

13.1 Classification of organisms

It is believed that life originated on earth about 3.6 billion years ago. It is accepted that the life originated as unicellular organisms & thereafter complex multi cellular organisms were evolved gradually. Today about 8.7 million species are living on earth. There is a great diversity among those organisms. Once these organisms are classified, it is easy to study them and use them for different functions.

Activity 13.1

- Identify the species of organisms in Fig. 13.1
- Classify the organisms using appropriate criteria
- Compare your classification with other students in the class

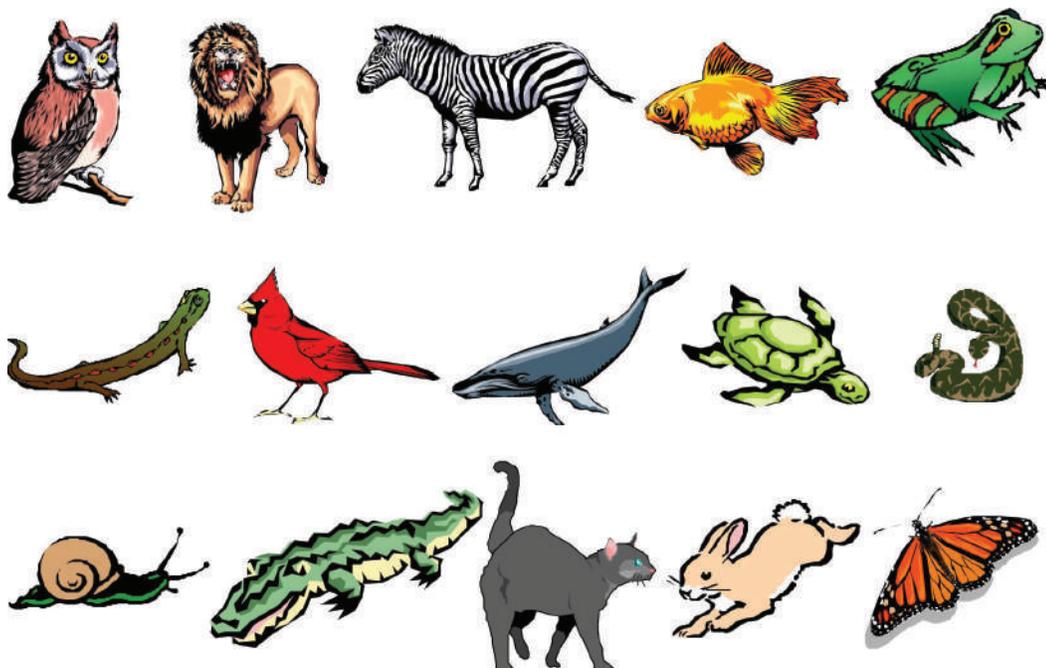


Figure 13.1 - Different species of animals

You may have classified the above animals on the basis of different criteria.

Grouping of organisms into different levels based on their common characteristics is known as classification.

- **Significance of classification of organisms**

There are various uses of classification of organisms. Let us examine as to what they are,

- Easy to study about organisms
- Ability to identify specific distinguishable characteristics of a given organism
- Ability to get an idea about the whole biosphere by studying about few selected organisms, without studying each and every organism
- Ability to reveal the relationship between different groups of organisms
- Identification of organisms with economical uses to human

- **The methods of classification of organisms**

Aristotle in 4th B.C. introduced the first scientific classification of organisms. Carolus Linnaeus in 18th A.D. introduced a successful classification. All organisms on earth including human is classified according to two methods. They are,

- Artificial classification
- Natural classification

1. Artificial classification

In artificial classification, the external features of organisms and habitats are considered. It does not depict the evolutionary relationships among organisms. Examples for artificial classification are as follows.

Plants can be grouped as ornamental plants, herbal plants and poisonous plants.

Animals can be grouped as animals with wings and without wings.

There are many weaknesses in artificial classification.

Under the criteria of presence of wings in the above example birds & insects both are included into a single group. But they belong to two groups when considering evolutionary relationships.

2. Natural classification

A natural classification depicts the evolutionary relationships among living organisms. In natural classification, morphological, physiological, cytological and molecular biological features of organisms are considered. The natural classification possesses below features.

- Explains the natural relationships among organisms of the same species
- Explains the evolutionary relationships among different organisms

In a natural classification organisms are grouped into taxonomic levels in a hierarchy of categories.

