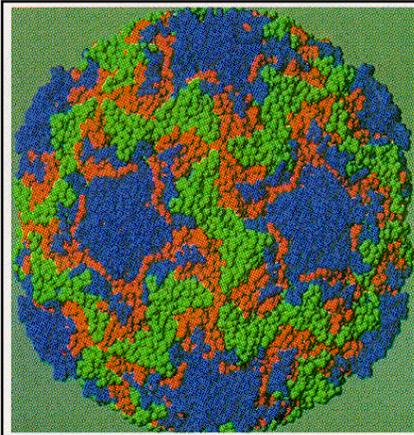


Chapter 6 - Virology

- Topics
 - Structure
 - Classification
 - Multiplication
 - Cultivation and replication
 - Nonviral infectious agent
 - Teratogenic/Oncogenic

Viruses in Action!!



Human
Rhinovirus

Common
Cold

- Viruses have a host range. That is, viruses infect specific cells or tissues of specific hosts, or specific bacteria, or specific plants.

- Viral specificity refers to the specific kinds of cells a virus can infect. It is regulated by the specificities of attachment, penetration and replication of the virus

Properties of viruses

Viruses are not cells, do not have nuclei or mitochondria or ribosomes or other cellular components.

Viruses replicate or multiply. Viruses do not grow.

Viruses replicate or multiply only within living cells.

Viruses are obligate intracellular parasites.

The term virus was coined by Pasteur, and is from the Latin word for poison.

Components of viruses -

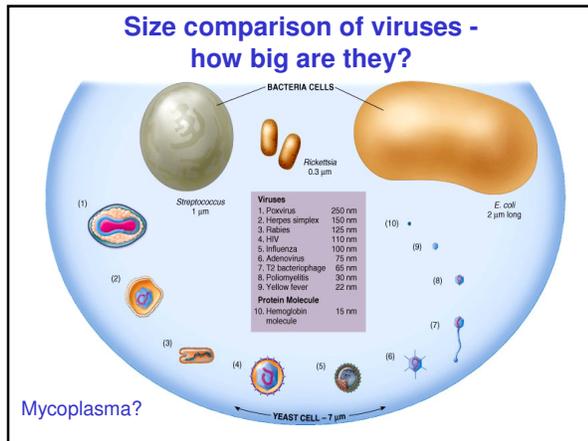
A **virion** is an infectious virus particle - not all virus particles are infectious

Viruses are composed of a nucleic acid, RNA or DNA - **never both**.

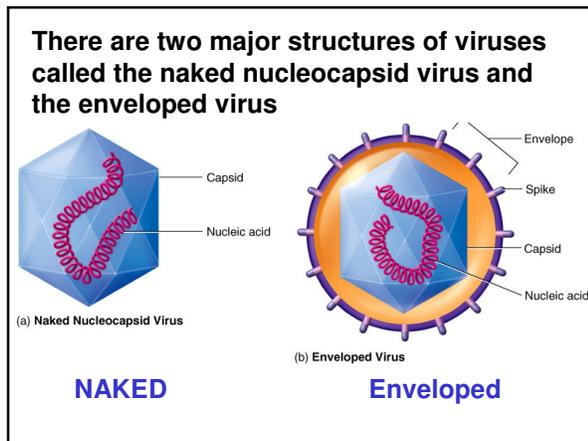
All viruses have a protein coat or shell that surrounds and protects the nucleic acid core.

Some viruses have a lipid envelope or membrane surrounding a nucleocapsid core. The source of the envelope is from the membranes of the host cell.

Some viruses package enzymes - e.g. RNA-dependent-RNA polymerase or other enzymes - some do not package enzymes



- ## Structure
- Size and morphology
 - Capsid
 - Envelope
 - Complex
 - Nucleic acid



