

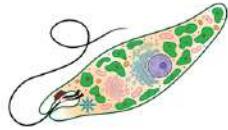
2

Classification of Living Beings

Look at the picture below and discuss the following questions:



Bacteria



Euglena



Mushroom



Fern



Frog

fig 2.1

- According to five kingdom classification, which kingdom do these organisms belong to?
- How are bacteria and Euglena different from each other?
- What could be the similarities and dissimilarities between a mushroom and a fern?
- On what basis, are ferns and frogs placed in plant and animal kingdom, respectively?

Environment is a home for microscopic organisms to giant organisms like blue whale, elephant, banyan, peepal, etc. On the basis of structure of cell, body structure, mode of nutrition, presence or absence of cell wall etc., Robert Harding Whittaker classified these organisms into the five kingdoms. Among them, we already discussed about kingdoms monera, protista and fungi in grade nine. Here, let's recall the main characteristics of the organisms that belong to those three kingdoms.

All the organisms that belong to monera have prokaryotic cell. Protista includes unicellular organisms whereas fungus consists of saprotrophic organisms that have cell wall but no chlorophyll.

Among the organisms given above, bacteria have prokaryotic cell. Euglena is a unicellular organism. Mushroom does not have chlorophyll. And it decomposes dead and decaying plants to derive its food. Fern is an autotroph because of the presence of chlorophyll but frogs are heterotrophs because they lack chlorophyll.

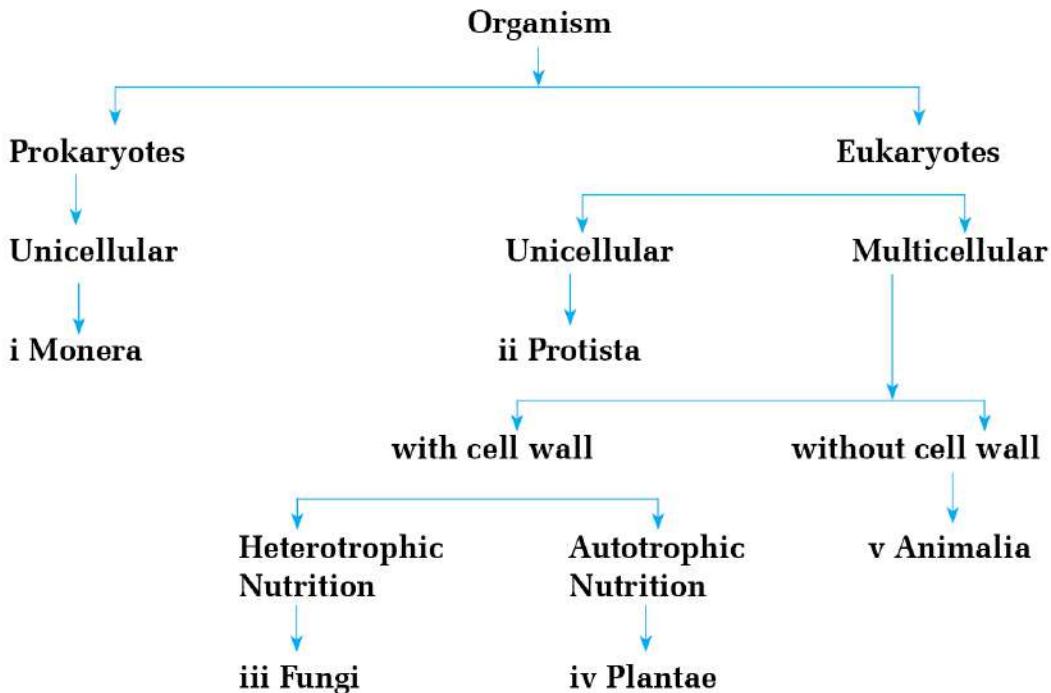


Figure 2.2 Five kingdom classification system

2.1 Plantae Kingdom

Look at the picture below and discuss the following questions:



Figure 2.3

- i. What are the similarities in the organisms shown in the picture?
- ii. In which kingdom do they belong?
- iii. What are the main features of the kingdom they belong to?
- iv. What are the differences between moss and fern?

Chlamydomonas, moss, fern, pine, pea, maize have green pigments called chlorophyll in their body. They belong to kingdom plantae that includes unicellular as well as multicellular green plants. Their cell wall is made up of cellulose. They are autotrophs. Some of these plants are flowering and some are non-flowering. On the basis of their structure, these plants are classified into three divisions: Algae, Bryophyta and Tracheophyta.

1. Algae

Activity 2.1 The study of Algae

Objective: To identify the characteristics of algae

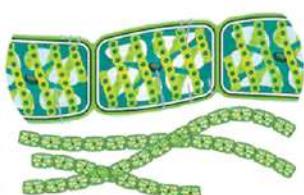
Materials required: Bottle, dropper, glass slide, cover slips, and compound microscope

Method

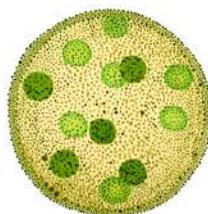
- i. Collect water with algae in a bottle from a nearby pond or a damp marshy place.
- ii. Put a drop of water along with algae on the slide with the help of dropper.
- iii. Cover the algae with a cover slip.
- iv. Observe the slide under microscope.
- v. After observing, draw a diagram to show the structure of the algae.
- vi. Based on the observation, discuss the characteristics of the algae.

Conclusion

Observe the given picture and identify their characteristics.



Spirogyra



Volvox



Fucus

Figure 2.4

In plants -Spirogyra, Volvox, Fucus etc. shown in the picture, root stem and leaf cannot be differentiated. Their plant body is called thallus. Their cells contain cell wall and chlorophyll. These plants belong to division algae. Characteristics of the plants under this division are as follow:

- They are either unicellular or multicellular.
- They are autotrophs due to the presence of chlorophyll. They prepare and store food in the form of starch.
- Their cell wall is composed of cellulose.
- They reproduce both sexually and asexually.
- These plants are found in pond, river, sea and marshy places.

Example: Chlamydomonas, Volvox, Spirogyra, Ulothrix, Fucus etc.

2. Bryophyta

Activity 2.2 Observation of the moss

Objective: To identify the characteristics of bryophyta.

Materials required: moss, needle, chart paper

Method

- Take a moss plant.
- Observe its various parts and identify them.

- iii. Note its features based on the observation.
- iv. Draw its neat diagram on a chart paper based on observation.
- v. Browse the internet and find out its other characteristics.
- vi. Present the characteristics of bryophyta in your class on the basis of internet research and direct observation of the moss.
- vii. Based on the discussion, make a list of characteristics of bryophyta.

Conclusion

Look at the picture below and identify their characteristics.



