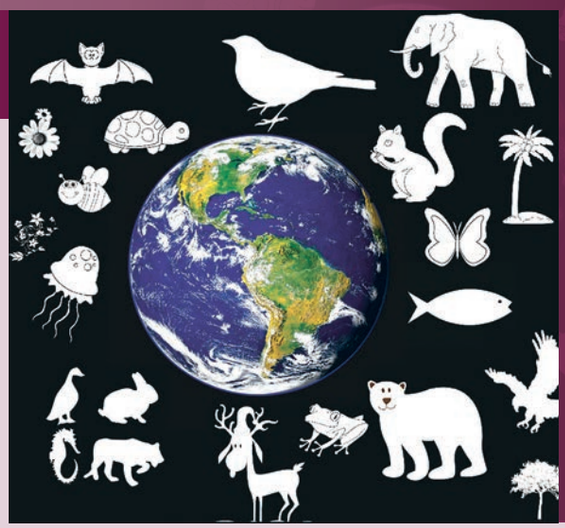
UNIT I

Chapter 1

The Living World

Chapter Outline



"Our task must be to…
embrace all living creatures and
the whole of nature and its beauty."
— Albert Einstein

Learning Objectives:

- *Learns the importance of the living world and its diversity*
- *Understands the need for classification*
- *Creates an interest in systematics and understands the importance of taxonomy for classification of animals*
- *Knows the key rules of nomenclatures and their uses*

67VHIT

All living forms co-exist with each other. There are about 8.7 million species of organisms have been estimated to exist on earth. A study reports that 86% of all species on the land and 91% of those in the seas are yet to be discovered, described and catalogued. Though humans are placed in the top most position on the hierarchy, they have to depend on plants and animals for food. Animals are also used as source of labour, in farming, as pets, and for other economic benefits. Understanding animals and their unique characteristics, habitats, behaviour and evolutionary relationships is very important. This chapter deals with, diversity in the living world, need for classification, types of classification, taxonomical hierarchy, nomenclature and tools for studying taxonomy.

1.1 Diversity in the Living World

Earth has numerous habitats with a wide range of living organisms inhabiting them. Plants and animals are present in almost all the places, from polar icecaps to volcanic hot springs, from shallow lagoons to the deepest oceans, from tropical rain forests to dry and parched deserts. There are a variety of species that have been adapted successfully to live in diverse ecosystems.

Ecosystem is a community of biotic and a biotic factors and their interrelationships (**A.G. Tansley, 1935**). The presence of a large number of species in a particular ecosystem is called 'biological diversity' or in short **'biodiversity'.** The term biodiversity was first introduced by **Walter Rosen (1985),** and defined by E.D. Wilson.

Characterstic features of living organisms

Living organisms show a variety of unique characters different from non-living matter. The key characters of living organisms are, cellular organization, nutrition, respiration, metabolism, growth, response to stimuli, movement, reproduction, excretion, adaptation and homeostasis. Numerous scientists and taxonomists have made tremendous contribution and documentation in the observation and study of even minute characters in living organisms. Their keen observations have led to the classification of living organisms and the study of their interrelationships.

1.2 Need for classification

We come across many places where things are arranged in specific categories. In super markets, the shelves can have rows and columns of groceries, cosmetics, toys, stationeries, snacks and utensils. If it is not arranged in a well organized manner, customers and sales persons will waste lot of time in finding an item. In the same way, libraries also organize the books alphabetically or genres-wise into autobiographies, novels, kids stories, science fictions, etc. Likewise it is nearly impossible to study all the living organisms. Hence it becomes necessary to device some means and methods to make this possible and this process is called **classification**. Classification is a process by which things are grouped in convenient categories, based on easily observable characters. The scientific term used for these categories is **taxa** (taxon–singular). Taxa indicates categories at different levels, for example Kingdom Animalia, includes multicellular animals such as reptiles, mammals, etc. Based on their characteristics, all living organisms can be classified into different taxa. This science of classification is called **taxonomy**. External and internal structures along with developmental processes and ecological information of organisms are essential, as they form basis of the taxonomical studies. Hence, characterisation, identification, nomenclature and classification are the scientific stages that are basic to taxonomy.