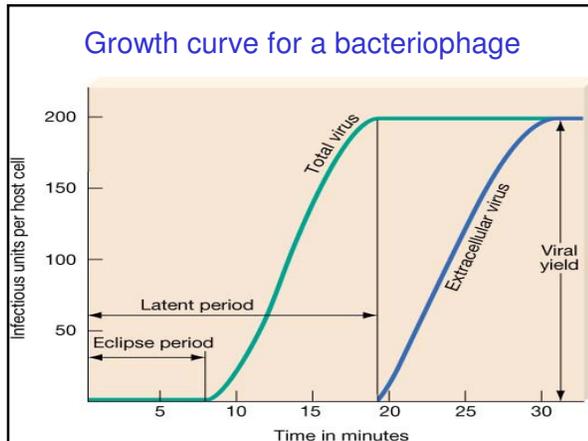
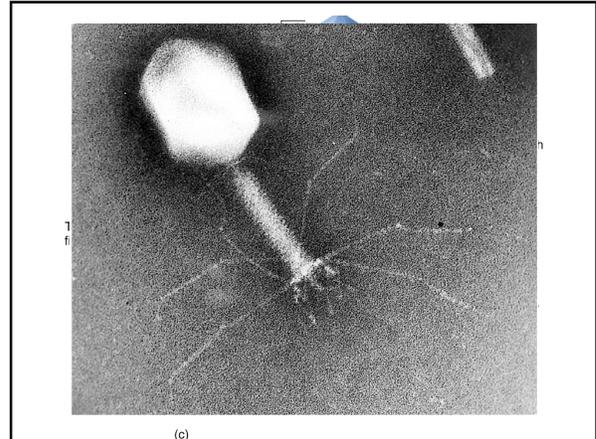
- ## Capsid
- Protective outer shell that surrounds viral nucleic acid
 - **Capsid spikes** - used for binding to cell surface proteins
 - Composed of **capsomer** subunits - collectively protect the nucleic acid from the environment

- ## Envelope
- **Lipid and proteins** - basically a modified version of our membranes
 - **Envelope spikes** - bind to cell surface proteins
 - During release of animal viruses, a part of the host membrane is taken

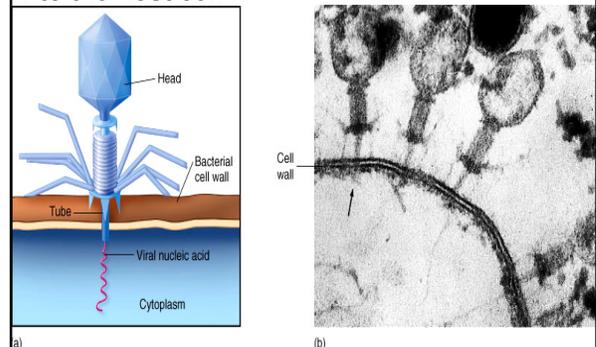
- ## Nucleic acid
- Viruses contain either **DNA or RNA**
 - Possess only the genes to invade and regulate the metabolic activity of host cells
 - Ex. Hepatitis B (4 genes) and herpesviruses (100 genes)
 - **No viral metabolic genes**, as the virus uses the host's metabolic resources

Bacteriophages

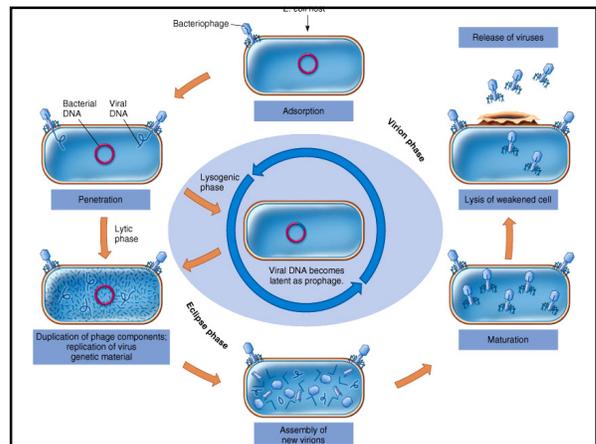
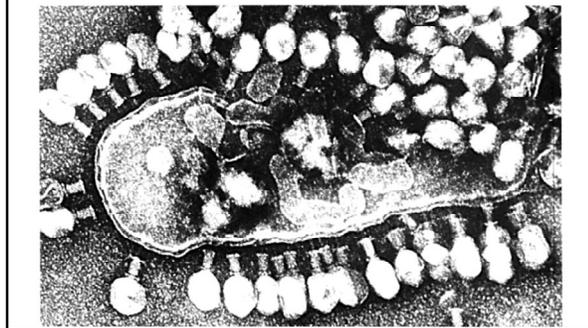
- **Bacteriophage**
 - Polyhedral head
 - Helical tail
 - Fibers for attachment
- Are considered either **LYTIC** or **TEMPERATE**
- Are often associated with virulence genes in bacteria
 - EX. - diphtheria toxin in *Clostridium diphtheriae* - also Bo-Tox from *C. botulinum*

