grows up.

The sexual method of reproduction is conjugation. The adult filaments rest side by side. The cell walls of opposite cells project and they meet. The separating walls disintegrate and a narrow passage, conjugation canal, is established

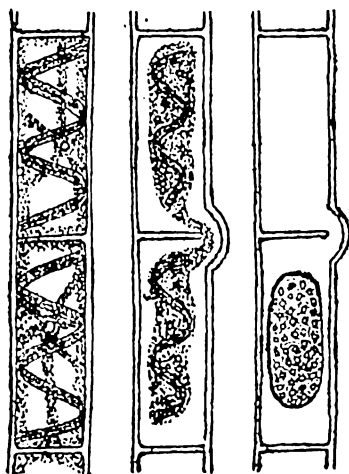


SPIROGYRA

- 1-3 Stages in conjugation
4. Zygote germinating

between the two. The contents of one cell get rounded up and pass to the opposite cell through the conjugation canal. These fuse with the contents of the other cell and the product of fusion becomes the zygote. A number of zygotes

are produced in the filament in this way. Then the outer walls disorganise and the zygotes get



Spirogyra.
Lateral conjugation

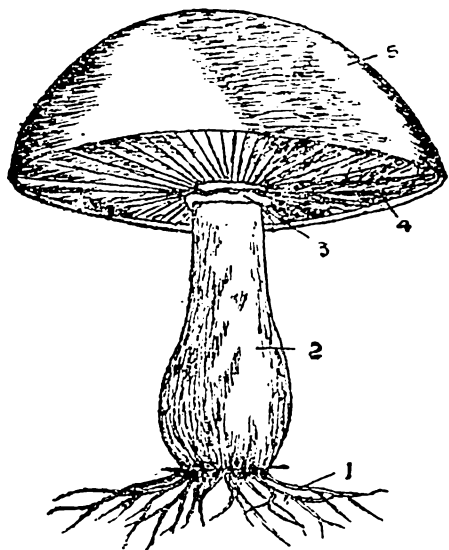
out. They settle down and germinate into new filaments.

Sometimes conjugation may take place between adjacent cells of the same filament.

5. Describe the structure and reproduction of *Agaricus*.

Agaricus is a saprophytic fungus growing in decayed organic matter. The plant body is a net work of thread-like structures called mycelium. Each thread is a hypha. The hyphae may be septate or non-septate. The mycelium is seen beneath the soil. The fleshy structure outside the soil is the fruit body.

The fruit body consists of a vertical pillar-like structure the *Stipe*. This carries an umbrella shaped top called *pileus*. At the place where the stipe meets the pileus a collar-like annulus can be



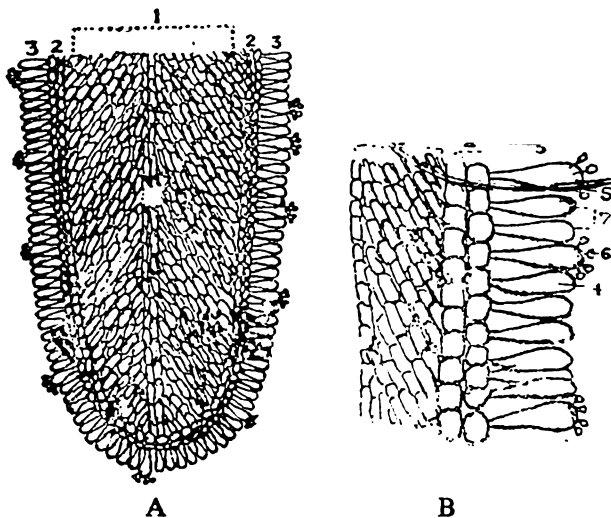
AGARICUS

1. Underground mycelium
2. Stipe
3. Annulus
4. Gills
5. Pileus

seen. The ventral surface of pileus is made up of radial plates called '*Gill plates*'.

Each gill plate is made up of a loose tissue called *trama*. The surface of the trama is covered by two layers of cell—the sub-hymenal layer and the hymenal layer. The hymenal layer consists of club shaped basidia which develop spores called basidio-spores. When the spores are mature they get detached from the stocks and are scattered by wind. Each spore reaching the fertile soil germinates and a hypha is produced. The

AGARICUS-GILLSECTION



A. Gill section

B. A portion of
A magnified

1. Trama
2. Subhymenal layer
3. Hymenal layer
4. Basidium
5. Sterigmia
6. Basidiospore
7. Paraphyses

hypha will begin to branch and a new mycelium is produced.

