



19

CLASSIFICATION OF LIVING ORGANISMS

Do you know that

- earth is the only planet in our solar system of eight planets on which life exists;
- living organisms derive most of their requirements for survival from the non living sources of earth;
- every organism begins life as a single cell;
- there are plants which eat insects;
- mushrooms that we relish as vegetarian food are fungi. Fungi are the group of organisms which subsist on dead and decaying matter;
- certain bacteria live in oceanic vents at temperatures as high as 80°C to 110°C.

Note the temperature at which you feel uncomfortable on a sunny summer day or an icy cold winter night and it will give you an idea of how high the temperature is at which these bacteria survive.

This lesson deals with the diverse kinds of organisms found on earth and the ways and means of studying this vast biodiversity. It also emphasizes the need for conservation of biodiversity.



OBJECTIVES

After completing this lesson, you will be able to:

- *recognize the vast diversity of living organisms in terms of variety of size and complexity;*
- *explain the meaning of biodiversity;*
- *describe the levels of biodiversity;*

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- *appreciate the need for classification of living organisms;*
- *justify the rationale underlying the five kingdom classification and the hierarchy in classification of living organisms;*
- *argue in favour of binomial nomenclature with examples;*
- *classify kingdom Plantae upto division; kingdom Animalia upto phyla and the chordates upto classes;*
- *become aware of and take steps towards conserving biodiversity.*

19.1 BIODIVERSITY

19.1.1 What is biodiversity

We find living organisms all around us, even deep under the oceans and in the snow covered Arctic and Antarctica. There are organisms which are single celled and microscopic, as well as animals as large as the elephant, the rhinoceros, the hippopotamus and the whale. Have you seen the movie “Jurassic Park” by Steven Spielberg? From the movie you get an idea of how huge the dinosaurs were which roamed the earth millions of years ago and then became extinct. Also if you were to take a drop of water from the nearby pond and view it under a lens you will be amazed to see the enormous variety of organisms moving about in that drop of water. You might be wondering how many kinds of organisms there would be on earth! It is estimated that about 10 to 15 million different kinds of organisms have been found on earth including the ones that lived in the past. However, scientists have till date identified only over two million of them.

The enormous variety of organisms is termed biodiversity (bios means life and diversity means variety). There is not only diversity in size among organisms but also in complexity. eg. bacteria are simple single celled organisms and humans are made of a trillion cells and are highly complex.

All organisms have come to exist on earth because of **evolution** and are related through ancestry. You shall learn about evolution and its mechanism in the next (Lesson 20) entitled ‘History of Life on Earth’. The humans are at the top of the evolutionary ladder. It is sad that lots of different kinds of organisms have been lost due to the impact of human activities. Therefore, we have to be conscious and aware so that damage to the earth on which we live along with other organisms, is avoided.



ACTIVITY 19.1

If you are a stamp collector, make an album or chart of stamps on animals and plants.



ACTIVITY 19.2

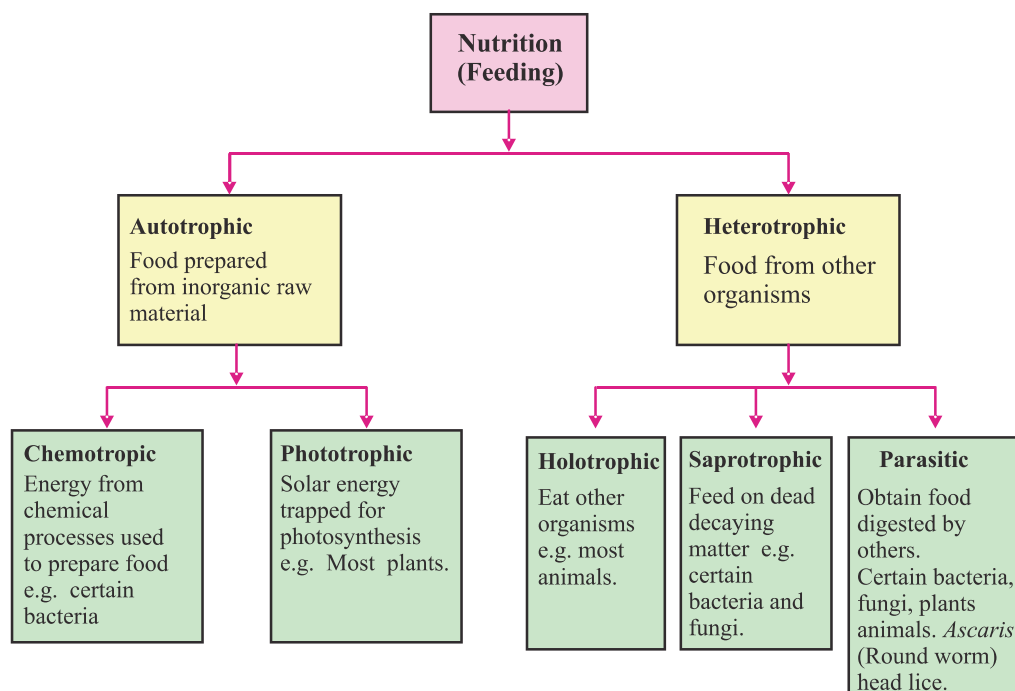
Some calendars are based on birds or wild animals. Collect the pictures from old calendars and make a scrap book.

