Viruses

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Discuss whether viruses are living or non-living organisms and explain why viruses are obligate parasites.

Non-living characteristics:

- They are non-cellular. They do not contain cytoplasm or cellular organelles
- They are strict obligates intracellular parasites. They do not carry out metabolism on their own
    - They do not generate usable chemical energy such as ATP of synthesise nucleic acids or viral proteins using compounds such as amino acids and nucleotides

Living characteristics:

- Within their host cells, they reproduce at a fast rate. This includes the ability to direct their host cell's machinery to synthesis viral components
- Viruses contain genes and show inheritance
- They are able to undergo spontaneous mutation, allowing for evolution to occur

Obligate intracellular parasites:

- When viruses are not in a host cell, they do not appear to carry out many of the functions ascribed to living organisms, and only perform the maintenance of arrangement of the capsid coat independently of the host cell
- When they infect a host cell, they acquire these capabilities as they take over the host cell's cellular machinery
- Because viruses do not seem to be alive until it infects a cell, they are considered *obligate intracellular parasites*

Nature:

- Microscopic, intracellular parasites
- Non-cellular, lacks cytoplasm and cellular organelles
- Can only grow and reproduce inside host cells by invading and controlling the host cell's cellular machinery for synthesis of new viral components and assembly

Describe the structural components of viruses.

Genome:

- Contains a central core of nucleic acid
    - DNA or RNA
    - Single or double stranded
    - Linear or circular
    - One or more molecules of nucleic acid
- Encodes genetic information for the synthesis of new viral components and enzymes needed for reproduction of viruses in the host cells
- Nucleic acid can undergo mutations, which are then inherited by new viruses

Nucleocapsid:

- Protein capsid coat consisting of capsomeres, containing nucleic acid
- Function: to protect the nucleic acid within it
- Involved in attachment and entry of virus into host cell

Envelopes:

- Some viruses may have lipid membranes called envelopes
    - Enveloped viruses vs. naked viruses
    - Derived from cell's plasma membrane of host cell
- May be incorporated with viral glycoproteins
    - Involved in attachment and entry of virus into host cell

Describe the reproductive cycles of the following virus types:

i. bacteriophages that reproduce via a lytic cycle, e.g. T4 phage;
ii. bacteriophages that reproduce via a lysogenic cycle, e.g. lambda phage;
iii. an enveloped virus e.g. influenza;
iv. retroviruses e.g. HIV.

Life cycle	Lytic cycle/T4 phage	Lysogenic cycle/Lambda (λ) phage	Enveloped virus/Influenza	Retrovirus/HIV
Attachment /Absorption	• Attachment of tail fibres to specific receptors on surface of bacterium	• Attachment of tail fibres to specific receptors on surface of bacterium	• Attachment of glycoprotein (hemagglutinin) of viral envelope to specific receptors (containing salic acid) on the membrane surface of host cells (epithelial cells) • Conformation change of receptors facilitate entry of virus	• Attachment of glycoprotein (gp120) of viral envelope to specific receptors (CD4) on the membrane surface of host cells (T helper cells) • Conformation change of receptors facilitate entry of virus
Penetration /Entry	• Contraction of the contractile sheath which drive a hollow tube facilitating the entry of viral DNA into the host's cytoplasm • Empty protein capsid coat is left outside the cell	• Contraction of the contractile sheath which drive a hollow tube facilitating the entry of viral DNA into the host's cytoplasm • Empty protein capsid coat is left outside the cell	• Endocytosis ; the host cell surface invaginates and pinches off to form an endosome containing the virus • Membrane of the vesicle fuses with the viral envelope; nucleocapsid is released • Uncoating of capsid; viral RNA and enzymes are released • 8 strands of viral RNA, accessory proteins, RNA-dependent RNA polymerase	• Fusion of viral envelope with the plasma membrane of host cell; nucleocapsid is released • Uncoating of capsid; viral RNA and enzymes are released • 2 copies of viral RNA and reverse transcriptase
Replication	• Expression of viral genes and replication of viral genome occur in the cytoplasm using host cell's machinery	• Viral DNA is inserted into a specific site on the bacterial chromosome • Inserted DNA --> Prophage ○ Codes for a repressor	• Viral RNA and accessory proteins from a complex and enter the nucleus; serves as a template for replication of more RNA • Viral RNA exits nucleus and serves as	• Reverse transcriptase synthesises double-stranded DNA from single-stranded RNA • Viral DNA enters nucleus and inserts