

A close-up photograph of two clownfish swimming among the tentacles of a sea anemone. The clownfish have bright orange bodies with white stripes around their mouths and black outlines on their fins. The sea anemone has numerous long, translucent tentacles with distinct blue-tipped clubs.

# Structures and Functions of Living Organisms

# **Structures and Functions of Living Organisms**

**8.L.1 Understand the structure and hazards caused by agents of disease that affect living organisms.**

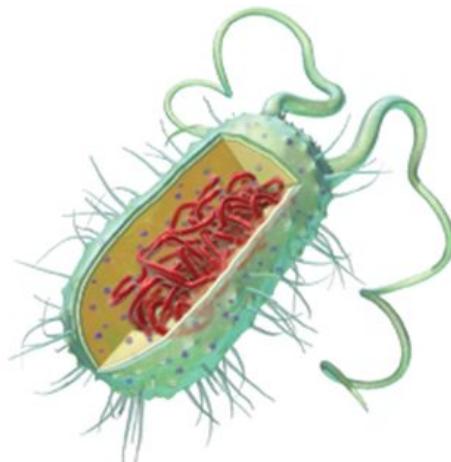
8.L.1.1 Summarize the basic characteristics of viruses, bacteria, fungi and parasites relating to the spread, treatment and prevention of disease.

8.L.1.2 Explain the difference between epidemic and pandemic as it relates to the spread, treatment and prevention of disease.

# Sized Extra-Small

## **What is a prokaryote?**

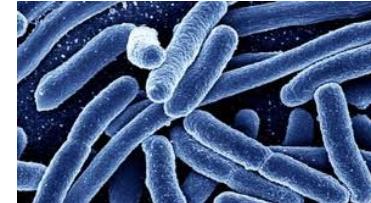
- All living things are either prokaryotes or eukaryotes.



# What is a prokaryote?

- Eukaryotes are made up of one or many cells, each of which has a nucleus enclosed by a membrane.
- Prokaryotes do not have a nucleus or membrane-bound organelles.
- Almost all prokaryotes are single-celled.

# What is a prokaryote?

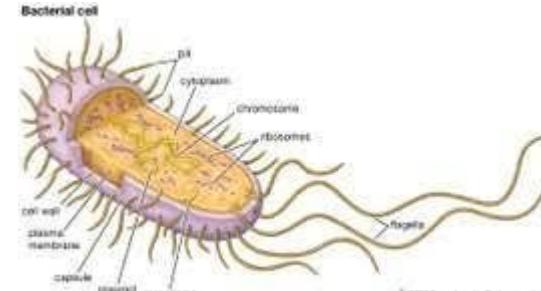


- Prokaryotes can be seen with a microscope only, so they are called *microorganisms*.
- Prokaryotes are divided into two domains, Bacteria and Archaea.
- **Bacteria** is a domain of prokaryotes that usually have a cell wall and usually reproduce by cell division.

# Beautiful Bacteria

## What are some characteristics of bacteria?

- Most known prokaryotes are bacteria.
- The domain Bacteria contains more individuals than all other domains combined do.



# What are some characteristics of bacteria?

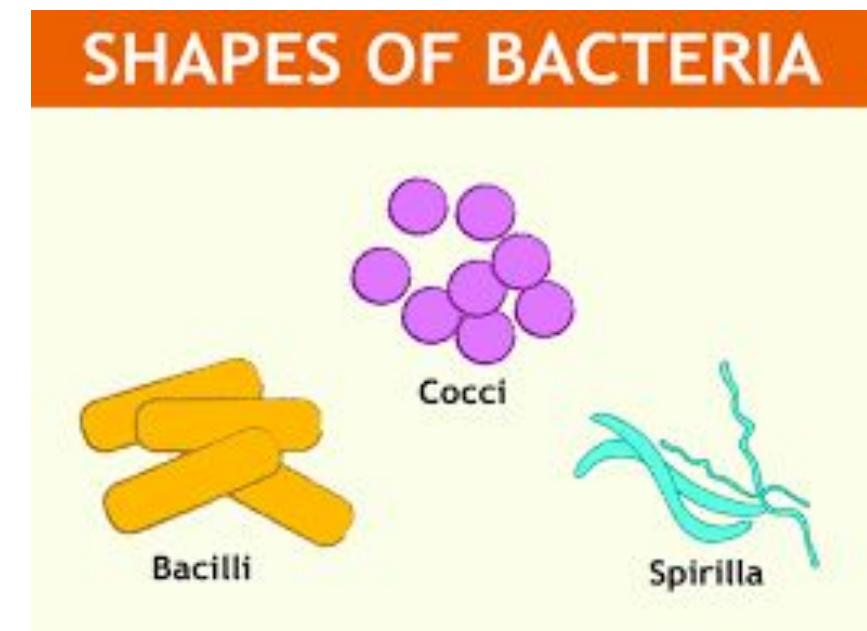
- Many bacteria are *consumers* that get nutrients by feeding on other organisms.
- Some bacterial consumers are *decomposers*, which feed on dead organisms. Other bacterial consumers live in or on another organism.
- Bacteria that make their own food are called *producers*. These bacteria use energy from sunlight to make food, and are often green.

