How Germs Spread

Grades 3-5

Science, Math, ELA

Objectives

Students will conduct scientific experiments to learn how germs are spread. Students will participate in a simulation of how germs spread, analyze the data and express the results as a fraction of the whole and as a decimal. Students will simulate exposure to multiple germs simultaneously. Students will chart frequency and number of exposures.

Vocabulary

bacteria—any one of a group of very small living things that often cause disease
contagious—able to be passed from one person or animal to another
fungus—any of a group of spore-producing life forms including molds, yeast, mushrooms, and toadstools.
germ—a very small living thing that causes disease
pandemic—an occurrence in which a disease spreads very quickly and affects a large number of people over a wide area or throughout the world
quarantine—the period of time during which a person or animal that has a disease or that might have a disease is kept away from others to prevent the disease from spreading
vector—an insect, animal, etc., that carries germs that cause disease
virus—an extremely small particle that causes a disease and that spreads from one person or animal to another

Background

WHAT IS A GERM?

The term "**germ**" refers to a very small living thing that causes disease. Germs can be **viruses**, **bacteria**, or **fungi**. Viruses are very small particles that cause a disease. They spread from one person or animal to another. They are so simple that they are often not even considered alive. This is because they are not able to grow or reproduce on their own. Instead they must take over a host cell to grow or reproduce.

Bacteria are much larger in size and can live anywhere. There are bacteria in the soil and at the depths of the ocean. They can also be on the surfaces of teeth and in the digestive tracts of humans and animals. Most bacteria are not disease-causing. In fact, many bacteria are very helpful to us. There are bacteria that break down trash or clean up oil spills. They can even be used to make medicines.

Fungi are larger, plant-like organisms that lack chlorophyll. Chlorophyll is what makes plants green and changes sunlight into energy. Since fungi do not have chlorophyll they cannot make food. They have to absorb food from whatever they are growing on. Fungi can be very helpful. Fungi can make bread rise, or break down trash. But they can also be harmful if they steal nutrients from another living thing.

HOW GERMS SPREAD

The most common way for disease to spread is through the direct transfer of bacteria, viruses, or other germs from one person to another. This can occur when a person with **contagious** germs touches, coughs on, or kisses someone who is not sick. These germs can also spread through body fluids or a blood transfusion.

How Germs Spread (continued)

Animals carry many germs. Being bitten or scratched by a sick animal can make you sick. You might also become infected by scooping your cat's litter box. You can even get sick by cleaning mouse droppings in your house or garage. The best way to keep this from happening is to wash your hands often.

Disease-causing organisms can also be passed along by indirect contact. Many germs can stay on an object, such as a tables, doorknob, or faucet handle. When you touch the same doorknob as someone who is sick, you can pick up the germs he or she left behind. If you then touch your eyes, mouth, or nose before washing your hands, you may become sick.

When you cough or sneeze, you send droplets into the air around you. When you're sick these droplets have the germs that made you sick. Crowded, indoor rooms may increase the chance of droplets being spread. Some germs travel through the air in particles much smaller than droplets. These tiny particles remain in the air for long periods of time. They can travel in the air. If you breathe in an airborne virus, bacteria, or other germ, you may become sick. You will then show signs and symptoms of the disease. The flu and SarS are two contagious diseases often spread through the air.

COVID-19 is a new virus. Scientists and doctors are still learning about it. So far, this virus has made many people sick. Scientists and doctors are trying to learn more so they can help people who get sick. Doctors and health experts are working hard to help people stay healthy. The virus is thought to spread mainly from person-to-person.

Some germs rely on insects—such as mosquitoes, fleas, lice, or ticks— to move from host to host. These carriers are known as **vectors**. Mosquitoes can carry the malaria parasite or West Nile virus, and deer ticks may carry the bacteria that causes Lyme disease.

Another way disease-causing germs can infect you is through food and water. E. coli is a bacteria that can be in some foods, such as hamburger that is not cooked enough. It can also be in unwashed fruits or vegetables due to waste. When you eat foods that have E. coli, you could get an illness, often called food poisoning.

