

LIVING WORLD AND CLASSIFICATION OF MICROBES

CHAPTER OUTLINE

- 1.1 Biodiversity and need of classification
- 1.2 Whittaker's 5 kingdom classification system
- 1.3 Classification of microbes

IMPORTANT POINTS

Can you recall? (Textbook page 1)

(1) What is the hierarchy for classification of living organisms?

Ans. The hierarchy for classification is as follows : Kingdom, Phylum, Class, Family, Genus and species.

(2) Who invented 'binomial system' of nomenclature?

Ans. Carl Linnaeus invented 'binomial system' of nomenclature.

(3) Which levels of hierarchy are considered while writing the name in binomial nomenclature?

Ans. The levels of hierarchy considered while writing the name in binomial nomenclature, are genus and species. The genus is written by the first word and the species is shown by the second word.

1. Biodiversity and need of classification :

- (1) All the living organisms residing on the earth have adapted to their surroundings according to geographic regions, food ingestion, defence, etc. This causes variations among them. Even the organisms belonging to the same species also show differences.
- (2) About 87 million species of living organisms are seen on the land and seas on the Earth (Ref. 2011 Census). For studying their characteristics in a systematic way, they are divided into different groups. This division is based on the similarities and the differences among the different living beings. Thus all the plants and animals are subdivided into groups and subgroups. This process of placing them in different groups is called biological classification.

(3) History of classification :

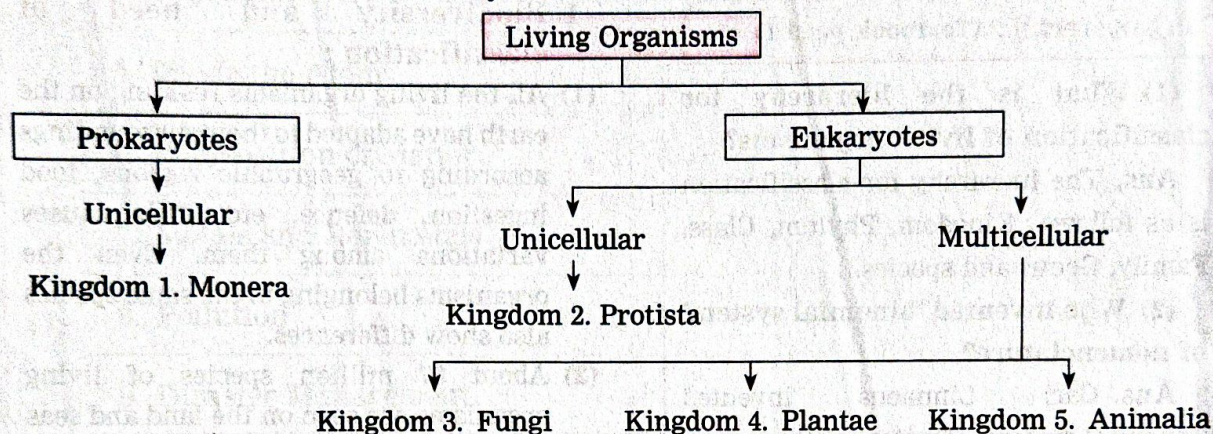
Year	Scientist	How many kingdoms?	Method
1735	Carl Linnaeus	2	Vegetabilia and Animalia
1866	Haeckel	3	Protista, Plants and Animals
1925	Chatton	2	Prokaryotes and Eukaryotes
1938	Kopland	4	Monera, Protista, Plants and Animals
1969	Robert Harding Whittaker	5	Monera, Protista, Fungi, Plants and Animals

(4) Whittaker's criteria used for classification :

Characteristics	Type
Complexity of cell structure	Prokaryotic and Eukaryotic
Complexity of organisms	Unicellular or Multicellular

Mode of nutrition	Plants – Autotrophic – Photosynthetic Fungi – Saprophytic – (Absorption from dead and decaying matter.) Animals – Heterotrophic (Consumers)
Lifestyle	Producers – Plants Consumers – Animals Decomposers – Fungi
Phylogenetic relationship	Prokaryotic to Eukaryotic, unicellular to multicellular.

(5) Five Kingdom classification system :



Try this : (Textbook page 2)

As per the activities given on this page, observations of the organisms belonging to the kingdoms of Monera, Protista and Fungi can be done in the school laboratory.