● For extra knowledge ●

Consider the following examples to identify the taxonomic levels in a hierarchy of categories

Modern Human (*Homo sapiens*)

1. Domain - Eukarya
2. Kingdom - Animalia
3. Phylum - Chordata
4. Class - Mammalia
5. Order - Primates
6. Family - Hominidae
7. Genus - Homo
8. Species - *Homo sapiens*

Coconuts (*Cocos nucifera*)

1. Domain - Eukarya
2. Kingdom - Plantae
3. Division - Magnoliophyta
4. Class - Liliopsida
5. Order - Arecales
6. Family - Arecaceae
7. Genus - Cocos
8. Species - *Cocos nucifera*

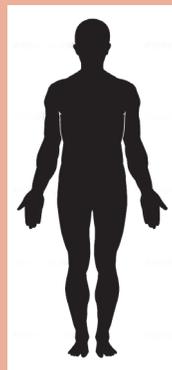


Figure 13.2- Taxonomic levels in a hierarchy of categories

● **Three Domain system of classification**

The most appropriate system to classify organisms is the natural classification. Different scientists have introduced different classification methods from past. Five kingdom classification system introduced by Robert Whittaker (1969) is accepted today. Later in 1990, Carl Woese introduced another classification system with three domains. The 3 domains are,

1. Domain Archaea
2. Domain Bacteria
3. Domain Eukarya

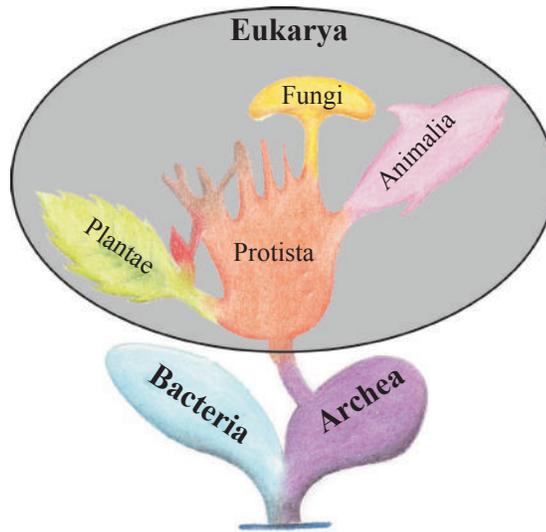


Figure 13.3 - Three domain classification

1. Domain Archaea

The organisms belong to this domain are prokaryotes (without an organized nucleus). They have the ability to live in extreme environmental conditions like, volcanoes, deserts, hot springs, ocean beds, high saline environments & polar ice caps. They are not sensitive to most antibiotics. That is they can not be destroyed with antibiotics.

Examples :- Methanogens
Halophiles

2. Domain Bacteria

The organisms belong to this domain are also prokaryotes. (without an organized nucleus) They are sensitive to antibiotics & sometimes are pathogenic. They can be found every where in the environment. They are the most abundant group of organisms. Bacteria & Cyanobacteria belong to this domain.



Bacteria



Cyanobacteria

Figure 13.4 - Organisms belong to Domain Bacteria

● For extra knowledge ●

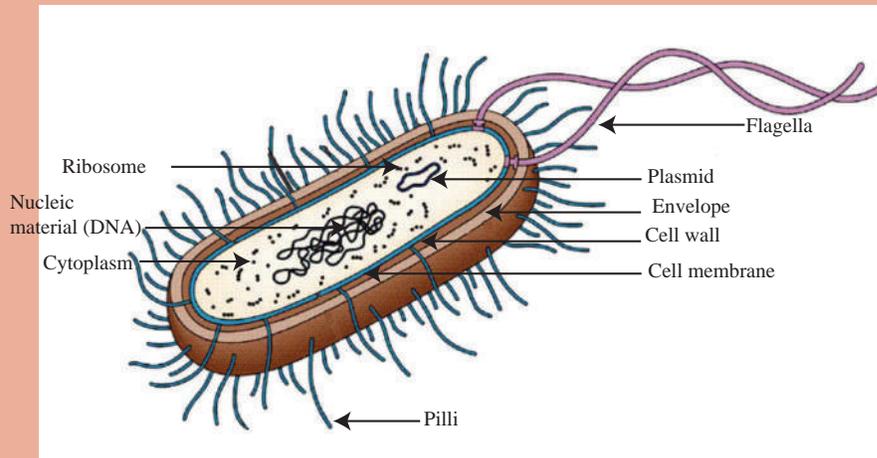


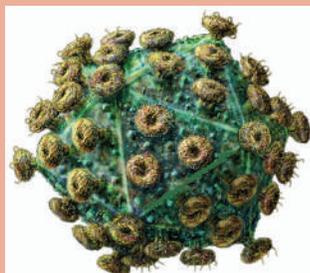
Figure 13.5 - Electrone microscopic structure of a Bacterial cell

Several harmful and useful effects of Bacteria to human are given below.

