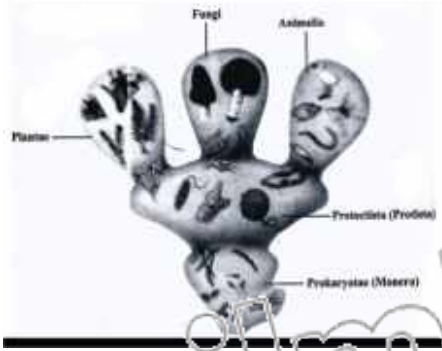


Chapter 5

Variety of Life

5.1 INTRODUCTION

Biodiversity

- Over one and a half million species of animals.
- Over a half million species of plants are known.

NEED OF CLASSIFICATION SYSTEM

To deal with such a large collection of dissimilar forms, certainly we need some system by which species can be classified in a reasonable way.

Many types of classifications are possible.

We could, for example, classify flowering plants according to their;

- Colour
- Height
- Or any other character.

➢ This type of classification is not meaningful since it does not provide any information about the basic differences and similarities among different individual.

➢ All organisms are related to one another at some point in their **evolutionary histories**. However, some organisms are more closely related than other.

➢ Sparrows are more closely related to pigeons than either to the insects.

Basis of Classification

Classification is based on **relationship among individuals,** i.e, Similarity in form or structure.

Biologist have classified all living things into groups showing similarities, based upon;

- Homologies
- Comparative biochemistry
- Cytology
- Genetics etc.

Large groups are divided into smaller groups up to species level.

Species

A species is a group of natural population which can interbreed freely among themselves and produce fertile offspring's, but are reproductively isolated from all other such groups in nature.

Asexually Reproducing Species

However "interbreeding" cannot be used as a criterion for species recognition among predominantly asexually reproducing organisms.

Species is an Independent Evolutionary Unit

Each species possesses its own distinct structural, ecological and behavioral characteristics, hence species are independent evolutionary units.

Different species do not exchange genes between them.

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Two Kingdom Classifications

Since long the living things are divided in **two kingdoms: plants** and **animals.**

- Next each kingdom is divided into **smaller groups called phyla** (also divisions for plants, algae and fungi).
- A phylum, in turn, is divided into **classes.**
- Classes into **orders.**
- Order into **families**.
- Family contains related **genera**.
- Genus is composed of one or more **species.**
- Species is the **basic unit of classification.** Conversely speaking, the organisms are grouped into larger, more inclusive categories (taxa).
- Each category is more general than the one below it and has emergent properties.
- The taxonomic categories from species to kingdom form a hierarchy as described in the classification of corn.

Biological classification of Corn, *Zea mays*

Kingdom	**Plantae**
Division (phylum)	**Anthophyta (Tracheophyta)**
Class	**Angiospermae**
Order	**Poales**
Family	**Poaceae**
Genus	***Zea***
Species	***Mays***

Members of a lower category resemble one another more than do the members of a higher tax on.

QUESTION RELATED TO ABOVE ARTICLE

What is nomenclature, describe its important with the help of examples? (LHR 2022)

5.2 NOMENCLATURE

From the earliest times plants and animals have been given common names by the people.

Different Names for the Same Organism

Since no system was used in choosing common names, in many cases, various regions had their own names for the same plant or animal.

Take 'Onion' for example;

- Its common Urdu name is **'Piyaz'**

But in different regions of Pakistan it is also known as;

- Ganda
- Bassal
- Vassal

In different countries it would have another set of names.

Similarly **'amaltas'**, 'argvad',' gurmala', 'golden shower', purging cassia' are common names for the same plant.

Thus the same plant may have different names.

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Similar Name for Different Organisms

In some cases, a single name refers to several different plants or animals. What is 'blue bell'?

Dozens of plants with bell shaped flowers are called **'blue bells'.**

Similarly the word **'black bird'** would mean;

- A crow
- As well as raven.

Common Names Have No Scientific Basis

To a biologist, a fish is a vertebrate animal with following features;

- Backbone
- Fins
- Gills etc.

But 'silver fish' is an insect, and a 'cray fish', 'jelly fish', and 'start fish' do not fit the biologist's definition of a fish.

NEED OF SCIENTIFIC NAMES

Common names had long caused confusion.

Work of Carlous Linnaeus

During the 18th century, Carlous Linnaeus (1707 – 1778), a Swedish botanist, devised a system for naming and classifying all the organisms known to him.

- He took the scientific name from ***latin word.***
- His system is used today internationally.
- He discarded the common names of plants and gave each one a scientific name.

He took the scientific name from 'Latin word. Linnaeus published the list of name of ***plants*** in ***1753.***

Binomial Names

The scientific name of each plant had two parts. Usually, the name referred to some characteristics of the organisms or the person who collected it.

His system spread rapidly and became so popular that he used it later on in naming ***animals*** and published his list in ***1758.*** Many of his names are in use today.

Linnaeus's system of giving each species a scientific name comprising two words is known as ***binomial nomenclature.***

- The ***first name*** refers to the ***genus*** (pl. genera) and is called generic name and always ***begins with a capital letter.***
- The specific name follows the generic name refers to ***species*** and ***begins with small letter.***

Scientific Names of Some Organisms

The scientific name for:

- Onion is *Allium cepa*
- Amaltas is *Cassia fistula*
- Man is *Homo sapiens*
- Potato is *Solanum tuberosum*
- Brinjal is *Solanum melangena*

The same generic name for potato and brinjal reflects close relationship between these two species

Every species has only one scientific name the world over.

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Basis of Classification

Initially the classification was based on the appearance or morphology of plants and animals but with advancement in the knowledge of cytology, physiology, genetics and molecular biology the classification of organism has been modified.

QUESTION RELATED TO ABOVE ARTICLE

Define Binomial Nomenclature. Give its rules and why it is needed? (BWP 2019)

Describe Linnaeus system of binomial nomenclature in detail. (RWP 2021)

5.3 TWO TO FIVE KINGDOM CLASSIFICATION SYSTEMS

Different classification systems recognize two to six kingdoms.

TWO KINGDOM CLASSIFICATIONS

For centuries, the living organisms have been classified into two kingdoms;

- **Plants**
- **Animals**

Plants can prepare their own food from simple inorganic material and store energy (autotrophs).

While animals cannot synthesize their own food from simple inorganic material and depend for their food either on autotrophs or on decaying organic matter **(**hetorotrphs).

Bacteria were included in plants.

THREE KINGDOM CLASSIFICATIONS

Many biologists found this system satisfactory, while others found it unworkable for many unicellular organisms like;

Euglena that have both **plant like** (presence of chlorophyll) and **animal like** (lack of cell wall) characters and also because it ignores the differences between prokaryotic and eukaryotic cells.

Work of Ernst Hackel

In 1966 Ernst Hackel proposed a third **kingdom protista** to accommodate Euglena like organism and bacteria.

Work of E. Chatton

In 1937, E-Chatton suggested differentiating terms **procariotique** (from **Greek** pro, meaning before, and karyon, meaning nucleus) used to describe bacteria and blue-green algae, and the term **eu-cariotique** (from **Greek** eu, meaning true) to describe animal and plant cells.

