

Chapter = 05

A Cellular Life

INTRODUCTION:

First life form was molecular such as DNA and protein later on cellular life evolved.



Viruses, prions and viroid's are non-cellular living things. Living things are Categorized into:

- a. Non cellular livings things.
- b. Complete cell based organisms

Viruses causes diseases such as small pox, influenza and corona causes millions of deaths in the world. Viruses also destroy crops and live stock.

LIVING CHARACTERISTICS:

The living characteristics of viruses are:

- i. Viruses occur in different varieties or strains,
- ii. They have their own genetic material in the form of either DNA or RNA that can undergo mutation.
- iii. They reproduce using the metabolic machinery of the host cell they infect.
- iv. They enter living organism and cause disease i.e., intracellular obligate parasite.
- v. They get destroyed by ultraviolet rays.

NON-LIVING CHARACTERISTICS:

The nonliving characteristics of viruses are:

- i. They lack cellular structure, coenzyme and enzyme system and do not have metabolic activity of their own.
- ii. They can be crystallized and stored in bottles.
- iii. They do not respire. Viruses behave as nonliving, inert infectious particles outside the host.
- iv. They do not have a cellular structure, which is the basis of all life.

VIRUS DISCOVERY AND STRUCTURE:

The study of virus is called virology. The word virus is derived from a Latin word "venom" meaning 'poison'. In past, the term virus was associated with infectious diseases which have unknown cause.

FIRST EVIDENCE:

- The first evidence about the existence of virus came when in 1884 Charles Chamberland.
- He found that the causative agents of rabies could pass through the porcelain filter (which has pore sizes of 0.1 - 1 micron i.e., 100 - 1000 nm).
- However such filters could be used to completely remove all bacteria or other cells known at the time from a liquid suspension.

WORK OF IVANOSKY:

- Tobacco mosaic disease was thought to be caused by bacteria.
- In 1892 Ivanvosky extracted the juice from the leaves of tobacco having tobacco mosaic disease.
- In order to remove bacteria the juice was passed through porcelain filter. He then rubbed the filtered juice on the leaves of healthy plants, expecting no disease to develop, but the healthy leaves soon showed the symptoms of the disease.

FILTERABLE VIRUSES:

- By 1900, similar disease producing substance had been discovered in both plants and animals.
- The name filterable viruses were given to these substances.



CRYSTALLIZATION OF TMV:

In 1935 W. M. Stanley crystallized the infectious particle, now known as tobacco mosaic virus (TMV).

GENERAL STRUCTURE OF VIRUSES:

Viruses have a very simple structure. A complete viral particle is called virion. Primarily, it can be divided into two parts i.e., core and coat.

CORE:

The core is inner part of virion which consists of viral genome and various proteins (enzymes).

- Genome is the genetic material, which is either DNA or RNA, which may be single stranded or double stranded.
- Core proteins include one or more enzymes that facilitate the virus in its mode of action within host body. For example;
- All single stranded RNA viruses have the enzyme transcriptase (RNA dependent RNA polymerase) to convert single stranded RNA genome into double stranded RNA genome.
- Retroviruses and hepatitis B virus contain the enzyme reverse transcriptase to convert single stranded RNA genome into double stranded DNA genome.

COAT:

The coat is the outer covering of viral particle which consists of capsid and envelope.

CAPSID:

The capsid is the protective coat of protein surrounding the core.

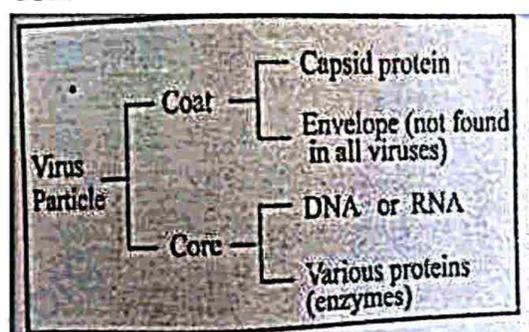
- Capsid is composed of identical repeating subunits called capsomers
- The number of capsomers is specific to a particular kind of virus.

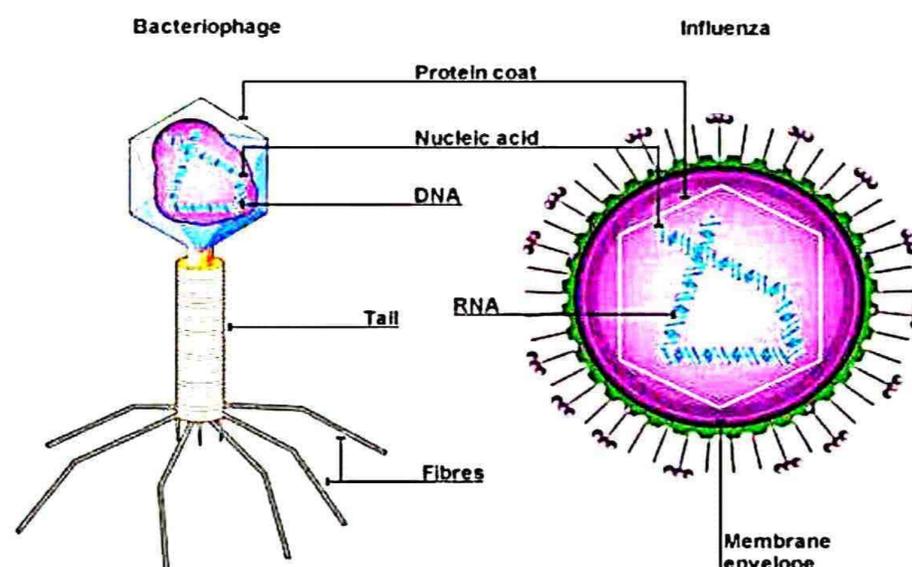
For example:

- Herpes virus has 162 capsomers in its capsid.
- Adenovirus that causes common cold contains 252 capsomers in its capsid.
- There are two forms of symmetry in virus' capsid.
- When the capsomers are arranged in 20 triangles, it is called icosahedral (polyhedral or spherical).
- When the capsomers are arranged in a hollow coil that appears rod shaped, it is called helical.

ENVELOPE:

- A few viruses have an additional lipoprotein envelope around the capsid which is derived from the cell surface membrane of the host and also contain virally encoded proteins.
- The viral envelope is often covered with glycoprotein spikes that help them to recognize the host cell.