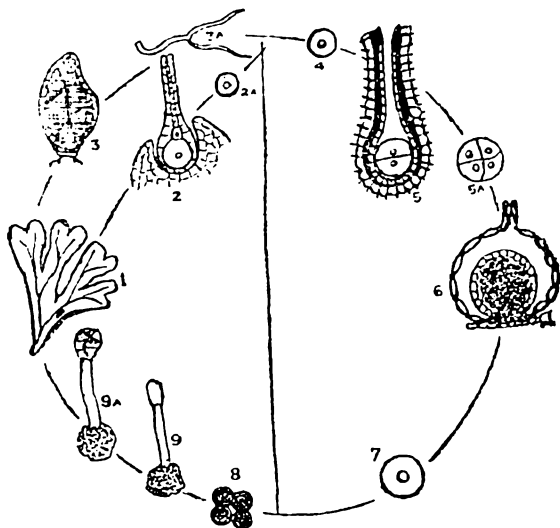
During the time of reproduction the mycelium develops fruit bodies.

6. Describe the structure and reproduction of Riccia.

Riccia is representative of Bryophyta. The plant grows in moist shady regions. The thallus

or the plant body is a flat dorso-ventrally differentiated dichotomously branched structure. It is fixed to the soil by root-like rhizoids. Furrows and grooves are seen on the dorsal side of the thallus. The sex organs are situated in these grooves.

There are two types of tissues in the plant body—the upper food producing tissue which is richly supplied with chlorophyll and the lower storage tissue.



RICCIA-LIFE CYCLE

- | | |
|-------------------|---------------------|
| 1. Riccia thallus | 4. Fertilised egg |
| 2. Archegonium | 5, 5A, 6—Sporophyte |
| 2A Egg | 7. Spore |
| 3. Antheridium | 8, 9 & 9A—Stages in |
| 3A Biciliatesperm | germination |

The male sex organ is called *antheridium* and the female sex organ is the *archegonium*. The sperm mother cells of antheridium divide and produce sperms. The archegonium encloses the female egg. When the egg is mature the tip of the archegonium breaks open and the cells above the egg move out in a disintegrated state. The biciliate sperms rush towards the open archegonium. That which succeeds to reach there first, enters the archegonium and fuses with the egg.

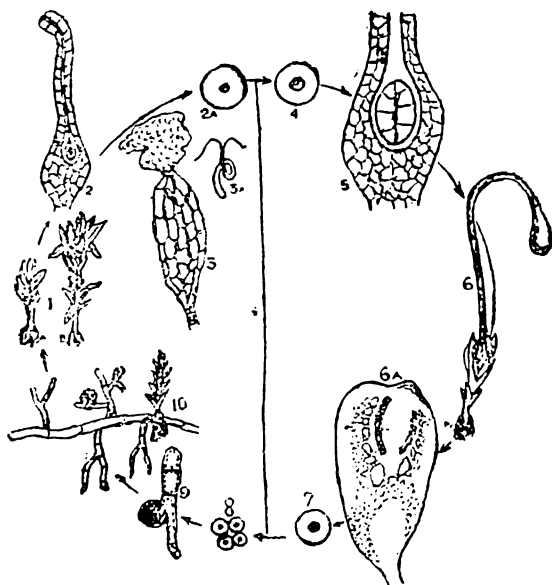
The fertilised egg-zygote divides repeatedly and becomes multicellular. These cells further divide and produce the spores. When mature the spores get out. The outer wall of the sporophyte will be ruptured by this time. Spores are distributed by wind. When they reach fertile soil they germinate and develop into new riccia plants.

7 Give an account of the Structure and reproduction of Moss

Mosses grow on moist muddy walls. When compared to riccia they are better developed. The plant is differentiated into root-like, stem-like and leaf-like parts.

Male and female sex organs are produced by different plants. At the tip of the male plant a cluster of club shaped antheridia can be seen. At the tip of the female plant there will be the flask shaped archegonium. Sperms are produced by the cells of antheridia and they rush towards the archegonium when it is open and the egg is ready for fertilisation.

Fertilisation is in the same way as in *riccia*. The zygote develops as a multicellular structure at first and becomes capsule later. The lower part of the archegonium elongates into a stalk



MOSS-LIFE CYCLE

1. Male and females plants of Moss. 2. Archegonium.
- 2A. egg. 3. Antheridium. 3A. Biciliate sperm. 4. Zygote.
5. Sporophyte. 6 Capsule formation. 6A. Capsule.
7. Spore. 8, 9, 10—Stages in germination.

called seta. This carries the capsule at its tip. The remnants of the ruptured archegonium can be seen over the capsule.