FOUR KINGDOM CLASSIFICATIONS

Some biologists also disagree about the classification of **fungi.**

Such as bread mold, yeast and mushrooms, which resemble plants in many ways but are not autotrophs.

Fungi are special forms of hetorotrophs that obtain energy and structural material by breaking down (**decomposing**) and **absorbing food** substances from the surroundings, and possess chitin as a major structural component in their cell walls.

FIVE KINGDOM CLASSIFICATIONS

A relatively recent system of classification.

Work of Robert Whittaker

The five kingdom system was proposed by Robert Whittaker (1969).

Basis of Classifications used by Robert Whittaker

This system of classification is based on;

- Three different ***levels of cellular organization***.
- Three principal modes of nutrition- ***photosynthesis, absorbing*** and ***ingestion*.**

The five kingdoms proposed were;

(i) Monera: The prokaryotic unicellular organism such as bacteria.

(ii) **Protista:** The eukaryotic predominantly unicellular organism such as euglena and amoeba.

(iii) **Plantae:** The eukaryotic multicellular autotrophs.

(iv) **Fungi:** The eukaryotic multicellular reducers for example mushrooms.

(v) **Animalia:** The eukaryotic multicellular consumers.

- Plants are autotrophic in nutritional mode, making their own food by photosynthesis such as mosses, fern, and flowering plants.
- Fungi are heterotrophic organisms that are absorptive in their nutritional mode. Most fungi are decomposers that live on organic material, secrete digestive enzymes and absorb small organic molecules which are produced by digestion.
- Animals live mostly by ingesting food and digesting it within specialized cavities. They lack cellulose and show movements for example birds and reptiles.
- In five kingdom classification all eukaryotes that did not fit the definition of plants, fungi or animalia were included in Protista.
- Most Protists are unicellular forms, but this kingdom also includes relatively simple multicellular organisms that are believed to be direct descendants of unicellular Protists.

Work of Lynn Margulis and Karlene Schwartz

Lynn Margulis and Karlene Schwartz (1988) ***modified five kingdom classification of Whittaker.***

Basis of Classifications used by Margulis & Schwartz

- By considering cellular organization
- Mode of nutrition
- Cytology
- Genetics
- Organelles of symbiotic origin (mitochondria, chloroplast)

These five kingdom are:

1) Prokaryotae (Monera)
2) Protoctista (protists)
3) Plantae
4) Animalia
5) Fungi

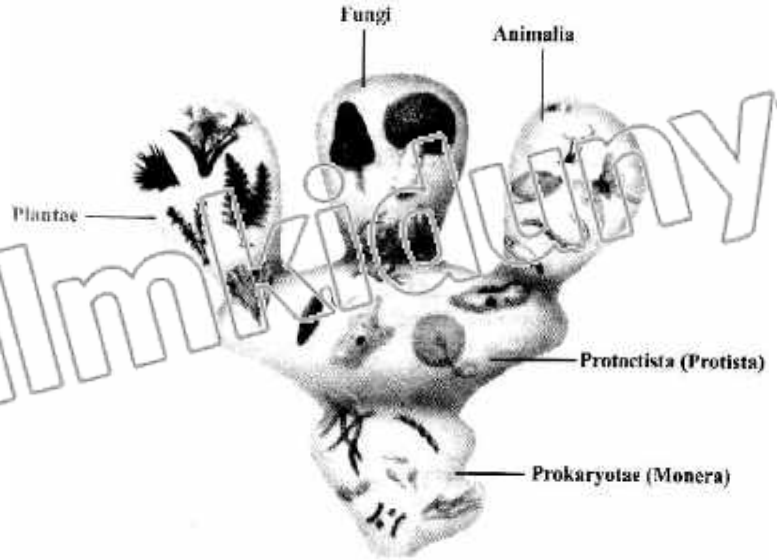


Fig. 5.1 Relationship of Five kingdom

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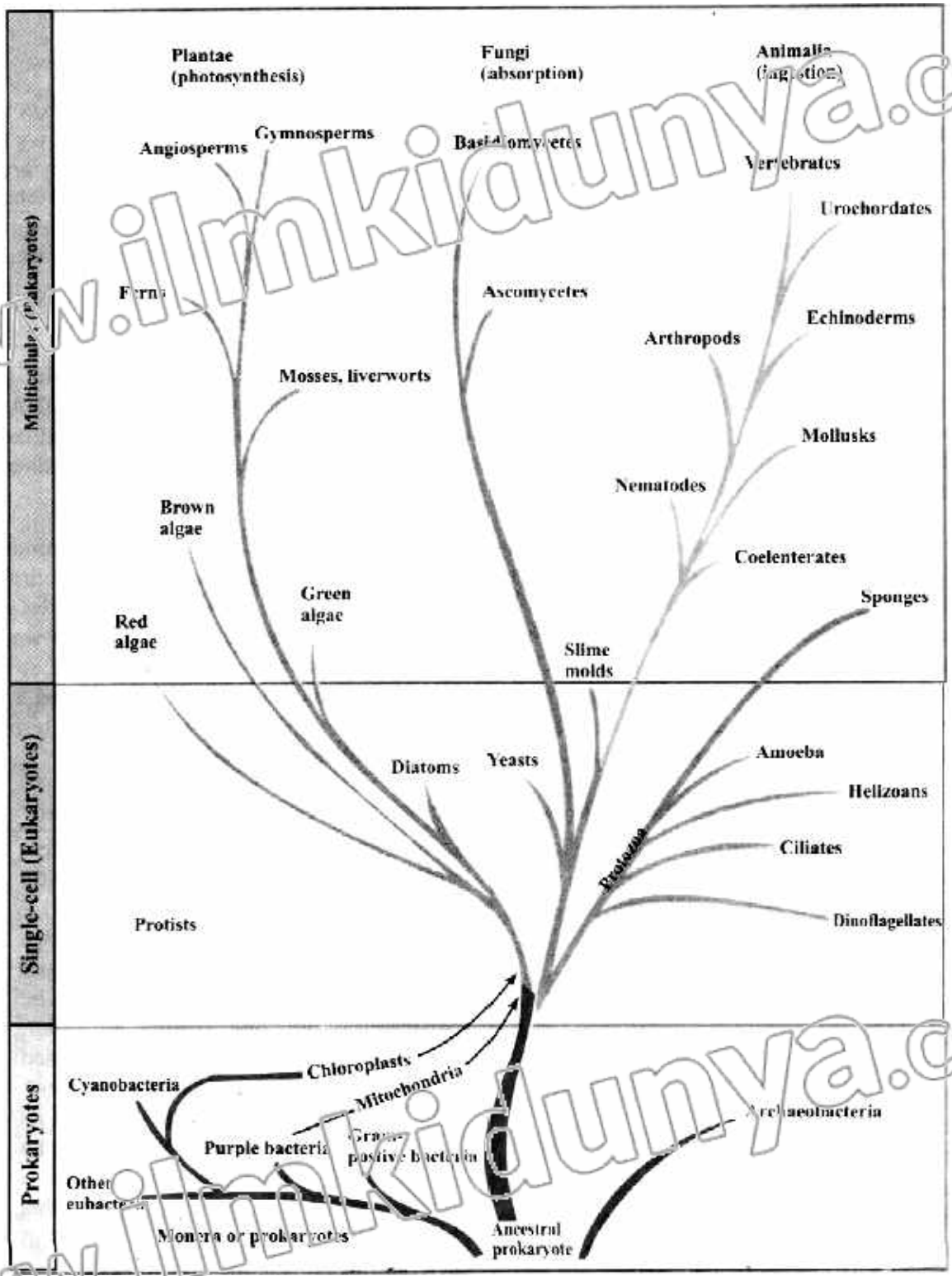