Apart from variety of size and complexity, there is diversity in modes of feeding, reproduction and other body functions among organisms.



ACTIVITY 19.3

Prepare flow charts by using terms given below in brackets for diversity in reproduction and respiration. Diversity in feeding is given below as a sample:



Use the words given below to draw flow charts like the one given above depicting variety in reproduction and respiration.

Reproduction: Asexual, sexual, single parent, two parents.

Respiration: Oxygen from water, oxygen from atmosphere, Carbon dioxide into water, into atmosphere, gills, lungs, anaerobic, aerobic.

You may seek help of your friends and use other innovative ways of presenting the data.

Organisms live up to 8 km in air and up to 5 km below sea level. This part of the earth which supports life is the **biosphere**. Biosphere has diverse **ecosystems** such as the



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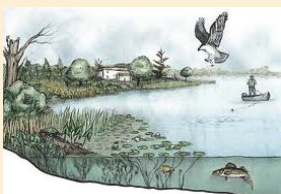
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pond, river, oceans, and mountains, deserts etc. Various kinds of organisms or different species live in these ecosystems. They interact with each other and also interact with the physical components of the ecosystem such as light, temperature etc.

Read the following table and perform the accompanying activities.

Table 19.1 Biosphere, ecosystem and species

Level of Organisation	Images/ pictures of each level	Diversity of features	Activity
Biosphere the physical part of earth on which organisms can survive	 Fig. 19.1a Earth as seen from space	Oceans, mountains, fresh water bodies, forests, snow clad areas, deserts and grasslands.	Obtain an outline map of the world and mark in different colours, the diverse components mentioned in the adjacent column.
Ecosystem Definite geographical region in which various species of organisms live and interact with each other and the physical environment	 Fig.19.1b Ecosystem	Oceans, mountains, rivers, ponds, forests, snow-clad areas, deserts etc.	Collect pictures or read from your geography book or see a website to record specific features of the ecosystems mentioned in the previous column.
Species Group of very similar organisms which can interbreed to produce fertile offspring.	 Fig. 19.1c Species	Different kinds of bacteria, protozoa, fungi, plants and animals	Collect pictures of humans belonging to different parts of the world. They look different. Why are they said to belong to the same species?

19.1.2 Levels of biodiversity

All the varieties of living organisms on earth constitute biodiversity. Three levels of biodiversity have been recognized:

1. Ecological/Ecosystem diversity

Organisms evolved features which helped them adapt to their surroundings or the ecosystems in which they live. There are different ecosystems and even related organisms living in different ecosystems may differ vastly from each other. For

example tortoises are terrestrial and turtles are aquatic. Both are related but differ much especially in their feet. **There is diversity of ecosystems**—terrestrial ecosystems include forests, plains, deserts and mountains and aquatic ecosystems are sea, river, pond etc. Organisms living in these have evolved suitable adaptations. India has very diverse terrestrial and aquatic ecosystems.



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2. Species diversity

Variety of species living in a certain geographical area constitutes species diversity. Individual organisms belonging to a particular species are similar and are able to undergo reproduction to produce fertile offspring. They cannot interbreed with another species. There is an enormous number of species of organisms as you have already learnt. It refers to the variety of genes contained within species of plants, animals and microorganisms. Can you say how new variations arise in an individual?

3. Genetic diversity

Organisms are made of cells and cells in their nuclei contain chromosomes which bear the genes. Genes control the features of a particular species. Genes of individuals belonging to the same species are similar. Every species has a gene pool. Gene pool means all the different kinds of genes found in a species. The gene pool of a species differs from that of another species.



Fig.19.2 Levels of biodiversity



ACTIVITY 19.4

Prepare a chart or flash cards or an album or a power point presentation to depict the three levels of biodiversity. You may use pictures, photocopies of illustrations, photographs, drawings, scanned pictures/photographs etc.

You may even make a model showing various levels of biodiversity.

19.1.3 Patterns of biodiversity

Global Scenario

The entire world is divided into six **biogeographic** regions (Fig. 19.3). The organisms found in these regions are adapted to the climate of these regions. Certain kinds of

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organisms are common to all regions while some are restricted to certain regions only e.g. elephants are found only in Asia and Africa and nowhere else in the world. Grass is found all over the world.