Kingdom	Characteristics	Examples
Monera	<ol style="list-style-type: none"> All are unicellular. Either autotrophic or heterotrophic. Prokaryotic cell structure without distinct nucleus and cell organelles. 	Bacteria <i>Clostridium titani</i> , <i>Vibrio choleri</i> , <i>Treponema pallidum</i> , <i>Streptococcus pneumoniae</i> , <i>Legionella pneumoniae</i> , <i>Salmonella typhi</i> , <i>Staphylococcus aureus</i> , <i>Clostridium botulinum</i>
Protista	<ol style="list-style-type: none"> Unicellular organisms with nucleus enclosed in a nuclear membrane. Pseudopodia or cilia or flagella for locomotion. Autotrophs possess chloroplast. 	<i>Euglena</i> , <i>Volvox</i> , <i>Amoeba</i> , <i>Paramecium</i> , <i>Plasmodium</i> , etc.
Fungi	<ol style="list-style-type: none"> Non-green, eukaryotic, heterotrophic organisms. Saprotrophs, feeding upon decaying organic matter. Cell wall made up of complex sugar, 'Chitin'. Thread like body with many nuclei. 	Different types of fungi. Baker's yeast, <i>Aspergillus</i> (Fungus on corn), <i>Penicillium</i> , Mushrooms

- Under the jurisdiction of Indian Council of Medical Research, in 1952 National Institute of Virology was established at Pune to conduct research on the viruses.

2. Classification of microbes :

Microorganisms or microbes are maximum in number on this Earth in every possible environment. They can be divided into following groups :

Type	Size	Characteristics	Examples
Virus	10 nm to 100 nm 10 to 100 times smaller than bacteria.	<ol style="list-style-type: none"> 1. "Organisms on the borderline between living and non-living." Extremely minute, visible only through electron microscope. 2. In the form of independent particles. A long molecule of DNA or RNA having a covering of a protein coat. 3. Can survive only in other host living cell → produce viral proteins with help of host cell → create their numerous replica → Destruction of the host cell → Free viruses cause reinfection to other new host cells. 4. Causative agent for many plant and animal diseases. 	<p>(1) Human –</p> <ul style="list-style-type: none"> • polio virus, • Influenza virus, • HIV – AIDS virus etc. <p>(2) Cattle – picorna virus</p> <p>(3) Plants –</p> <ul style="list-style-type: none"> • Tomato – Wilt virus • Tobacco mosaic virus, etc. <p>(4) Bacteria – Bacteriophage</p>
Bacteria	1 μm to 10 μm	<ol style="list-style-type: none"> 1. Single cell → independent solitary or colonial → forming Colonies . 2. Prokaryotic with cell wall. No well-formed nucleus. Cell organelles are absent. 3. Reproduction → Simple binary fission 4. Vigorous growth in favourable conditions → Number doubles in 20 minutes. 	Coccus, Cocco- bacillus, Bacillus, Vibrio, Spirillum
Protozoa	200 μm	<ol style="list-style-type: none"> 1. Present in soil, sea water and fresh water. Some pathogenic → Present as parasites inside the host body. 2. Eukaryotic, unicellular organisms. 3. Great variation in cell structure, organs of locomotion and modes of nutrition. 4. Reproduction is by binary fission which is similar to cell division. 	<p><i>Amoeba</i>, <i>Paramecium</i> –Free living.</p> <p><i>Entamoeba histolytica</i> → pathogenic causing Amoebiasis</p> <p><i>Plasmodium vivax</i> – causes malaria</p> <p><i>Euglena</i> – autotrophic.</p>

Fungi	Approximately 10 μm to 100 μm	<ol style="list-style-type: none"> 1. Eukaryotic unicellular 2. Some species are visible with naked eyes. 3. Saprotrophic, feed on decaying organic matter by absorption. 4. Found on dead and decaying organic matter. 5. Sexual reproduction or asexual reproduction by binary fission or by budding. 	Baker's yeast, <i>Candida</i> , Mushroom.
Algae	10 μm to 100 μm	<ol style="list-style-type: none"> 1. Aquatic. 2. Eukaryotic, unicellular, autotrophic 3. Photosynthesizing organisms having chloroplasts. 	<i>Chlorella</i> , <i>Chlamydomonas</i>

1. QUESTIONS AND ANSWERS

Q. 1 Rewrite the sentences after filling the blanks :

- (1) The process of dividing living organism into groups and subgroups is called
- (2) Organisms with cell wall but not able to perform photosynthesis are called
- (3) Most of the fungi are
- (4) Viruses can be seen only with
- (5) viruses attack bacteria.
- (6) In fungi the cell wall is made up of tough and complex sugar called

Ans.

- (1) The process of dividing living organism into groups and subgroups is called Biological classification.
- (2) Organisms with cell wall but not able to perform photosynthesis are called Fungi.
- (3) Most of the fungi are saprotrophic.