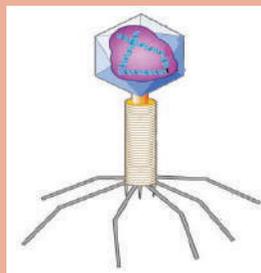
- Bacteria cause diseases to human as well as to other organisms
Eg :- Tuberculosis, Pneumonia, Diarrhoea, Tetanus, Leprosy.
- Food spoilage
- To produce curd, yoghurt & cheese
- Separation of fibres from coconut husk, agave leaves & to tan leather
- To fix atmospheric nitrogen to increase soil nitrate level
- To decompose dead bodies and structures

● For extra knowledge ●

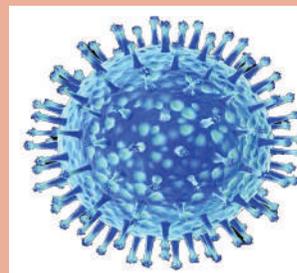
Virus was first observed by a Russian scientist named D.J. Ivonouski in 1892. They are not identified as living organisms. They possess both living & non living features. The only living feature of them is the multiplication within a host cell.



AIDS virus



Bacteriophage virus



Bird flu virus

Figure 13.6 - Electrone microscopic view of several viruses

3. Domain Eukarya

The most prominent organisms with a eukaryotic cellular organization belong to this domain. They have the ability to live in different environments. They are not sensitive to antibiotics.

There are 4 kingdoms belong to this domain.

1. Kingdom Protista
2. Kingdom Fungi
3. Kingdom Plantae
4. Kingdom Animalia

1. Kingdom Protista

Organisms belong to kingdom protista possess an eukaryotic cellular organization. They are either unicellular or multicellular organisms without specialized tissues. They live in environments associated with water & mostly are photosynthetic. Some species are heterotrophic. Algae & protozoans belong to this kingdom.



Algae
Eg : *Ulva*



Protozoa
Eg : *Paramecium*

Figure 13.7 - Organisms belong to kingdom Protista

Below are some useful and harmful effects of protists to human.

- Act as primary producers, in the food chains of aquatic environments
- Algae involve in forming mutualistic associations with fungi called lichens
- To extract agar which is used to prepare culture media to grow bacteria
- To extract alginic acid used to make ice cream
- Some protozoans cause diseases to human
Eg :- Amoebiasis, Malaria, Sleeping sickness

For extra knowledge

Below are some algae belong to kingdom protista. They are classified according to the colour of them.



Figure 13.8 - Algae with different colours

2. Kingdom Fungi

A kingdom of organisms with chitinous cell walls & eukaryotic cellular organization. There are unicellular or multicellular fungi species. There are about 1.5 – 5 million species belong to this kingdom. They contribute greatly to decompose organic matter in the environment. They also form symbiotic associations with other organisms.



Figure 13.9- Fungi mycelium



Figure 13.10 - Reproductive structures of Fungi

Below are some useful and harmful effects of fungi to human.

- As a supplementary for protein - Eg :- *Agaricus* - Mushroom
- Bread & alcohol fermentation - Eg :- Yeast
- To produce antibiotics - Eg :- *Penicillium*
- Decomposition of dead bodies and structures
- To cause diseases to plants & animals - Eg :- Pityriasis versicolor (Aluham) by *Candida*, potato late blight by *Phytophthora*
- Spoilage of food

Activity 13.2

Let us observe *Mucor* on a slice of bread.

Add few drops of water onto a slice of bread & leave it for 2 days. You will see a mycelium of fungi. Obtain small amount of the mycelium using a glass rod, put it on to a glass slide, cover it with a coverslip & observe under the microscope.



Figure 13.11 - Slice of bread affected by Fungi

Table 13.1 - Characteristics of species that belong to the Domain Bacteria, Kingdoms of Protista and Fungi

Feature	Bacteria	Protista	Fungi
Structure	Microscopic, unicellular and prokaryotic organisms	Most are microscopic. But some red algae possess large bodies. They are eukaryotes. Mostly unicellular. Some are multicellular without a tissue differentiation.	Most of them are microscopic. But some reproductive structures can be seen with the naked eye. (Mushroom) They are eukaryotic organisms. Some are unicellular some are multicellular. They exist as multicellular mycelium. No tissue differentiation.
Shape	Spherical (coccus), Rod shaped (bacillus), spiral (spirillum), comma shaped (vibrio) are the different shapes of bacteria. Cyanobacteria also exist as single cells, branched or unbranched filaments	Leaf like, horse shoe shaped, & other different shapes	As single spherical cells or fungi mycelium
Nutrition	Mostly heterotrophic. But Cyanobacteria are autotrophic.	Algae are phototrophic. The unicellular animals (Protozoans) are heterotrophic.	All are heterotrophic. Most of them obtain nutrition as saprophytic organisms.
Reproduction	Mostly perform asexual reproduction. Bacteria reproduce by binary fission, Cyanobacteria by fragmentation & budding	Reproduces asexually. Binary fission, fragmentation & spore production.	Mostly reproduce by asexual spores

Distribution	Widely distributed, in air, water, soil & in the body of organisms. Almost everywhere	Marine, Freshwater, damp soil and inside the body of organisms	Live on organic matter & living body. Less in aquatic environments.
Examples	Bacteria, Cyanobacteria	Algae, unicellular animals (<i>Amoeba</i> , <i>Paramecium</i>)	Fungi

3. Kingdom Plantae

It's a kingdom with multi-cellular organisms known as plants. There are about 287,000 species of plants. Plant cells possess cell walls with cellulose. Plants appear in green colour, because they possess chlorophyll pigments. They can absorb solar energy and produce food by photosynthesis.

