# DIGITAL TEXT BOOK

**6**

# Classification

- Three Domain classification
- Classification of Animals
- Classification of Plants
- Classification of newly Discovered Organisms
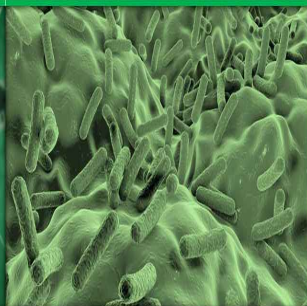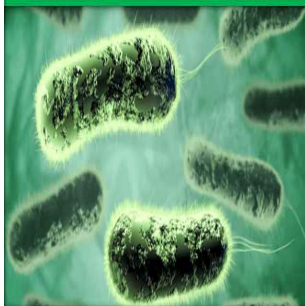- Evolutionary Tree
- DNA Barcoding

Do Archaebacteria belong to the Kingdom Monera?

| ARCHAEBACTERIA | EUBACTERIA |
| --- | --- |
| ✓ Cell walls lack peptidoglycan | ✓ Cell walls contain peptidoglycan |
| ✓ Found in extreme environment | ✓ Found everywhere in the environment |
| ✓ These are primitive and oldest bacteria | ✓ These are advanced or true bacteria |
| ✓ They are always aerobic | ✓ They may be aerobic or anaerobic |
| ✓ Less sensitive to antibiotics | ✓ May show sensitivity or resistance to antibiotics |

Haven't you noticed the doubt raised by the child watching the programme on KITE VICTERS channel?

What will be your response?

...........................................................................................................

It is from such doubts that classification methods have been evolved and updated.

Identifying organisms and understanding their characteristics lead to additions and updations in classification methods. The five-kingdom classification system has also been subjected to updations. Analyse the description and illustration 6.1 based on the indicators and prepare a note.

## Three Domain Classification

Carl Woese

A scientist named **Carl Woese** **(1928- 2012)** tried to study more about the organisms that belonged to Kingdom Monera. Through scientific observation, he realised that these microorganisms are distinct from bacteria. He also noted the structural differences between these organisms and their diverse adaptations for surviving the environmental changes. He identified that the genetic materials of such organisms were different from that of bacteria. Based on this, he classified **Kingdom Monera** into two, namely **Bacteria** and **Archaea** and further included another classification level called **Domain** above the Kingdom. Organisms belonging to all six kingdoms were organised into three domains. These were named as **Domain Bacteria, Domain Archaea** and **Domain Eukarya.**    CLICK TO SEE THE VIDEO
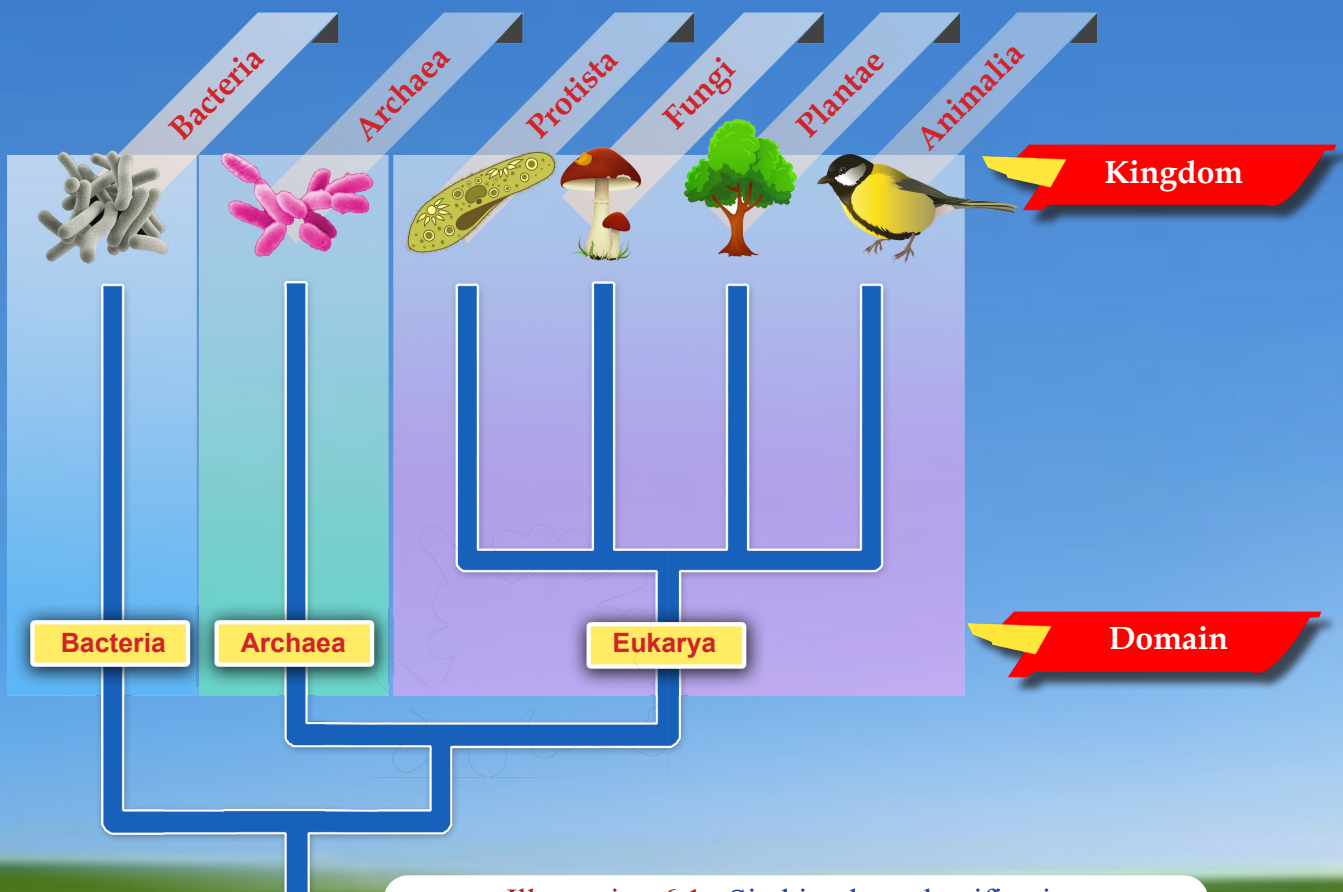
Bacteria   Archaea   Protista   Fungi   Plantae   Animalia

