1. Biodiversity

2/3 MARK

1. Define biosphere.

The term ‘biosphere’ had been coined to highlight the interdependence of living and non-living world. It represents a stable environment of various physical and biological factors which have been operating since the past. The organic continuity of the system rests on a delicate network of inter-dependent relationships.

2. What is environment?

The air, the water, the animals, the plants, the microbes and human beings are all interlinked in a life sustaining system, called the environment.

3. Write notes on Numerical Taxonomy.

Michael Adamson a French botanist, stressed that classification should be based on as many characters as possible. His concept helped to develop a new type of taxonomy called ‘Numerical Taxonomy’.

4. Write short notes on biological taxonomy.

Morphological characters were studied along with other characters as behavior, sound, ecology, genetics, zoogeography, physiology and biochemistry. Thus taxonomy was transformed into biological taxonomy.

5. Define Taxonomy.

The term taxonomy is a Greek word. Its components are taxis and nomos. While taxis mean arrangement, nomos means law. Thus taxonomy is defined as the “theory and practice of classifying organisms” (E. Mayr 1966).

6. Mention a biologist to faces three scientific ideas during arranging of the organism.

While grouping or arranging the organisms, a biologist faces three scientific ideas, namely taxonomy, systematics and classification.

7. Define Systematics?

Systematics is the scientific study of the kinds and diversity of organisms and of any all relationships among them”.


The term classification in meaning partly overlaps with taxonomy. However it simply means the activity of classifying. Thus according to Simpson “Zoological classification is the ordering of ani-mals into groups on the basis of their relationships”.

9. Define Taxon

Based on specific characteristics, animals are grouped in various categories. These categories are otherwise called taxa (singular: taxon). “A taxon is a taxonomic group of any rank that is sufficiently distinct to be worthy of being assigned to a definite category”.

10. What are the several taxa in animal taxonomy?

The several taxa in animal taxonomy are the Phylum, Class, Order, Family, Genus and Species. This arrangement from Phylum to Species is designated as the hierarchic system of classification.

11. What is hierarchic system of classification.

The several taxa in animal taxonomy are the Phylum, Class, Order, Family, Genus and Species. This arrangement from Phylum to Species is designated as the hierarchic system of classification. In this system each taxon is based on specific characters of a group of organisms. Eventhough such an arrangement appears to be man made, each taxon is a natural assemblage. However, human error in identification and grouping may happen.

12. What is phylum?

The taxon, ‘Phylum’ is the largest group. There are several such Phyla constituting the animal kingdom. Members of a Phylum are recognised by certain distinctive features as shown below.

<table>
<thead>
<tr>
<th>Characters</th>
<th>Phylum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single celled animals</td>
<td>Protozoa</td>
</tr>
<tr>
<td>Pore bearers</td>
<td>Porifera</td>
</tr>
<tr>
<td>Common body cavity and digestive cavity</td>
<td>Coelenterata</td>
</tr>
<tr>
<td>Flatworms</td>
<td>Platyhelminthes</td>
</tr>
</tbody>
</table>

13. What is Class?

A Class is the next level in the hierarchy. There are only few Classes in a Phylum. The members of each Class are identified by some specific character. Thus for example the Phylum : Protozoa comprises four Classes as follows.

<table>
<thead>
<tr>
<th>Class</th>
<th>Character</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rhizopoda</td>
<td>with root like pseudopodia</td>
</tr>
<tr>
<td>Ciliata</td>
<td>having cilia</td>
</tr>
</tbody>
</table>

14. What is Order?

An Order is another level in the taxonomic hierarchy. It is marked by some specific feature. A Class may have several Orders. For example, the Class : Insecta is subdivided into nearly 29 Orders. Each Order is identified by a specific character.

<table>
<thead>
<tr>
<th>Order</th>
<th>Character</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aptera</td>
<td>No wing</td>
<td>Lepisma</td>
</tr>
<tr>
<td>Coleoptera</td>
<td>Horned wings</td>
<td>Beetles</td>
</tr>
</tbody>
</table>
15. What is Diploblastic animal.

Diploblastic animals - having ectoderm and entoderm as two layers in the body wall. Ex: Coelenterata-(Hydra).

16. What are Triploblastic animals?

Triploblastic animals - having ectoderm, mesoderm and endoderm as three layers in the body wall.

The Triploblastic animals are further divided into three groups based on the presence or absence of an embryonic body cavity called coelom.

17. How animals are classified based on coelom?

1. Acoelomata - no coelom Ex: Platyhelminthes
2. Pseudocoelomata - with a false coelom Ex: Nematoda
3. Coelomata - with a true coelom

18. Phylum protozoa.

This phylum includes a great diversity of small, microscopic organisms. These are single celled eukaryotes. Their locomotion happens using pseudopodia, cilia or flagella.

19. Phylum : Porifera

These are multicellular, aquatic organisms. They have a cellular grade of construction without the occurrence of tissues. The sponges belonging to this phylum are characterised by the presence of a canal system in their body. The body wall contains spicules. They can reproduce both by asexual and sexual methods. Ex: Sponges.

20. What are the layers present in the coelenterate?

In coelenterate the body wall is of two layers of cells. The outer layer is called the ectoderm. The inner layer, entoderm is separated from the ectoderm by a non-cellular mesogloea. The mesogloea is a jelly-like sub- stance. Due to the presence of two layers in the body wall, these are said to be diploblastic animals.

21. What is polymorphism in coelenterate?

Many coelenterates exhibit polymorphism. In this phylum, organisms exist in two different body forms namely, a polyp, and a medusa.
22. What are nematocysts?

In coelenterate the ectoderm contains stinging cells called nematocysts (cnidoblasts). These cells when triggered can explosively penetrate prey and inject poison.

23. What is flame cell?

In Platyhelminth the alimentary canal is either absent or very simple. Excretion and osmoregulation occur through flame cells.

24. Mention any three characters of class Trematoda.

These are flukes living as parasites inside a host (endoparasites). A protective cuticle covers the outer surface of the body. Flukes have suckers for attachment to the host tissues. The examples are Fasciola (liver fluke), Schistosoma (blood fluke).

24. Write short notes on tapeworm.

Their body characters are adaptations for parasitic life. Mouth and alimentary canal are absent. Food is absorbed through general body surface. The head is called the scolex. It has a ring of hooks and suckers for attachment to the host tissue. The body consists of several segments called Proglottids. (eg) sheep and cattle tapeworms.

25. What is nephridia?

In annelida excretion and osmoregulation are achieved by ciliated tubules called nephridia.

26. What is cephalization?

In annelid The brain is formed of ganglia in the head region. The nerve cord is ventral in position. For the first time head formation or cephalization happens.

27. What is trochophore?

It is a common larva of both annelida and mollusca. These are bi- sexual and hermaphroditic. The larva is called the trochophore.

28. Why Peripatus considered as a connecting link?

Class Onychophora: It includes small worm like Peripatus. Peripatus shows Annelidan and Arthropoda characters. Hence this may be considered as a connecting link between the two groups.

29. Write short notes on Echinodermata.

These are marine organisms. While the adults are radially symmetrical the larvae remain bilaterally symmetrical. The mouth is on the lower surface. They have a water vascular system with tube feet. eg. star fishes, brittle stars, sea urchins and sea-cucumbers.
30. What is chordata?

This phylum derives its name from one of the common characteristics of this group namely the notochord (Gr. noton, back + L. chorda, cord). The backboned animals (vertebrates), together with a few closely related animals which do not possess a backbone, are included in this phylum. Most of the living chordates are familiar vertebrate animals.

31. What are the general characters of chordate?

The Six distinctive characteristics of the chordates are the presence of notochord, dorsal tubular nerve cord, pharyngeal gill slits, Ventral heart, closed blood vascular system and Hepatic portal system.

32. What is Hepatic portal system?

In chordates, the food laden blood from the digestive tract passes through the capillary net work in the liver, before reaching the heart. Thus the veins originating from the digestive tract as capillaries and ending in the liver again as capillaries constitute the hepatic portal system.

33. What are the sub phylum are in the phylum chordate and give example?

The Phylum Chordata is classified into four sub phyla:

Sub phylum 1. Hemichordata - Balanoglossus
Sub phylum 2. Cephalochordata - Amphioxus
Sub phylum 3. Urochordata - Ascidia
Sub phylum 4. Vertebrata. – Human

34. What are prochordates?

The protochordates are considered as the fore runners of vertebrata The classification of the protochordates is based on the nature of the noto- chord. Its otherwise called Acrania.

