CLASSROOM STUDY PACKAGE

BIOLOGY

DIVERSITY IN LIVING ORGANISMS

JEE EXPERT

BIOLOGY

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CONTENTS

DIVERSITY IN LIVING ORGANISMS

DIVERSITY IN LIVING ORGANISMS (BIODIVERSITY) : A GENERAL IDEA :

Every organism of this living world, whether an animal, a plant or a microorganism (true bacteria, cyanobacteria, protozoans, etc.) is **unique** in itself. The uniqueness (or the special diagonostic features of the particular organism) is the basis of the **diversity** (or species richness) in life forms, which is the most important aspect of the biological world. Diversity simply means variety of forms. Thus,

Biodiversity means different forms of living organisms or a variety of life forms found in a particular region.

Each and every living organism possesses a distinct form that distinguishes it from others. In other words, each organism has its own identifying characters that make it to identify and differentiate from others.

Different places in different parts of the world have their own distinct types of organisms. They vary in their shapes, sizes, colours, external appearance, longevity and behaviour. For example, some microscopic bacteria measure only a few micrometers in size whereas blue whales are more than 30 metres long and red wood trees of California are more than 100 metres tall. Some pine trees live for thousands of years whereas mosquitoes die within a few days. Some organisms are colourless or hyaline whereas others have beautiful colours. This clearly indicates that the **extent of biodiversity is endless.**

In fact, we are familiar with the common and easily available animals and plants. At present, approximately 1.7 to 1.8 million types of living organisms are known to us. The flora and fauna of the remote areas of deep forests, high mountains, deserts, depths of oceans are still unexplored. You will be surprised that we know only one out of six plants growing in tropical forests and, therefore, more than 80 percent plants are hidden in the unknown places without proper identification. If we include all the living organisms of the world, about 92% of them are still unexplored.

CLASSIFICATION OF LIVING ORGANISMS :

The diverse forms of living organism that we see today are in fact the product of past 3.5 billion years (or 3500 million years) of organic evolution. In addition, during the same duration, a countless number of species appeared and many more were lost unnoticed (i.e, became extinct). These findings are based on **palaeontological studies** which provided valuable informations regarding the ancient geography, past ecology and definite lines of ancestry for many living organisms. According to a rough calculation, the number of extinct species (those which are lost and do not exist) is atleast fifty times more than the present existing species. Thus, to find out an organism of known characters from such a vast number of organisms is simply impossible. Moreover, it is also practically not possible to examine and study every living organism separately at individual level. It is, therefore, advisable to study the diversity of organisms by placing them in different groups and arranging them in an orderly manner (or systematic manner). **Arrangement of organisms is called classification**.

Classification of organisms may be defined as a system of arrangement of organisms into different groups and sub-groups on the basis of their similarities, differences and relationship.

Attempts at clasifying living organisms have been made since time immemorial. Early attempts of classifying the organisms were made by Greek thinkers **Aristotle** (384-322 B.C.), **Theophrastus** (372-287 B.C.) and **Pliny the Elder** (28-79 A.D.).

Artificial Classification. Earlier biologists used habitats and major habits of the organisms as the basis of classification. **Aristotle** classified animals according to their habitat, whether they lived on land, in water or in the air.

The system of classification which is based on one or few arbitrarily chosen criteria such as habitat or one or more major habits of organisms is called artificial classification.

Draw back of artificial classification :

Such a classification, based on one or a few criteria, although was simple, but misleading. The major drawaback of artificial classification was that it did not reflect natural relationships of organisms. As a result, different types of organisms were grouped together (e.g., flying animals -insects, birds and bats) while related organisms such as bat (flying mammal), whale (aquatic mammal) and rat (land mammal) were separated. The fact is that if we examine the animals living in the sea they cannot be categorized under a single group. The animals living in sea are fishes, whales, sharks, octopuses, starfish, corals, etc. which are very different from each other. In fact, their habitat is the only character which is common whereas all other characters are different. So all these animals cannot be grouped together.

Natural Classification. This system of classification involves categorization of the living organisms into broad groups (or divisions) on the basis of large number of their chracters both similarities and dissimilarities. This process of classification, based on certain characters to divide into broad groups and then on the basis of some other charactes into sub-groups and so on, should continue till the smallest unit of classification is achieved.

Some examples of such characters, used in grouping and sub-grouping of organisms, are as follows :

1. **Cells are prokaryotic or eukaryotic.** Organisms may be grouped into two broad categories on the basis whether they possess prokaryotic cells or eukaryotic cells. In case of prokaryotic cells the nuclei and other organelles are not clearly demarcated. The eukaryotic cells, on the other hand, have membrane-bound organelles, including a nucleus.
2. **Cells occur singly or in clusters.** Many organisms are unicellular, i.e, made up of only one cell, e.g., Amoeba. Others are multicellular organisms in which the different groups of cells carry out specialised functions.
3. **Organism is photosynthetic or takes food from outside.** Green plants perform photosynthesis and synthesise their own food (autotroph). Animals cannot perform photosynthesis. They get food from outside i.e. heterotrophs.
4. **Organisation of different body parts.** Grouping of organism may be done on the basis of body organisation. For example, plants possess stem, root and leaves. Similarly, the animals possess specialised organs to perform different functions. The characteristics based on body design used for classification of plants is quite different when used for classifying animals.

   There are so many other characters which are used for classfication of lving organisms. These include presence or absence of flagella ; type of nutrition ; type of pigments present in the cells, presence or absence of cell walls, composition of cell-wall, etc.

Taxonomy :

It is an important branch of science dealing with identification, nomenclature and classification of organisms following certain rules or principles. **Carolus Linnaeus** (1707-1778), a Swedish scientist is called **father of taxonomy.** He introduces system of **binomial nomenclature**.

Importance of classification : Classification has the following advantages :

1. Classification makes study of a wide variety of organisms convenient and easy.
2. It is not possible for man to know about the entire organism but the study of few representatives from each taxonomic group gives a general idea of all life forms at a glance.
3. Classification also reveals the interrelationship among different groups of organisms.
4. Correct identification of an organism and its replacement in a definite taxonomic group is the basic requirement of various branches of biological science. Thus classification of organism provides a base for the development of other biological science. **For example** geographical distribution of plants and animals that is **biogeography** is totally based on the information regarding the organism supplied by the classification. Likewise the process in the field of ecology, forestry and behavioral science is also not possible without correct identification and classification of the organism.
5. Studies concerned with the identification, nomenclature and classification are needed in various fields of applied biology such as agriculture, horticulture, floriculture,pisciculture, pharmacology, public health and environmental biology. **For example** exact identification and classification of an agricultural pest and disease vector and pathogen is needed for its proper control and cure. Taxonomic knowledge of a component of ecosystem is required to study the food chain and energy flow.

Classification and evolution : As we know the organisms are identified and classify on the basis of their body design, form and function. The body design, however, is not a constant feature. If we keep a watch on the form and function of a particular organism for several generations there is the possibility of a slight variation in one or the other characters in some generation. There is a chance that some generation may acquire a specific character which was not present in earlier generations this may be due to mutation on any other reason. Once a specific character appears in an organism it will affect the form and function of organism and lead to a type of diversification. This is a major theme of evolution. The changes in living organism in due cource of time is called **organic biological evolution**.

Theory of organic evolution states that the present day complex organisms have originated during the course of ages from the earliest simple forms of life by an accumulation of changes in body design that allow the organism possessing them to survive the changes required in sequential manner which are in accordance with environmental requirement.

Phylogenetic classification :

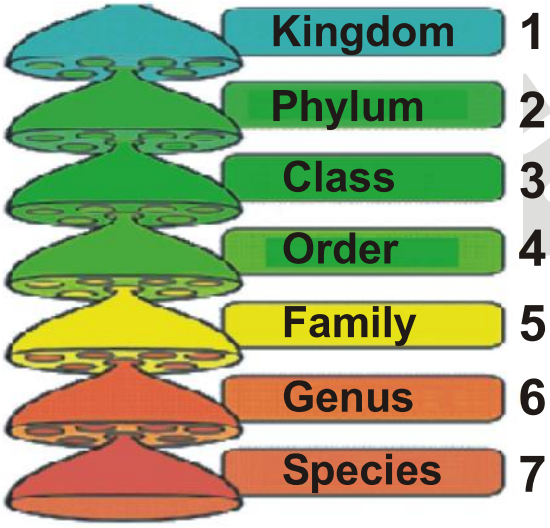
The concept of organic evolution has also show that the species are capable of changing. Some group of organisms, having ancient body designs, have not changed very much but other has acquired the body designs relatively recent. Thus, the organism belonging to first group are considered as **"primitive"** or **"lower organism"** by those belonging to second group are called as **"advanced or higher organism"**. The primitive groups are relatively simple where as advance group are more complex. Thus, the evidence suggests that the existing complex organisms have evolved by modification of the earlier simpler once over the ages.

The system of classification of organism which is based on large number of characteristics and also reflects their evolutionary relationship is called as Phylogenetic classification.

The Hierarchy of classification groups : Classification involves Hierarchy of steps and each step represents a rank or category. Taxonomic category is the overall taxonomical arrangement of category. All categories together constitute a taxonomic hierarchy, **Taxon.**

The organisms that closely resemble one another are placed in a group. These groups are further place in large groups on the basis of close similarities. The larger groups are again placed in still largest group. The various groping level or ranks in classification are known as categories. Each category has its specific name. There are seven major categories.

1. **Species**
2. **Genus**
3. **Family**
4. **Order**
5. **Class**
6. **Phylum (for animals)/ division (for plant)**
7. **Kingdom**



1. **Species :** Species is the lowest category regarded as "basic unit of classification". It is a group of similar individuals which resemble with each other in morphology, breed among them self but not with other and probably descended from a common ancestor.

   So it is a group of individual organisms with fundamental similarities as a species.

   Example : *Mangifera indica*(mango), *Solanum tuberosum*(potato), *Panthera* leo(lion) Here *indica, tuberosum* and *leo* represent species which represent different organism

2. **Genus**: It is a group of closely resembling species having a common ancestry. All the species in a genus showing similarities in broad features of their organization but differ in minor details.

   It comprises a group of related species which has more characters in common in comparison to species of other genera. Genera are aggregate of closely related species.

   Example: *Panthera leo* (lion), *Panthera paradus* (leopard), *Panthera tigris* (tiger). They have all different species that is *leo, paradus, tigris* but common genus that is Panthera.

3. **Family** : A family represents a larger group of closely related genera. It is composed of one or more genera. For example the genus *Felis* of cat and the genus *Panthera* of lion, tiger and leopard are placed in the family **Felidae** because all these animals have retractile claws.

   It has a group of related genera with still less number of similarities as compare to genus and species. They are characterized on the basis of both vegetative and reproductive features.

   E.g. Solanaceae (Solanum, Petunia and Datura)

4. **Order:** An order is a group of closely related families. For example the family **Felidae** that includes cats and the family **Canidae** that includes dogs are assigned to the order **Carnivora** because both cats and dogs have large canine teeth and are flesh eaters.

Advance : They are identified on the basis of aggregated characteristic. It is a higher category and the assemblies of families which exhibit a few similar characters.

E.g. Plant family, Solanaceae, Convoluvlaceae (based on floral characteristics)
Animal family : Felidae and Canidae (belongs to Carnivora)

5. **Class :** It includes related orders
E.g. : Mammalia (includes order Primata [monkey, gorilla, gibbon
Order Carnivora (tiger, cat, dog)

6. **Phylum/ Division :** Phylum include the basic common features like notochord, dorsal hollow neural system which includes in phylum chordata In case of plant it is known as division

7. **Kingdom :** It is the highest category in biological classification. It is a group of Phyla in case of animals or division in case of plants. The various categories used in biological classification can be arranged in a hierarchy which are placed one over the other. It was introduced by Linnaeus and is therefore called **Linnaean hierarchy**. It indicates the various level of kinship that is relationship by blood. Near the category in hierarchy the greater is the similarity between the organisms. After civilization there is a need for classification of all organisms.