Within the capsule there are two rows of fertile cells. They divide and produce spores. When the capsule is filled with spores the operculum drops off and the spores escape. The spores germinate after reaching moist soil. A net work of filamentous structures called protonema is produced first, then it develops male and female plants.

8. Describe the structure and reproduction of fern.

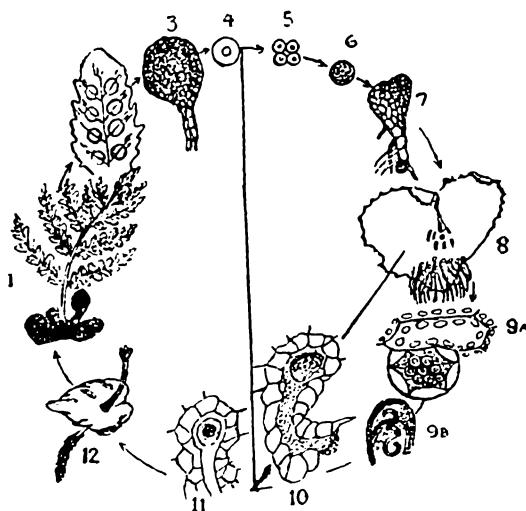
Fern is an ornamental plant growing in shady regions and sometimes cultivated in gardens. It is a representative of pteridophyta.

The plant has a ^{growing part} prominent stem which shows the presence of vascular bundles. In the histological structure the fern stem shows more advancement than any other cryptogam. Cluster of bipinnate leaves can be seen at the top of the stem.

The root system, if it can be called so consists of horizontal rhizomes and a large number of rhizoids. On the ventral side of the leaves dark tiny box-like structures are seen. These are called *sori*. Each sorus contains many *sporangia* and within each sporangium a large number of spores. When the spores are well developed they are liberated from the sporangium. The spores which reach suitable soil germinate.

The germinated spore becomes a green multicellular heart shaped structure called *prothallus*. This will be fixed to the soil by

FERN-LIFE CYCLE



1. Fern plant. 2. Sori (on the dorsal side of the leaf). 3. Sporangium. 4. Spore. 5, 6, 7—Stages in the formation of the prothallus. 8. Prothallus. 9A. Archegonium. 9B. Multiciliate sperms in the Antheridium. 10. Zygote. 11, 12—Stages in germination.

rhyzoids. The cells of prothallus contain chlorophyll and so they can manufacture their own food. The prothallus develops the sex organs antheridium and archegonium. From the antheridium multiciliate sperms come out. The egg will be ready for fertilisation within the archegonium by that time. The product of fusion is the zygote.

Zygote germinates and a new fern plant is produced.

9. Describe Alternation in Generation with reference to Riccia, Moss and Fern.

Riccia, Moss and Fern are said to be exhibiting alternation in generation. When we observe the life cycles of these plants we can find two different stages. Each of the three has a sporophytic and gametophytic stage. The plant or the stage in the life history which produces the actual sex gametes is a gametophyte. Similarly the plant which produces the spores is a sporophyte. The former is a sexual generation and the latter is an asexual generation. When the plant has to undergo these two generations or phases to complete the life cycle it is said to be exhibiting alternation in generation.

In Riccia, the proper plant produces male and female sex gametes. So it is the gametophyte. The multicellular zygote which produces the spores is the sporophyte.

In Moss, the plants are gametophytes because they produce antheridia and archegonia. The capsule within which spores are developed is the sporophyte.

In Riccia the sporophyte, being not well developed, is thoroughly dependent on the plant. It can manufacture its own food.

Alternation in generation is seen to the maximum in fern. Fern plant, unlike Riccia and

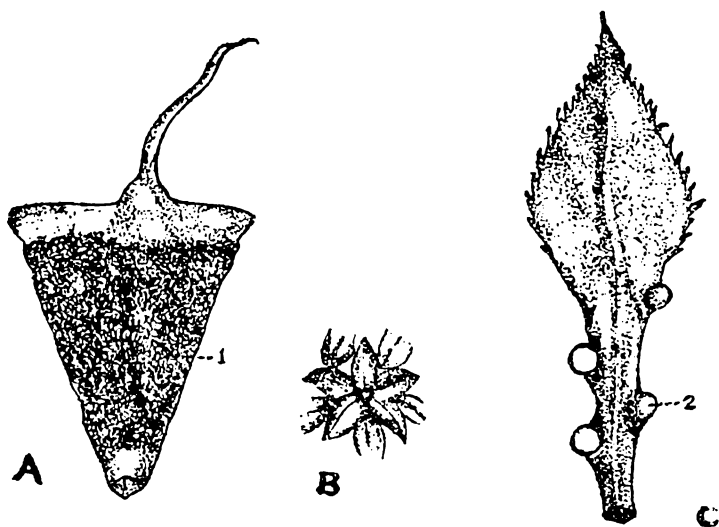
moss, is the sporophyte. The prothallus is the gametophyte. There is no connection whatsoever between the sporophyte and the gametophyte, except in the early stages of germination. The prothallus and fern plant can lead independent lives.

