5. According to Hardy Weinberg Principle, $(p + q)^2 = 1$. Explain this mathematical expression.

.....

1.3 CLASSIFICATION

1.3.1 Meaning of Classification

Classification means identifying similarities and differences between different kinds of organisms and then placing similar organisms in one group and different kinds of organisms in different groups.

Taxonomy, may thus be defined as the science of classification of organisms into categories, maintaining certain rules. Early taxonomists classified organisms according to **morphological features** only. Once the concept of organic evolution was accepted, taxonomists began to draw evolutionary relationships between different kinds of organisms. This was termed **systematics.** Today taxonomy and systematics are treated as synonymous, since for classification, both morphological and biochemical resemblances and even those between molecules such as DNA and RNA are studied to establish evolutionary relationships.

1.3.2 Taxonomic categories

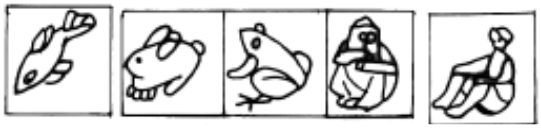
While classifying an organism, it is assigned to categories which show its evolutionary relationship with other groups of organisms. Each level or category is termed **taxon** (plural-taxa). The lowermost category of classification or taxon is **species**. Other categories are arranged above the species so that there is a hierarchy of categories. The various taxonomic categories are given below :

Species	:	Group of individuals of one kind which can interbreed to produce fertile offsprings.
Genus	:	Group of species resembling each other in several features indicating common ancestry.
Family	:	Group of genera (singular-genus) resembling each other. e.g. *Felis domestica* (the cat) and *Panthera tigris* (the tiger), both belong to the family Felidae.
Order	:	Includes families showing similar characteristics.
Class	:	Includes related orders.
Phylum	:	Includes related classes. (See Fig. 1.13)

The various phyla belong to their respective **kingdoms**. There are **five kingdoms** about which you will learn later. Humans belong to the kingdom Animalae and classification of humans is given as an example to describe the manner in which living organisms are classified.

Kingdom : Animalae (Animals)

Phylum : Chordata (Animals with notochord/ backbone)



Class : Mammalia (Animals that suckle their young ones.)

Order : Primates (Mammals with larger brains and binocular vision)

Family : Hominidae (Humans and human like ancestors)

Genus : *Homo* (Fossilmen and modern man)

Species : *H.sapiens* (Modern man)

Fig. 1.13 Classification of Human species

1.3.3 Scientific naming of organisms

Different plants and animals have different common names. A cat is called 'billi' in Hindi, 'biral' in Bengali, 'punai' in Tamil and 'manjar' in Marathi. There are different words for cat in French or German. Thus, there arose the need to give organisms names which could be understood throughout the world. Therefore, scientific names which are understood all over the world were given to organisms.

A simplified system of naming organisms called **binomial nomenclature** has been the standard for more than two centuries now. It was proposed by the Swedish biologist, **Carolus Linnaeus (1707-1778)**. Binomial nomenclature simply means **two-name** system of naming. The name of every category of organism has two parts, that of the **genus** followed by that of **species**. The generic name is written with a capital letter and the specific name with a small letter. e.g. ***Homo sapiens*** is the scientific name of modern man, ***Mangifera indica*** is the boctnical name of mango.

Three main features of biological naming are as follows :

1. A scientific name, by convention, is printed in **italics** or **underlined** when hand written.
2. Scientific naming is according to a set of scientific rules of nomenclature.
3. Scientific names are mostly in *Greek* and *Latin*. They are uniformely understood all over the world and have made communication about organisms easier.

1.3.4 Prokaryotes and Eukaryotes

The organisms that are most primitive or the first to evolve on earth are the bacteria. They do not possess a nuclear membrane around their single chromosome. Absence of a well-defined nucleus or in other words a primitive nucleus terms them **prokaryotes** (pro = primitive, karyon = nucleus). **All bacteria including blue-green algae (Cyanobacteria) are prokaryotes**. As a constrast, **organisms other than bacteria** possessing a well-defined nucleus are **eukaryotes** (eu = true; karyon = nucleus). There are other differences between prokaryotes and eukaryotes which are given below in Table 1.1.

Table 1.1 Differences between Prokaryotes and Eukaryotes

Characteristics	Prokaryotes	Eukaryotes
1. Size	0.1-10 µm	10-100 µm (larger volume)
2. Genetic material	Circular DNA, no linear DNA, no histones associated with DNA, nucleoid form, no nuclear membrane	Histones present on which DNA molecule wrapped, well defined linear chromosomes, with free terminal end nuclear membrane present
3. Site of nuclear material	DNA in cytoplasm	DNA inside distinct nucleus
4. Organelles	No membrane bound organelles	Mitochondria, golgi body, lysosomes present in the cell
5. Cell wall	Always present, Contains peptidoglycan	None in (animals) and made of cellulose/chitin in plants and fungi
6. Respiration	By mesosomes	By mitochondria
7. Reproduction	Mostly asexual e.g. bacteria and cyanobacteria (blue-green algae)	Asexual and sexual e.g. Protoctista, fungi, plants Animals

1.3.5 The Five Kingdoms of Organisms

Till recently there were only two kingdoms for classification - **Plantae** and **Animalae**. Such a two kingdom classification had several drawbacks, e.g. bacteria and fungi were kept alongwith plants although they are very different.

