

Understanding Viruses
BIOL 114
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Introduction

We live and prosper in a cloud of viruses.

- viruses infect all living things
- We eat and breath billions of virions regularly
- Viral genomes are part of our genomes

The number of viruses on earth is staggering.

- More than 10^{30} bacteriophage particles in world's waters

Whales get infected with influenza viruses just like people, birds, and pigs.

Viruses are not just purveyors of bad news.

- more viruses in a liter of coastal water than people on Earth

Viruses drive global cycles.

Why do we care:

- Viruses outnumber cellular live by at least 10:1.
- Viruses comprise the greatest biodiversity on Earth.
- Most genetic information on Earth is viral.
- Without viruses.....

There are $\sim 10^{16}$ HIV genomes on the planet today.

How infected are we?

- there are 8 known human herpes viruses – every person is infected with several of these, at least!
- once infected, we are infected for life

You are a reservoir for viruses that set up residence in your lungs, gastrointestinal tract, and other places.

The majority of DNA in vertebrate genomes are remains of ancient viruses. These viral remnants tend to be highly conserved suggesting they are beneficial.

Amazingly, the vast majority of the viruses that infect us have little or no impact on our health and well-being.

What is a virus?

- an infectious, obligate intracellular parasite comprising genetic material (DNA or RNA) surrounded by a protein coat and/or an envelop derived from a host cell membrane

Are viruses alive?

Viruses are very small.

- 500 rhinoviruses (cold viruses) can fit on the head of a pin!
- when you sneeze, you fire an aerosol that contains enough viruses to infect thousands.

How old are viruses?

- estimates of molecular evolution place some viruses among the dinosaurs
- likely originated billions of years ago

There are ancient references to viral diseases like rabies and polio.

Variolation – inoculation of health individuals with material from a smallpox pustule

- 1790's Edward Jenner establishes vaccination

Virus Discovery – Filterable agents

- virus = slimy liquid, poison
- Ivanovsky discovered a non-bacterial pathogen infecting tobacco
- Beijerinck discovered the virus that infects tobacco (tobacco mosaic virus, TMV)

Virus Discovery

- 1901 – first human virus – yellow fever virus
- 1903 – rabies virus
- 1906 – variola (smallpox) virus
- 1908 – chicken leukemia virus, polio
- 1911 – rous sarcoma virus
- 1915 – bacteriophages
- 1933 – influenza viruses

Raw sewage harbors diverse viral populations

Some viruses are good. They exist in mutualisms with other organisms.

Herpes simplex virus infections

- in US >80% seropositive
- millions carry latent viral genomes in nervous system without symptoms
- 40 million experience recurrent herpes diseases
- a well adapted pathogen

Herpes simplex may be beneficial. Dormant infections (latency) may protect against bubonic plague (*Yersinia pestis*) and *Listeria monocytogenes* (serious disease from contaminated food. 20% mortality)! May make immune system more vigilant.

Epstein-Barr Virus (EBV, HHV4)

- 95% of US adults are seropositive and carry genome

- genome resides in B lymphocytes
- most are infected at early age and are asymptomatic
- causal agent of infectious mononucleosis, and certain cancers (lymphoma)

Varicella-zoster virus (HHV3)

- 99% adults infected prior to vaccine, 30% develop zoster (shingles), 2/3 >50 years of age

Giant Viruses = Giruses

- Mimivirus, Pandorvirus, Pithovirus, host for all of these is amoeba

Virophages

- “virus eaters”, these are parasites of other viruses
- replicate only in cells infected with giant virus
- virophage interferes with giant virus replication
- gene exchangers?
- impact on ocean ecology?

Where do viruses fit on the tree of life?

*based on lecture given by Dr. Vincent Racaniello

Study Objectives

1. Don't worry about exact dates.
2. How many bacteriophages are estimated to on the Earth?
3. How infected are we?
4. Why do we care?
5. How old are viruses?
6. In general, how many people are infected with herpes viruses? Can these infections be beneficial? Explain.
7. Describe virophages.