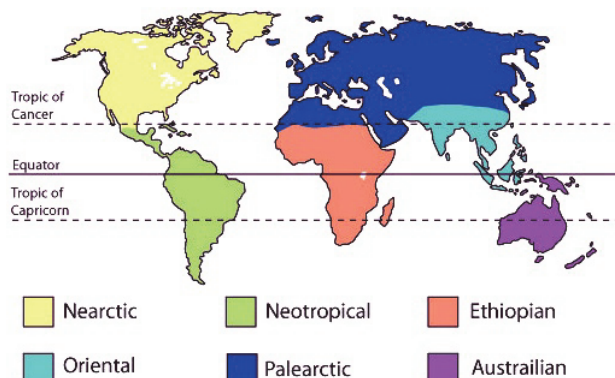


Fig. 19.3 The six biogeographic regions

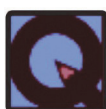
Indian Scene

India has two biodiversity 'hotspots'—the Western Ghats and North Eastern regions (including Eastern Himalayas). (Fig.19.4) '**Hotspots**' are regions of the world where many different kinds of organisms live. Many of these organisms are not found elsewhere e.g. Many species of frogs live only in the Western Ghats of India.

The flora and fauna are our heritage. We must conserve our biodiversity.



Fig. 19.4 Biodiversity Hotspots of India



INTEXT QUESTIONS 19.1

1. What does biodiversity mean?



2. Define (i) species, (ii) biosphere (iii) ecosystem.

3. Name the three levels of biodiversity.

4. What is meant by biodiversity hotspots?

19.2 CLASSIFYING AND NAMING ORGANISMS

How may this enormous diversity of living beings be studied and comprehended? This riddle has been solved by categorising diverse kinds of organisms and providing them with scientific names.

19.2.1 Classification of organisms

You have already learnt that about 10-15 million species are supposed to have evolved on the earth till now.

Try and calculate how much 10 million would be by adding zeroes after 10. Till now, approximately 2 million have been identified and named. How do scientists study and identify organisms? They do it by arranging organisms into groups and subgroups.

Grouping of organism according to similarities and differences is termed classification. When an organism is classified into various categories a hierarchy is maintained. Accordingly, an organism belongs to Kingdom, Phylum, Class, Order, Family, Genus and Species in hierarchical order. These are groups to which an organism belongs and which express its evolutionary relationship with other organisms.

Thus classification shows evolutionary relationships between organisms and is also termed Systematics. The science of classification or systematics is termed Taxonomy.

The scientific name of a human being is *Homo sapiens*. Humans are classified as follows:

Name of Group	Characteristic features of the groups into which humans are classified	
Kingdom Animalia	All animals (Multicellular, eukaryotic, heterotrophs)	
Phylum Chordata	Animals with notochord at some stage of life.	

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Subphylum Vertebrata	Animals possessing a back bone.	
Class Mammalia	Animals with mammary glands to provide milk for their young.	
Order Primates	Grasping hands and feet . Share the group with monkeys and apes.	
Family Hominidae	Group shared with primitive humans.	
GenusSpecies	<i>Homo sapiens</i>	

Homo sapiens means the wise hominid.

19.2.2 The Three Domains of Classification

All organisms are now classified into three major domains (Fig. 19.5)

Archaeobacteria are thermophilic or heat loving bacteria that live in high temperature vents.

Eubacteria are single celled organisms without well developed nucleus.

Eukarya are all other organisms with a well formed nucleus in their cell/cells. (Eu: true; Karyon : nucleus)

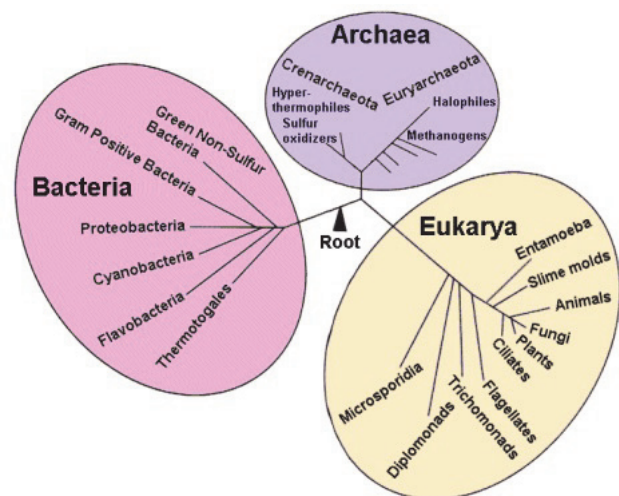


Fig. 19.5 The three domains of life

19.2.3 The Five Kingdoms of Life

Earlier there were only 2 kingdoms of plants and animals. Whittaker in 1969 suggested that bacteria should not be in plant kingdom and protozoa not in animal kingdom. He gave the five kingdom classification. Given below are the 5 kingdoms of life and their typical features.