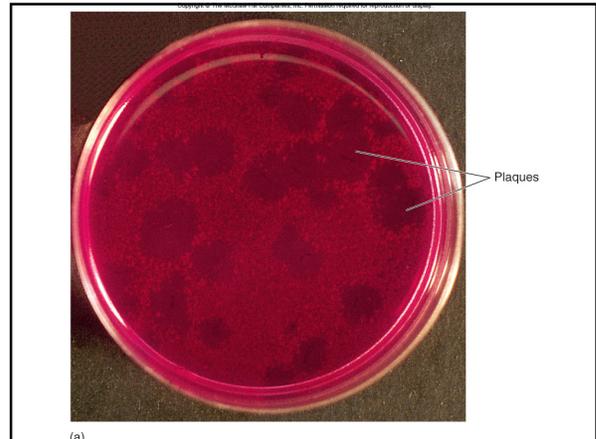
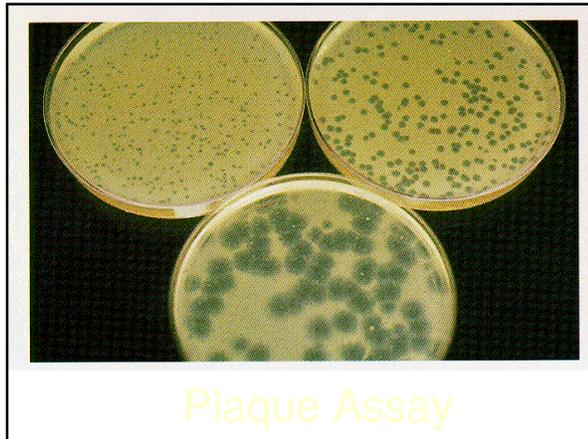


T-even bacteriophage penetrate the host cell by specifically binding and injecting their DNA into the host cell



After replication, bacteriophage release **lysozyme**, weaken/destroy/rupture cell and release numerous virions



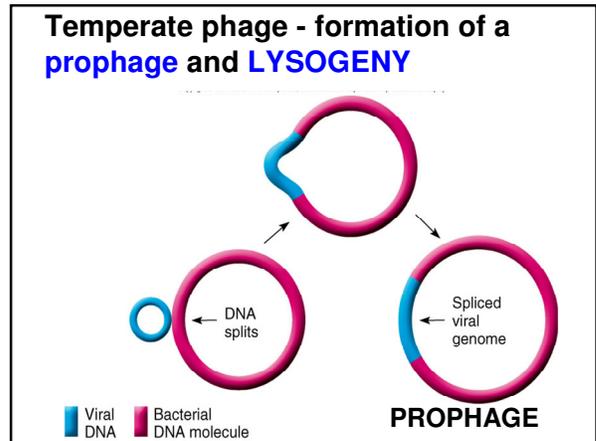


Temperate phages can cause disease

For example, *Corynebacterium diphtheriae* and *Clostridium botulinum* contain **prophages** that have genes which encode for toxins

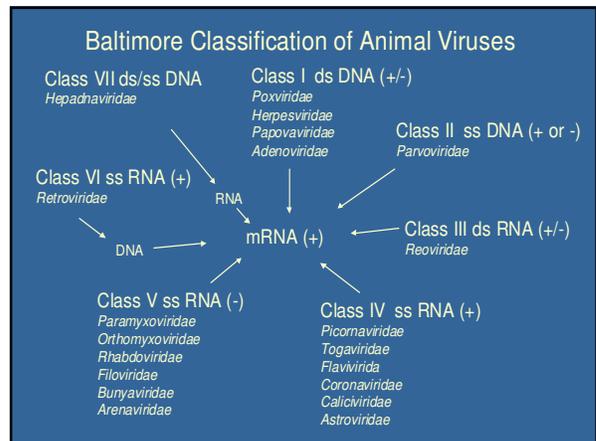
Without these prophages, they **DO NOT** produce the toxin – without toxin, no disease

Thus, they are examples of bacteria and viruses interacting to cause medically relevant disease



