



The Hierarchy and Diversity of Living Things, Unicellular Organisms



B10CH2



Learning Objectives

Upon completion of these topics, learners will:

- outline the diversity of living things;
- discuss the basis of taxonomy (classification);
- discuss the relationship of viruses bordering between living and non-living things;
- listing the major characteristics of the kingdoms Monera (bacteria), Protista (protists), Fungi (fungi), Plantae (plants) and Animalia (animals);
- classify organisms into kingdom, phylum, class, order, family, genus and species;
- explain the basic characteristics of unicellular organisms;
- name unicellular organisms that are causative agents of diseases and the diseases they cause.

2.1. WHAT IS CLASSIFICATION?

All living organisms vary in their forms, structure and mode of life. This is due to diversity in the life forms. Scientist have divided plants and animals in various categories to make the study of living organisms simpler. These categories are based on similarities and differences in structure, development and behaviour. This is called **classification**.



The branch of biology concerned with classification is called **taxonomy**.

2.2. IMPORTANCE OF CLASSIFICATION

- Classification makes the study of a wide variety of living organisms easier.
- Classification gives us a picture of all life forms at a glance.
- It provides knowledge about the origin and genetic relationship among living beings.
- It gives vital information needed for all the branches of biology.

2.3. THE HIERARCHY OF CLASSIFICATION— GROUPS

Carl Linnaeus (1707–1778), a Swedish scientist broadly classified living organisms into four categories. These are class, order, genus and species. Later on, two additional categories family and phylum were added. Furthermore, all living beings were split into two kingdoms—Animal Kingdom and Plant Kingdom. Linnaeus' scheme of arranging organisms into an ascending series (Fig. 2.1) of groups is known as **hierarchy system of classification**. Now the categories used in the classification of plants and animals are kingdom, phylum, class, order, family, genus and species. Both in animal and plant kingdoms, the lowest category is the **species** and highest is the **kingdoms**.

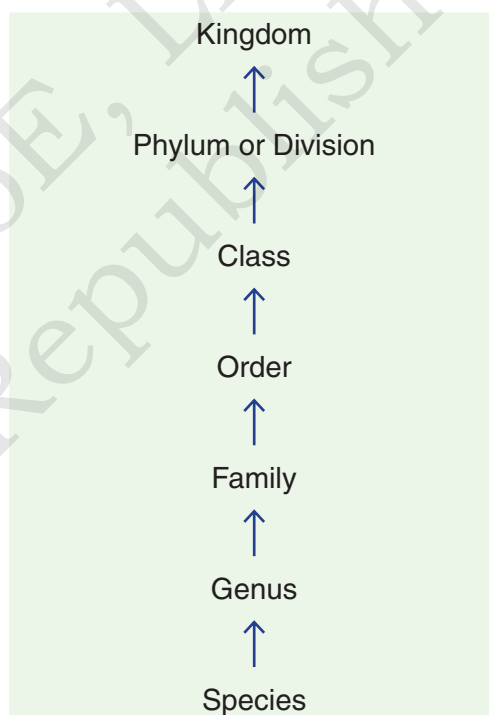


Fig. 2.1. Hierarchy of classification

2.4. THE BINOMIAL SYSTEM FOR NAMING THE ORGANISMS

In biology, every organism is given a proper names consisting of two words. The first word is the name of **genus** to which the organism belongs. The second word is the **species** epithet of the genus. The process of giving the two-word name to a particular organism is called **binomial nomenclature**. Thus, according to the binomial nomenclature, the leopard's name is *Panthera pardus*. *Panthera* is the genus name and *pardus* is its species name. The scientific names are unique, understood

and followed all over the world. They are guided by a set of rules in the International Code of Biological Nomenclature.

Following specific rules are followed while giving the scientific name to an organism.

1. Biological names are derived from Latin language.
2. The name of the genus begins with capital letter.
3. The name of the species begins with a small letter.
4. When printed, the scientific name is given in *italics*.
5. When written by hand, the genus name and the species name have to be underlined separately.

Table 2.1. Scientific Name of Some Organisms

Common Name	Generic Name	Specific Name
Mountain Gorilla	<i>Gorilla</i>	<i>beringei</i>
Human being	<i>Homo</i>	<i>sapiens</i>
Frog	<i>Rana</i>	<i>tigrina</i>
Mango	<i>Mangifera</i>	<i>indica</i>
Lion	<i>Panthera</i>	<i>leo</i>
Tiger	<i>Panthera</i>	<i>tigris</i>

ACTIVITY 2.1

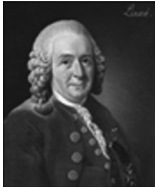
Mention 'True' or 'False' in your notebook.

- (i) Both in animal and plant the lowest category is the species.
- (ii) The name of the genus begins with capital letter.
- (iii) The name of the species begins with a capital letter.

ACTIVITY 2.2

Go to the library or use the internet to research information on the International Code of Biological nomenclature. Write a short report on your findings to discuss the naming of living organisms.