CLASSIFICATION OF VIRUSES:

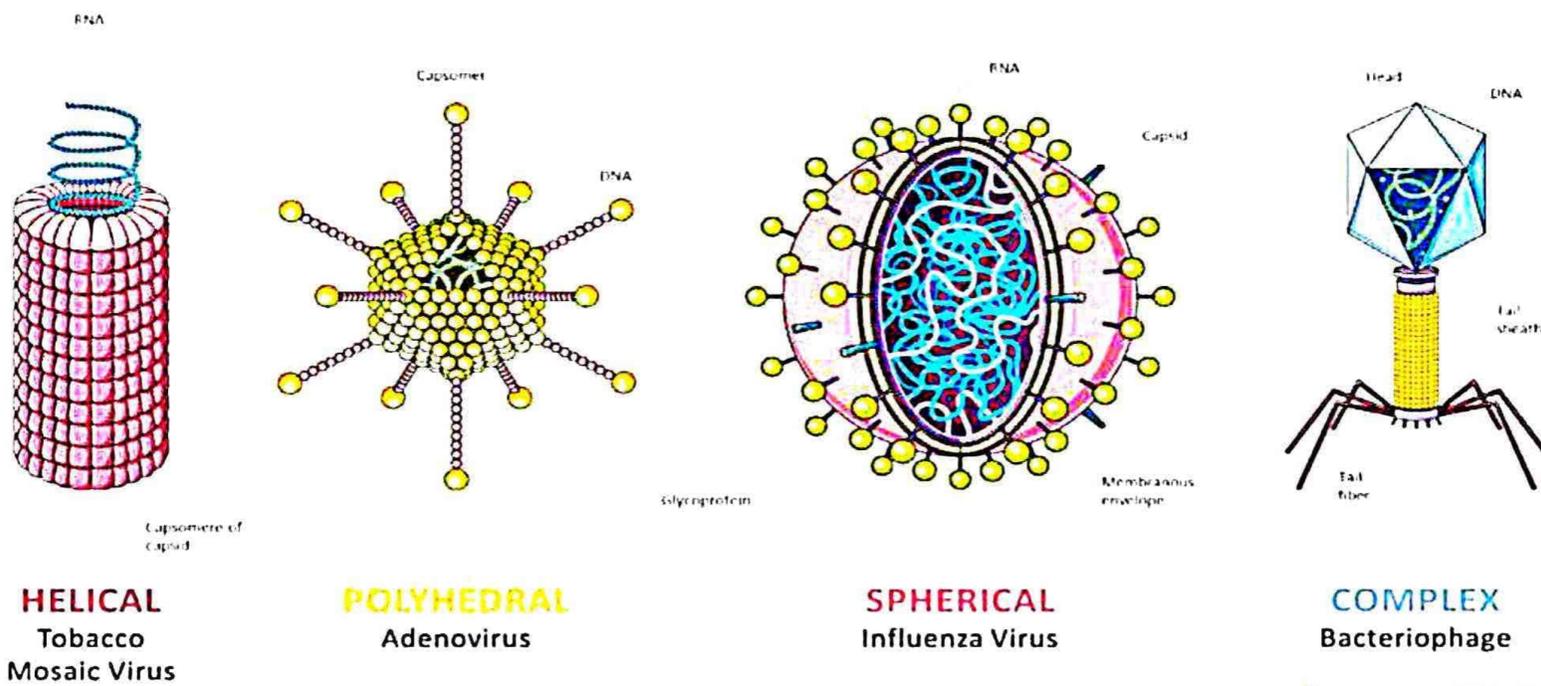
Virus are obligate parasite so it can be classified on the basis of host or shape or genome.

CLASSIFICATION ON THE BASIS OF HOST

Phytophage (Plant viruses)	Zoophage (Animal Viruses)	Bacteriophage (Bacterial viruses)
More than 2000 types RNA genome	DNA or RNA genome both	Ds DNA as genome
Rod shaped capsid usually	Spherical in shape usually	Have head and tail
E.g. T.M.W, CaMV,(Cauliflower mosaic viruses) etc.	E.g. Rhino viruses, Covid-19 etc.	E.g. T phages, X Phages

CLASSIFIATION ON THE BASIS OF CAPSID

Shape of capsid	Viruses
Helical shape	TMV
Polyhedron	Adenoviruses
Tadpole shaped	Bacteriophage
Envelop shape	Flu viruses
Spherical shaped	CaMV
Circular	HIV



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DNA VIRUSES:

i. Double stranded DNA virus:

Synthesize mRNA by using host enzymes. Ex; Herpes.

ii. Single stranded DNA virus:

Synthesize mRNA but first they need to become double stranded in host cell. Ex: Parvovirus.

RNA VIRUSES:

iii. Double stranded RNA virus:

Synthesize single stranded mRNA by using host cell enzymes, which either function as translating material or genomic material. Ex: Reovirus.

iv. Single stranded RNA Virus:

a. Single Stranded RNA Virus-Positive Sense:

mRNA is 5-3 prime and can be directly translated into proteins.

b. Single Strand RNA Virus-Negative Sense:

mRNA is 3-5 prime and cannot be directly translated into proteins hence they first form second 5-3 prime strand then translated into protein. Ex: Corona virus, Dengue virus, Hepatitis C virus

v. Reverse transcribing virus:

They have ability to synthesized DNA from RNA with the help of reverse transcribing enzyme.

a- Single strand RNA virus with DNA intermediate :

They have positive sense and can synthesize DNA from RNA with the help of its own reverse transcriptase enzyme, but needs to replicate via DNA intermediate hence, integrated into host DNA and direct the transcription and translation process by integrase. Ex: HIV

b- Double strand DNA virus with RNA intermediate:

synthesize RNA from DNA and then RNA is used for transcription. Ex: Hepatitis virus.

PARASITIC NATURE OF VIRUSES:

Virus needs a host cell to complete its life cycle:

A virus must have a host cell to complete its life cycle because viruses are obligate intracellular parasites, which mean they cannot multiply outside a living cell.

- Viruses lack organelles, metabolic enzymes, ribosomes, etc., for making proteins.
- Thus, they need host cell that provides all facilities to complete their life cycles.
- Viruses have such a strong genes that can overtake the host cell's metabolic machinery including enzymes and organelles, to work according to viral genome.
- Following are the different ways that how a virus survives inside a host cell, protected from immune system.

HOW VIRUS SURVIVE INSIDE A HOST CELL?

i. Degrading host cell genome:

Phage virus can degrade the host DNA with the help of endonuclease enzyme and take the control of biosynthetic machinery.

ii. Deactivating complement system:

The complement system is a part of the immune system that enhances (complements) the ability of antibodies and phagocyte cells to clear pathogens from an organism and promote inflammation. Virus can synthesize proteins similar to complement protein activators hence, prevent immunity of host cell.

iii. Block interferon response:

Interferons are a group of signaling proteins made and released by infected cells of host. Interferon send signals to the immune cells hence enhance immunity. Virus inhibit the interferon synthesis.

iv. Suppressing major histocompatibility complex:

Virus hinders the Th cells to present the viral components by MHC to other immune cells.

v. Reducing B-cell activation:

Virus suppress the B cells proliferation and differentiation.

vi. Viruses can alter their genome: Viruses changing their own genetic constitution so rapidly that vaccines or antibodies of host against them become ineffective.

VIRUS SURVIVAL IN ENVIRONMENT

Viruses, unlike other "living" organisms do not need food to survive. They remain dormant or inactive outside the host body. Being tiny, they are not threatened by the other microorganisms. Virus growth can be influenced by different environmental factors such as temperature, humidity, organic compounds (mucus), radiations (UV).

1. VIRUS SURVIVAL AND TEMPERATURE:

High temperature has a great impact on the virus survival such as at 60°C virus become inactive. Virus try to escape from the harsh temperature by protecting themselves in blood, feces, saliva etc. similarly influenza and corona virus sheltered themselves in saliva and mucus from unfavorable environment.