Classification

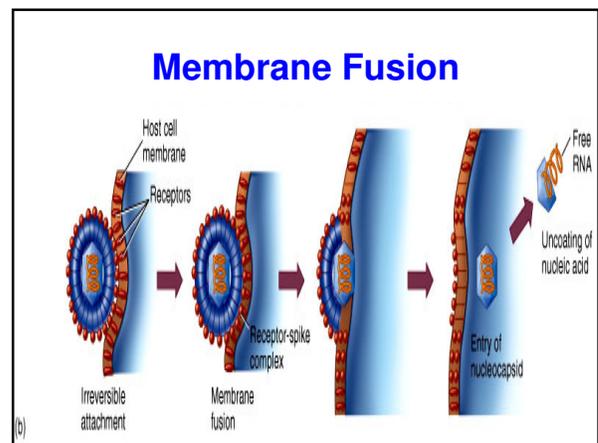
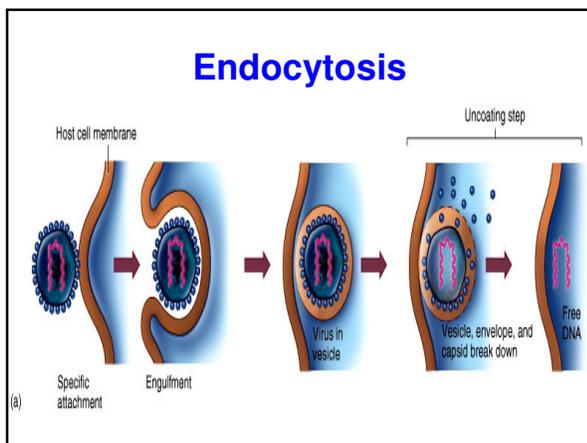
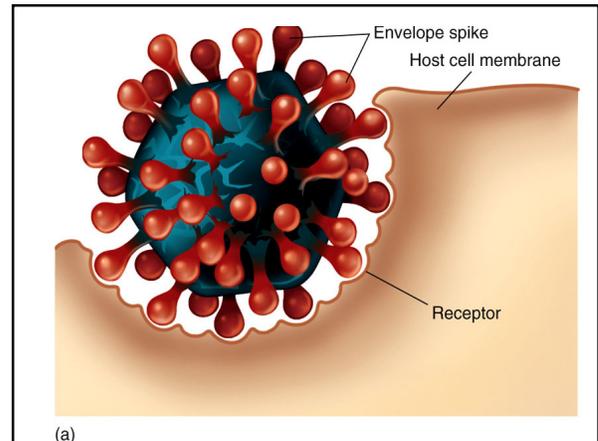
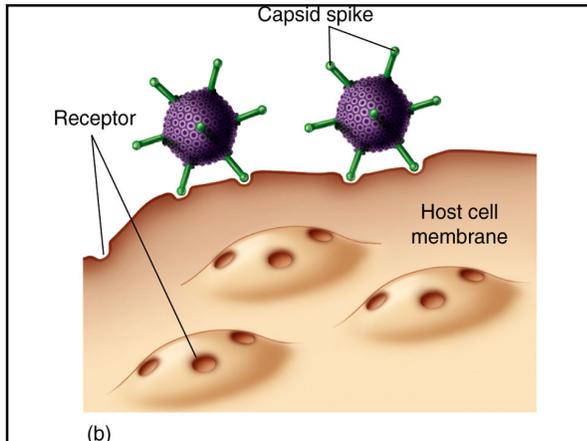
- Structure
- Chemical composition
- Genetic makeup
- Host relationship
- Type of disease
- **Baltimore Classification of Viruses**



General Steps in Viral Multiplication

- Adsorption
- Penetration
- Uncoating
- Synthesis
- Assembly
- Release

Viruses recognize specific receptors **Figure 6.12** and then the virus penetrates the cell **Figure 6.13**

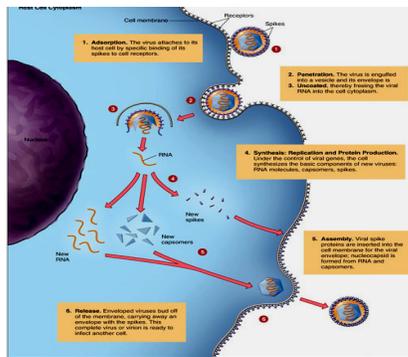


Animal Virus Replication

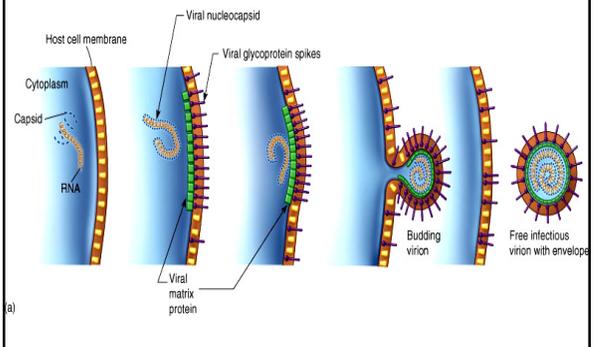
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- Adsorption
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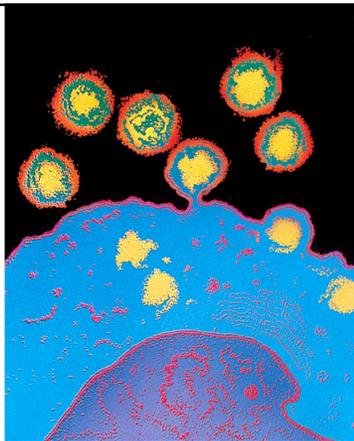
General replication scheme for an animal virus