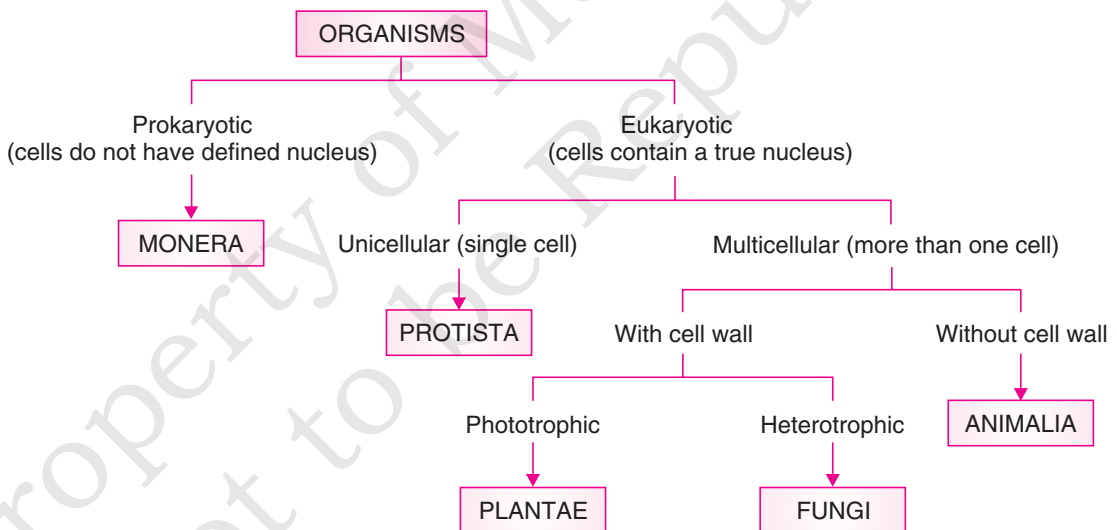
AMAZING FACTS



Carolus Linnaeus (Karl von Linne) (1707–1778) was a Swedish doctor. He had an interest in the study of plants. He classified plants based on a simple scheme so as to be able to identify them again. He introduced the **Binomial System of Nomenclature** for naming the organisms. Linnaeus is known as ‘**the father of Taxonomy.**’

2.5. THE FIVE KINGDOM SYSTEM OF CLASSIFICATION

Biologist, Robert Whittaker (1959) has tried to classify all living organisms into broad categories called kingdoms. The classification Whittaker proposed has five kingdoms: Monera, Protista, Fungi, Plantae and Animalia. These groups are formed on the basis of their cell structure, mode of nutrition and body organisation.








- 1. Kingdom-Monera (The kingdom of prokaryotes):** This kingdom includes all prokaryotic organisms *i.e.*, the organisms which do not have well defined nucleus and membrane bound cell organelles. Mostly they are unicellular, however some may be multicellular. They have cell wall made up of non-cellulosic material. They show different types of nutrition. Some are autotrophic (*i.e.* synthesize their own food) others are heterotrophic (*i.e.* get food from the environment). Bacteria and cyanobacteria are the examples of this kingdom.

- 2. Kingdom-Protista (The kingdom of unicellular eukaryotes):**
This group include many kinds of unicellular eukaryotic organisms. They have well defined nucleus and membrane bound organelles. Many of these organisms use hair like cilia or whip like flagella for locomotion. Their mode of nutrition may be autotrophic or heterotrophic. This kingdom include diatoms and protozoans.
- 3. Kingdom-fungi (The kingdom of multicellular decomposers):**
Fungi are heterotrophic eukaryotic organisms. Except yeast they have multicellular filamentous body called **mycelium**. They have cell wall made up of tough complex sugar called **chitin**. Many of them obtain food from decaying matter and are called **saprophytes**, others obtain food from other living organisms and are called **parasites**. Moulds, yeasts, mushrooms etc. are some examples of this kingdom.
- 4. Kingdom-plantae (The kingdom of multicellular producers):**
They are commonly called **plants**. The plants are multicellular eukaryotes in which cells are covered with rigid cell wall made up of cellulose. They are fixed in the soil a large number of them, however grow in water. They are autotrophic (prepare their own food in sunlight with the help of green pigment chlorophyll by the process of photosynthesis).
- 5. Kingdom-Animalia (The kingdom of multicellular consumers):** They are commonly called **animals**. The animals are multicellular eukaryotes which are without cell wall and photosynthetic pigment chlorophyll. Most of them are capable of moving freely from one place to another. They are heterotrophs (obtain food from outside).