To keep from spreading germs, the CDC says you should:

1. Wash your hands often with soap and water for at least 20 seconds especially after you have been in a public place, blown your nose, coughed, or sneezed.
2. Avoid close contact with people who are sick**.** If possible, keep 6 feet of space between the person who is sick and yourself. If outside your home, keep 6 feet between you and others.
3. Everyone (older than 2) should wear a mask when around people who do not live in your house, especially when you can not stay 6 feet apart.
4. Always cover your mouth and nose with a tissue when you cough or sneeze or use the inside of your elbow and do not spit.
5. Clean and disinfect surfaces that are touched daily.

WHAT IS A PANDEMIC?

A **pandemic** is an occurrence in which a disease spreads very quickly and affects a large number of people over a wide area or through the world. A disease is not a pandemic only because it is widespread or kills many people. The disease must also be contagious.

According to the World Health Organization, a pandemic can start when three conditions have been met:

1. A new disease arrives.
2. The disease transfers from animals to humans and causes serious illness.
3. The disease spreads easily among humans.

One contagious disease that medical professionals are always concerned about is the flu virus. Flu viruses infect many species of animals including humans, swine, poultry, waterfowl, and many others. Sometimes these viruses combine or mutate and the fear is that the new flu virus can be more deadly and more easily transmissible to humans which could cause a pandemic.

We depend on animals for food, fiber, and many other products so it's important to protect them from becoming ill. Once an animal is sick, no one wants the disease to spread. That is where biosecurity comes into play. Biosecurity refers to management practices that reduce the chances contagious diseases will be carried onto a farm by animals or people.

The US Department of Agriculture (USDA) has safeguards in place to protect against the introduction of many diseases into the United States.

Livestock producers should use these five biosecurity precautions:

1. **Quarantine** all new animals for at least 30 days.
2. Properly vaccinate all animals.
3. Wash hands before and after dealing with livestock and wash boots and clothing after visiting another farm and after dealing with sick animals.
4. Contact proper authorities if an animal is sick or acting oddly or if a suspicious person has been around.
5. Limit all contact of animals with other animals (wild and domesticated) and with people from farms where proper hygiene is not practiced.

The USDA works closely with international organizations like the World Organization for Animal Health (OIE), the United Nations Food and Agriculture Organization (FAO), and World Health Organization (WHO) to assist avian flu-affected countries with disease prevention, management, and eradication activities. By helping these countries prepare for, manage, or eradicate avian flu outbreaks, the USDA helps control the spread of the virus.

Background sources: US Department of Agriculture; Oklahoma State Department of Health, Communicable Disease Division; Nemours Foundation Kidshealth; and Center for Disease Control and Prevention

Additional Reading

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Websites

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https://www.ok.gov/health/County_Health_Departments/Comanche_County_Health_Department/Services/Communicable_Disease/index.html

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Activity 1: Disease Spread, (Health, Math, Science) 1 50 minute class period

Students will participate in a simulation of how germs spread, analyze the data and express the results as a fraction of the whole

Oklahoma Academic Standards

Activity 1: Disease Spread Simulation (Health, Math, Science)

Health 7.5.3	Demonstrate a variety of behaviors that avoid or reduce health risks.
3.N.3.3	Recognize unit fractions and use them to compose and decompose fractions related to the same whole. Use the numerator to describe the number of parts and the denominator to describe the number of partitions
4.N.2.1	Represent and rename equivalent fractions using fraction models (e.g. parts of a set, area models, fraction strips, number lines).
5.N.2.2	Represent, read and write decimals using place value to describe decimal numbers including fractional numbers as small as thousandths and whole numbers as large as millions.
3.LS4.3	Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all.
4.LS.1.1	Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.
5.PS1.4	Conduct an investigation to determine whether the mixing of two or more substances results in new substances.