Marchantia



Moss



Riccia

Figure 2.5

Plants such as Marchantia, moss, Riccia shown in the picture are more developed than algae. They are green plants. Plant body of Marchantia is thallus but plant body of moss is differentiated into rhizoid, stem, and simple leaf. These plants are found in moist and shady places. Plants under bryophyta need water for fertilization. So, they are also called amphibian plants. General characteristics of plants under bryophyta are as follows:

- a. They are multicellular plants.
- b. They are autotrophs.
- c. Plant body is either thallus or differentiated into rhizoid, stem and simple leaf.

- d. They are found in moist and shady places.
- e. These plants are dioecious and plant body is gametophyte. Male plant produces male gamete in antheridium. Female plant produces female gamete in archegonium. Hence, this phase is called gametophyte. The male gamete is released from antheridium and reaches the archegonium through water, where it fuses with the ovum to form a zygote. Then, zygote germinates and develops into a sporophyte. In this phase, the spore mother cell divides by meiosis to form haploid spores. This phase is called the sporophyte phase because spores are produced here.
- f. The phenomenon in which sporophytic and gametophytic generations come one after another to complete life cycle of a plant is called alternation of generation. The gametophytic generation is dominant and independent in the life cycle of these plants.
- g. They have no vascular tissue. So they grow up to few centimetres high or are found attached and spread on substratum.

Example: Marchantia, moss, Riccia, etc.

3. Tracheophyta

Observe the picture below and discuss their structure and characteristics



Figure 2.6

Plant body of fern, Cycas, banana, peepal etc. shown in the picture is differentiated into root, stem and leaf. They have xylem

and phloem as vascular tissue which perform transportation of substances throughout the body.

So these plants are under the division tracheophyta. Division tracheophyta includes non-flowering fern plant, small herbs, shrubs to huge and developed plants. On the basis of structure, plants in division tracheophyta are classified into three subdivisions: pteridophyta, gymnosperm and angiosperm.

A. Pteridophyta

Activity 2.3 Observation of the fern

Objective: To identify the characteristics of fern

Materials required: fern plant, chart paper, gum, etc.

Method

- i. Bring a rooted fern plant.
- ii. Observe its root, stem and leaves thoroughly.
- iii. Note down its characteristics based on observation.
- iv. Draw a neat diagram of fern plant on chart paper on the basis of your observation.
- v. Paste the chart paper on aboard and discuss its feature in the class.
- vi. Based on the discussion, prepare a list of characteristics of fern plant

Conclusion



Fern



horse tail



clubmoss

Figure 2.7

Root, stem and leaves are prominent in the plants like fern, clubmoss, horse tail and these plants do not bear flower. They have feather like leaves. Generally, their stem is in the form of rhizome which lies horizontally under the soil. General characteristics of the plants under the subdivision pteridophyta are mentioned below:

- a. They are found in moist and shady places.
- b. They have no seed but plant body is differentiated into root stem and leaf. Leaf is feather like; stem is under-developed in the form of rhizome and root is developed.
- c. They have developed vascular tissue like xylem and phloem.
- d. These plants have numerous brown spots on the lower surface of leaves which are called sori (singular: sorus). Inside the sorus lies sporangium (plural: sporangia) that produces spores. Some leaves may not contain sori. Leaf with sori is called sporophyll and that without sori is called tropophyll. Plant body is called sporophyte because it produces haploid spores.
- e. Spores fall on the ground by the rupture of sporangia which germinate into gametophytes named prothalli (sing., prothallus) under suitable condition. Gametophyte produces both male and female gametes.
- f. Their life cycle also shows alternation of generation. Sporophytic phase is dominant and lasts longer.

Plants like Fern, fiddlehead fern, Ground gooseberry, Lycopodium, Selaginella, Pteris etc. fall under this division.

B. Gymnosperm

Look at the pictures given below and discuss.



Pinus



Juniper



Cycas

Figure 2.8

- i. Do these plants bear flower?
- ii. Where can we find their seeds and what do they look like?
- iii. How are their leaves different from leaves of other plants?

Plants such as Cycas, Juniper, Pinus etc. are kept under flowering plants but they bear cones instead of flowers. They have naked seeds without fruits. So these plants are kept in the sub-division gymnosperm. Following are the characteristics of the plants under the sub-division gymnosperm:

- a. Incourse of evolution of plants, gymnosperms are the first plant to produce seed.
- b. They bear cones instead of flowers. Male and female cones are separate. So they are unisexual. Pollination takes place through wind.
- c. There is no ovary in cone and hence no fruits. Seed is naked.
- d. Their leaves are elongated and needle like.
- e. Stem is enclosed within thick bark.
- f. Shape of these plants is inverted cone like and hence they are called coniferous plants.
- g. The roots of these plants are spread far into the ground.

Example: Cycas, Pinus, Juniper, Himalayan yew, Himalayan cedar

C. Angiosperm



bamboo



soybean

figure 2.9

Plants such as soybean, bamboo, etc. are real flowering plants. They have seeds enclosed in fruit. Sothese plants are placed under subdivision angiosperm. General characteristics of plants kept under angiosperm are given below:

- They are most advanced plants of kingdom plantae.
- These plants are found everywhere in land and water.
- They have well developed root, stem, leaf, flower and fruit.
- They bear real flower and flower contains both ovary and ovule.
- Some plants are bisexual and some are unisexual.
- Pollination takes place through various medium such as wind, water, insects, animal.
- These plants contain seeds inside the fruit.

Orange, maize, banana, paddy, soybean, water hyacinth, Lemna, Pistia, etc. belong to this subdivision.

On the basis of number of cotyledons present in their seeds, angiosperms are grouped into two classes- monocotyledon and dicotyledon.

a. Monocotyledon

Activity 2.4

Observation of the maize plant

Objective: To identify the characteristics of monocotyledonous plant

Materials required: maize plant, chart paper, gum

Method

- i. Obtain a rooted maize plant.
- ii. Observe the root, stem, leaf, flower, fruit, and seed of the plant thoroughly.
- iii. Based on your observations, note down the arrangement of veins in the leaf, the type of root, parts of the flower, and the characteristics of the seed.
- iv. Draw a neat diagram of maize plant on chart paper.
- v. Paste the chart paper on the board and discuss the plant's characteristics in class.
- vi. On the basis of maize plant, you have studied, prepare a list of characteristics of monocotyledonous plant.