Fig. 5.2 Five kingdom classification by Whittaker

QUESTION RELATED TO ABOVE ARTICLE

Explain the two to five kingdom system of classification.
Explain five kingdom system of Robert Whittaker and its modification. (SWL 2019)
Write a note on five kingdom classification system of Robert Whittaker. (FSD 2022)
Discuss biological journey from two to five kingdom classification system.(SGD 2022)

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5.4 VIRUSES

5.4.1 INTRODUCTION

The word virus is derived from ***Latin*** word ***'venome'*** meaning ***poisonous fluid.***

Definition

It can be defined as non-cellular infectious entities which contain either RNA or DNA, normally encased in proteinaceous coat, and reproduce only in living cells.

Viruses utilize the biosynthetic machinery of the host for its own synthesis and then transfer themselves efficiently to other cells.

Virology

The branch which deals with the study of viruses is known as ***virology.***

5.4.2 DISCOVERY OF VIRUS

Early Period

About a century ago, at the time of Louis Pasteur (1822-1895) and Robert Koch (1843-1910), the word "virus" was generally referred to as a poison associated with disease and death.

Present Concept of Virus

- The present notion of virus is entirely different. Now viruses are recognized as particles of nucleic acid often with a protein coat.
- They replicate in living cells and cause many disease such as influenza, hepatitis, small pox and AIDS.

Work of Edward Jenner

- Some viral disease have been known for centuries.
- In fact, the first infections disease against which effective ***method of prevention*** was developed was a ***viral disease.***
- In 1796, Edward Jenner first vaccinated an 8 years old boy with material removed from cowpox lesion on the hand of milkmaid.
- After six weeks the boy was inoculated with pus from a small pox victim, but he did not develop the disease.
- Later Jenner used material for vaccination from cowpox lesion and successfully vaccinated 23 persons.
- As the material he used was obtained from cow (Latin: ***Vacca***), latter the term ***vaccination*** was used by Louis Pasteur for inoculation against disease.

Work of Charles Chamberland

In 1884, one of Pasteur's associates, Charles Chamberland, found that:

- Bacteria cannot pass through porcelain filters.
- While agent responsible for rabies (a disease which is transferred to human by bites of rabid dogs, foxes, cats, bats and other animals) can pass through these filters.

As in those days the word virus was loosely used to describe any toxic substance that caused disease, those unseen filterable agents of disease were describe as ***filterable viruses.***

Work of Ivanovski

In 1892, Ivanovski discovered that the agent which caused ***tobacco mosaic disease*** was filterable.

- He obtained bacteria free filtrate form ground up infected plants and placed it on healthy leaves of tobacco.
- He observed that filtrate produce the disease in healthy plants.
- After that, presence of similar filter passing ultramicroscopic agents was seen in the victims of many disease, including foot and mouth disease (1898) and yellow fever (1901).

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Work of Twort and D' Herelle

Bacteriophages, viruses that infect bacteria, were discovered independently by **Twort** in **1915** and **D' Herelle** in **1917**. **Twort** observed that bacterial colonies sometimes undergo Lysis (dissolved and disappeared) and that this lysis can be transferred form one colony to other. Even highly diluted material from lysed colony can transfer the lytic effect. However, heating the filtrate destroyed its lytic property. From these observations, he concluded that lytic agent might be a virus. **D' Herelle** rediscovered this phenomenon in **1917** and used the word ***bacteriophages*** meaning **"bacteria**

Work of Stanley

The filterable agents were first purified in 1935, when Stanley was successful in ***crystallizing the tobacco mosaic virus.***

Chemical Composition of Virus

Chemical analysis of these particle showed that they contained only nucleic acid and protein. This suggested that, unlike other forms, viruses are of simple chemical composition.

5.4.3 CHARACTERISTICS OF VIRUS

Size

Viruses are extremely small infectious agents, which can ***only be seen under an electron microscope.***

- They range in size form ***250 nanometer*** (nm) of ***poxviruses*** to the ***20 nm*** of ***parvoviruses***.
- They are ***10*** to ***1000 times smaller than most bacteria,*** so they can pass through the pores of filter, from which bacteria cannot pass.

Obligate Parasites

- Viruses ***cannot be grown on artificial media.*** They can reproduce only in animal and plant cells or in microorganisms, where they reproduce by replication (a process by which many copies or replicas of virus are formed).
- Thus the viruses are ***obligate intracellular parasites.***

Nature

- Viruses ***lack metabolic machinery*** for the synthesis of their own nucleic acid and protein. They depend on the host cell to carry out these vital functions.
- During reproduction in the host cells, ***viruses may cause disease.***
- All viruses are ***generally resistance to broad range of available antibiotics*** such as penicillin, streptomycin, and others.

QUESTION RELATED TO ABOVE ARTICLE

What are viruses? Give their discovery and general characteristics.
What are viruses? Give their three characteristics.
Give characteristics of viruses. **(SGD 2021)**

5. 4.4 STRUCTURE

Virion

The complete, mature and infectious particle is known as ***virion.***

The virions are composed of;

- A central core of ***nucleic acid,*** either DNA or RNA, which is also known as ***the genome.***
- A protein coat, ***the capsid*** **that** surrounds genome.

Role of Capsid

- Capsid gives definite shape to virion.
- Capsid is made up of protein subunits known as ***capsomeres***.

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Importance of Capsomeres

The number of capsomeres is characteristics of a particular virus.

For example

- ***162 capsomeres*** are present in the capsid of ***herpes virus.***
- ***252 capsomeres*** in the capsid of ***adenovirus*** which cause some common colds.

Animal Viruses

In some animal viruses the ***nucleocapsid*** (nucleic acid and capsid) is covered by another membrane derived from the host cell. ***the envelope.***

Non enveloped viruses are known as **naked virions**.

Shape of Animal and Plant Viruses

Animal and plant viruses may be;

- **Polyhedron** (having many sides).
- **Helical** (spiral).
- **Enveloped or complex**

Sub-viral Agent

The most recently discovered (1983) and least understood microorganisms are the ***prions***, which may be infectious proteins. Their nature is very controversial. They are composed of protein only that contains the information what codes for their own replication. All other organisms contain their genetic information in nucleic acid (DNA or RNA). Prions are responsible for ***mad cow infection*** and ***mysterious brain infection*** in man.

Bacterial Viruses

Bacteriophages occur in two structural forms i.e,

- **Cubical:** In general appearance cubical phages are regular solid or icosahedral (having 20 faces)
- **Helical:** Helical phages are rod shaped.

Many phages consist of head and tail. In those cases heads are polyhedral but tails are rod shaped. Morphology of some viruses and bacteriophages has been shown in.

