



Chapter 20: Viruses & Prokaryotes



Class

Biology

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20.1 — Viruses

The Discovery of Viruses

Martinus Beijerinck → named disease-causing particles *viruses* (*poison* in Latin)

- Wendell Stanley found crystallized versions (theorized they were not alive)

Virus: a nonliving particle made of proteins, nucleic acids, and sometimes lipids

Viruses can reproduce **ONLY** by infecting living cells.

Structure & Composition of Viruses

Capsid: the protein coat surrounding a virus

Viruses enter cells with receptor proteins on the capsid or by tricking the cell into letting them in.

- They begin to reproduce once the viral genes are expressed

Receptor proteins are made for specific cells.

- Plant viruses only infect plants.
- Animal viruses only infect animals.
- **Bacteriophages** only infect bacteria.

Viral Infections

Lytic Infections

A virus enters a bacterial cell and makes copies of itself and causes the cell to burst.

- When the infected cell bursts, new viruses are released

Lysogenic Infections

A host cell is not **IMMEDIATELY** taken over.

- Viral DNA multiplies with the host cell so that daughter cells retain the viral DNA

Prophage: bacteriophage DNA that is embedded in the bacterial host's DNA

- Forms new virus particles when activated

Retroviruses: viruses from which genetic information is copied from the RNA to the DNA

Viruses & Cells

All viruses are **PARASITES**.

- Depend entirely on hosts for their existence

20.2 — Prokaryotes

Classifying Prokaryotes

Prokaryotes → most abundant of microorganisms

- Unicellular & lack a nucleus

Prokaryotic genetic material is not membrane-bound.

Prokaryotes are either *Bacteria* or *Archaea*.

Bacteria

- Larger of the two prokaryotic domains
- Wide range of organisms
- *Usually* surrounded by a cell wall (protects the cell and gives it shape)
 - Contains peptidoglycan (polymer of sugars and amino acids that surrounds the cell membrane)
- Some bacteria have flagella for movement

Archaea

- Look similar to bacteria
 - Cell walls lack peptidoglycan
 - Membranes contain different lipids

Archaea is more closely related to eukaryotes than bacteria.

Archaea can live in harsh environments

Prokaryote Structure & Functions

- Vary in size and shape
- Vary in how they move
- Vary in their energy absorption and release

Shape Variations

Bacilli: rod-shaped prokaryotes

Cocci: spherical prokaryotes

Spirilla: corkscrew-shaped prokaryotes

Nutrition & Metabolism

- Energy is stored in sugars

Heterotrophs → take in organic molecules from the environment or other organisms

Photoheterotrophs → take in light energy in addition to what heterotrophs do

Photoautotrophs → use light energy to convert carbon dioxide into carbon compounds

Chemoautotrophs → use energy released by chemical reactions

Prokaryotic Growth, Reproduction & Recombination

Binary Fission: division of a prokaryotic cell after growing to twice its original size

- How prokaryotes reproduce (asexual)

When growth conditions are unfavorable, prokaryotes form **endospores**.

- Thick internal walls that enclose the DNA and some of the cytoplasm
 - Allows prokaryotes to survive harsh

How Prokaryotes Evolve

Mutation: random changes in DNA that occur in all organisms

- Inherited in binary fission

Conjugation: genetic material moves between prokaryotic cells (in a plasmid)

- Increases genetic diversity

The Importance of Prokaryotes

- Maintain an ecological balance in the living world

Decomposers

Prokaryotes decompose materials that the environment can use.

- Help in maintaining an equilibrium in the environment
- Can also disrupt ecosystem health

Producers

- Produces food and biomass

Nitrogen Fixers

All organisms need **nitrogen** to grow.

- Only prokaryotes can convert nitrogen gas into useful forms

Nitrogen Fixation → converting nitrogen gas (N_2) into ammonia (NH_3)

- Ammonia is converted into nitrates that plants need

Human Uses of Prokaryotes

- Food production
- Production of multiple commercial products
- Petroleum digestion
- Waste removal
- Drug synthesis
- Genetic engineering
- Medicine
- Industrial chemistry

20.3 — Diseases Caused by Bacteria & Viruses

Bacterial Diseases

Pathogens: disease-causing agents

- Bacteria and viruses are the most common

Louis Pasteur showed that bacteria can cause disease.

Bacterial Disease Mechanisms

Bacteria produce disease by ...

- Destroying living cells
- Releasing chemicals that upset homeostasis

Controlling Bacteria

- Washing hands & keeping clean
- Using disinfectants
- Storing food at lower temperatures
- Boiling food to kill bacteria
- Using heat to sterilize

Vaccine: a preparation of weakened or killed pathogens / inactivated toxins

- Builds immunity to a certain disease

Immunity: the body's ability to recognize and destroy pathogens before they cause disease

Antibiotics: drugs that block the growth and reproduction of bacteria

Viral Diseases

Viral Disease Mechanisms

Viruses cause disease by ...

- Destroying living cells directly
- Upsetting homeostasis

Preventing Viral Disease

The best way to prevent viral disease is with **vaccines** and **personal hygiene**.

- Not all viral diseases can be cured
 - **Antiviral drugs** are being made to combat viruses

Emerging Diseases

Emerging Disease: an unknown disease that appears in a population for the first time / a well-known disease that suddenly becomes much harder to control

More people are brought into contact with more advanced technology.

"Superbugs"

The use of antibiotics produces **antibiotic resistance**.

- **Superbugs** → resistant to multiple antibiotics

New Viruses

- Viruses replicate very quickly and can quickly change their genetic makeup

Prions

Prions: tiny protein particles found in the brain

- Occur when certain proteins are misfolded and build up
- Can damage the nerves in the brain