They reproduce sexually and asexually. The plants in kingdom plantae, can be divided into two groups considering presence or absence of flower. They are,

1. Non- flowering plants
2. Flowering plants

● Non-flowering plants

Plants that can not produce flowers are known as non-flowering plants. These non flowering plants again can be divided into two groups according to the ability of producing seeds. They are,

1. Non-flowering, seedless plants
2. Non-flowering seed plants

● Non- flowering seedless plants

Plants that do not produce flowers & seeds belong to this type.

Examples :- *Marchantia*, *Pogonatum*, *Selaginella*, *Nephrolepis*, *Salvinia*, *Acrosticum*, *Drynaria*



Marchantia



Pogonatum



Selaginella



Nephrolepis



Salvinia

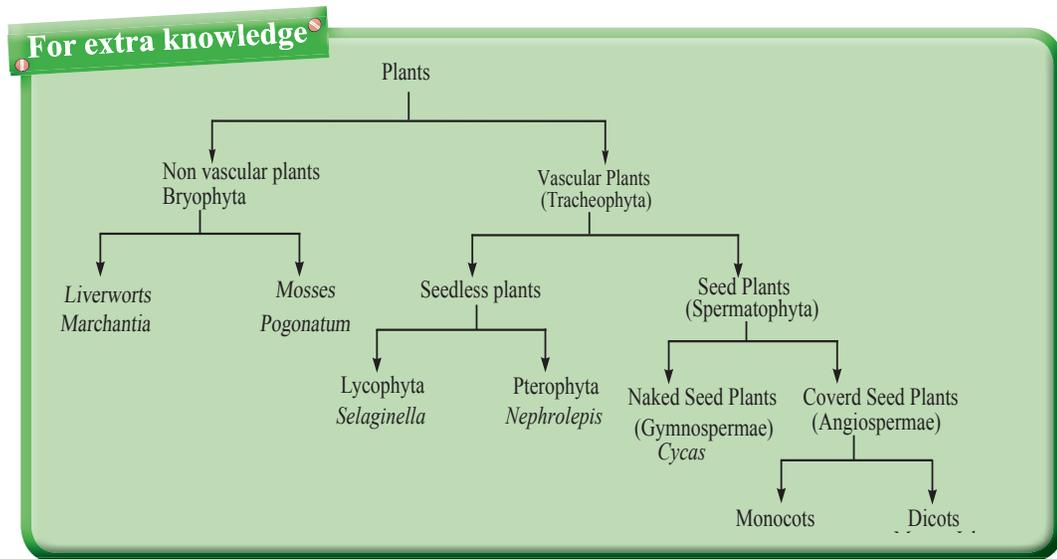


Acrosticum



Drynaria

Figure 13.12 -Non-flowering seedless plants



Below are features of Non- flowering seedless plants.

13.2 Table - Features of Non- flowering seedless plants

Feature	Special facts
Structure	Small to large sized plants. Some plants lack a tissue differentiation. No stem, leaves & roots. These plants, are known as thallus. Some plants possess differentiated vascular tissues. They possess stem, leaves & roots
Shape	Thalloid body or small fern type
Nutrition	All are autotrophic photosynthetic. Some plants are epiphytes.
Reproduction	Asexual reproduction by spores & fragmentation of vegetative parts. Perform sexual reproduction too.
Distribution	Terrestrial environments with low sunlight, shady and wet places.

- **Non-flowering seed plants**

The seeds of these plants are not covered by a fruit. Seeds are naked. Therefore they are known as Gymnosperms.

Examples :- *Cycas*, *Pinus*



Cycas



Pinus

Figure 13.13 - Gymnosperms

Below are features of Non- flowering seed plants.

Table 13.3 - Features of Non- flowering seed plants

Feature	Special facts
Structure	True tissue differentiation is present. Possess vascular tissues. Root, stem & leaves are present.
Shape	Large in size. Most of them are trees. Straight woody stems. Some are shrubs.
Nutrition	All are autotrophic photosynthetic.
Reproduction	Sexual reproduction by seeds. Asexual reproduction by spores.
Distribution	Distributed in terrestrial environments.

● Flowering plants

Plants that produce flowers are known as flowering plants. The seeds that are produced by flowers, (which is the sexual reproductive structure of flowering plants) are covered by a fruit. Therefore they are termed covered seed plants or Angiosperms. These plants are well adapted to life on land & show various adaptations, to conserve water. They can be divided into two groups according to the number of cotyledons in the seed.

