

Diversity in Living Organism

CLASSIFICATION

Biodiversity: The variety of living beings found in geographical area is called biodiversity of that area. Amazon rainforests is the largest biodiversity hotspot in the world.

Need for Classification: Classification is necessary for easier study of living beings. Without proper classification, it would be impossible to study millions of organisms which exist on this earth.

Basis of Classification:

Ancient Greek thinker Aristotle classified living beings on the basis of their habitat. He classified them into two groups, i.e. those living in water and those living on land. But his classification was too simple to justify inclusion of a particular organism into a particular group.

Some examples of scientific bases of classification are as follows:

Organization of nucleus: Nucleus may or may not be organized in an organism. On this basis, organisms can be divided into two groups, viz. prokaryotes and eukaryotes.

(a) **Prokaryotes:** When nucleus is not organized, i.e. nuclear materials are not membrane bound; the organism is called prokaryote.

(b) **Eukaryotes:** When nucleus is organized, i.e. nuclear materials are membrane bound; the organism is called eukaryote.

Number of cells: An organism can be composed of a single cell or many cells. An organism with a single cell is called unicellular organism. On the other hand, an organism with more than one cell is called multicellular organism.

Mode of Nutrition: On this basis, organisms can be divided into two broad groups, i.e. autotrophs and heterotrophs. An autotroph makes its own food, while a heterotroph depends on other organisms for food.

Level of Organisation: Even in case of multicellular organisms, there can be different levels of organization. When a cell is responsible for all the life processes, it is called cellular level or organization. When some cells group together to perform specific function, it is called tissue level of organization. When tissues group together to form some organs, it is called organ level of organization. Similarly organ system level of organization is seen in complex organisms.

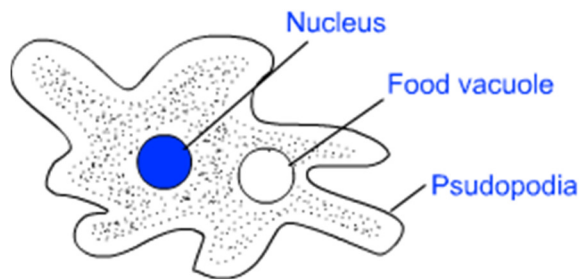
Classification and Evolution: It is a well established fact that all the life forms have evolved from a common ancestor. Scientists have proved that the life begun on the

earth in the form of simple life forms. During the course of time, complex organism evolved from them. So, classification is also based on evolution. A simple organism is considered to be primitive while a complex organism is considered to be advanced.

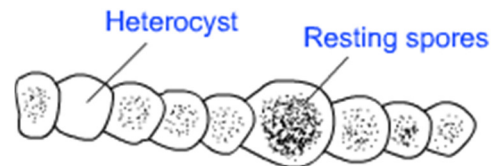
Five Kingdom Classification by Robert Whittaker (1959)

This is the most accepted system of classification. The five kingdoms and their key characteristics are given below:

1. **Monera:** These are prokaryotes; which means nuclear materials are not membrane bound in them. They may or may not have cell wall. They can be autotrophic or heterotrophic. All organisms of this kingdom are unicellular. Examples: bacteria, blue green algae (cyanobacteria) and mycoplasma.

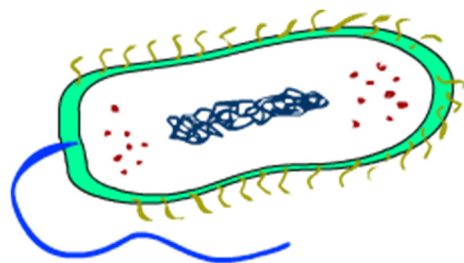


Amoeba

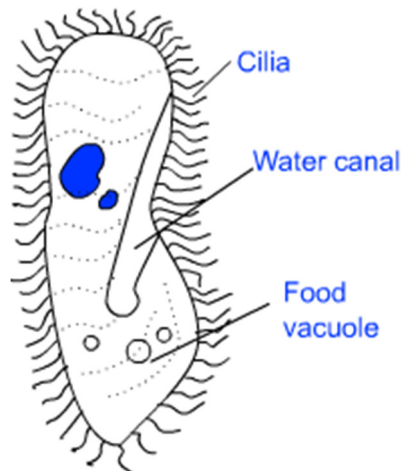


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2. **Protista:** These are eukaryotes and unicellular. Some organisms use cilia or flagella for locomotion. They can be autotrophic or heterotrophic. Examples: unicellular algae, diatoms and protozoans.