Conclusion



Barley



Figure 2.10

The leaves of the plants shown in the picture are slender and elongated. Veins are arranged in parallel. The roots of the plants are all equal and arise from the same place. So these plants are kept in the monocotyledon class. General characteristics of plants under this class are mentioned below:

- a. They have parallel venation in leaves.
- b. They have fibrous root.
- c. Usually, they have hollow stem. Nodes are prominent, at equal interval. From the node arise branch and leaf. The leaf base expands into a sheath covering the stem.
- d. Vascular tissues are xylem and phloem scattered within the stem.
- e. Floral parts are three or multiples of three in number.
- f. They have seeds enclosed in fruit. Seed consists of only one cotyledon.
- g. They are found both in land and water. Wheat, sugarcane, banana, barley, bamboo etc. belong to this class.

b. Dicotyledon

Activity 2.5 Observation of the gram

Objective: To identify the characteristics of dicotyledonous plant

Materials required: gram plant, soaked gram seed, chart paper, glue

Method

- i. Take a few soaked gram seeds in a bowl.
- ii. Take out a seed, remove its outer covering, and observe and note down the number of cotyledons in the seed.
- iii. Bring a rooted gram plant. If you do not find one, look for a gram plant on the internet.

- iv. Observe its roots, stems, leaves, flowers, fruits, and seeds.
- v. Based on your observations, note the arrangement of veins in leaves, the type of roots, parts of the flower, and characteristics of the seeds.
- vi. Draw a neat picture of gram plant on a chart paper based on your observations.
- vii. Paste the chart paper on the board and discuss the characteristics of the gram plant in your class.
- viii. On the basis of gram plant you have discussed, prepare a list of characteristics of dicotyledonous plants.

Conclusion



Figure 2.11

Plants shown in the picture, such as mustard, pea, orange, soybean, and bean, have broad and flat leaves. There is a mid-rib from which many veins and veinlets arise forming a network throughout the leaf blade. They have a prominent main root from which small root branches arise. Their seeds contain two cotyledons. So they are placed in the class dicotyledon. Dicotyledonous plants have following characteristics:

- a. These plants range from small shrubs to very large trees.
- b. They have a taproot system.
- c. The stem is solid, strong, and mostly woody. Nodes are present at unequal intervals.

- d. Vascular bundles are arranged in a ring-like form within the stem.
- e. Reticulate venation is found in the leaf. The stem is petiolated and leaf is either simple or compound.
- f. Seeds are enclosed within fruit. The seed consists of two cotyledons.

Soybean, mustard, pea, orange, mango, gram, beans, pumpkin, etc., belong to this class.

Activity 2.6 Classification of plants

Objectives: To classify plants

Materials required: Plants found in your locality, chart paper, glue

Method

- i. Collect small rooted plants from your locality.
- ii. Collect leaves of larger plants.
- iii. Observe the plants collected in student groups in the classroom.
- iv. Compare the roots, stems, and leaves of the collected plants and discuss in groups which plant falls into which division and class.
- v. Draw the classification chart of plant kingdom on chart paper and paste the plants properly according to their group on chart paper.
- vi. Now, paste the chart paper on the wall of the classroom.

Project work 2.1

Prepare herbarium by collecting various plants with their roots, stems, leaves, and flowers found in your locality.

2.2 Kingdom Animalia

Look at the picture of animals given below and discuss.



Sycon



Earthworm



Cockroach



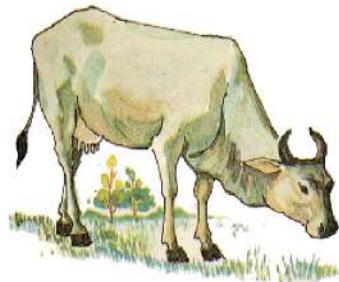
Starfish



Fish



Pigeon



Cow

Figure 2.12

- i. Which kingdom do these animals belong to?
- ii. Do they have cell wall in their cells?
- iii. Which animals have a vertebral column?
- iv. What differences are found in starfish and fish?
- v. What is the reason for placing all these animals in one kingdom?

All these animals have body made up of eukaryotic cells without cell walls. These animals are heterotrophs. Sycon, earthworms, cockroaches and starfishes have no vertebral column or backbone. But fish, pigeons, and cows have a vertebral column in their body. Various types of animals are found in this kingdom. These animals differ in their body structure, shape, forms, etc. Some animals possess an endoskeleton, while some animals' bodies are covered by hard exoskeletons.

Body structure is simple in some animals while all the systems are developed in the body of some animals. Some animals under this kingdom have no vertebral column in their body. They are called invertebrates. Animals having vertebral column are called vertebrates. According to the five kingdom system, among the animals in kingdom Animalia, the animals without a vertebral column are classified into eight phyla: Porifera, Coelenterata, Platyhelminthes, Nemathelminthes, Annelida, Arthropoda, Mollusca, and Echinodermata. Animals with a notochord and vertebral column are classified under the phylum Chordata. Hence, there are altogether nine phyla in the kingdom Animalia.

Porifera

Look at the pictures of animals given below and discuss:



Spongilla



Sycon



Euspongia

Figure 2.13

- i. Where can these organisms be found?
- ii. How can they perform nutrition and excretion?
- iii. How do they move from one place to another place?

Spongilla, Sycon, and Euspongia in the figure are multicellular organisms. They are found in marine water (sea). They have pores in their body. Water enters and exits the body through these pores. So these animals are kept in phylum Porifera. These

animals are also called poriferans or sponges. They are found attached on the substratum.

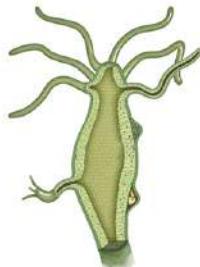
General characteristics of animals under this phylum are given below:

- a. They are the first multicellular organisms.
- b. Tissue is not developed in these organisms.
- c. Their body develops from two germ layers in the embryonic stage and hence, they are called diploblastic animals.
- d. They have pores in their body in which a larger pore is called osculum and smaller pores are called ostia. Water enters the body through ostia and exits through osculum which is called water canal system.
- e. They respire through the general body surface.
- f. Their adult forms are found attached to substratum.
- g. They have high regeneration capacity. When their body splits accidentally into pieces, each piece give rise to a new individual.
- h. They reproduce both asexually and sexually. Asexual reproduction takes place by budding and regeneration, and sexual reproduction takes place by the formation of gametes.
- i. Their bodies are radially symmetrical in some forms i.e. body is divisible into equal halves by any one of many longitudinal planes. They are mostly asymmetrical.

Animals such as Sponge, Leucosolenia, Hylonema, Cliona, etc., are grouped under this phylum.

Coelenterata

Look at the pictures of animals given below and make discussions:



Hydra



Jellyfish



Coral

fig 2.14

- i. What may be the function of appendages or outgrowths arising from the body of these animals?
- ii. How do these animals obtain their food?
- iii. What is the structure of the body of these animals?