35. Write a short notes on sub phylum Cephalochordata.

Cephalochordates are small fish like marine chordates. The persistent notochord extends forward beyond the brain. Hence these are called cephalochordates. The epidermis is single layered. Paired fins are absent. Muscles, nephridia and gonads are segmentally arranged. The pharynx is large with numerous gills. It is a filter feeder. Example: Amphioxus.

36. Mention the different types of scales in the pisces.

The body has a covering of scales. They are of various types like placoid, cycloid, ctenoid and ganoid scales.

37. what is myotomes?

In pisces The body muscles are arranged into segments called myotomes.

38. What is Tetrapoda?

The vertebrates with two pairs of limbs adapted for locomotion on land are known as tetrapods. The limbs are of pentadactyl type. The tetra- pods are identified by a cornified outer layer of skin and nasal passages communicating with mouth cavity and lungs. The super class Tetrapoda is divided into four classes namely. Amphibia, Reptilia, Aves and Mammalia.
39. Why the amphibians are considered, a defeated group?

The transition from aquatic to terrestrial living is clearly indicated in the class Amphibia. These were the first vertebrates to live on land. Amphibians are not completely land adapted. They hover between aquatic and land environments. This double life is expressed in their name, amphibia. It is because of these reasons ‘the amphibians are considered, a defeated group’.

40. What is Amniota

The tetrapods like reptiles, birds and mammals are referred to as amniotes. The amniotes have certain membranes associated with embryos inside the egg. It is an adaptation in terrestrial forms during development. These membranes are the amnion, chorion and allantois.

41. Why do we call bird as a glorified reptile?

The feet are covered with scales. Fertilization is internal. Eggs are provided with large amount of yolk. The egg is covered by a hard calcareous shell. In spite of several advanced features the birds have certain reptilian characters. Hence they are known as “glorified reptiles”.

Examples: Pigeon, parrot.

42. Why mammals are consider as a successful group?

Because they adapt themselves readily to new situations and to new food habits.

43. Write short notes on Marsupialia or Metatheria

These are popularly called as marsupials or pouched mammals. The young ones are born in an immature stage and migrate into the pouch on the mother’s body. Further development is completed in the pouch or marsupium. Example: Kangaroo.

44. Write short notes on Placentalia or Eutheria

In this group eggs develop within the uterus. The developing embryo receives nutrition through maternal blood circulation via the placenta. Example: Elephant, tiger.

45. Write four species of plasmodium.

P. vivax, P. falciparum, P. malariae and P. ovale, are known to attack man causing different kinds of malaria.

46. Why man consider as a intermediate host and mosquito considered as a definite host?

The life cycle of the malarial parasite involves two hosts, the man and the mosquito. The modes of development in these two hosts are different. In man the mode of reproduction is asexual and in mosquito it is sexual. Man is the intermediate host and the mosquito is the definitive host.

47. What is syngamy?

Inside the stomach of the mosquito the microgamete and the macro-gametes come into union and nuclear fusion takes place. This kind of union is called syngamy and the resultant form is known as zygote.

48. List out various synthetic drugs to cure malaria.

Paludrine, Atabrin, Camoquin, Chloroquine, Resochin, Pamaquin.

49. Write any two preventive measure in malaria.

• Using protective measures such as mosquito nets, anti-mosquito creams (repellants) and coils.
• Use of the prophylactic drugs; small daily dose of anti-malarial drugs will kill the parasite.
either in the sporozoite or merozoite stage.

50. Write the type study of Earthworm.

<table>
<thead>
<tr>
<th>Phylum</th>
<th>- Annelida</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class</td>
<td>- Chaetopoda</td>
</tr>
<tr>
<td>Order</td>
<td>- Oligochaeta</td>
</tr>
<tr>
<td>Type</td>
<td>- Lampito mauritii</td>
</tr>
</tbody>
</table>

51. Write the type study of Plasmodium.

<table>
<thead>
<tr>
<th>Phylum</th>
<th>- Protozoa</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class</td>
<td>- Sporozoa</td>
</tr>
<tr>
<td>Order</td>
<td>- Haemosporidia</td>
</tr>
</tbody>
</table>

52. Write short notes on Earthworm.

Earthworms are nocturnal animals. They lie in the burrows during the day and come out at night for food. Earthworms leave the burrow only during the rainy season when their burrows are flooded with water.

53. What are setae?

Tiny curved bristles called setae are found embedded in small pits of the body wall. These pits are called the setigerous pits. The setae are arranged around the body. They are made of chitin and have a swollen middle part and pointed curved ends. The setae resemble the mathematical symbol \( \int \). They can be moved in any direction and extended or withdrawn by the action of muscles. They are used for locomotion.

54. What is worm casts?

The earthworm feeds on decaying organic materials contained in the soil. It takes the soil into its alimentary canal where the organic matter is digested and absorbed. The unwanted soil particles are sent out as worm casts.

55. What is nephridia?

Excretion is the process of elimination of metabolic waste products from the body. In earthworm, excretion is effected by minute paired tubes called nephridia. A typical nephridium has an internal funnel like opening called the nephrostome. It is fully ciliated. The nephrostome is in one segment and the rest of the tube will be in the succeeding segment.

56. What are receptors are present in the Earthworm?

- tactile receptors
- chemoreceptors
- Photoreceptors
- Gustatory receptors
- olfactory receptors

57. What is protandry?

Both male and female reproductive organs are present in the same worm. Hence the earthworms are known as hermaphrodites. Since the sperms develop earlier than production of ova, self-fertilization is avoided. It is known as protandry.
58. What is cocoon?

The girdle containing the germ cells (ova and sperms) and the nutrient albuminous fluid is slipped off at the anterior end and it becomes a closed sac called the cocoon. Fertilization and the development of the eggs into worms takes place within the cocoon. Young worms come out of the cocoon after complete development.

59. Write the type study of pigeon.

<table>
<thead>
<tr>
<th>Sub phylum</th>
<th>Class</th>
<th>Order</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vertebrata</td>
<td>Aves</td>
<td>Columbiformes</td>
</tr>
<tr>
<td>Type</td>
<td>Columba livia</td>
<td></td>
</tr>
</tbody>
</table>

60. What is the major function of uropygeal gland?

Above the tail is a knob on which opens an oil gland or preen gland or uropygeal gland. It secretes a fluid used for preening the feathers.

61. Differentiate between prepatagium and postpatagium

- A fold of skin the alar membrane or prepatagium, stretches between the upper and forearm along the anterior border of the limb.
- A smaller fold known as postpatagium is present between the trunk and upperarm.

62. Write notes on Mechanism of Respiration in pigeon.

In birds the expiration is an active process. The process of inspiration is passive. In a resting bird, the sternum is moved up and down with the help of intercostal and the abdominal muscles. During flight, the sternum is rendered immovable due to the support of wings, but the body cavity is raised and lowered by the action of wings and by the lowering of the vertebral column.

63. Write short notes on pecten.

Inside the eye, a vascular pigmented process projects into the vitreous body. It is known as the pecten. It arises from the point of entry of the optic nerve into the eye ball. Its function is not definitely known, but possibly it may help in long distance vision.

64. What are the components present in the pigeon male reproductive system?

The male has a pair of oval testes. From each testis, a duct, the vas deferens, passes back and opens into the cloaca. The vas deferens is dilated at its posterior end into a seminal vesicle. There is no copulatory organ.

BOOK BACK QUESTIONS:

65. Why do we consider Aristotle as the father of biological classification?

He emphasized that animals can be classified according to their way of living, actions, habits and body parts. The insect orders like Coleoptera, Diptera were created by him. Due to his contributions, he is considered as the ‘father of biological classification’.

66. What is the characteristic feature of biological taxonomy?

The several taxa in animal taxonomy are the Phylum, Class, Order, Family, Genus and Species. This arrangement from Phylum to Species is designated as the hierarchic system of classification.
67. Mention any one characteristic feature of the primates.
   Primates are **omnivorous** in habit. The body is covered with **hairs** except palm, sole and parts of face.

68. What are cryptozoites?
   In human the sporozoites penetrate the liver cells and develop into forms known as **cryptozoites**. A cryptozoite has a compact nucleus and no pigment or vacuoles.

69. What is Ookinete?
   Inside the stomach of the mosquito the zygote assumes an elongated form and is capable of movement. It is known as **ookinete**.