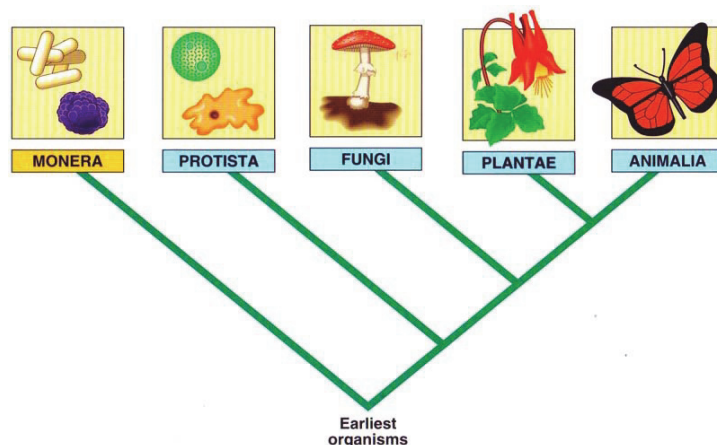
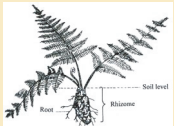


Fig. 19.6 The five kingdom of life

Table 19.2 The five kingdoms of life

Kingdoms	Pictures of examples	Name	Features
Kingdom I	 Fig. 19.7a Bacteria	Monera	Single celled, No well formed nucleus (Prokaryotes)
Kingdom II	 Fig. 19.7b Protozoa	Protoctista or Protista	Single celled with well formed nucleus (Eukaryotes)
Kingdom III	 Fig. 19.7c Mushroom	Fungi	Eukaryotes, multi-celled saprotrophs
Kingdom IV	 Fig. 19.7d Fern and Tree	Plantae	Eukaryotes, multicelled, autotrophs
Kingdom V	 Fig. 19.7e Earthworm and cat	Animalia	Eukaryotes, multicelled, heterotrophs

The kingdoms are further divided into divisions (as in bacteria, fungi and plantae) or phyla (as in Protoctista and Animalia). Every phylum includes several classes, Classes are divided into orders. Orders include families.

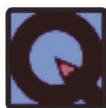
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A family is made up of many genera (singular: genus). Every genus includes several species. Species are segregated from their related species under the same genus through reproductive barriers. This means that members of one species cannot interbreed with members of another species to produce fertile offspring. See fig. 19.1c



INTEXT QUESTIONS 19.2

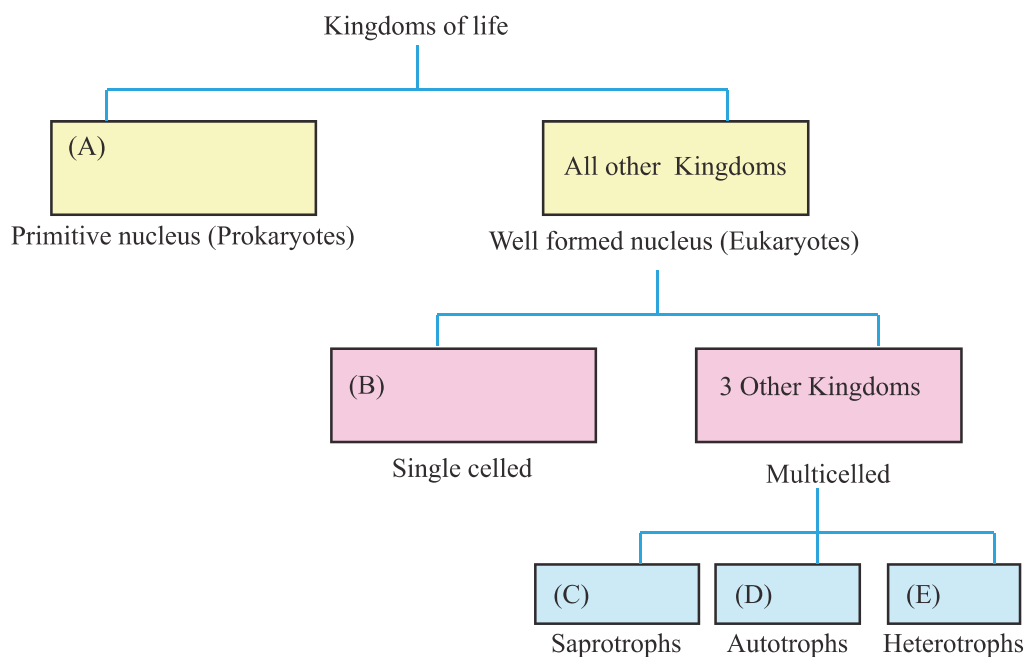
1. What is meant by classification?

2. How has classification made study of diversity possible?

3. Name the three domains into which all the organisms of the world are categorised

4. Name the five kingdoms of life and mention the three features on which this classification is based.

5. Study the table 19.2 on kingdoms of life and fill in the names of kingdom at A to E in the flow chart given below :



19.2. 4 How organisms are named

Every organism has a scientific name beside the name by which it is known in a particular language. For example, mango is its name in English, Aam in Hindi and *Mangifera indica*, its scientific name. In scientific naming, genus and species of the organism are mentioned. eg. *Homo sapiens*.

The Scientific Name

A Scientific name has several advantages and constitutes the specific identity of the specific organism.