The appendages or outgrowths arising from the body of Hydra, Coral, and Jellyfish shown in the picture are called tentacles. Tentacles help in feeding and movement. They have an internal hollow cavity in their body which is called coelenterons, and hence they are kept in the phylum coelenterata. General characteristics of the organisms under this phylum are given below:

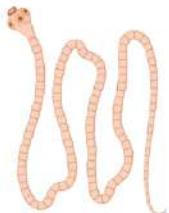
- a. Animals in this phylum are multicellular and diploblastic.
- b. They are the first tissue graded animals. They have an empty vessel-like hollow cavity inside the body called coelenteron. Coelenteron is also called gastrovascular cavity since it performs the functions of both digestion and transportation.
- c. They have a single opening of the alimentary canal, which is called the mouth. The mouth is surrounded by tentacles. Their feeding and locomotion take place by tentacles. Tentacles contain stinging cells or nematocysts which help to sting/kill and capture the prey.

- d. They respire through the general body surface.
- e. They reproduce both sexually and asexually. Asexual reproduction takes place by budding and regeneration method.
- f. They are found in ponds, lakes, and seas.
- g. Their bodies show radial symmetry.

Example: Hydra, Coral, Jellyfish, etc.

Platyhelminthes

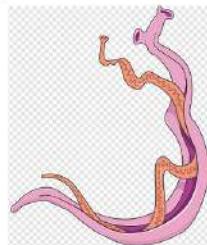
Observe the picture given below. If possible, Search the internet about these animals and discuss the following questions:



Tapeworm



Liverfluke



Bloodfluke

Figure 2.15

- i. What is the structure of the body of these animals?
- ii. Do they have a developed organ system?
- iii. Where are these organisms found?
- iv. What is their mode of nutrition?

The body of animals such as tapeworms, liverflukes, blood flukes shown in the picture is like the tape or flat leaf. Animals belonging to this group are mostly parasites. They get shelter in the bodies of other animals. These animals are classified under the phylum platyhelminthes. ‘Platy’ means flat and ‘helminthes’ means worms. Their general characteristics are:

- a. Shape of their body is flat leaf-like or long ribbon-like and hence they are called flatworms.
- b. Their body is developed from three germ layers in the

embryonic stage. So, they are triploblastic animals.

- c. At the anterior and ventral surface of their body lies mouth, but these animals are without anus. The mouth is surrounded by hooks that help them to attach to the host.
- d. A sucker is found around the mouth that helps to attach and absorb blood and nutrients from the host.
- e. They do not have well-developed organ system.
- f. The space between the body wall and internal organs is filled up with parenchyma tissue. It helps in transportation. There is no circulatory system.
- g. They respire through their general body surface.
- h. They have male and female reproductive organs in the same body, and hence they are called hermaphrodite or bisexual animals. Fertilization is internal.
- i. They reproduce both sexually and asexually. Asexual reproduction takes place by fragmentation and regeneration.
- j. They are mostly parasites and a few are free-living.

Examples: Liverfluke, Tapeworm, Diplozoon, Otoplana, Blood fluke, Planaria etc.

Nemathelminthes

Look at the picture given below and discuss the following questions.



Round worm



Hook worm



Pinworm

Figure 2.16

- i. Have you ever had roundworm (Ascaris) in your abdomen?
- ii. What is the structure of roundworm like?
- iii. Where are hookworms and pinworms found?
- iv. Do these animals harm the human body?

Ascaris, hookworms, and pinworms are parasites. They suck blood from humans and other animals. Their bodies are long, cylindrical and wormlike. They belong to Nemathelminthes. The characteristics of animals in this phylum are as follows:

- a. Animals under this phylum have elongated and cylindrical body with tapering ends.
- b. Their bodies can be divided into two equal halves which is called bilaterally symmetrical.
- c. They are triploblastic.
- d. They have a developed digestive system with mouth, anus, and sucker.
- e. Their respiratory system and circulatory systems are absent.
- f. They respire through their general body surface.
- g. They are unisexual.
- h. They reproduce by sexual methods only. Fertilization is internal.
- i. They are mostly parasites. Few are free-living organisms. Parasites cause disease in the body of other animals.

Example: Ascaris, Hook worm, Pinworm, etc.

Annelida

Activity 2.7

Objective: To identify the characteristics of phylum Annelida

Materials required: Earthworm, needle, forceps

Method

- i. Take an earthworm. Observe its structure thoroughly.
- ii. Note its characteristics.
- iii. For more information, search about earthworm in the internet and note the features.
- iv. Draw a neat diagram of earthworm on chart paper.
- v. Paste the chartpaper on the board and discuss characteristics of earthworm.
- vi. After the discussion, prepare a list of characteristics of phylum Annelida based on the study of earthworm.

Observe the picture of animals below and discuss their features.



Earthworm

Leech

Nereis

Figure 2.17

Animals such as earthworm, leech and Nereis are found in swampy or moist lands. Their bodies are elongated, cylindrical, and metamerically segmented. Earthworms are free-living and are found in moist soil. Leeches are ectoparasites, that are found in swamps. They suck blood from vertebrates. All these animals belong to the phylum Annelida. Characteristics of animals of this

phylum are given below:

- a. Their body is elongated, cylindrical and segmented both externally and internally.
- b. The body is bilaterally symmetrical and triploblastic.
- c. They have moist skin.
- d. They respire through their outer body surface.
- e. Excretion takes place through nephridia.
- f. The circulatory system is well-developed. Haemoglobin is found in their blood.
- g. The nervous system consists of a nerve ring and nerve cord with nerves.
- h. The digestive system is well-developed.
- i. Some of them are hermaphrodite and some are unisexual.
- j. They have a high regeneration capacity.
- k. They are found in moist lands, water, and some of them are ectoparasites.

Examples: earthworms, leeches, Nereis, etc.

Arthropoda

Look at the animals shown in figure or if possible, observe the specimens and discuss.



Butterfly



Crab



Prawn



Spider



Centipede

Figure 2.18

- i. What are the similarities in the body structure of these animals?
- ii. Where are these animals found?
- iii. What is the outer covering of their body made up of?
- iv. Why are these animals kept in phylum Arthropoda?

Butterflies fly from a flower to another with the help wings. Centipedes have many legs, prawns and crabs live in water. They have jointed legs. So, these animals belong to phylum arthropoda. This phylum is the largest one in the animal kingdom. Animals in this phylum have following characteristics:

- a. Their body is externally covered by a hard covering called exoskeleton which is made up of chitin.
- b. The body is bilaterally symmetrical, triploblastic, and segmented.
- c. Their body is divisible into the head, thorax, and abdomen. In some forms, the head and thorax are fused and called cephalothorax. The head bears a pair of compound eyes, paired antennae and mouth parts.
- d. Legs are jointed and arising from thorax.
- e. Generally, insects have two pairs of wings. But one pair of wings is present in some arthropods or sometimes wings are absent.
- f. Male and female are separate. They perform sexual reproduction.
- g. They breathe through their body surface, gills, or trachea. They are found in all types habitats like air water and land.

Examples: butterfly, bee, centipede, millipede, crab, spider, prawn, housefly, etc.