R.H. Whittaker in 1969 suggested the five kingdom classification which is based on the following three criteria.

(i) The presence or absence of a well-defined nucleus.

(ii) Unicellular or multicellular

(iii) Mode of nutrition

The five kingdoms are Monera, Protista or Protoctista and Fungi, Plantae and Animalae. Based on the three criteria mentioned above, (Fig. 1.13) the five kingdom classification is explained as under.

Table 1.2 The five kingdom classification of organisms

Names of Kingdoms	Nature of nucleus	Whether unicells or multicells	Kinds of nutrition
1. **MONERA** (Blue green algae and bacteria)	Prokaryotic	Unicellular (except some cyanobacteria that are filamentous or multicellular and sometimes branched.	Diverse types of nutrition
2. **PROTOCTISTA** (some Algae and Protozoa)	Eukaryotic	Unicellular	Diverse kinds of nutrition
3. **FUNGI** (Moulds, etc.)	Eukaryotic	Unicellular or Multicellular	**Saprophytic** (Feed on dead, organic matter)
4. **PLANTAE** (All green plants)	Eukaryotic	Multicellular	**Autotrophic** (Synthesize food by photosynthesis)
5. **ANIMALAE** (Animals)	Eukaryotic	Multicellular	**Heterotrophic** (Depend on other organisms for food)

The five kingdoms are shown below in Fig. 1.14

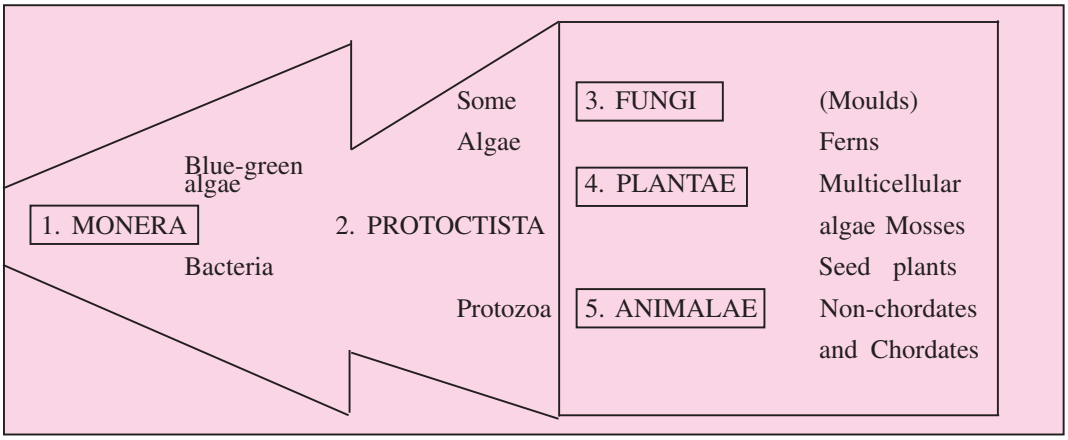


Fig. 1.14 The Five Kingdoms of Life

INTEXT QUESTIONS 1.4

1. Name the scientists who proposed :

   (a) Binomial nomenclature .....

   (b) Five Kingdom Classification .....

2. Which were the first organisms to appear on earth?

   .....

Notes

3. Name the taxonomic categories which come before and after family.

   .....

4. Name the categories above order level in a correct sequence.

   .....

5. Rewrite the following in correct form –

   (a) Mangifera Indica .....

   (b) Homo Sapiens .....

   (c) Felis leo .....

6. Place the following in their respective kingdoms

   (a) Bacteria which curdle the milk .....

   (b) Cow .....

   (c) Grass .....

   (d) Amoeba .....

   (e) Bread mould .....

1.4 VIRUSES - AN INTRODUCTION

- You have heard about diseases such as influenza, polio, mumps, rabies, small-pox, AIDS and dengue are caused by viruses.
- They are non-living and made up of DNA or RNA surrounded by a protein coat. They can replicate. However, they cannot reproduce on their own. They reproduce when inside a living cell. Therefore viruses pose a special classification problem.
- Logically, therefore, they cannot be placed in any of the five kingdoms because they can multiply in their host cells, and can mutate – like living organisms but, can be crystallised exhibiting a non-living feature.

Discovery of Viruses

In 1892, the Russian botanist Iwanowsky prepared an extract from tobacco plants suffering from tobacco mosaic disease. The extract was filtered to keep back bacteria in the residue. The filtrate was still infectious. Dutchman Beijerinck gave the term virus in 1898 (Virus - poison in Latin) to these infective particles.