Table 2.2. Characteristics of the Five Kingdoms

Charac- ters	Five Kingdoms				
	<i>Monera</i>	<i>Protista</i>	<i>Fungi</i>	<i>Plantae</i>	<i>Animalia</i>
Cell type	Prokaryotic	Eukaryotic	Eukaryotic	Eukaryotic	Eukaryotic
Cell wall	Non-cellulose	Present in some	Present (without cellulose)	Present (Cellulose)	Absent
Body organi- sation	Unicellular or multicellular	Unicellular	Multi-cellular	Multi-cellular	Multicellular

Mode of nutrition	Autotrophic or heterotrophic	Autotrophic or heterotrophic	Heterotrophic	Autotrophic	Heterotrophic
Example	 <i>Bacteria</i>	 <i>Paramecium</i>	 <i>Penicillium</i>	 Plant	 Animals

2.6. IDENTIFYING LIVING THINGS BY KEYS

Keys are used for quick and accurate identification of organisms. Two types of keys are used to identify living things—a dichotomous key and a numbered key.

Let us consider identification of animals such as wasp, housefly, spider, snail and earthworm using the two types of keys.

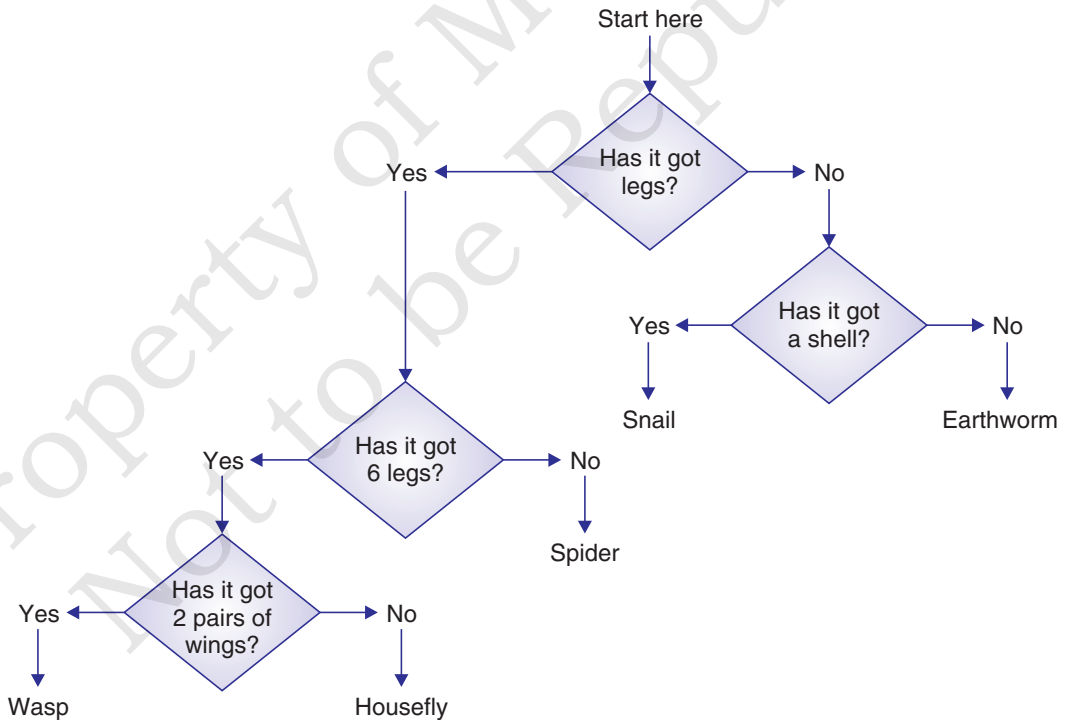


Fig. 2.2. A branching dichotomous key

Scientists use **dichotomous key** to identify living things. Dichotomous means dividing into two.

A key has a number of steps—you can see them in the branched key and the numbered key on this page. At each step in the branching key you find a question or statement. Start at the beginning and answer 'Yes' or 'No' to the first question and the statement. This takes you to another question or to an identification.

Use the **numbered key** below to identify the animals. Start at the beginning and answer the questions at each stage.

- | | |
|--------------------------|-----------|
| 1. Has legs | Go to 2 |
| Has no legs | Go to 3 |
| 2. Has 6 legs | Go to 3 |
| Has 8 legs | Spider |
| 3. Has one pair of wings | Housefly |
| Has 3 pairs of wings | Wasp |
| 4. Has a shell | Snail |
| Has no shell | Earthworm |

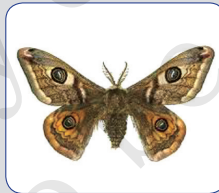
Dichotomous keys take up space, particularly if many organisms are involved. Therefore a numbered key is better.

ACTIVITY 2.3

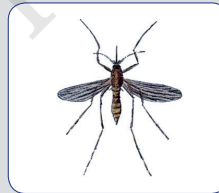
Use numbered key to identify the organisms given below.



Butterfly



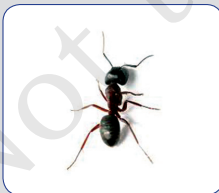
Moth



Mosquito



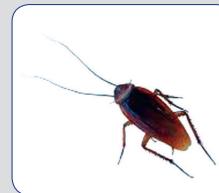
Housefly



Ant



Louse



Cockroach

2.7. UNICELLULAR ORGANISMS

A unicellular organism, also known as single celled organism. Bacteria, some fungi and protozoans (single celled animals) are unicellular

organisms. They occur in water (both in brackish/pond water, damp soils and even in the bodies of others animals including humans. They can be observed under a microscope in a drop of pond water. Many of them occur as parasites on other organism including humans, and cause series diseases. Viruses are acellular infectious particles also cause diseases in living beings. Many of the unicellular bacteria, fungi and protozoans and a cellular viruses are the cause of sexually transmitted infections.

