Viruses, Bacteria, Protists and Fungi

Microbes
• A **virus** is a tiny **NON-LIVING** particle that invades and then multiples inside a living cell.
Viruses

- Viruses act like **PARASITES**, organisms that live in or on another organism and cause it harm.
- The living organism that a virus attaches to and uses as a source of energy is called the **HOST**.
- Once the **HOST** is carrying and transmitting a virus it is referred to as a **VECTOR**.
Viruses are smaller than cells, but can vary greatly in size and shape.

BUT, ALL viruses have three things in common.

1. A **PROTEIN COAT** that protects them
2. An **INNER CORE** that contains genetic material (direction for making new viruses)
3. **SURFACE PROTEINS** that allow it to attach to certain cells in the host.
The proteins on the surface of a virus play an important role during the invasion of a host cell. The shape of the surface proteins allow the virus to attach to the proteins on the surface of a host’s cells.
How DoViruses Multiply?

• Once inside a cell, a virus genetic material takes over many of the cells functions.
• It instructs the cell to produce the virus’s proteins and genetic material.
• These proteins and genetic material assemble into new viruses which go on to infect more cells.
1. A virus attaches to the surface of a bacterium.

2. The virus injects its genetic material into the bacterium.

3. The virus's genetic material takes over the cell functions of the bacterium. The cell starts to produce the virus's proteins and genetic material.

4. The proteins and genetic material assemble into new viruses that fill the bacterium.

5. The bacterium bursts open, releasing new viruses. The viruses go on to infect more cells.

Active Virus
Hidden Virus

1. A virus attaches to the surface of a bacterium.

2. The virus injects its genetic material into the bacterium.

3. The virus’s genetic material becomes part of the genetic material of the bacterium.

4. After some time, the virus’s genetic material removes itself and becomes active.

5. The cell begins to produce the virus’s proteins and genetic material, which assemble into new viruses.

6. The new viruses crowd the bacterium. Finally, the cell bursts open and releases the new viruses.
Common Viruses

• Some viruses are very mild such as the common cold, while others, such as HIV have severe consequences for the host.
Common Viruses

- **Bacteriophage** are robot like viruses that infect bacteria
Common Viruses

Common Cold - Rhinovirus

The Flu - Influenza Virus
Common Viruses

Chicken Pox

Measles
Common Viruses

HIV - Human Immunodeficiency Virus

SARS - Severe Acute Respiratory Syndrome
Ebola Virus

Ebola virus’ typical path through a human being

First symptoms

Day 7-9
Headache, fatigue, fever, muscle soreness

Day 10
Sudden high fever, vomiting blood, passive behavior

Day 11
Bruising, brain damage, bleeding from nose, mouth, eyes, anus

Day 12
Loss of consciousness, seizures, massive internal bleeding, death

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Source: U.S. Centers for Disease and Control, BBC
Graphic: Melina Yingling

(Source: cdc.gov) Ebola is a rare and deadly disease caused by infection with a strain of Ebola virus. The 2014 Ebola epidemic is the largest in history, affecting multiple countries in West Africa. The risk of an Ebola outbreak affecting multiple people in the U.S. is very low.
Viral Transmission

Viruses can be spread in many ways:

• Contact with a contaminated object
• Bite of an infected animal
• In sneezes and coughs
• Contact with body fluids such as blood
Viral Treatment

• There are currently no cures for viral diseases.
• There are prescription medications called “ANTIVIRAL DRUGS” that can be used to treat influenza illness.
• Resting, plenty of fluids, and well balanced meals may be all you can do to help your immune system fight a virus.
Preventing Viral Diseases

- A **VACCINE** is a substance introduced into the body to trigger the body’s natural defenses.
- A weakened or altered version of the virus puts the body on “alert”. The immune system fights it off and makes antibodies so that if the virus ever infects the body it can be destroyed before it becomes harmful.
Video Link

- How Virus Invades Your Body
- https://www.youtube.com/watch?v=Rpj0emEGShQ
Bacteria

• Bacteria were discovered by accident in the late 1600’s by a Dutch merchant named Anton van Leeuwenhoek.
Bacteria

Structure

• Bacteria are **PROKARYOTES**:
  – No nucleus
  – DNA in a loop in the cell
  – Few organelles
  – Usually have a cell wall
  – Usually have a flagellum
Most bacteria cells have one of three basic shapes:

- (a) Spherical: Coccus
- (b) Rod-shaped: Bacillus
- (c) Spiral: Spirila
## Bacterial shapes and arrangements

<table>
<thead>
<tr>
<th>Coccus</th>
<th>Rod, or Bacillus</th>
<th>Curved forms: Spirillum/Spirochete</th>
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<tbody>
<tr>
<td>Diplococci (cocci in pairs)</td>
<td>Neisseriae (coffee-bean shape in pairs)</td>
<td>Coccobacilli</td>
</tr>
<tr>
<td>Tetrads (cocci in packets of 4)</td>
<td>Sarcinae (cocci in packets of 8,16,32 cells)</td>
<td>Mycobacteria</td>
</tr>
<tr>
<td>Streptococci (cocci in chains)</td>
<td>Micrococci and staphylococci (large cocci in irregular clusters)</td>
<td>Streptomycetes (moldlike, filamentous bacteria)</td>
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</tbody>
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<thead>
<tr>
<th></th>
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<th>Spirilla</th>
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Bacteria obtaining food and energy

• Like all living things, bacteria need to have a sources of food and a way to break that food down in order to survive.