A Magnified View of Viral Budding - ENVELOPED VIRUSES

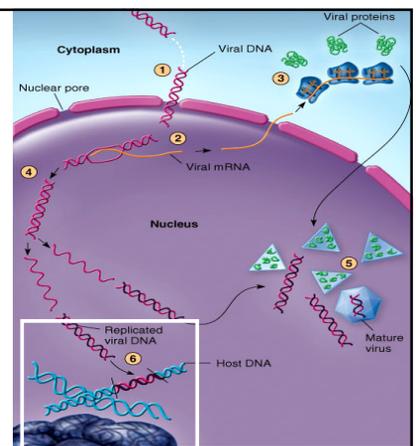


Worst case scenario - HIV virions exiting from a T cell



What happens if it is a dsDNA virus???

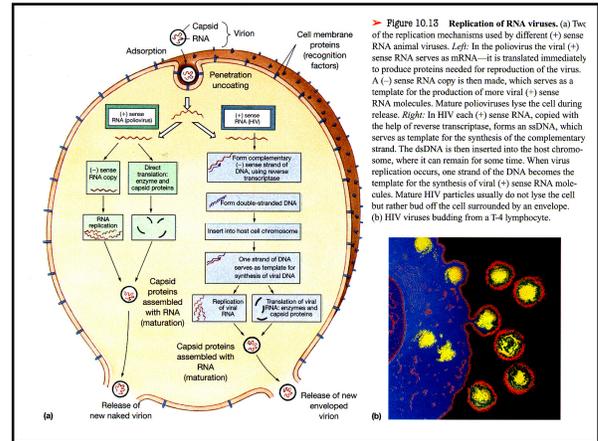
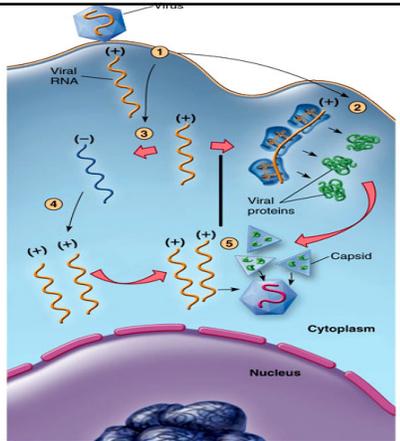
Examples: Herpesvirus



Most simple - and efficient case = ss+RNA virus

Examples: Coronavirus

RETROVIRUS



Replication of RNA viruses
Insight 6.2 - Note differences between + sense, - sense and retrovirus replication

Also, be able to compare - contrast phage and animal virus replication

Cytopathic effects

- Damage to the host cell due to a viral infection
 - Transformation

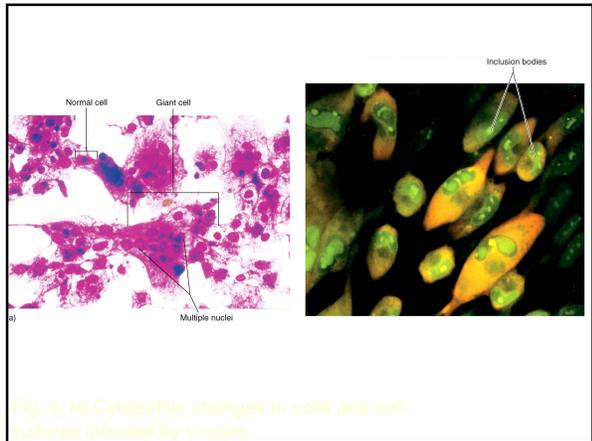
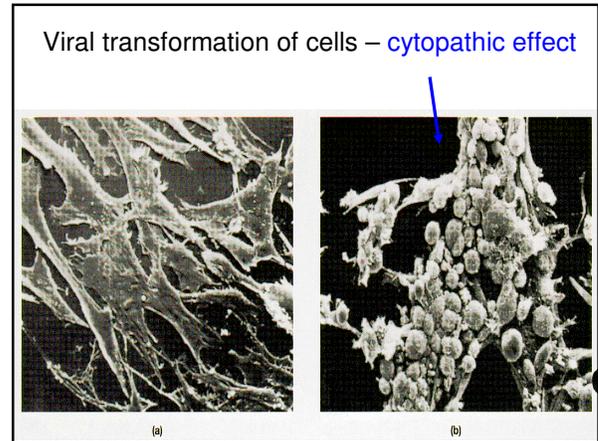