- (4) Viruses can be seen only with electron microscope.
- (5) Bacteriophage viruses attack bacteria.
- (6) In fungi the cell wall is made up of tough and complex sugar called 'Chitin'.

Q. 2 State whether the following statements are *True* or *False*. Explain your statement :

* (1) *Lactobacilli* are harmful bacteria.
Ans. False.

Explanation : *Lactobacilli* are useful bacteria. They are used for curdling the milk. They are also used for preparing variety of milk products.

* (2) Cell wall of fungi is made up of chitin.

Ans. True.

Explanation : The cell wall of the plants is made up of cellulose while the cell wall of fungi is made up of complex sugar called chitin. Inside the fungal cell wall there is cytoplasm which contains many nuclei.

Note : Questions marked with asterisk (*) are textual questions.

*** (3) Organ of locomotion in amoeba is pseudopodia.**

Ans. True.

Explanation : Amoeba is a protozoan, primitive organism which possesses pseudopodia as the organ for locomotion.

(4) Plasmodium causes dysentery.

Ans. False.

Explanation : *Plasmodium* causes malaria. *Entamoeba histolytica* causes amoebic dysentery or amoebiasis.

*** (5) Tomato wilt is a viral disease.**

Ans. True.

Explanation : Tomato wilt is a viral disease. These viruses are able to infect only plant cells.

Q. 3 Find out my partner :

* (1) A	B
(1) Fungi	(a) Chlorella
(2) Protozoa	(b) Bacteriophage
(3) Virus	(c) Candida
(4) Algae	(d) Amoeba
(5) Bacteria	(e) Prokaryotic

Ans. (1) Fungi – Candida (2) Protozoa – Amoeba (3) Virus – Bacteriophage (4) Algae – Chlorella (5) Bacteria – Prokaryotic.

(2) Scientist	Pattern of classification
(1) Carl Linnaeus	(a) 5 groups of living organisms
(2) Haeckel	(b) 2 groups as Prokaryotes and Eukaryotes
(3) Chatton	(c) 4 groups as Monera, Protista, Plants and Animals
(4) Kopland	(d) 3 kingdoms – Protista, Plants and Animals.
(5) Whittaker	(e) 2 kingdoms of living organisms

Ans. (1) Carl Linnaeus – 2 kingdoms of living organisms

(2) Haeckel – 3 kingdoms – Protista, Plants and Animals

(3) Chatton – 2 groups as Prokaryotes and Eukaryotes

(4) Kopland – 4 groups as Monera, Protista, Plants and Animals

(5) Whittaker – 5 groups of living organisms.

(3) Living organism	Group
(1) <i>Clostridium titani</i>	(a) Heterotrophic Protista
(2) <i>Paramoecium</i>	(b) Fungi
(3) <i>Chlamydomonas</i>	(c) Bacteria belonging to Monera
(4) Baker's yeast	(d) Algae
	(e) Virus

Ans. (1) *Clostridium titani* – Bacteria belonging to Monera (2) *Paramoecium* – Heterotrophic Protista (3) *Chlamydomonas* – Algae (4) Baker's yeast – Fungi.

(4) Microbes	Size
(1) Virus	(a) 1 μm to 10 μm
(2) Algae	(b) 200 μm
(3) Protozoa	(c) 10 μm to 100 μm
(4) Bacteria	(d) 10 nm to 100 nm

Ans. (1) Virus – 10 nm to 100 nm

(2) Algae – 10 μm to 100 μm

(3) Protozoa – 200 μm

(4) Bacteria – 1 μm to 10 μm

*** Q. 4 Who am I ?**

(1) I don't have true nucleus, cell organelles or plasma membrane.

Ans. Microbe from Monera

(2) I have nucleus and membrane bound cell organelles.

Ans. Protozoan from Protista / I am any one of Eukaryote

(3) I live on decaying organic matter.

Ans. Fungus

(4) I reproduce mainly by *cell division. (* Binary fission)

Ans. Bacteria and some Protozoa.

(5) I can produce my replica.

Ans. Virus

(6) I am green, but don't have organs.

Ans. Algae

***Q. 5** Arrange the following in ascending order of size :

Q. Bacteria, Fungi, Virus, Algae.

Ans. Virus, Bacteria, Fungi, Algae.

Q. 6 Name the following/ Give examples :

(1) Three organs of locomotion in Protista :

Ans. (1) Pseudopodia (2) Cilia (3) Flagella

(2) Two autotrophic Protista :

Ans. (1) Euglena (2) Volvox

(3) Institute in India which is involved in research on viruses :

Ans. National Institute of Virology, Pune

(4) Two methods of asexual reproduction in Fungi :

Ans. (1) Binary fission (2) Budding

(5) Two pathogenic protozoans and the diseases caused by them :

Ans. (1) *Entamoeba histolytica* causes amoebiasis (2) *Plasmodium vivax* – causes malaria.