The basic need for classifications are:

- To identify and differentiate closely related species
- To know the variation among the species
- To understand the evolution of the species
- To create a phylogenetic tree among the different groups
- To conveniently study living organisms

1.3 Taxonomy and Systematics

Taxonomy (G. *taxis*- arrangement; *nomos*-law) is the science of arrangement of living organisms along with classification, description, identification, and naming

of organisms which includes all flora and fauna including microorganisms of the world. The word taxonomy was coined by **Augustin Pyramus de Candole (1813).** Taxonomy is a theoretical study of classification with well defined principles, rules and procedures. **Aristotle** is called the father of taxonomy (classical) and **Carolus Linnaeus is** the father of modern taxonomy.

Systematics (G. *System*/sequence)

The objectives of taxonomy and systematics are very similar; their goal is to classify organisms with stipulated rules. The main criteria of systematics is identifying, describing, naming, arranging, preserving and documenting the organisms. Apart from the above said features, evolutionary history of the species and the environmental adaptations and interrelationship between species are also being investigated in systematics.

Carolus Linnaeus is the father of modern taxonomy, which is the system of classifying and naming organisms. One of his contributions was the development of a hierarchical system of classification of nature. Today, this system includes eight taxa: domain, kingdom, phylum, class, order, family, genus, and species.

History of Classification

Early classification of organisms were based on only two criteria, beneficial or harmful animals. An ancient classification system recognized 5 animal groups - domestic, wild, creeping, flying and sea animals. Initially the classification was based on organism's fundamental characteristics such as the habitat and morphology only.

Aristotle (384 to 322 BC), was the first to classify all animals in his **History of Animals** (*Historia Animalium* in Latin). He attempted a basic classification of all living organisms into Plants and Animals. Animals were classified based on locomotion; walking (terrestrial), flying (aerial) and swimming (aquatic). Based on the presence or absence of red blood he classified the animals into two as *Enaima* with blood and those without blood as *Anaima*.

Aristotle's classification system had limitations and many organisms were not fitting into his classification. For example, the tadpoles of frogs are born in water and have gills but when they metamorphosed into adult frogs they have lungs and can live both in water and on land. How to classify frogs and where to place them? Aristotle classified organisms based on locomotion, hence, birds, bats, and flying insects were grouped together just by observing one single characteristic feature, the flying ability. On the contrary to the above said example, the ostrich, emu and penguin are all birds but cannot fly. So Aristotle would not have classified them as birds. In spite of these limitations Aristotle's classification system was followed for more than 2000 years upto 1700.

After Aristotle, his student **Theophrastus** (372-287 BC) continued his research on the classification of plants, and he was known as the "Father of Botany." There was a huge gap till 16th century, then the English naturalist **John Ray** (1627–1705) wrote several important works through his life. His most important contribution was the establishment of species as the ultimate unit of taxonomy. In 1682 he published the *Methodus Plantarum Nova*, which contained about **18,000** plant species, a result of a relatively narrow species concept. His complicated classification was based on many combined characters, as opposed to earlier taxonomists. John Ray also aimed at publishing a complete system of nature, which included works on mammals, reptiles, birds, fishes and insects. The Swedish biologist **Carolus Linnaeus (1707 - 1788)** father of modern taxonomy and founder of modern systematics developed a scientific system of taxonomy and binomial nomenclature, which is still (with modifications) in use.

Aristotle to Linnaeus employed easily observable single to few traits for classification of organisms. With increased knowledge of the several biological domains, many characters were considered for classifying organisms. This represented the phase of classical taxonomy which was based on overall similarities or affinities derived from morphology, anatomy and embryology of organisms. A modification of this system is the numerical taxonomy, which evolved in the 1950s. This system evaluates the resemblances and differences through statistical methods followed by computer analyses to establish the numerical degree of relationship among individuals. Later on biologists initiated studies on the evolutionary and genetic relationships among organisms, which led to the emerge of **phylogenetic classification or cladistics.** It is an evolutionary classification based on how a common ancestry was shared. Cladistic classification summarizes the genetic differences between all species in the 'phylogenetic tree'. **Ernst Haeckal** introduced the method of representing evolutionary relationships with the help of a tree diagram known as **cladogram**.