10. Describe briefly the structure and reproduction of Cycas

Cycas is a gymnosperm, a member of the family Cycadaceæ. Being a primitive seed-bearing plant it has some similarity with ferns. It is a palm-like plant growing in dry places. The aerial stem bears at the top a crown of large green leaves. The root system is highly developed, a tap root and side-roots with vascular bundles being present. The stem is unbranched and cylindrical, the internal structure resembling that of the dicot stem. The leaves are 4-5 feet in length and pinnately compound. They are folded in the young condition. The plants are either male or female.

The reproductive organs are cones. The male cones called microsporophylls are compactly arranged on stout central axes at the terminal portion of the male plant. They are spirally arranged and each one of them bears egg-shaped microsporangia on the lower side. Pollen grains develop inside the sporangium. These pollen grains contain the male gametes. The female plant produces at its stem-apex, a cluster of megasporophylls. The megasporangia found at

CYCAS



- | | |
|--------------------|-------------------|
| A. Microsporophyll | 1 Microsporangia. |
| B. Microsporangia | |
| C. Megasporophyll | 2 Ovule |

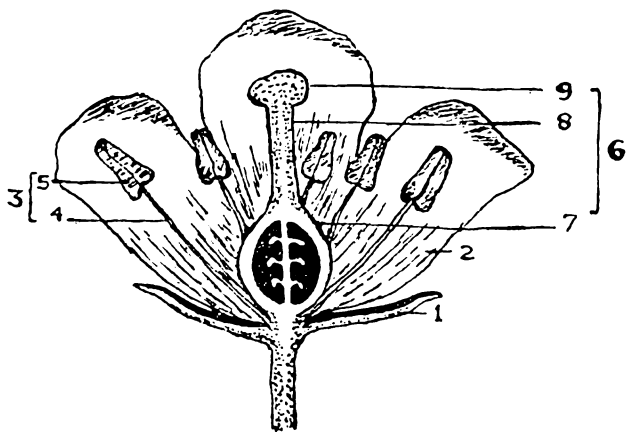
the margin of each megasporophyll produce the egg. Pollination brings the gametes together, and the male gamete fuses with the egg, forming a zygote. The zygote gives rise to the embryo, which becomes a seed later. The seeds germinate into fresh plants.

11. Describe the structure of a typical flower.

Flowers are the reproductive structures of plants. They take their origin from the tip of a branch or from the axil of a leaf.

Flower is connected to the plant by a stalk. The joint is swollen in many flowers to form the *thalamus*. Just above this there is a cup shaped structure usually green in colour. This is called *Calyx*. The calyx is made of sepals free or united. The calyx gives protection to the flower when it is in the bud stage. Next to the calyx there is the *Corolla* made up of free or united petals. The corolla will be usually coloured. It is the corolla which attracts insects in many cases. Further the corolla protects the inner stamens and pistil.

The male reproductive part is the *Androecium* consisting of *Stamens*. The stamen has a long filament and an anther tube at its end. Within the anther tube pollen grains are produced.



1. Calyx
2. Petal
3. Stamen

4. Filament
5. Anther
6. Pistil

7. Ovary
8. Style
9. Stigma

The gynoecium or pistil is the female reproductive part. It is situated in the centre. This has a sac-like structure in the bottom called *ovary*. *Ovules*, the female sex units, are produced within this. The long slender part of the pistil above the ovary is *Style*. The tip of the style is modified as a receptive surface called *Stigma*. The pollen grains are transferred to this surface by some method in the first stage of reproduction.

12. What are the methods of cross pollination ?

Pollination is the process by which pollen grains of a flower are transferred to the stigma. If the pollen grains are deposited on the stigma of the same flower the process is self pollination. Sometimes pollen grains may be deposited on the stigma of another flower belonging to the same class. This is called cross pollination.

Nature prefers cross pollination, as the fruits produced by this are bigger and healthier. Wind, water, insects and birds are the natural agents of cross pollination.