# What are some characteristics of bacteria?

- Bacteria are small, single-celled organisms.
- Some bacteria stick together to form strands or films, but usually each bacterium still functions as an independent organism.
- Each bacterium must take in nutrients, release energy from food, get rid of wastes, and grow on its own.

# What are some characteristics of bacteria?

- Most bacteria have a rigid cell wall that gives them their shape. Each shape helps bacteria in a different way.
- Bacteria that are shaped like spirals can move like corkscrews.
- Bacteria shaped like rods quickly absorb nutrients.
- Round bacteria do not dry out quickly.



# What are some characteristics of bacteria?

- Bacteria can be found almost everywhere on Earth.
- They can be found breaking down dead material in soil, making nitrogen available inside plant roots, and breaking down nutrients in animal intestines.

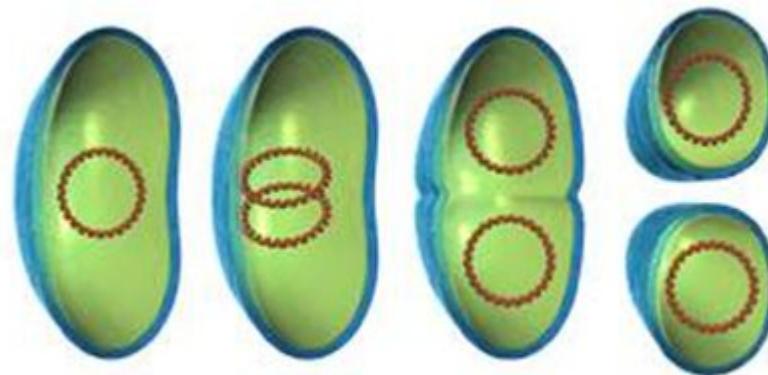
# What are some characteristics of bacteria?

- Some bacteria can survive during periods when environmental conditions become harsh by forming *endospores*.
- An endospore is made up of a thick, protective coating, the bacteria's genetic material, and cytoplasm.
- They can survive in hot, cold, and very dry places. When conditions improve, endospores break open and the bacteria become active again.

# Split Personality

## How do bacteria reproduce?

- Both archaea and bacteria reproduce by **binary fission**, which is reproduction in which one single-celled organism splits into two.



# How do bacteria reproduce?

- The first step in bacterial reproduction is copying the cell's genetic information, which is in the form of a long, circular strand of DNA.
- This loop, called a *chromosome*, is copied. Then, the two chromosomes separate, with one on each side of the cell.

# How do bacteria reproduce?

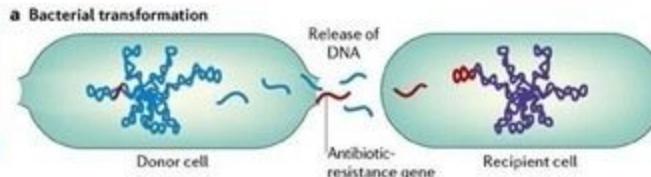
- The cell's membrane then starts to grow inward, separating the two halves of the cell. A new cell wall forms and separates the two new cells.
- At the end of binary fission, there are two identical bacterial cells, each with identical DNA.
- This type of reproduction, in which one parent produces genetically identical offspring, is called *asexual reproduction*.

# How do bacteria exchange DNA?

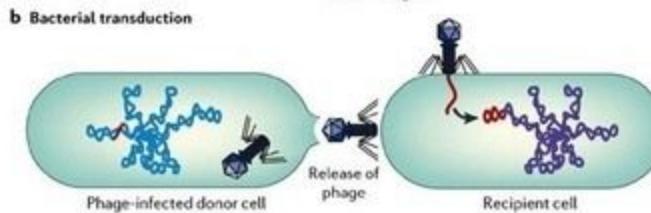
- There are three ways bacteria can acquire new genetic information: transformation, transduction, and conjugation.
- *Transformation* occurs when bacteria take up DNA from the environment.
- *Transduction* happens when a virus injects DNA into a bacterium.

