

Bacteria and Viruses

This demonstration document provides background information on senses and is meant to act as a guide for your presentation. DO NOT use it as a script for your presentation.

How does this relate to Manitoba curriculum? This presentation complements the grade 5 “Maintaining Healthy Bodies” unit and provides useful context to the COVID-19 pandemic.

Have you ever wondered how teeny, tiny things can make us sick? Or, how they spread? In this presentation, we'll answer these questions and learn about bacteria and viruses.

Bacteria and Viruses

In the first part of this presentation, we'll talk about what viruses and bacteria are. We will explore the different characteristics of each.

Today, we are here to talk about germs – A.K.A “bugs”. Do you know what a germ is? *Let students answer.*

Summary: Germs or bugs are tiny living things.



How big are they?

Are they this big? *Motion a large circle with your arm.*

Are they this big? *Form hands together into a circle.*

Are they this big? *Touch fingertip to the thumb in a circle.*

Are they this big? *Finger and thumb very close together.*

Can you see them? Can you see them in the air? Can you see them on your desk? Can you see them on your hands?

Summary: Germs are so small that you can't see them.

Bacteria vs. Viruses

There are different kinds of germs (or bugs). The two major types of germs are bacteria and viruses. Explain different components of each.



Figure: (a) Components of virus, (b) components of bacteria

What is the difference between viruses and bacteria?

Advanced explanation (paraphrase):

Bacteria are single-celled "living" microorganisms that reproduce by dividing. Most bacteria can grow on non-living surfaces, such as countertops and doorknobs. Not all bacteria are harmful. Some bacteria are even beneficial to your health. In fact, ninety-nine percent of all known bacteria are considered beneficial to humans. We get a healthy dose of bacteria from our Mom during childbirth and these microbes colonise our intestines, spending their days happily breaking down organic matter and destroying harmful parasites. But when infectious bacteria enter your body, they can make you sick. Bacteria can make toxins that damage the cells they've invaded. Some bacterial infections are contagious. Others are not.

Viruses are not "living" organisms but capsules of genetic material. They require living hosts - such as people, plants or animals - to multiply. Otherwise, they can't survive. When a virus enters your body, it invades some of your cells and takes over the cell machinery, redirecting it to produce the virus.

Simplified Explanation:

Bacteria are small, one-celled organisms that get food from the environment in order to live. Bacteria come in all sorts of different shapes and sizes. Some bacteria grow on nonliving surfaces (such as your desk or door-knobs) and some grow on the human body. Good bacteria live in our intestines and help us break down what we eat, but bad bacteria can cause infections and make us sick.

Viruses are small, “non-living” agents that get their nutrients from the cells of living things like plants, animals, or people to survive and multiply. Whatever a virus lives in is called its **host**. When viruses get inside a host, they can spread and make the host sick.



What are some common illnesses caused by bacteria and viruses? *Ask the students if they know any illnesses that are caused by bacteria or viruses. Alternatively, ask if some of the following illnesses are caused by bacteria or viruses.*

Bacterial	Viral
• Strep throat • Tuberculosis • Whooping cough • Lyme disease • Botulism • Food poisoning • Gangrene • Urinary tract infections • Diarrhoea • Pneumonia • Bronchitis • Gonorrhoea • Syphilis	• Influenza (common cold) • HIV • Hepatitis A/B/C • Polio • Herpes • Yellow fever • West Nile virus • Measles • Mumps • Rabies • Ebola* • Zika* • *more info given at end of write-up

Antibiotics, Antivirals, and Vaccines

In this part, we will cover treatment and prevention of bacteria and viral infection through use of antibiotics, antivirals, and vaccines. We will also discuss the problems of medication using the example of antibacterial resistance.

What do you use to kill a virus or bacteria?

- An **antibiotic** is a substance or compound that kills or stops the growth of bacteria, such as penicillin.

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- An **antiviral** substance or compound is used to kill viruses or stop them from reproducing (many antivirals have names that are very difficult to pronounce, such as lamivudine, which is used to treat hepatitis B and HIV infections.)

Q: So, penicillin is an antibiotic. Colds are caused by viruses. If you take penicillin, will it cure your cold? A: No, penicillin only works to kill bacteria. It does not work on viruses.

Vaccines

Since we talked about treatments for viruses and bacteria, there must be a way to prevent them. **Vaccines** help to prevent viral and bacterial infection. When a doctor gives a vaccine through methods like a needle or spray, they insert a weaker version of the pathogen into your body. This way, your immune system will be able to defend against this weakened or dead virus and memory cells will remember this virus for the next encounter.