Coconuts and other palms pollinate with the help of wind. Pollen grains will be light and dry and produced in large quantities. Wind takes them up. In wind-pollinated flowers the stigma will be feathery, broad and sticky so that they can easily catch the pollen grains carried by wind.

In some Aquatic plants like the *Vallisneria* water itself is the agent of cross pollination.

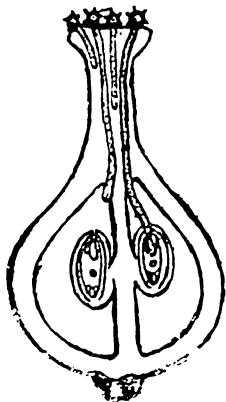
Majority of plants are pollinated by insects. Flowers attract the insects by their colour, fragrance and nectar. Some provide shelter and a cool place for laying the eggs. When the insects visit the flowers they unknowingly transfer the pollen grains.

Certain birds visit flowers to get honey. They too bring about pollination.

13. Give an account of Fertilisation in plants.

Pollination is immediately followed by fertilisation. Pollen grain is externally covered by a hard spinous membrane *Exine*. Next to this there is an inner thin membrane *Intine*. The single cell of the pollen grain inside these two membranes divide into two—a generative cell and a vegetative cell.

When the pollen grain germinates the outer exine ruptures and the intine grows down through



Pollen grains
Germinating on stigma

the style. The nucleus of the generative cell divides into two and they are carried down by the pollen tube. (The nucleus of the vegetative cell also is carried down but it disappears soon.)

Ovules are situated within the ovary. The ovule is attached to the ovary by the funicle. Externally the ovule is covered by two integuments. The inner mass of cells is the nucellus. At the tip of the nucellus there will be a minute opening in the integument, and this is called Micropyle. Within the nucellus an embryo sac is developed when the ovules mature. At the Micropylar end of the embryosac a group of three cells can be seen. One of the three grows more vigorously than the other two. This is the egg and the other two cells are synergids. Another group of three cells can be seen in the opposite pole. These are Antipodal cells. In the centre of the embryosac there is the secondary nucleus.

The pollen tube grows down through the style and reaches the micropyle. The tip of the pollen tube opens and one generative nucleus enters the ovule. It fuses with the egg cell. The second generative cell also enters the ovule and this fuses with the secondary nucleus.

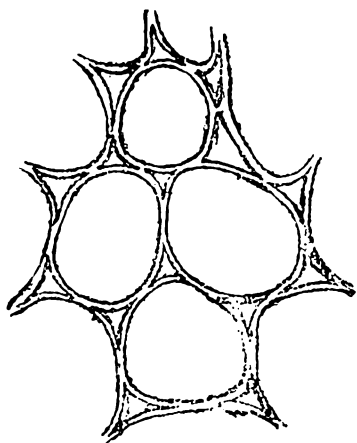
The fusion between the first generative cell and the egg cell is the fertilisation.

When both the generative cells enter into fusion it is called a double fertilisation.

14. Give an account of the primary tissues in plants.

A major part of the plant body is composed of parenchymatous-tissue.

Parenchyma cells are loose, thin walled and isodiametric or oval shaped. They have inter-cellular spaces. Because of this the parenchyma tissues help the conduction of water.

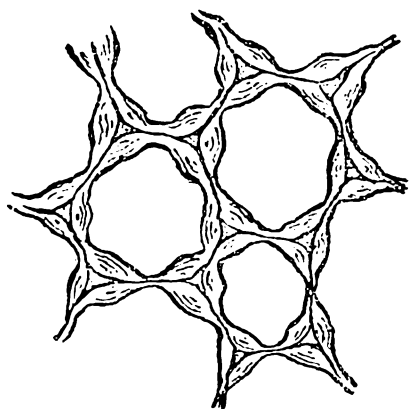


PARENCHYMA

Some of the parenchyma possess chloroplasts. They are said to be chlorenchyma. Some are supplied with starch grains.

Another primary tissue is collenchyma. This can be considered as a modification of parenchyma. The corners of collenchyma are thickened. They do not have intercellular spaces as they are closely packed. Collenchyma tissues are seen in

the growing regions of plant body. This is a mechanical tissue. This is protective in function.



COLLENCHYMA

Woody portions of the plant are made up of sclerenchyma. They are polygonal in structure and have very thick cell walls. The inner cytoplasm will be dried up. These are considered as dead cells. This protects the inner soft tissues.