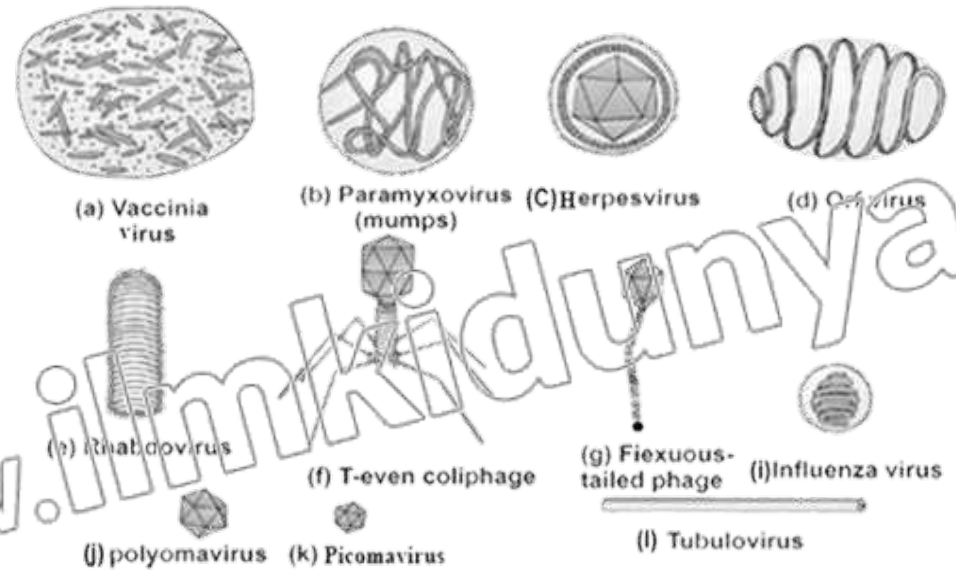


Fig. 5.3 Different types of viruses

QUESTION RELATED TO ABOVE ARTICLE

Give characteristics of viruses. **(RWP 2019)**

Describe the structure of a Virus giving example of bacteriophage. **(BWP 2021)**

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5.5 LIFE CYCLE OF BACTERIOPHAGES

Earlier researches on bacteriophages were mainly on limited number of phages that infect ***Escherichia coli*** of these the best known phages are T phages (T for type)

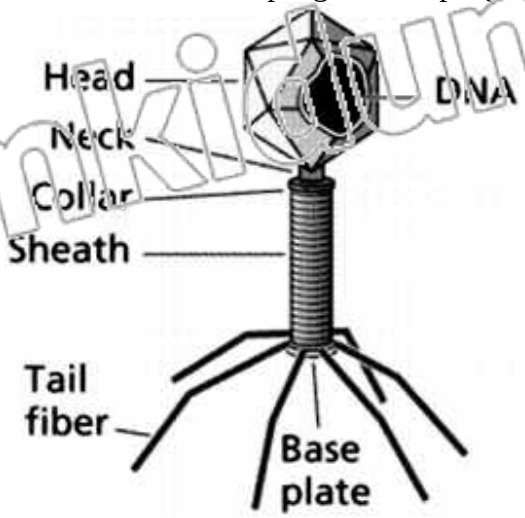


Fig. 5.4 A Bacteriophage

Among T phages the T_2 and T_4 phages are mainly used in phage studies.

Structure of T_4 Bacteriophage

The overall structure of T_4, studied with electron microscopy resembles that of ***tadpole,*** consisting of head and tail.

Head

- The head is an elongated pyramidal (having two triangular structures with common base), hexagonal, prism-shaped structure, to which straight tail is attached.
- Within the head double stranded DNA molecule is present.

Tail

- The structure of phage tail is more complex than head.
- A layer of distinct protein forms the inner tube or ***core,*** which is enclosed in ***sheath*** made up of another type of protein.
- On one side of sheath is ***collar*** and on other side is ***end plate***.
- To end plate six ***tail fibers*** are attached, which are the structures for attachment. The volume of the phage is about 1/1000 of the host.

LYTIC CYCLE

The bacteriophages replicates only inside the bacterial cell.

Adsorption or Attachment

- The first step in the replication of bacteriophages is its attachment (adsorption) to host cell at ***receptor site*** on the cell wall of bacterium. During attachment, week chemical union between virion and receptor site takes place.

Penetration

- In the next step, the tail releases the enzyme ***lysozyme*** to dissolve a portion of the bacterial cell wall. The tail sheath contracts and tail core is forced into the cell through cell wall and cell membrane. The virus ***injects its DNA into the cell*** just as the syringe is used to inject the vaccine.
- The protein coat, which forms the phage head and tail structure of virus remains outside the cell.

➢ Many animal viruses, however, enter the host cell as a whole.

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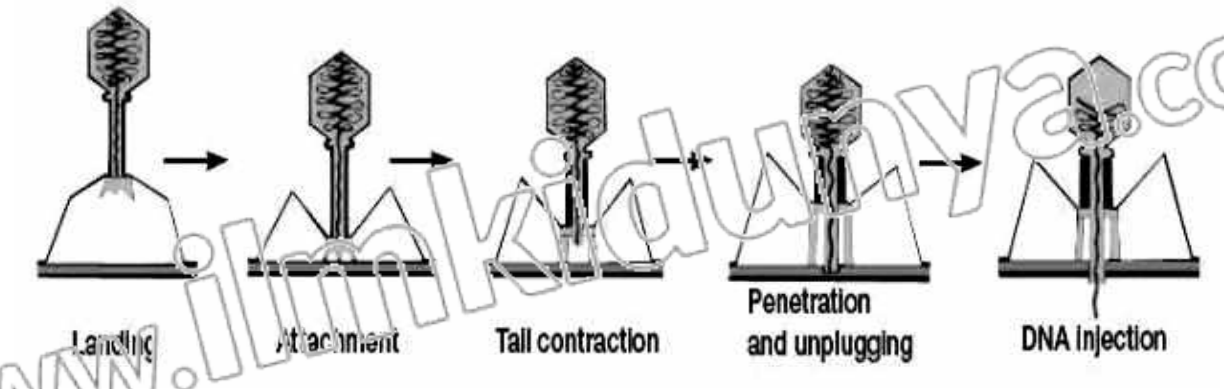


Fig. 5.5 A phage injecting its DNA in to host

Multiplication

- Immediately after entering the host cell, the ***viral nucleic acid takes the control of the host's biosynthetic machinery*** and induces the host cell to synthesize necessary viral components (DNA, proteins), and starts multiplying.

Lysis or Bursting

About 25 minutes after initial infection, approximately 200 new bacteriophages are formed, bacterial cell bursts, i.e., it undergoes ***lysis.***

Amplification

Newly formed phages are released to infect the new bacteria and another cycle, ***the lytic cycle*** beings. The phage which causes lysis of the host cell is known as ***lytic or virulent phage.***

LYSOGENIC CYCLE

- All infections of bacterial cells by phages do not result in lysis.
- In some cases ***viral DNA***, instead of taking over the control of host's machinery, becomes ***incorporated into the bacterial chromosome.***
- Phage in this state is called ***prophage*** and this process is known as ***lysogeny.***
- The phage which causes lysogeny is called ***temperate (lysogenic) phage.***
- In this condition the ***bacterium continues to live and reproduce normally.***
- Viral DNA being the part of bacterial chromosome passes to each daughter cell in all successive generations.
- Sometimes, however, the viral DNA gets detached form the host's chromosome and lytic cycle starts.
- This process is called ***induction.***

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Benefit of Lysogenic cycle

Lysogenic bacteria are resistant to infection by the same or related phages.