2. AIRBORNE VIRUS SURVIVAL AND RELATIVE HUMIDITY:

Outside the host body virus survival depends on humidity. Enveloped viruses are more susceptible to relative humidity than un-enveloped viruses. Enveloped viruses can survive at 20-30% of humidity while un- enveloped survive at 70-90%.

3. VIRUS SURVIVAL AND LIGHT:

Phytoplanktons viruses required energy for its replication, which is provided by light energy. Light also has adverse impact on the virus as UV light destroy the viruses and also photosynthetic host.

4. PH FACTORS AFFECTING VIRAL SURVIVAL:

Viruses survive on suitable pH, such as 6.5 pH is the most suitable value, above or below this is damaging pH. For example, 7.2-8 and 5.5 pH is harmful for viruses. Organic solvents, detergents and sanitizers of alkaline nature can interact with lipoprotein envelop of viruses hence destroy the virus structures. Un-enveloped viruses remain save at alkaline pH but it can obstruct the replication process of virus.



STRUCTURE OF BACTERIOPHAGE:

The word bacteria means bacteria and phage means eater. A bacteriophage means eater of bacteria. Bacteriophages are viruses that infect bacteria It is generally a tadpole shaped virus. A bacteriophage or simply phage consists of head, neck and tail.

HEAD:

- The head is icosahedral in shape.
- The inner core of head consists of a single stranded DNA genome.
- Therefore Bacteriophages are DNA viruses.
- The head is also called capsid, made up of protein subunits called capsomers.

NECK:

- Below the head is narrow neck or collar which separate head and tail.

TAIL:

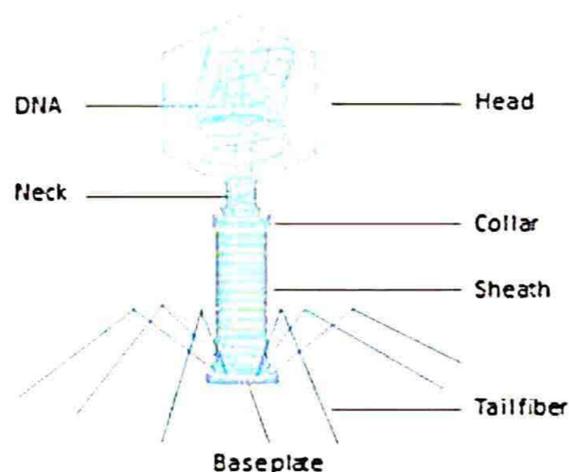
- The tail is hollow tubular and made up of proteins.
- The tail passes the nucleic acid to host cell during infection.
- The tail is surrounded by a contractile sheath, made of proteins.
- Sheath contracts during infection of the bacterium.

BASAL PLATE:

- It is the last part of the tail
- It possesses about six tail fibres around it and several tail pins or spikes at its lower surface.
- The tail fibres and tail pins are involved in the binding of the phage to the bacterial cell.

LYSOZYME:

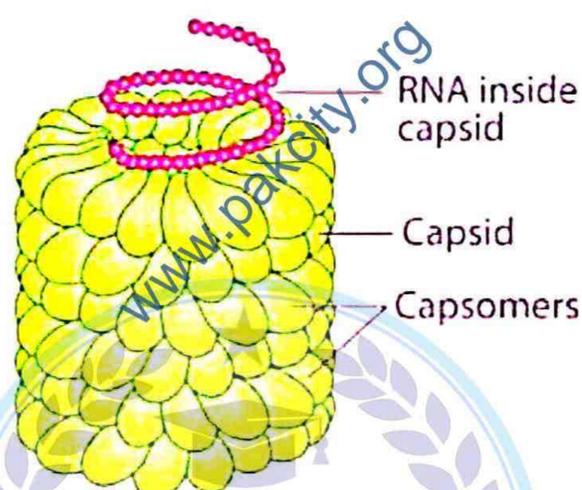
- At the bottom of core tube of tail, an enzyme, the lysozyme is present
- It is released upon contraction of tail.
- It digests the portion of host cell wall so that core tube can be penetrated into the host cell during infection.



BACTERIOPHAGE STRUCTURE

TOBACCO MOSAIC VIRUS (TMV):

- TMV is the virus of tobacco plant and cause Tobacco mosaic disease. It is made up of centrally located single stranded RNA surrounded by capsid.
- Most of its structure formed by protein coat with estimated 2,130 subunits named capsomeres.
- Each capsomere contains about 158 amino acids and arranged in about 130 turns per rod.



LIFE CYCLE OF BACTERIOPHAGE:

Bacteriophage can reproduce by two alternative mechanisms.

1. LYTIC CYCLE:

In lytic cycle virus reproduce with the destruction of host cell (bacteria). In the lytic stage, many viral particles are made and copies are sent back into the environment.

STEPS IN LYTIC CYCLE:

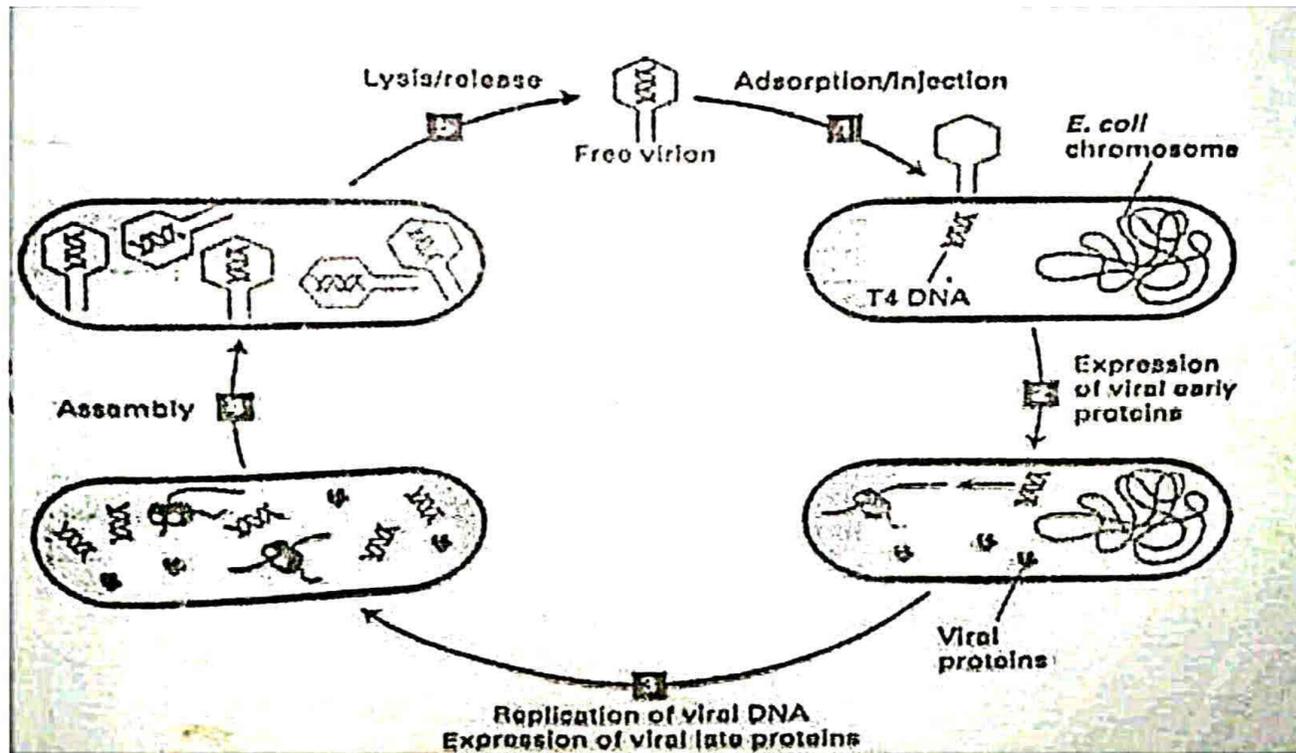
1) Attachment: Bacteriophage virus uses its tail fiber to attached with bacterial cell wall.