Kingdom

Bacteria   Archaea   Eukarya

Domain

Illustration 6.1 : Six kingdom classification

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- Contribution of Carl Wouse in Taxonomy
- Relevance of dividing the Kingdom Monera into different kingdoms such as Archaea and Bacteria
- Domains and their corresponding kingdoms.

Now you understood how organisms are classified into different kingdoms.

Complete the illustration 6.2 by including the peculiarities of kingdoms, citing suitable examples.

**Bacteria**
- Prokaryotes
- The cell wall consists of peptidoglycan.
- Found everywhere like soil, water, and inside other organisms.

e.g. Rhizobium, Vibrio cholerae

**Archaea**
- Prokaryotes
- The cell wall lacks peptidoglycan.
- Found in the extreme environment like hot springs, saline areas, etc.

e.g. Thermococcus, Halobacterium

**Animalia**
- ................................................
- ................................................

e.g.: ................................................
................................................

**Kingdom**

**Protista**
- ................................................
- ................................................

e.g.: ................................................
................................................

**Plantae**
- ................................................
- ................................................

e.g.: ................................................
................................................

**Fungi**
- ................................................
- ................................................

e.g.: ................................................
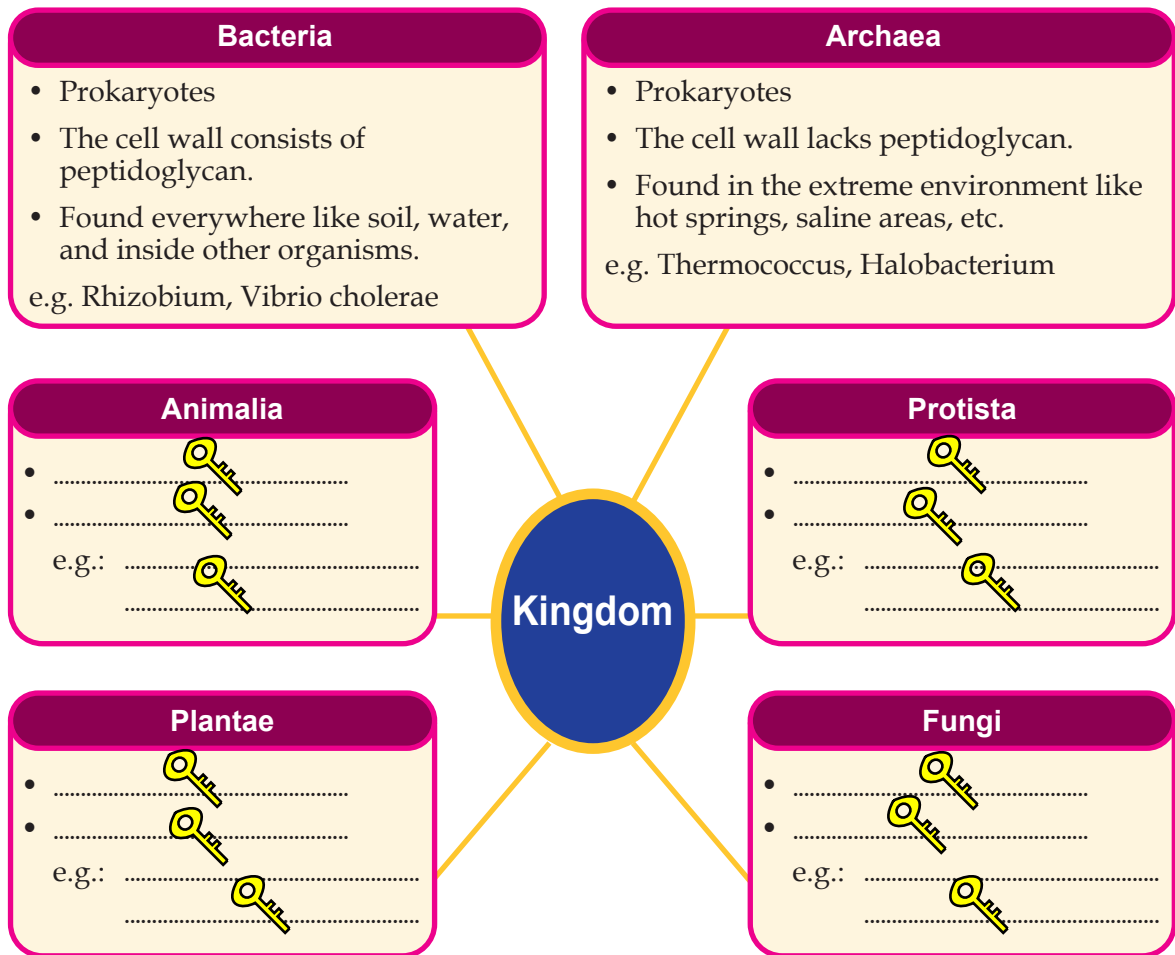................................................

Illustration 6.2 : Kingdoms and their peculiarities

Shall we learn more about the diverse animal world and the plant world?

## Classification of Animals

Animals are grouped into different phyla based on their structure, body cavities, germ layers and symmetry. Within the classification hierarchy of certain animals, there are additional subdivisions between phylum and class, such as subphylum, division and superclass. After analysing illustrations 6.3 (a, b, c), understand how organisms in the animal kingdom are classified into different phyla, and complete the worksheet 6.1.

### Phyla included in the Kingdom Animalia

| Porifera | Cnideria (Coelenterata) |
|---|---|
|  |  |
| CLICK TO SEE THE VIDEO | CLICK TO SEE THE VIDEO |
| Aquatic organisms with minute pores throughout the body<br>e.g. Sponges | Aquatic organisms with tentacles bearing cnidoblast<br>e.g . Hydra, Jelly fish, Sea anemone |
| Platyhelminthes | Nematoda |
|  |  |
| CLICK TO SEE THE VIDEO | CLICK TO SEE THE VIDEO |
| Small, soft and flat bodied worms | Long and round bodied worms |
| e.g. Planaria, Tape worm, Fluke | e.g. Round worm, Hook worm, Pin worm |

Illustration 6.3 (a) : Classification of animals

## Annelida

Segmented-bodied organisms

e.g. Earth worm, Leech

## Arthropoda

Organisms with jointed legs and exoskeleton

e.g. Prawn, Cockroach, Crab

## Mollusca

Soft body, in most organisms a shell made of calcium carbonate covers the body.

e.g. Snail, Octopus, Clam

## Echinodermata

Marine organisms with spiny body.

e.g. Sea Urchin, Star Fish.