This system of classification takes into account ancestral characters (traits of basic body design which would be in the entire group) and derived characters (traits whose structure and functions differs from those of ancestral characters). One or more derived characters which appeared during evolution resulted in the formation of new subspecies. In a cladogram each evolutionary step produces a branching and all the members of the branch would possess the derived character which will not be seen in organisms below the particular branch point. Arranging organisms on the basis of their similar or derived characters which differ from the ancestral

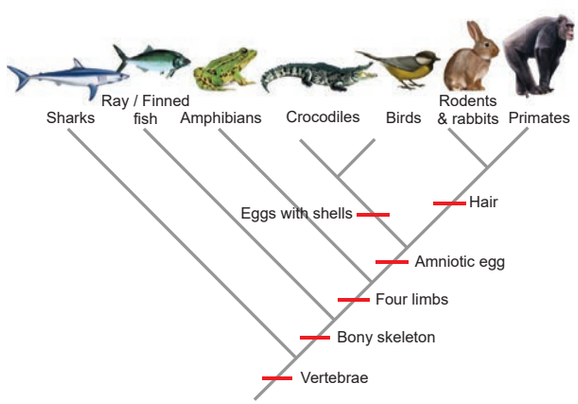


Figure 1.1 Example of a Cladogram

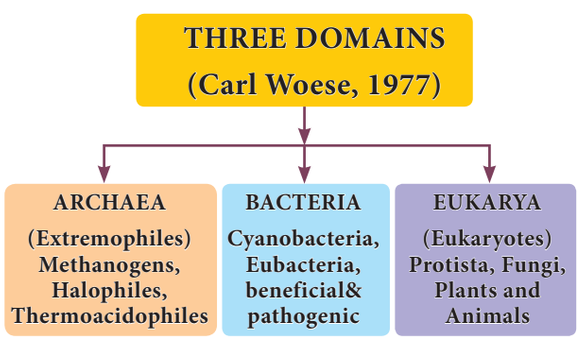
characters produced a **phylogenetic tree or cladogram** (Figure 1.1).

Depending on the system of classification, organisms were classified into two or three kingdoms. Later into four, five, six and now into seven kingdoms. **R.H.Whittaker** (1969) proposed the **Five kingdom Classification**, the Kingdoms defined by him were **Monera, Protista, Fungi, Plantae, and Animalia** based on the cell structure, mode of nutrition, mode of reproduction and phylogenetic relationships. Table 1. gives a comparative account of different characteristics of the five kingdoms.

Classification has come a long way and now takes into an account even molecular level DNA and RNA identification. The advancement in molecular techniques and biochemical assays has led to a new classification - The "**Three Domain" classification**.

1.4 Three Domains of life

Three domain classification was proposed by **Carl Woese** (1977) and his co-workers. They classified organisms based on the difference in 16S rRNA genes. The three domain system adds the taxon 'domain' higher than the kingdom. This system emphasizes the separation of Prokaryotes into two domains, Bacteria and Archaea, and all the eukaryotes are placed into the domain Eukarya. Archaea appears to have more in common with the Eukarya than the Bacteria. Archaea differ from bacteria in cell wall composition and differs from bacteria and eukaryotes in membrane composition and rRNA types.



1. Domain Archaea

This domain includes single celled organisms, the prokaryotes which have the ability to grow in extreme conditions like volcano vents, hot springs and polar ice caps, hence are also called **extremophiles.** They are capable of synthesizing their food without sunlight and oxygen by utilizing hydrogen sulphide and other chemicals from the volcanic vents. Some of the them produced methane (methanogens), few live in salty environments (Halophiles) and are thermoacidophiles which thrive in acidic environments and at high temperatures.

Thermus aquatics is a bacterium which can tolerate high temperatures. The first DNA polymerase enzyme was isolated from *T. aquaticus* it is used in **PCR** (Polymerase Chain Reaction) for DNA amplification.

2. Domain Bacteria

Bacteria are prokaryotic, their cells have no definite nucleus and DNA exists as a circular chromosomes and do not have histones associated with it. They do not possess membrane bound organelles except for ribosome (70S type). Their cell wall contains peptidoglycans. Many are decomposers, some are photo-synthesizers and few cause diseases. There are beneficial **probiotic** bacteria

and harmful **pathogenic** bacteria which are diversely populated. Cyanobacteria are photosynthetic blue green algae which produce oxygen. These had played a key role in the changes of atmospheric oxygen levels from anaerobic to aerobic during the early geologic periods.

