Virophages

- Viruses that infect other viruses
- Mamavirus
    - Greatly reduced amoeba survival and reproduction
- Amoebas
    - There were smaller viruses inside the mamavirus and the amoeba's cytoplasm
    - Smaller icosahedral virions
    - Reduces mamavirus replication
    - 3-fold decrease in amoeba death
    - 70% reduction of mamavirus output
    - Greatly increased amoeba growth without mamavirus
    - New virus named Sputnik

Prokaryotes

- Lack a membrane bound nucleus
- Carl Woesa→ came up with the different domains (Eukarya, Bacteria, Archaea)
- Bacteria and archaea are prokaryotes
- Prokaryote fossil
    - 3.8 billion years ago→ anoxic environment
    - Complex lipids found in modern bacteria present in fossils
    - Evidence for carbon fixation
        - Inorganic carbon→ organic carbon
- Prokaryotes are the most abundant life forms on Earth
- Living systems would collapse without them

Bacteria and Archaea

- Very simple organisms morphologically
    - **Bacillus**- rod shaped
    - **Coccus**- round/oval (coccoid)
    - **Spirillum**- spiral/helical
- Can form filaments
    - Examples: coccoid bacteria linked together

Bacillus bacteria linked together

- Because they are so simple morphologically…
    - … led to the use of biochemical/genetic comparisons to determine prokaryote diversity
- 3 differences between Archaea and Bacteria
    1) Structure of cell/plasma membrane differs
        a. Bacteria have ester bonds in their membranes

b. Archaea have ether bonds in their membranes
    i. This has a huge impact on where you find them
    ii. Ether bonds are much more stable than ester bonds (tough to break down)

2) Cell wall structure differs
    a. Bacteria have peptidoglycan as their major structural component
    b. Archaea have no peptidoglycan

3) Genetic machinery associated with protein synthesis/production differs
    a. Archaea have the same system as Eukarya
        i. They use introns and exons
        ii. Alter the pattern of gene expression which results in differences in protein produced
        iii. Lots of protein diversity
    b. Bacteria have a unique, simpler system
        i. Lack introns and exons
        ii. Decreased protein diversity

<u>Archaea</u>

- Found everywhere
- No parasites or pathogens in this group
- Many are found in normal environmental conditions
- **Extremophiles**
    - Lovers of extreme conditions
    - Some symbiotes
        - Commensalists (+,0)
        - Mutualists (+,+)

1) Thermophiles (60- 80 degrees Celsius)
    a. Hot springs, deep sea thermal vents
    b. Have heat-stable enzymes
    c. Deep sea vents
        i. Loaded with hydrogen sulfide (H_2S)
        ii. Archaea metabolize H_2S for their energy needs
    d. *Thermus aquaticus*
        i. Only in Yellowstone National Park
        ii. Produces heat stable enzyme- Taq polymerase
        iii. Taq used in PCR (polymerase chain reactions)
            - Takes a single piece of DNA and amplify it into thousands/millions of copies.
    e. Hypothermophile
        i. *Pyrococcus furiosus*
        ii. Optimal growth temperature = 100 degrees Celsius

iii. Heat-stable enzyme has Tungsten→ which has the highest melting point

2) Acidophiles- do well below pH = 2.0
    a. Found in acidic aquatic conditions (bogs) and terrestrial environment (pine forest soils)
    b. Acid mine drainage (OH, PA, Wales)
        i. Archaea→ only living thing in them
        ii. Common in yogurt, buttermilk, sour cream
        iii. Can block proton uptake (increases acidity)
3) Halophiles
    a. High salinity- optimal is 40% salinity (still maintain normal osmotic pressure)
    b. Great Salt Lake, Dead Sea, Soy Sauce, sauerkraut
    c. Highly saline soils → where no plants grow
        i. Take halophile genes that allow increased survival under saline conditions
        ii. Insert into crop genome
4) Methanogens
    a. Produce massive amounts of methane (atmospheric greenhouse gas)
    b. Wetlands→ produce a large portion of Earth's methane
    c. Cow intestines are loaded with methanogens
    d. Trash dumps
        i. Burning off methane
    e. Use methane for biogas, power sources