# Horizontal Gene Transfer: New Gene Acquisition

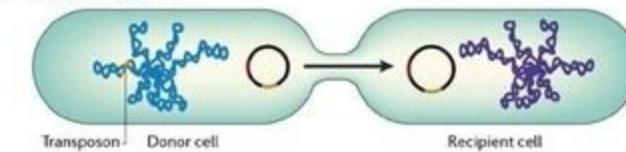
Transformation: naked DNA uptake by bacteria



Transduction: bacterial DNA transferred by viruses (phage)



Conjugation: DNA transfer between bacterial cells

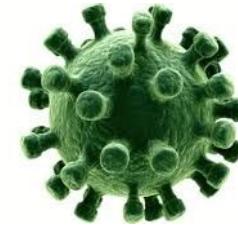


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# How do bacteria exchange DNA?

- Some bacteria have a second loop of DNA, smaller than the main chromosome, called a plasmid.
- During *conjugation*, two bacteria temporarily join together, and a plasmid transfers from one bacterium to the other.
- The bacterium that gets the plasmid now has new genes to use.

# Alive or Not Alive?



## What are some characteristics of viruses?

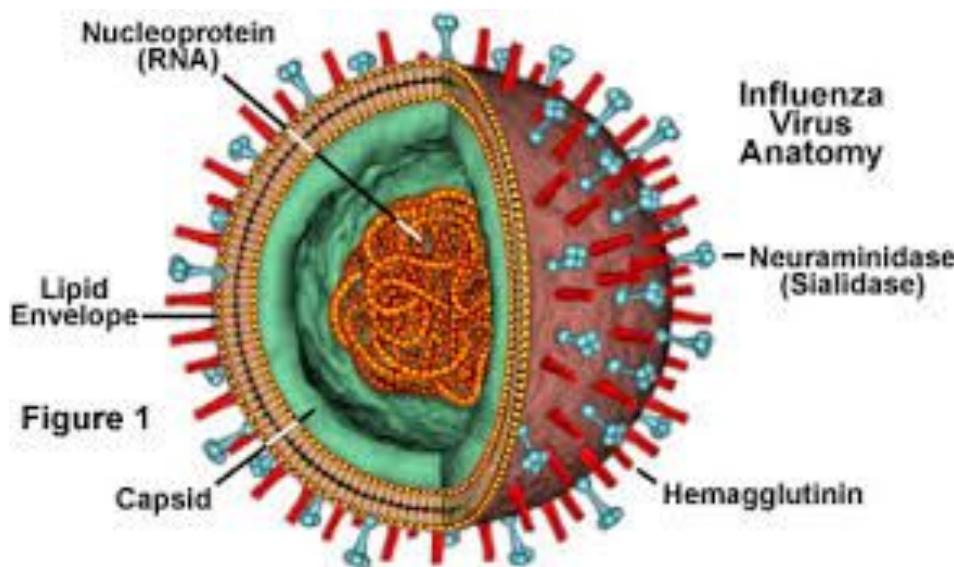
- A **virus** is a microscopic particle that cannot replicate on its own. It either gets inside a cell or injects a cell with its DNA, often destroying the cell.
- Many viruses cause diseases, such as the common cold, flu, and acquired immune deficiency syndrome (AIDS).
- Viruses can infect people, plants, animals, and prokaryotes.

# Are viruses living?

- Viruses contain genetic material and protein, but do not perform any life functions.
- Viruses do not use energy from nutrients, do not maintain homeostasis, can't grow, and do not respond to stimuli such as light, sound, or touch.
- A virus cannot function on its own. It can replicate only inside a cell it infects. Thus, viruses are not living.

# The Flu

- Most influenza viruses are not very harmful. When a new virus spreads to many people around the world, however, it can cause a flu pandemic.
- The 1918 Flu was caused by one of the world's deadliest viruses, which killed more than 50 million people and infected more than 500 million.
- New strains of flu viruses are constantly developing. Scientists monitor these outbreaks closely so that vaccines can be made.



# A Gift for the Host ...

## How do viruses replicate?

- Viruses can replicate only inside a living cell that serves as a **host**, which is a living thing that a virus or parasite uses for resources or shelter.
- Viruses attach to specific types of host cells and invade them.
- Many viruses cannot be spread from one type of organism to another.