- **Aristotle :** first person to classify on the basis of simple morphological characters into plants (shrubs and herbs) and animals (having RBCs and not having RBCs)

- **Carolus Linnaeus (1758):** The "**Father of taxonomy**". They give 2 Kingdom classifications that are Animalia and Plantae.
Drawback of this classification: Many unicellular organisms do not fit into Plantae and animale. E.g. Euglena (have characteristic of both plant and animal), viruses (belongs to neither plant nor animal kingdom.)

- **R.H. Whittaker (1969) :** He proposed five kingdom classifications. It includes Monera, Protesta, Fungi, Plantae and Animalia. Main criteria included cell structure, Phylogenetic relationship, and reproduction, mode of nutrition and thallus organization

Table : comparative account of monera, protista, fungi, Plantae and Animalia

Kingdoms	Body organization	Prokaryotic / Eukaryotic	Cell wall	Mode of nutrition
Monera	Unicellular	Prokaryotic	Some have cell wall while some do not	Autotrophic as well as Heterotrophic
Protista	Unicellular	Eukaryotic	Some have cell wall while some do not	Autotrophic as well as Heterotrophic
Fungi	Multicellular	Eukaryotic	With cell wall made up of Chitin	Heterotrophic
Plantae	Multicellular	Eukaryotic	Cell wall made up of cellulose	Autotrophic
Animalia	Multicellular	Eukaryotic	Without cell wall	Heterotrophic

1. **Kingdom : Monera**

- **Copeland (1956) creates this kingdom Monera.**
- **Carl Woese (1994) divides this Monera kingdom into Archaebacteria and Eubacteria :**
It includes most ancient, the smallest, the simplest and the most plentiful **PROKARYOTES.** These organisms are most primitive. They were first inhabitants of the earth, and they still continue to flourish.

Characteristics of Monera :

- They are mostly unicellular organisms. The Cynobacteria are however filamentous
- They do not have a definite nucleus. The genetic material is a circular, double- stranded, helical DNA

(Deoxyribonucleic acid) not enclosed by a nuclear envelop. Such organisms which do not have a definite nucleus are called as **Prokaryotic.**

- The cytoplasm of organisms is devoid of membrane bound organelles, i.e., Mitochondria, Plastids, Golgi apparatus, lysosomes, endoplasmic reticulum, centrosome etc are lacking. However the ribosomes are present
- Cell wall is generally present. Some of prokaryotes do not have cell walls
- The mode of nutrition of organism in this group can be the "Autotrophic" (synthesize their own food by photosynthesis) or "Heterotrophic"(get organic food from the environment).
- Single stranded flagella are present in many Monera.

Kingdom monera include true bacteria, actinomycetes, Cynobacteria or blue green algae, mycoplasma and Archaebacteria.

Advance :

(i) True bacteria (Eubacteria) :

- Its sole members are bacteria which are abundant microbes.
- Occurance : Everywhere in the world.
- Number : 100 of bacteria are present in handful of soil.
- Habitat : They can live where very few life forms survive that is extreme habitate (hot, cold, desert, deep oceans)
- They have simple structures and complex behavior.
- Categories based on shape are- Spherical-coccus (cocci),Rod shaped-bacillus (Bacilli),Comma-shape-vibrium/ vibrio (vibria) and spiral Ispirillun (Spiralla)
- They are basically unicellular and morphological least complex.
- They really exceed 2 microns in diameter and 10 microns in length.
- The cell wall is composed of peptidoglycan.
- The cell very in shape.
- Most of them have flagella for its motility

(ii) Archaebacteria:

- They can live in very hot habitat :

  Extreme salty areas : These bacteria's are called as Helophytes

  - Extreme hot springs: - These bacteria are called as Thermoacidophiles.

  - Extreme marshy areas: - These bacteria are called as Methanogens which produce Methane gas.
- They are different from other bacteria as, due to the structure and composition which allow them to survive in extreme conditions.

  Ex. *Streptomyces, Mycobacterium, Actinomyces*

(iii) Cynobacteria or blue green algae :

- Habitat: unicellular-colonial, filamentous-freshwater, marine and terrestrial algae.
- Photosynthetic due to the presence of chlorophyll 'a'.
- They are prokaryotic organisms that occupy a wide range of habitats and grow almost everywhere
- Nitrogen fixing bacteria : Heterocyst (Nostoc and Anabaena) having mucilaginous sheet.
- They help in fixing atmospheric nitrogen and increase soil fertility.

Nostoc

Anabaena heterocyst

(iv) Mycoplasma :

- They are the smallest and can survive without oxygen
- They are unicellular, non motile, prokaryotes, which lack a distinct cell wall.
- They occur in soil, sewage water and in decaying organic matter.
- Many are pathogenic which can infect animals as well as plants.
- They cause diseases (eg. Pneumonia in human beings is caused by *Mycoplasma pneumoniae.*
- Some mycoplasma occur parasitically in plants and animals.

2. KINGDOM PROTISTA :

It includes universal eukaryotic organisms They show following characterization

- They are mostly aquatic and live where ever there is water.
- The cell structure is typically eukaryotic. The protoplasm surrounded by a plasma membrane. In addition some protease has an outer covering of cellulose wall.
- The genetic material is the linear, double stranded, DNA helical, complex with proteins, organized into distinct chromosomes .The chromosomes are enclosed by nuclear envelope. Nucleolus is present.
- The cytoplasm contains membrane bound organelles such as mitochondria, plastids, Golgi bodies, Endoplasmic reticulum, ribosome's etc.
- Their mode of nutrition can be autotrophic or heterotrophic.
- Motile protist move from one place to another with the help of pseudopodia, flagella, or cilia.

Ex. Unicellular algae, diatoms protozoans.

Advance : Unicellular protistians has been divided into following groups

(a). The Protistians algae : These are mainly unicellular eukaryotic algae which live in water bodies. They usually grow and cover the surface of water body and move on the mercy of water current. They are the major producers of aquatic ecosystem.

Examples :

(i) Diatoms : Cell walls are two overlapping shells which fit together as soap box. Cell wall contains silica. They are indestructible and leave behind large amount of cell wall deposit in their habitat. Billions years of accumulation now forms diatomaceous earth or siliceous earth. Soil is used in polishing and filtering of oils and syrups.

(ii) Dinolflagellates : Photosynthetic mostly marine. Can be yellow, green, brown, blue, red depend on marine pigment in their cell. Cell wall's outer surfaces is made up of cellulose plate and have flagella. Red Dinolflagellates release some toxins which even kill fish

(iii) Euglena : Majority is fresh water organisms. Body is flexible with two flagella's (short and long).Mode of nutrition- photosynthetic (in presence of sunlight) and when deprive of sunlight they predate on other organisms (heterotroph) Euglenoids pigments are identical to higher plants.

(b). Slime moulds : It include very interesting organisms which share the characters of both animals and fungi.

- The vegetative parts do not posses cell walls.
- They either occur as free living multinucleated mass of protoplasm (the plasmodium)
- Mode of nutrition - Holozoic

e.g. *Physarum*

(c). Protozoon's

These are unicellular eukaryotic organisms which mostly occur in aquatic habitat.

They are in various shapes and symmetry. The cells may be uninuucleate, binucleate of multinucleate. Cell wall in them are absent.

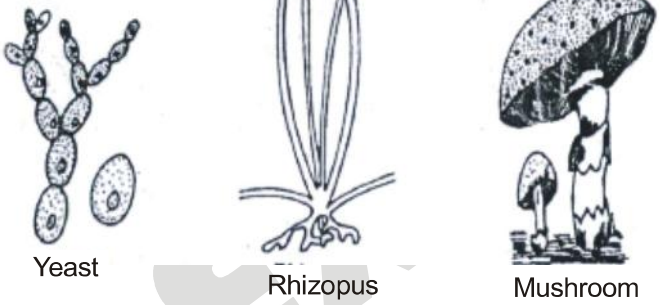
Example : *Paramoecium, Amoeba, Entamoeba.*

3. Kingdom Fungi : Study of fungi is known as Mycology.

They includes those organisms whose body form is a thallus (i.e., not differentiated into root, stem and leaves) build up of single cell or cells that possess definite cell wall(containing cellulose and chitin both) and true nucleus but lack chlorophyll and differentiation of vascular tissues.

They have following characteristics :

- They are thalloid, unicellular, filamentous or mycelia. Single filament is called as hypha and cluster is called as mycelium.
- They have definite cell wall of cellulose or chitin (tough sugar complex).
- They are Heterotrophic and obtain their food either from dead organic matter or from other living organisms.
- Reserved food material = glycogen and oil globules.
- They have 2 phases (1) vegetative phase (mycelium absorb food material from surroundings) and (2) reproductive phase (asexual reproduction occur by spores and sexual by fusion of gametes)
- Example : mushrooms, *Rhizopus, Aspergillus, Agaricus campestris* (button mushroom)
- Some fungi makes symbiotic association with algae (Cynobacteria) called as lichens.

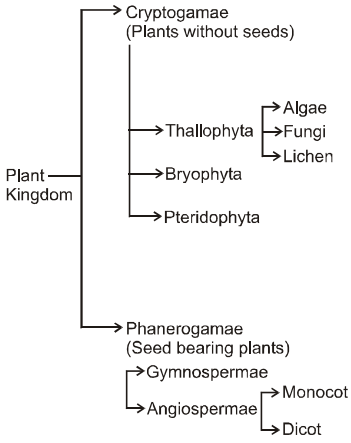


KINGDOM PLANTAE : Eukaryotic chlorophyll organism called as plants. Some are partially heterotrophic (insectivorous plants = Venus fly trap, Bladder-wort). There cell wall is made up of cellulose. Life cycle of Plantae show 2 distinct phase they are saprophytic (2n) and gametophytic (n).

Characteristics of Plantae :

- Multicellular eukaryotic organisms
- Mode of nutrition is autotrophic
- Cells have large central vacuoles and rigid cell wall of cellulose.
- They have reserve food material as starch and fats.
- Plants are largely non-motile, being anchored to the substratum. A few forms are free- floating in fresh or sea water
- Growth of plant body is indefinite and new organs are continuously added throughout life.
- Plants are the producers of biospheres

Plantae are classified into different divisions. They are :



Division (THALLOPHYTA (algae)) : The plant in this division is commonly called as algae. The term Algae was coined by C.Linnaeus which means (sea weeds). They show following characteristics-

- Plants show most primitive and simple structures. They are not differentiated into roots, stems and leaves hence called as thalloid (thallus-like)
- They are aquatic and occur in both marine and as well as fresh water (some are terrestrial also).
- Algae are photo synthetically active hence can make their own food.(photoautotrophic)
- Some algae have additional accessory pigments of other colors (such as red, green, brown, yellow etc) and accordingly they have been classified into different groups.
- Plant body may be unicellular (*Chlamydomonas, chlorella*), colonial (*Volvox, Hydrodictyon*), filamentous unbranched (*Spirogyra, Ulothrix*), filamentous branched (*Chara, Cladophora*)
- Reproductive organs are unicellular and completely converted into spores/gametes.
- After fertilization embryo is not formed.


Spirogyra

Importance of algae :

1. More than ½ of the total CO_2 on earth carried out by algae.
2. Increase dissolved oxygen in immediate environment.
3. They are primary producers of energy rich compounds
4. It is the main base of food cycle(aquatic animals)
5. 70% algae used as food (marine algae)
6. Brown and red algae are hydrocolloids(water holding substance)
7. Agar is produce by algae which is used to grow micro-organisms, used as solidifying agent, used to prepare ice creams and jellies.