Illustration 6.3 (b) : Classification of animals

## Chordata



**CLICK TO SEE THE VIDEO**

Organisms with rod shaped notochord or vertebral column

e.g. Man, Fish, Frog

Illustration 6.3 (c) : Classification of animals

### Notochord and Vertebral column

The notochord is a rod-like structure that appears in the place of the vertebral column during the early stages of growth, or throughout the life of animals in the phylum Chordata. Phylum Chordata derived its name due to the presence of the notochord. **Urochordata, Cephalochordata** and **Vertebrata** are the three sub phyla of Phylum Chordata. Notochord is seen in different forms in these organisms. In the sub phylum Urochordata, the notochord is restricted only to the tail region during the larval stage. However, in organisms included in the **subphylum Cephalochordata,** the notochord which extends as a rod-like structure from head to tail remains till the end of life. Whereas in subphylum Vertebrata, the notochord is present only during the embryonic stage, and as the embryo grows, it transforms into the vertebral column.

| Peculiarity | Phylum | Example |
|---|---|---|
| Marine organisms with a spiny body | Echinodermata | Sea Urchin, Star Fish |
| Worms with long, round bodies | Nematoda | Round worm, Hook worm |
| Aquatic organisms with minute pores throughout their bodies | Porifera | Sponges |
| Aquatic organisms with tentacles bearing cnidoblast | Cnidaria | Hydra, Jelly fish |
| Soft body, covered by a carbonate shell in most organisms | Mollusca | Snail, Octopus |
| Segmented bodied organisms | Annelida | Earth worm, Leech |
| Organisms with legs made up of small segments | Arthropoda | Prawn, Cockroach |
| Small, soft, flat-bodied worms | Platyhelminthes | Tape worm, Planaria |
| Organisms with rod shaped notochord or vertebral column | Chordata | Man, fish, frog |

Worksheet 6.1

Phylum Chordata consists of organisms having notochord. Vertebrates are included in subphylum **vertebrata** of Phylum Chordata. Analyse the table 6.2 and gather additional information to understand how the organisms included in this list are further classified. Based on this, complete the table by including the organisms given in the box.

| Super class | Class | Peculiarities | Examples |
|---|---|---|---|
| Pisces (having fins) | Chondrichthyes (Cartilaginous fishes) | Scales are there in the body. Heart is two-chambered. Habitat ------------- Means of Locomotion ----------- Respiratory organs ----------- | |
| | Osteichthyes (Bony fishes) | | |
| Tetrapoda (Having limbs) | Amphibia (Amphibians) | Complete the life cycle in land and water, Moist and slimy skin, Lay eggs, Respiratory organs----- Number of heart chambers ------- | |
| | Reptilia (Reptiles) | Reptiles, dry skin, scales are there in the body, nails on digits (except in snakes) Respiratory organs----- Number of heart chambers ------- Reproductive method -------- | |
| | Aves (Birds) | Body is covered with feathers, wings, claws on digits, Respiratory organs----- Number of heart chambers ------- Reproductive method -------- | |
| | Mammalia (Mammals) | Body is covered with hair/fur, nails on fingers and toes, lactate, respiratory organs----- Number of heart chambers ------- Reproductive method -------- | |

Table 6.2 : Classification of sub phylum vertebrata

Find out the number of heart chambers of crocodile and alligator.

Frog, Rohu, Cat, Crocodile, Mackerel, Tree frog, Kiwi, Viper, Crow, Wall lizard, Garden lizard, Domestic Fowl, Cow, Pigeon, Tiger, Pearl spot, Shark, Dolphin, Salamander, Alligator, Snake, Elephant, Penguin

Observe the other animals in your surroundings and group them into different classes. Now, create a digital presentation and present it in the class.