- It is understood all over the world.
- It consists of two words, name of the Genus to which it belongs begins with a capital letter and name of the species to which it belongs, begins with a small letter e.g. cat is *Felis domestica* where *Felis* is the genus name and *domestica* the name of the species.
- A scientific name is always written either in italics or underlined.
- Having two names is the Binomial system of nomenclature (naming) introduced by the Swedish naturalist of 18th century, Carolus Linnaeus.

The term binomial nomenclature pertains to the two word naming system (binomial = two names; nomenclature = naming)



Carolus Linnaeus

19.2.5 Who's Who in the Living World— Classification of Kingdoms Plantae and Animalia

Every organism belongs to one of the five kingdoms of life.

- Kingdom MONERA** includes microscopic, single celled organisms with cell wall, no proper nucleus e.g. All bacteria.
- Kingdom PROTOCTISTA (PROTISTA)** includes single celled organisms with well formed nucleus e.g. Amoeba, malarial parasite, *Chlamydomonas*. (Fig. 19.8)
- Kingdom FUNGI** includes multicellular or many celled organisms. The body is made of network (mycelium) of fine threads called hyphae. Fungi feed on dead decaying matter (saprotrophs) eg. Mushroom, yeast, bread mould.
- Kingdom PLANTAE** includes:
 - Multicellular eukaryotes with

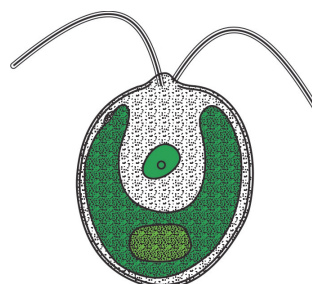


Fig. 19.8 Chlamydomonas



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- cellulose cell wall and chlorophyll present in their cells
- Autotrophs and thus carry out photosynthesis.

E. Kingdom ANIMALIA includes organisms with the following characteristics.

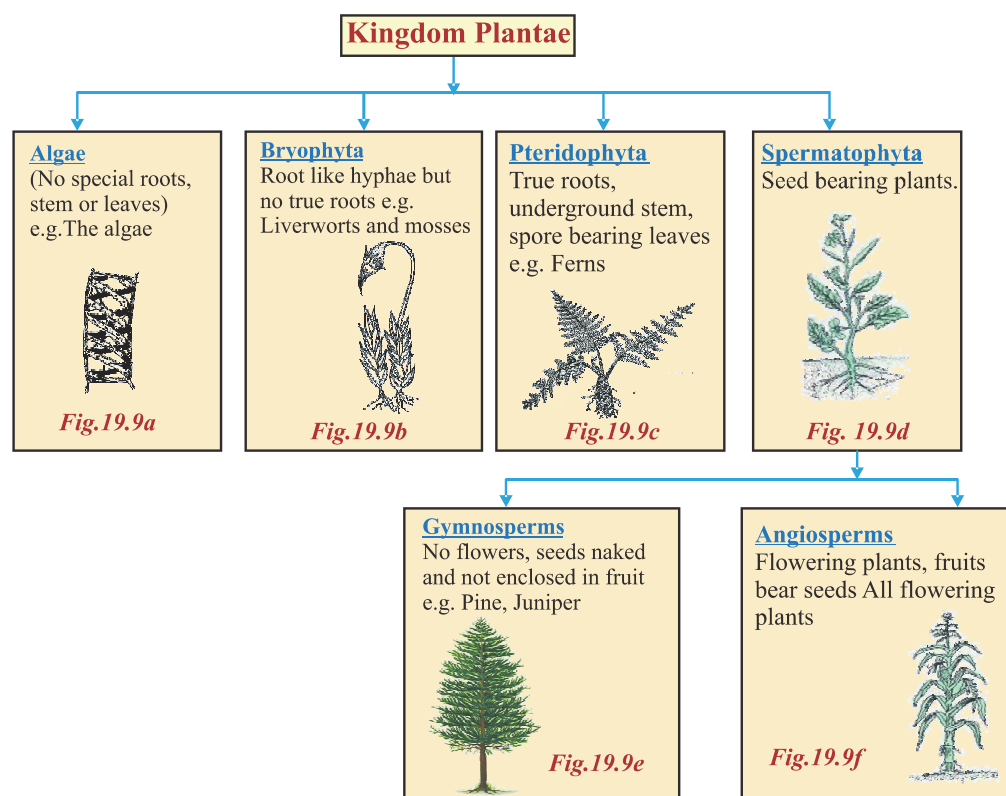
- Multicellular, eukaryotes.
- Heterotrophic so feed on plants or other animals
- Possess special organs for locomotion or movement from one place to another.
- Possess nervous system with sense organs.

Classification of Plants

Kingdom Plantae is divided into the following divisions.