(1) Monocotyledonae plants

(2) Dicotyledonae plants

Comparison between monocots & dicots is shown in the table below.

13.4 Table - Features of monocots & dicots

Monocotyledonae	Dicotyledonae
<ul style="list-style-type: none"> • A single cotyledon in the seed • Stem is unbranched • No tap root. Possess a fibrous root system • Leaves possess a parallel venation. • Trimerous flowers • No secondary growth • The diameter of the stem is even <p>Eg :- Paddy, Grass, Banana</p>	<ul style="list-style-type: none"> • Two cotyledons in the seed • Stem is branched • Root system with a tap root & lateral roots • Leaves possess a reticulate venation • Tetra or pentamerous flowers • Secondary growth takes place • The base of the stem is broad & tip is thin <p>Eg :- Chili, Jak, Blue lotus</p>



Monocots - Coconut



Dicots - Mango

Figure 13.14 - Flowering plants

Activity 13.3

Uproot a paddy or grass & a Kuppamenia/ Kupameni plants & wash their root system carefully & list out their features.

Assignment 13.1

Prepare a dried collection of plant parts belong to flowering and non-flowering plants.

4. Kingdom Animalia

It is a kingdom with animals, who are multicellular. There are about 1260,000 species in this kingdom. They are unable to produce their own food. They are heterotrophic. Animals belong to kingdom animalia again can be divided into two groups according to the presence or absence of the vertebral column.

1. Invertebrates
2. Vertebrates

● Invertebrates

Organisms without a vertebral column is known as invertebrates. The invertebrates again can be divided into different phyla according to their features. Five main phyla are,

1. Cnidaria / Coelenterata
2. Annelida
3. Mollusca
4. Arthropoda
5. Echinodermata

● Cnidaria/Coelenterata

Diploblastic organisms like Hydra, Sea anemone & Jelly fish belong to this phylum.



Hydra

Sea anemone

Jelly fish

Figure 13.15- Several species of Cnidaria

Features of Cnidaria

- All are aquatic and mostly marine. Few of them are fresh water dwellers.
- Multicellular body build up of two germinal layers. Therefore known as diploblastic.
- A cavity present within the body called coelenteron acts as the digestive tract.
- There are 2 forms as Medusa & Polyp. Medusa can move while Polyps attach to surface.
- They have a radial symmetry.
- All are predators. Attack small organisms to paralyze them using nematoblasts.

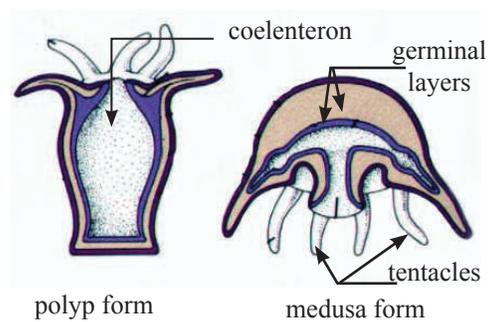


Figure 13.16 - Longitudinal section of a Cnidarian

For extra knowledge

Coral reefs produced by a coral polyp belong to phylum Cnidaria. They play a major role for the survival of marine organisms.



Figure 13.17- Polyp coral colonies

● **Annelida**

The first organisms to evolve a body cavity called coelom belong to this phylum. Segmented worms like earthworm, leech, *Nereis* are examples for Annelids.



Earthworm

Leech

Nereis

Figure 13.18 - Several species of Annelida

Annelids show following Features.

- Live in damp soil, marine & fresh water habitats.
- Multicellular body made up of three germinal layers. Therefore known as triploblastic. Possess a slender, worm like body.
- Body is divided into segments internally & externally. Therefore known as segmented worms.
- Body shows a bilateral symmetry.
- There is a fluid filled cavity between body wall & the digestive tract. It is known as the coelom. It provides an independent movement for the gut wall irrespective of the body movements.
- Some reproduce asexually & some by sexual reproduction.

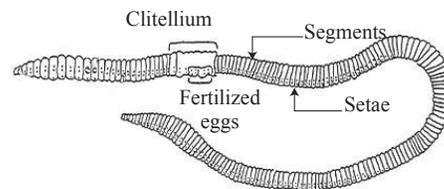


Figure 13.19 - External appearance of an Annelid

- **Mollusca**

Soft bodied triploblastic organisms belong to this phylum. Species such as Snail, Bivalve, Chiton, Slug, Squid, & Octopus belong to this phylum.