## Classification of Plants

You have understood the classification of animals into different groups. Kingdom Plantae is classified into different divisions on the basis of the similarities and differences in the body structure, vascular system and seed formation. Analyse the illustration 6.4 and prepare a note on the basis of indicators.
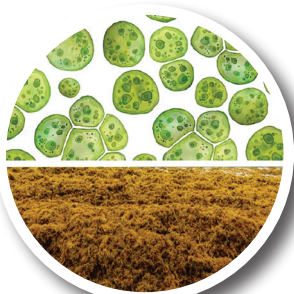
### Divisions of Kingdom Plantae

| Algae | Bryophyta | Pteridophyta |
|-------|-----------|--------------|
| CLICK TO SEE THE VIDEO | CLICK TO SEE THE VIDEO | CLICK TO SEE THE VIDEO |
| Most of them are aquatic. The body called as Thallus is not differentiated into root, stem and leaves as in higher plants. Both sexual and asexual modes of reproduction are seen. Vascular tissues are absent. | Mostly found on moist surfaces. There are parts like root, stem and leaf. Reproduction is done through gametes and spores. Vascular tissues are absent. | Mainly terrestrial plants. Root, stem and leaf have been formed. Reproduction is mainly through spores. Vascular tissues with simple structure are seen. |
| e.g. Spirogyra, Sargassum | e.g. Riccia, Funaria | e.g. Lycopodium, Pteris |

| Gymnosperms | Angiosperms |
|-------------|-------------|
| CLICK TO SEE THE VIDEO | CLICK TO SEE THE VIDEO |
| Reproductive structures known as cones are present. Even though seeds are formed, they are not embedded fruits. Complex vascular tissues are seen, but xylem vessels are absent. | Reproductive parts are present in the flowers. Fruits are seen covering the seeds. Complex vascular tissues are seen. Xylem vessels and tracheids are present. |
| e.g. Cycas, Pine | e.g. Hibiscus, Mango tree, Coconut tree. |

Illustration 6.4 : Classification of plants

- Different divisions of Kingdom Plantae
- Peculiarities in reproduction
- Presence of vascular tissues

## Difference in the classification

Earlier, the Kingdom Plantae was classified into five divisions: Thallophyta, Bryophyta, Pteridophyta, Gymnosperms and Angiosperms. Algae and fungi were included in the Thallophyta. However, in subsequent classification systems, fungi were placed in a separate kingdom based on their unique characteristics. In many modern classification systems, some algae are included in the Kingdom Protista. Algae, which share many characteristics with plants, are still classified within the Kingdom Plantae.
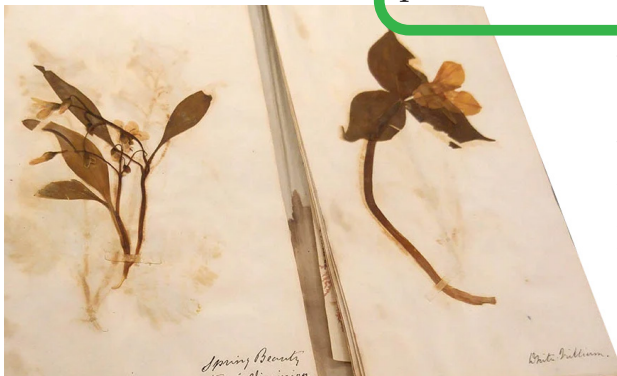
You have understood how plants are classified. Find out more plants that belong to each level and tabulate them. With the help of your teacher, prepare a herbarium of locally available plants. How will the plants included in the herbarium be scientifically classified and given names?

Pay attention to the following extract from a science article.

## The fame within the name

*Something interesting can also be found in the scientific names of organisms.*

### Sandracottus vijayakumari
A new species of beetle discovered in Nelliampathi

### Litsea vagamonica
A new plant in the category of Kuttippanal from Vagamon

### Brucethoa ISRO
A kind of parasite found in fishes at Kollam coastal area

New organisms are being discovered like this. There are continuous efforts to classify them as well. How can we understand that a newly discovered organism is not currently classified? Write down your assumption.

.................................................🔑.....................................................

Analyse the description and check the validity of your assumption.