Classification of Plants

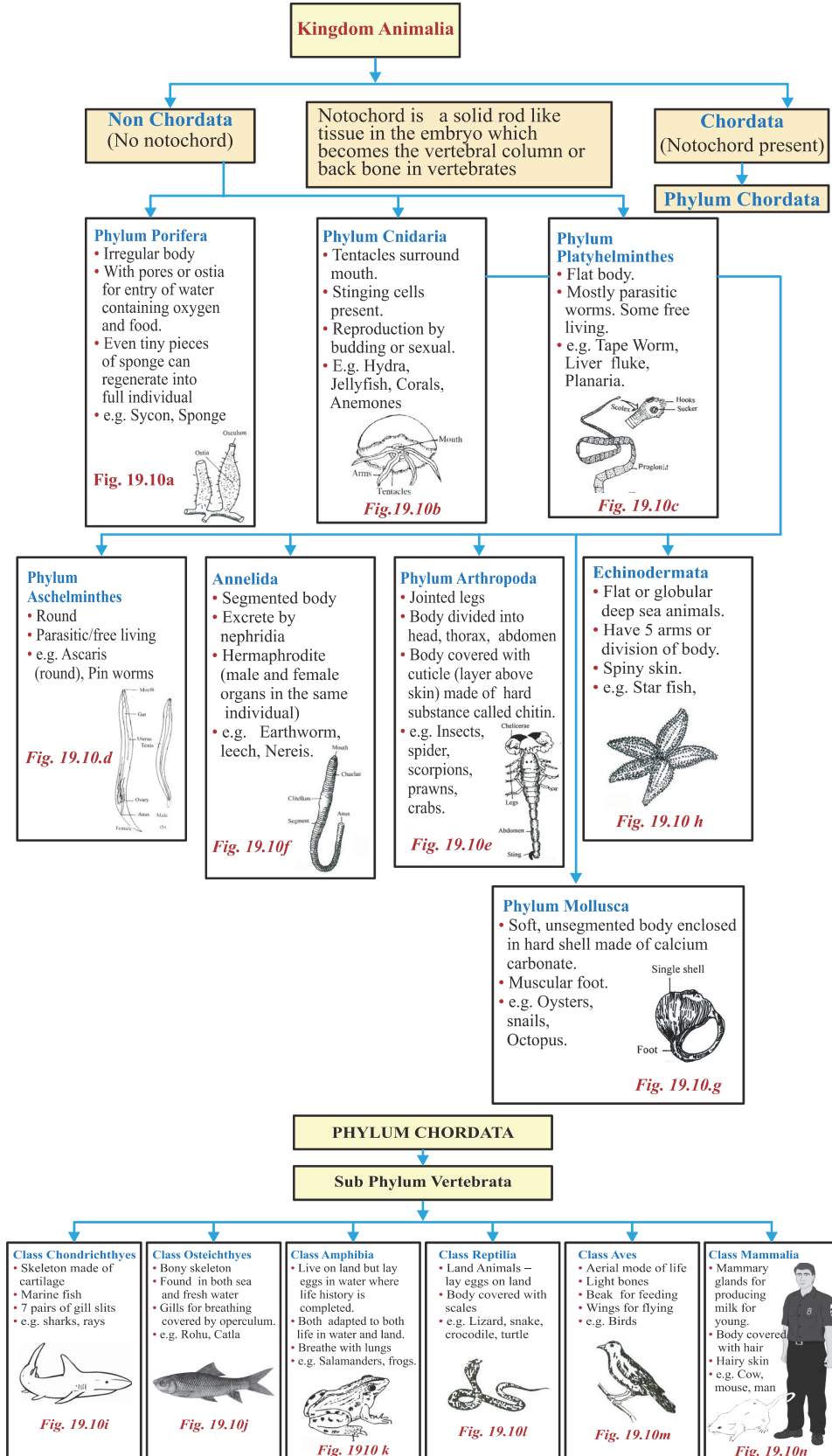
Kingdom Plantae is divided into the following divisions.





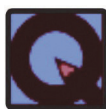
Notes

Classification of Animals





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INTEXT QUESTIONS 19.3

- Find out the scientific name of the following :

Frog, cat, China rose, onion.

You may get them from someone in your neighbourhood who knows Biology or from internet or some Biology book.

- In the following table, fill in plus (+) for present and minus (-) for absent to show the difference between plants and animals.