Q. 7 Answer the following questions in one sentence :

(1) What are the types of living organisms according to their lifestyle?

Ans. Producers, consumers and decomposers are the types of living organisms according to their lifestyle.

(2) What are the characteristics of prokaryotic cells?

Ans. Absence of nuclear membrane, well-formed nucleus and lack of cell organelles are the characteristics of the prokaryotic cells.

*(3) Explain the nutrition in fungi.

Ans. Most of the fungi are saprophytic in their nutrition. They absorb the nourishment

from dead and decaying matter. By taking the organic matter from dead bodies of plants and animals, fungi survive. In this process they degrade the organic matter completely.

(4) When do virus destroy the host cells?

Ans. After synthesising their own proteins and creating numerous replica of their own type, then the virus destroys the host cells.

Q. 8 Give answers :

*(1) State the merits of Whittaker's method of classification.

Ans. For the answer of Merits of Whittaker's method refer to point I of answer given on this Digest's page no. 11; under "Use your brain power!" (Textbook page 3)

*(2) Write the characteristics of viruses.

Ans. (1) Viruses are extremely minute of the size range of 10 nm to 100 nm. They are on the border line of living and non-living. They are 10 to 100 times smaller than bacteria and are visible only through the electron microscope.

(2) Though they are not considered as living, they can make replica of their own.

(3) They exist in the form of independent particles. They are long molecules of DNA or RNA which are covered by a protein coat.

(4) Their survival is possible only inside the living plant or animal cells. When they infect the host cells, they produce their own proteins with the machinery of the host cell. These proteins form many replicas of the infecting virus.

(5) This infection destroys the host cell and the virus replicas are released. These free replicas re-infect the other adjoining cells of the host.

(6) Most of the viruses are pathogenic, they cause diseases in plants and animals.

*** (3) Which living organisms are included in the kingdom Monera?**

Ans. (1) All the living organisms belonging to Kingdom Monera are unicellular.

(2) The mode of nutrition in them is either autotrophic or heterotrophic.

(3) All of them are prokaryotic and thus they do not have well-formed nucleus. The nuclear membrane and the cell organelles are absent in them.

(4) Kingdom Monera consists of different types of bacteria and blue-green algae. E.g. Bacteria *Clostridium titani*, *Vibrio choleri*, *Treponema pallidum*, *Streptococcus pneumoniae*, *Legionella pneumoniae*, *Salmonella typhi*, *Staphylococcus aureus*, *Clostridium botulinum*.

*** (4) Use Whittaker method to classify bacteria, protozoa, fungi, algae, prokaryotic, eukaryotic, microbes.**

Ans. Bacteria : Kingdom Monera

Protozoa : Kingdom Protista

Fungi : Kingdom Fungi

Algae : If unicellular, Kingdom Protista.
If multicellular, Kingdom Plantae

Prokaryotic : Kingdom Monera

Eukaryotic : Any kingdom other than Monera.

Microbes : Kingdom Monera or Protista.

(5) Which criteria were considered for classification method of Whittaker?

Ans. The criteria considered for classification by Whittaker are as follows :

(1) Complexity of cell structure : Whether the cells of the organisms are prokaryotic or eukaryotic.

(2) Complexity of organisms : Whether the organisms are unicellular or multicellular is considered.

(3) Mode of nutrition : Whether the organism is autotrophic and is performing photosynthesis on its own or it is heterotrophic is considered. Plants are

autotrophic, fungi are saprotrophic while animals use food from plants or other animals and hence they are heterotrophic.

(4) Lifestyle : According to nutrition, every living organism is at certain trophic level. This is called lifestyle. Plants are producers, animals are consumers while fungi are decomposers.

(5) Phylogenetic relationship : When the evolution proceeded gradually, there was transition from prokaryotes to eukaryotes, unicellular to multicellular. In this order the different groups of living organisms were evolved. This is known as phylogenetic relationship.

Use your brain power!

(Textbook page 3)

• Explain merits and demerits of Whittaker's classification.

Ans. I. Merits of Whittaker's classification :

(1) The classification system that Whittaker has adapted is totally based on scientific foundation.

(2) Prokaryotes are placed separately in a different kingdom. The prokaryotic organisms are different from other organisms, thus placing them separately is justified.