• Most bacteria need oxygen to break their food down, but a few do not require oxygen for respiration.
Bacteria obtaining food and energy

An organism that cannot manufacture its own food and instead obtains its food and energy by taking in organic substances, usually plant or animal matter. All animals, protozoans, fungi, and most bacteria are **HETEROTROPHS**.

An organism that manufactures its own food from inorganic substances, such as carbon dioxide and ammonia. Most **AUTOTROPHS**, such as green plants, certain algae, and photosynthetic bacteria, use light for energy.
Bacteria reproduction

• Bacteria can reproduce **ASEXUALLY** (one parent) by means of **BINARY FISSION**: one cell divides into two identical cells.

• Bacteria can reproduce **SEXUALLY** (two parents) by means of **CONJUNCTION**: one bacteria transfers some genetic material to another bacteria though a thread like bridge.
Bacteria
Endospore formation

• Some bacteria can survive harsh conditions like freezing, heating and drying by forming an endospore.

• An endospore is a small rounded, thick walled, resting cell that forms in a bacteria cell and houses the bacterial DNA.
Is Bacteria **Good** or **BAD**?
Is Bacteria **Good** or **BAD**?

**TYPHUS**

*IS SPREAD BY *

**LICE.....**

*REPORT LICE AT ONCE USE LOUSE POWDER*

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**The Black Death**

- Bubonic Plague: Mortality Rate: 30-75%. Symptoms: Enlarged or inflamed lymph nodes (Arm Pit, Neck and Groin).

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**The Anthrax Cycle**

- **Cutaneous**
  - Biting Fly: From infected animal
  - Ingestion: Vegetative Forms
  - Inhalation: Anthrax Spores
- **Inhalation**
  - Anthrax Spores
  - Ingestion: Vegetative Forms
  - Inhalation
- **Vegetative Forms**
  - Bacteria in animal waste and decomposition

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  - Bacteria in animal waste and decomposition
Is Bacteria **Good** or **BAD**?

Salmonella

- Fever
- Vomiting
- Diarrhea
- Abdominal Cramps

Strep
Lyme Disease

Lyme disease is a bacterial infection primarily transmitted by Ixodes ticks, also known as deer ticks, and on the West Coast, black-legged ticks.

These tiny arachnids are typically found in wooded and grassy areas.

Once a tick has attached, if undisturbed it may feed for several days.

The longer it stays attached, the more likely it will transmit the Lyme and other pathogens into your bloodstream.
Transmission of Bacterial Pathogens

• PATHOGENS are microorganisms that can cause disease

• In Sneezes, Coughs, Saliva:
  (Pneumonia, Whooping Cough, Bacterial Meningitis)

• By Animal Vectors:
  (bubonic plague, typhus)

• In Contaminated Food or Water:
  (typhoid, salmonella, e. Coli)
ANTIBIOTICS

Treatment of Bacterial Pathogens

• The discovery of the antibiotic penicillin in the 1920s made a big impact on human history. Not only did it lead to a cure for bacterial infections that were once deadly, but it also led a big interest in finding new antibiotics.

• The antibiotic penicillin works by keeping a bacterium from building a cell wall.

• Antibiotics work by affecting things that bacterial cells have but human cells don’t.
How Antibiotic Resistance Happens

• Bacterial resistance to antibiotics is produced by changes in the bacterium’s DNA, called ‘Mutations’.
• One bacterium with a mutation can survive the antibiotic and reproduces millions more with the same resistance within the space of a day.
Video Link

• What is Bacteria?
• https://www.youtube.com/watch?v=pcXdfofL0j0
# The 5 Kingdoms

<table>
<thead>
<tr>
<th>Kingdom</th>
<th>Example</th>
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<tbody>
<tr>
<td>Plants</td>
<td>Sunflower</td>
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<tr>
<td>Fungi</td>
<td>Mushrooms</td>
</tr>
<tr>
<td>Animalia</td>
<td>Ladybug</td>
</tr>
<tr>
<td>Protista</td>
<td>Amoeba (Protozoa)</td>
</tr>
<tr>
<td>Prokaryotae</td>
<td>Bacteria</td>
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</tbody>
</table>

*Viruses?*

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Protists

- Protists are eukaryotes that cannot be classified as animals, plants or fungi.
- Because protists are so diverse they are grouped according to the characteristics they share with organisms in other kingdoms.
Animal-Like Protists

- Animal-like protists are heterotrophs and most are able to move from place to place to obtain food, however, unlike animals they are unicellular.