Materials:

- Measuring cups and spoons
- Red cabbage water. To make the cabbage solution: Cover 2 cups of finely chopped red (purple) cabbage with boiling distilled water and let stand in a glass or stainless steel container for 10 minutes or more to leach color from the cabbage. Or process cabbage with distilled water in a blender until it forms a pulp. Strain residue using a strainer or funnel lined with a coffee filter. Do not use tap water as it will affect the pH of the solution and the results of the activity. Can be prepared ahead of time and refrigerated in a sealed container for 2-3 days or frozen for several months.
- distilled water
- saturated baking soda solution - baking soda dissolved in water until no more can dissolve (about 1 Tablespoon of baking soda dissolved in 1 cup of distilled water) Allow solution to "settle" and pour off clear liquid for use in activity. Rinse solids down the drain with cool water.
- Citric Acid solution - ¼ cup citric acid crystals dissolved in 1 cup distilled water (this solution has the same pH as vinegar, but without the odor)
- numbered clear plastic 12-ounce cups
- Activity 1, Worksheet 1 "**Infection Rate"**

Procedures

1. Allow baking soda solution to stand until clear. Pour ½ cup of solution into a plastic cup and label the bottom to distinguish it from other cups. This will be the teacher's cup.

Procedures continued

2. Add ½ cup of citric acid solution to 2-3 of the cups. Record the numbers on these cups for use in the activity to follow. **These cups have been "vaccinated" and the *color change in these cups will represent the presence of antibodies.***
3. Set aside one cup each of the baking soda and citric acid samples to test at the end.
4. Add ½ cup distilled water to the remaining cups
5. Have each student pick up a cup. ***Instruct students to not drink from the cups.***
6. **Tell students an infected animal has entered the classroom, and one unknown person in the class will represent the infected animal.**
7. Students will predict if the infected animal will infect other animals and if so, at what rate.
8. Students will spend the next 5-10 minutes mingling and sharing water by pouring small amounts into each others' cups, being careful not to overfill the cups. Instruct students to share their cup with at least 5 other students.
9. The teacher will use the cup prepared ahead of time to participate in the mingling without letting students know of the baking soda addition.
10. After 5-10 minutes stop and ask these questions:
    a. Did you "drink" after each other?
    b. Did you walk in the contaminated "droppings" of another animal?
    c. Were you in the same area as other animals (students)?
    d. Do you think you shared any germs?
    e. What biosecurity measures could you put into force to better protect your herd or flock?
11. Put 1-2 medicine droppers full of cabbage water into each student's cup.
12. Students will observe what happens:
13. If the water turns blue or blue green, a germ (represented by the baking soda) was shared. The samples "vaccinated" with citric acid will turn purple or pink depending on the concentration of acid. Depending on the degree of "sharing", some samples may be murky. This indicates the presence of both the germ and the antibodies (from the vaccination)
14. Discuss the following:
    a. Was your hypothesis correct? Did the sick animal infect other animals? To what extent?
    b. Can germs be easily and unknowingly shared?
    c. How did the contamination occur?
15. Reveal to students that the teacher was the "host animal," and explain that cabbage water is an indicator and turns blue green when it comes into contact with a base (baking soda) and purple or pink when in contact with an acid.
16. Was there variation in the color change? Why do you think there was a difference?
17. Were there samples with minimal color change? Why do you think that might be?

After students complete the following worksheet, reveal the sample numbers which were "vaccinated" with citric acid prior to the activity. The acid neutralizes the baking soda, just as a vaccine helps the body form antibodies. Vaccinated samples should turn some shade of pink/purple, depending on their exposure to the infected sample.

Refer students to their previous list from the background and ask:
- "How does this activity simulate the transfer of germs?"
- "Which kind of transfer does this activity represent?"

Adapted from: *Infectious Disease Spread Activity,* Partnership for Environmental Education and Rural Health at College of Veterinary Medicine & Biomeducal Sciences, Texas A&M University

How Germs Spread

Activity 1 Worksheet 1: Infection Rate

Name: _____ Date: _____

Infection Rate

As cabbage juice is added to each cup, record the results in the chart below. Each cup has a number. Use the using the following letters in each blank:

If the liquid turns blue or blue-green, write the letter **B**
If the liquid turns pink or purple, write the letter **P**
If the liquid turns gray or brown, write the letter **G**
If there is no change, write the letter **N**

1.	2.	3.	4.	5.	6.	7.
8.	9.	10.	11.	12.	13.	14.
15.	16.	17.	18.	19.	20.	21.
22.	23.	24.	25.	26.	27.	28.
29.	30.	31.	32.	33.	34.	35.