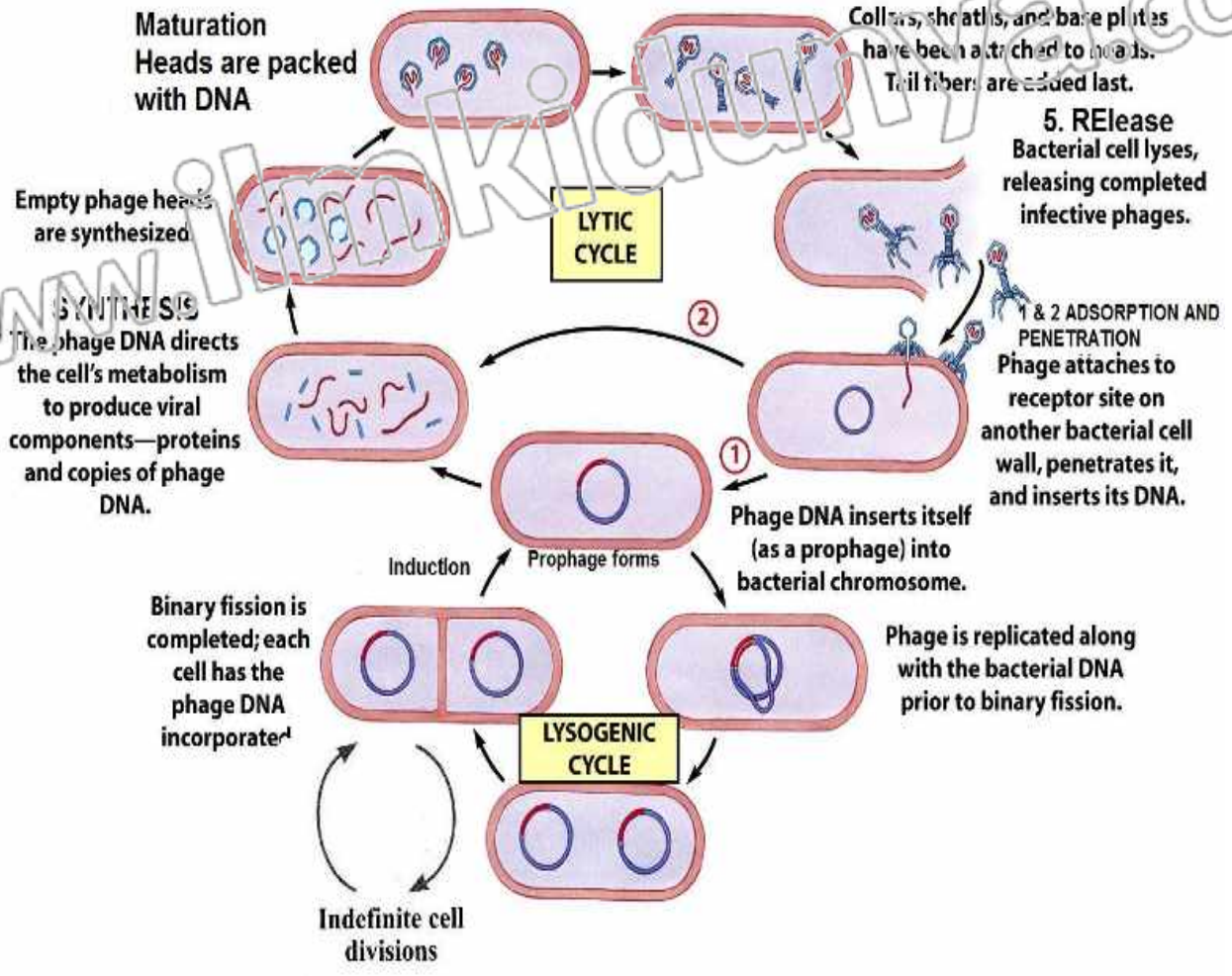


Fig. 5.6 Replication of a bacteriphage. After adsorption and penetration, the virus undergoes prophage formation (1) in the lysogenic cycle, phages can exist harmlessly as a prophage with in the host cell for long periods of time. Each time the bacterial chromosome is replicated, the prophage also is replicated, all daugthterbacterial cells are "infected" with the prophage induction involves either a spontaneous or environmentally induced exision of the prophage from the bacterial chromosome. (2) A typical lytic cycle, involves synthesis and maturation of phage

QUESTION RELATED TO ABOVE ARTICLE

Explain the lytic and lysogenic cycle of bacteriophage.

Explain lytic life cycle of virus.
Give lytic life cycle of bacteriophage. Show your answer with diagram.
Explain the structure of bacteriophage. **(GRW 2017)**
Explain lytic cycle of virus in bacteria. **(LHR 2018)**
Describe lytic cycle of bacteriophage. **(LHR 2019)**
Give lytic cycle of bacteriophage. **(FSD 2019)**
Describe lytic cycle.
(LHR 2017, 2019, MTN 2019, LHR 2021, GRW 2021, MTN 2021)
Explain replication bacteriophage. **(DGK 2021)**
What are bacteriophages? Describe its Lytic life cycle. **(MTN 2022)**

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5.6 CLASSIFICATION OF VIRUSES

Virus morphology and nucleic acid properties are most important for classifying plant, animal and bacterial viruses.

(i) DNA virus
(ii) RNA virus
(iii) Naked Virus
(iv) Enveloped Virus

On the basis of morphology, viruses are classified into;

(i) Rod shaped (T.M.V)
(ii) Spherical (poliovirus)
(iii) Tadpole like bacteriophages viruses

5.7 SOME VIRAL DISEASES

There are many disease which are caused by viruses.

- Only those are being mentioned here which are common in Pakistan.

(i) SMALL POX

Pathogen

Smallpox, which is caused by ***pox viruses*** (the DNA enveloped virus).

History

It is an ancient disease that is known to have occurred as epidemic in China as really as the twelfth century B.C.

Until the early twentieth century, small pox was a common disease throughout the word.

Significance

In small pox, raised fluid-filled vesicles are formed on the body which become pustules later on and form pitted scars, ***the pocks.***

Control

By 1950's immunization and other control measures had largely decreased the danger, but it is still present in the third world countries where many people are affected.

(ii) HERPES SIMPLEX

Pathogen

Herpes simplex is caused by ***herpes virus*** (DNA virus).

Signs

It is naturally occurring disease of mankind. In this vascular lesions in the epithelial layers of ectodermal tissues are formed. Most commonly this disease occurs in the mouth, on the lips, and at other skin sites.

(iii) INFLUENZA

Pathogen

Influenza is caused by ***influenza virus*** (enveloped RNA viruses).

Infection

Influenza is wide spread disease in man and occurs in epidemic form.

(iv) MUMPS & MEASLES

Pathogen

Mumps and Measles virus belong to group ***paramyxoviruses*** (enveloped RNA viruses).

Infection

Mumps is highly contagious, wide spread, but seldom fatal. About 60% of adults are immune to it. Measles is one of the commonest disease of the childhood and adult human population is equally susceptible the world over. This disease develops immunity in its victim.