Advance :

Algae are subdivided into following 3 classes :

1. Chlorophyceae :

- Mainly having green algae (*unicellular, colonial, filamentous*)
- Cell wall = rigid and made up of cellulose and pectose.
- They have storage bodies called pyrenoids (proteins + starch)
- Examples : *Chlamydomonas, volvox, ulothrix, spirogyra*

2. Phaeophyceae :

- They are brown algae(*marine habitat*)
- It stores complex carbohydrates

- Examples : *Focus, Ectocarpous*

3. Rhodophyceae :

- They contain red pigment hence they appears red in color.
- Major concentration is found in warmer areas, margins of water where maximum light is present and at depth of water where less amount of light is available.
- Pigments = chlorophyll a, d and phycoerythrin
- Example : *Gracilaria and gelidium*

Division–BRYOPHYTA :(Amphibians of plant kingdom) :

- ''Bryon'' means moss; phyton means plants
- Found in moist shady areas (hills).
- Common plants are Live Worts and Mosses.
- Occurrence = Damp, humid, shady localities (live in soil but need water for reproduction)
- Play important role in plant succession on bare rocks and soils
- Plant body = Gametophyte (Haploid body responsible to produce gametes)
- Plant has an embryo stage in its life cycle.
- Sex organs are multi cellular. The male sex organs are Antheridia and female sex organs are Archegonia
- Vascular system is completely absent
- An embryo is formed upon fertilization. Sex organs are multicellular, jacketed.
  e.g. Liver worts (*Riccia, Marchantia*), Hornworts(*Anthoceros*), Mosses (*Funaria*).

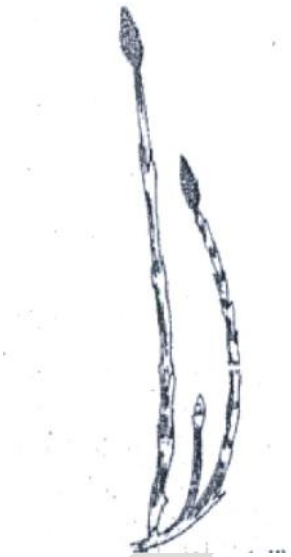
Liverwort

Division 3 PTERIDOPHYTA : [Botanical snake/vascular cryptogams]

- ''Pteris'' means fern
- They are mostly used as medicinal purpose.
  Main plant body sporophyte (2n) Originate seed habit. (Made up of true roots, leafs, stems)
- Frequently grown as ornamental plants.
- They act as a soil binders.
- First terrestrial plants having xylem and phloem (vascular bundle)
- Dominant phase is saprophyte in life cycle which develops into roots, stems and leaves
- Here zygote develops into young embryo. They are precursor to produce seed habits which is a major step in evolution
- EXAMPLES : *Pteridium, Azolla,Lycopodium*

Advance :

- All the plant parts possess vascular tissue
- Reproduction occurs by spores produce inside the sporangia. Plants may be Homosporous i.e. produce only one type of spores or Heterosporus i.e. produce 2 different types of spores (smaller microspores and larger megaspores in separate sporangia.
- Thallophytes, bryophytes and pteridophytes have naked embryos that are spores.
- Fertilized egg develops into embryo.



Equisetum (Horsetail)

Division GYMNOSPERMS :

- ''Gymno'' = naked; ''sperm'' = seed
- It includes medium sized trees, tall trees, shrubs, sequaria-gaint red wood trees (only tall gymnosperm)
- Ovules before and after fertilization enclosed by ovarian wall. Post fertilization produced naked seeds.
- They have tap root system. If root is associated with fungi = Mycorrhiza (pinus), if associated with corolloid roots i.e. Nitrogen fixing (Cynobacteria)
- Leaves are simple and compound, well developed to withstand extreme conditions like temperature, humidity, winds.
- In conifers leaves are needle like, thick cuticle, sunken stomata.

Advance :

- The group includes those vascular plants which are usually perennial, evergreen and woody.
- Sporophylls are aggregated to form cones. They are separated male and female cone. The male spore is called as microspores or pollen grains. They are produced inside the microsporangia
- The female egg is formed inside the ovule. In gymnosperms, the ovules are not enclosed within ovaries so that they are naked.
- Pollination occurs by wind. After fertilization, the ovules become seeds.
- Thus, the seeds are naked and not enclosed inside the fruits.
- True vascular bundles are absent in the xylem of gymnospermous plants. Phloem is devoid of companion cells. Sieve cells are present
- Examples : *Cycas, Pinus, Araucariaetc*

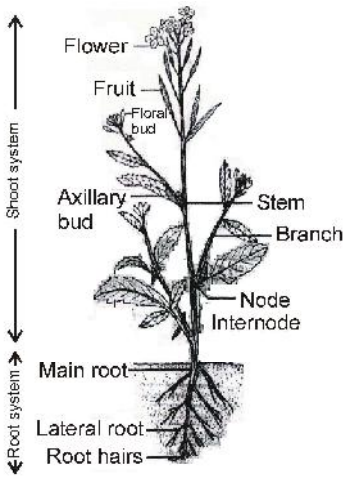
Cycas

Division - ANGIOSPERMS :

- The group angiosperms are the sub division of seed plants which includes flowering plants in which the seeds are enclosed in fruits.
- It includes those vascular plants which produce flowers. The flowers bear stamens and carpels.
- The stamens are male reproductive organs which produce pollen grains. The carpels are female reproductive organs which bear ovules. After fertilization, the ovules develop into seeds and ovary develops into fruit. Thus, the seeds are protected and enclosed in the fruits.
- The seeds enclose embryo, the miniature of plant body .the embryo had plumule (future shoot), radical (future root) and cotyledons (seed leaves). The cotyledons represent embryonic leaves which expand and became green when the seed germinates. On the basis of the number of cotyledons in the embryo, the

angiosperms are distinguished into 2 groups :

- Dicotyledons: The group includes those flowering plants in which the embryo possess 2 cotyledons. The plant bears a prominent tap root system. Leaves usually show reticulate venation. Vascular bundles are arranged in rings. Example : Pea, gram, Mustard etc
- Monocotyledons : The groups include those flowering plants in which the embryo posses single cotyledon. The plants bear fibrous root system. Leaves usually show parallel venation and vascular bundles are scattered. Examples: Wheat, Rice, Maize



A dicot plant (mustard)


Monocot plant (maize)

TABLE : DIFFERENCES BETWEEN ALGAE AND FUNGI

Algae	Fungi
1. These are autotrophic in nature.	**1.** These are heterotrophic in nature
2. Photosynthetic pigments are present	**2.** Photosynthetic pigments are absent
3. Cell wall is made of cellulose.	**3.** Cell wall is made of chtin.
4. Algae are mostly aquatic.	**4.** Fungi are mostly terrestrial.
5. These contain starch as stored food material.	**5.** These contain glycogen and oil as stored food material.

TABLE : DIFFERENCES BETWEEN CRYPTOGAMAE AND PHANEROGAMAE

Cryptogamae	Phanerogamae
1. It includes seedless plants.	**1.** It includes plants having seeds.
2. It has both non-vascular and vascular plants.	**2.** It has only vascular plants.
3. Plant body may or may not be differentiated into true roots, stem and leaves	**3.** Plant body is differentiated into true roots, stem and leaves.
4. Water is required for fertilization.	**4.** Water is not required for fertilization.

TABLE : DIFFERENCES BETWEEN BRYOPHYTES AND PTERIDOPHYTES

Bryophytes	Pteridophytes
1. Plant body is gametophyte (Haploid).	**1.** Plant body is sporophyte (Diploid).
2. Plant body is either thallus or foliose. However, true stem, leaves and roots are absent.	**2.** Plant body is differentiated into true roots, stem and leaves.
3. Plant is fixed to the substratum by rhizoids.	**3.** Plant is fixed to the substratum by roots.
4. Sporophyte is parasitic over gametophytic plant body throughout life.	**4.** It has small, independent gametophyte.
5. These are non-vascular plants	**5.** These are vascular plants.

TABLE : DIFFERENCES BETWEEN GYMNOSPERMS AND ANGIOSPERMS

Gymnosperms	Angiosperms
1. Vessels are absent in xylem and companion cells are absent in phloem.	**1.** Vessels and companion cells present.
2. The ovules are naked.	**2.** The ovules are protected within the ovaries or carpels.
3. Fruits are not formed and seeds are naked.	**3.** Fruits are formed and seeds are protected.

KINGDOM Animaliae :

Characteristic

- These organism are multicellular, eukaryotic and without chlorophyll.
- The cells possess no cell walls and plastids.
- Central vacuoles are absent but small vacuoles may occur.
- Most of them are free moving (excepts sponges and some coelenterates).
- Nutrition is primarily ingestive.
- Reproduction is generally sexual and the haploid stage is represented only by gametes.
- Growth of organisms stops when the adult stage is reached.

Characters responsible for the classification :

The animal kingdom is classified into several phyla (Sing phylum) mainly on the basis of certain criteria's such as structural organization of animal body, body symmetry, presence or absence of notochord, presence or absence of body cavities or coelom, the number of germ layers present in the embryo, mode of origin of mouth and so on.

Some of the criteria's are :

1. The structural organization of animal body :

- There are three distinct level of structural organization :

(1) Cellular level : the body is formed by loosely aggregated cells

(2) Tissue level : the body is made up of tissue of specialized cells

(3) Organ system level : the body has organized tissues, organ and system.

2. Digestive system and circulatory system :

• Body can have :

(i) Incomplete digestive system: it has only a single opening to the outside of the body that serves as both mouth and anus example : Platyhelminthes

(ii) Complete digestive system: They posses 2 opening that is mouth and anus.

(a) Open circulatory system: in which the blood is pumped out of the heart like structure and the cells and tissues are directly bathed in it.

b) Closed circulatory system: in which the blood is circulated through a series of vessels of varying diameters

3. Body symmetry :

(a) Asymmetrical : Any plane that passes through the centre does not divide them into equal halves e.g. Sponges

(b) Symmetrical : When any plane passing through the central axis of the body divides the organism into 2 equal halves. E.g. coelenterates, ctenophore, echinoderms

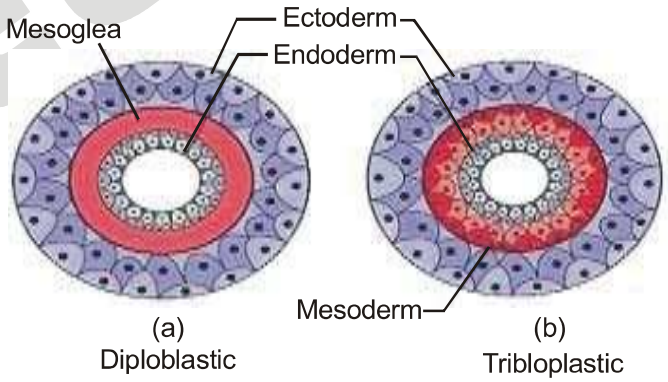
(c) Bilateral symmetry : When body can be decided into identical left and right halves (in only one plane).

A beetle has bilateral symmetry | a coral polyp has radial symmetry | a sponge has no symmetry

4. Diploblastic and triploblastic organization :

(I) Diploblastic: animal cells are arranged into 2 embryonic layers i.e Endoderm and Ectoderm. It contains a Mesoglea layer (undifferentiated) present between 2 layers. E.g. Coelenterates

(II) Triploblastic : Animal having 3 embryonic germ layers. Middle layer is termed as Mesoderm.
E.g. From Platyhelminthes to chordates.

