Chapter 1
Biodiversity and Classification

Living organisms

Prokaryote   Eukaryote

Unicellular

Monera   Unicellular   Multicellular

Protista

With cell wall   Without cell wall

Animalia

can photosynthesize   cannot photosynthesize

Plantae   Fungi
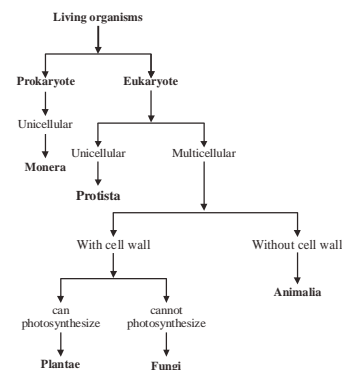
1.1   Biodiversity

We see different groups of organisms all around us sharing similarities and differences. For example, groups of animals include those like horses, dogs, cats etc. while plants would include neem, banyan, jamun, pomegranate, etc. If we compare the properties of each group, we would find that members of a group share more similarities amongst themselves than with members of other groups.

The members of these groups may be further grouped under even smaller groups such as groups of horses or dogs or cats or neem tree, dhatura, etc. If we compare the characters of each of these smaller groups, we would find that, the members share several similar properties which clearly separate them from the other smaller groups. These properties are found in the members of the group independent of the habitats around the world they might be living in. All the properties are specific to a group and the group that shares maximum similarities is usually called "species". Let us take the example of man: human species consists of groups that are present all over the world and have same characters like well-developed brain, sparsely distributed body hair, etc. We may say that these properties are specific to humans and separates them from members of other groups.

•   Discuss with your friends whether members of same species always share the same properties?

So far, we have discussed the similarities of members of the same species. Let us now study them and see whether we may also find some differences.

Activity-1
Observing neem plants

Collect two nearly similar neem plants from your surroundings. Observe them carefully and fill the following table-

Table 1

S.No.	Name of Plant	Length of Stem	Number of of Leaves	Shape and Size of Leaves	Colour of Leaves	Edge of Leaves	Venation
1	Neem plant -1						
2	Neem plant- 2						

- What differences did you observe in the similar looking neem plants?

Activity - 2

Observing Humans

This activity may be done in a group of at least 10 children. All information as in the table should be collected and noted.

Table 2

S.No.	Name of Student	Height	Weight	Length of Pointer Finger	Thumb Print	Palm	
						Length	Breadth

- Which of these properties were similar (at least in some individuals)?
- Which of these were different in all individuals?
- Could you find any two individuals of your class whose properties were exactly the same?

You will find that the thumb imprints of all your classmates differ. Thus, we may say that the thumb imprint is a specific character of an individual.

We can say on the basis of the above activities that species have similar as well as different characters. These differences are called "variations". Variations help us to identify individuals of a species. Due to these variations, we find different varieties of organisms in a particular area. The variety of organisms present in a particular area comprises the biodiversity of that area.

We shall need a schema of study, if we start by taking diversity as a basis to make a systematic and detailed study of all substances and organisms on earth (See page 281).

Let us try to understand this schema with the help of some examples.

1.2 Grouping and Classification

Activity- 3

We observe several types of things around us daily and categorize them differently to use them in different ways. For example, things used in the kitchen, things used for play, etc. You have been given a list of different things. Categorize them on the basis of their properties.