ACTIVITY 2.4

Observe unicellular organisms under a microscope by examining a drop of brackish/pond water.

Procedure:

Bring some water from a salty lake or pond in a beaker to your biology lab. Take a glass slide and put a drop of the water brought from the lake or pond on it. Observe the drop under microscope using first low power and then high power objective lens. Try to identify some of the protozoans present in the water and draw their diagrams in your note book.

2.7.1. Viruses

Viruses are ultra microscopic infections agents that replicates only inside the living cells. Viruses did not find a place in classification since they are not truly living. They are acellular entities *i.e.*, not made up of cell. They are crystalline particles made up of nucleic acid and proteins. In a virus particle nucleic acid may be DNA (deoxyribose nucleic acid) or RNA (ribose nucleic acid) remain surrounded by a coat made up of proteins. Viruses cause serious diseases in plants and animals including humans. Some common human diseases caused by viruses are AIDS, Hepatitis, Syphilis, Gonorrhoea, mumps, poliomyelitis, chicken pox etc.

2.7.2. Some Common Unicellular Organisms

1. **Amoeba:** *Amoeba* occur in ponds, ditches, lakes, streams, etc., which have plenty of decaying matter. It is an unicellular microscopic organism, which appear greyish in colour. Under a microscope a living *Amoeba* appears like an irregular jelly like tiny mass of protoplasm. The protoplasm contains food vacuoles, contractile vacuole and prominent nucleus. The outline body continues changing due to the formation of small

finger like projections called **pseudopodia**. The pseudopodia help in locomotion and capture of food.

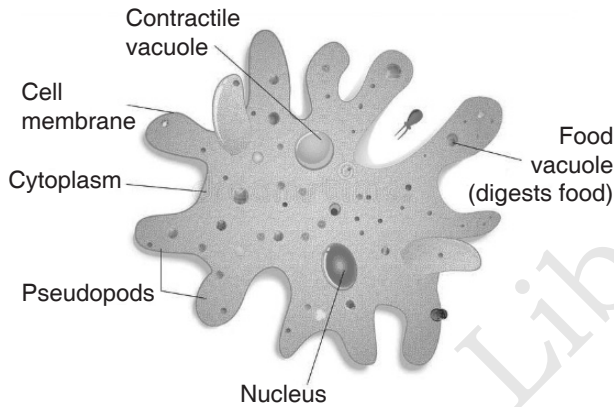


Fig. 2.3. *Amoeba*

- 2. *Paramecium*:** *Paramecium* is a unicellular organisms commonly found in ponds, ditches, pools, lakes, streams etc. It swims actively and feeds on tiny organisms like bacteria. It has a definite slipper like shape due to flexible outer covering called pellicle, and have numerous fine bristle like outgrowths called **cilia** on its entire surface. Cilia help in locomotion and food capturing. It has a definite food passage called gullet, contractile vacuole and a macronucleus and micronucleus.

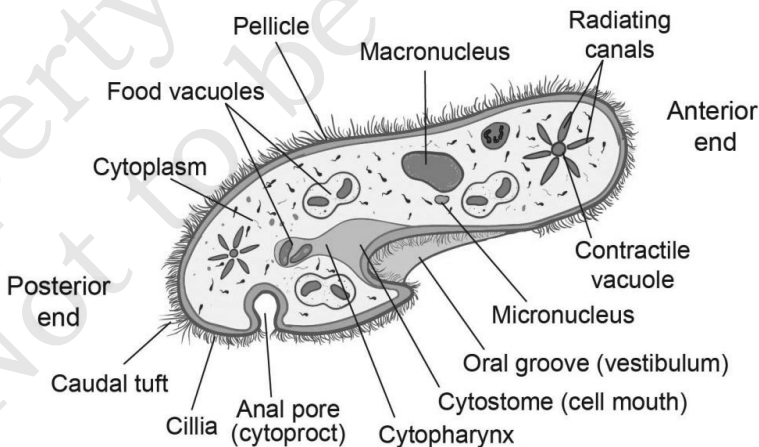


Fig. 2.4. *Paramecium*

- 3. *Euglena*:** *Euglena* is a free living motile protist found in stagnant water like ponds and ditches and also in damp soils. It is one

of the most easily and readily available specimen for laboratory observation. It is most interesting organism which shows both plant and animal like characters. It has a spindle shaped body covered with a flexible **pellicle**. At one end, it has a flask shaped depression called gullet, which contains one short (usually remains within the gullet) and one long flagella for locomotion. It contains chloroplast like higher plants. *Euglena* prepares it own food through photosynthesis, but in absence of light it behaves as heterotrophs and feed on other smaller organisms.