70. What is tertian malaria?
   *P. vivax* causes **benign tertian malaria**, *P. falciparum* is largely limited to the tropics and subtropics and causes the **malignant tertian or subtertian malaria**.

71. What are ‘lateral hearts’?
   In the anterior part of earthworm body the dorsal vessel is connected with the ventral vessel by eight pairs of **commissural vessels** or the **lateral hearts** lying in the segments 6 to 13.

72. How to prevent infection of malaria?
   It can be effected in two ways.
   1. Using protective measures such as mosquito nets, anti-mosquito creams (repellants) and coils.
   2. Use of the prophylactic drugs; small daily dose of anti-malarial drugs will kill the parasite either in the sporozoite or merozoite stage.

5 MARK

1. Explain about biodiversity in India.
   - India’s immense biological diversity represents about 7% of world’s flora and 6.5% of world’s fauna.
   - About 62% animals in India are endemic to the country. India is one of the 12 countries identified as mega centres of biological diversity.
   - As per the State Forest Report 1999, based on visual and satellite data from IRS-1B, 1C and 1D, the total forest cover of India is 637,293 sq. km.
   - It is 19.39% of the total geographic area of the country. It comprises about 64 million hectares.
   - Indian flora comprises about 15,000 flowering plants of which roughly around 1,500 plant species are threatened.
   - Mammalian fauna of India is 372 species with 63% in Assam. India’s 1228 bird species represent about 13% of world’s total.
   - Reptilian and amphibian fauna includes 446 and 204 species respectively.
   - Since the world has a vast range of organisms, identifying the useful, as well as harmful living beings is a need.
   - Differentiating, grouping and giving names to living things has been an ancient activity of
every human culture.

- Without proper classification it would be impossible to deal with enormous diversity of life forms.

2. Discuss -Concept of Species

Initially the Species was considered as a group of organisms showing similar or specific characters. However modern workers have identified three main concepts regarding Species.

1. **Typological Species concept** - This concept has its beginning from the essentialism concept of Aristotle. According to this concept a Species is recognised by its essential characters expressed in morphology.

2. **Nominalistic Species concept** - According to this concept Species are man made ideas. Nature produces individuals and not Species. Thus a species is considered as a mental concept.

3. **Biological Species concept** - According to this concept, “Species are groups of interbreeding natural populations that are reproductively isolated from other such groups”. This concept is mostly accepted by present day taxonomists.

3. List out Basic principles of nomenclature (any 6)

1. Providing **stability** in the naming and classification of organisms is emphasized. Any taxon must have only one correct name.

2. If two or more names are already in use the correct name will be the one that was published earlier. This system is referred to as the **law of priority**.

3. If two or more workers at one particular time describe the same organism using different names, it results in synonyms. However only one name will be held as a valid name. The validity is provided to the senior synonym.(law of priority)

4. When names referring to two separate taxa of the same nomenclatural level are spelt the same, the two names are called **homonyms**. This situation arises when two separate authors used the same name to refer to two different taxa. This condition is called **homonymy**. In this situation the junior name is invalid and a new replacement has to be proposed.

5. A material on which an original description is based, gets a special status. It will form the basis for any future identity of a taxon. This idea is called the **type concept**. Thus the concept of a genus and species are fixed by their **type genus** or **type species**.

6. Names that were used prior to those included by Linnaeus in the “Systema Naturae”, tenth edition, 1758 are not recognised.

7. Scientific names must be either Latin or latinized. The name should be mentioned in italics.

8. The genus name should be a single word beginning with a capital letter.

9. The species name should be a single or compound word beginning with a small letter.

4. Identification key

Identification of animals is an integral part of taxonomy. Identification could be made thorough literature, keys, pictures and comparison with type specimens. Of these, the most commonly used method is, using of keys.

A key is essentially a printed information or a computer software package. The construction of the key is an important job of a systematist.

A good key is strictly dichotomous and not having more than two alternatives at any point. The language of a key is telegraphic.
The key may be either bracketed or indented. In a bracketed key alternative contrastive characters are used for identification. The number on the right side indicates the next alternative character for consideration.

In an indented key a series of choices are provided for identifying a taxon. The user should choose from among the choices.

The following examples provide the keys for identification four species of frogs in Tamil Nadu, namely *Rana hexadactyla*, *R. tigrina*, *R. cyanophilicis* and *R. limnochoris*.

**The Bracketed key (Genus : Rana)**

1. Large size, snout - vent 100 - 200mm....... 3
2. Small size, snout to vent less than 100 mm........ 2
3. Pointed snout .......................... *R. limnochoris*
4. Obtusely pointed snout ............ *R. hexadactyla*

**The Indented key (Genus : Rana)**

- Large sized body
  - skin smooth .................... *R. hexadactyla*
  - skin with folds ............... *R. tigrina*
- Small size
  - blunt snout ..................... *R. cyanophilicis*
  - pointed or round snout ........ *R. limnochoris*

### 3. Methods of Animal grouping

There are several ways of grouping animals. One of the earliest method of grouping the animals could be dividing the Animal kingdom into two assemblages called Invertebrata and Vertebrata.

This scheme was provided initially by Aristotle. This scheme does not have a place for the Prochordates.

I. Animals can also be grouped as **single celled** and **multicellular**. The single celled organisms are called the Protozoa. The multicellular could be called the Metazoans. In this arrangement among the metazoans the unique nature of the sponges in not having a tissue grade of body construction is not mentioned.

II. In yet another method the animals are grouped under following three assemblages.

1. **Protozoa** - single celled animals
2. **Parazoa** - Multicellular without tissue grade (sponges).
3. **Eumetazoa** - Multicellular with tissue grade.

   **Eumetazoa** is a large group including most of the multicellular animals. Hence it is subdivided further into two groups.

   1. Diploblastic animals - having ectoderm and entoderm as two layers in the body wall. Ex : Coelenterata.
   2. Triploblastic animals - having ectoderm, mesoderm and endoderm as three layers in the body wall.
The **Triploblastic animals** are further divided into three groups based on the presence or absence of an embryonic body cavity called **coelom**.

4. Acoelomata - no coelom Ex: Platyhelminthes
5. Pseudocoelomata - with a false coelom Ex: Nematoda
6. Coelomata - with a true coelom

**III.** In a recent system, the entire living world is subdivided into 5 kingdoms. This system is much more broader including algae, fungi, and plants. It is known as the **Five kingdom concept.**

1. **Kingdom : Monera** - It includes all bacteria and the cyanobacteria. A circular DNA occurs in the cytoplasm. The cell wall is a rigid structure.  
   a) Phylum : **Cyanobacteria**  
   b) Phylum : **Bacteria.**
2. **Kingdom : Protocista or Protista** - It includes single celled eukaryotes. It has two subkingdoms, namely **Protozoa** and **Algae.**
3. **Kingdom : Fungi**
4. **Kingdom : Plantae (green plants)**
   Kingdom : **Animalia** - multicellular, eukaryotic animals

4. **Explain about coeletrata.**

All coelenterates are aquatic animals. They are mostly marine. The body is radially symmetrical. The body wall is of two layers of cells.  

The outer layer is called the **ectoderm.** The inner layer, **endoderm** is seperated from the ectoderm by a non-cellular **mesogloea.**

The mesogloea is a jelly-like substance. Due to the presence of two layers in the body wall, these are said to be **diploblastic animals.**

Many coelenterates exhibit **polymorphism.** In this phylum, organisms exist in two different body forms namely, a **polyp**, and a **medusa.**

The ectoderm contains stinging cells called **nematocysts (cnidoblasts).** These cells
when triggered can explosively penetrate prey and inject poison.

The layers in the body wall contain several cells and tissues such as muscle cells, epithelial tissues, gland-cells and sensory cells.

They reproduce both asexually and sexually. They are divided into three classes, namely **Hydrozoa**, **Scyphozoa** and **Anthozoa**. In **Hydrozoa**, the animal has a dominant polyp body form and a reduced medusa stage. (e.g) **Hydra**, **Obelia**.

In **Scyphozoa** the medusa form is permanent. This group includes jelly fishes such as **Aurelia**. They swim in the surface waters. They have a bell shaped medusa stage.

The Anthozoans mostly remain as polyps. Their body cavity is divided by large radial partitions called **mesenteries**. (eg) **sea-anemone** and **corals**.