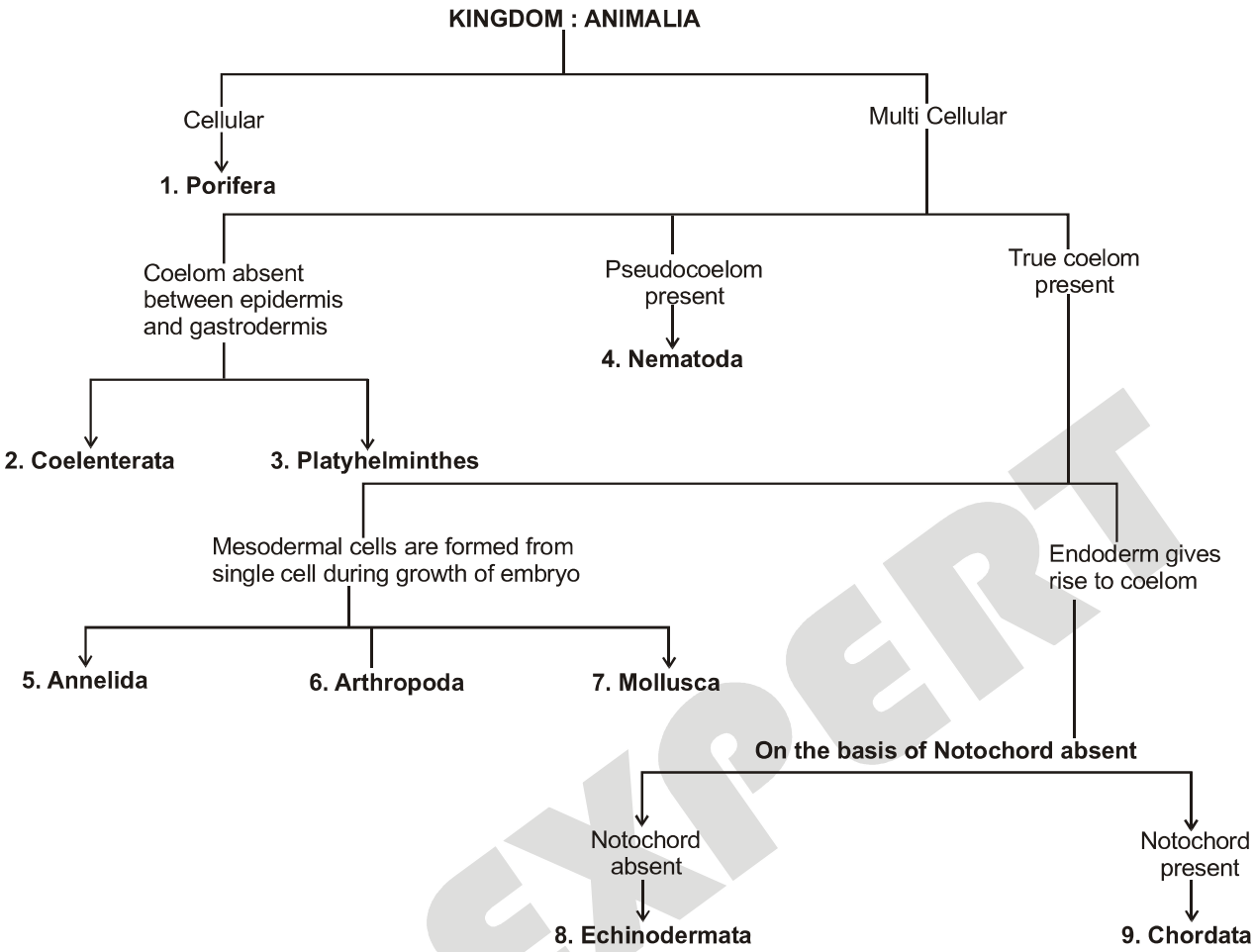


5. Presence or absence of notochord. Some animals possess a skeletal rod, called notochord, at some stage of their life. All those animals which possess notochord are grouped under the phylum chordata state of their life. All those animals which does not possess notochord are grouped together as non-chordates (invertebrates).

6. Presence or absence of body cavity. Depending on the presence or absence of body cavity or coelom, the animals are grouped into three categories :

(i) Animals having no cavity in the body except in digestive tract are called acoelomate ;

(ii) Those having body cavity that does not arise from the mesoderm are called pseudocoelomate ; and
(iii) The animals having true body cavity are called coelomate.

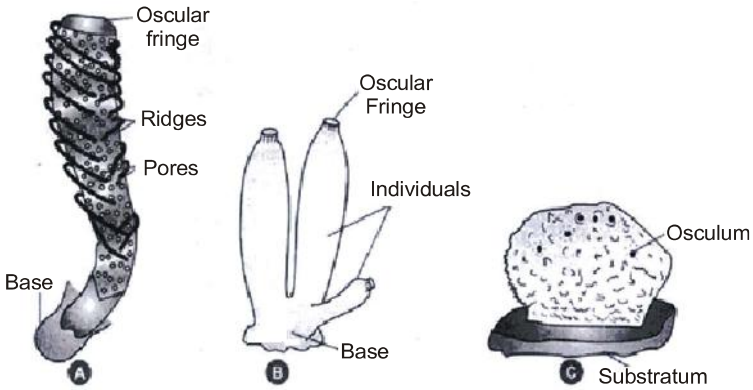


Phylum 1 : PORIFERA : e.g. (Pore bearing).

- The porifera includes plants-like creatures commonly called sponges.
- They are mostly marine.
- Some sponges are cylindrical and shaped have radial symmetry.
- Other form of flat, globular or irregular, branching masses. they are asymmetrical.
- They are mostly sessile (stalk-less) and attached to the substratum.
- Sponges are simplest multicellular animals.
- They have cellular level of organization. They don't have any tissues, organs and organ system.
- The cells are loosely held together and perform life functions more or less independently.
- Body is perforated by numerous pores (Ostia), with a single large opening called Osculum on the top.
- Ostia open into canal system consisting of intercommunicating canals and chambers.
- The current of water enters through dermal Ostia and after passing through various canals finally leaves through Osculum.
- The water brings food and oxygen.
- The sponges lacks mouth, digestive system and anus
- They are covered with hard outside layer or skeleton (exoskeleton) called spicules.
- Reproduction: both by sexual and asexual process.
- Asexual reproduction: Occurs through budding or special cell mass called as gemmules.
- Sexual reproduction: It involves the formation of ova and spermatozoa. The sperms leave one sponge and

entre another with water current to fertilize the egg in situ (internal fertilization).

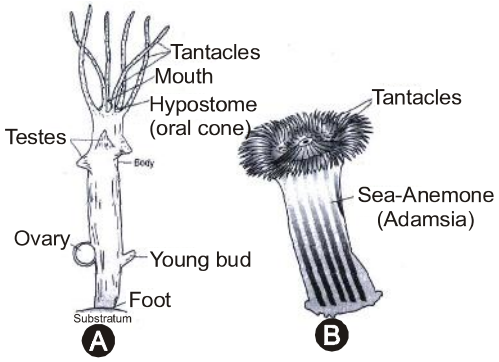
- Examples : Euplectelia, Sycon, Euspongia



Porifera A. Eupletella ; B. Sycon ; E. Euspongia

Phylum 2 : COELENTERATA or CNIDERIA : (Gr., Koilos = hollow ; enteron = gut)

- This includes Hydra, jelly fish, sea- anemones and corals.
- They may be solitary or colonial.
- They all are aquatic (both fresh water and marine), hydra occurs in fresh water.
- The body of animals is made up of 2 layers of cells.
- The animals are multicellular with tissue level of organisation. They lack organ and organ system
- Symmetry is usually radial.
- The body enclosed a single cavity. it has a single aperture, the mouth. There is no anus.
- The mouth serves both for taking food and for throwing out faeces.
- Mouth offen bears flexible processes called tentacles.
- Cnidarians body wall is supplied with special cells called Cnidoblasts.
- Cnidoblast posse's defense and offence. These cells, when discharged, give out from a cnidocyst a long thread tube that may coil round the prey, or attach to it, or inject a toxin round the prey, or attach to it, or inject a toxin called HYPNOTOXIN ; into it to paralyse it.Reproduction: usually asexual (budding) and sexual in Medusa.
- Fertilization can be external or internal
- The soft body may be supported by horny or calcareous skeleton. Hard skeleton occurs in corals.
- Examples : ***Hydra***, ***Obelia*** (the sea fur), ***Admasia*** *(*the sea anemore), ***Aurelia***(the jelly fish)



Coetenlerata A. Hydra ; B. Adamsia (sea-anemone)

Phylum 2 Ctenophora : (Advance)

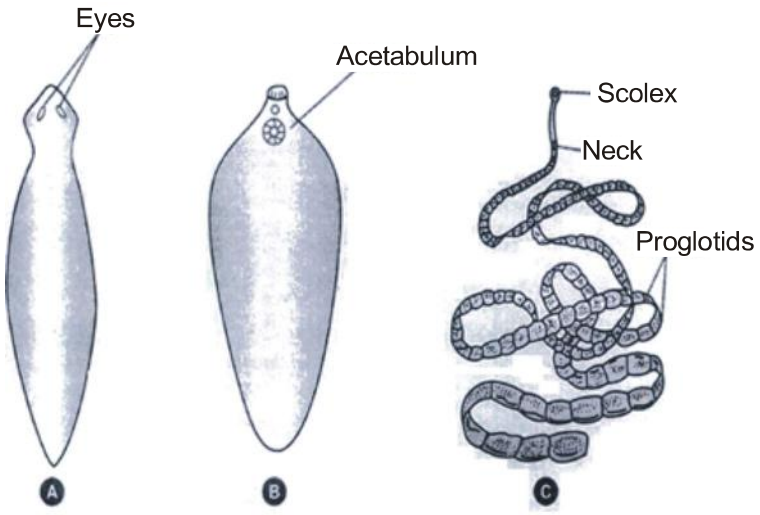
- Organization = This phylum posses tissue level of organization.
- Common member of this phylum: Sea walnuts, comb jellies.
- Animals are Diploblastic, Radially symmetrical, marine.
- Comb plates: Body has 8 external rows of ciliated plates, which helps in locomotion.
- Digestion : both extra cellular and intracellular
- Bioluminescence: Their body emits light.
- Sexes: they are not separated
- Reproduction : only by Sexual means
- Fertilization: external and internal.
- Examples : Pleurobrachia and Ctenoplana

Ctenoplana

Pleurobrachia

Phylum 3 : PLATYHELMINTHES : (Flat worms)

- They are most primitive one.
- Symmetry = bilateral (flat worms).
- Body : soft and leaf like or ribbon like dorsoventrally flattened without segmentation.
- Most of animals belonging to this phylum are parasites. few of them are free living
- Parasitic form attach to host by Sucker's and hooks.
- Germ layers: They are first triploblastic animals. They have 3 germ layers. This means their tissues differentiate from 3 embryonic germ layers and posses some degree of tissue differentiation leading to organ formation. Mesoderm appeared between the ectoderm and endoderm. .
- Coelom: There is no body cavity or no coelom.
- Digestive track, if present, it is still incomplete .The indigested food particles are removed out through mouth.
- The excretory system : includes Flame cells (Protonephridia) leading to tubules that open out by one or more excretory pore.
- Sexuality: Animals are Hermaphrodites (bisexual) i.e., both male and female sex organs are present in the same animal.
- Examples : Planaria (Class I. Turbellaria - *Dugesia*), Liver fluke (Class II. Trematoda - *Fasciola*), tape worm (*Taneia solium*)



Platyhelminthes A. Planarela ; B. Fasciola (Liver fluke) ; C. Tape worm

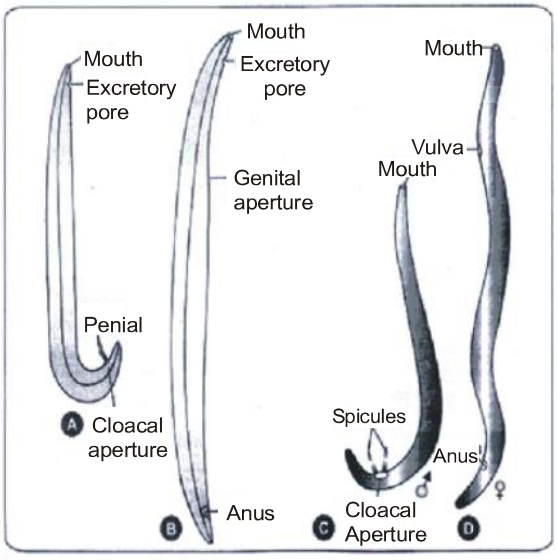
Phylum 4 : NEMATODA or ASCHELMINTHES (Round worm) :

- They have organ system level of organization
- The animal body is Cylindrical, or flattened, Bilaterally symmetrical, triploblastic and unsegmented.
- Body size varies from microscopic to several centimeters in length.
- Body wall is covered with tough and resistant cuticle. cilia's are absent.
- The cavity present between body wall and digestive track is not a true coelom. hence it is called as Pseudocoelom.
- Animal include in this parasitic worms are disease causing.