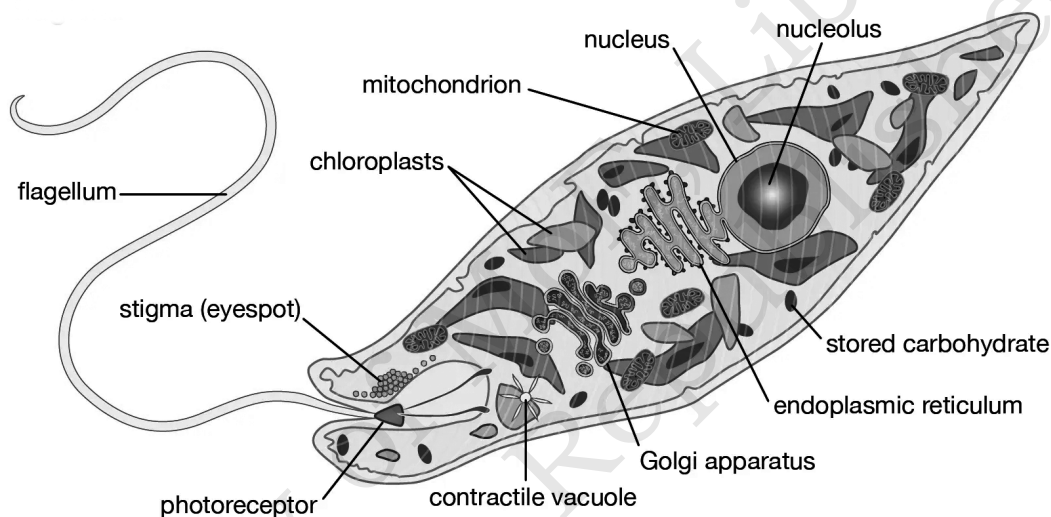


Fig. 2.5. *Euglena*

2.7.3. Some Common Sexually Transmitted Infections (STIs)

1. STI Caused by Virus

Viruses are acellular tiny infectious particles that may cause mild to severe illness in humans, animals and plants. In humans diseases like common cold, measles and life threatening sexually transmitted infection-AIDS are caused by viruses.

AIDS (Acquired Immuno Deficiency Syndrome) – AIDS is one of the most severe and deadly sexually transmitted infection. It was first detected in USA in 1981. Today it is estimated that about 18 millions people in the world are HIV positive. The causative agent of AIDS is a virus known as HIV (Human Immuno Deficiency Virus). HIV is detected in the blood and semen of the infected person. It attacks and destroy lymphocytes (a type of white blood cells or WBCs) which are important part of human

immune system. Damages to lymphocytes make the patient susceptible to a wide variety of secondary infections such as pneumonia, tuberculosis and also some kinds of cancer, leading to death of the patient. AIDS can be detected by **ELISA test**.

HIV is transmitted through sexual contact with the infected person, contaminated blood transfusion, sharing of contaminated needles and syringes, and infected mother to child during pregnancy.

There is no cure of AIDS. Prevention is the only method to check the transmission of this STI.

2. STI Caused by Bacteria

- (i) **Gonorrhea:** Gonorrhea is a curable sexually transmitted disease caused by a bacterium, *Neisseria gonorrhoeae*. The bacteria is transmitted during sexual intercourse—vaginal, oral and anal. The bacteria can infect the genital tract, the mouth and rectum. It attack the urinary passage in males and cervix of genital track of females. The disease, when left untreated leads to serious complications affecting the joints, heart valves or the brain, miscarriage in pregnant females. However, the disease is curable, if treated properly.

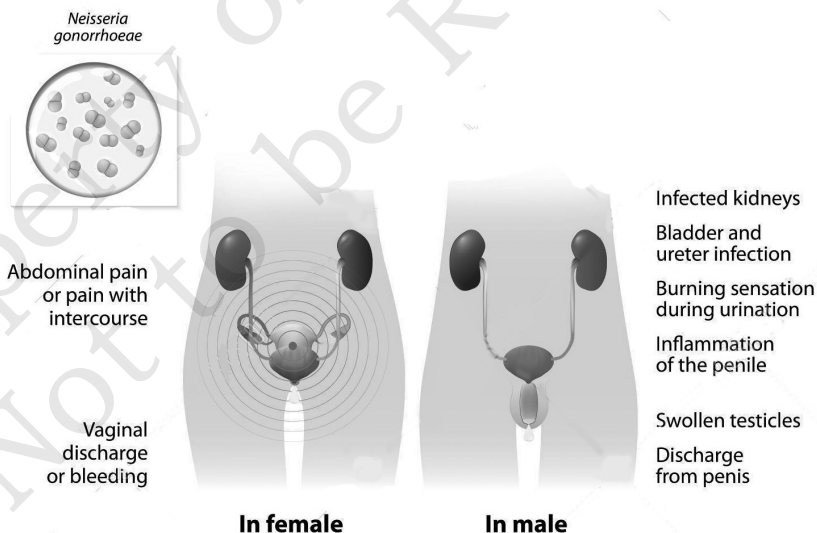


Fig. 2.6. Gonorrhea

- (ii) **Syphilis:** Syphilis is a rare sexually transmitted disease that causes serious health problems and complications if left untreated. This disease is caused by a bacterium, *Treponema*

pellidum. The bacteria grows on mucus of the genital organs or mouth. The infection occurs through intercourse with infected person or orally. The disease is characterised by the presence of painless ulcers also known as cancer, which later develop into open sore on genital organs and mouth. An infected woman can pass this disease on their children, if not treated before birth. The disease may some time leads to heart and brain damage.