Mollusca

Look at the animals shown in figure or if possible, observe the specimens and discuss.

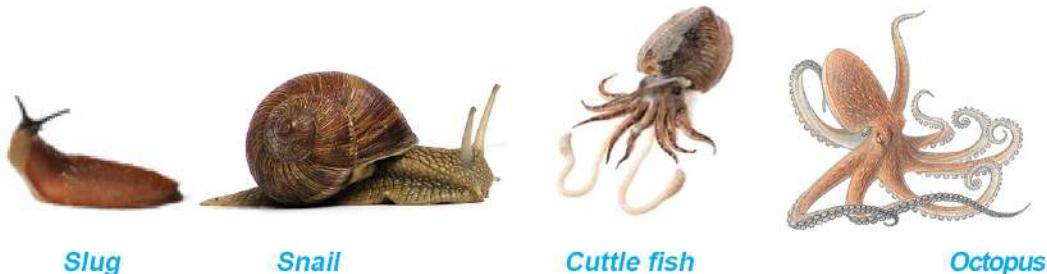


fig 2.19

- i. What is the function of the hard cover in the bodies of these animals?
- ii. How do these animals sense the presence of an enemy and hide themselves inside the covering?
- iii. How do they move?
- iv. Can their body be divided into two equal halves?

Slug and snail are found in damp soil. Octopus and cuttlefish are found in marine water. They have tentacles in their head. Tentacles are sensory in function and are used to detect surrounding stimuli. They also have muscular feet which are used for locomotion. So, these animals are grouped under the phylum Mollusca.

Following are the characteristics of this phylum:

- a. They are soft-bodied animals.
- b. Their body is divided into head, visceral mass, muscular feet, and mantle.
- c. Most of their body is covered with an exoskeleton made of calcium. They hide their body inside the hard exoskeleton when they touch an object.
- d. The head bears tentacles and eyes.

- e. Their body is asymmetrical which means body cannot be divided into equal halves by any means.
- f. Muscular feet help in swimming in water or gliding on the surface.
- g. They respire through the body surface, gills or pulmonary sac.
- h. The digestive system, circulatory system, and nervous system are developed.
- i. They are usually unisexual, but few are hermaphrodite or bisexual.

They are found in both land and water. Examples: slug, snail, octopus, cuttlefish, unio, etc.

Echinodermata



Starfish



Sea cucumber



Sea urchin

Figure 2.20

Animals shown in the picture are spiny skinned. They belong to the phylum echinodermata. Following are the characteristics of animals under this phylum:

- a. Their body is externally covered by hard calcareous (made of calcium carbonate) spines.
- b. Animals are of various shapes like globular, star-like, elongated and spherical.
- c. They do not have distinct head.
- d. They are triploblastic and radially symmetrical animals.

- e. They move with the help of tube feet.
- f. The digestive system is developed.
- g. They respire through gills.
- h. They are unisexual.
- i. These animals reproduce sexually.
- j. Regeneration is common in them.
- k. All the animals in this phylum are found in marine water or sea water.

Example: Starfish, Sea urchin, Sea cucumber, etc.

Project work 2.2 Collection and classification of animals

With the help of your teacher, form groups of students and collect small animals found around your school. Adopt precautions while collecting the animals. Follow the teacher's instructions. Carefully observe the collected animals. Classify them on the basis of external feature into different phyla. Prepare a report on it and present in the class room.

Phylum: Chordata

This phylum consists of the most advanced animals of animal kingdom. All animals bearing a notochord are classified in the Chordata phylum. Animals belonging to this phylum have the following characteristics:

- a. They have a developed, elastic, rod-like notochord between the nerve cord and alimentary canal at any stage of life.
- b. Paired lateral gill openings are situated on both sides of pharynx in the embryonic stage.
- c. A hollow, tubular nervous tissue is found in the vertebral canal.

- d. The skeleton is covered with muscles.
- e. They have a closed circulatory system.

Phylum Chordata is divided into four sub-phyla. They are Hemichordata, Urochordata, Cephalochordata, and Vertebrata. The first three subphyla are collectively called Protochordata since animals belonging to these subphyla are more primitive than the animals in Vertebrata. Here, we are going to discuss sub-phylum Vertebrata only.

Sub-phylum vertebrata

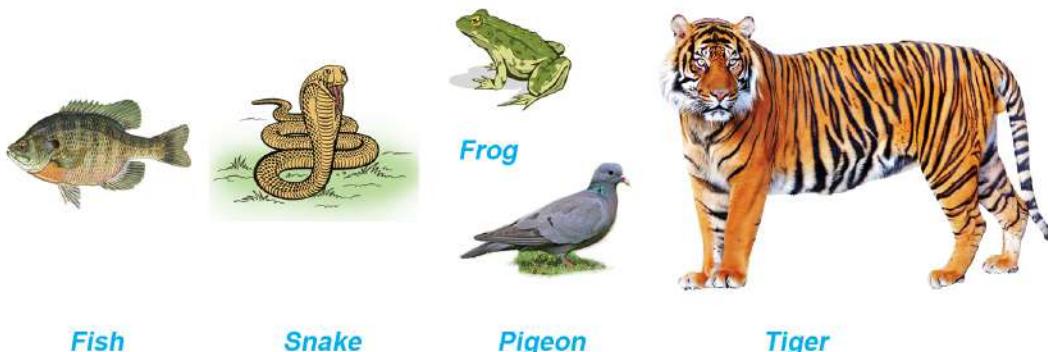


Figure 2.21

All the animals shown in picture have backbone or vertebral column. Animals having vertebral column are called vertebrates. Notochord developed in the embryonic stage of these animals is later replaced by vertebral column.

Fish, frog, snake, pigeon, whale, Bat, etc. are under the subphylum vertebrata. They have mostly similar features, however very few features are not common. Animals belonging to this sub-phylum have the following features:

- a. Their body is bilaterally symmetrical.
- b. The respiration takes place through gills or moist skin or lungs.
- c. The body temperature of some animals which are called

poikilothermic or cold blooded animals, changes according to the surrounding environment.

- d. The body temperature of some animals which are called homeothermic or warm blooded animals does not change according to the surrounding environment. They maintain their body temperature slightly higher than that of environment.
- e. They have well developed circulatory system. Number of heart chambers range from two to four.
- f. Some animals called oviparous give birth to their young ones by laying eggs while some animals called viviparous directly give birth to their young ones.

Based on their physical structure and development, animals in sub-phylum vertebrata are divided into five classes: pisces, amphibian, reptilia, aves, and mammalia.