**5. Discuss -Phylum: Platyhelminthes :**

This phylum includes flatworms. These are acoelomates, without a body cavity called **coelom**.

The alimentary canal is either absent or very simple. Excretion and osmoregulation occur through **flame cells**.

These worms are mostly hermaphrodites, having both male and female reproductive organs in a single individual.

Most of the members are parasites. It is divided into three classes, namely **Turbellaria**, **Trematoda** and **Cestoda**.

**Class Turbellaria** :- These are free living aquatic flatworms. The Planaria of this class shows characteristic regeneration.

**Class Trematoda** :- These are flukes living as parasites inside a host (endoparasites). A protective **cuticle** covers the outer surface of the body. Flukes have **suckers** for attachment to the host tissues. The examples are **Fasciola** (liver fluke), **Schistosoma** (blood fluke).
Class Cestoda :

It includes all tape worms. These are internal parasites with a complex life history. The life cycle involves two hosts.

Their body characters are adaptations for parasitic life. Mouth and alimentary canal are absent. Food is absorbed through general body surface.

The head is called the scolex. It has a ring of hooks and suckers for attachment to the host tissue. The body consists of several segments called proglottids, (eg) sheep and cattle tape worms.

5. Phylum: Annelida :

These are worm like animals. The body segments are rings externally. Internally the segments are separated by septa. Externally the body is protected by a cuticle.

Excretion and osmoregulation are achieved by ciliated tubules called nephridia. There is a central nervous system.

The brain is formed of ganglia in the head region. The nerve cord is ventral in position. For the first time head formation or cephalization happens. These are bisexual and hermaphroditic. The larva is called the trochophore.

This phylum includes three Classes, namely Polychaeta, Oligochaeta and Hirudinia. The polychaetes are marine worms. They have a distinct head. There are pairs of lateral projections called parapodia. The examples are Nereis (ragworms), Arenicola (lugworm).

Earthworms are included in the Class Oligochaeta. The Class: Hirudinia includes leeches. These are blood suckers and ectoparasites. They have well developed suckers for attachment at anterior and posterior ends.
6. Discuss - Phylum: Arthropoda:

These are the most successful group of animals. They outnumber all other animals in population strength. The body is segmented.

It is covered by a hard exoskeleton made of chitin. During growth the exoskeleton is shed (moulting of ecdysis). The legs or paired appendages are jointed.

The head region has a pair of prominent compound eyes. Each compound eye is made up of several photoreceptor sub units called Ommatidia.

They have an open circulatory system without vessels. The body cavity is filled with a fluid called haemolymph. Such body cavity is known as haemocoel.

These are unisexual, exhibiting sexual dimorphism. The young forms produced are invariably called the larvae. The larvae undergo metamorphosis and develop into adults.

This Phylum comprises five Classes, Class Onychophora: It includes small worm like Peripatus. Peripatus shows Annelidan and Arthropoda characters. Hence this may be considered as a connecting link between the two groups.

Class Crustacea: The examples for this class are prawns, crabs and lobsters. The dorsal body surface is covered by a shield like carapace.

Class Myriapoda: It includes centipedes and millipedes. These organisms have a distinct head and simple eyes. The centipedes have a pair of poison claws. The body consists of numerous segments, bearing pairs of legs.

Class Insecta: It comprises the common insects. The body is divided into head thorax and abdomen. In several insects, the adults have two pairs of wings on the thorax. Respiration happens through the tracheal system.

Class Arachnida: It includes scorpions, spiders, ticks and mites. The body is divided into cephalothorax and abdomen. There are four pairs of legs attached to the cephalothorax.
7. Discuss phylum Molusca

Phylum Mollusca: It is a very successful and diverse group of animals. Considered to be the second largest group of animals with regard to species number.

These are soft bodied animals without segmentation. The body is divided into head, muscular foot and visceral mass. The body is covered by a mantle and a shell.

Respiration happens through gills (ctinidia) in the mantle cavity. The most common larva is a trochophore larva.

There are seven classes of which three are more prominent.

Class Pelecypoda or Bivalvia: These are aquatic molluscs having bivalves. They burrow in mud and sand. The body is laterally compressed. (eg) mussels, clams, oysters.

Class Gastropoda: These are either aquatic or terrestrial molluscs. They possess a spiral shell. The foot is large and flat. They have well developed head with tentacles and eyes. (eg) snails, slugs, and limpets.

Class Cephalopoda: These are mostly marine. They are adapted for swimming. The foot is modified into eight to ten long tentacles in the head region. The shell is either internal or absent. (eg) Octopus, Loligo, Sepia.

8. What are the general characters of chordates?

The three distinctive characteristics of the chordates are the presence of notochord, dorsal tubular nerve cord and pharyngeal gill slits.

1. Notochord:

During the embryonic development of a chordate there appears a sup-porting rod called the notochord. It lies dorsal to the alimentary canal and ventral to the nerve cord.

In some chordates this structure persists throughout life. In others it is partially or completely replaced by a ‘backbone’. It is made up of separate bony elements or vertebrae.

Structurally it is com-posed of large number of specialized vacuolated cells. It is surrounded by fibrous and elastic sheath.

The stiffness of the notochord is due to the tur-gidity of fluid-filled cells and surrounding connective tissue sheath.

2. Dorsal tubular nerve cord

The nerve cord lies just above the notochord and remains entirely out-side the coelom. It is a tubular structure having a small hollow canal running from one end
to the other. The dorsal hollow nerve cord persists throughout the adult life of almost all chordates.

3. Gill slits or Pharyngeal clefts

These are paired lateral clefts leading from the pharynx to the exterior. They are present throughout life in fishes and a few tailed amphibians. In amphibians, like frogs and toads it is found only in the larval stages. In higher vertebrates (reptiles, birds and mammals) they are embryonic and non-functional.

4. Ventral heart

The heart is chambered. It is located ventral to the alimentary canal.

5. Closed blood vascular system

In chordates, the blood passes through a continuous system of tubes namely arteries, capillaries and veins.

6. Hepatic portal system

In chordates, the food laden blood from the digestive tract passes through the capillary network in the liver, before reaching the heart. Thus the veins originating from the digestive tract as capillaries and ending in the liver again as capillaries constitute the hepatic portal system.

8. How phylum chordata classified? Explain any 2

Sub phylum 1. Hemichordata,
Sub phylum 2. Cephalochordata
Sub phylum 3. Urochordata
Sub phylum 4. Vertebrata.

First three sub phyla are collectively known as Protochordates. Since the members of these sub phyla do not have a cranium or skull they are also referred to as Acrania.

Protochordata (Acrania)

The protochordates are considered as the fore runners of vertebrata. The classification of the protochordates is based on the nature of the notochord.

Sub phylum : Hemichordata.

These are exclusively marine organisms. They are solitary or colonial forms. They mostly remain as tubiculous forms.

The body is soft, vermiform, unsegmented, bilaterally symmetrical and triploblastic. The body is divisible into three distinct regions namely proboscis, collar and trunk.

The body wall is composed of single layer of epidermal cells. The dermis is absent. They have no endoskeleton.

A projection from pharynx, projecting inside the proboscis may be considered as notochord.

They have a spacious coelom lined by coelomic epithelium. The alimentary canal is a straight tube running between mouth and anus. They are ciliary feeders. Sexes are separate.

Examples : Balanoglossus, Saccoglossus.
Sub phylum : Cephalochordata.

Cephalochordates are small fish like marine chordates. The persistent notochord extends forward beyond the brain.

Hence these are called cephalochordates. The epidermis is single layered. Paired fins are absent.

Muscles, nephridia and gonads are segmentally arranged. The pharynx is large with numerous gills. It is a filter feeder.

Example : Amphioxus.

Sub phylum : Urochordata

This taxon constitutes a unique group of animals exhibiting diversity in form and habit. In Urochordata the notochord is confined to the tail region of the larva.

The adults are mostly degenerate, sessile forms. The body is enveloped by a tunic or test. The free end of the body bears two openings, the mouth and the atrio pore.

The proximal part of the alimentary canal is greatly enlarged to form a spacious pharynx.

They are hermaphroditic animals. The development occurs through free swimming tadpole like larva.

Example : Ascidia, Doliolum, Salpa.

9. Discuss - Sub phylum : Vertebrata (Craniata)

This group is characterized by the presence of brain case or cranium and a vertebral column which forms the chief skeletal axis of the body.