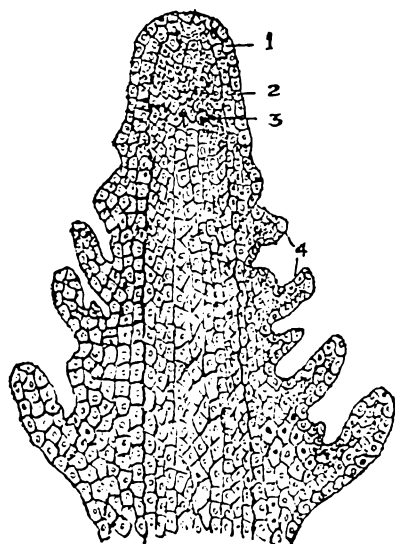
The cortex, pith and medullary rays are mainly constituted by parenchyma.

The vascular bundles are made up of xylem, phloem and a meristematic strip of cambium in dicots. Xylem consists of xylem parenchyma, xylem vessels and wood fibres. The phloem consists of phloem parenchyma, sieve tubes and companion cells.

15. Describe how plants grow in height and thickness.

Growth in plants is in two ways-growth in height (or length) and growth in thickness. Shoot system grows by the activity of the apex of the stem. Similarly root system grows by the activity of the root tip.

The apex of the stem is made up of soft meristematic tissues. Only meristematic tissues



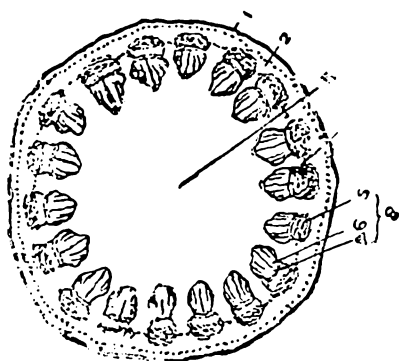
1. Dermatogen
2. Periblem
3. Pterome
4. Leaf primordia

are able to divide and add cells. The Apical meristem can be divided into three layers-the outer dermatogen, the middle periblem and the inner pterome. The dermatogen cells divide and

add cells for the growth of the epidermis. The periblem divide and supply cells to the growing cortex. The plerome cells are responsible for the growth of the vascular cylinder.

The meristem seen at the apex is called primary meristem. Meristems that are formed later are said to be secondary.

Growth in thickness is brought about by the activity of cambium. Cambium is the strip of meristematic tissue situated in between the xylem and the phloem. It is otherwise called fascicular



1. Epidermis
2. Cortex
3. Medulla or Pith
4. Medullary ray
5. Phloem
6. Cambium
7. Xylem
8. Vascular bundle

cambium. During the time of secondary thickening some cells situated in the medullary ray region become meristematic. A new strip of meristematic tissue is formed there. This is called *Inter fascicular cambium*. The fascicular

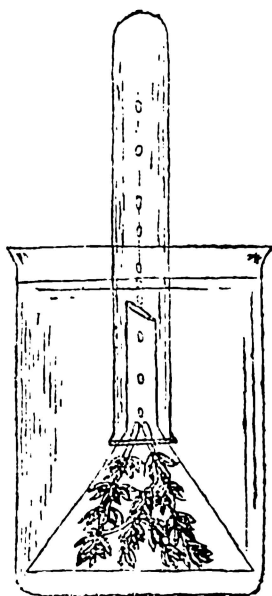
and inter fascicular cambium unite to form a *cambium ring*. Cells of this ring divide vigorously and supply cells to both sides. Cells that are supplied to the outer region get converted to phloem elements and those supplied to the inner region to xylem elements. The quantity of secondary xylem elements will be greater than that of phloem. The plant grows thick and woody.

16. What is photo synthesis? What are the factors that control this activity? Compare photosynthesis and respiration?

Photosynthesis is a chemical activity by which the leaves are manufacturing the starch they require for food. Starch is a complex organic matter. The plants synthesise starch from simple substances. Carbon di oxide, water, sunlight, chlorophyll—these are the four factors required for photo synthesis.

Plants take up carbon di oxido from the atmosphere through the stomata. Sub soil water is absorbed by the roots and this will be transmitted to leaves. The chlorophyll of the leaves breaks down carbon di oxide and water into their constituents viz carbon, oxygen and hydrogen. These elements are then synthesised so that starch is formed. The whole activity is done with the help of sunlight.

During photosynthesis carbon di oxide is taken in and oxygen is let out. This can be proved experimentally.



Experiment to demonstrate
the evolution of oxygen
during photosynthesis

In the evening pluck a healthy leaf from a plant growing in the open place and test it for starch. Dip the leaf first in boiling water and then wash it with alcohol. The leaf turns yellow. Then add a few drops of Iodine solution. The leaf turns blue indicating that it contains starch.