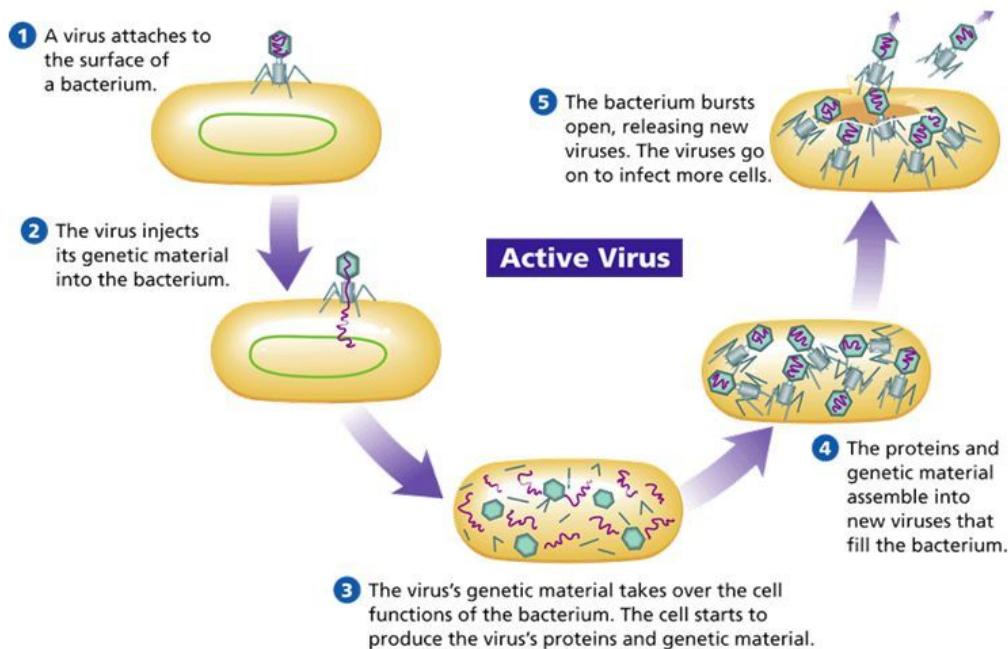
# How do viruses replicate?

- When a virus enters a cell or when its genetic material is injected into a cell, the virus takes over the host cell, which follows instructions in the viral DNA.
- The host cell replicates the viral DNA and makes new protein parts for the virus. Then, parts of the new viruses assemble in the host cell.
- When the host cell is full of new viruses, they burst from the host cell. This step, called *lysis*, kills the host cell.

# How do viruses replicate?

- The new viruses search for new host cells, and the *lytic cycle* begins again.
- Some viruses insert their genes into the host cell, but new viruses are not made right away.
- The genes can stay inactive for a long time. When the genes do become active, they begin the lytic cycle and make copies of the virus.

# Lytic Cycle



# On the Move!

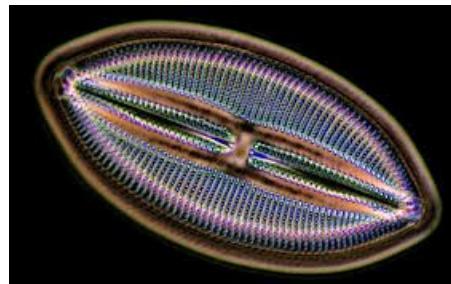


## What are some characteristics of protists?

- The kingdom **Protista** is a group of eukaryotic organisms that cannot be classified as fungi, plants, or animals.
- Members of the kingdom Protista are called protists, which are a very diverse group of organisms.
- Many members are not closely related or are more closely related to members of other kingdoms, so classification of protists is likely to change.

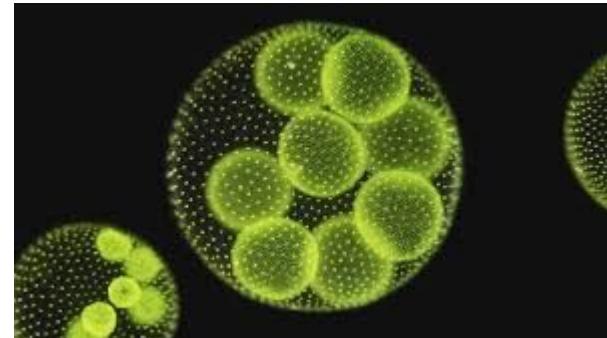
# What are some characteristics of protists?