Pisces

Activity 2.8: Observation of the fish

Objective: To identify the characteristics of Pisces

Materials required: fish, chart paper

Method

- i. Take a fish.
- ii. Observe its structure in detail.
- iii. With the help of your teacher, identify it's all organs.
- iv. Note its characteristics based on your observation.
- v. Draw a neat and labelled diagram of fish on chart paper.
- vi. On the basis of the study of fish, discuss the characteristics of pisces.



Sea horse



Fish



Shark

Figure 2.22

Animals shown in the picture belong to the class pisces. General characteristics of these animals are given follow:

- a. Their body is elongated, flat, and streamlined. Their bodies are covered by scales.
- b. Their body is divisible into head, trunk, and tail. The neck is absent.
- c. Gills are found on the lateral side of head. They help in respiration.
- d. They have paired and unpaired fins for locomotion.
- e. They have air sacs in their body.
- f. Their heart is two-chambered.
- g. These animals are poikilothermic.
- h. They are unisexual animals.
- i. They are mostly oviparous but few are viviparous.
- j. Most fishes perform external fertilization but internal fertilization is found in some fishes like sharks.
- i. They live in water. All fishes, sea horse, etc. belong to this class.

Amphibia

Activity 2.9 Observation of the frog

Objective: To identify the characteristics of amphibians

Material: Frog

Method

- i. Take a frog.
- ii. Observe its external structure thoroughly.
- iii. With the help of the teacher, identify its all organs.
- iv. Note its characteristics based on your observation.
- v. On the basis of observation of the frog, discuss the characteristics of amphibia.

Conclusion



Toad



Frog



Salamander

Fig.2.23

Toads, salamanders, and frogs live on land and water both. They belong to the class Amphibia. The characteristics of animals in this class are given below:

- a. Their body is covered by moist skin.
- b. Their body is divided into head and trunk. Tail is found in some amphibians.

- c. They have two pairs of limbs.
- d. They are poikilothermic.
- e. Their young ones are tadpoles that respire through gills. Adult forms respire through lungs and moist skin.
- f. They have a three-chambered heart.
- g. They are unisexual.
- h. These are oviparous and lay eggs in water. Fertilization is external.
- i. They need water for reproduction. Examples: frogs, toads, and salamanders,etc.

Reptilia

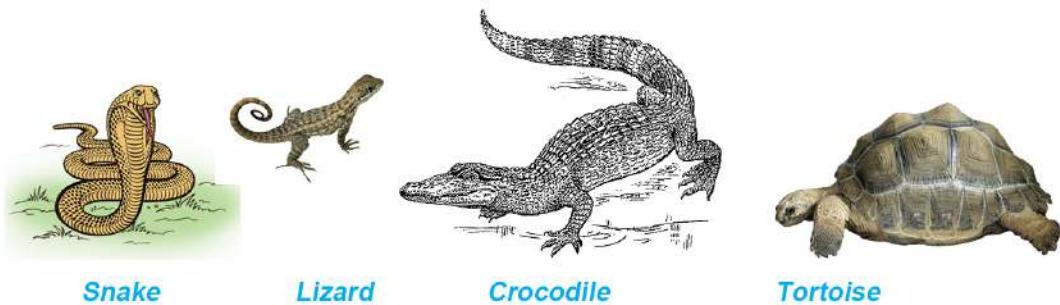


Figure 2.24

Animals such as snake, lizard, crocodile, tortoise, etc. crawl on the ground. So they are grouped in the class reptilia. Animals in this class have following characteristics:

- a. Their bodies are covered with dry and horny scales.
- b. Their bodies are divided into four parts: head, neck, trunk, and tail.
- c. They have two pairs of limbs which crawl on the ground for locomotion.
- d. These animals are poikilothermic.

- e. They respire through lungs.
- f. They have a three-chambered heart. But crocodiles have a four-chambered heart.
- g. They are unisexual. Fertilization is internal and they are oviparous.
- h. They are mostly found on land although some of them live in both land and water. The aquatic ones come to the surface of water for respiration.

Example: snake, garden-lizard, wall-lizard, crocodile, tortoise, etc.

Aves

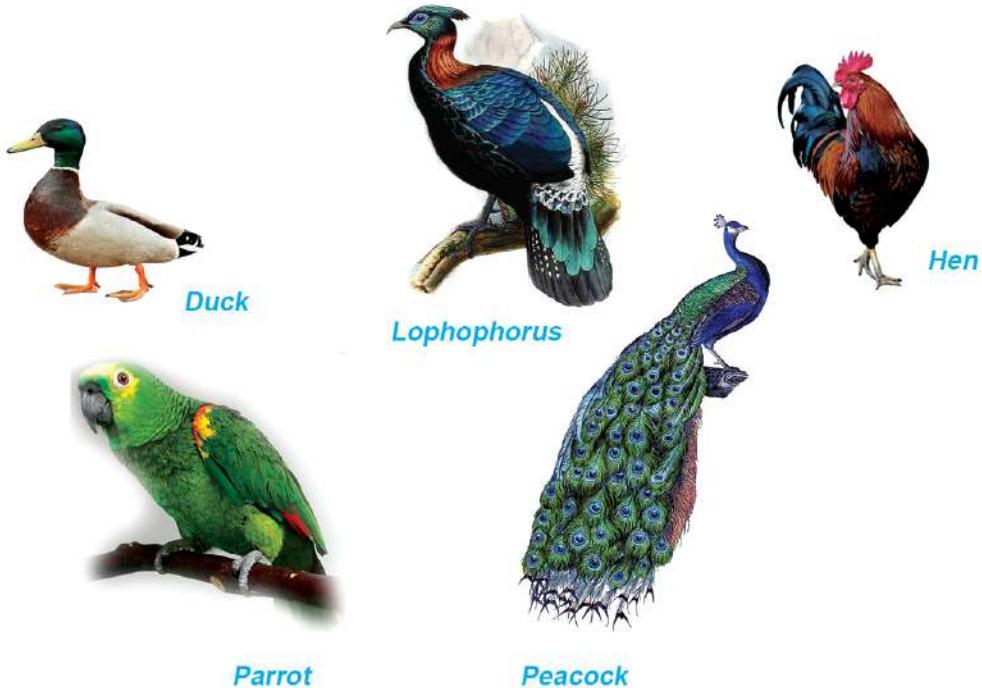
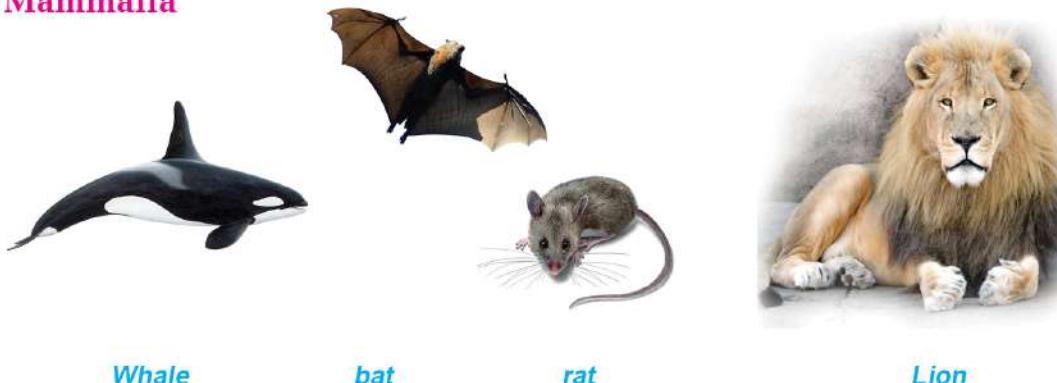