Cover half of a leaf with black paper from morn to eve. Then take the leaf and do the test described above. Only the half which was exposed to sunlight shows blue colouration. This

shows that sunlight is an essential factor for photo synthesis.

Some garden plants have multicoloured leaves. Take such a leaf in the evening and test for starch. Only the parts which were originally green will be having blue colouration. This shows the necessity of chlorophyll.

Keep half a leaf, without plucking it from the plant, within an airtight bottle containing some caustic potash. Let the plant and the apparatus remain in the sun. In the evening detach a leaf and do the starch test. The half which was inside the caustic potash bottle will not be having starch. That half was not able to get carbon di oxide because the caustic potash had absorbed all the carbondioxide contained in the bottle. This shows that photo synthesis will take place only when there is carbondioxide available.

Photo synthesis and Respiration-differences.

(1) During photo synthesis the plant takes up carbondioxide and lets out oxygen. But during respiration the plant takes up oxygen and lets out carbondioxide.

(2) Photo synthesis is done only during day time (when there is sunlight). But respiration

is carried out by the plant all the twenty four hours.

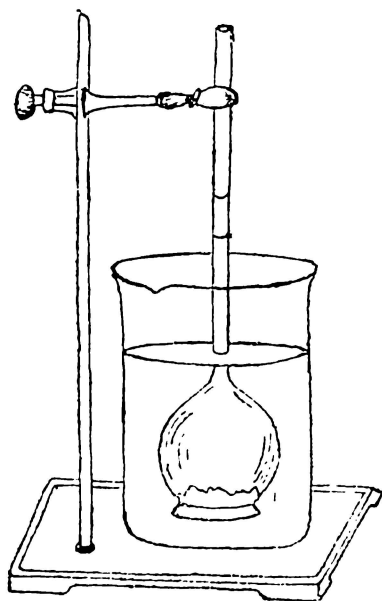
(3) Photo synthesis is performed only by leaves which possess chlorophyll. All living parts of the plant take part in the process of respiration.

(4) Photo synthesis is a constructive process because the plant is accumulating energy by it. But respiration is destructive. The plant has to spend a part of the energy already stored up during every attempt of respiration.

17. How do plants absorb water? Or how do plants apply the principle of Osmosis in absorbing water.

Without water plants cannot exist. A major portion of the total weight of a plant is made up of water. Plants require water for photo synthesis and for many other physiological activities.

Root hairs absorb water by the principle of osmosis. If two fluids of different densities are separated by a thin semi-permeable membrane, the lighter fluid will pass on to the denser fluid through the membrane. This is called osmosis. This can be demonstrated as follows:—Close the mouth of a thistle funnel tightly with pig's bladder or some other semi-permeable membrane. Fill the funnel with copper sulphate solution. Mark the level of the solution in the stem by a thread. Keep the funnel inverted in a beaker filled with



Experiment to
demonstrate osmosis

water for sometime. After one or two hours the level of copper sulphate solution in the stem can be found risen up.

Same is the case with plants. The cells of the root hairs will be containing cell sap. Cell sap is denser than water. Surrounding the root hairs there will be water. Water and dense cell sap are separated by the cell walls. The cell walls act as semipermeable membranes. According to the principle of osmosis the lighter water enters the denser cell sap through the semipermeable cell wall (cell wall becomes semipermeable because of the inner lining layer of cytoplasm).

18 What is respiration? When is it said to be anærobic? Describe an experiment to show that a plant gives out carbondioxide during respiration.

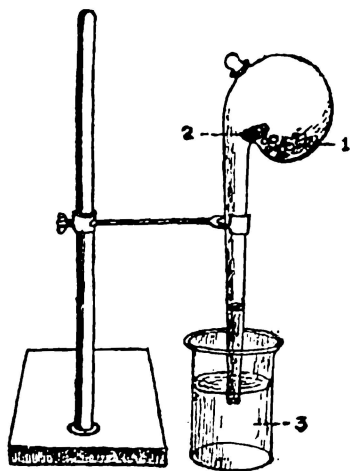
By respiration is meant the gaseous interchange between a living organism and the air in which the former absorbs oxygen from the air and gives out carbondioxide. It means in its wider sense, the katabolic activity in which food materials are disintegrated into simpler substances resulting in the release of energy. Thus the supply of oxygen necessary for the above purpose and the removal of carbondioxide and water formed as waste products during the above process, are the objectives of respiration.