(3) All unicellular eukaryotic organisms are clubbed together in one kingdom named, Protista. This has helped to solve the placement of Euglena.

(4) Euglena has chloroplasts like plants but as animals it has flagella and thus there was conflict about such species during previous classification systems. It was placed in protozoa previously.

(5) Fungi are saprophytic and hence they are placed separately in a unique kingdom.

(6) According to five kingdom classification, the cell structure, organization of cell, mode of nutrition,

lifestyle and phylogenetic relationship are taken into consideration.

(7) Therefore the system of 5 kingdom classification becomes most authentic system of biological classification.

II. Demerits of Whittaker's method of classification :

(1) Some organisms belonging to Monera and Protista have ability to perform photosynthesis. Thus they show mode of nutrition as autotrophic, while others are heterotrophic. Similarly some monerans have cell wall and some Protists also have cell wall. This becomes confusing during their placement.

(2) In kingdom Protista, organisms show varied characteristics. In spite of this they are placed together.

(3) In kingdoms, Plantae, Animalia and Fungi the organisms having primitive characters and were initial examples during evolution are not included. E.g. In Kingdom Animalia, amoeba is not included though it is said to be unicellular animal. This creates confusion.

(4) Similarly if algae are unicellular, they are placed in kingdom Protista and if they are multicellular they are placed in kingdom Plantae. In reality, unicellular and multicellular algae both show much similarity. But due to Whittaker's classification system they are placed away from each other.

(5) Species of algae such as *Chlorella*, *Chlamydomonas* are not included in Kingdom Protista.

(6) Viruses are not included in any of the kingdoms by Whittaker. Their classification has become a point of debate among the biologists.

Q. 9 Write short notes :

(1) Characteristics of Fungi.

Ans. (1) The organisms which are placed in kingdom Fungi are multicellular,

heterotrophic, non-green, and eukaryotic in nature.

(2) Most of the fungi are saprophytic and they sustain on the dead and decaying organic matter.

(3) The cell wall of the fungal cells is made up of chitin. Chitin is the tough and complex sugar.

(4) Fungi have thread like body. The cytoplasm of the fungal cells contain many nuclei.

(5) The reproduction in Fungi is either sexual or asexual. Asexual reproduction is by fission or by budding.

(6) Examples : Baker's yeast, *Candida*, Mushroom, *Aspergillus* (Fungus on corn), *Penicillium*

(2) Characteristics of Bacteria.

Ans. (1) Bacteria are microscopic, unicellular, prokaryotic organisms belonging to the kingdom Monera.

(2) Some bacteria are solitary with independent existence. Some are colonial forms.

(3) The bacterial cell lacks well-formed nucleus with nuclear membrane and cell organelles.

(4) Reproduction is by binary fission.

(5) In favourable conditions, bacteria duplicate with a great speed. Within 20 minutes they can double in number.

(6) Bacteria may be round as in Cocci, elongated as in Bacillus, comma shaped as in Vibrio and spiral shaped as in Spirillum.

(3) Characteristics of Protozoa.

Ans. (1) Protozoa are unicellular, eukaryotic organisms belonging to kingdom, Protista.

(2) They are microscopic of the size of about 200 μm .

(3) They have different organs of locomotion such as pseudopodia, cilia and flagella.

(4) Reproduction is by asexual method, usually by binary fission. .

(5) Protozoa are seen in varied habitats such as soil, fresh water and marine water.

(6) Some protozoans are parasitic and cause various types of illness in hosts. E.g. *Entamoeba histolytica* is a species of amoeba that causes amoebiasis. Malaria is caused by *Plasmodium vivax*.

(7) Protozoa show different modes of nutrition. E.g. Euglena is autotrophic as it does photosynthesis with the help of chloroplasts present in its body. Amoeba and *Paramecium* are heterotrophic and free living seen in contaminated water.

Q. 10 Complete the paragraph using the words given in the brackets :

[*Monera, Euglena, autotrophic, cell organelles, chitin, nuclear, prokaryotic, viruses, replicas, saprotrophic, viral particles*]

In Kingdom bacteria were included but not Viruses are on the border line of living and non-living. Do we really call them living? If they are making of their own type, are they not considered as living? Throughout the world