Features	Plant	Animal
Chlorophyll		
Muscles		
Nerves		
Locomotion		
Leaves and Roots		
Mouth and Anus		

- See the pictures of the two arthropods shown below. Mark one similarity and one difference

Spider

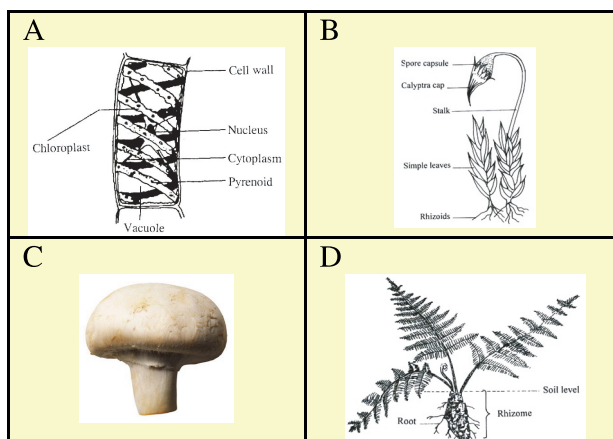


Honeybee



- Which out of ABCD is

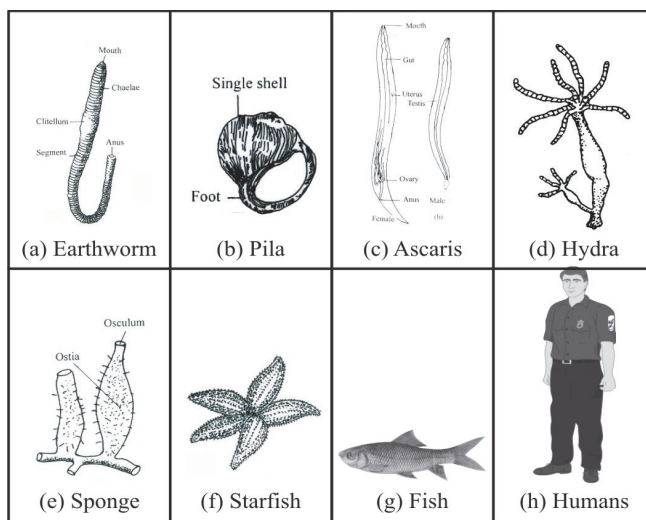
a. Fungus b. Fern c. Moss d. Alga





Notes

5.



Write the name of the phylum to which each of the animal shown in the pictures above, belongs.

19.3 CONSERVING BIODIVERSITY

Having got an idea of biodiversity, you must be feeling sad that human activities have put the lives of so many other living beings in jeopardy. Your conscience must be telling you, 'don't all different species have a right to live on earth?' You are right. We must all strive to conserve biodiversity because organisms are interdependent and together maintain a balance in nature. The flora and fauna of our nation is our heritage. We have to conserve our heritage. Let us examine how biodiversity maintains equilibrium and harmony in nature.

19.3.1 Role of biodiversity in maintaining harmony in nature

Biodiversity maintains equilibrium in nature because of which all kinds of organisms are able to survive. The bacteria and fungi recycle organic matter to feed diverse organisms. Algae and plants trap solar energy for photosynthesis and produce food for all living creatures. Insects and bats pollinate flowers. Animals also disperse seeds. Ecosystems such as the forests, deserts, aquatic bodies, wetlands sustain their own typical biodiversity, some of which are part of their unique food chains and food webs.

19.3.2 Conserving Biodiversity

Due to increased land use by humans required for constructing houses and buildings, road and train lines, quarrying and cultivation (agriculture), habitats of plants and animals have been destroyed and biodiversity has been threatened. It is the duty of every human being to protect biodiversity. Conservation keeps ecosystems stable.



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Human populations are also making excessive demands upon environmental resources for food and energy and generating a lot of waste. Many plants have become extinct. Some are close to extinction. Endangered species need to be protected. Fish and mollusc stocks have to be conserved and prevented from overexploitation by humans for food. Animals are poached for fur and ivory. Each year about 10 million birds from the wild are traded some of which die even before reaching the destination. Monkeys and tigers have been killed for making traditional medicines. A ban has been imposed on international trading in animals. You might have heard of Veerappan who used to illegally cut sandalwood trees and sell them.

"Operation Tiger" and "Operation elephants" are projects that have helped in preventing decline in their numbers due to habitat destruction.

19.3.3 What Can You Do?

You can spread awareness regarding the dwindling biodiversity and the necessity of conserving their habitats. You can form a group with your friends and organise painting and chart making competitions, essay writing, declamation and slogan writing contests on conservation of biodiversity and also hold debates on issues of biodiversity conservation in your neighbourhood. You may even write and enact street plays to create awareness. You can use the photographs of birds /trees/animals to make greeting cards.



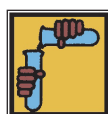
ACTIVITY 19.5

Collect pictures of 10 trees and animals found only in the biogeographic region to which India belongs.



ACTIVITY 19.6

Take an outline map of India showing different states. Mark the areas where tigers, rhinoceros and elephants are conserved in wild life sanctuaries. If possible, make a trip to a zoo or wild life park or sanctuary or bioreserve park in your neighbourhood. Record what you see.



ACTIVITY 19.7

Write a story, poem or a play, imagining yourself to be a bear or monkey who has been captured from the wild for showing pranks to earn money.



ACTIVITY 19.8

Bird watching is fun. Keep a record of birds that you come across. Use Salim Ali's book, "Birds of India" to identify them.



ACTIVITY 19.9

Find out the common and scientific names of any two bacteria, two protozoans, two fungi, five plants and five animals. To do this you may seek help of someone who know biology or text books in biology or research by surfing on the internet.