- Most protists are single-celled organisms that cannot be seen without a microscope.
- Diatoms are single-celled protists that have cell walls with unusual shapes.
- Some have many cells, and some live in colonies. Volvox, a kind of green algae, has cells that form spherical colonies.



Diatom

Volvox

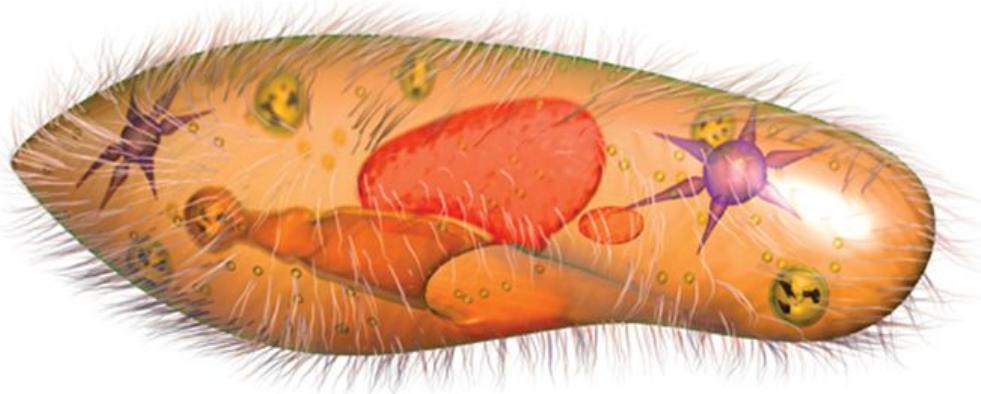


# What are some characteristics of protists?

- Protists have membrane-bound organelles, which are structures that carry out jobs inside a cell.
- Many protists have contractile vacuoles that remove excess water from the cell.
- Some protists have structures for movement. Most protists that move do so in order to find food.

# What are some characteristics of protists?

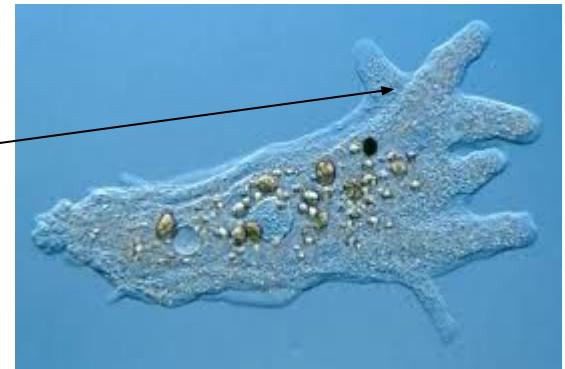
- Some protists move by using cilia or hairlike structures that beat rapidly back and forth.



# What are some characteristics of protists?

- Other protists use a flagellum, a whiplike structure that propels the cell forward, to move.
- Amoebas move by stretching their bodies, forming a *pseudopod* or “false foot.” When cytoplasm flows into the pseudopod, the rest of the cell follows.

Pseudopod



# Protist Production

## **How can protists reproduce?**

- Most protists can reproduce asexually, when the offspring come from just one parent.
- Every organism can produce offspring that are genetically identical to the parent.

# How can protists reproduce?

- Protists can reproduce asexually by binary fission and fragmentation.
- During binary fission, a single-celled protist copies its DNA. The protist then divides into two cells, each of which has a copy of the DNA.
- In fragmentation, a piece breaks off an organism and develops into a new individual. Many multicellular protists reproduce this way.

# How can protists reproduce?

- Some protists reproduce sexually, when two cells, called **gametes**, join together.
- Each gamete contains a single copy of the genes for the organism. A cell with one copy of genetic material is *haploid*; a cell with two copies is *diploid*.
- Each gamete comes from a different parent. When the haploid gametes join, the diploid offspring has a unique combination of genetic material.

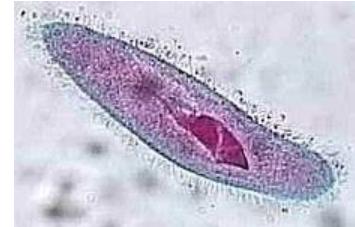
# How can protists reproduce?

- In some protists, generations alternate between using sexual and asexual reproduction.
- Haploid generation adults are called *gametophytes*.  
Diploid generation adults are called *sporophytes*.
- Diploid adults undergo meiosis to make haploid spores.
- **Spores** are reproductive cells that are resistant to stressful environmental conditions.

