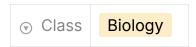


# Chapter 20: Viruses & Prokaryotes



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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 (N₂) into ammonia (NH₃)

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