Plastic scale, book, pen, test-tube, wooden block, lens, plane mirror, piece of glass, piece of plastic, rubber ball, cricket bat, rope, needle, wooden scale, pencil.
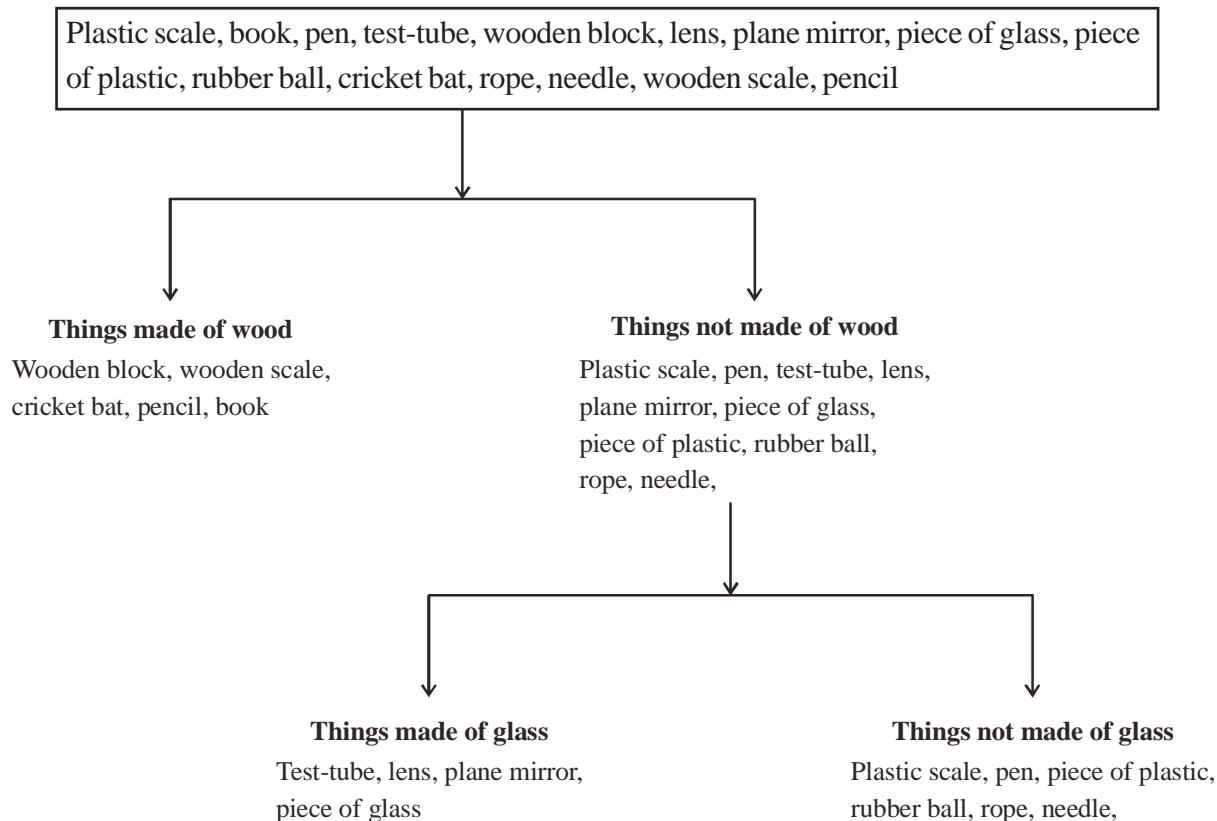
Table 3

S.No.	Name of Group	Things that fall under the group
1.	Wooden things	
2.	Cuboidal things	
3.		
4.		
5.		

• What are the different properties that you kept in your mind to form groups?

• In which group could you keep maximum objects together?

• On the basis of which specific property could you form a group with minimum of the given things?

You may have observed that certain properties are similar within a group. This property is considered as the character of the group. We could use a rubber ball, a cricket bat, a rope and a plane mirror to play. So, 'things used for play' could be a character of the group according to which they could be kept under the same group.

We choose several bases to identify the characteristic features of the things mentioned in the previous section. These could be shape of the thing, material of which the thing is made, its use, etc. In a similar manner, we can identify other bases using some other properties. Thus, the process of categorizing on the basis of a characteristic feature shared similarly by the members of a group is called as "grouping". In the process of grouping, an object can be present in two or more groups as it could have characteristic features related to two or more groups.

Another process of grouping of the things of the same list has been given here.