# How can protists reproduce?

- These spores develop into haploid adults, which undergo mitosis to form haploid gametes.
- Two gametes join to form a diploid zygote, which grows into a diploid adult.
- This continuing cycle is called *alternation of generations*.

# A Diverse Group



## What are different kinds of protists?

- Animal-like protists cannot make their own food.
- They get nutrients by ingesting other organisms. Many eat small organisms such as bacteria, yeast, or other protists.
- Most animal-like protists can move, allowing them to search for food.

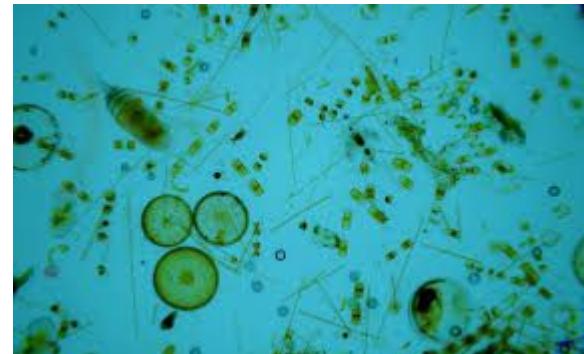
# What are different kinds of protists?



- Fungus-like protists absorb nutrients from the environment. Many absorb nutrients from living or dead organisms.
- Fungus-like protists produce spores that are used in reproduction.
- Protists release spores into the environment. The spores can survive through periods of harsh conditions.

# What are different kinds of protists?

- Plant-like protists are producers, which means they use the sun's energy to make food through photosynthesis.
- Single-celled, free-floating, plant-like protists are a main part of the ocean's phytoplankton.
- Phytoplankton—tiny, floating organisms—provide food for larger organisms. They also produce much of the world's oxygen.



# What are different kinds of protists?

- Multicellular plant-like protists are called **algae**.
- All algae have the green pigment chlorophyll in their cells. Many also have other pigments.
- Algae are grouped by color, which determines what wavelengths of light the algae can absorb. The three main groups are brown algae, red algae, and green algae.



# Lots of Fun(gi)!



## What are some characteristics of fungi?

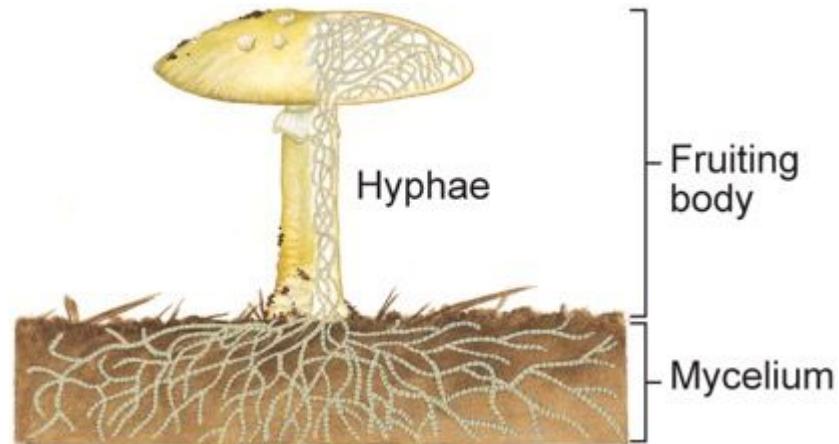
- **Fungi** are spore-producing organisms that absorb nutrients from the environment. Because they are so different from other organisms, fungi are placed in their own kingdom.
- Fungi are *consumers*, which means they cannot make their own food. They cannot move to catch organisms to eat.
- Fungi get nutrients by secreting digestive juices onto a food source and then absorbing nutrients from the dissolved food.

# What are some characteristics of fungi?

- Many fungi are *decomposers*, which get nutrients from dead matter.
- All fungi are made of eukaryotic cells that have nuclei.
- Fungi are unique because their cell walls contain *chitin*, a hard substance that strengthens the cell walls.

# What are some characteristics of fungi?

- Some fungi are single-celled.  
Most are made up of many cells  
that form chains, or threadlike  
fungal filaments called **hyphae**.
- Most hyphae in a fungus form a  
twisted mass called a *mycelium*,  
which makes up the major part  
of the body of a fungus.



# What are some characteristics of fungi?

- Thread-like hyphae make up the body of this mushroom. Most of the hyphae are underground.



