
Topic: The Diversity of Prokaryotes and Viruses

Reading: Chapter 19

Main concepts:

- Prokaryotic organisms, like all living organisms, have DNA and have cell membranes. However, they lack internal membranes, and thus no nucleus.
- Members of Domain Bacteria and Domain Archaea have several fundamental differences. One significant difference is that the cell wall of Bacteria contain a substance called peptidoglycan, which the Archaea lack.
- Most prokaryotes are much smaller than eukaryotic cells. Three common shapes are coccus (spherical), bacillus (rod-shaped), and spirillum (spiral-shaped).
- Some prokaryotes can move by means of flagella.
- Many prokaryotes secrete sticky substances that form slime layers (biofilms) for protection and to help them stick to surfaces. Tooth plaque is one example of a biofilm.
- Some prokaryotes form tough endospores that allow them to survive hard conditions for years or even centuries.
- While all eukaryotes carry out cellular respiration to get energy to run their cells, prokaryotes have many different chemical pathways for metabolism. Some are anaerobic: some can get by without oxygen, others cannot live with oxygen. Various prokaryotes can obtain energy from a much wider range of organic and inorganic compounds than eukaryotes can.
- Prokaryotes multiply through binary fission (a method of cell division). They can exchange genetic material by trading small DNA rings called plasmids.
- While some prokaryotes cause disease, most bacteria are essential to the ecosystem. Prokaryotes may recycle organic material (such as dead organisms) into inorganic compounds; they may capture atmospheric nitrogen and convert it into a form that plants can use; they may live within animal digestive systems, where animals depend on them to release critical nutrients; some bacteria, the cyanobacteria, are photosynthetic, while some (especially bacteria in deep ocean hot vents) are chemosynthetic, using chemicals and heat to produce energy-rich compounds.
- Viruses are considered non-living particles because they lack a metabolism and other essential characteristics of life. They consist of a molecule of DNA or RNA surrounded by a coat of proteins. Some are surrounded by a lipid membrane. Viruses reproduce by injecting their genetic material into a host cell, and forcing the host cell to make more viruses.
- Viroids are rings of naked RNA that can act as infectious agents.
- Prions are self-replicating proteins. One kind of prion is responsible for so-called "mad cow disease." Prions are poorly understood. It is not known if they are infectious or if the ability to make prions is inherited, or both.

Common misconceptions:

- Many students lump one-celled organisms together, and make little distinction between bacteria, viruses, "germs," molds, various protists, and even molecules. Bear in mind that bacteria, molds (a division of fungi), and protista are all distinct organisms. Viruses are non-living entities. Molecules are structures that living things are made of.
- Many people believe that all bacteria are harmful. In fact, very few cause disease. Most are essential to the ecosystem, and a few have been harnessed by humans to produce foods such as cheese, yogurt, and tofu.
- Some students, especially younger children, fail to recognize the connection between bacteria and the process of decay, thinking that decay is just a natural process that organic material goes through.

Reading notes:

- Describe the features that all prokaryotic organisms have in common. Describe the differences between Domain Bacteria and Domain Archaea.
 - Describe the ways in which bacteria move.
 - Define "biofilm," and describe how biofilms form.
 - Describe some of the ecological roles of prokaryotes, and some of the special habitats they occupy.
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Notes

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- Describe some of the alternate ways that bacteria get energy.
- Prokaryotes reproduce by dividing in half, which produces genetically identical daughter cells. How do prokaryotes increase their genetic diversity?
- Describe interactions between prokaryotes and larger eukaryotic organisms.
- Describe what a virus is, and why scientists usually consider it non-living. Can you make a case for describing it as living?
- Describe how viruses reproduce.
- Describe what a prion is, and what we know of prions so far. What are some major questions about prions that are still unanswered?

Useful websites:

- "Introduction to the Bacteria" <http://www.ucmp.berkeley.edu/bacteria/bacteria.html> is a site that includes both modern and fossil bacteria. Some parts are under construction.
 - "Microbe World" <http://www.microbeworld.org/findex.aspx> has information and good photos of bacteria and archaea. Click on "Meet the Microbes" in the navigation bar.
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