Plastic scale, book, pen, test-tube, wooden block, lens, plane mirror, piece of glass, piece of plastic, rubber ball, cricket bat, rope, needle, wooden scale, pencil

Things made of wood
Wooden block, wooden scale, cricket bat, pencil, book

Things not made of wood
Plastic scale, pen, test-tube, lens, plane mirror, piece of glass, piece of plastic, rubber ball, rope, needle,

Things made of glass
Test-tube, lens, plane mirror, piece of glass

Things not made of glass
Plastic scale, pen, piece of plastic, rubber ball, rope, needle,

Fig. 1: Classification of things

A special way of grouping has been followed here. At each level, grouping has been done on the basis of presence or absence of a character in such a way that members of one group do not belong to the other.Things are grouped into separate classes that are discrete while members of the same class share similar characteristic features. This form of grouping is called "classification".

Grouping and classification are used in all areas, whether they are the grouping or classification of elements, solutions, forces or living organisms. In this chapter, we shall study about grouping and classification by taking living organisms as examples. We shall come across other examples in the following chapters.

Now, let us try to see how different efforts towards grouping or classification had been carried out over time by observing the similarities and differences of living organisms.

1.3   Former attempts of grouping and classification

According to historical accounts we find that over a thousand years ago, Aristotle had made attempts towards grouping organisms on the basis of their habitat. Thus, he grouped organisms as those of land or water. Perhaps, other attempts had also been made towards grouping or classification; but, we have only a

few records available regarding the same. We find that around the year 1686, John Ray, an English naturalist tried to classify plants on the basis of their external structures. After John Ray, it was Linnaeus who tried to classify all plants on earth. His most important contribution is: the use of some specific observable characters like the presence of male and female parts and their number to prepare a simple schema of classification. It is called as sexual system of classification. The description of this system is given in his book 'Systemae Naturae' published in the year 1735.

Linnaeus made comparative study of several specimens of plants and animals that he collected. He developed such a schema of classification where species of plants and animals could be classified separately. The knowledge that Linnaeus acquired about the structures of animals and plants had a great impact on life sciences. According to his schema, the whole living world could be divided into two categories -Plant kingdom and Animal kingdom. Linnaeus first introduced hierarchy in his system. Organisms were arranged on the basis of their characters and developmental history in a definite sequence of groups. Like -

The Linnaean hierarchy for man is

Kingdom - Animalia (Multicellular, eukaryote, nutrition starts with ingestion of food)

Phylum - Chordata (vertebral column, paired appendages)

Class - Mammalia (hair on body, external ear)

Order - Primate (opposable thumb, 5 fingers each in fore and hind palm)

Family - Hominidae (Bipedal movement)

Genus - *Homo* (Well developed brain)

Species - *sapiens*

There were some limitations in the two kingdom classification system. Linnaeus classified organisms as either plants or animals, but several organisms were eventually found to express both animal and plant characters.

Do you know?

Euglena is such an organism that shows both animal and plant characters. It has chloroplasts, does not have a cell wall and acquires food both autotrophically and heterotrophically.

Chloroplasts

Euglena
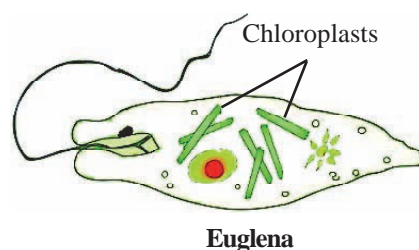
Linnaeus did not have the scope to study the internal structure of cells during his time. Thus, internal cellular structures did not find any place in his classification schema. It was much later when microscopes with higher magnification power were invented that variations in internal cellular structure also formed a basis of classification.

As the knowledge of internal structures of cells increased and new organisms discovered, the basis of classification was also modified. Different ways of classification started finding way. One such schema was suggested by R.H. Whittaker in the year 1969.

