Viruses and other Acellular Biological Entities, Viroids, & Prions
(Outline)

• Acellular entities as disease agents: viruses, viroids, and prions
• Contrast structure and properties of viruses with living cells
• Parasitic nature of viruses:
  – Host-cell specificity: relate to common human diseases
  – Insertion of some viral genomes into host DNA
• Ebola Virus
• Retroviruses and their life cycle (example: HIV)
• Role of ancient and current retroviruses in major evolutionary steps and in shaping animal genomes.
• Role of ancient and current viral infections as selective pressure affecting human genetic variability
Acellular Disease-causing infectious biological entities

*(Health Connection)*

**Virus** -
Packaged genetic material in transit for one host cell to the next

**Viroid** -
Circular naked RNA

**Prion** -
Mis-folded infectious proteins
Viroids and Prions: The Simplest Infectious Agents

- **Viroids** - infect plants and disrupt their growth-
  Cadang-Cadang of coconut trees

- **Prions** - slow-acting, indestructible infectious proteins
  that cause brain diseases in mammals (mad cow disease,
  ; Kuru- Fore tribe of Papua New Guinea;
  Scarpie in sheep)
Viruses are nucleic acids (genes) packaged in protein

- Biological non-living entities
- Have no cytoplasm
- Cannot self-replicate
- Cannot metabolize
- Genetic material either DNA or RNA never both
Viruses

• To replicate they need to infect a living cell
• Every living cells has one or more viruses that can infect it, specifically
• **Phage**: a virus that infect bacterial cells to reproduce using the machinery of bacterial cells

https://www.youtube.com/watch?v=3Ms04x6MvMY (First 3 mins of “The Virus Hunters” DVD)
Viral Shapes

Naked

Capsomere of capsid
Glycoprotein
Capsomere

DNA
RNA

70–90 nm (diameter)

Enveloped

Membranous envelope
RNA
Capsid

Glycoproteins

80–200 nm (diameter)

Complex

Head
DNA
Tail sheath
Tail fiber

80 × 25 nm

(a) Tobacco mosaic virus
(b) Adenoviruses
(c) Influenza viruses
(d) Bacteriophage T4

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Basis of Host-Range of Viruses

- Host range is determined by “lock-and-key” fit between virus surface and cellular receptors on host cell

- Most viruses infect only specific types of cells in one host
  Narrow host range with tissue specificity
  - cold viruses: upper respiratory tract cells.
  - HIV, AIDS virus: a certain white blood cell.

- Some have a broad host-range infecting multiple species – rabies
Viral genomes are made of either DNA or RNA

- Flu viruses are RNA
- Genital warts virus (HPV) and Herpes virus are DNA viruses
Animal Virus Life Cycle

- Attachment
- Entry
- Uncoating of virion separate protein from NA
- Replication of nucleic acid and synthesis of viral proteins
- Maturation of virions (assembly of NA and proteins)
- Release: cell lysis or budding
Emerging viruses threaten human health

Figure 10.20A, B

Ebola Virus (RNA)  SARS Virus (RNA)
The Ebola virus

— An enveloped RNA (- strand)

Entry and exit

— [http://www.youtube.com/watch?v=57P6MuM3_F8](http://www.youtube.com/watch?v=57P6MuM3_F8)

Links

Centers for Disease Control and Prevention


WHO

Retroviruses

https://www.youtube.com/watch?v=3Ms04x6MvMY (min 3 -12)

The Virus Hunters (DVD)

• Retroviruses in human genomes
  (first 12:30 mins)
The AIDS virus

- HIV is an RNA retrovirus
- It makes DNA using RNA template
- Inside a cell, HIV uses its RNA as a template to make a DNA copy of itself, which integrates into the host genome.

http://www.susanahalpine.com/anim/KubyHTML/HIV.htm
Viral DNA

About 8% of our genome is derived from RNA retroviruses
- Evidence of past infection
- Sequences tend to increase over time

Figure 11.11
Roles of human endogenous retroviruses

Endogenous retroviruses

• Placenta formation
• Large Brain development
• Powerful emotions

Explorer: The virus hunters (DVD)
https://www.youtube.com/watch?v=xtnejNGOONk
https://www.youtube.com/watch?v=3Ms04x6MvM
Role for Viruses in shaping the Human Genome

• Past retroviral infection in a primate ancestor
  – Insertion of sequences
  – New proteins or protein domains for host that maybe beneficial and influence behavior

• Present retroviral infections add to the genetic variability of the human populations