Figure 2.25

Fore limbs are modified into wings in parrot, lophophorus, peacock, duck, hen, etc. They have a beak. Their bodies are covered with feathers. So, these animals are grouped under the class aves. Their general features are given below:

- i. Their body is covered with feathers.
- ii. Body is divisible into head, neck, trunk, and tail.
- iii. They have two pairs of limbs in which the forelimb is modified into wings and the hind limbs are used for walking.
- iv. They have hollow pneumatic bones in their bodies which make their bodies lighter for flying.
- v. These animals are homoeothermic.
- vi. They breathe through lungs.
- vii. They have a four-chambered heart.
- viii. They are unisexual. Fertilization is internal and they are oviparous.
- ix. These animals have air sacs inside their bodies. They live on land, and they can fly. Example: parrot, lophophorus, peacock, duck, hen, etc.

Mammalia



Whale

bat

rat

Lion

Figure 2.26

Animals shown in the picture such as rat, bat, lion etc., have body covered with hair. They give birth directly to young ones and suckle milk to their babies. All of them belong to the class mammalia. Animals under this class have following characteristics:

- a. Their body is covered with hair.
- b. Generally, their body is divided into head, neck, trunk, and tail.
- c. They have developed mammary glands.
- d. They breathe through lungs.
- e. These are homeothermic.
- f. They have a four-chambered heart.
- g. They are unisexual. Fertilization is internal. They are viviparous.

Human, horse, whale, cow, etc., belong to this class.

Activity 2.10: Study of museum specimen of animals

Objective: To classify and identify the characteristics of animals

Material required: Specimens of animals in the science laboratory

Method

- i. Observe various animal specimen in the science laboratory.
- ii. Study their features.
- iii. Classify these animals on the basis of their features.
- iv. Prepare an animal classification chart on a chart paper. Fill in the chart with the name of the animals you observed.

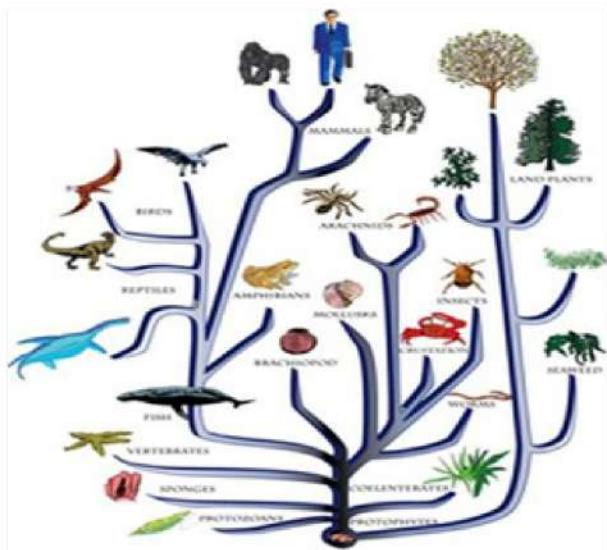


Fig. 2.27 Evolution of organism and classification

Relation of classification of living beings and evolution

Look at the given picture and discuss the following questions.

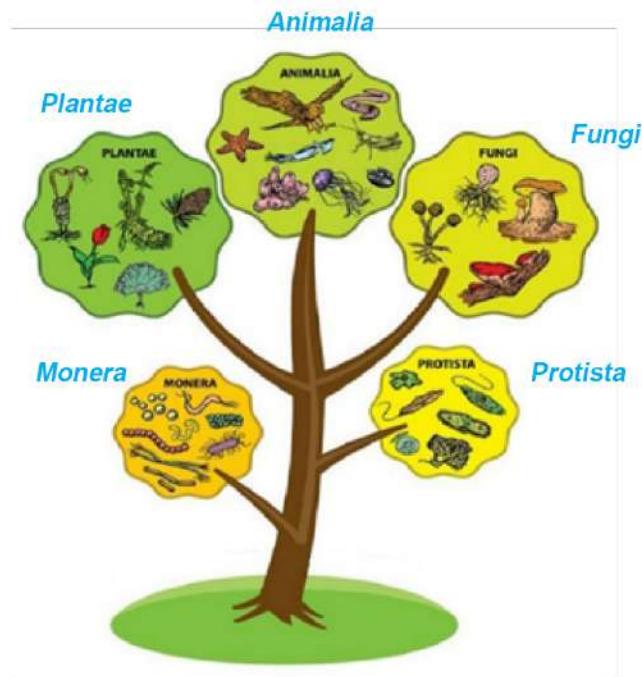


Figure 2.28 Classification of living being

- i. Which organisms do you think evolved earlier among the organisms under the protists and the organisms under the monerans?
- ii. The five kingdoms are shown in the tree diagram. Discuss the relationship between the evolution and classification of living beings based on the given diagram.

When we study the basis of five kingdom classification, some kingdoms have many common features but a few of them have less common features. It indicates that all living beings have a common ancestry. Here, the common characteristics of all living beings is that their body is developed from a living cell.

Classification of living beings shows that prokaryotic organisms evolved first on the Earth, which are now in the kingdom Monera. Then, eukaryotic organisms evolved slowly, which are now in the Protista kingdom. During the course of evolution, other multicellular organisms like fungi, plants, and animals developed gradually.

Classification of living beings and evolution are separate disciplines of biology. Classification of living beings is the process of grouping them on the basis of their similarities and differences. Similarly, evolution is the process of gradual change of living beings from a simpler to a more complex form. Those animals which have many common features are kept in the same group in the classification of living beings. When we compare the animals of class Mammalia and Aves, they have a few common features. When we compare the animals of class Mammalia and Pisces, they have very few common features. It indicates that animals belonging to mammals underwent speciation from the same ancestor some years ago.

When we observe the animals within group vertebrates, pisces have two-chambered heart. Reptiles have three-chambered heart but aves and mammals have a four-chambered heart. It also indicates that advanced animals developed from less developed animals. Classification of living beings is possible because of such differences in the organisms.