Usually a living organism respires only in an atmosphere of free oxygen. But certain plants or their parts continue to respire and give out carbondioxide for a limited period, even when they are placed in an atmosphere devoid of oxygen. This kind of respiration is termed anærobic respiration or fermentation

The process of respiration which takes place in all living parts of a plant can be experimentally demonstrated by the aid of a retort-like respiroscope. Some wet germinating seeds are put inside the bulb portion of the respiroscope. The mouth of the respiroscope is immersed into mercury contained in a beaker. A small stick of caustic potash is also placed inside the respiroscope. The apparatus is fitted up on a stand as shown in the figure. After some time, the

mercury level in the tube portion of the respiroscope shows a rise. The oxygen in the

RESPIRATION - RESPIROSCOPE



- 1 Germinating seeds
- 2 Potassium Hydroxide
- 3 Mercury

retort is absorbed by the germinating seeds and carbon dioxide is given out in turn. The carbon dioxide is absorbed by the caustic potash, and due to the decrease in pressure effected, the mercury level has risen up.

SHORT NOTES

1. Symbiosis

This is a kind of partnership established between a higher plant and a lower organism, or in general, between any two organisms, resulting in mutual benefit. The two partners are called

symbionts. For example, there is a type of Bacteria able to manufacture proteins from the free nitrogen of the atmosphere. These bacteria live in the root nodules of Leguminous plants. (eg: *Bacillus radicicola*). The bacteria form a colony in the root of the host plant where they live merrily, and in return, supply proteins to it.

Other examples of symbiosis are protozoans living in the alimentary canal of white ants and the helpful association of parents and young.

2. Antibiotics

Antibiotics are medicines extracted from some of the lower plants. Because of their capacity to counteract and kill bacteria antibiotics are used to cure many serious diseases.

Penicillin, an important antibiotic, is prepared from the secretion of a fungus *penicillium notatum*. This checks the growth of bacteria. This medicine is used for many purposes. It was Sir Alexander Fleming who found out that the secretion of *penicillium* fungus can kill bacteria.

Streptomycin, a stronger antibiotic, is prepared from the fungus *streptomyces griseus*. This medicine can be used against tuberculosis very effectively. This was discovered in 1943. Another antibiotic Terramycin is prepared from *Streptomyces rimosus*.

Scientists are still working to isolate more antibiotics.

3. Mendelism

Mendel did a number of botanical experiments to come to the laws of heredity. The important points of Mendelism are:—

1. The predominant character of the parents will be inherited by the offsprings.

2. Segregation of characters takes place in the sexual cells of the first generation. Characters are divided during the formation of gametes.

3. These are different sets of characters in plants. These character units are inherited independently.

4. Tuber plants of Kerala

A tuber is an underground organ of a plant. Some are swollen underground roots whereas some others are such underground stems. Their importance lies in the fact that they store up starchy food materials. The white potato (*Solanum tuberosum*) cultivated in some parts of Kerala, is a food plant, and it is a starchy food-stuff. Sweet potato (*Ipomoea batatas*) is cultivated in many parts of Kerala. It is a weak-stemmed plant. The adventitious roots, which are swollen parts, are edible. Tapioca (*Manihot utilissima*) is the chief tuber crop of Kerala, the tuberous roots of which are very rich in starch. Nowadays, synthetic rice is manufactured from its flour. Yams are also cultivated in Kerala.

SOME PLANTS OF ECONOMIC IMPORTANCE

1. *Oryzasativa*—Paddy This belongs to the family gramineæ. The plant produces dry indehiscent grains. The grains contain starch and they provide food for man.

2. *Saccharum officinarum*. This is the sugarcane plant. The stem contains sugar in a dissolved state. Cane sugar is extracted from the stem of the plant.

3. *Ma ihot utilissima*. This is the Tapioca plant. This plant stores reserve starch in the root tubers. Tapioca tubers are used as food and nowadays starch is extracted from it for making artificial rice and for textile industry.

4. *Solamum tuberosum* (potato'. Potato plant yields stem tubers which are rich in starch.

5. *Havea brasiliensis*. This is a plant of great economic importance. The bark of the plant contains latex vessels. This latex is taken out and coagulated to make rubber.

6. *Camellia-thea*, *camellia-theifera* and *thea sinensis*: These are tea plants. The tea is produced by processing the tender leaves and buds of the plant.

7. *Coffea Arabica*, the coffee plant. The dried seeds are powdered and used to prepare the beverage.

8. *Cocos nucifera*—the coconut plant.

9. *Gossypium herbaceum* and *gossypium barbadense* are cotton plants. The white fibres which cover seeds are used for textile industry.

10 *Nicotiana tabacum*, the tobacco plant. The leaves are processed into tobacco.



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