3. Domain Eukarya (Eukaryotes)

Eukaryotes are animals which have true nucleus and membrane bound organelles. DNA in the nucleus is arranged as a linear chromosome with histone proteins, ribsosomes of 80S type in the cytosol and 70S type in the chloroplast and mitochondria. Organisms in this domain are classified under kingdoms, namely, Protista, Fungi, Plantae and Animalia.

In 1987, **Cavalier-Smith** revised the six kingdom system to **Seven Kingdom system.** The concept of super kingdom was introduced and revised to seven kingdom classification. The classification is divided into two Super Kingdoms (Prokaryota and Eukaryota) and seven kingdoms, two Prokaryotic Kingdoms (Eubacteria and Archaebacteria) and five Eukaryotic Kingdoms (Protozoa, Chromista, Fungi, Plantae and Animalia). (Table 1.1).

Curd is one of the best sources of probiotics, which are friendly bacteria that can improve our health. e.g. *Lactobacillus sp.*

The Three-Domain System

Archaea | Bacteria | Eukarya

The traditional Five – Kingdom system

Monera | Protista | Fungi | Plantae | Animalia

The Six –Kingdom system

Bacteria | Archaea | Protista | Fungi | Plantae | Animalia

The Seven – Kingdom system

Eubacteria | Archaea bacteria | Protozoa | Chromista | Fungi | Plantae | Animalia

Table 1.1 Five Kingdom Classification

Salient features	KINDS OF KINGDOM				
	Monera	Protista	Fungi	Plantae	Animalia
Cell type	Prokaryotic	Eukaryotic	Eukaryotic	Eukaryotic	Eukaryotic
Cell wall	Non-cellulose structure	Present in some	Present	Present	Absent
Body organisation	Cellular	Cellular	Multicelluar Tissue	Tissue Organ	Tissue Organ Organ system
Mode of nutrition	Autotrophic Heterotrophic	Autotrophic Heterotrophic	Heterotrophic	Autotrophic	Heterotrophic

1.5 Taxonomic hierarchy

In biological classification, the taxonomical hierarchy includes seven major categories namely kingdom, phylum, class, order, family, genus and species and other intermediate categories such as subkingdom, grade, division, subdivision, subphylum, superclass, subclass, superorder, suborder, superfamily, subfamily and subspecies.

Species

Species is the basic unit of classification in the taxonomic hierarchial system. It is a group of animals having similar morphological features (traits) and is reproductively isolated to produce fertile offspring. There are some exceptional animals which can produce **sterile offspring** because of mating with closely related species (Figure 1.2).

Genus: It is a group of closely related species which have evolved from a common ancestor. In some genus there is only one species which is called as **monotypic genus** (e.g. Red panda is the only species in the genus *Ailurus* : *Ailurus fulgens*). If there are more than one species in the genus it is known as **polytypic genus,** for example 'cats' come under the Genus *Felis*, which has a number of closely related species, *Felis domestica* (domestic cat), *Felis margarita* (jungle cat). *Felis silvestris* (wild cat)

Family: It is a taxonomic category which includes a group of related genera with less similarity as compared to genus and species. For example, the family Felidae includes the genus *Felis* (cats) and the genus *Panthera* (lions, tigers, leopards).

Order: This category includes an assemblage of one or more related families which show few common features. One or more similar families are grouped together to form an order. For example, family *Canidae* and *Felidae* are placed in the order Carnivora.

Class: This category includes one or more related orders with some common characters. For example order Primata comprising monkeys, apes and man is placed in the Class Mammalia, along with

Hinny

Mule

Liger

Tigon

Figure 1.2 Sterile offsprings

Crosses between

Male horse and Female Donkey results in **Hinny** (Sterile).