Fig. 2.7. Syphilis

3. STI Caused by Protozoa

Trichomoniasis. Trichomoniasis is a sexually transmitted disease caused by a protozoan parasite, *Trichomonas vaginalis*. This disease is more common in ladies. The parasite is passed from an infected individual to a healthy individual during sex. The body part that are affected in females include vulva, vagina or urethra and in males in the penis and urethra (urinary passage). Trichomoniasis is a curable disease if treated properly.

2.7.4. Some Other Common Disease Caused by Protozoa

- 1. Malaria:** Malaria is a mosquito borne disease affects 300 millions people annually and more than 200 millions people die every year due to malaria. The disease is caused by three species of parasitic protozoan (sporozoan). *Plasmodium vivax*, *Plasmodium falciparum* and *Plasmodium ovulae*. The parasite is transmitted from person to person by the bite of an insect vector, the female *Anopheles* mosquito. After entering the human body the parasite initially multiply within the liver cells and then attack the red blood cells (RBCs) resulting in their rupture. The rupture of RBCs is associated with the release of a toxin, called haemozoin, which causes chill and high fever. The parasite also produce gametocytes in RBCs.

When a female *Anopheles* mosquito bites an infected person, the parasite (*Plasmodium*) is sucked into the stomach of a mosquito. Where it breed and multiply, and reach into the salivary glands of the mosquito. The bite of such infected mosquito to a healthy person, transmit the parasite into his body causing malaria.

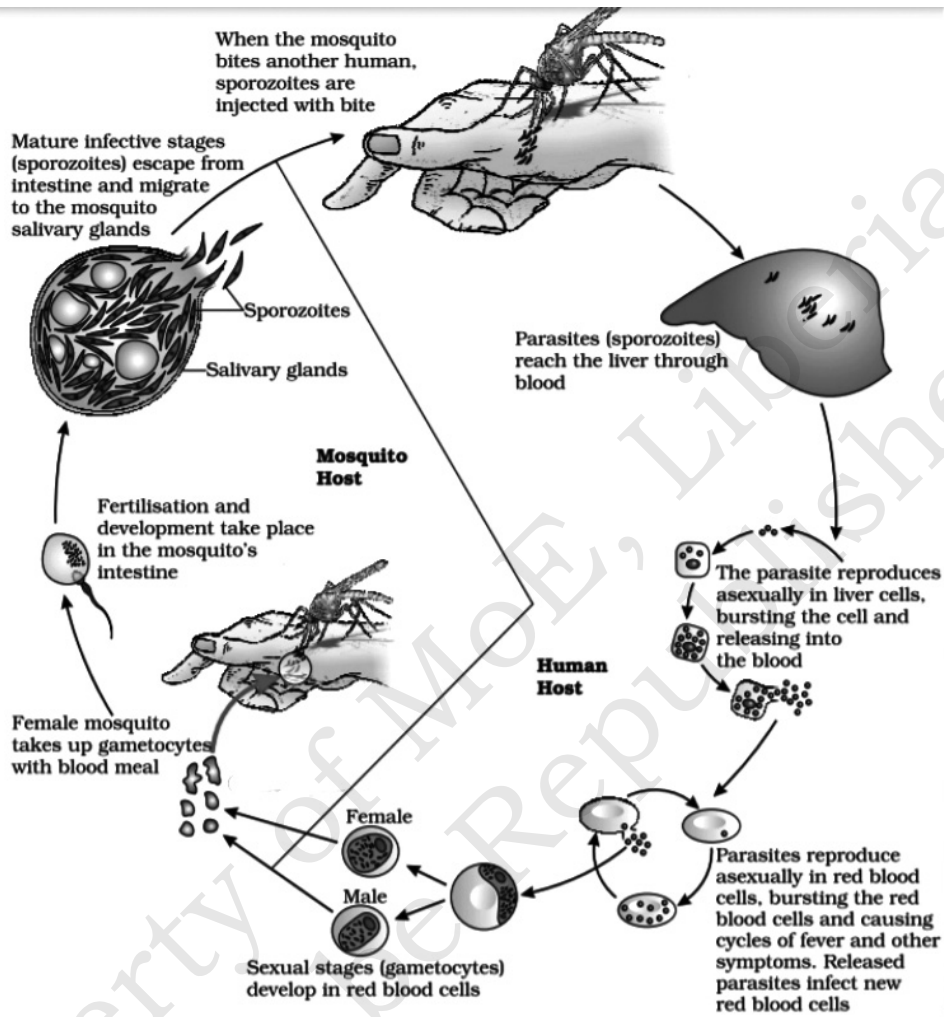


Fig. 2.8. Life cycle of Plasmodium

Symptoms: Malaria is characterised by high fever with violent shivering (rigours) headache, bodyache, nausea and profuse sweating. The fever subsides after sweating, and is repeated on the third or fourth day. This leads to general weakness of the patient. The disease may cause enlargement of the liver and spleen.