2) Genome Penetration: Virus inserts its DNA into the bacteria hollow through tube. The empty capsid of the phage is left as a ghost (waste) outside the cell.

3) Biosynthesis or replication of Phage DNA: Virus takes the cell's metabolic machinery and start the production phage proteins and nucleotides from the cells degraded DNA and make copies of the phage genome.

4) Maturation: When virus protein (capsid, tail tall fibers) and nucleic acid synthesized then self-assembles and form new phage.

5) Lysis and release of phage viruses: When about 200 phage viruses formed inside the host cell then viruses break cell wall of bacteria with the help of lysozyme enzyme and released into surroundings.



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2. LYSOGENIC CYCLE

In the lysogenic cycle viral genome replicates without destroying the host cell. Viruses that are capable of using both modes of reproduction in bacteria are called temperate viruses (Lysogenic). The virus is called "prophage" at this stage.

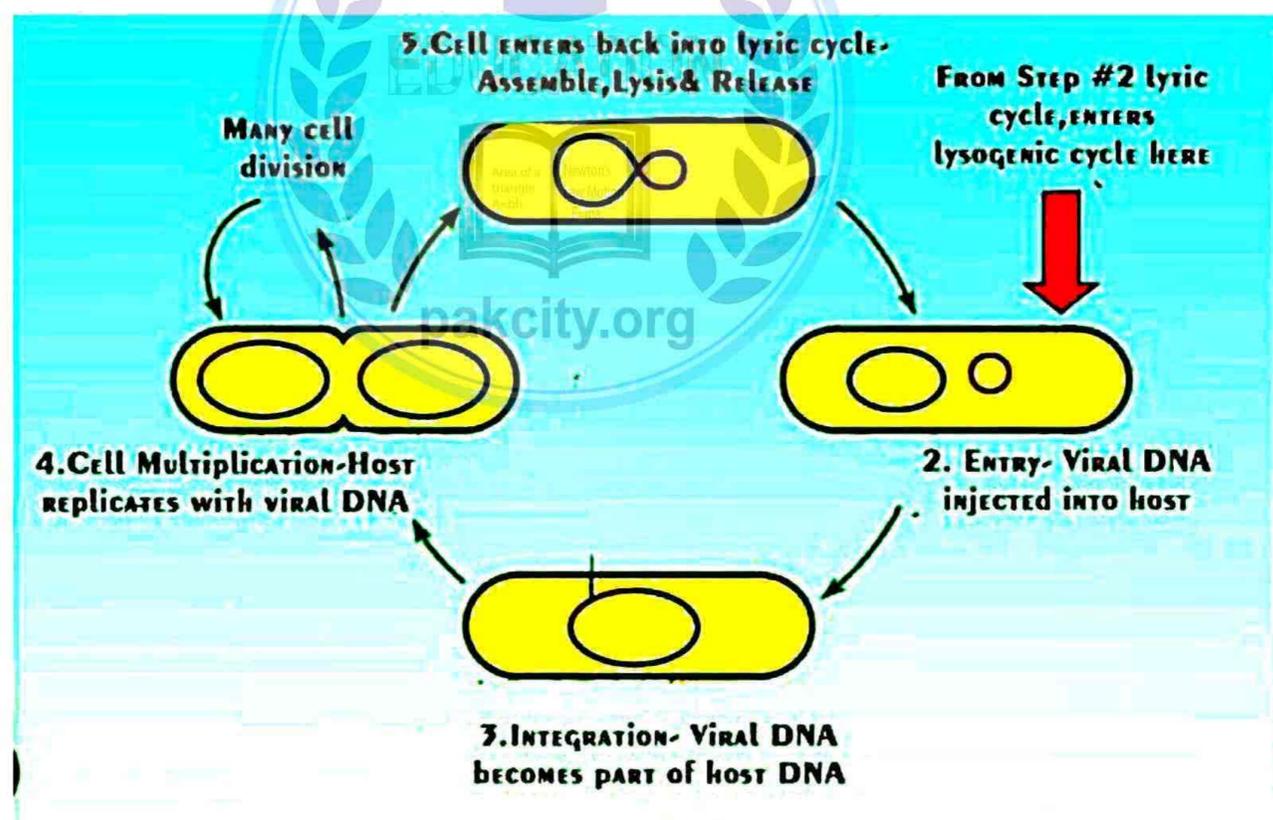
Steps of lysogenic cycle

Step 1: The virus binds to bacteria with the help of its tail fibers and then inserts its DNA into the bacteria.

Step 2: Viral DNA gets incorporated into the cell's chromosome and become a prophage.

Step 3: Viral DNA is replicated along with chromosomal material of bacterial cell during bacterial division without harming.

Step 4: Under unfavorable condition prophage turn into lytic cycle.



LYSOGENIC CYCLE

BACTERIOPHAGE AND GENETIC ENGINEERING:

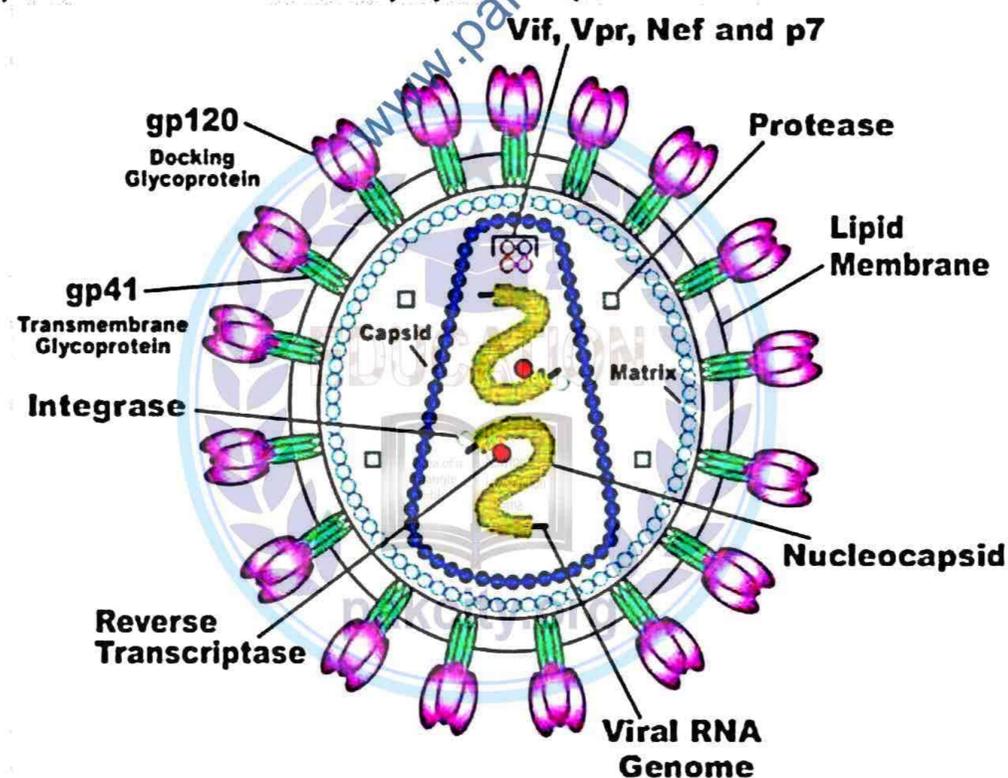
- Bacteriophage used in to transfer the desired genes from one cell to another cell in order to produce valuable products.
- Genetically modified bacteria (GMB) used to treat the bacterial infection.
- GMB are host specific.
- GMB attack on pathogenic bacteria inside the body and finish them without damaging other cells of the body.
- GMB also serve as antigen presenting cell hence activate the immune response which is required to eliminate pathogens from the body.

HUMAN IMMUNODEFICIENCY VIRUS:(HIV)

AIDS (Acquired immune Deficiency Syndrome) caused by a virus called HIV. It was first reported in 1981 in California.

STRUCTURE OF HUMAN IMMUNODEFICIENCY VIRUS:

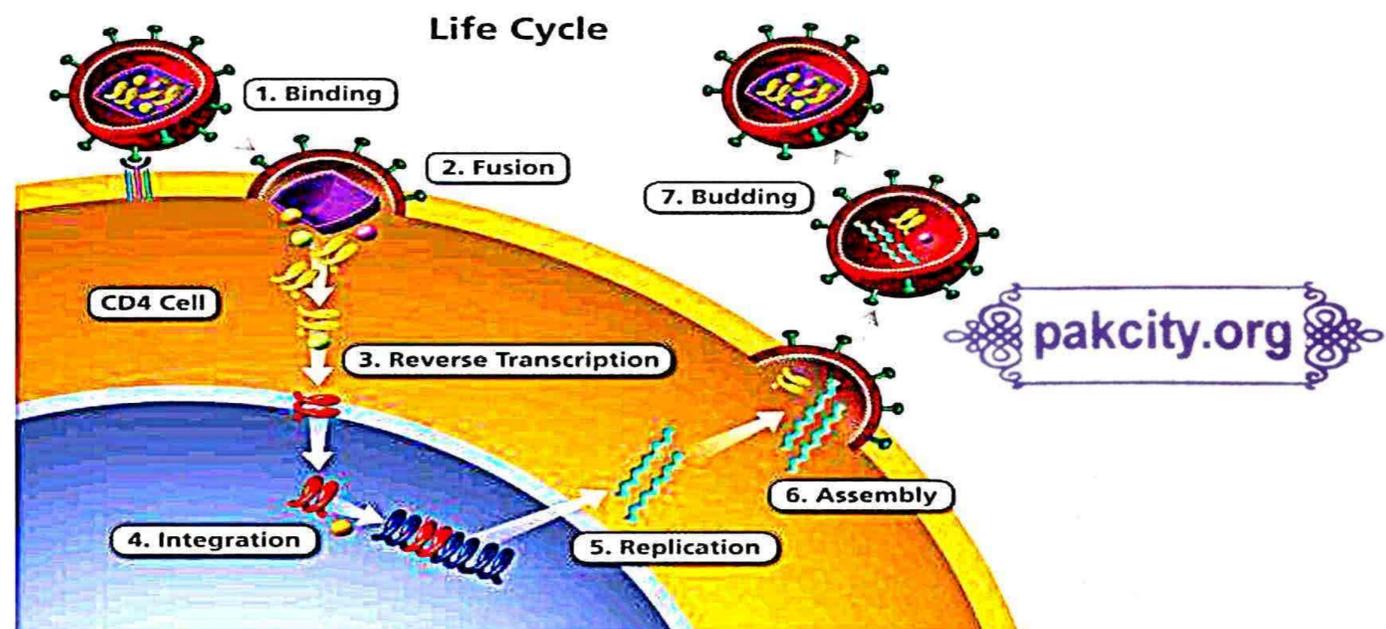
- HIV is a retrovirus, i.e. it consists of RNA and has reverse transcriptase enzyme.
- It is spherical in shape.
- HIV size is about 60 times lesser than an RBC.
- HIV is an enveloped virus which is made of two layers of lipid with spikes made of glycoprotein
- These spikes helps virus to get stuck on the surface of receptors.
- These enzymes has capability of reverse transcription and make DNA from its RNA by using enzymes revers transcriptase and intergase.
- It causes AIDS (Acquired Immune Deficiency Syndrome).



LIFE CYCLE OF HUMAN IMMUNODEFICIENCY VIRUS:

INTRODUCTION:

- The primary hosts of HIV are helper T lymphocytes (CD4 or T4 cells).
- In addition macrophages and certain brain cells may also be affected.
- Since, helper T cells regulate immunity by enhancing the response of other immune cells so, the decrease in the number of helper T cells causes deficiency of the human immune system.
- The virus affects the human immune system, therefore, the virus has been named Human Immunodeficiency virus (HIV).



STEPS IN LIFE CYCLE:

Following steps are involved in the life cycle of HIV.

ATTACHMENT:

It is characterized by the binding of the virion glycoprotein 120 envelope proteins to the CD4 proteins (a receptor) on the surface of T4 cells.

PENETRATION:

- Next the fusion of the viral envelope with the cell membrane takes place and the virion enters the cell by endocytosis.
- Once inside the host cell, the HIV particle sheds its protective coat i.e. uncoating occurs.
- This leaves the single stranded viral RNA in the cytoplasm along with viral enzymes.

REVERSE TRANSCRIPTION:

The enzyme called reverse transcriptase synthesizes a single stranded DNA complementary to virus RNA therefore, called complementary DNA (cDNA).

BREAK DOWN OF VIRAL RNA:

After reverse transcription the viral genomic RNA is disintegrated by the ribonuclease (RNAase) enzyme.

REPLICATION OF cDNA:

- The single stranded cDNA is replicated to form double stranded cDNA.

INTEGRATION OF cDNA:

The double stranded cDNA then integrates into the host cell DNA. Integration is mediated by a virus encoded enzyme integrase.

PROVIRUS:

The integrated DNA is now called provirus.

TRANSCRIPTION:

Viral mRNA is transcribed from the proviral DNA by the host cell RNA polymerase.