Bacteria



Paramecium

3. **Fungi:** These are heterotrophic and have cell wall. The cell wall is made of chitin. Most of the fungi are unicellular. Many of them have the capacity to become multicellular at certain stage in life. They feed on decaying organic materials. Such a mode of nutrition

is called saprophytic. Some fungi live in symbiotic relationship with other organisms, while some are parasites as well. Examples: yeast, penicillium, aspergillus, mucor, etc.

4. **Plantae:** These are multicellular and autotrophs. Presence of chlorophyll is a distinct characteristic of plants, because of which they are capable of doing photosynthesis. Cell wall is present.

5. **Animalia:** These are multicellular and heterotrophs. Cell wall is absent.

Kingdom Plantae:

The Plant Kingdom can be further classified into five divisions. Their key characteristics are given below:

1. **Thallophyta:-** The plant body is simple thallus type. The plant body is not differentiated into root, stem and leaves. They are commonly known as algae. Examples: Spirogyra, chara, volvox, ulothrix, etc.

2. **Bryophyta:-** Plant body is differentiated into stem and leaf like structure. Vascular system is absent, which means there is no specialized tissue for transportation of water, minerals and food. Bryophytes are also known as the amphibians of the plant kingdom, because they need water to complete a part of their life cycle. Examples: Moss, marchantia.

3. **Pteridophyta:-** Plant body is differentiated into root, stem and leaf. Vascular system is present. They do not bear seeds and hence are called cryptogams. Plants of rest of the divisions bear seeds and hence are called phanerogams. Examples: Marsilea, ferns, horse tails, etc.

4. **Gymnosperms:-** They bear seeds. Seeds are naked, i.e. are not covered. The word 'gymnos' means naked and 'sperma' means seed. They are perennial plants. Examples: Pine, cycas, deodar, etc.

5. **Angiosperms:-** The seeds are covered. The word 'angios' means covered. There is great diversity in species of angiosperm. Angiosperms are also known as flowering plants, because flower is a specialized organ meant for reproduction. Angiosperms are further divided into two groups, viz. monocotyledonous and dicotyledonous.

(a) **Monocotyledonous:** There is single seed leaf in a seed. A seed leaf is a baby plant. Examples: wheat, rice, maize, etc.

(b) **Dicotyledonous:** There are two cotyledons in a seed. Examples: Mustard, gram, mango, etc.

Kingdom Animalia:-

The animal kingdom is classified into different phyla. Their detail is given below:

1. **Porifera:** These animals have pores all over their body. The pores lead into the canal system. Water flows through the canal system and facilitates entry of food and exchange of other materials. The animal is not differentiated into tissues. The body is covered with a hard outer skeleton. These are commonly known as sponges. They are marine animals. Examples: Sycon, spongilla, euplectelea, etc.

2. **Coelenterata:** The body is made up of a coelom (cavity) with a single opening. The body wall is made up of two layers of cells (diploblastic). Some of the species live a solitary life while others live in colonies. Examples: Hydra, Jelly fish, Sea anemone, etc.

3. **Platyhelminthes:** The body is flattened from top to bottom and hence the name platyhelminthes. These are commonly known as flatworms. The body wall is composed of three layers of cells (triploblastic). Because of three layers, it is possible to form some organs as well. But a proper coelom is absent in platyhelminthes and hence proper organs are absent. They are free-living or parasitic animals. Examples: Planaria, liver fluke, tapeworm, etc.

4. **Nematohelminthes:** The body is bilaterally symmetric and there are three layers in the body wall. Animals are cylindrical in shape. A pseudocoelom is present and hence organs are absent. Examples: Roundworms, pinworms, filarial parasite (Wuchereria), etc.

5. **Annelida:** True body cavity is present in these animals. The body is divided into segments and hence the name annelida. Each segment is lined one after another and contains a set of organs. Examples: Earthworm, leech, etc.

6. **Arthropoda:** Animals have jointed appendages which gives the name arthropoda. Exoskeleton is present which is made of chitin. This is the largest group of animals; in terms of number of species. Circulatory system is open, which means blood flows in the coelomic cavity. Examples: cockroach, housefly, spider, prawn, scorpion, etc.

7. **Mollusca:** The animal has soft body; which is enclosed in a hard shell. The shell is made of calcium carbonate. Circulatory system is open and kidney like organ is present for excretion. The body has well developed muscular feet for locomotion. Examples: Snail, mussels, octopus, etc.

8. **Echinodermata:** The body is covered with spines, which gives the name echinodermata. Body is radially symmetrical. The animals have well developed water canal system, which is used for locomotion. Skeleton is made of calcium carbonate. Examples: Starfish, sea urchins, etc.