The notochord is an embryonic structure. It is replaced in the adult stage by a cartilaginous or bony vertebral column. The body is covered with an integument having an outer epidermis and an inner dermis. The skin has many modifications such as glands, scales, feathers, claws horns and hairs.

The digestive system is ventral to the vertebral column. It is provided with a large liver and pancreas. The circulatory system consists of the ven-tral, chambered heart.

The circulatory system is of a closed type with arteries, veins and capillaries. The blood plasma contains red and white blood corpuscles.
Gill slits are limited in number (usually 5 pairs). There are two pairs of appendages. The anterior part of the nerve cord becomes differentiated into brain and spinal cord.

The special organs of sense like the nose, eyes and ears are closely connected with the brain.

Urinary and genital systems are closely connected to form an urinogenital system. The sub phylum vertebrata may be classified into two groups (i) Pisces and (ii) Tetrapoda.

10. Explain Class: Pisces

Fishes are poikilothermic, aquatic vertebrates with jaws. The body is streamlined. It is differentiated into head, trunk and tail. Between head and trunk, the neck is absent. Locomotion is effected by paired and median fins.

The body has a covering of scales. They are of various types like placoid, cycloid, ctenoid and ganoid scales. The body muscles are arranged into segments called myotomes.

The alimentary canal consists of a definite stomach and pancreas and terminates into cloaca or anus. Respiration is performed by gills. Gill slits are 5-7 pairs. They may be naked or covered by an operculum. The heart is two chambered (an auricle and a ventricle).

Sinus venosus and renal portal system are present. The red blood corpuscles are nucleated. The functional kidney of the adult is of mesonephric type.

The external nostrils do not communicate with the buccal cavity. Lateral line sense organs are well developed. Sexes are separate. Fertilization is either internal or external. Examples: Shark, Catla.

11. Discuss Class: Amphibia

The living representatives of this class include frogs, toads, newts, salamanders and limbless caecilians.

The transition from aquatic to terrestrial living is clearly indicated in the class Amphibia. These were the first vertebrates to live on land.
Amphibians are not completely land adapted. They hover between aquatic and land environments. This double life is expressed in their name, amphibia.

It is because of, these reasons ‘the amphibians are considered, a defeated group’.

The body forms vary greatly from an elongated trunk with distinct head, neck and tail to a compact, depressed body with fused head and trunk and no intervening neck.

The forelimbs of frogs and toads are smaller than hind limbs. In frogs, hindlimbs have webbed feet. The surface of the skin is smooth and slimy.

The slimy nature is due to the presence of mucous secreting glands. Scales are practically absent.

The mouth is usually large with small teeth in upper or both jaws. The external nostrils communicate into the anterior part of the mouth cavity. Respiration is effected by gills, lungs, skin and pharyngeal region.

The heart is three chambered with two auricles and a single ventricle. The skeleton is mostly bony, with varying number of vertebrae; exoskeleton is absent. Sexes are separate.

Fertilization is either external or internal. The tadpole metamorphoses into adult. Examples: Frog, Toad, Salamander, Caecilian

12. Discuss - Class: Reptilia

Reptiles are represented by lizards, snakes, turtles, tortoises, alligators, crocodiles and the tuatara lizard, *Sphenodon punctatum*.

The body is variable in shape. It is covered with an exoskeleton of horny imbricate epidermal scales. Skin glands are practically absent.

The limbs are of pentadactyl type adapted for climbing, running and paddling. The endoskeleton is well ossified. Respiration is by lungs.

The heart is three chambered (In crocodiles it is four chambered). The functional kidney of the adult are *metanephros*. The Sexes are separate.

Fertilization is internal. The eggs are covered with leathery shells. Reptiles have developed some form of copulatory organ to transfer the sperms into the cloaca of the female. Example: Garden lizard, Cobra, Monitor lizard, Crocodile, Turtle.

13. Discuss Class: Aves

Birds are one of the most interesting and widely known group of animals. There are more than 8600 species of birds distributed all over the world.

Birds as a group exhibit a characteristic uniformity in structure. Aves are warm blooded vertebrates with an exoskeleton of feathers forming a non-conducting covering to keep the body warm.

The feet are covered with scales. The forelimbs are modified as wings and provided with feathers for flight.

The hindlimbs are attached far forwards to balance the weight of the body. The bones are spongy, containing air-cavities rendering the body light.

There is a fusion of bones and this is especially seen in the vertebral column. Only three digits are present in the forelimbs.

In the hindlimbs there are four toes with the first directed backwards. A horny beak
The alimentary canal ends in a **cloaca**.

Inside the body **air sacs** are present and some of them communicate with air cavities in the bones. The heart is four chambered.

The red blood corpuscles are oval and nucleated. The kidneys are three lobed. The ureters open into the cloaca. Urine is semi-solid and contains **uric acid**.

The nervous system is well developed. Eyes are usually powerful and a specialized structure called **pecten** is present inside the eye ball to help in accommodation.

Sexes are separate, Fertilization is internal. Eggs are provided with large amount of yolk. The egg is covered by a hard calcareous shell.

In spite of several advanced features the birds have certain reptilian characters. Hence they are known as “**glorified reptiles**”.

**Examples :** Pigeon, parrot, crow, sparrow, peacock, ostrich, penguin.

### 14. Class : Mammalia

The term “mammalia” was given by Linnaeus (1758) to that group of animals which are nourished by milk from the breasts of the mother.

They are a successful group, for they adapt themselves readily to new situations and to new food habits. The body is generally covered with epidermal **hairs**.

The integument is provided with **sweat, sebaceous and scent glands**.

The **mammary glands** are modified integumentary glands. The external ear or the **pinna** is present in most of the mammals.

A muscular **diaphragm** is present in between thoracic and abdominal cavities. It helps in respiration. The red blood corpuscles are non-nucleated, biconcave and usually circular in form.

The heart is four chambered. Only the **left aortic arch** is present. In brain **cerebral hemispheres** are very large and highly convoluted. **Corpus callosum**, a transverse band of nerve fibres connecting the two cerebral hemispheres, is present.

Dentition is **thecodont, heterodont and diphyodont**. Cloaca is absent. **Testes** lie outside the body cavity, enclosed in **scrotal sacs**.

Eggs are small with little or no yolk. Fertilization is always internal. Mammals are **Viviparous** i.e., they give birth to alive young ones. **Placenta** is usually present.

15. **Explain sub classes of mammalian**

The class **Mammalia** is subdivided into three subclasses namely **Monotremata, Marsupialia** and **Placentalia**.
Sub class: Monotremata or Prototheria

These are primitive **egg laying mammals** Example: Spiny ant-eater, duck billed platypus.

Sub class: Marsupialia or Metatheria

These are popularly called as **marsupials** or **pouched mammals**. The young ones are born in an immature stage and migrate into the pouch on the mother’s body.

Further development is completed in the pouch or **marsupium**. Example: Kangaroo

Sub class: Placentalia or Eutheria

In this group eggs develop within the uterus. The developing embryo receives nutrition through maternal blood circulation via the placenta.

Example: Elephant, tiger, lion, man, monkey, dog, cat , rat, bat.

16. Explain character of primates

Order Primates:

It is an order coming under the subclass Eutheria. This order is of interest because it includes **man**, besides **lemurs, tarsiers, monkeys** and **apes**.

They inhabit chiefly the warmer parts of the world. This group stands first in the animal kingdom in brain development.

However, most of them are unspecialized and **tree dwelling** (**arboreal**). Primates are **omnivorous** in habit.

The body is covered with **hairs** except palm, sole and parts of face. The **neck** is mobile. The forelimbs are shorter than the hindlimb.

The limbs have five digits and all the digits end in flat **nail**. The **pollex** or **thumb** or **first toe** are smaller than other digits and are **opposable** (except the **hallux** of man).

The brain is highly developed. The **cerebral hemispheres** are much **convoluted** and cover the cerebellum.

The **eyes** are directed **forward** and the vision is **binocular** and **stereoscopic**. Mammae are two and **thoracic** in position.

17. Discuss - Plasmodium Life cycle in Man - Pre erythrocytic cycle

The pre-erythrocytic cycle comprises the asexual reproduction of the parasite in the liver.

When an infected female Anopheles mosquito bites a person, thousands of slender, sickle shaped nucleated **sporozoites** are injected in the blood.