Count the number of squares with each letter and write the total below:

B=_____ P=_____ G=_____ N=_____ Total Samples _____

Express your answers as fractions to show each part of the set of samples

$\frac{\textbf{B}}{\textbf{Total}}$ = _____ $\frac{\textbf{P}}{\textbf{Total}}$ = _____ $\frac{\textbf{G}}{\textbf{Total}}$ = _____ $\frac{\textbf{N}}{\textbf{Total}}$ = _____

Express each fraction as a decimal (B, P, G or N ÷ Total)

B ÷ Total= _____ **P** ÷ Total=_____

G ÷ Total= _____ **N** ÷ Total= _____

Activity 2: Bacteria, Fungus or Virus (Health, Math) 1 50 minute class period

Students will simulate exposure to multiple germs simultaneously. Students will chart frequency and number of exposures.

Oklahoma Academic Standards

Activity 2: Bacteria, Fungus or Virus, (Health, Math)

Health 7.5.3	Demonstrate behaviors that avoid or reduce health risks to self and others.
3.D.1.1	Summarize and construct a data set with multiple categories using a frequency table, line plot, pictograph, and/or bar graph with scaled intervals
4.D.1.1	Represent data on a frequency table or line plot marked with whole numbers and fractions using appropriate titles, labels, and units.

Materials:

- Hand sanitizer
- Clear disposable gloves
- Fine glitter (assign three colors to represent bacteria, fungi and virus)
- Reading page: Bacteria, Fungus or Virus
- Activity 2, Worksheet 1 **"Bacteria, Fungus or Virus"**

Procedures

1. To demonstrate how germs spread:
   — Teacher, "We are going to do an experiment to see how fast germs spread."
   - Select 2-3 students to be "sick" and squirt a good amount of hand sanitizer on their gloved hands and have them rub around (not rub it in)
   - Sprinkle with fine glitter (each student needs a different color to represent bacteria, fungi and virus). One color might be a cold, one salmonella and one ringworm.
2. Have all other students put gloves on.
3. Give "infected" students one minute to high five as many people in the group as they can.
4. To control group - all other students will stand still with hands up.
   —Once a student has been high fived, they can high five those beside them without moving.
5. After one minute, check to see if anyone is still "healthy" (no glitter).
6. If someone has managed not to high five and is still "healthy" then ask, "Is it really possible to avoid all germs without living in a bubble? Usually everyone will have multiple colors of germs on them.
7. Have students try to dust the glitter off, wipe it off - glitter won't usually come off and if it does, it is still on their clothes, so students can see the "germs" and how quickly they spread.

Procedures continued

8. Have students stand in a straight line. Ask students to step forward by the following groups:
    a. students with no germs
    b. students with bacteria
    c. students with fungus
    d. students with virus
    e. students with bacteria and fungus
    f. students with bacteria and virus
    g. students with fungus and virus
    h. students with bacteria, fungus and virus

9. Record the results on the board and have students record the number in each category on Worksheet 1, "**Bacteria, Fungus or Virus**" and then plot the numbers on the graph.
10. Have students dispose of gloves and wash hands if needed.
11. Ask students the following questions:
    - "How does this activity show us that germs will spread?"
    - "What can we do to keep germs from spreading?"

How Germs Spread

Activity 2 Worksheet 1: Bacteria, Fungus or Virus

Name: _____ Date: _____

Record the following information from the activity:

students with no germs _____
students with bacteria only _____
students with fungus only _____
students with virus only _____
students with bacteria and fungus _____
students with bacteria and virus _____
students with fungus and virus _____
students with bacteria, fungus and virus _____

Plot the data in the graph below:

Frequency									
	25								
	20								
	15								
	10								
	5								
		No germs	Bacteria	Fungus	Virus	Bacteria & Fungus	Bacteria & Virus	Fungus & Virus	Bacteria, Fungus & Virus
Variables									

List three situations where you might be exposed to multiple disease causing germs at the same time:

1.

2.

3.

Activity 3: What are Germs? (ELA) 1 50 minute class period

Students will read about germs including viruses, bacteria, and fungi. Students will create a summary chart which includes classification and will explain how germs can be helpful.