  There is a straight, one way alimentary canal with mouth as well as anus. Such a digestive tract is said to be complete.

Advance :

- *Digestion :* Alimentary canal is complete (having mouth as well as anus) with well developed Muscular Pharynx.
- *Sexes :* separated (Dioecious), male short, and female long. Fertilization: internal and development direct or indirect.
- Examples : *Ascaris* (Round worm) , *Wuchereria* (Filaria worm), *Anylostoma* (Hook worm), *Enterobium* (the pin worm)



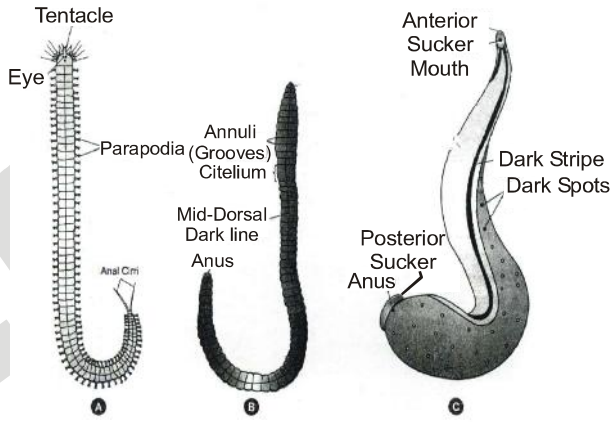
Nematodes A. Male Ascoris ; B. Female Ascaris ;
C-d. Wuchereia (The filarial worm)

Phylum 5 : ANNELIDA (SEGMENTED WORMS)

- Organization = organ system level.
- Animal body is soft elongated, bitaterally symmetrical, vermiform and cylindrical.
- Body is divided into segments/metamers by ring-like grooves, the annuli.
- Organs are packed into body structures
- This phylum includes Earthworms, leeches, Nereis, etc.
- The body is divided into segments or metameres by ring like grooves, the annuli.
- Some of the anterior body segments concentrate to form head.

Advance :

- Body bears lateral locomotors appendages in the form of segmentally arranged paired Parapodia, chitinous Setae or Chaete.
- The body cavity is a true coelom (first animal having true body cavity.)
- Body is divided by transverse septa or compartment.
- Alimentary canal is complete, straight and extended through the entire body from mouth to anus.
- Excretory system : Consist of tubules, the metanephridia which remove wastes from coelom and blood stream directly to exterior in the form of urea and ammonia.
- A closed circulatory system has appeared.
- The nervous system includes a circumentric nerve ring and a soild, double, mid ventral, nerve cord with ganglia.
- Reproduction : Occurs by sexual means. the sexes are separated (unisexual) or united (hermaphrodites).
- Examples : Nereis (the sandworm), Aphrodite(the sea mouse), Pherretima(earthworm), Tubiflex(blood worm), Hirudinaria (the cattle leech) etc.



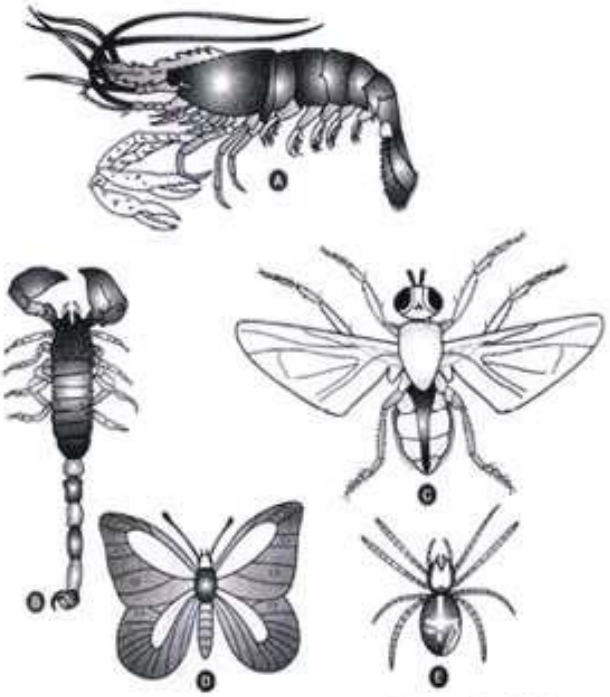
Annelida A. Nereis ; B. Pheretima (Earthworm) ; C. Hirudinaria(Leech)

Phylum 6 : ARTHROPODA : Animals with jointed legs)

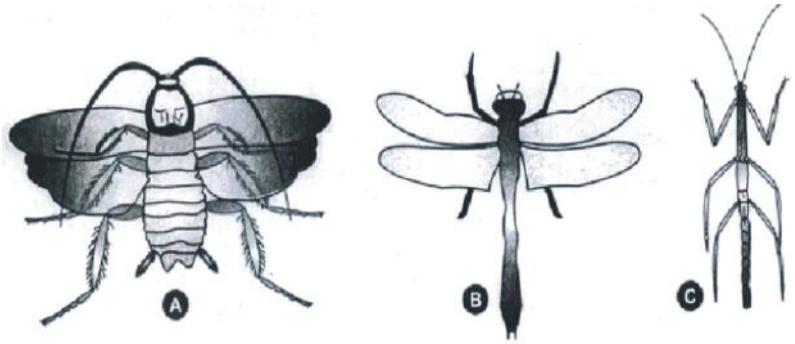
- This has organ system level of organization.
- This phylum includes about 90,000 species (which includes prawns, crabs, insects,spiders, shrimps, scorpions, ticks, centipedes and millipedes.
- They occur on land, in soil, in fresh water, in sea water and as parasites on and in the bodies of aniamals as well as plants.
- The arthropods are found everywhere from latitude of over 5,000 meters on the mountains to depths of more than 4,500 meters in the sea.
- There is open circulatory system so blood does not flow in the well defined blood vessels.
- The body is segmented externally, but not separated internally by septa.
- The segments are grouped into 2 regions : cephalothorax (head and thorax together) and Abdomen/ or segmented into 3 regions : head, thorax and abodomen.

Advance :

- Anterior part of the body forms a distinct head. It consists of many fused segments. It bears well developed sense organs and brain.
- Sensory organs : Antennae, eyes
- Some or all the body segments bear jointed appendages (legs).
- Exoskeleton is made of a thick chitinous cuticle.
- The hard cuticle restricts growth and is periodically changed during growth. The process called Moulting.
- The body cavity is reduced and contains blood and is called the Haemocoel.
- The alimentary canal is complete. Mouth is provided with movable appendages. Anus lies at the opposite end of the body.
- Respiration generally takes place by special structures such as gills, tracheas, book lungs, book gills, etc
- Sexes are separated
- Examples : *Palaemon* (Prawns), *Palinurus* (the lobster), *Scolopendra* (centipede), *Palamnaeus* (Scorpian), House flies, butterflies, spiders, crabs, cockroaches, Dragon fly, stick insects, Laccifer , Apis , Bombyx etc.



Arthropoda A. Palaemon (Prawn) ; B. Palamnaeus (scorpion); C. Musca (House fly), D. Butter fly ; E. Aranea (spider)



Arthropoda A. Periplameta (Cockroach); B. Draon fly ; C. Caraushus (Stick insect)

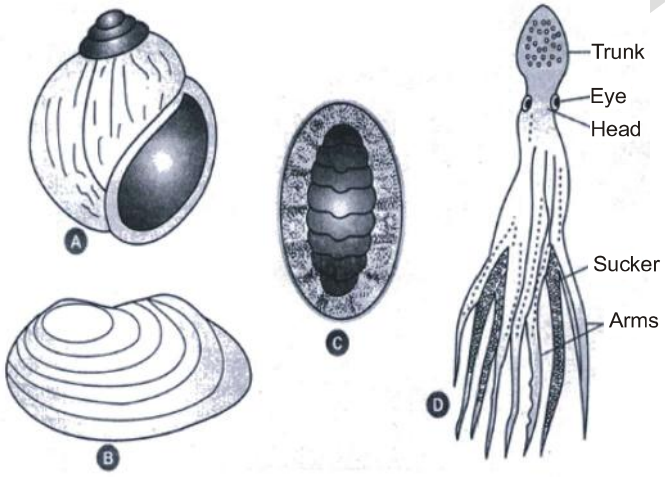
Phylum 7: MOLLUSCA (Soft body)

- This phylum have organ system level of organization.
- This includes forms like mussels, oysters, snails, slugs, squids, conches, cuttle fishes, octopus, etc
- The animals vary in size from microscopic to giant forms like octopus of size up to 50 feet.
- They have bilateral symmetry with reduced coelomic cavity.
- Body is little segmented with open circulatory system.
- The animal body is soft and unsegmented without external appendages.

  The body is usually differentiated into 3 regions- anterior Head with sense organs, dorsal Visceral mass containing organ system and ventral foot for locomotion.

Advance :

- A thin fleshy fold (or outgrowth of dorsal body wall) covers the body. This fold is called the Mantle. It encloses a cavity called mantle cavity. The anal, excretory and genital apertures are situated in this cavity.
- In most cases, a calcareous shell is secreted from the mantle which covers the body.
- Alimentary canal is complete
- Respiration usually takes place by gills, called the ctenidia.
- Mouth have file like rasping organ for feeding called as Radula.
- Sexes are usually separated.
- Examples : *Chiton*, *pila* (the apple snail), Turbinella (the Shankh), *Unio* (fresh water mussels), Octopus etc.



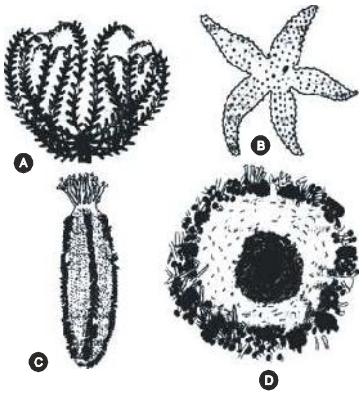
Mollusca A. Pila ; B. Unio; C. Chitton ; D. Octopus

Phylum 8: ECHINODERMATA : (Spiny skinned animals)

- Organ system level of organization
- Adult body has radial symmetry (larva- bilateral symmetry), Triploblastic, Coelomate, spiny body.
- It includes marine, gregarious(live at the bottom in groups), slow moving and free living animals commonly called as star fishes, brittle star, sea dollars, sea urchins, sea cucumbers and sea lilies etc.
- Shape: may be star – like, cylindrical, melon-like, disc-like, or flower- like
- They have calcium carbonate covering called skeleton.

Advance :

- They are unsegmented animals having radial symmetry in the adults and bilateral in the larvae.
- All echinoderms lack head.
- A true coelom is present. Peculiar tube feet (podia) are developed for locomotion. A part of larval coelom is modified into a unique water filled Water vascular system with tube feet extended out to help in locomotion
- Sexes are separated
- Examples : *Asterias* (star fish), *Ophiothrix* (brittle fish), *Astropecten* (basket star), *Echinus*(sea urchin), *Echinarachinus* (sand dollar), *Holothuria* (sea cucumber), *Antedon* (feather star)



Echinodermata A. Antedon (the feather star) ; B.Asterias ; (star fish) ; C. Cucumarla (Sea cucumber) ; D.Echinus (sea urchin)

Phylum 9 : CHORDATA

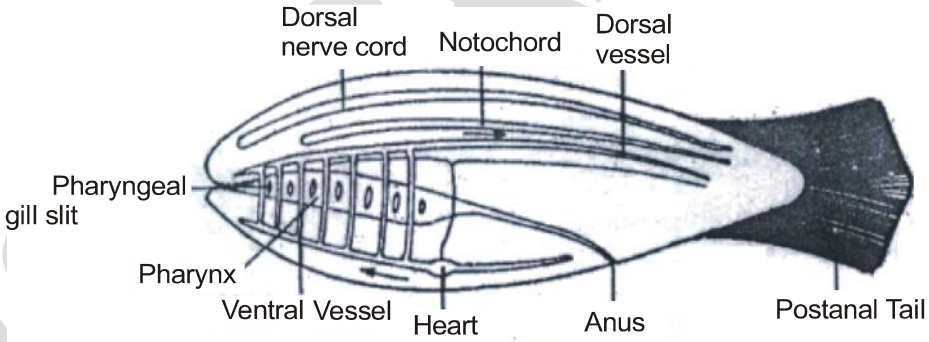
Chordata is the most advances animal phylum. The main distinctive characters of this phylum are :

(a) Notochord, a solid unjointed rod, is present in chordates at some stage of life. In lower chordates, it persists throughout life, but in the higher ones, it is present in the embryo and is surrounded or replaced by vertebral column.