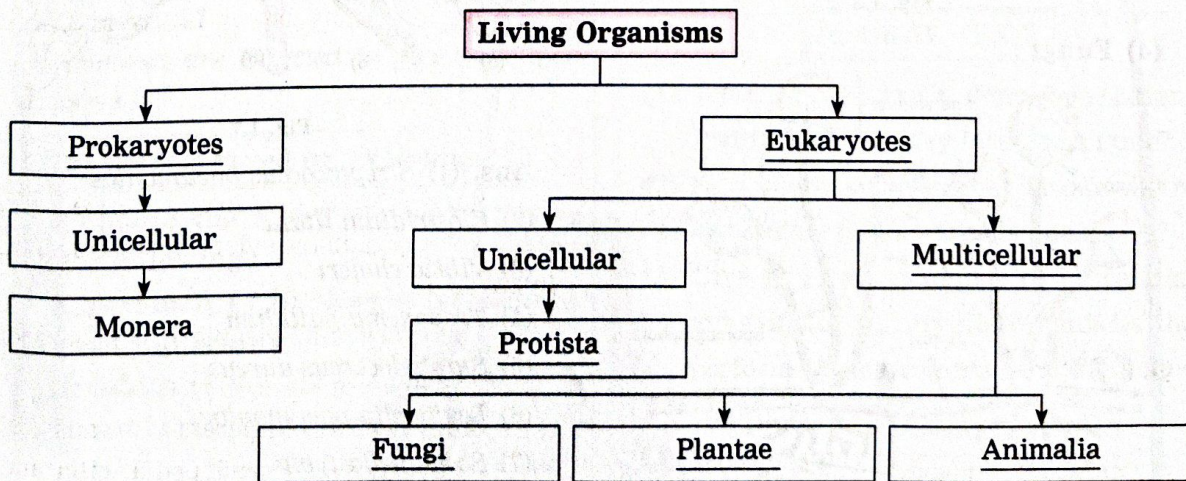
they spread hazardous epidemics. Antibiotics do not act on However, bacteria can be controlled by antibiotics. All the living organisms belonging to Monera are with cell. They do not have membrane and neither they have But a nice nucleus is seen in Euglena is protist. The fungi with cell wall of are in their mode of nutrition.

Ans. In Kingdom Monera bacteria were included but not viruses. Viruses are on the border line of living and non-living. Do we really call them living? If they are making replicas of their own type, are they not considered as living? Throughout the world they spread hazardous epidemics. Antibiotics do not act on viral particles. However, bacteria can be controlled by antibiotics. All the living organisms belonging to Monera are with prokaryotic cell. They do not have nuclear membrane and neither they have cell organelles. But a nice nucleus is seen in Euglena. Euglena is autotrophic protist. The fungi with cell wall of chitin are saprotrophic in their mode of nutrition.

Q. 11 Complete the chart :

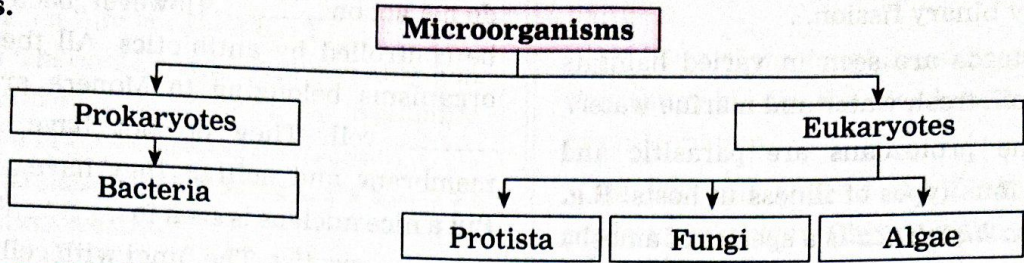
***(1)** Complete the five kingdom method of classification using - living organism, prokaryotes, eukaryotes, multicellular, unicellular, protista, animals, plants, fungi.

(The answer is given directly.)



(2) Draw a chart showing different types of Microorganisms.

Ans.



Q. 12 Draw neat and labelled diagrams :

***(1) Different types of bacteria :**

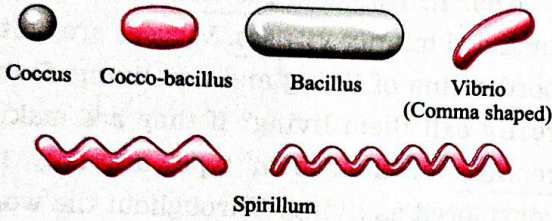


Fig. 1.1

***(2) Paramecium :**



Fig. 1.2

***(3) Bacteriophage :**

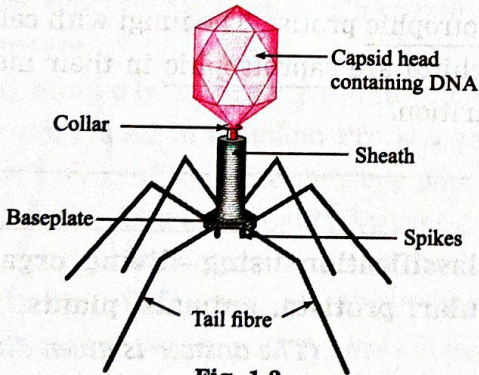


Fig. 1.3

(4) Fungi :