Diagnosis: Malaria is diagnosed by the blood test.

Prevention and Control: The infection can be prevented by avoiding mosquito bite by using wire mesh on doors and windows and mosquito repellent (creams), and destroying their breeding by spraying kerosene on stagnant water, introducing larvicidal fish *Gambusia* in ponds and swamps. Malaria can be

treated with preparations of *quinine* which is obtained from a plant, *cinchona*.

- 2. Amoebic dysentery:** Amoebic dysentery is a severe disorder of large intestine. It is caused by a protozoan parasite *Entamoeba histolytica*. The parasite penetrates into the wall of patient's large intestine and feeds upon its cells causing the formation of ulcers. These ulcers rupture and discharge blood and mucus into the intestine that pass out with stool.

Houseflies act as carriers and serve to transmit the parasite from faeces of infected person to food and other eatables, thereby contaminating them. Mixing of sewage with water supply may contaminate the drinking water. Consuming food and water contaminated with the parasite are the main source of infection in healthy person.

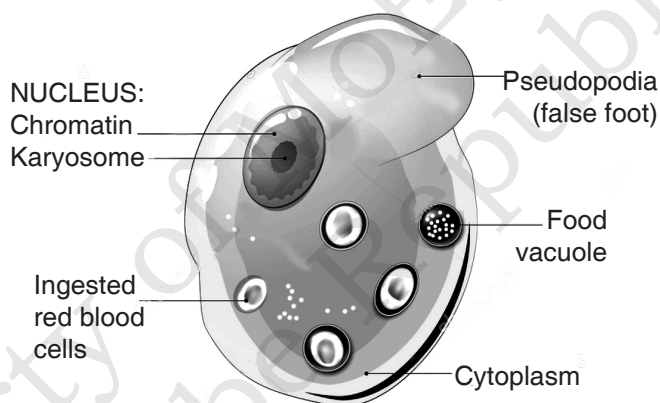


Fig. 2.9. *Entamoeba histolytica*

Symptoms: The symptoms of the disease include constipation, abdominal pain and cramps, stool with excess mucous and blood clots.

Prevention and Control: The disease can be prevented by maintaining personal and public hygiene, washing of hands before handling or taking meals, protection of food from flies, cockroaches and dust, proper cooking of food, proper washing of raw vegetables and fruits before use etc. The infection of the parasite can be treated by taking anti-amoebic drugs.

- 3. Giardiasis:** Giardiasis is an infection of small intestine. It is caused by a parasitic protozoan, *Giardia lamblia*. Giardiasis spreads by eating contaminated food or drinking contaminated

water with the faecal matter of infected person or poor sanitation and hygienic conditions.

Symptoms: The common symptoms of the disease include fatigue, nausea, diarrhoea or greasy stool, loss of appetite, vomiting, abdominal cramps and pain, excessive gas etc.

Prevention and Control: The disease can be controlled by maintaining proper personal and public hygiene and proper sanitation, protecting the food from flies and cockroaches. The disease can be treated with anti-giardiac antibiotics.

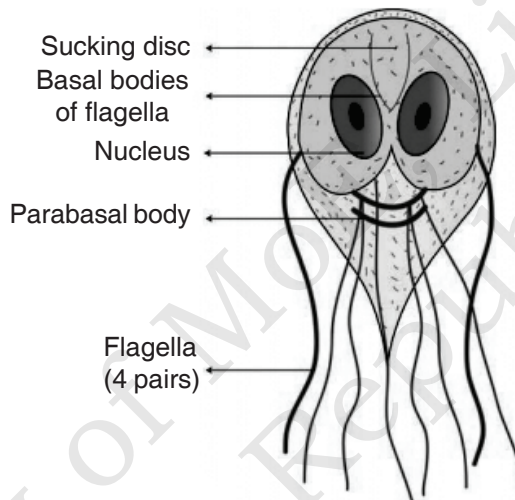


Fig. 2.10. *Giardia Lamblica*

SUMMARY

- There exist a wide variety of living organisms. To make the study of organisms easier biologists classified them into different categories based on similarities and difference.
- Classification gives us a broad picture of all life forms at a glance. For scientific studies all organisms have been given scientific names that consists of two words.
- The first word is the genus name and the second is species epithet. The scientific names are unique and followed all over the word.
- The living organisms are into five kingdoms-Monera protista, Fungi, Plantae and Animalia.
- Kingdom-Monera includes prokaryotic organisms, unicellular, eukaryotic organisms are included in kingdom Protista, kingdom

fungi include multicellular, eukaryotic decomposer organisms, all green photosynthetic organisms with cell wall are included in kingdom.