WHAT YOU HAVE LEARNT

- An enormous biodiversity occurs on earth.
- Biodiversity is the term given to the variety of organisms that live on earth.
- Biodiversity exists at three levels:
 - i) Ecological diversity,
 - ii) Species diversity and
 - iii) Genetic diversity.
- Since there is an enormous variety of living beings or organisms, their study requires dividing them into groups. Such grouping, based on similarities and differences between organisms is termed classification or systematics. Such grouping expresses evolutionary relationships between organisms as all organisms have resulted through the process of evolution. Study of classification is Taxonomy.
- All organisms are classified into three domains
 - a) Archebacteria includes thermophilic bacteria
 - b) Eubacteria includes all other bacteria
 - c) Eukarya includes organisms other than bacteria

Further, all organisms are classified into 5 kingdoms which are based on 3 features

- i) Prokaryotes or eukaryotes
- ii) Single celled or multicelled and
- iii) Mode of feeding



Notes



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- Accordingly absence of well formed nucleus or prokaryotes
 - i) Belong to Kingdom Monera which includes all bacteria.
 - ii) Presence of well formed nucleus or eukaryote but single celled organisms belong to Kingdom Protoctista
 - iii) Multicells feeding on dead decaying matter form Kingdom Fungi, while
 - iv) Photosynthetic organisms that prepare own food constitute Kingdom Plantae and those feeding on others are grouped together into Kingdom Animalia.
- Kingdom Plantae has five divisions namely Algae, Bryophyta, Pteridophyta, and Spermatophyta. Spermatophyta further divided into Gymnospermia and Angiospermia or flowering plants.
- Kingdom Animalia is grouped into non chordates which are further divided into the phyla Porifera, Cnidaria, Platyheminthes, Aschelminthes, Annelida, Arthropoda, Mollusca, and Echinodermata.
- The chordates which have notochord at some stage of life form a single phylum Chordate. Chordate vertebrates are divided into the classes Chondrichthyes (Cartilaginous fish) Osteichthyes (bony fish) Amphibia (Frog, salamander), Reptilia (Lizards, snakes etc.) Aves (Birds) and Mammalia (rats, tigers, horses, humans)



TERMINAL EXERCISES

1. Define biodiversity. Mention its three levels and briefly explain them.
2. What are the global and Indian patterns of biodiversity? What do you mean by a 'hot spot' of diversity?
3. Name the three domains of life and state one distinguishing features of each.
4. Name the five kingdoms of life and state one feature of each of the kingdoms which differs from that of the others.
5. Give an account of the classification of Kingdom Plantae into its divisions. Cite examples.
6. State the difference between chordates and non chordates.
7. Name the phyla to which the following belong: wolf, earthworm, sponge, jelly fish, sparrow, butterfly, starfish, snail, tape worm, round worm
8. To which class of chordates do the following belong? Justify your inclusion into the class by stating any one characteristic feature. Crow, lion, cobra, flying frog, shark, fresh water fish.



Notes

9. Write three sentences on why we need to classify and give scientific names to organisms.
10. Why does biodiversity need to be conserved?
11. State three ways by which biodiversity may be conserved?
12. List 10 ways in which organisms help each other survive in nature. What message can you derive from their interdependence?
13. Why have some plants and animals become endangered? State at least five human activities as causes.
14. Write in a paragraph on "what would happen if living beings did not have scientific names and were not grouped." Mention at least five consequences.
15. You find some boys pelting stones at a monkey sitting on a tree. Write five sentences which can dissuade those boys.



ANSWERS TO INTEXT QUESTIONS

19.1

1. The various living beings living on earth constitute biodiversity.
2. Species : Group of interbreeding populations
Biosphere : Livable part of earth
Ecosystem: an area whose inmates interact with each other and also the physical surroundings.
3. Ecological diversity, species diversity, genetic diversity.
4. Hot spots are those areas of a country where some typical plants and animals (organisms) are exclusively present.

19.2

1. Classification: Categorising biodiversity into groups based on similarity and differences of organisms.
2. To make study of the enormous diversity possible.
3. Archaea, Prokarya, Eukarya
4. Monera, Protoctista (Protista), Fungi, Plantae, Animalia
5. A= Monera, B= Protoctista, C= Fungi, D= Plantae, E= Animalia



Notes

19.3

1. Rana trigina, Felis domestica, Hibiscus rosa sinensis, Allium cepa
2. + -, - +, - +, - +, + -, - +
3. Similarity = jointed legs / Head divided into head, thorax and abdomen.
Differences = No. of pairs of legs
4. A = Algae, B = Moss, C = Fungus, D = Fern
5.

a. Earthworm	Annelida
b. Pila	Mollusca
c. Round worm	Aschehelminthes
d. Hydra	Cnidaria
e. Sponge	Porifera
f. Starfish	Echinodermata
g. Fish	Chordata
h. Humans	Chordata