Whittaker classified the whole living world into 5 kingdoms. His classification was based on the following characters -

1.   The absence or presence of nuclear membrane (prokaryotic or eukaryotic)

2.   Level of organization (unicellular or multicellular)

3.   Process of acquiring nutrition (autotrophic or heterotrophic)

1.4   Whittaker's Classification

As compared to other former systems of classification, Whittaker's appears to be more developed. There is a better insight regarding biodiversity in this system. The entire living world has been divided into the following kingdoms:

1.   Kingdom Monera   2.   Kingdom Protista   3.   Kingdom Fungi

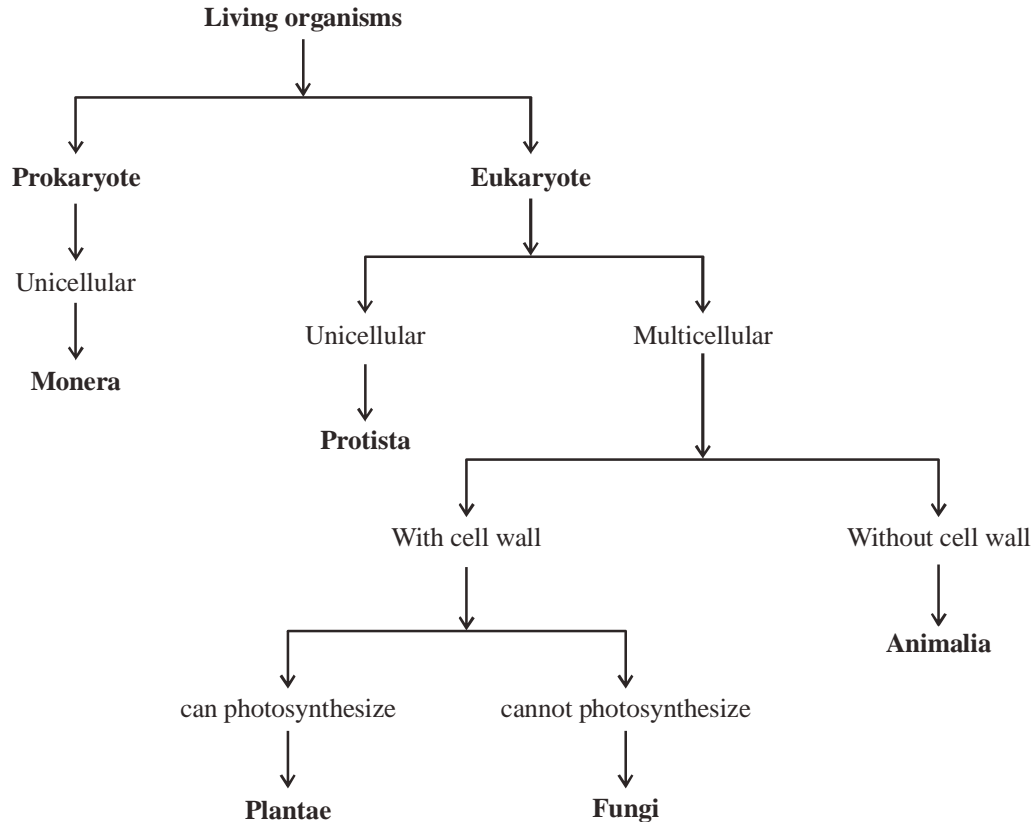4.   Kingdom Animalia   5.   Kingdom Plantae

**Fig. 2 : Five Kingdom Classification**

1.4.1 Kingdom Monera

1.   Unicellular organisms that lack a nuclear membrane or are prokaryotes are classified under this kingdom.

2.   Organisms may be autotrophic or heterotrophic.

3.   Cell wall is present around the cell membrane.

4.   Their cell wall is different from that of plants and is mainly made of peptidoglycan (a compound formed of protein and carbohydrate).
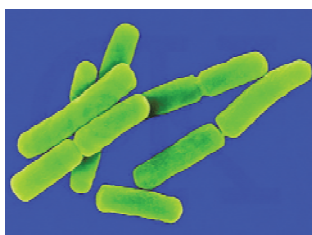
        Example: Bacteria, Cyanobacteria.