# How can fungi reproduce?

- Asexual reproduction in fungi occurs in three ways. In fragmentation, hyphae break apart, and each piece becomes a new fungus.
- In budding, a small portion of a parent cell pinches off to become a new individual.
- In asexual reproduction by spores, hyphae produce a long stalk called a *sporangium*, in which spores develop through mitosis and spread by wind.

# How can fungi reproduce?

- In most fungi, sexual reproduction occurs when hyphae from two individuals join together, producing a special reproductive structure.
- Genetic material from both individuals fuse to form diploid cells. The cells undergo meiosis to become haploid again. The spores are then released.
- Like asexual spores, these spores also spread easily through the environment.

# What are some kinds of fungi?

- Zygote fungi are named for sexual reproductive structures that produce zygotes inside a tough capsule.
- Most of the fungi in this group live in the soil and are decomposers.
- A mold is a fast-growing fungus that reproduces asexually. Bread molds and molds that rot fruit are examples of this asexual stage of a zygote fungus life cycle.



# What are some kinds of fungi?

- Sac fungi, the largest group of fungi, include yeasts, powdery mildews, morels, and bird's-nest fungi.
- Sac fungi reproduce asexually and sexually. Sexually produced spores develop within a microscopic sac that then opens to release the spores.
- Most sac fungi are multicellular. Some single-celled sac fungi reproduce asexually by budding, which occurs when a new cell pinches off from an existing one.



# What are some kinds of fungi?

- Club fungi are named for the microscopic structures in which the spores develop.
- Club fungi are important decomposers of wood. Without fungi, the nutrients in wood could not be recycled.



# How do fungi form partnerships?

- Some fungi grow on or in the roots of plants, providing nutrients to the fungus, which helps the roots absorb minerals.

This is called a **mycorrhiza**.

Mycorrhiza



- A **lichen** is a partnership between a fungus and a green alga or cyanobacterium, which uses photosynthesis to make food.

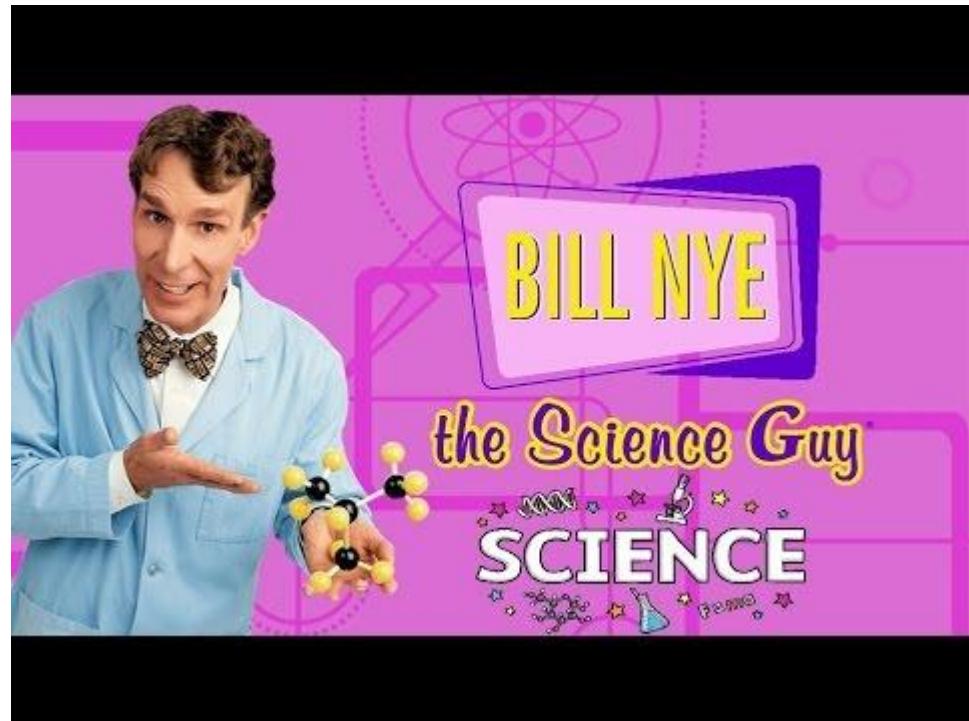
- The fungus gives protection, water, and minerals. For example, lichens provide food for animals in polar climates.

Lichen



# What is an infectious disease?

- A disease that is caused by a *pathogen* is called an **infectious disease**.
- Living pathogens include bacteria, fungi, and parasites.
- Viruses are pathogens that are noncellular. They cannot function on their own.