Oklahoma Academic Standards

Activity 3: What are Germs? (ELA)

3.2.R.1	Students will locate the main idea and key supporting details of a text or section of text.
4.2.R.4 5.2.R.3	Students will begin to paraphrase main ideas with supporting details in a text.
3.3.R.7 4.3.R.7	Students will ask and answer inferential questions using the text to support answers.

Materials:

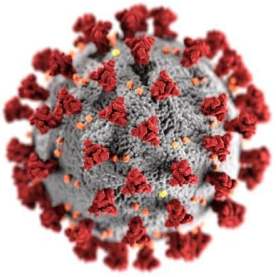
- Activity 3, Reading Page **"What are Germs?"**
- Activity 3, Worksheet 1 **"Comparing Germs"**

Procedures

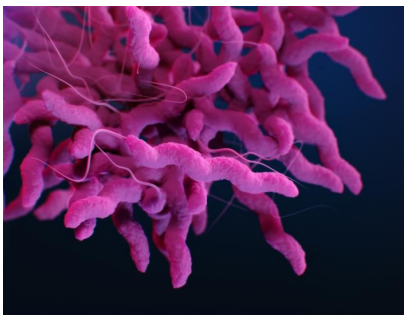
1. Discuss the following vocabulary with students before passing out the **"What are Germs?"**" reading page:
   —bacteria—any one of a group of very small living things that often cause disease
   —fungus—any of a group of spore-producing life forms including molds, yeast, mushrooms, and toadstools.
   —germ—a very small living thing that causes disease
   —microorganism—an extremely small living thing that can only be seen with a microscope
   —virus—an extremely small particle that causes a disease and that spreads from one person or animal to another
2. Students will read the reading page and use the information to complete Worksheet 1 **"Comparing Germs"**

What are Germs?

The word "**germ**" means any **microorganism** which can make you sick. Germs are very small. Germs can enter your body without you seeing them because they are so tiny. Most of the time, you will not know you have a germ in your body until you start to feel sick. Germs are all around us, even when they can not be seen. There are different kinds of germs: **viruses**, **bacteria**, and **fungi**.



Viruses are so small they can only be seen with a special, very strong microscope. Viruses can not live very long if they are not in a person, animal or plant. The person, animal, or plant is then called the host. Viruses are not able to make food, grow, or reproduce on their own. Instead they must take over their host. When the virus spreads then the person, animal, or plant can become sick. Flu and a common cold are both a virus. Viruses are not good. Wash your hands often to help keep viruses away.



Bacteria are larger than viruses. Bacteria can live anywhere. There are bacteria in the soil, at the bottom of the ocean, and even on your teeth. Most bacteria do not cause you to get sick. In fact, many bacteria are very helpful to us. Bacteria can live in our intestines and help us use the nutrients in the food we eat. There are also bacteria which decompose trash, clean up oil spills, and even make medicines. But bad bacteria can cause cavities, strep throat, and ear infections.

Fungi are made up of many cells and are plant like. However, fungi cannot make their own food. They have to get their food from what they are growing on. Fungi can be very helpful. They can make bread rise or decompose trash. Fungi can also be harmful if they steal nutrients from another living thing. Fungi love to live in damp, warm places- like between your toes. Fungi cause athlete's feet or ringworm.

How Germs Spread

Activity 3 Worksheet 1: Comparing Germs

Name: _____ Date: _____

Use the information from the "What are Germs?" reading page to complete this table.

Disease	**Classification** Is it a: virus, bacteria, or fungi?
Athlete's foot	
Common Cold	
Ringworm	
Ear Infection	
Flu	
Strep Throat	
Cavity	

Which germs can be good?

_____

_____

How can germs be helpful?

_____

_____

_____

How Germs Spread

Activity 3 Worksheet 1: Comparing Germs

Name: _____ Date: _____

Use the information from the "What are Germs?" reading page to complete this table.

Disease	**Classification** Is it a: virus, bacteria, or fungi?
Athlete's foot	fungi
Common Cold	virus
Ringworm	fungi
Ear Infection	bacteria
Flu	virus
Strep Throat	bacteria
Cavity	bacteria

Which germs can be good?

bacteria and fungi

How can germs be helpful?

Answers may vary, but could include: they help to decompose trash, they help clean oil spills, they help us digest food, they make bread rise.