(b) A dorsal hollow nerve cord develops in embryo which usually persists throughout life in most chordates.

(c) Gill slits are present at some stage of life.

(d) A tail is present behind the cloacal or anal opening at some stage of life . it is reduce or absent in the adults of some chordates.



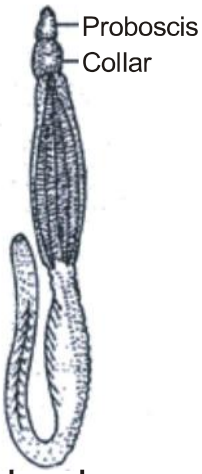
Basic chordate features

Classification of phylum : Chordata (up to class level) :

The phylum chordata is divided into 2 subphylum : Protochordata (lower chordata) and vertebrata. The vertebrates are commonly called higher chordates or euchordates.

(A) Subphylum: PROTOCHORDATA :

- They have organ system of organization.
- They termed as lower chordates.
- They do not possess brain, vertebral column, jaw and paired appendages.
- Marine animals (worm like), triploblastic. Coelomate. Bilateral cylindrical body.
- During some stage of life they show notochords (long string which separating nervous tissue from gut.
- Notochord provides a place for muscles to attach.
- It increases internal support and locomotory power.
- Example: *Balanoglossus*(a corn worm or tongue worm), *Herdmania* and *Amphioxus* etc.



Balanoglossus

A PROTOCHORD

(B). Subphylum : Vertebrata or Craniata : Majority of chordates are included in this phylum

Sub-phylum : VERTEBRATA

1. The sub-phylum vertebrata includes animals which are bilaterally symmetrical, triploblastic, coelomic and segmented.
2. The animal body typically consists of four regions ; head, neck, trunk and tail.
3. The notochord is replaced partly or fully by a jointed vertebral column (back bone) in the adult. The body of vertebrates is characterised by the presence of a well developed skeletal system that allows a special distribution of muscle attachment points to be used for movement.
4. Besides vertebral column and internal skeleton, the vertebrates have a well developed nervous system (brain) and sense organs (eyes, ears and nose).
5. The vertebrates have a complex differentiation of body tissues or organs.
6. There are two pairs of appendages (fins or limbs).
7. Respiration is by gills in lower aquatic vertebrates. Higher land forms have lungs for gaseous exchange.
8. Sexes are separate.

Subhylum vertebrata is divided into seven classes :

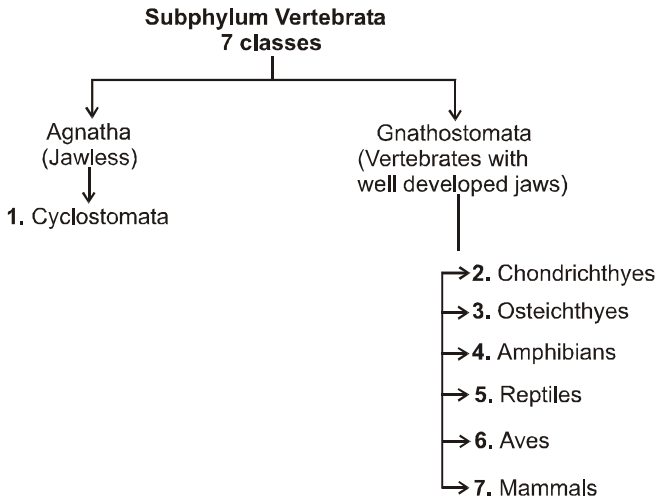
(i) Class : Pisces

(ii) Class : Amphibia

(iii) Class : Reptilia

(iv) Class : Aves

(v) Class : Mammalia



(i) Class : PISCES :

1. The animals belonging to class-Pisces are commonly called fishes. They exclusively live in water
2. The skin of fishes is covered with scales/plates, which help these animals to live in water.
3. The body may be long, laterally compressed and spindle shaped or dorsiventrally flattened and disc shaped. It usually consists of head, trunk and a muscular tail.
4. The muscular tail and fins help them to swim in water and move from one place to another.
5. Fishes are cold-blooded animals and their hearts have only two chambers - one auricle and one ventricle.
6. Fishes obtain oxygen dissolved in water and breathe through gills.
7. They are egg laying animals. Fertilization is external.

(a) Class Cyclostomata (Gr. Cyclos = circular ; stome = mouth; the circular mouth fishes)

- These are the most primitive vertebrates
- Animals are jawless and posses a circular mouth.
- They are ecto parasites on fish and use mouth to stick to fish.(the mouth is therefore suctorial)
- Notochord is present in the form of a cylindrical rod.
- Head and brain are poorly developed.
- Cartilaginous endoskeleton is present.
- Respiration occurs throught gills contained in pouches.
- Heart is 2 chambered consisting of 1 auricle and 1 ventrical
- Gonad is single and fertilization is external.
- Example : Hag fish, Lamprey

A = Lamprey

Hag fish

(b) Class Chondrichthyes : The cartilaginous fish

- Skeleton is cartilaginous, streamlined body.
- Gills are seprated
- Skin are tough and have scales.
- Heart 2 chambered.
- Some have electric organs or poisonous strings
- Cold blooded animals.
- Fertilization internal, viviparous
- Examples : Dog fish, saw fish, great white shark, sting ray

A = dog fish

B = Saw fish

C = Sting Fish

D = White Shark

members of Chondrichthyes

(C) Class Ostichthyes :

- Having both marine and fresh water fishes
- Body is streamed lined.
- Skeleton is cartilaginous in embryonic stages, but replaced by bones in adults
- Air bladder regulate buoyancy
- Heart is 2 chambered
- Cold blooded animals with separate sexes.
- Fertilization external, oviparous.

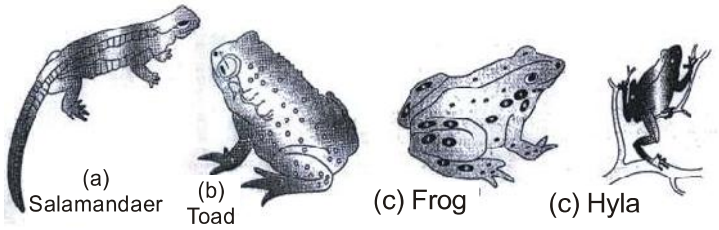
DIFFERENCE BETWEEN CHONDRICHTHYES AND OSTEICHTHYES

S. No.	Chondrichthyes	Osteichthyes
1.	Mouth ventral.	Mouth terminal.
2.	Tail fin asymmetrical (heterocercal).	Tail fin symmetrical (homocercal).
3.	5-7 pairs of gills are present.	4-5 pairs of gills are present.
4.	Gills are naked.	Gills are covered by operculum.
5.	Cloacal aperture is present.	Anus and urinogential apertures are separate.
6.	No swim bladder	Swim bladder usually present.
7.	Fertilization is internal.	Fertilization is external.

(ii). Class Amphibia : (The vertebrates leading dual life)

- They are the first land vertebrates, amphibious means partly terrestrial and partly aquatic. Some frogs live on tree.
- They found in both fresh water and moist places
- The skin is smooth, moist, rich in Mucous and poison fluid
- Body is without scales
- Endoskeleton is mostly bony, notochord does not persist in adults
- Head and trunk are distinct; neck and tail may or may not be present

- Limbs tetrapods(4 limbed, pentadactyl limb, each with 4-5 or fewer digits.
- Respiration takes place by gills, lungs, lining of buccopharygeal cavity and skin.
- Heart is 3 chambered (2 auricles and 1 ventricales).
- Examples : *Rana tigerina* (the common Indian frog), *Bufo*(toad), *Hyla*(tree frog), *Necturus*(mud puppy), *Salamandra* (spotted salamander), *Triturus* (Himalayan salamander).



Members of Amphibia

(iii) Class Reptilia. (Creeping vertebrates) :

- They include lizards, snakes, tortoise, turtles, alligators, and crocodiles.
- First vertebrate to fully adapted for life on dry land.
- They are cold blooded animals.
- Reptiles are mostly terrestrial animals and live in warmer regions.
- Some are aquatic and live in water too, but they return on land for breeding.
- Body is covered by epidermal scales(the scales contain a water proof protein called keratin)
- Teeth are present except turtles and tortoise.
- Respiration occurs through lungs. Gills are absent.
- Heart is 3 chambered.(auricles and partly divides ventricles.)
- They are either carnivores or insectivores (tortoise is herbivorus)
- They lay eggs outside water, the eggs have a tough covering.
- Examples : *Hemidactylus* (wall lizard), *Varanus*(monitor lizard), Calotes(garden lizard), *Draco* (flying lizard), *Python*(ajgar), Naja(Cobra), *Testudo*(tortoise), *Chelone*(turtle), *Crocodilus*(Crocodiles), *Gavialis*(Gharial).

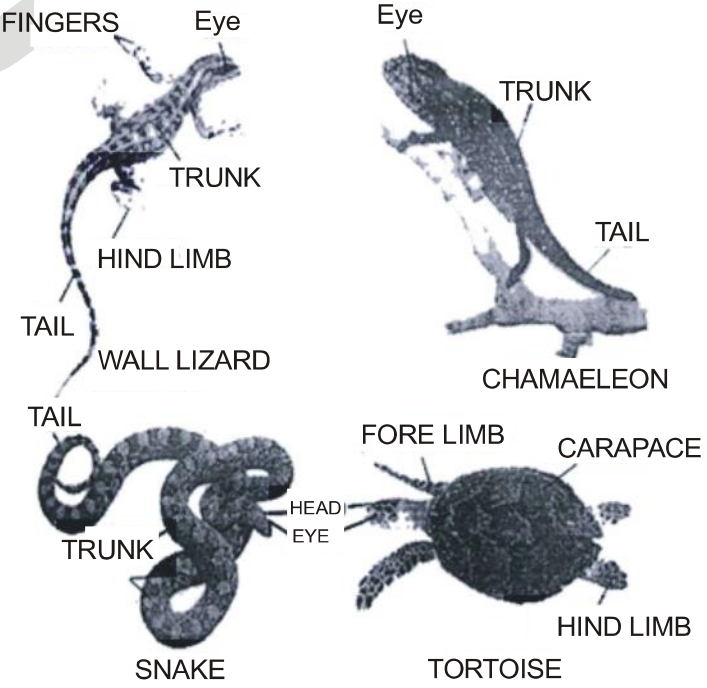
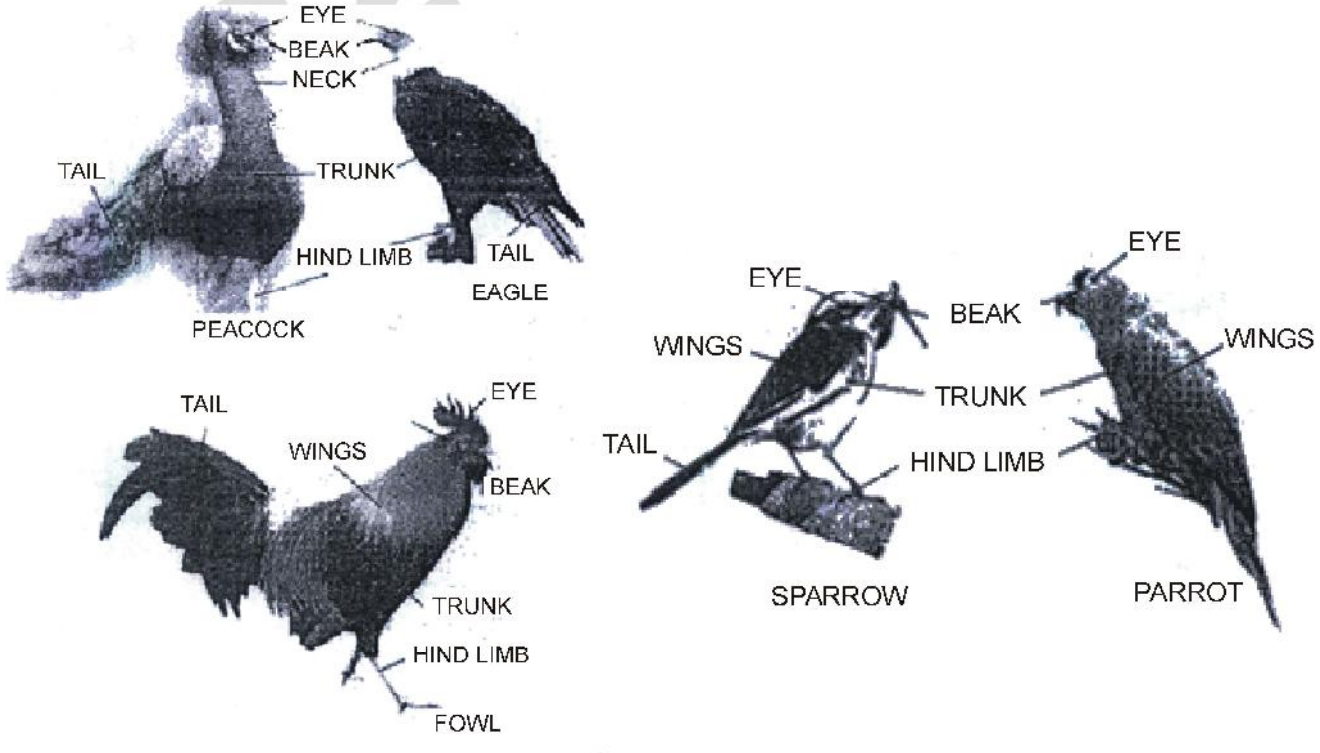