BIOSYNTHESIS:

During transcription not only viral mRNAs for different protein are formed but viral genomic RNA is also produced.

FORMATION OF PROTEINS:

- The viral mRNAs are translated by host ribosomes into several large proteins.
- These are then cleaved by the virus-encoded protease to form the virion structural proteins.

MATURATION:

The viral components are assemble and virions are produced.

RELEASE:

- Finally, the mature virions are gradually released by budding off from the host cell and enclosing a portion of host cell membrane around them.
- In this way host cell size is decreased enough that it becomes non-functional.

HIV host specificity for the host cell:

- HIV attack on T_h cells of the immune system. T_h cells identify pathogenic invasion and activate other cells such as T_c cells, B cells and macrophages. T_c cells kill viruses, B cells release antibodies and macrophages ingest and destroy pathogens.
- HIV attack on T_h cell, not on other immune cells because on T_h cells specific protein receptors are present, which are identified by glycoprotein spikes of HIV. Glycoprotein binds with receptors of T_h cells and initiates T_h cells destruction.

SYMPTOMS OF AIDS:

An HIV infection can be divided into 3 stages.

- Asymptomatic carrier,
- AIDS Related Complex (ARC),
- Full Blown AIDS.

i. ASYMPTOMATIC CARRIER:

In asymptomatic carrier symptoms that may include are.

- Fever, chills, aches (continued pain), swollen lymph glands and an itchy rash.
- These symptoms disappear and there are no other symptoms months or longer.
- Although the individual exhibit no symptoms during this stage, he or she is highly infectious.
- The standard HIV blood test for the presence of antibody becomes positive during this stage.

ii. AIDS RELATED COMPLEX:

The most common symptoms of AIDS related complex are:

- Swollen lymph glands in the neck, armpit or groin that persist for months.
- Other symptoms include night sweats, persistent cough, flu, and persistent diarrhea, loss of memory inability to think clearly, loss of judgment and depression.

iii. FULL BLOWN AIDS:

The full blown AIDS is the final stage. In it there is severe weight loss and weakness due to persistent diarrhea and usually one of several opportunistic infection.

OPPORTUNISTIC DISEASES:

HIV does not cause any disease nor kills any person. It only destroys T-cells of immune system.

- The decrease in the human immune system results in the inability of the body to fight diseases.
- Getting this opportunity of less or no immune system i.e., weak defence system a person suffering from AIDS is attacked by diseases called opportunistic diseases.
- For example, Kaposi's sarcoma (Cancer or lesion on skin), fungal infection, viral infection, gastrointestinal diseases, respiratory diseases, nervous system and eye diseases.

**TREATMENT OF AIDS:**

The quantity of virus at which it is detected in an organism is called viral load. The aim of HIV treatment is to reduce the viral load to an undetectable level as long as possible and to reduce transmission by using antiviral drugs.

The decision to start therapy is a major one. It is dependent upon the symptom status of the patient, the CD4 count, the viral load and wishes of the patient.

- HIV is treated using a combination of medicines to fight HIV infection. This is called antiretroviral therapy (ART).
- ART is not a cure, but it can control the virus so that HIV positive person can live a longer, healthier life and reduce the risk of transmitting HIV to others.
- ART is a highly effective treatment for HIV infection, preventing progression of the disease in the vast majority of recipients.
- When ART is accessible and started early in the course of infection, the lifespan of HIV-positive people is typically very close to that of comparable HIV-negative people.
- But ART can have toxicities, is often costly, and requires strict daily pill taking that can lessen quality of life."
- Because of the limitations of ART a cure for HIV infection remains a vital goal for research.

TRANSMISSION AND CONTROL OF HIV:**TRANSMISSION:**

- **The direct contact with HIV:** throw open wounds
- **Intravenous injection of drugs:** with common syringes.
- **Body fluid** (blood, serum, semen etc.), from patient to unaffected person such as.
- **From Mother to Child:** Through placenta.
- **Sexual Contact:** with infected partner.

NO TRANSMISSION OF AIDS OCCURS BY:

- * Shaking hands
- * Swimming in the same pool do not transmit
- * Mosquitoes and other insects
- * Coughing or sneezing HIV.
- * Hugging
- * Inanimate objects such as toilets, door knobs, telephones, office machines and house hold furniture.

CONTROL MEASURES AGAINST THE TRANSMISSION OF HIV:

AIDS can be controlled by preventing transfer of body fluid (blood, serum, semen, etc.,) from patient to unaffected person. The following behavior of precautionary measure will prevent AIDS.

- Do not use used syringes and needles.

- For blood transfusion, blood must be used after proper screening for HIV.
- Do not share toothbrushes, blades and towels with anyone. Special cares to be taken at barber's shop or hair cutting saloons, beauty salons.
- Surgical instruments must be properly sterilized.
- AIDS is primarily a sexually transmitted disease. Refrain from immoral sexual activities and follow Islamic teachings to pass healthy, neat and clean life.
- Mother having HIV should not feed their babies.

VIRAL DISEASES:

1. HEPATITIS:

Hepatitis is generally characterized as inflammation of liver, including other symptoms.

- It is generally caused by viral infection or rarely due to toxicity of drugs and certain other causes.
- The most common causes of viral hepatitis are the five unrelated hepatotropic (that replicate in liver cells) viruses i.e., Hepatitis A, Hepatitis B, Hepatitis C, Hepatitis D and Hepatitis E.

Hepatitis

CAUSATIVE AGENT:

Hepatitis virus

SYMPTOMS:

Fever, pain in Belly, dark yellow urine, Fatigue, Jaundice, Pain in joint, loss of appetite.

TRANSMISSION:

Through Fecal oral, Needle, blood sexual activities.

TREATMENT AND PREVENTION:

Proper hand wash before and after meal, avoid to meet infected person with close contact use clean food and sanitize yourself by soap.



2. HERPES:

CAUSATIVE AGENT:

Herpes simplex virus.

SYMPTOMS:

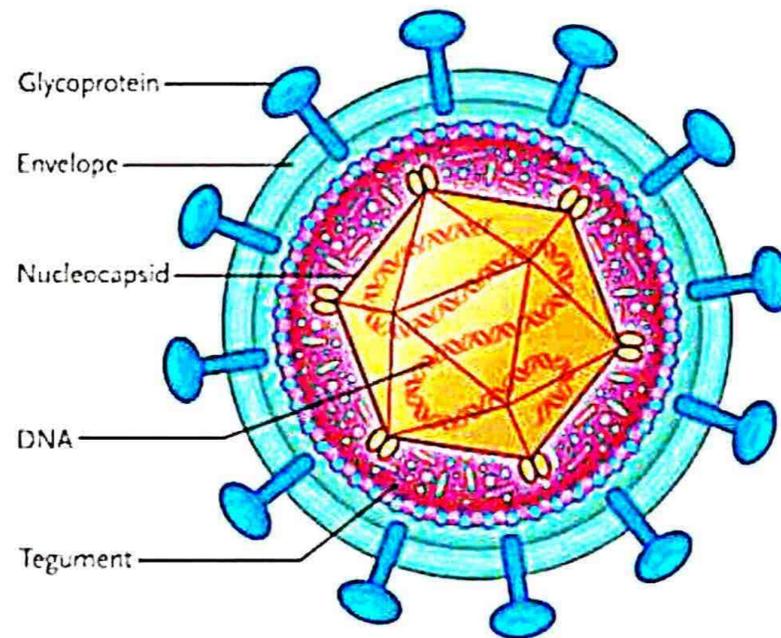
Fever blister around the mouth and sexual organs. A person may experience painful sores in genital region and anus, burning sensation in urination, flu and fever.