9. **Protochordata:** Animals are bilaterally symmetrical, triploblastic and coelomate. Notochord is present at least at some stages of life. Notochord is a long rod-like structure which runs along the back of the animal. This provides attachment points for

muscles. It also separates the nervous tissues from the gut. Examples: Balanoglossus, herdmania, amphioxus, etc.

10. Chordata: Animals have notochord, pharyngeal gill slits and post anal tail; for at least some stages of life. Phylum chordata is divided into many sub-phyla; out of which we shall focus on vertebrata.

Vertebrata:

The notochord is replaced by a spinal column during embryonic stage. Following are the main characteristics of vertebrates.

- Notochord present; which is replaced by spinal column.
- Dorsal nerve chord is present.
- Animals are triploblastic and coelomate.
- Animals have paired gill pouches.

Vertebrates are divided into two super classes, viz. pisces and tetrapoda.

A. Pisces: They are commonly known as fish. The body is streamlined. Muscular tail is present which assists in locomotion. Body is covered with scales. Paired gills are present; which can breathe oxygen dissolved in water. They are cold-blooded animals. The heart has only two chambers. They lay eggs. Fishes can be bony or cartilaginous. Shark is an example of cartilaginous fish. Rohu and katla are examples of bony fish.

B. Tetrapoda: Animals have four limbs for locomotion and hence the name tetrapoda. Tetrapoda is divided into four classes, viz. amphibia, reptilia, aves and mammalia.

(1) Amphibia: These animals are adapted to live both in water and land. Mucus glands on skin keep the skin moist. The animals breathe through skin when in water and through lungs when on land. The heart has three chambers. These are cold blooded animals. Examples: Frog, toad, salamander, etc.

(2) Reptilia: These animals show crawling movement for locomotion. Skin is hardened to form scales. Most of the reptilians have three chambered heart but crocodile has four-chambered heart. They don't need water to lay eggs, rather eggs are covered with hard shells and laid on land. Examples: snakes, lizards, crocodile, turtle, etc.

(3) Aves: The body is covered with feathers. Forelimbs are modified into wings. These are warm-blooded animals. The heart has four chambers. Bones are hollow (pneumatic); which assists in flying. All the birds belong to this class.

(4) Mammalia: The body is covered with hairs. Skin has sweat glands and sebaceous glands. Mammary glands are present in females and are used for nourishing the young ones. Most of the mammalians give birth to young ones and are called viviparous. Some of the mammals lay eggs and are called oviparous. Examples: human, chimpanzee, lion, platypus, horse, etc.

Binomial Nomenclature of Organisms:

The system of binomial nomenclature was proposed by Carolus Linneaus (1707 – 1778). Conventions of writing biological name are as follows:

- The biological name is composed of two terms. The first term is called genus name and the second term is called species name.
- The genus name starts with a capital letter, while the species name starts with a small letter.
- In print, the scientific name is written in italics.
- When handwritten, the genus name and species name need to be underlined separately.

Question: 1. Why do we classify organisms?

Answer:- There are millions of species on this earth. For anybody, it is impossible to study about each of them in his lifetime. Classification makes it easy to study the organisms; on the basis of certain common characters.

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

Answer:- Three examples of the range of variations in life forms:

- Ants, cockroaches, spiders, houseflies, etc. live in the same building. They look entirely different from each other yet all of them belong to arthropoda.
- Humans, monkeys, cats and dogs lives in the same neighbourhood. They look entirely different yet all of them belong to mammalia.
- A nearby park may show wide variety of plants; right from small grass to a giant banyan tree.

Question: 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?

Answer: The kind of cells an organism is made of is more basic characteristic of classifying organism because it gives a scientific angle to classification. Moreover, a particular dwelling place can be full of organisms of a wide variety.

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

Answer: Organisation of nucleus is the primary characteristic on which the first division of organisms is made. Based on this, organisms can be either prokaryotic or eukaryotic.

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

Answer: Plants are autotrophs, while animals are heterotrophs. Cell wall is present in plant cells, while it is absent in animal cells. Plants do not need to move from one place to another, while most of the animals need to move in search of food.

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

Answer: An organism which is simple is called primitive. On the other hand, an organism with high level of division of labour; by formation of organs and organ system is called advanced.

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

Answer: Complexity in body design evolves because of necessity to adapt according to the changing environment. Hence, a complex organism would be an advanced one; in comparison to a simple organism.

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

Answer: Organisms which are prokaryotes belong to the kingdom Monera. On the other hand, organisms which are eukaryotes and unicellular belong to the kingdom Protista.