## If a new organism is discovered...

The characteristics of an organism are examined and compared with that of other known species and its classification is done. This includes morphological features, peculiarities of body structure and biomolecules. Comparative analysis of the organism's DNA with that of other species is also crucial. If there are significant genetic differences, it can be confirmed that this organism belongs to a new species. This discovery is then published in an international science journal and made available to the scientific community and the general public.



> None of these classification methods include virus!

You have noticed the doubt of the child. What would be your response to this doubt? 🔑

Analyse the characteristics of viruses based on the given indicators and prepare a note.

Capsid

Genetic material
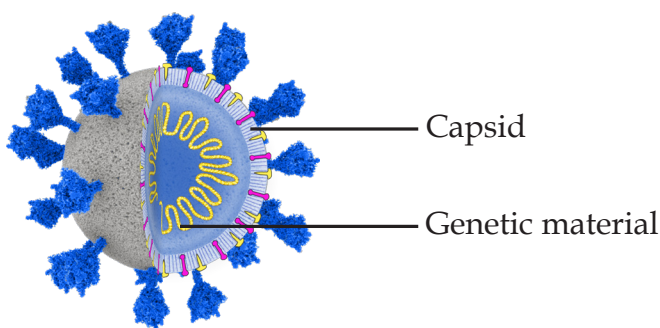
**CLICK TO SEE THE 3D VIEW OF VIRUS**

Fig. 6.1 : Virus

## Viruses and classification

Viruses could not be included in any category of the six-kingdom classification system. However, considering their structure, mode of division, genes, etc., virologists and taxonomists have classified viruses into families, genus and species which are meant only for them. This classification of viruses helps scientists to study their nature, evolution, development, etc. and develop methods to combat viral diseases.

Viruses have a simple structure devoid of cytoplasm, cell organelles and nucleus. Genetic materials (DNA or RNA) are found inside an outer protein coat called a capsid. They infect a wide variety of organisms, including plants, animals, bacteria and archaea.

Organisms having the ability to reproduce, respond to the environment, to grow, and do metabolic activities are included in the process of classification. Viruses cannot multiply without the help of a host cell. They are inactive outside any living cell. Due to these unique characteristics, they are not included in any category of the current six-kingdom classification.

- Structure of the virus
- Difference between Viruses and other Cells
- Reasons for not including Viruses in the classification.

Isn't it clear that none of the classification methods are complete?

Efforts to develop more scientific classification methods are going on.

Analyse the given description about modern techniques in classification and gain an understanding about it.

## Evolutionary Tree

The biodiversity of earth was developed as a result of the evolutionary processes. The evolutionary relationship between different organisms can be illustrated as branches of a tree. This is called an **Evolutionary Tree**. Here, the place where branches develop indicates ancestral organisms. The classification becomes more accurate by illustrating evolutionary relationships. It helps in developing an indepth understanding about biodiversity. In short, the Evolutionary Tree plays a crucial role in the studies of classification.

How is the Evolutionary Tree illustrated?

Observe the table 6.3 showing four peculiarities of organisms such as Lung Fish, Wall Lizard, Dog and Man. Analyse them on the basis of the indicators.

| Organisms | Peculiarities | | | |
|---|---|---|---|---|
| | Skull | Forelimbs | Hair/Fur | Lactation |
| Lung Fish | Yes | No | No | No |
| Wall Lizard | Yes | Yes | No | No |
| Dog | Yes | Yes | Yes | Yes |
| Man | Yes | Yes | Yes | Yes |