Snail

Cuttle fish

Octopus

Figure 13.20 - Several species of Mollusca

Below are the features of Mollusca,

- Live in terrestrial, fresh water and marine habitats.
- Multicellular, Triploblastic, Soft bodied animals.
- The body is divided into head, muscular foot and visceral mass. The body is not divided into segments.
- The body is moistened by mucous.
- Some Molluscs possess internal and external shells made up of CaCO_3 .
- Possess a bilaterally symmetrical body.
- Show sexual reproduction. Most of them are unisexual (produce one type of gamete)

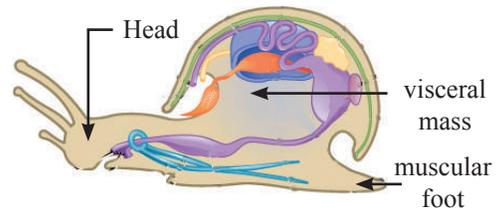


Figure 13.21 - Longitudinal section of a mollusc

- **Arthropoda**

This is the phylum with the highest number of species in the animal kingdom. 75% of the animal species belong to this phylum. The class insecta of this phylum Arthropoda, possesses the highest number of organisms. There are about 950,000 species belong to this phylum. The organisms with jointed limbs, such as Insects (Bee, Butterfly, Cricket, Mosquito), Spider, Scorpion, Millipede, Centipede, Prawn, Crab, Barnacle belong to this phylum.



Figure 13.21 - Several species of Arthropoda

Arthropods possess below features.

- Live in Marine, fresh water and terrestrial habitats.
- Triploblastic, coelomic and possess jointed limbs. They are known as Arthropods. (Arthro=jointed, pods=legs)
- Body is segmented and several segments collectively form functional segments called Tagma (Head, Thorax, Abdomen).
- There is a chitinous cuticle on the body. It acts as an exoskeleton.
- Some possess special wings.
- There are separate female and male organisms. They show sexual dimorphism. Carryout sexual reproduction.

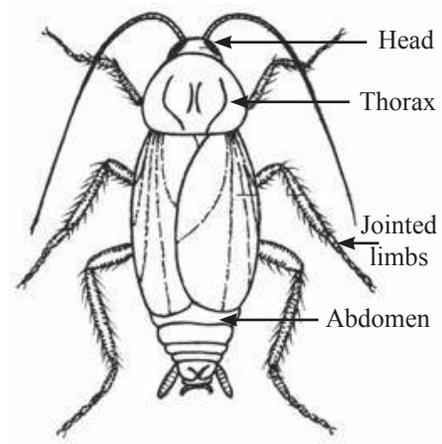


Figure 13.22- External appearance of an insect

Assignment 13.2

Prepare an insect box using dead insects found in your home.

• Echinodermata

It is a phylum that shows phylogenetic (evolutionary) relationship to phylum chordata. Starfish, Brittle star, Sea urchin, Sea cucumber, Sea lilly belong to this phylum.

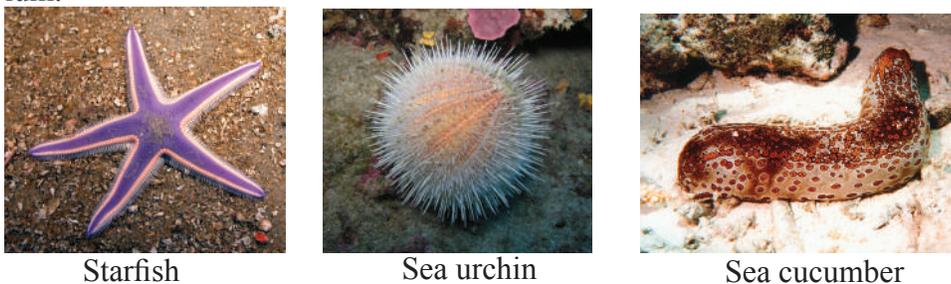


Figure 13.23 - Several species of Echinodermata

Echinodermates possess below features.

- All are marine.
- Triploblastic. Coelomic. Body is separated into 5 radial arms.
- Possess a sharp spiny body covering.
- Body is star shaped, cylindrical or flower like.
- A highly distributed water vascular system present in the body.
- Tube feet present for locomotion and respiration.
- Heart, brain and eyes are absent.
- Body shows penta radial symmetry.
- They show sexual dimorphism and carryout sexual reproduction.

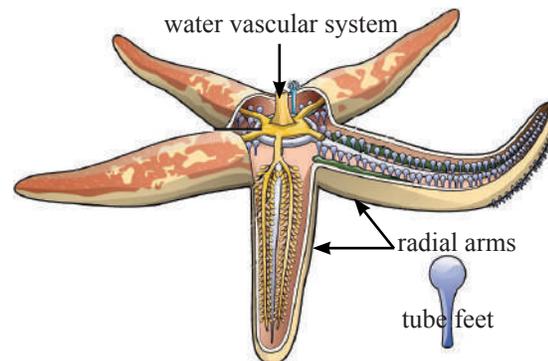


Figure 13.24 - Cross section of an Echinodermate

• Vertebrates

An organism with a vertebral column is referred to as a vertebrate. They show below features (Fig. 13.25) at any stage of their life cycle. They can be classified into five groups considering their structural features.