- Animal-like protists may be called PROTOZOANS.
Animal-Like Protists

1. Protozoans with Pseudopods (ex. Amoeba)

2. Protozoans with Cilia (ex. Paramecium)

3. Protozoans with Flagella (ex. *Peranema*)

4. Protozoans that are Parasites. (ex. Plasmodium)
**Pseudopods**

**Pseudopod**
An amoeba uses pseudopods to move and feed. Pseudopods form when cytoplasm flows toward one location and the rest of the amoeba follows.

**Food Vacuole**
When the ends of two pseudopods fuse, they form a food vacuole. Food is broken down inside the food vacuole in the cytoplasm.

**Contractile Vacuole**
The contractile vacuole collects excess water from the cytoplasm and expels it from the cell.

**Nucleus**
The nucleus controls the cell’s functions and is involved in reproduction. Amoebas usually reproduce by binary fission.

**Cell Membrane**
Because the cell membrane is very thin and flexible, an amoeba’s shape changes constantly.
Ciliates

**Figure 16**

**Paramecium**

Paramecia are ciliates that live mostly in fresh water. Like amoebas, paramecia feed on bacteria and smaller protists.

- **Pellicle**: A stiff but flexible covering, called the pellicle, surrounds a paramecium and gives it shape.
- **Contractile Vacuoles**: Two contractile vacuoles collect excess water from the cytoplasm and expel it from the cell.
- **Anal Pore**: Wastes leave through the anal pore.
- **Cilia**: Thousands of cilia project through the pellicle. The beating cilia enable a paramecium to move smoothly in one direction.
- **Food Vacuole**: A food vacuole forms and pinches off from the oral groove. It moves into the cytoplasm. Inside the vacuole, the food is broken down and then distributed.
- **Oral Groove**: The oral groove is a funnel-like indentation lined with cilia. The cilia move water containing food into the vacuole that forms at the end of the oral groove.
- **Large Nucleus**
- **Small Nucleus**
- **Cytoplasm**
Flagellates

Giardia

Trichonympha

Parasites

Plasmodium
Plant-Like Protists

- Plant-like protists are commonly called ALGAE. They are grouped together because, like plants, they are all autotrophs.
Plant-Like Protists

- Plant like protists play an important role in ecosystems.
- They provide a source of food for many other organisms.
- They make much of the oxygen that makes up the Earth's atmosphere.
Fungus-Like Protists

- Like fungi, fungi-like protists are heterotrophs, have cell walls, and use spores to reproduce.
- Molds are part of the natural environment, and can be found everywhere, indoors and outdoors. Mold is not usually a problem, unless it begins growing indoors.
- The best way to control mold growth is to control moisture.

Slime Mold  Downy Mold  Water Mold
Diseases Caused by Protists

• African sleeping disease (caught via flies) and **CHAGAS** (caught via the 'assassin bug') are each caused by different types of Trypanosoma protists.

• Treatment of Chagas disease focuses on killing the parasite in acute infection and managing signs and symptoms in later stages.
Diseases Caused by Protists cont..

- **MALARIA** is caused by a *Plasmodium* protist, which travels via a mosquito vector. Treatment should be initiated as soon as possible.
Diseases Caused by Protists cont..

- **GIARDIA** is found in untreated water. Children and adults who have giardia infection without symptoms usually don't need treatment unless they're likely to spread the parasites. Many people who do have problems often get better on their own in a few weeks.
Fungi

• Fungi are **EUKARYOTES** that have cell walls, are **HETEROTROPHS** that feed by absorbing their food, and use spores to reproduce.
Fungi
Cell Structure

• Fungi may be unicellular, like yeast, or **MULTICELLULAR**.

• The cells of multicellular fungi are arranged into branching threadlike tubes called **hyphae**.
Fungi

Obtaining Food

• First fungi grow hyphae into a food source.
• Then digestive chemicals ooze from the hyphae into the food, breaking it down into small substances that can be absorbed by the hyphae.
Fungi Reproduction

• Fungi usually reproduce by making lightweight spores in reproductive structures called fruiting bodies. The spores can then be carried easily through the air or water to new sites.

• Most fungi reproduce both sexually and asexually.
Fungi
Reproduction

• **Asexual Reproduction:** Cells at the tips of the hyphae can divide to form spores, which grow into fungi that are genetically identical to the parent.

• **Sexual Reproduction:** Hyphae of two fungi can grow together and exchange genetic material, then grow a new spore producing structure.
Classification of Fungi

Three major groups of fungi include sac fungi, club fungi, and zygote fungi.

Sac Fungi
Sac fungi produce spores in structures that look like long sacs, such as these. The largest group of fungi, they include yeasts, morels, and truffles.

Club Fungi
Club fungi produce spores in tiny clublike structures. This group includes mushrooms, rusts, and puffballs, such as these.

Zygote Fungi
Zygote fungi produce very resistant spores. This group includes many common fruit and bread molds, like this Rhizopus.
Fungi
role in nature

• Fungi are food
• Fungi are environmental recyclers
• Fungi fight disease
• Fungi cause disease
• Fungi help plants grow
Fungal Diseases

In most cases, ringworm of the skin can be treated with antifungal creams or ointments. Many are available without a prescription.

Most cases of athlete's foot can be treated at home using an antifungal medicine to kill the fungus or slow its growth.