Table 6.3  Organisms and Peculiarities

- Features considered 🔑
- Organisms having all these features. 🔑

Analyse the illustration 6.5 and record your inferences about how the Evolutionary Tree of these organisms is constructed based on the characteristics given in the table.
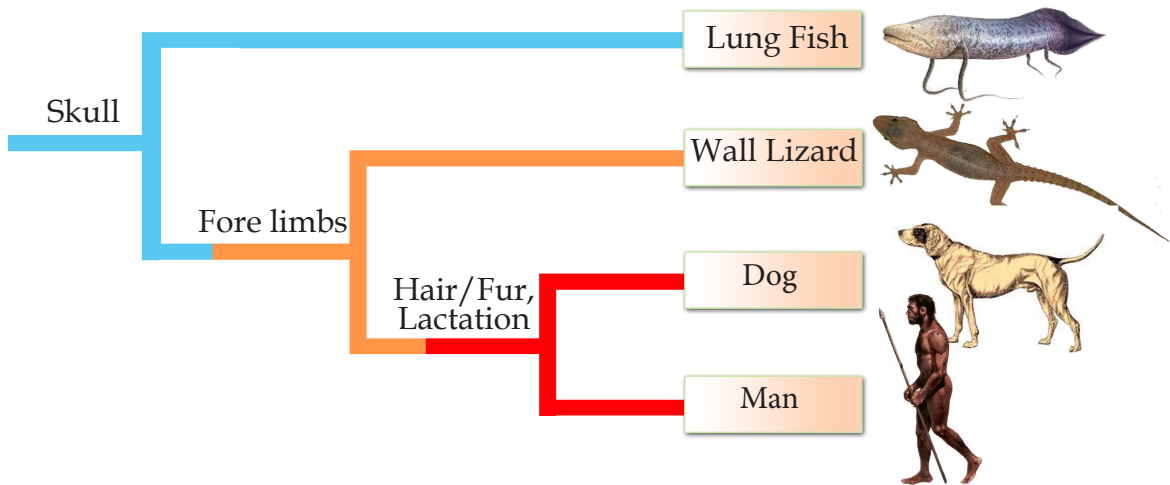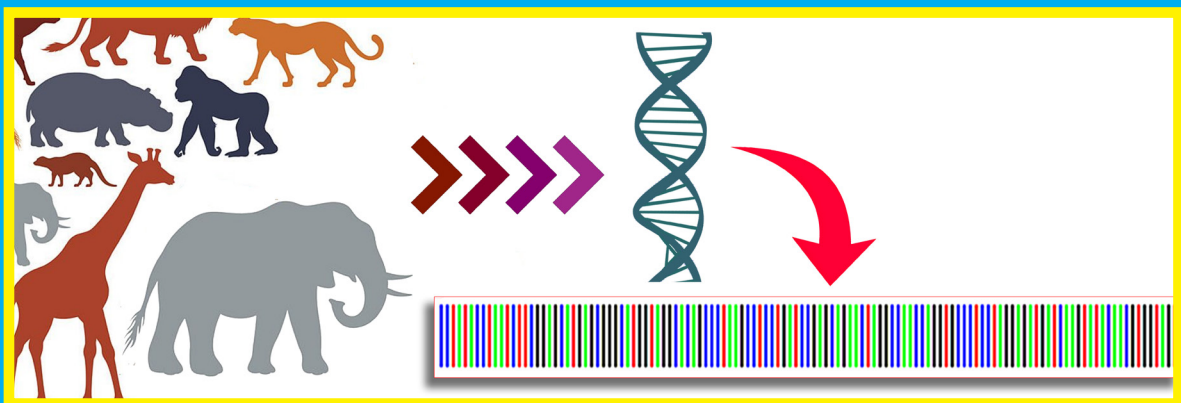
Illustration 6.5 : Evolutionary Tree

You have understood how to prepare an Evolutionary Tree based on similarities and differences between organisms.

To know more about the Evolutionary Tree and the relation between the organisms, visit the website **https://www.onezoom.org**

The most modern technology for classifying organisms is DNA barcoding.

## DNA Barcoding

Analyse the given description on the basis of indicators, collect more information and gain knowledge about this.