- (1) Pisces
- (2) Amphibia
- (3) Reptilia
- (4) Aves
- (5) Mammalia

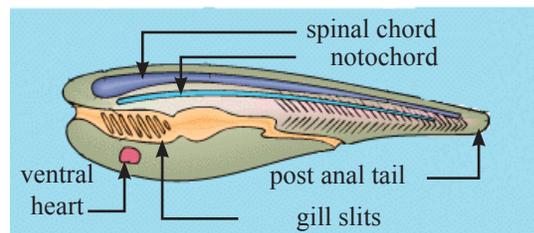


Figure 13.25 - Longitudinal section of a chordate

• Pisces

Fish that are well adapted to live in water belong to this group. They live in fresh water and marine environments.



Butterfly fish

Skate

Sea horse

Fig 13.26 - Several species of Pisces

Common features of fish are as follows.

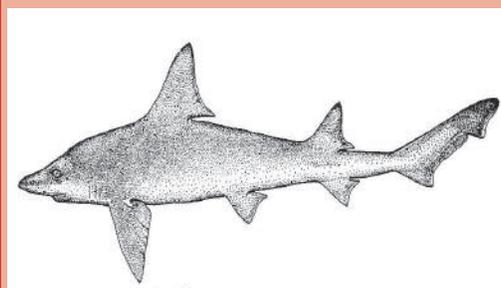
- Possess a bony or a cartilage endo skeleton.
- Body is streamline shaped to swim in water.
- Body is covered by scales.
- Possess fins for swimming and balancing.
- Possess a lateral line to detect vibrations in water.
- Two chambered heart. Single atrium and a ventricle.
- Respiration is done by gills.
- Cold blooded animals. (body temperature changes according to the environmental temperature)
- Eyes are without eye lids.

For extra knowledge

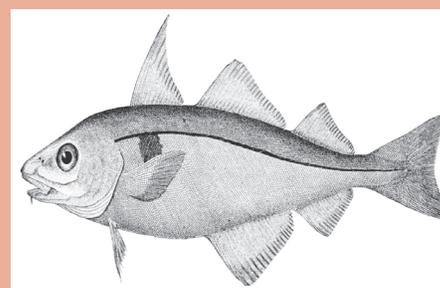
The fish live on earth can be divided into two classes considering the endo-skeleton. They are,

- (1) Chondrichthyes - The fish with skeleton made up of cartilages belong to this class
- (2) Osteichthyes - The fish with skeleton made up of bones belong to this class

Chondrichthyes	Osteichthyes
• Endoskeleton is made up of cartilage	• Endo skeleton is made up of bones
• Live only in sea	• Live in both sea and freshwater
• About 10% of fish belong to this group	• 90% of fish belong to this group
• Gill slits are not covered by an operculum	• Gills are covered by a pair of operculum Gills are not visible to outside.
• Anterior, ventral mouth	• Terminal mouth
• Heterocercal caudal fin	• Homocercal caudal fin



Chondrichthyes
(Shark, Skate)



Osteichthyes
(Seer fish, Tilapia, Sea horse)

Figure 13.27 - Classes of Pisces

- **Amphibia**

Amphibians which have the ability to live in both land and water belong to this class. They are the first organisms to invade land during evolution. Frogs, Toads, Salamander, Newt, *Ichthyophis* are some animals belong to this class.



Toad



Frog



Salamander

Figure 13.28 - Several species of Amphibia

Below are the features of Amphibians.

- Water is essential to complete the life cycle. (an aquatic stage is present in the life cycle)
- Possess a thin mucous skin with glands. No scales on skin.
- Pentadactyle limbs are used for locomotion.
- Possess a three chambered heart with two atria with a single ventricle.
- Respiration is done by lungs, moist skin and buccal cavity.
- They are cold blooded animals (poikilothermic)

- **Reptilia**

Animals that are well adapted to life on land belong to this class. They live in terrestrial, fresh water and marine ecosystems. Tortoise, Turtle, Snakes, Lizard, Monitor, Iguana and Crocodile are some animals belong to this class.



Tortoise



Crocodile



Cobra

Figure 13.29 - Several species of Reptilia

Reptiles possess below features.

- Dry skin without glands. Possess scales on skin.
- Presence of pentadactyle limbs for locomotion.
- Heart with two atria and incompletely divided ventricle.
- Respiration is done by lungs.
- Cold-blooded animals (poikilothermic).
- Possess Internal fertilization.

● **Aves**

Birds that have adapted for flying belong to this class. The largest bird Ostrich and the smallest bird Humming bird, Jungle fowl, Blue magpie, Kiwi, Duck, Swan, Owl, parrot and penguin are some examples for birds.



Jungle fowl



Ostrich



Penguin

Figure 13.30 - Several species of Aves

Below are the features of birds.

