

How Germs Spread

Objective

Students will conduct scientific experiments to learn how germs are spread.

Background

I. HOW GERMS SPREAD

The most common way for infectious disease to spread is through the direct transfer of bacteria, viruses or other germs from one person to another. This can occur when an individual with the bacterium or virus touches, coughs on or kisses someone who isn't infected. These germs can also spread through the exchange of body fluids from sexual contact or a blood transfusion.

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

Disease-causing organisms can also be passed along by indirect contact. Many germs can linger on an inanimate object, such as a tabletop, doorknob or faucet handle. When you touch the same doorknob grasped by someone ill with the flu or a cold, for example, 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 infected.

When you cough or sneeze, you expel droplets into the air around you. When you're sick with a cold or the flu—or any number of other illnesses—these droplets contain the germ that caused your illness. Crowded, indoor environments may promote the chances of droplet transmission.

Some disease-causing germs travel through the air in particles considerably smaller than droplets. These tiny particles remain suspended in the air for extended periods of time and can travel in air currents. If you breathe in an airborne virus, bacterium or other germ, you may become infected and show signs and symptoms of the disease. Tuberculosis and SARS are two infectious diseases usually spread through the air, in both particle and droplet forms.

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 bacterium that causes Lyme disease.

Another way disease-causing germs can infect you is through food and water. *Escherichia coli* (*E. coli*) is a bacterium present in certain foods, such as undercooked hamburger or unwashed fruits or vegetables. When you eat foods contaminated with *E. coli*, chances are you'll experience an illness, also referred to as food poisoning.

II. WHAT IS A PANDEMIC?

A pandemic is an epidemic (an outbreak of an infectious disease) that spreads across a large region (for example a continent), or even worldwide.

Oklahoma Academic Standards

GRADE 5

Physical Science: 1-4. Life Science: 2-1,2

Data & Probability: 1.1,2
Speaking and Listening: R.1,2,3; W.1,2. Research: R.1,2,3; W.1,2,4

GRADE 6

Life Science: 1-1,3; 2-2,4
Data & Probability: 1.1,2
Speaking and Listening: R.1,2,3; W.1,2. Research: R.1,2,3; W.1,2,4

GRADE 7

Physical Science: 1-2. Life Science: 4-4
Data & Probability: 1.1,2
Speaking and Listening: R.1,2,3; W.1,2. Research: R.1,2,3; W.1,2,4

Materials

phenolphthalein

bleach

water

clear plastic cups

500 ml beaker

25 ml graduated cylinder

hand sanitizer

fine glitter (various colors)

What is a Germ?

The term “germ” refers to any microorganism, especially those microorganisms that cause disease. Included in this category are certain viruses, bacteria, and fungi.

Viruses are simple organisms that are so tiny they can only be seen with a special, very powerful microscope called an “electron microscope.” They are so simple that they are technically not even considered alive, since they are not able to metabolize, grow, or reproduce on their own. Instead they must take over a host cell that provides these functions.

Bacteria are much larger in size and can live anywhere. There are bacteria in the soil, at the depths of the ocean, on the surfaces of teeth, and in the digestive tracts of humans and animals. Most bacteria are not pathogenic (disease-causing). In fact, many bacteria are very helpful to us. There are species that decompose trash, clean up oil spills, and even produce medicines.

Fungi are larger, plant-like organisms that lack chlorophyll (the substance that makes plants green and converts sunlight into energy). Since fungi do not have chlorophyll to make food, they have to absorb food from whatever they are growing on. Fungi can be very helpful—making bread rise, decomposing trash—but they can also be harmful if they steal nutrients from another living organism.

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

1. A disease new to the population emerges.
2. The agent infects humans, causing serious illness.
3. The agent spreads easily and sustainably among humans.

A disease or condition is not a pandemic merely because it is widespread or kills many people; it must also be infectious.

One infectious disease that has begun to worry medical professional is the H5N1 avian influenza virus, commonly known as avian flu. The avian flu virus is found in wild birds, especially among waterfowl (ducks, geese, gulls). It is highly contagious and can infect domesticated birds, such as chicken, ducks, and turkeys. There have been no cases of avian flu reported in wild or domesticated birds in the US. The US Fish & Wildlife Service has an ongoing surveillance program to test wild birds for H5N1 virus.

Human infection from bird flu is rare but can happen when contact is made with the cages, equipment, water, or feed. Approximately 160 people have contracted avian flu worldwide, but there have been no reported cases in the United States.

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 infectious 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 the avian flu and other diseases into the United States. All live birds imported into the US are quarantined and tested. Pet birds returning to the US from other countries (except Canada) also are tested and quarantined at a USDA facility.

Individual poultry producers in the US 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, Kids Health

Science

1. Read and discuss the first section of the background, “How Germs Spread.”
—As you read, students will list the way germs can spread.
2. Conduct the following experiment to demonstrate how germs spread.
—Prepare a mixture of 50 ml water and 50 ml bleach. Mark this cup on the bottom to distinguish it from the other cups, and set it aside. This will be the teacher’s cup. CAUTION: Great care should be taken when handling bleach. This is a strong base and can cause irritation.
—Give each student a clear plastic cup.
—Each student will fill his/her cup with 100 ml of water. Instruct students to not drink from the cups.
—Tell students an infected bird has entered the classroom, and one unknown person in the class will represent the infected bird.
—Students will hypothesize as to whether the infected bird will affect other birds and, if so, to what extent.
—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.
—The teacher will use the cup prepared ahead of time to participate in the mingling without letting students know of the bleach addition.
—After 5-10 minutes stop and ask these questions:
Did you drink after each other?
Did you walk in the contaminated “droppings” of another?
Were you in the same area as other birds (students)?
Do you think you shared any germs?
—Put 5ml (approximately one eye dropper full) of phenolphthalein into each student’s cup.
—Students will observe what happens: If the water turns pink, a germ (represented by the bleach) was shared.
—Discuss:
 - Was your hypothesis correct? Did the infected bird infect other birds? To what extent?
 - Can germs be easily and unknowingly shared?
 - How did the contamination occur?
—Reveal to students that the teacher was the “host bird,” and explain that phenolphthalein is an indicator for bleach and turns pink when it comes into contact with bleach.
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?”
3. 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 hands and have them rub around (not rub it in) then sprinkle with fine glitter (each student needs a different color). One color might be a cold, one the flu, one pink eye...