TRANSMISSION:

Virus can enter the body through a break in skin, through mouth, reproductive organs and anus. Insanitary may lead to the spread of this disease.

TREATMENT AND PREVENTION:

Use antiviral drugs on doctors advice, avoid insanitary conditions.

**3. POLIOMYELITIS:****CAUSE:**

It is caused by polio virus which is also an enterovirus.

TRANSMISSION:

Polio virus is transmitted by the fecal oral route.

SYMPTOMS:

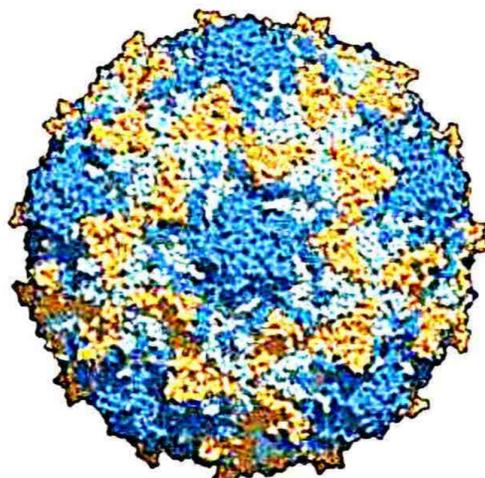
- It replicates in the oropharynx and intestinal tract and spread to blood and central nervous system where virus replicates in the motor.
- Death of these cells results in paralysis of the muscles innervated by neuron located in the spinal cord.
- The motor nerve damage is permanent.

TREATMENT:

- There is no antiviral therapy. Physiotherapy for the affected muscles is important.

PREVENTION:

Polio can be by the killed (salk vaccine, inactivated vaccine) and the live, attenuated (weakened) vaccine (sabin vaccine, oral vaccine).

**4. COTTON LEAF CURL DISEASE:**

Cotton leaf curl disease (CLCUD) is a serious disease of cotton.

CAUSE:

The viruses associated with the CLCuD complex on the Indian subcontinent, five of which have been identified as begomoviruses.

TRANSMISSION:

This disease is transmitted by the whitefly *Bemisia tabaci*.

SYMPTOMS:

- The symptoms are initially characterized by a deep downward cupping of the youngest leaves.
- This is followed by development of cup-shaped, leaf-like structures.

TREATMENT AND PREVENTION:

Control of CLCuD is mainly based on insecticide treatments against the insect vector.

**ECONOMIC LOSSES DUE TO VIRAL DISEASES:**

- Viruses are responsible to the sizable losses of agriculture products as well as livestock commodities.
- For example, Pakistan ranks fourth in area and production of cotton in the world. It has 9.36% of total world cotton area, 10.18% of consumption and 4.55% of total world export of raw cotton. The impact of cotton leaf curl virus on the Pakistan national economy cannot be forgotten as the country has lost Rs.50 to 55 billion since 1992 and it is essential to maintain vigilance over the disease.
- Similarly, bird flu viral disease caused around 700 to 800 million Rupees. Huge loss at one time during its peak time.

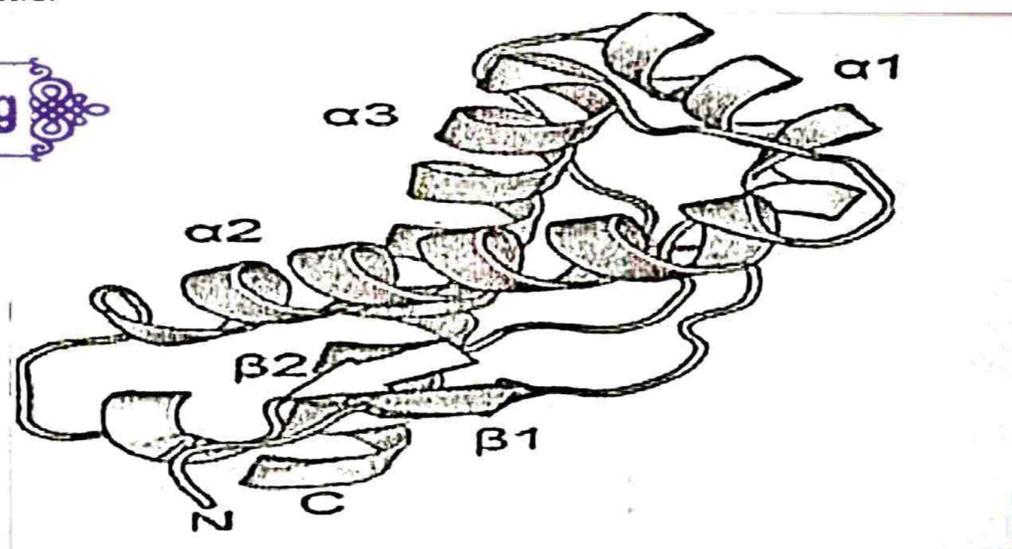
PRIONS AND VIROIDS:**PRIONS:****DEFINITION:**

An American biologist named Stanley B. Prusiner discovered Prions, so called because they are proteinaceous, are infectious particles, smaller than viruses, that contain no nucleic acids (neither DNA nor RNA).

PROPERTIES:

- Electron microscope reveals filaments rather than virus particles.
- Prions are much more resistant to inactivation by ultraviolet light and heat than are viruses.

- Prions are composed of a single glycoprotein, This protein is encoded by a single cellular gene.
- Prions may cause Trisomy 21, Alzheimer's disease, sleeplessness (insomnia) in humans and mad cow disease in cattle.



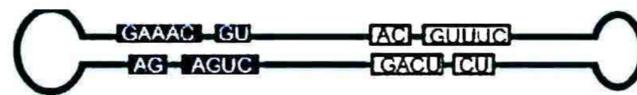
VIROIDS:

DEFINITION:

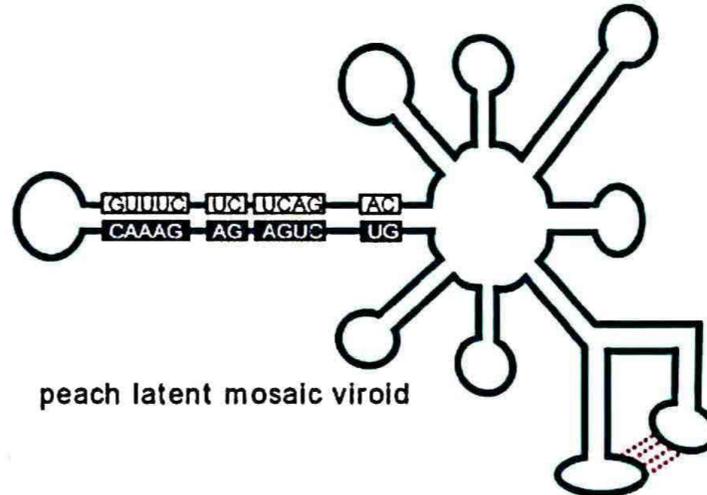
Viroids were discovered by an American plant pathologist are plant pathogens that consist of a short stretch (a few hundred nucleobases) of highly complementary, circular, single-stranded RNA without a protein coat or envelop.