Table : Differences Beetween Amphibia and Reptilla		
S. No.	**Amphibia**	**Reptillia**
1.	Skin is smooth and moist	Skin is dry and cornified.
2.	Scales are absent.	Scales are present over the body.
3.	Digits do not possess claws.	Digits end in claws.
4.	Heart is three chambered.	Heart in three chambered except crocodile (u-chambered)
5.	Fertilization is external.	Mostly internal
6.	Exta-embryonic membranes are absent.	Exta-embryonic membranes are present.
7.	**Examples :** Frog, Toad	**Examples :** Lizard, Snake, Tortoise.

(iv) Class Aves : (Birds)

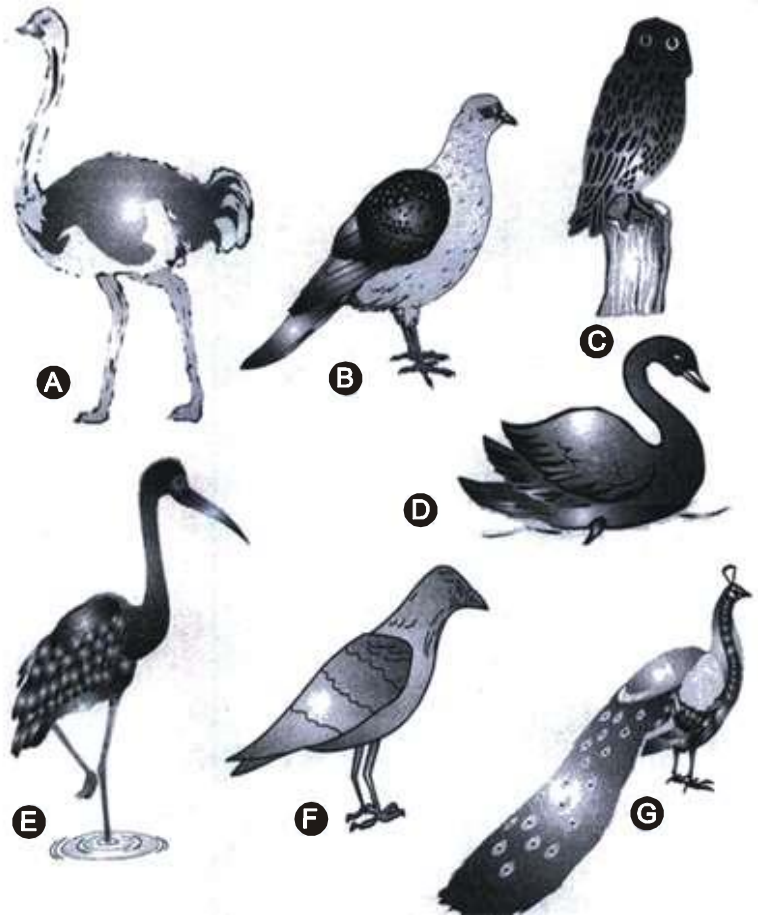
- The body is covered with soft feathers (feathery exoskeleton)
- The body is divisible into head , neck, trunk, and tail.
- There are 2 paires of limbs. The fore limbs are modified to form wings (in flying birds) or are reduced (non-flying birds)
- Jaws are modified to form a strong beak.
- Teeth are absent
- Respiration is by lungs only. Lungs have additional bag like membranous extensions called as air sacs.
- Sexes are seprated.
- Fertilization is internal. Fertilized egg are laid with a yolk (stored food) and with a hard calcareous shell.
- Like reptiles and mammles, they have the embryonic membranes namely the amnion, chorion, yok-sac, and allantois
- Heart is relatively large. It is four chambered having 2 auricles and 2 ventricles.
- Kiwi, penguin and ostrich are examples of flightless birds.
- Examples: *Columbo*(pigeon), *Struthio*(Ostrich), *Pavo*(pea fowl), *Passer* (sparrow), *Gallus*(fowl).



Members of Aves

(v) Class Mammalia :

- They are primarily terrestial vertebrates
- They occur in all sort of habitat from polar region to tropic (polar ice caps, desert, forests, grasslands, dark caves etc.)
- Body divisible into head, neck, trunk and tail (some don't have).
- Important feature : they have mammary glands which produce milk in females which was sucked by young ones after some time of birth.
- Skin is glandular and covered with hairs.
- There are 2 pairs of pentadactly limbs adopted for various purposes.(2 limbs used for walking, running, climbing, burrowing, swimming or flying)
- Respiration occurs only by lungs.
- The heart is four chambered(2 auricles and 2 ventricles)
- Sexes are usually distinguishable externally
- Mammls ar mostly viviparous (give birth to young ones), some are oviparous(lay eggs- eg platypus and echidna)
- Examples : Macropus(kangaroo), Bat, Rattus (rat), Oryctolagus(rabbits), Felis (cat), Panthera (lion, tiger, lepard), Canis(dog), Elephas (elephant), Balaena (whale), Macaca(monkey), Homo(man), Pan (chimpanzee).



Members of - Mammalia

S. No.	Characteristics	Pisces	Amphibia	Reptilia	Aves	Mammalia
1.	Habitat	Aquatic	Both land and water	Some terrestrial, others aquatic	Terristial(aerial)	Usually terrisitial, few aquatic
2.	Skin	Covered with scales/ plates	Smooth skin with mucus glands and lacking scales	Water proof skin with scales	Mostly covered with fathers	Covered with hair and contain sweat and oil glands
3.	Control of body	Cold blooded	Cold blooded	Cold blooded	Warm blooded	warm blooded
4.	Number of heart chambers	2	3	3(except crocodile)	4	4
5.	Respiration	Gills	Gills, lungs, skin	Lungs	Lungs	Lungs
6.	Mode of reproduction	Oviparous	Oviparous	Oviparous	Oviparous	viviparous (mostly)
7.	Tail and fins	Tail and fins	Limbs	Limbs	Wings	limbs
8.	Examples	Rohu, shark, sea-hourse, sting ray	Frog, salamander, toad	Crocodile, snake turtle, lizard	Pigeon, ostrich, hen, duck	Humans, whale bat, lion

POINTS TO REMEMBER

- Every living organism is unique and this uniqueness is the basis of the vast diversity displayed by the organisms in our world.
- This huge diversity is the result of evolution, which has occurred over millions of years.
- The massive biological diversity can only be studied by classification i.e., arranging organisms into groups based on their similarities and difference.
- The primary characteristics that determine the broadest divisions in classification are independent of any other characteristics. The secondary characteristics depend on the primary ones.
- Prokaryotic or eukaryotic cell organization is the primary characteristic of classification, as this feature influences every detail of cell design and capacity to undertake specialized functions.
- Being a unicellular or multicellular organism, forms the next basic feature of classification and cause huge difference in the body design of organisms.
- The next level of classification depends on whether the organism is autotrophic or heterotrophic.
- The evolution of organism greatly determines their classification.
- The organisms evolved much earlier have simple and ancient body designs whereas the recently evolved younger organism have complex body design.
- Older organism are referred as primitive or lower organisms whereas the younger organism are also referred to as advanced or higher organism
- The diversity of life forms found in a region is known as biodiversity.
- The region of mega diversity is found in the warm and humid tropical regions of the earth.
- Aristotle classified organism depending on their habitat.
- Robert Whittaker proposed the five kingdom classification, based on the cell structure, nutrition and body organization.
- The main characteristics of 5-kingdom classification are :
  1. Presence of prokaryotic or eukaryotic cells.
  2. If eukaryote, whether the organism is unicellular or multicellular
  3. Whether the cell posses or lack cell wall and whether they can prepare their own food.
- The categories or taxa used in the classification of organisms are kingdom, phylum/division, class, order, family, genus and species. The smallest unit of classification is species whereas highest unit is kingdom.
- The five kingdom proposed by Whittaker are Monera, Protista, Fungi, Plantae and Animalia. Carl Woese further divides Monera into Archaebacteria and Eubacteria.
- Monera includes prokaryotic, unicellular organism like Bacteria, Cynobacteria and Mycoplasma.
- Monerans show either autotrophic or heterotrophic nutrition .cell wall may be present or absent.
- Unicellular eukaryotic organisms such as protozoans, unicellular algae and diatoms are grouped under protista. They may be autotrophic or heterotrophic and may use appendages for locomotion.
- Fungi, such as yeast and mushrooms, include heterotrophic, eukaryotic organisms, which are normally saprophytes. Their cell walls are composed of chitin.
- Lichens are symbiotic associations of certain fungi with blue green algae.
- Multicellular, autotrophic eukaryotes possessing cell wall are included under kingdom Plantae.
- Classification of plants is done at three levels on the basis of :
  - Presence or absence of well- differentiated body.
  - Presence or absence of vascular tissue.
  - Ability to bear seeds, that could be naked or enclosed in fruits.