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(v) POLIO

Pathogen

Poliomyelitis**,** caused by ***polio virus*.**

Infection

Is found all over the world. It occurs mostly in childhood. The age at which primary infection occurs varies with social and economic factors. The polioviruses are the smallest known viruses and contain RNA in spherical capsid. Some common human viral disease are shown in.

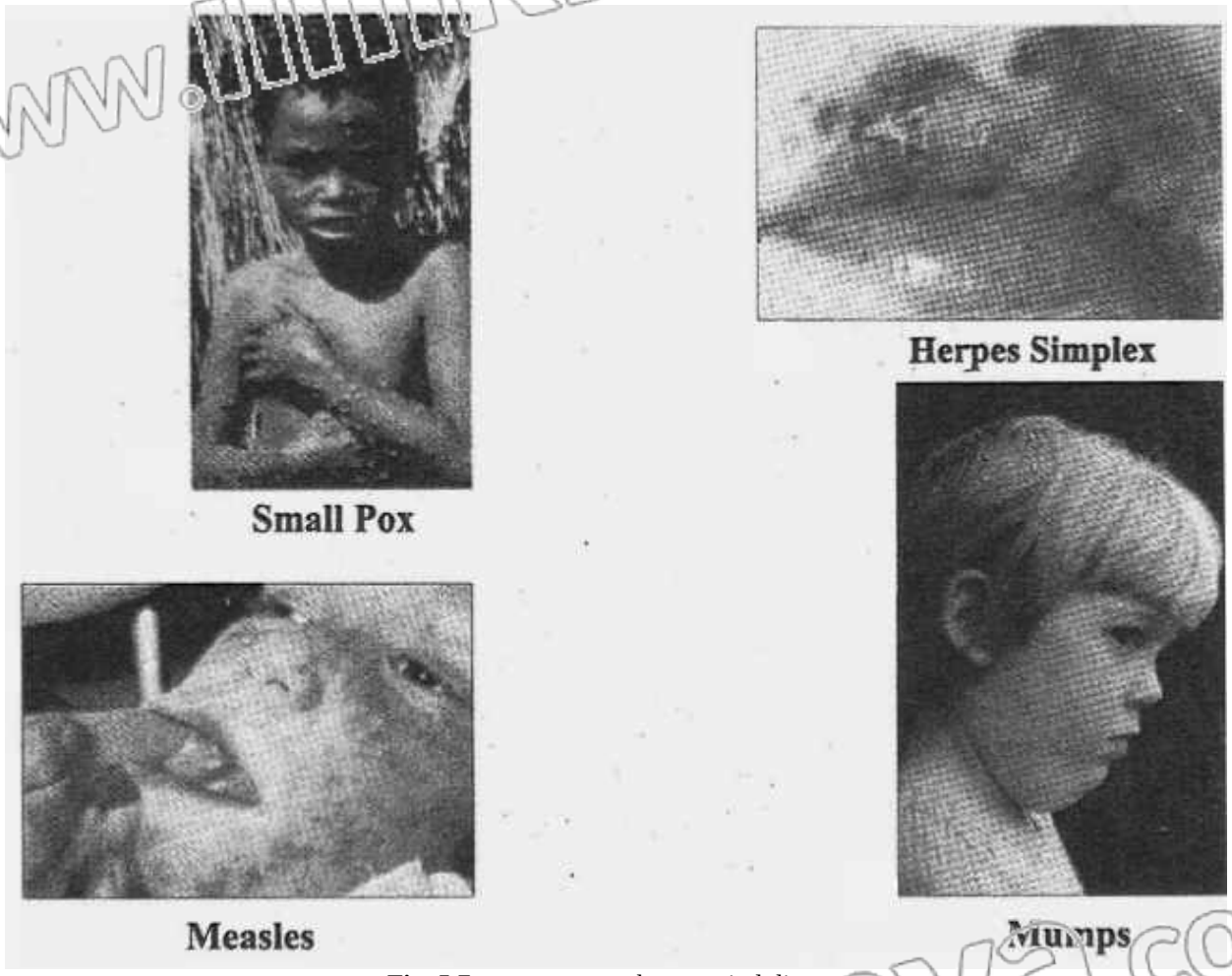


Fig. 5.7 some common human viral disease

QUESTION RELATED TO ABOVE ARTICLE

Explain the different viral diseases.

Write notes on smallpox and polio. (LHR 2018, 2021)

Write a note on any four viral diseases in man. (SWL 2021)

5.8 RETROVIRUSES

RNA tumor viruses have been known for many years.

These viruses are widely distributed in nature and are associated with ***tumor production*** in a number of animal species, such as fowl, rodents and cats.

Example

The most familiar of viruses is the ***human immunodeficiency virus (HIV)*** which causes ***acquired immune deficiency syndrome (AIDS).***

ONCOVIRUSES

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The single stranded ***RNA tumor viruses,*** which also include retroviruses (oncoviruses), are ***spherical*** in form about ***100nm in diameter*** and enveloped by host plasma membrane.

Features

- Although a few retroviruses are non specific that is, they can infect any cell, most of them can infect only host cells that possesses required receptors.
- In the case of AIDS virus, the host cell possesses a receptor that allows the viral adsorption and penetration in several types of ***leukocytes*** (white blood cells) and tissue cells.
- The retroviruses have a special enzyme called ***reverse transcriptase***, which can convert a single stranded RNA genome into double stranded viral DNA.
- Not only can this DNA infect host cells. But it also can be incorporated into host genome as a provirus that can be passed on to progeny cells. In this way some of retroviruses can convert normal cells into cancer cells.

5.8.1 ACQUIRED IMMUNE DEFICIENCY SYNDROME (AIDS)

Discovery

The AIDS was reported by some physicians in early 1980's in young males. All these young patients were homosexuals.

Soon after the disease was discovered in nonhomosexual patients who were given blood (blood transfusion) or blood products.

Signs

Severe pneumonia, a rare vascular cancer, sudden weight loss, swollen lymph nodes and general loss of immune functions.

Identification

In **1984,** the agent causing the disease was identified by research teams from Pasteur institute in France and National Institute of health in USA.

In **1986,** the virus was named as human immunodeficiency virus (HIV).

Susceptible Cells

(i) The major cell infected by HIV is the ***helper T-Lymphocyte,*** which is major component of immune system.

(ii) ***Cells in central nervous system*** can also be infected by HIV**.**

Effect

As the HIV infection continues in the host, the decrease of helper T-Lymphocyte, results in failure of the immune system and the infected person becomes susceptible to other diseases.

Host Specific

Recent studies on HIV reveal that the virus infects and multiplies in monkey but does not cause disease in them, which means that HIV is host specific**.**

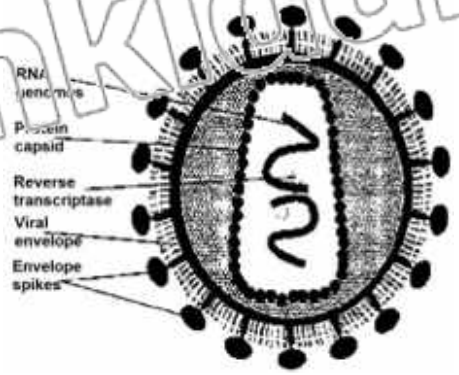


Fig. 5.8 Human immunodeficiency virus (HIV)

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Causes of Infection

- The HIV is transmitted by intimate sexual contact.
- Contact with blood.
- Breast feeding etc.