- Possess a light bony endoskeleton.
- Possess a streamlined body for flying.
- Skin is covered by feathers. Scales are restricted only to legs.
- No teeth. A beak that is adapted to different modes of nutrition is present.
- They have eyes with eye lids. Sharp sight.
- Four chambered heart with two atria and two ventricles.
- Warm-blooded animals (homoiothermic).
- Body temperature is not changed according to environmental temperature.

● **Mammalia**

Animals that nourish young with milk belong to class Mammalia . Human, Mice, Loris, Monkey, Orung utang, Gorilla, Chimpanzee, Bat, Whale, Dolphin Stag, Deer, Buffalo are some animals belong to this class.



Figure 13.31 - Several species of Mammalia

Below are features of mammals.

- Skin is covered by hairs. Hair present inside hair follicles.
- Possess Mammary glands, sweat glands and sebaceous glands (produce sebum)
- Possess ear lobes (pinnae)
- Four chambered heart with 2 atria & 2 ventricles.
- Complete double circulation.
- Biconcave red blood cells lacking a nucleus .
- Warm blooded animals. (Homoiothermic)
- Testes present outside the body.
- Internal fertilization.
- Possess a placenta & embryonic membranes.

For extra knowledge

Class Mammalia is divided into several orders. Four main orders are,

- (1) Order Primates - Eg :- Shrew, Loris, Monkey, Orung utang, Gorilla, Chimpanzee, Human
- (2) Order Chiroptera - Eg :- Bat
- (3) Order Cetacea - Eg :- Whale, Dolphin
- (4) Order Artiodactyla - Eg :- Stag, Deer, Buffalo

13.2 Nomenclature of organisms

In each language, an object is named using words. Different names are used to identify organisms. But these names vary according to the language, country & region. The evolutionary relationships are not depicted in those names. Therefore scientists wanted to avoid this situation and to name them using a common name.

- **Binomial nomenclature**

A successful nomenclature was introduced by a Swiss natural scientist called Carolus Linnaeus in 1753. As it contains two epithets for an organism, it is known as binomial nomenclature.

The methodology to name an organism is regulated by International Commission on Botanical Nomenclature (ICBN) & International Commission on Zoological Nomenclature (ICZN).

- **The standards of binomial nomenclature**

- The scientific name of a species or species name is composed of two epithets.
- The first epithet is generic name and the second epithet is the specific epithet.
- The species name is given in Latin or Greek.
- The first letter of generic epithet is capital and the other letters are simple.
- When hand written it should be underlined and when printed it should be italicized.

Eg :- *Mangifera indica*

For extra knowledge

- Few important scientific names

Man	-	<i>Homo sapiens</i>
Asian Elephant	-	<i>Elephas maximus</i>
Jungle Fowl	-	<i>Gallus lafayetti</i>
Asoka Pethiya	-	<i>Puntius asoka</i>
Blue Lotus	-	<i>Nymphaea stellata</i>
Na	-	<i>Mesua nagassarium</i>
Coconut	-	<i>Cocos nucifera</i>

Activity 13.4

Exhibit scientific names of few plants found in your school garden.

Assignment 13.3

Write scientific names of five animals & five plants with the help of news papers, books & internet.

Summary

- Organisms are classified into groups to make it easier to study.
- All organisms are divided into three domains. They are Archaea, Bacteria & Eukarya.
- Prokaryotic organisms that live in extreme environments belong to domain Archaea.
- Bacteria & Cyanobacteria belong to domain Bacteria.
- Protista, Fungi, Plantae & Animalia are the four kingdoms belong to domain Eukarya.
- Kingdom plantae is divided into two groups considering the fact that flowering & non flowering.
- Kingdom Animalia is divided into two groups considering the fact that the presence or absence of the vertebral column.
- Invertebrates again can be divided into phyla such as Cnidaria, Annelida, Mollusa, Athropoda & Echinidermata.
- Vertebrates are divided into groups like Pisces, Amphibia, Reptilia, Aves & Mammalia.
- Living organisms are named scientifically using binomial nomenclature.

Exersise

- (1) State different classification systems of organisms & the scientists who introduced them.

Classification System	Scientist
.....
.....
.....

- (2) Compare differences between natural & artificial classification systems.

- (3) State 3 domains & organisms belong to them.

Domains	Organisms
.....
.....
.....

- (4) State the uses of the coral reefs which is a creation of an organism belong to phylum Cnidaria.

- (5) Classify below mammals using a tree diagram.
Bat, Whale, Monkey, Rat, Bear

Technical terms

Classification	- வர்க்கீகரணம்	- பாகுபாடு
Domain	- அடிராச்சிமியம்	- பேரிராச்சியம்
Hierarchical organization	- டிராபி சிஸ்டம்	- படிநிலை அமைப்பு
Vertebrates	- பாஸ்டீலிசு	- முள்ளந்தண்டினிகள்
Invertebrates	- அபாஸ்டீலிசு	- முள்ளந்தண்டிலிகள்
Binomial nomenclature	- டீலீப்டி நாமகரணம்	- இரு சொற்பெயர்