Do you know?

In a gram of fertile soil, we have around 100 crore and in a milliliter of milk we have 3000 crore of these organisms.
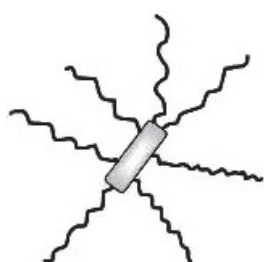
E. coli   Bacillus anthracis

(A) Bacteria   (B) Cyanobacteria (Anabaena)

Fig. 3

1.4.2 Kingdom Protista

1.   All organisms of this kingdom are unicellular with nuclear membrane around the nucleus or eukaryotic cells.

2.   Organisms can be both autotrophic or heterotrophic.

3.   All the life processes are carried out within the cell.

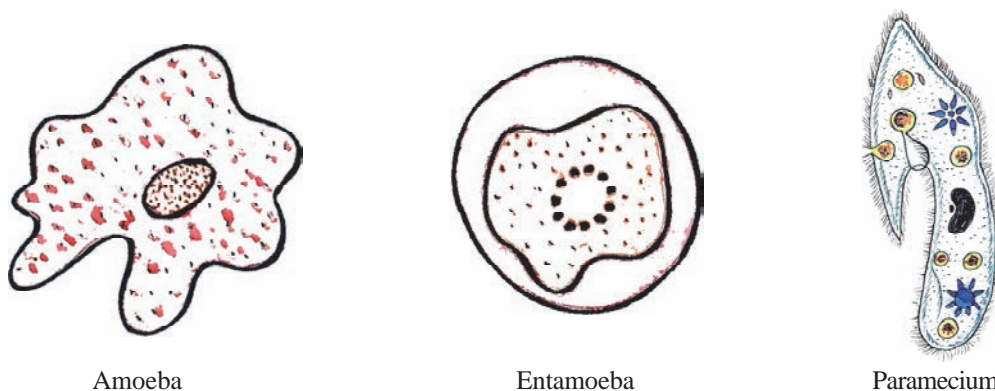   Example: Amoeba, Paramecium, Entamoeba, Euglena.

Amoeba   Entamoeba   Paramecium

Fig. 4

- Suggest a character on the basis of which Monerans can be distinguished from Protistants

1.4.3 Kingdom Fungi

1. Most fungi are filamentous. They form networks of filaments that are called mycelium.

2. Organisms of this kingdom are heterotrophic, unicellular or multicellular eukaryotic forms.

3. Chloroplasts are absent in their cells.

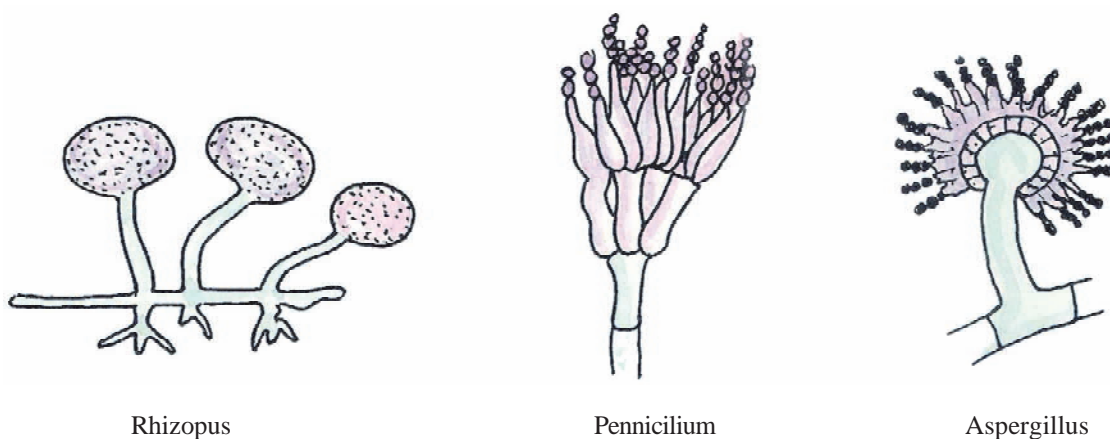   Example: Mucor, Yeast, Agaricus (Mushroom), Rhizopus(bread mould), Aspergillus, Pennicilium