- The important divisions of Plantae are Thallophyta , Bryophyta , Pteridophyta, Gymnosperms and Angiosperms.
- Thallophyta, Bryophyta, Pteridophyta possess inconspicuous reproductive organs and are called as Crypto gams.Gymnosperms and Angiosperms are group under Phanerogamae, since they posses well differentiated, seed- producing reproductive tissues.
- Thallophytes are the simplest plants lacking well differentiated body designs e.g. *Spirogyra.*
- Bryophytes such as mosses and Riccia show differentiated plant body lacking vascular tissue for conduction.
- Plants grouped under pteridophytes show well differentiated plant body with vascular tissue for conduction e.g. *Ferns*
- Gymnosperms, e.g. pines and deodar, are phanerogams bearing naked seeds.
- In angiosperms/flowering plants, the seeds are enclosed in fruits.
- Cotyledons are present in the embryos of the seeds
- Monocot plants possess seeds with single cotyledons whearas dicot plants with 2 cotyledons in each seeds.
- Monocot plants show fibrous root system, parallel venation of leaves and flowers with three or multiple of 3 petals.
- Dicots plants show tap root system, reticulate venation of leaves and flower with 5 petals.
- Organisms grouped under Animalia are eukaryotic,multicellular, heterotrophic and lacking cell wall.
- Kingdom Animalia is further divided under 10 groups- Porifera, Coelentrata, Platyhelminthes, Nematoda, Annelida, Arthopoda, Mollusca, Echinodermata, Protochordata and Vertebrata.
- Porifera, also called Sponges, the body is perforated by numerous pores and it shows cellular level of organization. In addition, a hard exoskeleton and a canal system is present. Sponges are non motile, e.g., Sycon
- Coelentrata, are radially symmetrical and show a cavity called coelenterons between epidermis and gastodermis. Some coelentrates such as hydra are solitary forms where as others such as corals live in colonies.
- Platyhelminthes, includes the flat worms which are bilaterally symmetrical, dorsoventrally flattened, triploblastic and acoelomates. They may be free living (*Planaria*) or parasitic e.g., (tapeworm)
- Nematode worms body is cylindrical, bilateral symmetrical, triploblastic and pseudocoelomate. They are usually parasitic, e.g, Ascaris.
- Annelida, are triploblastic, bilaterally symmetrical with true coelom and found in diverse habitats. Segmentation and extensive organ differentiation is seen, e.g., earthworm and *Nereis.*
- Arthopoda, largest phylumof animal kingdom, have bilateral symmetry and segmented animals. These animals posses jointed legs and open circulatory system, e.g., butterfly, centipede, crab, spider.
- Mollusca, (snails and octopus) organism showing bilateral symmetry, soft body, open circulatory system and reduced coelom
- Echinodermata, includes spiny skinned organisms with calcareous skeleton. They are triploblastic, coelomates, marine and free living. Water vascular system is an important feature. Starfish and Holothuria are examples of this phylum.
- All chordates have notochord, dorsal nerve cord and paired pharyngeal gill slits/ pouches. Also they are triploblastic, coelomic and bilaterally symmetrical.
- Vertebrates and protochordates are grouped under chordata.
- Protochordata posses notochord at some stage or the other stage of life, e.g., Balanoglossus, Amphioxus.
- Vertebrata show true vertebral column and endoskeleton. Complex body organization and differentiation is seen.
- The five classes of vertebrates are Pisces, Amphibia, Reptilia, Aves and Mammalia.
- The endoskeleton in fishes may be cartilaginous or bony.
- Mammary glands produce milk in mammals to nourish the young ones.
- Binomial nomenclature developed by Carolus Linnaeus, use 2 names to identify an organism. The first name is the generic name and begain with capital letter whereas the second name is of species and begins with small letter.

SOME IMPORTANT DEFINITIONS

1.	Classification	The method of arranging organisms into groups on the basis of similarities and di
2.	Characteristics	A distinguishing feature of an individual or group.
3.	Evolution	A gradual and continuing process of change in body design of organisms,
4.	Biodiversity	The variety of life forms found in a particular region.
5.	Regions of mega diversity	Region rich in diversity of plants and animal life
6.	Habitat	The natural abode of an animal or plant
7.	Species	It refers to all organisms that are similar enough to breed and perpetuate.
8.	Saprophytes	Organisms obtaining their nutrients from dead and decaying organic material
9.	Lichens	Symbiotic association of certain fungi and blue-green algae
10.	Monocots	Plants with seeds having single cotyledon
11.	Dicots	Plants with seeds having two cotyledons
12.	Bilateral symmetry	Symmetrical of an organism along a central axis, so that the body is divided into equivalent right and left halves by only one plane.
13.	Radial symmetry	A type of symmetry having only one body axis, through which the body can be divided into multiple planes to give mirror image.
14.	Notochord	A long flexible rod shape support structure that runs along the back of the animal
15.	Nerve cord	A dorsal tubular cord of nervous tissue above the notochord of a chordate.
16.	Diploblastic animals	Animals having two primary germ layer i.e. ectoderm and endoderm in the embryo.
17.	Triploblastic animals	Animals having 3 primary germ layers i.e., ectoderm and endoderm in embryo.
18.	Ectoderm	The outermost germ layer of multicellular animals that develops into skin and nervous tissue
19.	Endoderm	The innermost germ layer of multicellular animals that develops into the lining
20.	Mesoderm	The middle germ layer that develops into muscle, bone, cartilage, blood and
21.	Acoelomates	Animals lacking a body cavity between their gut and body wall
22.	Coelom	A fluid filled cavity formed within the mesoderm, in which well develop organs
23.	Pseudocoelom	An internal body cavity of some primitive invertibrates, similar to a coelom,
24.	Coelenterons	The central gastrovascular cavity of a coelenterate animals
25.	Cold blooded organisms	Organisms whose body temperature varies according to the external environmental temperature
26.	Warm blooded organism	Organisms whose internal body temperature is dependent upon its metabolic processes and is maintained at as constant level
27.	Oviparous	Animals that lays eggs
28.	Viviparous	Animals giving birth to live young ones
29.	Binomial nomenclature	The scientific system of naming each species of organism with 2 names, a genus and a species name

NCERT SOLVED QUESTION

1. Why do we classify organisms ?

Ans. A large number of organisms exist on this earth. We cannot study such enormous biodiversity one by one i.e. studying variety of life forms individually is an impossible task. Hence, we make groups or categories of organisms depending upon their similarities and dissimilarities with other organisms. This allows an easier and systematic study of the life forms.

2. Give three examples of the range of variations that you see in life forms around you ?

Ans. (i) Life forms vary in their size – Some organisms are too small and cannot be seen with naked eyes like microorganisms while others are too big like the biggest animal which is the blue whale.
(ii) Number and type of cells – Some organisms have a prokaryotic cell like bacteria and that single cell performs all the required functions while others have eukaryotic cells organized into tissue, organ and even organ systems like human beings.
(iii) Mode of nutrition – Some organisms are autotrophic i.e. capable of making their own food eg plants while other organisms are heterotrophic i.e. they are dependent on other organisms for their food supply.

3. Which do you think is a more basic characteristic for classifying organisms?
(a) the place where they live. (b) the kind of cells they are made of. Why ?

Ans. The classification of organisms based on the place where they live is not quite convincing because other living in the same habitat they hardly share any other feature for example whales, corals, starfishes, octopus, fishes, sharks etc all are aquatic i.e. they live in water their appearance and all other features are very different. Therefore classification of organisms based on the kind of cells they are made of is more widely accepted. For such catergorisation organisms belonging to prokaryotic group will have a particular cell structure and functional pattern which will be different from the eukaryotic group

4. What is the primary characteristic on which the first division of organisms is made?

Ans. The primary characteristic on which the first division of organisms is made is the form and functions of that organism

5. On what bases are plants and animals put into different categories ?

Ans. On the basis of presence or absence of cell wall and their mode of nutrition plants and animals are put into different categories.

6. Which organisms are called primitive and how are they different from the so-called advanced organisms?

Ans. Such organisms that possess quite simple structure and body design also haven't changed much from their ancient sort of details even after long period of evolution on earth are called as the primitive organisms like bacteria who are still single celled and prokaryotic while advanced organisms have complex body design like trees and humans

7. Will advanced organisms be the same as complex organisms ? Why ?

Ans. Yes, we can say that the advanced organisms are the same as complex organisms because advancement has occurred due to the process of evolution where a group of simple organisms have changed themselves into the complex forms of life for better survival.

8. What is the criterion for classification of organisms as belonging to kingdom Monera or Protista ?

Ans. The criterion used for classification of organisms as belonging to kingdom Monera or Protista is their cell structure. Both Monerans as well as Protists are unicellular or single celled organisms but among monerans the cell is prokaryotic i.e. do not contain well defined nucleus while in protists the cell is eukaryotic i.e. have a well-defined nucleus.

9. In which kingdom will you place an organism which is single celled, eukaryotic and photosynthetic?

Ans. Kingdom Protista.

10. In the hierarchy of classification, which grouping will have the smallest number of organisms with a maximum of characteristics in common and which will have the largest number of organisms?

Ans. Smallest number of organisms with a maximum of characteristics in common will be Species while grouping with largest number of organisms with common characteristics will be the Kingdom.

11. Which division among plants has the simplest organisms?

Ans. Division thallophyta.

12. How are pteridophytes different from the phanerogams?

Ans. Pteridophytes do not produce seeds but develop naked embryos while phanerogams are seed producing plants like gymnosperms and angiosperms.

13. How do gymnosperms and angiosperms differ from each other ?

Ans. Gymnosperms -They are plants producing male and female cones. They develop seeds but those seeds are naked i.e. fruits are not formed.

Angiosperms : They are flowering plants hence produce flowers as reproductive organs. They develop seeds which are covered inside fruits i.e. fruit formation occurs.

14. How do poriferan animals differ from coelenterate animals?

1. Poriferans -
   - They bear pores on their body.
   - They have cellular level of body organization.
   - Mesoglea absent

2. Coelenterates
   - Pores are absent on body.
   - They have tissue grade of body organization
   - Mesoglea(body cavity) present.

15. How do annelid animals differ from arthropods ?

Ans. annelid
- Body cavity is true coelom
- Body segmented and segments are called annuli.
- Legs absent.
- Closed circulatory system.

arthropods
- Body cavity is haemocoel like in cockroach
- Body segmented into head, mesothorax and metathorax.
- Three pairs of legs present.
- Open circulatory system.

16. What are the differences between amphibians and reptiles ?

Ans. amphibians
- Body is soft and slimy without scales
- Fertilisation external and lay eggs in water.

reptiles
- Body is covered with scales.
- Fertilization internal and lay eggs on land eg turtles.

17. What are the differences between animals belonging to the Aves group and those in the mammalian group?

Ans. Aves

• They lay eggs from which young ones hatch out.

• Body is covered with feathers.

• Bones are hollow or pneumatic

Mammalia

•They give birth to the young ones.

• Body is covered with hairs.

• Bones are filled with bone marrow

18. What are the advantages of classifying organisms ?

Ans. Planet earth has huge biodiversity i.e. variety of life forms existing on earth. So, it becomes very difficult to study them individually. To cope up scientists have made groups of organisms based on their similarities and dissimilarities. Such catergorisation of organisms is known as classification which help us to study them easily and systematically.

19. How would you choose between two characteristics to be used for developing a hierarchy in classification ?

Ans. We would choose the characteristic related to their structure and function that will help developing a hierarchy from one level to the next level. Like arthropods are organisms with jointed appendages but among arthropods insects and spiders make to separate groups having peculiar characteristics to define them. Hence we can make the hierarchy in classification by selecting general to specific characteristics.

20. Explain the basis for grouping organisms into five kingdoms.

Ans. The basis for grouping organisms into five kingdoms is as follows :

a) The organisms are made of prokaryotic or eukaryotic cells.

b) The organism has a single cell in its body or is a multicellular life form.

c) The organism prepares its own food or is dependent on other for food.

21. What are the major divisions in the Plantae? What is the basis for these divisions?

Ans. Thallophyta-Plant body not differentiated into root, stem and leaf.

Bryophyta - Develop root like structures called rhizoids but lack vascular tissues.

Pteridophyta - Develop vascular tissue for conduction but lack seeds.

Gymnosperms - Develop naked sees and lack flowers.

Angiosperms- Develop seeds covered inside fruits and produce flowers.

22. How are the criteria for deciding divisions in plants different from the criteria for deciding the subgroups among animals?

Ans. Animals are classified into subgroups on the basis of their level of body organization (cellular, tissue, organ grade) and symmetry, body cavity and presence or absence of notochord etc. Which is not seen in plants.

23. Explain how animals in Vertebrata are classified into further subgroups.

Ans. Animals in Vertebrata are classified into further subgroups based on their development of nervous system, circulatory system, reproductive methods etc.