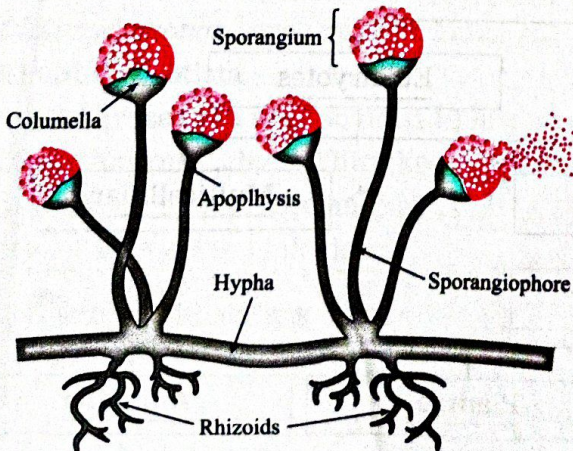


Fig. 1.4

(5) Euglena :

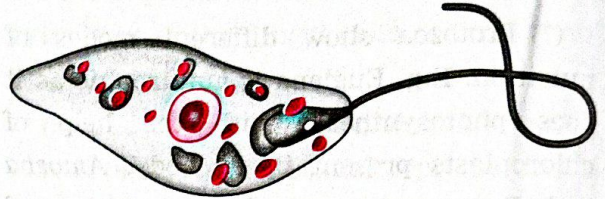


Fig. 1.5

(6) Amoeba :

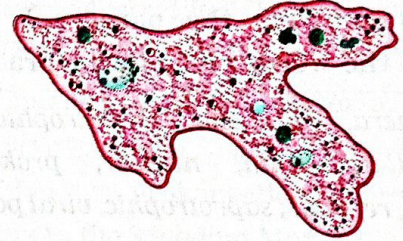


Fig. 1.6

(7) Correctly label the various organisms shown in the Kingdom Monera :

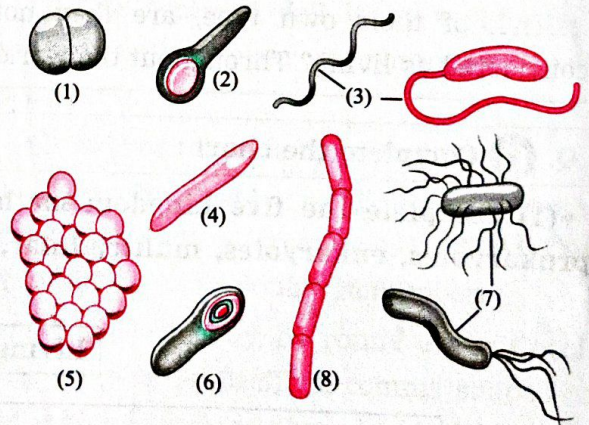


Fig. 1.7

- Ans.** (1) *Streptococcus pneumoniae*
 (2) *Clostridium titani*
 (3) *Vibrio cholera*
 (4) *Treponema pallidum*
 (5) *Staphylococcus aureus*
 (6) *Legionella pneumoniae*
 (7) *Salmonella typhi*
 (8) *Clostridium botulinum*

Q. 13 Activity-based questions :

(1) Try this : (Textbook page 2)

Activity : Take a small drop of curd or buttermilk on a clean glass slide. Dilute it with a little water. Carefully keep a coverslip. Observe it under high power of compound microscope. What did you see?

Ans. In the slide we can see *Lactobacilli* bacteria.

(2) Try this : (Textbook page 2)

Activity : Prepare a temporary mount of one drop of pond water on a glass slide. Observe it under low power and high power microscope.

Ans. The drop on the slide shows motile microscopic organisms which have irregular shape. They are amoeba.

(3) Try this : (Textbook page 2)

Activity : Take a moist piece of bread or bhakri and keep it in a container with lid for 2-3 days. After 2-3 days a fine cotton thread like tuft is found growing on the surface of the bread. Prepare a temporary mount of few threads from this culture and observe it under the microscope.

Ans. Upon observation of thread like structures the fungal hyphae (fibre like body) are seen.

Q. 14 Open ended questions :

- (1) Which method of classification do you find the best? Why?
- (2) Which diseases are caused by viruses?
- (3) Are all the bacteria harmful, what do you think?

(Students are expected to give their own answers.)