➢ Healthcare workers can also acquire HIV during professional activities.

Preventive Measures

- Avoiding the direct contact with HIV is important measure for preventing the disease.
- Prevention of intravenous drugs with common syringes and use of sterile needles/syringes and utensils is important.

Vaccine against HIV

Now vaccine against HIV has been synthesized and its experimental administration in humans started in early 2001 in South Africa.

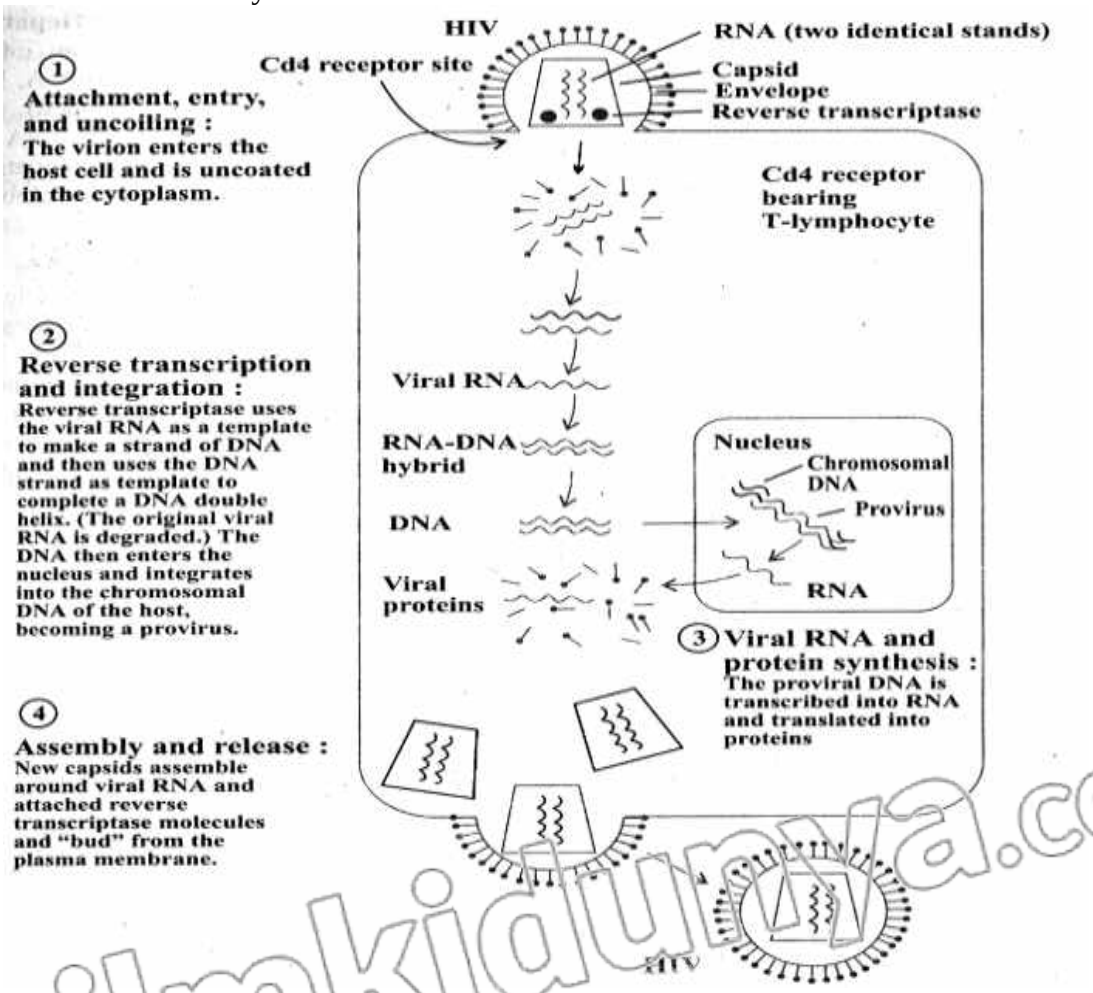


Fig. 5.9 Infection cycle of HIV

QUESTION RELATED TO ABOVE ARTICLE

What is AIDS? Explain its life cycle in detail.
Write not on AIDS.
What are retroviruses? Discuss.
Write a detailed note on "AIDS". Draw life cycle of HIV. (MTN-2019)
Write down a note on AIDS. (GRW-2021)
Give labeled sketch of infarction cycle of HIV. (DGL-2021)
Draw infectious life cycle of HIV. Give its labeling. (DGK-2022)

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5.9 HEPATITIS

Introduction

Hepatitis is an inflammation of the liver. People with chronic hepatitis infection are at the risk of liver damage.

Cause

It is usually caused by ***viral infection, toxic agents*** or ***drugs.***

Signs & Symptoms

- It is characterized by jaundice, abdominal pain, liver enlargement, fatigue and sometimes fever.
- It may be mild or can be acute and can lead to liver cancer.

Types of Hepatitis

The different types of viral hepatitis are;

i) Hepatitis A
ii) Hepatitis B
iii) Hepatitis C
iv) Hepatitis D
v) Hepatitis E
vi) Hepatitis F
vii) Hepatitis G

i) Hepatitis A

Hepatitis A formerly called ***infectious hepatitis.***

Transmission

Hepatitis A is transmitted by contact with faces from infected individuals.

ii) Hepatitis B

Hepatitis B is called ***serum hepatitis.*** Hepatitis B (HBV) is the second major form of hepatitis. It is caused by ***DNA virus*** which is very common in Asia, China, Philippines, Africa and the Middle East.

Transmission

Hepatitis B is transmitted by the exchange of body fluids, for example blood serum, breast milk and saliva, from mother to child during birth or afterward and by sexual contact.

Effects

During acute attacks of Hepatitis B, fatigue, loss of appetite and jaundice are reported. Infected persons can recover completely and become immune to the virus.

iii) Hepatitis C

Hepatitis C (formerly called non-A, non-B hepatitis Virus) Hepatitis C virus (HCV) is also ***RNA virus (enveloped)*** causes ***infusion hepatitis***, which is less severe than hepatitis A or hepatitis B, but hepatitis C often leads to chronic liver disease.

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Transmission

Hepatitis C passes through blood, from mother to child during pregnancy and afterward and by sexual contact.), which causes mild short term, less virulent disease.

iv) Hepatitis D (delta hepatitis),

v) Hepatitis E (a virus transmitted through the feces of an infected person). most recent work of Halbur and coworker (2001) reveals that pig could be the source of infection of infection of hepatitis E.

vi) Hepatitis F (caused by virus yet unidentified)

vii) Hepatitis G (caused by virus yet unidentified)

Control

Hepatitis can be controlled by adopting hygienic measures, with routine vaccination and screening of blood/ organ/ tissue of the donor.

Genetically engineered vaccine is available for HBV. Vaccine is also available for HAV but not for HCV.

QUESTION RELATED TO ABOVE ARTICLE

Write note on Hepatitis and its types.