The sporozoites first enter the capillary vessels of the skin and then enter the general circulation.
These parasites circulate in the blood for about 30 minutes and enter into the pre-erythrocytic cycle in the reticu-loendothelial cells of the liver.

The sporozoites penetrate the liver cells and develop into forms known as cryptozoites.

A cryptozoite has a compact nucleus and no pigment or vacuoles. Cryptozoites rapidly grow feeding on the liver cells.

When a cryptozoite has reached its full growth it fills the entire cell. In this stage it is known as the cryptoschizont.

It undergoes schizogony and the resulting cells known as crypto-merozoites are set free in the blood by the rupture of the liver cells.

The released crypto-merozoites invade fresh liver cells or red blood corpuscles.

This cycle is considered as a period of incubation before the parasites could start the erythrocytic cycle.

During this period of 7 - 17 days, the parasites are not seen in the blood stream.

18. Discuss - Erythrocytic or Endo-erythrocytic cycle.

Each cryptomerozoite makes its way into a red blood corpuscle and feeds on its contents. After some time, the parasite gets an amoeboid shape.

This growing stage is known as the trophozoite stage. Soon it develops a vacuole which gradually increases in size. Thus the nucleus is pushed to one side.
This stage is called the **signet ring** stage. With further growth the vacuole disappears and the amoebula occupies the entire interior of the corpuscle.

This stage is known as the **schizont** stage. In the schizont, the nucleus breaks up into bits (6-24) and each becomes surrounded by a small amount of cytoplasm.

These cells are known as **merozoites**. By the rupture of the wall of the red blood corpuscles the merozoites along with wastes (haemozoin) are released into the blood.

This causes the malarial fever. The liberated merozoites attack another set of corpuscles and start the life cycle anew.

This method of infection is known as **autoinfection**. The life cycle in the blood of man is called the **cycle of Golgi** or **schizogony** or **endoerythrocytic cycle**.

Schizogony keeps up the multiplication of the parasites and their maintenance in the blood.

After schizogony has taken place for several generations some of the merozoites which invade the red corpuscles, instead of developing into trophozoites and schizonts, develop into **gametocytes**.

The gametocytes are of two types - **macro-gametocytes** and **micro-gametocytes**. The macrogametocyte has a small nucleus and a dense food laden cytoplasm.

The micro-gametocyte has a relatively large nucleus and clear cytoplasm. Their further development depends on their entry into the stomach of a female **anopheles**. If it does not take place they disintegrate.

19. **Discuss - Life cycle in the mosquito - sporogony**

When a female anopheles mosquito bites an infected person, it sucks blood along with all the stages of parasite.

But in the gut of the mosquito, only the mature gametocytes survive and the rest of the stages are destroyed. From the gametocytes develop **gametes**.

The process of development of gametes from gametocytes is known as **gametogony**.

**Gametogony**:

The nucleus of the micro-gametocyte divides into many fragments and the cytoplasm is thrown into flagellated structures.

There may be as many cytoplasmic structures as there are nuclei. This process is known as **exflagellation**.

The resultant cells are called the **microgametes**. The nucleus of the macro-gametocyte divides equally into two.

The cytoplasm divides unequally. So among the resulting cells one is bigger and the other is smaller. The small cell is thrown out.

This process is known as **maturation**. The resulting bigger cell is known as **female gamete** or **macrogamete**.

**Syngamy and sporogony**:

Inside the stomach of the mosquito the microgamete and the macro-gametes come into union and nuclear fusion takes place.

This kind of union is called **syngamy** and the resultant form is known as **zygote**.

The zygote assumes an elongated form and is capable of movement. It is known as
ookinate.

It pierces the wall of the stomach and comes to lie under the outer layer of stomach wall. There, it ceases to move, becomes round and forms a membranous cyst-wall.

This stationary zygote enclosed in a cyst-wall is known as oocyst. It grows in size absorbing the nourishment from the host.

The nucleus of the oocyst divides repeatedly, each being surrounded by a fragment of cytoplasm.

Thus inside the oocyst, a large number of cells develop into minute, slender, sickle shaped bodies called sporozoites.

The cyst wall breaks, liberating the sporozoites into the body cavity (haemocoel) of the host.

They wriggle forward and enter the salivary gland. When such an infected female *anopheles* mosquito bites a healthy person, it injects into his blood a stream of sporozoites.

This kind of transmission is called inoculation.

20. Explain about types of malaria

The disease caused by *Plasmodium* is known as malarial fever. It is characterized by recurring bouts of fever, each lasting several hours.

The febrile condition in man is due to toxins liberated into the blood along with the merozoites when the corpuscle is ruptured at the end of schizogony.

There are four species of *Plasmodium* known to cause malaria in man. The commonest and most widely distributed species is vivax. It causes benign tertian malaria in which the fever recurs every third day (every 48 hours).

*P.falciparum* is largely limited to the tropics and subtropics and causes the malignant tertian or subtertian malaria. This type of malaria has a high death rate.

Blood corpuscle parasitised by this species tend to clump together and block up small blood vessels and damage the essential organs.

It is a dangerous species and the disease often appears in an epidemic scale. *P. malariae* causes quartan malaria with feverish fits every fourth day (every 72 hours). The fourth species is *P. ovale*.

It is principally found in west Africa but occasionally in S. America, Russia and Palestine. It causes benign tertian malaria in which the fever recurs every third day (every 48 hours).

These four species differ from each other in the details of structure, time needed to complete the schizogony, the incubation period, number of merozoites released and duration of sexual cycle.

21. How to Control of Malaria?

The control measures fall under the following three categories.

**Treatment of infected patient**

*Plasmodium* does not produce antitoxins or antibodies in human blood. Therefore malaria cannot be treated by inoculation or vaccination with immune sera.

It can only be treated with drugs that may kill all stages of the parasite without poisoning the patient.
**Quinine**, which is extracted from the bark of *cinchona* trees, had been used effectively for the past 300 years to cure malaria.

The various synthetic drugs, such as Paludrine, Atabrin, Camoquin, Chloroquine, Resochin, Pamaquin etc are used as suppressants of various stages of the parasites.

**23. How to control malarial vector?**

It is perfectly clear that if the vector is completely exterminated the infection cannot be transmitted from one person to another.

It is the most effective and surest way of controlling malaria. It is achieved by using effective insecticides and by draining swamps.

**Chemicals:**

It destroys the breeding places of mosquitoes. Adult mosquito can be most effectively controlled by spraying DDT, malathion or any other insecticide in the houses; fumigating pyrethrum cresol and other compounds of naptha; sterilization of male mosquitoes.

The young stages of mosquito can be controlled by introducing larvivorous fishes like Gambusia and Lebistes in ponds, lakes, canals and tanks.

**24. Explain External feature of *Lampito maruitii***

*Lampito* (*Megascolex*) *maruitii* is a common earthworm found in South India. The body is long, slender, cylindrical and bilaterally symmetrical.

It is about 8 to 21 cm long and 3 to 4 mm in thickness. The dorsal surface is dark purplish brown, and the ventral surface is paler in colour.

- It is marked by a series of segments. The segments are separated from one another by intersegmental grooves.
- The division is both external and internal. Inside the body, each cavity of the segment is separated from the next, by a thin partition called the *septum*.

All the segments look alike. This kind of repetitive arrangement of the segments is called *metamerism*.

The *mouth* is found in the centre of the first segment of the body, called the *peristomium*. Overhanging the mouth is a small flap called the *upperlip* or *prostomium*.

The last segment has the anus. It is called the *pygidium*. In mature worms, segments 14 to 17 may be found swollen with a glandular thickening of the skin called *clitellum*.

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**25. List out External apertures in Earthworm:**

(i). **Dorsal pores**: These are minute openings situated in the mid dorsal line in the intersegmental grooves commencing from the 10th segment. The coelom communicates to the exterior through these pores and keep the body surface moist and free from harmful microorganisms.

(ii). **Spermathecal openings**: Three pairs of openings are situated ventrolaterally in the intersegmental grooves between segments six and seven, seven and eight and eight and nine. These opening can be easily seen in mature worms.
(iii). **Openings of oviduct**: These are a pair of apertures lying close together on the ventral surface of the 14th segment.

(iv). **Openings of Spermiduct**: A pair of apertures are situated on the lowerside of the 18th segment.

(v). **Nephridiopores**: Numerous minute openings scattered on the body wall from 14th segment onwards.

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26. Explain Body wall of Earthworm:

The body wall of earthworm is thin soft and moist. It consists of the following layers arranged from outside.