PROPERTIES:

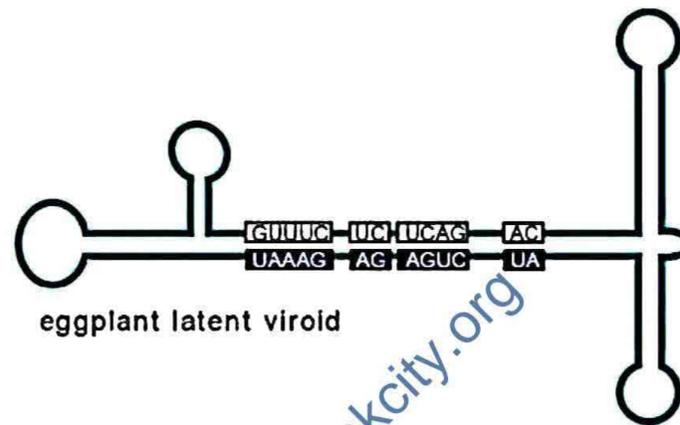
- The RNA is quite small.
- Viroid RNA does not code for any protein.
- They can be transmitted by pollen or seeds.
- The only human disease known to be caused by a viroid is hepatitis D.
- Viroids don't interrupt protein synthesis but they only replicate and produce specific RNA molecules.
- The potato spindle tuber viroid identified as first viroid and now the known species of viroids are about 33 in number.
- They cause diseases only in plants, e.g., in potato, coconut, apple, peach, etc.



avocado sunblotch viroid



peach latent mosaic viroid



eggplant latent viroid

ANIMAL VIRUSES THEIR TRANSMISSION AND SYMPTOMS:**NAME OF VIRUS:**

1. Chikungunya virus.

VECTOR/HOST:

Aedes Mosquito and nonhuman primates.

TYPE OF NUCLEIC ACID:

RNA virus with a positive-sense single-stranded genome.

TRANSMISSION:

Blood

SYMPTOMS:

Headache, body muscles and joints pain, Nausea, Vomiting, swollen glands, and painful eyes.

NAME OF VIRUS:

2. Dengue Virus.

VECTOR/HOST:

Aedes mosquito human.

TYPE OF NUCLEIC ACID:

Positive-sense, single stranded RNA

TRANSMISSION:

Blood

SYMPTOMS:

Vomiting Rashes with pain Nausea, pain typically behind the eyes and in the body.

NAME OF VIRUS:

3. Ebola virus.



VECTOR/HOST:

Canid animals Bats, dogs etc.

TYPE OF NUCLEIC ACID:

Negative sense stranded RNA virus.

TRANSMISSION:

Body fluid.

SYMPTOMS:

Haemorrhagic fever.

NAME OF VIRUS:

4. Hepatitis C virus

VECTOR/HOST:

Human infected blood.

TYPE OF NUCLEIC ACID:

Positive sense single-stranded RNA

TRANSMISSION:

Transmission of Hepatitis C virus occurred mainly blood transfusions.

SYMPTOMS:

Fever, yellow skin, Fatigue. Muscle and joint pain. Nausea and loss of appetite. Stomach pain.

NAME OF VIRUS:

5. Measles virus.

VECTOR/HOST:

Air borne droplets from nose and throat mucus in human.

TYPE OF NUCLEIC ACID:

Negative-sense RNA genome.

TRANSMISSION:

Sneezing and coughing infected person.

SYMPTOMS:

Fever, cough, and a runny nose, followed by a body rash.

NAME OF VIRUS:

6. Corona virus.

VECTOR/HOST:

Bats

TYPE OF NUCLEIC ACID:

RNA viruses

TRANSMISSION:

Air born droplets.

SYMPTOMS:

Laboured breathing pressure inside the chest with pain, weakness, difficulty in speech. Low oxygen level.

DIFFERENCE BETWEEN BACTERIOPHAGE AND HIV:

BACTERIOPHAGE	HIV
These viruses attack bacteria and eventually kill them.	These infect T-lymphocytes of human and cause AIDS.
These viruses are usually nonenveloped.	These viruses are enveloped.
These viruses have single stranded DNA	These viruses have 2 single-stranded RNA genome.
These are icosahedral and tadpole shaped	These viruses have somewhat spherical shape.
Tail fibres work as receptors to bind with the host (bacteria)	These viruses have spikes as receptors for binding with host membrane.

DIFFERENCE BETWEEN LYTIC AND LYSOGENIC CYCLE OF BACTERIOPHAGE:

LYTIC CYCLE OR MASTER- SLAVE RELATIONSHIP	LYSOGENIC CYCLE OR HOST GUEST RELATIONSHIP
In it bacteria is killed readily.	In it bacteria survives.
In it no prophage formation occurs.	In it prophage formation occurs.
In it phage controls and uses metabolic machinery of bacterium completely.	In it phage does not control and use metabolic machinery of bacteria completely.
In it only phage multiplies.	In it both phage genome and bacterium multiplies.

DIFFERENCE BETWEEN PRIONS AND VIROID:

PRIONS	VIROIDS
These are made up of protein only	These are made up of RNA only
It causes diseases to animals only	It causes diseases to plants only

These are filamentous in structure under EM	These are circular with double stranded regions.
These are much resistant to UV and heat	These are less resistance to UV and heat.

Difference b/w Lytic and Lysogenic Cycle:

Lytic Cycle	Lysogenic Cycle
The viral genome does not integrate with host DNA.	The viral genome or its complementary DNA gets integrated with the host DNA.
The host DNA is often hydrolyzed in the lytic cell.	The host DNA is not hydrolyzed during lysogenic phase.
The viral genome replicates repeatedly and forms a number of copies in same host cell.	The prophage or provirus replicates only once.
The cellular machinery of the host is completely taken over by the viral genome.	The cellular machinery of host is only slightly disturbed.
The virus is virulent.	The virus is non virulent or temperate.
A number of virus particles are liberated when the host cell become lysed.	Virus particles are liberated only rarely.

Difference b/w Viroid and Prions

Viroid	Prions
It is an infectious RNA particle.	It is an infectious protein particle.
Viroid is formed of only small single stranded circular RNA	It is formed of only proteins.
A protein coat is absent.	RNA or DNA is absent.
Viroid are inactive by ribonuclease digestion but resistant to proteinase K and trypsin digestion.	Prions are inactivated by proteinase K and trypsin digestion but resistant to ribonuclease treatment.
Viroid has a smaller size than viruses.	Mostly, smaller than viroid.
Viroid infects only higher plants.	Prions infects animal causing neurological degenerative diseases.