Fig. 6.16 Cytopathic changes in cells and cell cultures infected by viruses



Cultivation and Replication

- *In vivo* methods
 - Laboratory animals
 - Embryonic bird tissues
- *In vitro* methods
 - Cell or tissue culture

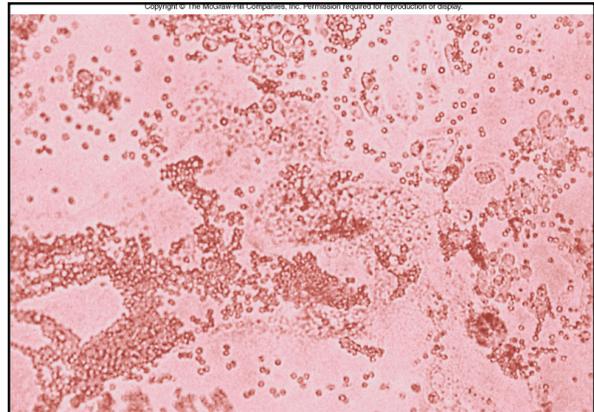
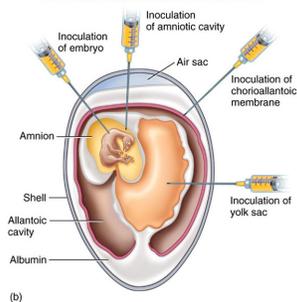
Cultivation of animal viruses –

It is possible to study viruses in animals, but due to the complexity of the animal, expense of animals and the political environment relative to the use of animals, alternatives have been developed.

Chick embryos in eggs - influenza

Persistent infection – transformation/cancer

Making the Influenza vaccine



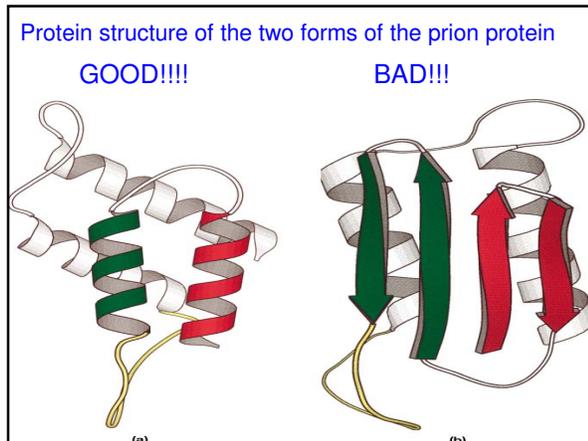
Noncellular Infectious Agents

• Prions

Prions – **Stanley Pruisner** – Nobel Prize in Medicine: 1978

Prions are proteinaceous infectious agents - **Prions do not have nucleic acid.**

Prions are considered to be the causative agents of Creutzfeldt Jakob disease, scrapie, bovine spongiform encephalopathy and kuru.



Oncogenic potential of viruses -

Cancer is a set of diseases known to disturb the normal functioning and properties of cells.

Tumors may be malignant or benign - malignant tumors spread by metastasis.

Peyton Rous in 1911 discovered that a filterable agent could transmit a sarcoma (a type of cancer) in chickens - Rous sarcoma virus - the first retrovirus described.

At least six viruses have been found to cause human cancer - Epstein-Barr virus, hepatitis B virus, hepatitis C virus, human papilloma virus (HPV-8, HPV-16), HTLV-I (adult T-cell leukemia and lymphoma), HTLV-II (hairy cell leukemia),

Oncogenes are normal cellular regulatory genes. When modified, these genes code for gene products that disturb the normal regulatory patterns of cells and can result in a loss of the normal properties of cell growth and division resulting in "cancer".

Viral oncogenes are found usually in retroviruses.

V-**oncogenes** are viral homologs of the cellular oncogenes.

V-**oncogenes** can disturb normal regulatory properties by certain mechanisms.