Vocabulary

bacteria—a group of single-celled microorganisms that live in soil, water, the bodies of plants and animals, or matter obtained from living things and are important because of their chemical effects and disease-causing abilities

biosecurity—management practices that reduce the chances infectious diseases will be carried onto a farm by animals or people.

contagious—capable of being transmitted by bodily contact with an infected person or object

fungus—any of a kingdom of living things (as molds, rusts, mildews, smuts, and mushrooms) that lack chlorophyll, are parasitic or live on dead or decaying organic matter, and were formerly considered plants

germ—a microscopic living thing, especially one that causes disease

pandemic—an outbreak of disease occurring over a wide area and affecting many individuals

pathogen—an agent that causes disease, especially a living microorganism such as a bacterium or fungus

population—a group of organisms of the same species populating a given area

quarantine—a strict isolation imposed to prevent the spread of disease

virus—any of various simple submicroscopic parasites of plants, animals, and bacteria that often cause disease and that consist essentially of a core of RNA or DNA surrounded by a protein coat. Unable to replicate without a host cell, viruses are typically not considered living organisms.

Ag Career: Microbiologist:

Microbiology is the study of living organisms that are invisible to the naked eye, such as bacteria and fungi. Though not living organisms, viruses also are studied by microbiologists.

Though many people tend to group them together, there are many different types of microbiology. Medical microbiology is perhaps the most well-known because it deals with the roles that microbes have in human illness. Other types include veterinary microbiology, environmental microbiology, food microbiology and pharmaceutical microbiology. All these deal with the way microbes or microorganisms affect animals, the environment, the food supply and the health care industry.

Most microbiologists work in one of the following fields: hospitals/clinical laboratories, the food industry, the environment, research laboratories and teaching at community colleges or universities. A career as a microbiologist usually requires an education beyond the high school level. Some microbiologists practice with two-year associate degrees in a scientific field such as chemistry or biology, but most have at least a four-year bachelor's degree from a college or university. Typically, these degrees are given in areas such as microbiology, chemistry or biology. Some microbiologists gain master's degrees, which require research and usually lead to teaching positions in universities or colleges, while others seek doctoral degrees. A doctoral degree, or Ph.D., serves to give a microbiologist a great amount of research experience and extensive schooling in the field of microbiology.

Source: Bioscience Careers— <http://www.aboutbioscience.org/careers/microbiologist>

- Give students one minute to high five as many people in the group as they can. To control group- everyone else has to stand still with hands up. Once they are high fived, they can high five those beside them without moving.
- After one minute, check to see if anyone is still “healthy” (no glitter). 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. Have students try to dust them off, wipe them off- glitter won't come off usually and if it does, it is still on their clothes, so students can see the "germs" and how quickly they spread.

Math

1. Evaluate the number of infections spread to other birds (from the previous activity).
 - Use tally marks on the chalkboard to record the number of cups with pink water.
 - Students will create a data table to compare the number of students who shared the germ with the number of students (if any) who were germ-free.
 - Students will find the measures of central tendency (mean, median, or mode) and range of the data set.
 - Students will explain and justify which measure of central tendency (mean, median, or mode) would provide the most descriptive information for the data.

English Language Arts

1. Read and discuss the second part of the background, “What is a Pandemic?”
 - Discuss how an infectious disease like the avian flu might spread.
 - How might birds spread disease? (Birds walking in droppings. Birds stung by a mosquito which then stings you.)
 - Discuss the differences between viruses, bacteria and fungi. (See the sidebar, “What is a Germ?” included with this lesson.)
 - Review “How Reliable Are Your Sources?” in the “Additional Resources” section of the OAITC website.
 - Students will use online or library references to research one of the common diseases listed below:

influenza	measles
common cold	whooping cough
strep throat	athlete's foot
parvovirus	distemper
hepatitis	Newcastle disease
Lyme disease	brucellosis
tuberculosis	salmonella
blastomycosis	aspergillosis
ringworm	

—Students will write reports based on their research. Research should determine if the diseases are viral, bacterial or fungal, if they infect humans, animals or both and which ones can be transferred from animals to humans, and vice versa.

—As a class, students will develop a disease comparison chart to record what they have learned.

Extra Reading

Goldsmith, Connie, *Invisible Invaders: Dangerous Infectious Diseases*, Lerner, 2006.

Hooper, Mary, *Petals in the Ashes*, Bloomsbury Children's, 2005.

Murphy, Jim, *An American Plague: the True and Terrifying Story of the Yellow Fever Epidemic of 1793*, Clarion, 2003.

Reed, Jennifer, *The AIDS Epidemic: Disaster & Survival (Deadly Disasters)*, Enslow, 2006.

Silverstein, Alvin, Virginia Silverstein, and Laura Silverstein Nunn, *Disease Update: The Flu and Pneumonia Update*, Enslow, 2006