# What is an infectious disease?

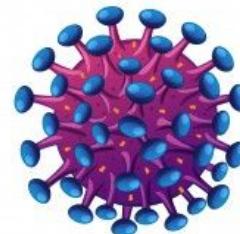
- Infectious diseases can be passed from person to person.
- Pathogens can be passed from nonliving objects and from other living things.



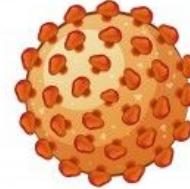
# That's Sick!

## What can cause infectious disease?

- Viruses are tiny particles that have their own genetic material and depend on living things to reproduce.
- Influenza, the common cold, and HIV are examples of diseases caused by viruses.



HIV



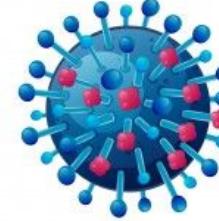
Hepatitis B



Ebola Virus



Adenovirus



Influenza



Bacteriophage

# **What can cause infectious disease?**

- Many bacteria are beneficial to living things, but some cause disease.
- Tuberculosis, strep throat, diarrheal illness, and some sinus infections are caused by bacteria.

# What can cause infectious disease?

- Most fungi are beneficial because they break down dead plants and animals.
- Some fungi are pathogens.
- Athlete's foot and ringworm are two common skin infections caused by fungi.



# What can cause infectious disease?

- A *parasite* is an organism that feeds on another organism, called a *host*.

- Some common parasites are single-celled *protists*.

- Parasites harm their hosts.



- Malaria, giardiasis, and worm infections are common parasitic infections.

# Don't Pass It On

## **How can infectious diseases be transmitted?**

- *Contagious diseases* can be spread easily from person to person or from other organisms to people.
- Water and food supplies can be contaminated and cause sickness.
- Diseases can be spread through the air, through touching an infected person, and through sexual contact.

# How can infectious diseases be transmitted?

- Insects, ticks, and other animals can spread disease.
- Objects that are handled by sick people or that come in contact with infected animals or contaminated food can pick up pathogens.
- Contaminated needles can transmit diseases.



# End Transmission

## How can diseases be reduced?

- Improved personal hygiene and improved technology have helped reduce the spread of disease.
- Vaccines prevent serious illnesses worldwide.
- Food preservation techniques help reduce contamination of foods by pathogens.



# How can disease be treated?

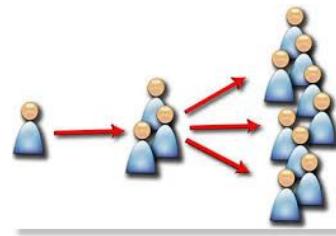
- **Antibiotics** are medicines used to kill or slow the growth of bacteria and other microorganisms, such as fungi.
- Antibiotics do not work on viruses.
- **Antiviral drugs** are drugs that destroy viruses or prevent their replication.

# Resisting Arrest

- Some bacteria have developed a resistance to antibiotics.
- Washing your hands throughout the day can reduce the risk for some infections.



# Epidemic



- An epidemic is an out break of disease that affects many individuals at the same time.
- An epidemic is any illness or health-related issue that is showing up in more cases then would normally be expected.
- It occurs when an infections disease spreads rapidly to many people.
- In 2003, the severe acute respiratory syndrome(SARS) epidemic took the lives of nearly 800 people.

# Pandemic

- A **pandemic** is an outbreak of disease that affects a large group (whole country or worldwide)



# Contrasting Epidemic vs. Pandemic

- Pandemic normally is used to indicate a far higher number of people affected than an epidemic.
- Pandemic also refers to a much larger region being affected.
- In the **most extreme** case, the entire global population would be affected by a pandemic.

# Contrasting Epidemic vs. Pandemic

- It is not unusual for a new virus to spread worldwide because if people have not been exposed to the virus their immune system are not ready to fight it off. This causes more people to become infected.
- Swine flu started in Mexico City where it was feared to lead to epidemic proportions in North America, now that the flu has been found in New Zealand, Israel, Scotland and many other countries it is a pandemic.

# Contrasting Epidemic vs. Pandemic

- The 1918 Spanish flu and the Black Plague are extreme examples of pandemics.
- Pandemic doesn't mean millions of deaths, it means a geographically widespread.

# Past Influenza Pandemics

## **Spanish Influenza : 1918**

→ 40-50 million dead

## **Asian Influenza : 1957**

→ 2 million people dead

## **Hong Kong Influenza : 1968**

→ 1 million people dead