Male Donkey and Female Horse results in **Mule** (Sterile)

Male Lion and Female Tiger results in **Liger**

Male Tiger and Female Lion results in **Tigon**

Systematics of Human being

KINGDOM
Animalia - Animals are multicellular eukaryotic organisms

PHYLUM
Chordata – Animals with a notochord or vertebral column (Back bone)

CLASS
Mammalia – Body covered with hair or fur. Mammary glands are present

ORDER
Primata – Mammals with forward looking eyes and grasping fingers

FAMILY
Hominidae – Primates with relatively flat faces and binocular vision

GENUS
Homo – Hominids with large brain and upright posture

SPECIES
sapiens – Bipedal and higher intelligence

Recently discovered species in South India

Scientists have discovered a new and unusual species of frog in the Western Ghats in India in August 2017. The frog has shiny, purple skin, a light blue ring around its eyes, and a pointy pig-nose. It is named as Bhupathy's purple frog (*Nasikabatrachus bhupathi*) to honour Dr.Subramaniam Bhupathy, herpetologist who lost his life in the Western Ghats in 2014.

the order Carnivora which includes dogs and cats.

Phylum: The group of classes with similar distinctive characteristics constitute a phylum. The classes Pisces, Amphibia, Reptilia, Aves and Mammalia constitute the next higher category, phylum Chordata. These classes share some common features like presence of a notochord and a dorsal tubular nerve cord hence included in the phylum Chordata.

Kingdom: All living animals belonging to various phyla are included

DO YOU KNOW?

In July, 2017, a 9 years old boy discovered a new Freshwater species of Jellyfish in the Kodaikanal lake, Tamilnadu.

DO YOU KNOW?

A newly discovered Himalayan forest thrush bird was named after the birdman of India, Ornithologist Dr. Salim Ali. The name of the bird is "*Zoothera salimalii*". A fruit bat is also named after him "*Latidens salimalii*"

in the Kingdom Animalia and it is the top most of the taxonomic hierarchy.

1.6 Nomenclature

Giza, Inimene, Emberi, Manna,
Doanna, Umano …….

In all probability these words must be new to you…but they all mean "Human" in different foreign languages! There are presently more than 6000 languages in the world and an animal can be named in more than 6000 ways! Unfortunately it is impossible for anyone to have a good functioning knowledge of most languages and hence there arises a need for a universally accepted scientific naming system for all organisms. The process of assigning scientific names to animals or taxonomic group is called nomenclature. For example, worldwide, the scientific name *Homo sapiens* denotes *human*. Classification and grouping were done to facilitate a deeper understanding of the unique characteristics of each organism and its interrelationship among closely related species. It plays a vital role in the arrangement of known species based on their similarities and dissimilarities. Numerous characters such as morphology, genetic information, habitat, feeding pattern, adaptations, evolution, etc., are examined before an organism is named.

One of the primary responsibilities of systematic biology is the development of biological nomenclature and classification. Nomenclature is not an end to systematics and taxonomy but it is necessary in organizing information about biodiversity. Nomenclature, functions to provide names for all taxa at all levels in the hierarchy of life. Naming of the organisms is done based on the guidelines of the International Code of Zoological Nomenclature (ICZN). The scientific name ensures that each organism has only one name.

Binomial nomenclature
(L. *Bi*-two; *Nomen*-Name)

Biologists follow universally accepted principles to provide scientific names to known organisms. Each name has two components, a generic name and a specific epithet. This system of naming the organism is called **Binomial Nomenclature** which was popularised by Carolus Linnaeus and practised by biologists all over the world. Example, the National Bird (Indian Peafowl) – *Pavo cristatus,* the National Animal tiger as *Panthera* tigris, and the Tamil Nadu State bird is the common Emerald dove *Chalcophaps indica*.

Biological nomenclature derives from the binomial (or binominal) nomenclature that was originally codified in the works of Linnaeus, *Species Plantarum* (1753) and *Systema Naturae*, 10th Edition (1758). These publications are the starting points for the modern biological nomenclature in most groups of plants and animals.

If you find an animal with four legs, with two eyes, paired ear pinna, covered with fur, possessing mammary gland , which class will you position it? How will you give a binomial name, if you are the first person to discover and report that animal.