- **Cuticle**: It is a thin, transparent, iridescent layer secreted by the underlying epidermis.

- **Epidermis**: It is in the form of a single layer of columnar cells. This layer contains gland cells and receptor cells.

- **Dermis**: It is a very thin sheet of connective tissue forming a basement for the epithelial cells on the outside and muscles on the inside.

- **Muscles**: The muscles are arranged in two layers, namely the outer circular and inner longitudinal.

- **Coelomic epithelium**: It is the inner most layer of the body wall forming the lining of the body cavity.
26. Explain Digestive System of earthworm:

The digestive system runs as a straight tube from mouth to anus. The mouth is situated in the first segment.

The mouth opens into the buccal cavity which occupies segments 1 and 2. The buccal cavity in turn leads into a thick muscular pharynx.

The pharynx occupies segments 3 and 4 and is surrounded by the pharyngeal glands. The oesophagus is a short narrow tube lying in 5th segment.

It leads into the gizzard lying in the 6th segment. Its inner surface has a chitinous lining. The intestine is a large tube extending from the gizzard to the anus.

The intestine upto the 14th segment is narrow and the remaining part is sacculated. The dorsal wall of the intestine is folded into the cavity as the typhlosole.

This fold contains blood vessels. It increases the absorptive area of the intestine. The inner epithelium consists of columnar cells and glandular cells.

Feeding:

The earthworm feeds on decaying organic materials contained in the soil. It takes the soil into its alimentary canal where the organic matter is digested and absorbed. The unwanted soil particles are sent out as worm casts.

27. Explain Circulatory System of Earthworm:

In the body of earthworm there are two median longitudinal vessels. The dorsal longitudinal vessel runs above the alimentary canal.

The ventral longitudinal vessel runs below the alimentary canal. The dorsal vessel is contractile and blood flows forwards in it.

There are paired valves inside this vessel which prevent the backward flow of the blood. The ventral vessel is non contractile and blood flows backwards in it.

The ventral vessel has no valves. In the anterior part of the body the dorsal vessel is connected with the ventral vessel by eight pairs of commissural vessels or the lateral hearts lying in the segments 6 to 13.

These vessels run on either side of the alimentary canal and pump blood from the dorsal vessel to the ventral vessel.

The dorsal vessel receives blood from various organs in the body. The ventral vessel supplies blood to the various organs.
28. Discuss-Excretory System of earthworm:

Excretion is the process of elimination of metabolic waste products from the body. In earthworm, excretion is effected by minute paired tubes called *nephridia*. These are found, one pair, in each segment. A typical *nephridium* has an internal funnel like opening called the *nephrostome*. It is fully ciliated.

The nephrostome is in one segment and the rest of the tube will be in the succeeding segment. This tube has three distinct divisions.

The first part following the nephrostome is ciliated inside. This is called the **ciliated region**. This part has glands on its wall. It is called the **glandular region**. The last part has neither cilia nor glands. It is called the **muscular region**.

This region opens outside by an aperture called the *nephridiopore*. The waste material is collected from the body cavity by the ciliated funnel. The ciliated region pushes the waste into the nephridium. The glandular part extracts waste from the blood and add it on to the waste inside.

Finally the waste goes out through the nephridiopore. In the South Indian earthworm, Megascolex, there are certain modifications.

There are three types of nephridia in the megascolex.

(i). **Meganephridia**, (ii). **micronephridia**, (iii). **Pharyngeal nephridia**.

Besides nephridia there are some special cells on the wall of the intestine called *Chlorogogen cells*. They collect the waste and then drop down into the body cavity. These are then sent out through nephridia.

30. Explain the earthworm nervous system.

The **brain** is formed of the supra pharyngeal ganglia. It is a bilobed mass of nervous tissue situated on the dorsal wall of the pharynx in 3rd segment.

The ganglia found below the pharynx in the 4th segments is called the **subpharyngeal ganglia**. The brain and the subpharyngeal ganglia are connected by a pair of **circum pharyngeal connectives**.

They run one on each side of the pharynx. Thus a nerve ring is formed around the anterior region of the alimentary canal.

The double, solid ventral nerve cord runs backwards from the subpharyngeal ganglia, in the mid ventral line to the hind end of the body.

The ventral nerve cord has segmental ganglion one in each segment. From the brain nerves are given off to the peristomium.

From each ganglion of the ventral nerve cord, three pairs of nerves are given off to the body wall and other organs.

**Receptors** which are stimulated by the sense of touch (*tactile receptors*), Chemical changes (*chemoreceptors*) and changes in temperature (*thermoreceptors*) are present in the body wall.

These receptors are in the form of groups of slender columnar cells with short hairs projecting at the free end and connected with sensory fibres at the inner end.
Receptors stimulated by changes in the intensity of light (Photoreceptors) are found on the dorsal surface of the body.

Gustatory receptors (sense of taste) and olfactory receptors (sense of smell) are found in the buccal cavity.

31. Discuss - Male reproductive organs of Earthworm:

The male sex organs are formed of two pairs of testes and a pair of vasa deferentia. Testes are found in segments 10 and 11.

They are tufts of finger shaped processes attached to the anterior septa of segments 10 and 11. There are two pairs of seminal versicles formed as outgrowths of the testicular segments.

Further two pairs of seminal funnels called ciliary rosettes are situated in the same segment as the testes.

The ciliated funnels of the same side are connected to a long tube called vas deferens.

The two vasa deferentia of both sides run backwards along the ventral body wall upto the 18th segment where they open to the exterior through the male genital aperture.

Male genital apertures contain penial setae for copulation. A pair of prostate glands, each in the form of a much coiled tube are situated in segments 18 and 19.

The prostate glands open to the exterior along with the vas deferens. The secretion of the prostate glands help to arrange the sperms into bundles called spermatophores.

32. Discuss about Female reproductive organs in earthworm.

A pair of ovaries are found lying in segment 13. They are attached to the anterior septum of the 13th segment. Each ovary is a flat structure with a number of finger like processes.

The ova are arranged in a linear order in the ovaries. There are a pair of oviducts. They open internally into the 13th segment and externally on the ventral surface of the 14th segment.

Three pairs of spermathecae are present in segments 7, 8 and 9. These external
openings are situated in the intersegmental grooves of segments 6 and 7, 7 and 8, and 8 and 9.

The spermatozoa received from another individual during copulation are stored in spermathecae.

During copulation the head ends of the two worms are directed in the opposite directions and the clitellum of one worm is opposite to the spermathecal segments of the other.

The spermatozoa of one worm pass into the spermathecae of the other worms. The worms separate after the mutual exchange of spermatozoa.

Later the glandular cells of the clitellum secrete a thick fluid which hardens into a girdle surrounding the clitellum.

The girdle is moved forward by the wriggling movements of the body. As the girdle is moved forwards it receives the ova and spermatozoa.

The girdle containing the germ cells (ova and sperms) and the nutrient albuminous fluid is slipped off at the anterior end and it becomes a closed sac called the cocoon.

Fertilization and the development of the eggs into worms takes place within the cocoon. Young worms come out of the cocoon after complete development.

33. Explain about External feature pigeons.

The Body is spindle shaped. Their size varies from 20-25 cm. They are covered by coloured feathers leaving beak and a small portion of the hindlimbs.

The body is divisible into head, neck, trunk and a small, conical tail. The head is round and drawn out anteriorly into a strong, hard, pointed beak.

The mouth is a terminal wide gape, guarded by elongated upper and lower beaks. The beaks are covered with a horny sheath or rhampotheca.

A swollen area of soft skin, the cere, surrounds the nostril. It is present on each side of the upper beak.

The eyes are large and guarded by upper and lower eyelids and a transparent nictitating membrane.

A pair of ear openings are situated at a short distance behind the eyes.

Each opening leads into a short external auditory meatus, ending in the tympanic membrane forming the ear drum.

The neck is long and mobile. It helps in the movement of the head in various directions. The trunk is compact, heavy and bears a pair of wings and a pair of legs.

The cloacal aperture is at its hind end on the lower surface. Projecting behind the cloacal aperture is the tail.

Above the tail is a knob on which opens an oil gland or preen gland or uropygeal gland. It secretes a fluid used for preening the feathers.
34. Explain about wings of pigeon

The forelimbs as modified wings are located in the anterior region of the trunk. The limbs are of the pentadactyl type.