**CLICK TO SEE THE VIDEO**

**DNA bar coding** is the technology of classifying organisms by comparing the special molecular sequences (codes) of DNA. It is the most scientific technology for identifying the species in modern biological researches. Unlike the traditional methods, it helps to recognize the species at molecular level. This is made possible by the creation and sharing of DNA barcodes by the researchers and laboratories all over the world.
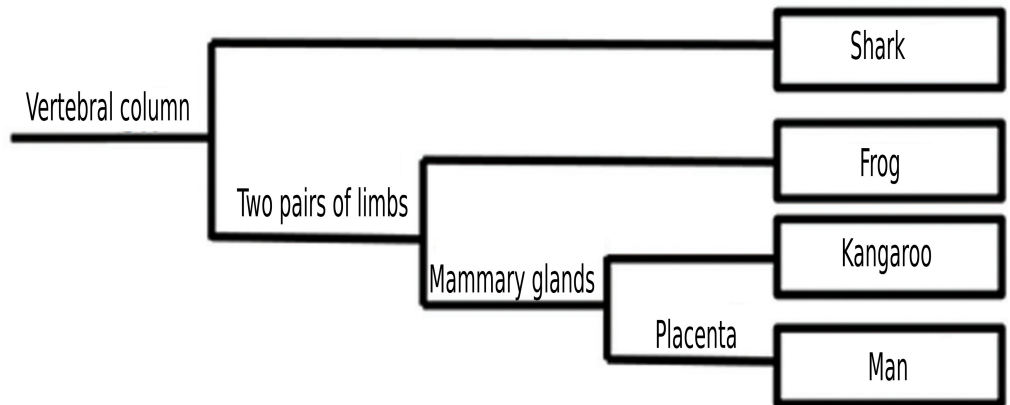
- DNA bar coding
- Importance of Barcoding

Classification has an impact on all areas such as characteristics of organisms, ecological interactions, biological evolution, biodiversity conservation, and biotechnology. There are millions of species on earth that are yet to be identified. Some became extinct even before they had a name of their own. Certain others are facing the threat of extinction. It is the responsibility of mankind to recognise all these species and protect them as they stand at the highest level of the taxonomical hierarchy. Only through this can man also ensure his survival.

## Let us Assess

1. Evolutionary Tree of the organisms

```
                                                        ┌──────────────┐
                                                        │    Shark     │
                        ┌───────────────────────────────┴──────────────┘
Vertebral column        │
────────────────────────┤                                ┌──────────────┐
                        │                                 │    Frog      │
                        │         ┌───────────────────────┴──────────────┘
                  Two pairs of limbs                      ┌──────────────┐
                                  │                       │  Kangaroo    │
                              Mammary glands ─────────────┤──────────────┘
                                             │            ┌──────────────┐
                                         Placenta ────────┤    Man       │
                                                          └──────────────┘
```

2. Different animals and the phyla to which they belong are given below. Make pairs as shown in the model.

   Model : Man – Chordata

   | Man, Sponges, Snail, Hydra, Round Worm, Starfish, Earthworm, Cockroach, Planaria | Porifera, Cnidaria, Platyhelminthes, Nematoda, Annelida, Arthropoda, Mollusca, Echinodermata, Chordata |
   |---|---|

3. How is the DNA barcoding technology used for identifying different species?

4. Plants without conducting tissues are included in a single group in Kingdom Plantae. Comment.

5. The peculiarities of certain divisions of Kingdom Plantae are given below. Identify and name the divisions by analysing them.

   a) Vascular tissues are present, Reproduction through spores.

   b) No fruits to cover the seeds. Reproduction through seeds.

   c) No vascular tissues. Reproduction with the help of gametes and spores.

6. Make corrections if any, in the underlined portions of the given statements.

    a) <u>Species</u> is the taxonomic level placed above the Kingdom.

    b) <u>Vertebrates</u> are included in sub phylum vertebrata of Phylum Chordata.

    c) <u>Mammalia</u> is the class containing organisms that complete their life cycle on land and in water.

7. Analyse the statement and reason, find the correct answer and write down.

    Statement : Viruses are not included in any category of the current six-kingdom classification.

    Reason : Viruses are inactive outside any living cell.

    a) Statement correct, reason false.

    b) Statement and reason are correct.

    c) Statement false, reason correct.

    d) Statement and reason are false.

8. Identify the relation and fill in the blanks.

    a) Jelly fish : Cnidaria;  Hook worm : ---------------

    b) Crab : Arthropoda;  Octopus        : ---------------

9. Which of the following category includes Mango tree and Coconut tree?

    a) Bryophyta

    b) Pteridophyta

    c) Gymnosperms

    d) Angiosperms

## Extended Activities

1. Prepare a Local Biodiversity Register including the common name and scientific name of various organisms in your locality and submit it to the local self government institution in your area.

2. Set up a Seed Library by collecting available seeds from your locality.

3. Collect data on the organisms recently discovered in Kerala, prepare a wall magazine and exhibit it in your class.

4. Observe the organisms that can be seen in your school campus and surroundings and classify them.