- Plantae and kingdom-Animalia includes animals which are multicellular eukaryotic and heterotrophic organisms, which are mobile and each cell wall.
- Viruses are acellular infectious entities did not find a place in the five kingdom system of classification.
- Many bacteria, fungi and protozoans and acellular virus cause serious diseases in humans.
- Some of these diseases spread through sexual contact. Some of the sexually transmitted diseases are not curable.



GLOSSARY

Animal kingdom: Organisms that usually move around and find their own food.

Binomial nomenclature: The process of giving two word name to a particular organism.

Diagnosis: To identify a disease through specific tests.

Dichotomous: Divided into two distinct parts.

Eukaryotic: A eukaryote is organism whose cells contain a nucleus and other organelles enclosed within membranes.

Hierarchy: A group of people or things arranged in order of rank.

Multicellular: Organism consists of more than one cell.

Parasite: An organism that depends on other organism for food.

Pathogen: A disease causing organisms.

Plant kingdom: Organisms that make their own food.

Prokaryotic: A prokaryote is an organism that lacks a true nucleus.

Symptom: Characteristic sign of a disease.

Vector: A carrier agent of a disease/pathogen.



EXERCISES

I. Multiple choice questions.

- The branch of biology concerned with classification is called
 - cytology
 - taxonomy
 - molecular biology
 - genetics
- Who introduced hierarchy of classification?
 - Carolus Linnaeus
 - Robert Brown
 - R. H. Whittaker
 - Carl Woese
- Who proposed five Kingdoms of Classification?
 - Carolus Linnaeus
 - Robert Brown
 - R. H. Whittaker
 - Carl Woese
- The process of giving two word name to a particular organism is called
 - classification
 - nomenclature
 - reproduction
 - binomial nomenclature
- Scientific name of humans is
 - Athala rosea*
 - Brassica campestris*
 - Homo sapiens*
 - Brassica capitata*
- This is a kingdom of unicellular eukaryotes.
 - Monera
 - Protista
 - Fungi
 - Animalia
- How many categories are there in hierarchy classification?
 - Seven
 - Eight
 - Five
 - Nine
- Which is the highest taxonomic category?
 - Class
 - Genus
 - Species
 - Kingdoms
- What is the basic unit of classification?
 - Class
 - Genus
 - Species
 - Kingdoms
- AIDS was first detected in—
 - China
 - Africa
 - USA
 - England

11. Gonorrhoea is a STI caused by a
- (a) virus (b) bacteria
(c) protozoa (d) worm
12. *Plasmodium* is a causative agent of
- (a) malaria (b) AIDS
(c) syphilis (d) giardiasis

II. Match the following.

- | | |
|------------------------------------|-------------------------------------|
| 1. R. H. Whittaker | (a) Bacteria |
| 2. Binomial System of Nomenclature | (b) Carl von Linnaeus |
| 3. Monera | (c) Five Kingdoms of Classification |
| 4. Protista | (d) Fungi |
| 5. Highest taxonomic category | (e) Plantae |
| 6. <i>Penicillium</i> | (f) <i>Rana tigrina</i> |
| 7. Plant Kingdom | (g) Kingdom |
| 8. Frog | (h) <i>Paramecium</i> |

III. Rearrange the following categories according to hierarchy system of classification.

Genus
↑
Kingdom
↑
Class
↑
Phylum
↑
Family
↑
Species
↑
Order

IV. Answer the question briefly.

1. What is classification?
2. Define the term 'taxonomy'.
3. Give three importance of classification.

4. Explain Hierarchy of classification.
5. Name the kingdoms of Whittaker's classification.
6. In which kingdom will you place an organism, which is single-celled, eukaryotic and photosynthetic.
7. What is binomial nomenclature? Who introduced it?
8. State why a numbered key is preferred to a dichotomous key.
9. Match the items in column A with those of column B.

Column A

- (a) Syphilis
- (b) Malaria
- (c) AIDS
- (d) Gonorrhoea
- (e) Amoebiasis

Column B

- (i) *Plasmodium*
- (ii) *Human immunodeficiency virus*
- (iii) *Entamoeba*
- (iv) *Neisseria*
- (v) *Treponema*

10. Write True (T) or False (F) for the following:

- (a) *Paramecium* is slipper shaped animal.
- (b) *Euglena* always feeds on tiny organisms like bacteria present in water.
- (c) Contractile vacuole in *a* helps in locomotion.
- (d) *Amoeba* moves with the help of pseudopodia.
- (e) STI gonorrhoea and syphilis are not curable.
- (f) AIDS is caused by a bacteria.
- (g) Malaria is spread by the bite of infected female *Anopheles* mosquito.

11. How does a healthy person acquired infection of AIDS?
12. How can malaria be prevented?

**PROJECT**

Find out the scientific names of any five animals and plants. Do these names have anything in common with the names you normally use to identify them?