Rhizopus   Pennicilium   Aspergillus

Fig. 5

You may have observed some filamentous hair like structures on rotting bread, in shoes during rainy season or sometimes over pickles (that was not preserved well). These structures are fungi. Mushrooms are a kind of fungi too. Fungi may be symbiotic, parasitic or saprophytic in mode of acquiring their nutrition.

Some fungi are harmful while some are useful. Some cause diseases while some are used in the production of certain food materials like the yeast, which is used in preparing bread and beer. Some fungi are also used to produce antibiotics.

• The growth of which organisms is arrested by keeping food in the refrigerator?

Do you know?

Lichens are formed of symbiotic associations of algae and fungi. They remain so closely associated that they appear as single organisms. Fungi use the food produced by algae through photosynthesis, while algae use the moisture and minerals absorbed by the fungi. Litmus is produced from a type of lichen.

Lichen

1.4.4 Plant Kingdom

1. All organisms of plant kingdom are multicellular, eukaryotic forms.

2. Most plants have chloroplasts in their cells, that help them to photosynthesize thus they are autotrophic.

3. These have a cellulosic cell wall.

Example: Spirogyra(Algae)*, Funaria(Moss)**, Fern***, Cycas, Date palm, Neem, Wheat

| Spirogyra | Funaria | Marchantia | Fern |

| Cycas | Neem | Coconut palm | Cactus |

Fig. 6

*Whittaker included multicellular algae in plant Kingdom. The body of algae cannot be differentiated into root, stem and leaves. During rainy seasons, we often find a shiny layer of scum along the sides of ponds and rivers and sometimes on wet floors. This layer is mainly algae. In local language this is called 'kai'.

**The body of moss can be differentiated into leafy structures and root like structures called as 'rhizoids'. Rhizoids help in drawing in water and minerals. These have been included under a group called Bryophyta. Other examples of this group are Riccia, Marchantia.

*** Try to find out ferns in your area. This belongs to the group Pteridophyta. The body of most plants of this group is like those of flowering plants; thus, their body can be differentiated into root, stem and leaves and they also have vascular tissue. These are usually non flowering plants and thus do not produce seeds. Marcellia is another example of this group.

Do you know?

Amarbel or Dodder is a member of the plant kingdom. This is a parasitic climber that wounds round a host plant. It does not contain chlorophyll. It acquires its food from the host plant. Dodder has a special type of root that helps to absorb food materials from the host plant.
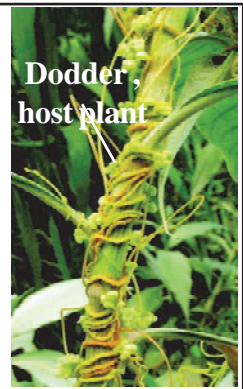
Classification of flowering plants (example of the Plant Kingdom.)
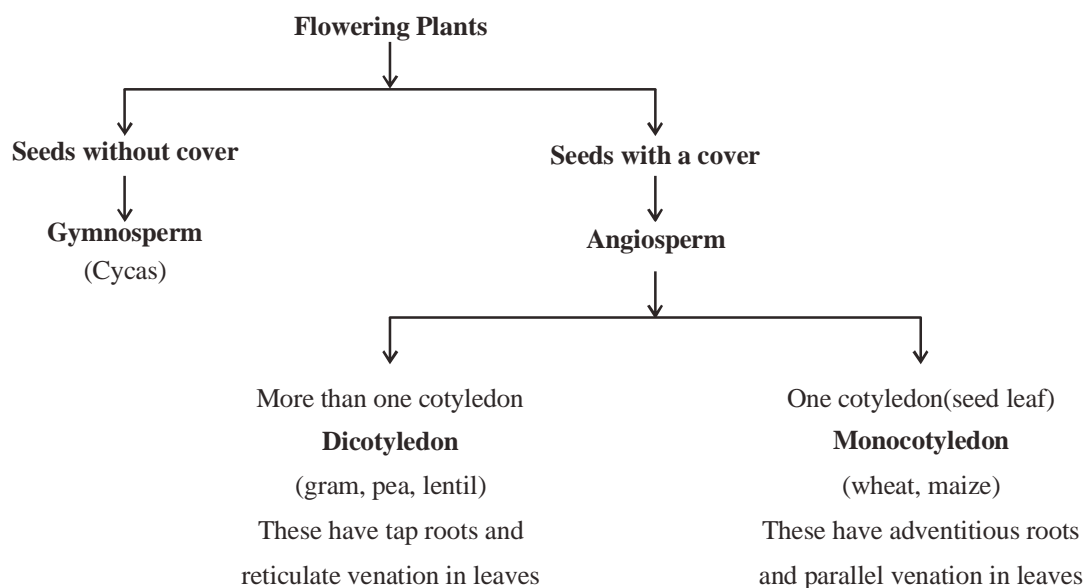
Fig. 7 : Classification of flowering plants