What is hepatitis? Give its symptoms and discuss its three common types. **(LHR 2017)**

Write a detailed note on Hepatitis. **(DGK 2019)**

Write a detailed note on different types of hepatitis. **(SGD 2019, FSD 2021)**

Define hepatitis. What are its various types? **(BWP 2022)**

What is hepatitis? Describe its different types. **(GRW 2019, MTN 2021 GRW 2022, RWP 2022)**

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KEY POINTS

Organelles of symbiotic origin, i.e. Chloroplast and Mitochondria:

There are two theories about the origin of chloroplast and Mitochondria.

- **Autogenic theory:** These organelles formed themselves. It is called autogenic theory.
- **Symbiotic origin theory:** According to this theory, chloroplast and mitochondria were complete prokaryotic organisms. They entered into other prokaryotic organisms for protection. Chloroplast provided food to the host cell and mitochondria provide energy. Both get protection from the host cells. So they develop symbiotic relationship with the host cell. With the passage of time they started living permanently in the host cell and first eukaryotic cells was formed. This is most acceptable theory.

Pus:

Pus contains killed Pathogen, Macrophage and Neutrophils. When this pus is injected into a normal person, he develops antibody against the Pathogen and become immune. If any live Pathogen of the same disease enters into the body, it is at once killed by the antibodies. Jenner used the pus of cowpox for producing antibodies.

T-Lymphocytes:

Lymphocytes are special white blood cells. There are two types of lymphocytes: T and B lymphocytes. **T-lymphocytes** are competed in Thymus gland (gland present in the chest cavity). **B-Lymphocytes** are produced and completed in bone marrow. Both these lymphocytes are involved in the immunity of the body. There is another type **helper T-lymphocytes.** These lymphocytes only help the other lymphocytes to recognize the foreign particles like virus bacteria. HIV virus destroys these helper T-lymphocytes.

Homology:

The structures which have common ancestry are called homologous structures. The study of homologous structures is called **homology.**

Blood Serum:

Plasma minus proteins which do not coagulate under normal conditions is called blood serum. When blood clotted a thin yellowish liquid remains. It is called blood serum. Blood serum is a blood plasma without it major proteins.

Why has vaccine been failed against AIDS virus?

HIV virus incorporated in DNA of the lymphocytes as provirus. This DNA is present in nucleus. Antibodies are present in the cytoplasm. These antibodies cannot enter into nucleus and the Viral DNA remains safe. Secondary, the HIV virus always mutates. So a single vaccine is unable to control them. Hepatitis viruses live in cytoplasm. So Hepatitis virus can be easily destroyed by antibodies.

CD_4 Cluster Designation:

These are special type of T-lymphocytes. They have special receptor sites called CD_4. These receptors contain proteins. The HIV virus can detect these receptors and attach with this T-Lymphocytes.

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EXERCISE

Q.1. Fill In the Blanks

i) C. Linneaus divided all known forms of organisms into two kingdoms _____ and _____. Bacteria were placed in the kingdom _____ because they have cell walls and protozoa were placed in the kingdom _____ because they move from place to place and ingest food.

ii) The most common system of classification used today developed in 1969 by Robert Whittaker of Cornell University, uses five kingdoms: _____, _____, _____, _____ and _____.

iii) Whittaker's five kingdom system of classification recognizes two basic types of cells: _____ and _____.

iv) In five kingdom of classification proposed by Margulis and Schwartz organelles of symbiotic origin such as _____ and _____ were also considered.

v) A bacteriophage reproduces by using the metabolic machinery of _____ and _____ of bacterial cell.

vi) The protein coat that encloses the viral genome is called _____ and is made up of _____.

vii) Retroviruses are _____ viruses, which have specific enzymes _____ by which they convert RNA to DNA.

viii) HIV infect _____ and the defect in these cells lead to failure in _____ system.

ix) Hepatitis is caused by _____.

x) Viral hepatitis is of _____ types. Hepatitis A and C are caused by _____ virus whereas _____ virus is the causative agent of Hepatitis B.

Ans:

(i) Animalia, plantae, plantae, animalia
(ii) Monera, protista, fungi, animalia, plantae
(iii) Prokaryotic, eukaryotic
(iv) Mitochondria, chloroplast
(v) Bacteria, proteins
(vi) Capsid, capsomeres
(vii) RNA, reverse transcriptase
(viii) Helper T lymphocytes, immune
(ix) Virus
(x) Seven, RNA, DNA

Q.2. Each question has four options. Encircle correct answer.

i) The enzyme involved in viral replication are synthesized:
(a) On the viral ribosomes
(b) On the interior surface of viral membrane
(c) By the host cell
(d) On the interior surface of viral coat

ii) A virion is a:
(a) Virus **(b)** Viral protein
(c) Viral lysozyme **(d)** Viral gene

iii) An isolated virus is not considered living, since it:
(a) Separates into two inert parts
(b) Cannot metabolize
(c) Rapidly loses its genome
(d) Is coated with an airtight shield

iv) In the lytic cycle of a bacteriophage, the host DNA is:
(a) Replicated
(b) Turned off by a protein coat
(c) Digested into its nucleotides
(d) Turned on by removal of a protein coat

v) In the lysogenic cycle, the DNA of a bacteriophage:
(a) Joins the bacterial chromosome
(b) Attaches to the inner surface of the host membrane
(c) Is immediately degraded when it enters the host
(d) Goes directly to the host's ribosome for translation

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vi) Temperate phage may exist as:
(a) Prophage **(b)** Capsid
(c) Viroid **(d)** Retrovirus

vii) Phylogeny describes a species:
(a) Morphological similarities with other species
(b) Evolutionary history
(c) Reproductive compatibilities with other species
(d) Geographical distribution

viii) In the binomial system of taxonomy, developed during the 18th century by C. Linnaeus, the first word of an organism's name is its:
(a) Species **(b) Genus**
(c) Race (d) Family

ix) In the five-kingdom system of classification developed by Robert Whittaker, member of the kingdom Plantae are autotrophic, eukaryotic and_____.
(a) Multicellular
(b) Motile
(c) Either unicellular or multicellular
(d) Have sexual reproduction

x) Five kingdoms of classification proposed by Margulis and Schwartz is not based on:
(a) Genetics
(b) Cellular organization
(c) Nucleic acid
(d) Mode of nutrition

Arrange the following in order of increasing group size, beginning with the smallest: family, kingdom, species, phylum (or division), genus, order, and class.
(a) _____
(b) _____
(c) _____
(d) _____
(e) _____
(f) _____
(g) _____

xi) The common name of Allium cepa is:
(a) Piyaz **(b)** Bathu
(c) Amaltas **(d)** Chana

xii) Pigs are reservoir for:
(a) Hepatitis A
(b) Hepatitis B
(c) Hepatitis C
(d) Hepatitis E

xiii) Which one of the following is false about AIDS?
(a) HAV
(b) Acquired immune deficiency syndrome
(c) T-lymphocytes
(d) Host specific

Answers Key:

i	**c**	**vi**	**a**	**xi**	**a**
ii	**a**	**vii**	**a**	**xii**	**d**
ii	**b**	**viii**	**b**	**xiii**	**a**
iv	**c**	**ix**	**a**		
v	**a**	**x**	**c**		

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