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

Answer: Plant Kingdom

Question: 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?

Answer: Species will have the smallest number of organisms with a maximum of characteristics in common. On the contrary, kingdom will have the largest number of organisms.

Question: 11. Which division among plants has the simplest organisms?

Answer: Thallophyta

Question: 12. How are pteridophytes different from the phanerogams?

Answer: In pteridophytes, the reproductive organs are hidden and they do not produce seeds. In phanerogams, reproductive organs are conspicuous and they produce seeds.

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

Answer: Seeds are naked in gymnosperms, while they are covered in angiosperms. Gymnosperms do not bear flowers, while angiosperms bear flowers.

Question: 14. How do poriferan animals differ from coelenterate animals?

Answer: In porifera, body has numerous pores, which are absent in coelenterates. Body has a cavity in coelenterates, while it is absent in porifera.

Question: 15. How do annelid animals differ from arthropods?

Answer: Segmented body in annelids, while true segmentation is absent in arthropods. Arthropods have jointed appendages, which are absent in annelids.

Question: 16. What are the differences between amphibians and reptiles?

Answer: Amphibians need water to lay eggs and fertilization is external. Reptilians do not need water to lay eggs and fertilization is internal. Amphibians use both skin and lungs for breathing. Reptilians breathe through lungs only.

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

Answer: In aves, body is covered with feathers; while in mammals, body is covered with hairs. Mammary glands are absent in aves. Forelimbs of aves are modified into wings which is not the case in mammals. Aves are oviparous, while most of the mammals are viviparous.

NCERT Exercise Solution

Question: 1. What are the advantages of classifying organisms?

Answer:- There are millions of species on this earth. For anybody, it is impossible to study about each of them in his lifetime. Classification makes it easy to study the organisms; on the basis of certain common characters.

Question: 2. How would you choose between two characteristics to be used for developing a hierarchy in classification?

Answer:- We need to look at the fact if given character is present in a small number of organisms or a larger number of organisms. In the first case, the commonality of characters would represent a species. In the latter case, the commonality of characters would represent a higher taxa; like genus, family, order or phylum.

Question: 3. Explain the basis for grouping organisms into five kingdoms.

Answer: Following points explain the basis of grouping organisms into five kingdoms.

Organization of nucleus: Organisms with unorganized nucleus are kept under the kingdom Monera. Those with organized nucleus are kept in other kingdoms.

Number of cells:- Unicellular eukaryotes are kept in the kingdom Protista, while multicellular eukaryotes are kept in other kingdoms.

Mode of nutrition and presence of cell wall: Heterotrophic organisms in which cell wall is present are taken under the kingdom fungi. Autotrophic organisms in which cell wall is present are taken in the kingdom Plantae. Organisms in which cell wall is absent are taken in the kingdom Animalia.

Question: 4. What are the major divisions in the Plantae? What is the basis for these divisions?

Answer: The major divisions of Plantae and the basis for these divisions are as follows:

- Thallophyta: Simple body design; with no differentiation into root, stem and leaves.
- Bryophyta: Body is differentiated into stem and leaf-like structures. Vascular system is absent.
- Pteridophyta: Body is differentiated into root, stem and leaves. Vascular system is present. Reproductive organs are inconspicuous. Seeds are not produced.
- Gymnosperms: Seeds are naked.
- Angiosperms: Seeds are covered.

Question: 5. How are the criteria for deciding divisions in plants different from the criteria for deciding the subgroups among animals?

Answer: In the plant kingdom, morphological characters are taken into consideration while deciding about the divisions. Morphology is the study of shapes and forms of various parts. In the animal kingdom, anatomical characters are taken into consideration

while deciding about subgroups. Anatomy is the study of various organs' design in animals.

Question: 6. Explain how animals in Vertebrata are classified into further subgroups.

Answer: Vertebrates are classified into further subgroups on following bases:

1. Pisces: The body is streamlined. Muscular tail is present which assists in locomotion. Body is covered with scales. Paired gills are present; which can breathe oxygen dissolved in water. They are cold-blooded animals. The heart has only two chambers. They lay eggs.

2. Tetrapoda: Animals have four limbs for locomotion and hence the name tetrapoda. Tetrapoda is divided into four classes, viz. amphibia, reptilia, aves and mammalia.
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 - c. Aves: The body is covered with feathers. Forelimbs are modified into wings. These are warm-blooded animals. The heart has four chambers. Bones are hollow (pneumatic); which assists in flying. All the birds belong to this class.

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and are called oviparous. Examples: human, chimpanzee, lion, platypus, horse, etc.