- Observe the leaves of some plants like mango, rice, mahua, grass, maize. What is the relation that you find in the type of root and venation of leaves?

1.4.5 Animal Kingdom

- Organisms of this kingdom are multicellular, eukaryotic, heterotrophic forms.

- These do not have a cell wall.

- These do not have chloroplasts.

- Mode of nutrition is mainly by ingestion. They have a specialized organ for intake of food. As for example butterflies have juice sucking tubes, humans have mouth, birds have beaks, etc.

- Most of the animals have specialized organs for movement (locomotion: movement in such a way that location changes).

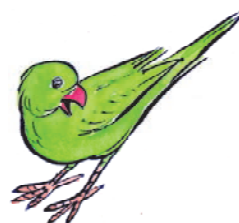   Example: Lion, mynah, fish, man, hydra, tapeworm, earthworm, mussel, scorpion, star-fish, etc.
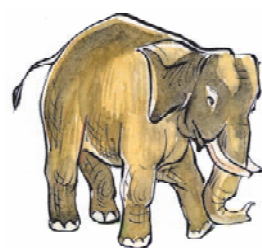
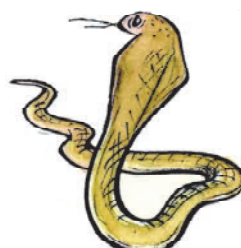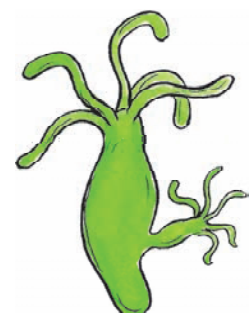|			
elephant	dragon fly	parrot	flatworm
leech	fish	snail	mussel
frog	snake	bat	hydra

Fig. 8

Following is an example of classification of animal kingdom considering only the vertebrates

Animal Kingdom

With vertebral column

Without vertebral column
Earthworm, leach, mosquito, snail, ant, tapeworm

Hair present on skin

Hair absent on skin

mammals
man, lion, cat, cow, bat

fish, amphibian, reptile, bird

Feathers present on skin

Feathers absent on skin

birds
mynah, parrot, crow, hen

fish

amphibian, reptile

Skin with moisture

Skin without moisture

fish

amphibian

reptile
lizard, snake, tortoise

Skin with scales

Skin without scales

fish
Rohu sp., Catla sp.

amphibian
frog, toad

Fig. 9 : Classification of Animal kingdom

•   Write a major difference between fishes and mammals.

1.5   Need and process of naming organisms

Naming is a process of assigning a proper place to an organism in the schema of classification.Thus an organism is assigned a specific name.