Q. 15 MCQs based on experiments :

• **Choose the appropriate alternative of the following :**

Experiment 1 : To observe lactobacilli in curd/buttermilk.

- (1) Which of the following bacterium is used to make curds from milk?
(a) *Streptococcus* (b) *Lactobacillus*
(c) *Staphylococcus* (d) *Clostridium*

- (2) In which kingdom is *Lactobacillus* included?

- (a) *Monera* (b) *Protista*
(c) *Fungi* (d) *Plantae*

- (3) Which is the other organism that has been added in kingdom Monera in addition to bacteria?

- (a) *Virus* (b) *Blue-green algae*
(c) *Fungi* (d) *Protozoa*

- Ans.** (1) *Lactobacillus* (2) *Monera*
(3) *Blue-green algae*

Experiment 2 : To observe fungus on the bread

- (1) In which kingdom is fungus growing on the bread included?

- (a) *Fungi* (b) *Protozoa*
(c) *Monera* (d) *Protista*

- (2) What are dark coloured particles which are seen when the fungus is growing on the bread?

- (a) *Sporangiophore* (b) *Rhizoids*
(c) *spores* (d) *Columella*

- (3) Why is there growth of fungus on all the stale food?

- (a) *Fungus has affinity for food.*
(b) *Fungus grows on decaying organic matter.*
(c) *As food is open, the fungus drops on it and starts growing.*
(d) *None of the alternative is correct.*

Ans. (1) *Fungi* (2) *spores* (3) *Fungus grows on decaying organic matter.*

2. ORAL TEST

- (1) What is the work done by National Institute of Virology located at Pune?
- (2) How many micrometres is one metre? How many nanometres is one metre?
- (3) Give any two examples of unicellular, autotrophic, eukaryotic organisms that perform photosynthesis with the help of chloroplasts.
- (4) What is study of viruses known as?
- (5) Which virus attacks bacterial cell?

FORMATIVE EVALUATION

1. ORAL WORK :

- (1) Name some organisms belonging to Kingdom Monera.
- (2) According to the census of 2011, how many species of living organisms are present on the earth?
- (3) Who was Robert Whittaker?
- (4) What are the living organisms that absorb nutrients from dead and decaying material? Give few examples of the same.

2. LIST OF EXPERIMENTS :

- **Experiment 1** To observe *lactobacilli* in curd/buttermilk.
- **Experiment 2** To observe fungus on the bread.

(For both the above experiments refer to Vikas Science Experiment book Standard VIII)

3. PROJECT :

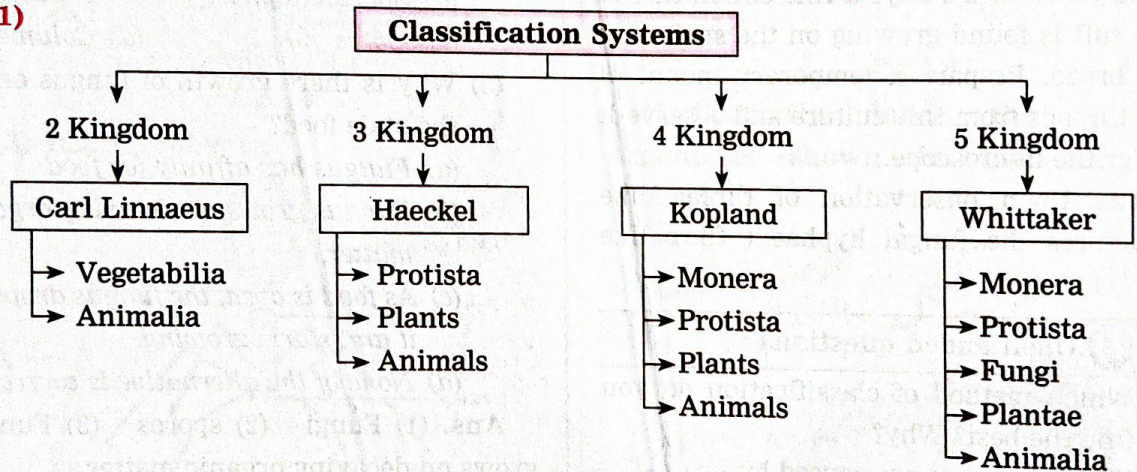
- **Internet My Friend** Collect pictures and characteristics of different microbes. Prepare a chart.

* (1) Prepare a chart showing infectious bacteria and the diseases caused by them.

* (2) Visit a nearby pathology lab. Get the information about pathogenic microbes, methods to observe them, different microscopes from the technicians there.

MEMORY MAP/CONCEPT MAP

(1)



(2)