The wing has three typical divisions as - the **upper arm**, **forearm** and **hand**. The hand has three imperfectly marked **digits**.

While the pigeon is at rest the three divisions of the wing are bent upon one another in the form of the letter ‘Z’. During flight the wings are straightened and extended.

A fold of skin the **alar membrane** or **prepatagium**, stretches between the upper and forearm along the anterior border of the limb.

A smaller fold known as **postpatagium** is present between the trunk and upperarm.

While the pigeon is not flying the whole weight of the body has to be supported by the hind limbs, In order to balance the heavy trunk the hindlimbs are attached for forwards.

Each hindlimb or leg has three typical divisions, the **thigh**, **shank** and **foot**.

The thigh without being free is enclosed within the boundaries of the trunk. Each hindlimb has four digits. The first toe is directed backward.

The feet are naked and covered with horny **epidermal scales**.

Each digit is provided with a horny **claw**. The tail is small and concealed by the feathers of the trunk. It bears the **tail feathers** or **rectrices**.
35. Explain about Quill feather:

Each quill feather has a central stem or scapus. It is divided into lower hollow part called the quill or calamus and a solid upper part termed rachis.

The quill has at its lower end an opening called inferior umbilicus, through which vascular processes or papilla of the dermis project into the growing feather.

Another opening the Superior umbilicus occurs at the junction of quill and the rachis on the inner face of feather. Close to this opening, there is a small tuft of soft feathers called aftershaft.

Attached to the rachis are small filaments or barbs. The rachis with the barbs constitute the vane or vexillum. Each barb is provided with barbules and hooklets.

The barbs remain attached with one another to form a continuous blade for striking the air in flight.

There are twenty three quill feathers or remiges in each wing. Eleven of these known as primaries are attached to the hand.

The remaining twelve fixed on the forearm are called secondaries. Attached to the thumb is a small tuft of feathers known as ala spuria or bastard wing.

The tail bears twelve tail feathers or rectrices which are arranged in the form of a fan. The contour feathers are soft and the barbs are plumule like with no interlocking mechanisms.

These help to keep the body warm and lock air pockets. The filoplumes have delictae hair like long axis and a few barbs devoid of barbules.

Down feathers have small axis and a few barbs devoid of locking structures at the distal end. Nestlings are covered with down feathers.

36. Flight muscles of pigeon:

The wings are the modified forelimbs. They are organs of flight. The musculature of the forelimbs are greatly modified in response to the function they perform.

Flight is the coordinated effort of a number of paired muscles of which the following are most important.

Pectoralis major (Depressor muscles)

These are the largest breast muscles. They are about one fifth of the body weight. By the contraction of this muscle the wings are lowered during flight.

Pectoralis minor or subclavius:

These are smaller but longer than pectoralis major. By their contraction the wings are raised in flight.

Coracobrachialis:

These small flight muscles pull the wing downwards in flight.

37. Explain about Digestive system of pigeon:
The two jaws of the mouth are modified into beak. Both the jaws are devoid of teeth. The mouth leads into the buccal cavity.

The floor of the buccal cavity is provided with a narrow, triangular tongue. It has a horny covering and is provided with sensory papillae.

The buccal cavity narrows behind into the Pharynx. The salivary glands are absent in the buccal cavity. Three pairs of buccal glands are present in the mouth. Their secretion is mainly mucous.

The alimentary canal proper starts from the Pharynx. The Pharynx leads into a long oesophagus that runs back through the neck. At the base of the neck region, it enlarges into a thin walled, distensible sac known as crop containing mucous glands. It serves as a store house for the food.

The crop is followed by the stomach. The stomach is divisible into two parts, the anterior tubular proventriculus containing gastric glands and a posterior laterally compressed gizzard.

The gizzard has a thick muscular wall and a horny inner lining. Its cavity is small and contains small stones which are helpful to grind the food. Thus the gizzard acts as a grinding mill. This type of arrangement is necessary because of the absence of teeth in the buccal cavity.

The intestine arises from the right side of the gizzard. It is divisible into an anterior U-shaped duodenum, and a posterior long coiled ileum.

The ileum enlarges posteriorly into a short rectum or large intestine. Anteriorly, the rectum bears a pair of small rectal caeca. The rectum opens to the exterior by the cloaca.

Internally the cloaca is divided into three chambers, the anterior coprodaeum, the middle urodaeum and the posterior proctodaeum.

The rectum opens into the coprodaeum. The urinogenital ducts open into the urodaeum. The proctodaeum opens to the exterior by a transverse slit like aperture called cloaca.

At the proctodaeum, there is a dorsal glandular sac known as Bursa of Fabricii. Its function is unknown.

The digestive glands associated with the alimentary canal are the liver and the pancreas. The liver is bilobed with a large right and a small left lobe.

It is devoid of gall bladder. There are two bile ducts. They are forms one from each lobe. They open into the duodenum independently.

The pancreas lies between the two limbs of the duodenum. It has three ducts, all opening into the distal limb of the duodenum.

38. Explain about Respiratory System in pigeon:-

The flight activity requires a continuous and abundant supply of oxygen. Hence the respiratory system of pigeon is highly developed and well differentiated.

The respiratory system consists of external nostrils, glottis, larynx, trachea, bronchus and lungs. The external nostrils are a pair of slit like apertures occurring at the base of upper beak.

They communicate to the pharynx by internal nostrils. A glottis lies behind the tongue. It opens into the larynx. The larynx opens into a trachea.
The **trachea** is a long, cylindrical and flexible tube running back ward through the neck. On entering the thoracic cavity, the trachea expands into a **syrinx** or **voice box**.

Later it divides into two **bronchi**, one for each lung. The walls of tracheal and bronchial tubes are supported by a series of closely set cartilagenous rings.

Each bronchus enters a bright red lung. The bronchus divides and subdivides into smaller branches, ultimately ending in fine air capillaries.

**Lungs** are solid spongy organs. They do not hang freely in the thoracic cavity but are lodged firmly in the ribs. Some of the branchial tubes pass through the lungs and communicate with the air cavities in the bone.

There are nine **air sacs**. They are a median interclavicular, a pair of cervical, two pairs of thoracic and a pair of abdominal air sacs.

The air sacs help to maintain high body temperatures. They make the body lighter and help in flight.

**Mechanism of Respiration** :-

In birds the expiration is an active process. The process of inspiration is passive. In a resting bird, the sternum is moved up and down with the help of **intercostal** and the **abdominal muscles**.

During flight, the **sternum** is rendered immovable due to the support of wings, but the body cavity is raised and lowered by the action of wings and by the lowering of the vertebral column.

39. **Circulatory system in pigeon** :-

The **heart** is four chambered, with two **auricles** and two **ventricles**. There is complete separation of the oxygenated and non-oxygenated blood.

Birds have two distinct circulations as **arterial** and **venous** systems.

**Arterial system** :-

From the right ventricle arises the **pulmonary artery** carrying deoxygenated blood to the lungs for purification. An **aorta** arises from the left ventricle (right systemic).

It carries oxygenated blood to various regions of the body through several arteries.
Venous system:

The deoxygenated blood from various regions of the body are collected by several veins. Finally these veins take the blood to the right auricle through the two precaval and a single postcaval veins.

40. Nervous system of pigeon:

The brain is divisible into the fore-, mid- and hind brains. The cerebral hemispheres are distinct. They are round and large in size.

The olfactory lobes are very small and they do not contain cavities. The diencephalon is hidden from the view by the forward prolongation of the cerebellum.

The diencephalon has the pineal body dorsally and infundibulum and pituitary body ventrally.

The optic lobes are lateral in position owing to the large size of the cerebral hemispheres and cerebellum.

The medulla oblongata instead of being continued backwards as in other tetrapods, descends almost vertically from the cerebellum.

41. Urinogenital system in pigeon:

The excretory organs are a pair of kidneys. They are dark red, three lobed structures. They open separately into the urodaeum of the cloaca through two different ureters. There is no urinary bladder. The urine is excreted in the form of uric acid, a semi solid white mass discharged along with faeces through the cloacal aperture.
Male Reproductive system :-

The male has a pair of oval testes. From each testis, a duct, the vas deferens, passes back and opens into the cloaca.

The vas deferens is dilated at its posterior end into a seminal vesicle. There is no copulatory organ.

Female reproductive organs :-

Only the left ovary persists in the adult. The right ovary disappears during development.

The ovary and the oviduct of only one side are functional during breeding season.