An object or a living organism is called by different names in different places due to the diversity in language. Like 'potato' is called as 'urullaikilanku' in Tamil, 'batata' in Marathi and aaloo in Hindi. Various names of the same object poses difficulty in identifying an object. Addressing this difficulty,Linnaeus suggested a system of naming living organisms that could be universally followed. This was a system of scientific naming according to him. According to this system, each organism would have a name comprising two words. This is the system of binomial nomenclature. In this system-

1.   The first word of the name would represent the genus while the second would represent the species.

2.   The first alphabet in the name of genus would be in capital letters while the rest would be in small letters. The name of species would be in small letters.

3.   Both the words in of the name are either underlined or written in italics.

The scientific name of some organisms is as follows-

Organism	-	**Scientific name**
Frog	-	*Rana tigrina*
Lion	-	*Panthera leo*
Sparrow	-	*Passer domesticus*
Man	-	*Homo sapiens*

Certain species are wiped out from earth while certain new ones appear. This process goes on continuously in nature. Thus, no schema of classification would be successful enough in including all species of organisms at a time. Even after Whittaker, there have been several other systems suggested for classification of living organisms. Thus, it is apparent that even the five kingdom classification cannot completely include the known forms of diverse organisms present on earth now. As more and more organisms would be discovered, the scope of biodiversity would expand and the basis of classification would change along with its system.

Keywords

Variations, biodiversity, grouping, classification, characters, species, genus, nomenclature

What we have learnt

*   Different types of organisms and substances are present on earth.

*   Categorizing things on the basis of their similar characters is called grouping.

*   Scientists have classified organisms on the basis of their similarities and differences.

*   Classification helps us to distinguish between different organisms.

*   Classification is essential for the study of different organisms easily, clearly and systematically.

*   Linnaeus divided the whole living world into two kingdoms (Plant and Animal).

*   Whittaker classified living organisms into 5 kingdoms on the basis of the following characters-

    1.   Absence or presence of nuclear membrane - prokaryotic and eukaryotic.

    2.   Organization of body of living organisms - unicellular or multicellular.

    3.   Mechanism of nutrition - Autotrophic or heterotrophic.

*   On the basis of the above characters the 5 kingdoms into which organisms are categorized are - 1.Monera 2. Protista 3. Fungi 4. Animalia 5. Plantae

*   On the basis of increasing complexity of organization of the body of organisms, they have been further categorized into different classes.

*   The hierarchy of organizing the classes depends upon the different characteristic features of living organisms.

*   Carolus Linnaeus proposed the system of binomial nomenclature in which the first word represents genus and the next the species.

*   The basis of classification and its system is bound to change due to the continuous extinction of species as well as their evolution into new forms.

Exercise

1.   Choose the correct option.

     (i)   In classification -

     (a)   Identifying characters is not essential

     (b)   Members of a class share maximum similarities

     (c)   Members of a class do not have similarities

     (d)   There is no basis

(ii)   A dicotyledonous plant is-

     (a) Onion   (b) Grass

     (c) Banana   (d) Mustard

(iii)   A character not similar to birds and fishes is-

     (a) Presence of body compartments   (b) Egg laying

     (c) Presence of vertebrae   (d) Presence of wings

2.   Fill in the blanks-

    (i)   It is important to select a basis for grouping and ....

    (ii)   Prokaryotic organisms are included in .... kingdom.

    (iii)   .... gave the 5 kingdom classification.

3.   Write two characteristic features of Kingdom Fungi that distinguish it from other kingdoms.

4.   Write two differences between amphibians and reptiles.

5.   Cell wall is found in organisms of kingdom fungi yet they are not included under plant kingdom. Why is it so?

6.   What is the basis of keeping snake and tortoise in the same group?

7.   Why do we need classification?

8.   What do you understand by binomial nomenclature? How do we write the names of organisms in this system? Give at least two examples.

9.   What are the similar characters of bats and rats?

10.   What is the basis of five kingdom classification? What are the kingdoms? Write in detail about them.

11.   "If the basis changes, the system of classification will also change." Justify this statement.