Trinominal nomenclature (*Tri* – three)

This naming system was proposed by Huxley and Stricklandt, Trinomen means, three names: generic name, species name and sub-species name. When members of any species which have large variations then trinomial system is used. On the basis of dissimilarities, this species gets classified into subspecies. It is the extension of binominal nomenclature system which has an addition of subspecies. All the three names are set in italics and only the first letter of generic name is capitalized, if handwritten then it should be underlined separately E.g.*Corvus splendens splendens* (Indian house crow)

Tautonymy: The practice of naming the animals in which the generic name and species name are the same, is called Tautonymy. e.g. *Naja naja* (The Indian Cobra).

What may be the reasons for the extinction of Dinosaurs? If you know the reasons for their extinction, why Sparrows are listed as endangered species?

Rules of Nomenclature

- The scientific name should be italicized in printed form and if handwritten, it should be underlined separately.
- The generic name's (*Genus*) first alphabet should be in uppercase.
- The specific name (*species*) should be in lowercase.
- The scientific names of any two organisms are not similar.
- The name or abbreviated name of the scientist who first publishes the scientific name may be written after the species name along with the year of publication. For example Lion-*Felis leo* Linn., 1758 or *Felis leo* L., 1758.
- If the species name is framed after any person's name the name of the species shall end with i, ii or ae.

For example, a new species of a ground-dwelling lizard (Cyrtodactylus) has been discovered and named after Scientist Varad Giri, *Cyrtodactylus varadgirii*.

1.7 Concept of species

Species is the basic unit of classification. The term species was coined by **John Ray**, and in his book ***"Historia Generalis Plantarum"*** (3 volumes) in 1693 described species as a group of morphologically similar organisms arising from a common ancestor. Carolus Linnaeus in his book ***"Systema naturae"*** considered species as the basic unit of classification. Species can be defined as a group of organisms that have similar morphology and physiology and can interbreed to produce fertile offsprings. In 1859 Charles Darwin in his book **Origin of species** explains the evolutionary connection of species by the process of natural selection.

1.8 Tools for study of taxonomy

Tools and taxonomical aids may be different for the study of plants and animals. Herbarium and Botanical garden

may be used as tools for the study of plant taxonomy. In the case of animal studies, the classical tools are Museum, Taxonomical Keys and Zoological and Marine parks.

The important components of the taxonomical tools are field visits, survey, identification, classification, preservation and documentation. Many tools are being used for taxonomical studies, amongst them some of the important tools are discussed below:

Arignar Anna Zoological Park, also known as the Vandalur Zoo is in the south western part of Chennai, Tamil Nadu, spreads over an area of 1500 acres, is one of the largest zoological parks in India. The zoo houses 2,553 species of both flora and fauna.

The classical taxonomical tools

Taxonomical Keys: Keys are based on comparative analysis of the similarities and dissimilarities of organisms. There are separate keys for different taxonomic categories.

Museum: Biological museums have collection of preserved plants and animals for study and ready reference. Specimens of both extinct and living organisms can be studied.

Zoological parks: These are places where wild animals are kept in protected environments under human care. It enables us to study their food habits and behaviour.

Marine parks: Marine organisms are maintained in protected enviroments.

Printed taxonomical tools consist of identification cards, description, field guides and manuals.

Molecular taxonomical tools

Technological advancement has helped to evolve molecular taxonomical tools from classical tools to molecular tools. The accuracy and authenticity is more significant in the molecular tools. The following methods are being used for taxonomical classification.

Molecular techniques and approaches such as **DNA barcoding** (short genetic marker in an organism's **DNA** to identify it as belonging to a particular species), **DNA hybridization** (measures the degree of genetic similarity between pools of DNA sequences), **DNA fingerprinting** (to identify an individual from a sample of DNA by looking at unique patterns in their DNA), Restriction Fragment Length Polymorphisms (RFLP) analysis (difference in homologous DNA sequences that can be detected by the presence of fragments of different lengths after digestion of the DNA samples), and Polymerase Chain Reaction (PCR) sequencing (to amplify a specific gene, or portion of gene,) are used as taxonomical tools.

Automated species identification tools

It consists of Cyber tools. For example: ALIS, DAISY, ABIS, SPIDA, Draw wing, etc.

ALIS ➜ Automated Leafhopper Identification System.

DAISY ➜ Digital Automated Identification System.

ABIS ➜ Automatic Bee Identification System.