Size

- Viruses are extremely small and can be seen only under the electron microscope.
- They are smaller than the smallest bacteria.
- Can pass through fiters which retain bacteria.
- Their size is indicated in nanometres (nm). Their size ranges from 10 nm to 300 nm in diameter.

Nanometre (nm)

It is a unit of microscopic measurement, equal to 10^{-9} m. It was formerly called millimicron

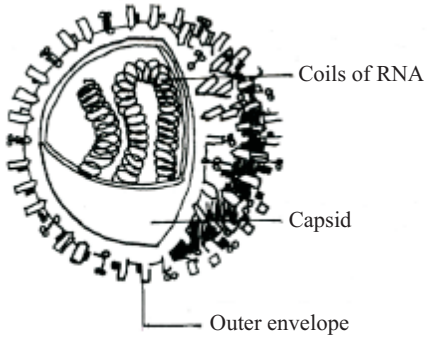


Fig. 1.15(a) Influenza virus

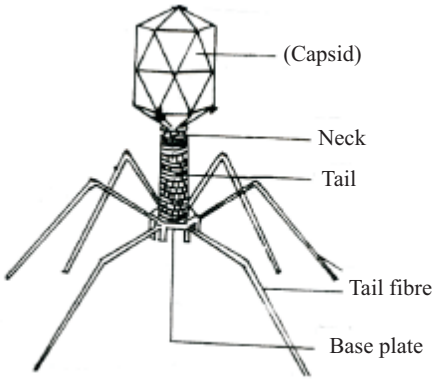


Fig. 1.15(b) T. Bacteriophage

1.4.1 Structure of virus

Virus has a simple structure consisting of a core and a cover. The core particle is the genetic material, either DNA or RNA. The cover is a protein coat called **capsid** (Fig. 1.16).

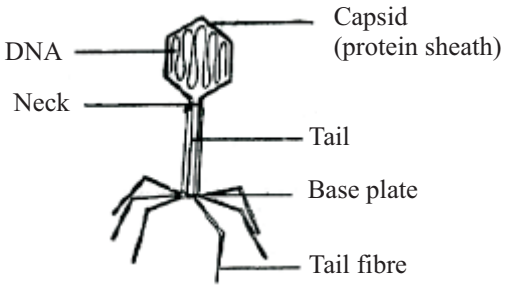


Fig. 1.15 Structure of Virus

Virus can reproduce only when inside the living cells.

A virus cannot reproduce by itself. For its reproduction it needs to enter the cell of some organism. From the host cell, it uses the raw material and enzymes and energy generating machinery of the host cell to produce its own DNA. A number of virus particles are thus formed inside the host cell. The host cell bursts to release the new virus particles.

Virus — living or non-living?

Though viruses possess nucleic acids as genetic material like the living organisms, they cannot make copies of DNA for reproduction on their own. They can make copies of themselves to reproduce only inside a living cell. And because their genetic material is DNA or RNA, they exhibit mutations followed by variations in their infective properties. Further, they are considered non-living because they are non-cellular, they have no enzymes of their own and they can be crystallised

1.4.2 Infective properties of virus

Viruses are known to attack bacteria, plants or animals. Viruses which invade bacteria are called **bacteriophages.**

Viruses are highly specific in their relationship with the host and tissue. For example – Polio virus attacks particular nerves; mumps virus attacks the particular pair of salivary glands (parotid glands) of humans.

Viruses keep on 'mutating'!

Mutation means change in genetic material. For example – Influenza virus which has RNA as its genetic material, mutates and so every year flu is caused by a different virus and scientists find it difficult to find a cure for influenza or flu.

1.4.3 Viruses and diseases

Table 1.3 indicates the names of certain viruses, their hosts and diseases and modes of their transmission

Certain cancers are also known to be caused by viruses. These viruses have RNA as genetic material and are called ***retroviruses***.

Table 1.3 Certain viruses, their hosts, diseases caused by them and mode of transmission.

	Virus	Host	Disease	Mode of Tranmission
Plants	Potato roll virus	Potato	Potato leaf roll	Air borne contact
	Tomato stunt virus	Tomato	Tomato bushy stunt	Air borne, contact
	Tobacco mosaic virus	Tobacco	Mosaic	Air borne, contact
Human	Herpes virus	Humans	Herpes	Air borne,, contact
	Pox virus	Humans	Small Pox	Air borne, contact
	HIV	Humans	AIDS	(i) Sexual contact (ii) Lactating mother to child (iii) Blood transfusion
	Dengue	Humans	Dengue	Bite of infected *Aedes* mosquito
	Hepatitis B	Humans	Hepatitis	Infected water

1.4.4 Viroids

Viroids are circular RNA molecules, consisting of several hundred nucleotides. They infect plants and even kill them. In plants, they use enzymes of the plant cells to replicate like the viruses do. When they infect plants, these RNA molecules cause defects in the regulatory systems controlling plant growth. Hence viroid infected plants show stunted growth and abnormal development.