What we know from the common features in pisces, aves and mammals is that the organisms belonging to these three classes evolved from the same ancestor many years ago. During the course of evolution, they developed new characteristics and, in this way, new organisms were formed. Here, aves are closer to mammalia than pisces. This means that aves and mammals appear to have diverged from a common ancestor only a few years earlier than pisces. Common features of pisces, mammalia and aves indicate that they were developed from a distant common

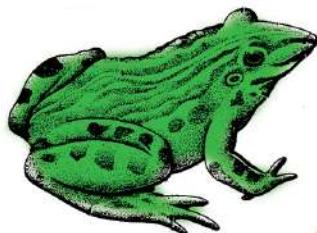
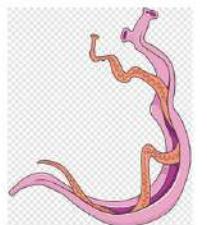
ancestor. In this way, if we study the characteristics of various phyla in the animal kingdom, we can find some similarities among them. It proves that all the organisms of the animal kingdom have common ancestry. In course of evolution, they advanced into various new forms.

Project work 2.3 Study the relationship between classification of living beings and evolution

Take a classification chart of living beings. Study the basis of classification in detail. Discuss with your friends the characteristics of animals of different groups in the chart. Identify their similarities and differences. Take the help of teacher and internet, if required. Based on your findings, prepare a short report on the relation between classification of living beings and evolution. If possible, prepare a powerpoint presentation of the report and present it to the class.

Exercise

1. Choose the correct options for the questions below.
- What are the main features of organisms under kingdom plantae?
 - Eukaryotic cell, cell with cell wall, heterotrophs
 - Eukaryotic cell, cell without cell wall, heterotrophs
 - Eukaryotic cell, cell with cell wall, autotrophs
 - Eukaryotic cell, cell with cell wall, saprotrophs
 - Why is Cycas kept in gymnosperm?
 - Bears flowers, produces seed.
 - Bears flowers, leaves are needle-like.
 - Bears cones instead of flowers, seeds are naked without fruit.
 - Bears cones instead of flowers, seeds are enclosed in fruit.
 - Two animals are shown here in figure. They belong to the same kingdom. Look at the figure and write the main reason for grouping them under the same kingdom.



- Multicellular and have various organ systems
- Multicellular and heterotrophic
- Multicellular and parasitic
- Multicellular and oviparous

- d. Based on evolution, which of the following groups of organisms are closely related?
- Porifera, Annelida, Chordata
 - Porifera, Arthropoda, Chordata
 - Coelenterata, Arthropoda, Chordata
 - Platyhelminthes, Nemathelminthes, Annelida
- e. What is the main reason for classifying whales in the class mammalia?
- Respires through lungs
 - Vertebral column is found in the body
 - Viviparous
 - Gives birth and suckle milk to young ones
- f. Why are club mosses more advanced than the mosses?
- Clubmoss grows on the land.
 - Clubmoss is sporophyte.
 - Xylem and phloem tissue are found in clubmoss.
 - Sporophyte is dominant in alternation of generation.
- g. To which kingdom do organisms having cell walls belong?
- monera, fungi, animalia
 - fungi, plantae, protista
 - fungi, plantae, animalia
 - fungi, plantae, monera
- h. To which class do egg-laying animals with a four-chambered heart and body covered with feather belong?
- Mammalia
 - Reptilia
 - Aves
 - Amphibia

- i. Which of the following group of plants belong to angiosperm?
 - i. pinus, fern, pea
 - ii. juniper, maize, gram
 - iii. moss, maize, bean
 - iv. paddy, banana, mango
- j. Which division do the plants having vascular tissue belong to?
 - i. Sporophyta
 - ii. Gametophyta
 - iii. Tracheophyta
 - iv. Spermatophyta

2. Differentiate:

- a. Plant kingdom and animal kingdom
- b. Fish and star fish
- c. Jelly fish and cuttle fish
- d. Moss and club moss
- e. Pinus and peepal
- f. Fish and whale
- g. Dove and Bat

3. Give reason:

- a. Living beings need to be classified.
- b. Fucus and Marchantia look alike, but Fucus is classified as algae while Marchantia is classified as bryophyta.
- c. Gymnosperms do not bear fruit.
- d. Although a crocodile has a four-chambered heart, it belongs to the reptilian class.

- e. Although bats and whales have dissimilar characteristics, they belong to the same class.
- f. Riccia is an amphibian plant.
- g. Fern is not a flowering plant; Cycas bears flower like cone but no fruit; banana bears flower and fruit. However, all these plants are kept in the same division.

4. Answer the following questions.

- a. Into how many divisions are the organisms in plant kingdom divided?
- b. Write the main features of kingdom plantae.
- c. Write the similarities of plants which belong to gymnosperm and angiosperm.
- d. If you are given only the leaves of some plants in tracheophyta and asked to distinguish their subdivisions using the taxonomic knowledge you have acquired in class. Is it possible to do so? Give your arguments.
- e. What are the main characteristics of pteridophyta?
- f. Roshni observed only the flowers of new plant in her garden and concluded that the plant belongs to monocotyledon. Is observation of only the flowers a right way to identify monocotyledon? Give reasons.
- g. Two plants are shown in the picture. Observe both pictures and answer the following questions:



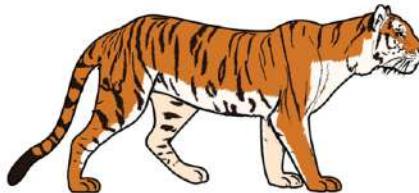
- i. Compare and write their similarities and differences.
- ii. Mention their subdivisions. Also write the reason for placing them in these subdivisions.
- iii. Which one of them is more advanced? Clarify with reasons.
- h. Following chart shows the group of four animals. In which group does fish belong to?

	<i>terrestrial</i>	<i>aquatic</i>
<i>invertebrates</i>	A	B
<i>vertebrates</i>	C	D

- i. Digestive system is not developed in the animals of phylum porifera. How do they digest food? Write.
- j. Rakesh saw an animal while he was playing in the ground. How can he identify the phylum of that animal by using taxonomic knowledge of kingdom Animalia? Explain.
- k. Shark and whale both live in water. Based on their features, which is more developed animal? Explain with reasons.
- l. Pictures of two animals are shown below, compare them and answer the following questions:



- i. In which phylum and class do they belong ?
- ii. Write any two similarities and dissimilarities between them.
- iii. How does the study of these animals clarify the concept of evolution?
- m. Explain the relation between classification of living beings and evolution.
- n. Draw a chart to show classification of kingdom plantae according to five kingdom system.
- o. Draw a chart to show classification of kingdom animalia according to five kingdom system.
- p. Look at the picture below and answer the following questions:



- i. Which animal has a two-chambered heart?
- ii. Which animal suckles milk to its young?
- iii. Write any two similarities between frogs and snakes.
- iv. Which of these animals have air sacs in their bodies?