SPIDA ➜ Species Identified Automatically (spiders, wasp and bee wing characters).

Draw wing ➜ Honey bee wing identification.

Neo taxonomical tools – This is based on Electron Microscopy images to study the molecular structures of cell organelles.

Ethology of taxonomical tools – Based on the behaviour of the organisms it can be classified. For example sound of birds, bioluminescence, etc.

e-Taxonomic resources – INOTAXA is an electronic resource for digital images and description about the species which was developed by Natural History Museum, London. **INOTAXA** means **In**tegrated **O**pen **TAX**onomic **A**ccess.

Summary

Earth has numerous habitats with a wide range of living organisms inhabiting it. Living organisms show a variety of unique characters different from non-living matter. Classification is the process by which anything is grouped in a convenient category based on some easily observable characters.

Taxonomy is the science of arrangement of living organisms. R. H. Whittaker proposed the five kingdom classification. Three domain classification was proposed by Carl Woese and his co-workers.

The taxonomical hierarchy includes seven categories namely kingdom, phylum, class, order, family, genus and species. The process of assigning scientific names to animal or taxonomic group is called nomenclature. Each scientific name has two components, generic name and a specific epithet. The important component of the taxonomical tools are field visits, survey, identification, classification, preservation and documentation. Molecular taxonomical tools are more accurate, authentic and significant for taxonimical classification.

Activity

The main objective of this activity is to check the students understanding about animals and its characteristics before learning the lesson. Observe the picture given below, identify the animals and classify them according to your own understanding; write one character about each class of animals.

Take the students to the school ground and ask them to observe and identify few invertebrates (insects, earthworm, spiders etc). Ask the students to write few characteristics of each animal which they have observed.

Sl.No	Name of the Animal	Known Character	Class	Habitat
1				
2				
3				
4				

Evaluation

1. A living organism is differentiated from non-living structure based on
   a. Reproduction
   b. Growth
   c. Metabolism d. All the above
2. A group of organisms having similar traits of a rank is
   a. Species b. Taxon
   c. Genus d. Family
3. Every unit of classification regardless of its rank is
   a. Taxon b. Variety
   c. Species d. Strain
4. Which of the following is not present in same rank?
   a. Primata b. Orthoptera
   c. Diptera d. Insecta
5. What taxonomicaid gives comprehensive information about a taxon?
   a. Taxonomic Key b. Herbarium
   c. Flora d. Monograph
6. Who coined the term biodiversity?
   a. Walter Rosen b. AG Tansley
   c. Aristotle d. AP de Candole
7. Cladogram considers the following characters
   a. Physiological and Biochemical
   b. Evolutionary and Phylogenetic
   c. Taxonimic and systematic
   d. None of the above
8. Molecular taxonomic tool consists of
   a. DNA and RNA
   b. Mitochondria and Endocplamic reticulum
   c. Cell wall and Membrane proteins
   d. All the above
9. Differentiate between probiotics and pathogenic bacteria.
10. Why mule is sterile in nature?
11. List any five salient features of the family *Felidae*.
12. What is the role of Charles Darwin in relation to concept of species?
13. Why elephants and other wild animals are entering into human living area?
14. What is the difference between a Zoo and wild life sanctuary?
15. Can we use recent molecular tools to identify and classify organisms?
16. Explain the role of Latin and Greek names in Biology.

ICT Corner Deep Tree

Let's do this activity to know the position of a particular species in the **Evolution path**.

Step – 1: Type the URL in the browser. Click 'Play Game' button then use your personal or school id to login. Otherwise use Guest Pass to enter. Then click the DEEP TREE icon that is given below The Evolution Lab to start the activity.

Step – 2: Input the common name of any animal in the SEARCH tab given at the bottom of the activity window, select the appropriate Zoological name from the list appeared.

Step – 3: The Classification and the place of the species in the animal Kingdom can be viewed by clicking the Icon placed next to the search tab.

Step – 4:Two different species can be compared by clicking on the RELATE button given at the bottom of the activity window. The relation between those species can be learnt by clicking the DNA icon appeared.

DEEP TREE url
http://www.pbs.org/wgbh/nova/labs/lab/evolution/

B167_STD_11_ZOOLOGY_EM