Protecting Against Germs

Where can we find germs? Are they in dirt? Are they in your desk? Are they in air? Are they on your skin? Are they in your mouth and nose?

Summary: Germs are everywhere!

Ask students to rank the following items from most contaminated to least contaminated:

Bus rails, playgrounds, pens (shared), public phones, cell phones, toilet seats, vending machines.

Answer:

	Contamination (%)
Cell Phone	96
Playground	44
Toilet seats	42

Bus rails	35
Pens (shared)	16
Vending Machines	14
Public phones*	13

*home phones more contaminated.

How do germs spread?

Germs can spread by touch, by respiratory droplets (breathing, sneezing, or coughing on others), and by contact with contaminated surfaces (like we just investigated). Let's take a look at how a cold can spread with our next activity!

Activity 1: Simulation of a Cold Virus Spreading

In this activity, we'll see how a cold can be spread among a group of people.

Materials:

1. Litmus paper pH indicator
2. 25 plastic cups, numbered
3. Tap water (approximately 1 bottle, supply your own)
4. Vinegar

Instructions:

1. Hand out one plastic cup per student. If there are less than 30 students, do not hand out the higher numbered cups (for example: if there are 20 students only hand out cups numbered 1 – 20).
2. Fill every cup with an inch of water, but fill cup #6 with 2/3 inch of vinegar and 1/3 inch of water. Remember who you gave #6 to but don't let the student know about the vinegar.

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3. Demonstrate the pouring method ($\frac{1}{2}$ of their cup into another cup x2) then pour $\frac{1}{2}$ back.
 4. Have the students wander around the classroom with their cup of water, and every 10 seconds call out a number. The student with that number must find any 2 other students and pour $\frac{1}{2}$ of their cup into each of the two others. The 2 chosen students must then pour half of their cup back into the first student's cup.
 5. Continue until all the numbers have been called. You can speed this up easily by calling out more than one number at a time.
 6. Use some pH paper and test each cup's pH. A pink colour indicates the solution in the cup is acidic (contains vinegar), while a purple/blue colour indicates the solution is neutral. How many people now have acidic solutions? All these people were 'infected' from the single person who initially had the vinegar in their cup.
 7. Take a vote to see how many people have a cold.

Discussion

Some illnesses like colds and the flu can also be spread from person to person by contact. Colds are caused by viruses, tiny particles that invade your body and replicate. There are lots of viral particles in the nasal secretions of someone with a cold, and often on their hands and things they have touched. If you touch anything with those viral particles on it, and then touch your eyes or nose, you can also be infected. Viral particles can also be transferred to you if you are coughed or sneezed on. In this experiment, the vinegar represents a cold. If the vinegar was a cold and each 'exchange' was a sharing toy, how many of you would be sick?

But, if germs are everywhere, why don't we get sick all the time?

Our body has a system to fight germs. It is called our **immune system**. For example, our skin keeps germs out of our body. There are even good bugs on our skin. These good bugs help fight off the bad bugs. Overall, our immune system is pretty good at its job!

How else can you protect yourself from bad bugs?

In the COVID-19 pandemic, we use 3 main ways to protect ourselves and others from pathogens. These are:

1. Cleansing our hands
2. Social distancing
3. Wearing a face mask

We cleanse our hands to remove harmful pathogens from our hands. This includes washing with soap and water and using hand sanitizer. Using soap and water is more effective, but using sanitizer is convenient when there is no washroom available.

Social distancing is when we stay at least 2 metres apart. This is because respiratory droplets have a low chance of causing infection from this distance. 2 metres can be hard to measure sometimes. But, we can compare it to everyday things! 2 metres is the same as 2 adult golden retrievers. The length of the average door or bed is over 2 metres away.

Lastly, we have masking. Even though we no longer have to wear facemasks in most places, it's still important to know when and why we mask. Masks are mainly used to prevent sick or asymptomatic people from spreading illness. It is also important to still wear a mask if you are healthy since it takes 5-6 days for COVID to present after you've been infected. So, even if you don't know you have COVID, it can still spread. Masking helps stop the spread! *Explain the importance of masking properly (for example, not touching the front of the mask) and list some locations where masking is still in place.*

Activity 2: How effective is social distancing and masking?

Let's look at some agar petri dishes to determine the effectiveness of social distancing and masks.

In the first image, we are presented with 4 different scenarios: sneezing, singing, talking and coughing respectively. The agar plates are used to culture (grow) various bacteria that form when we cough, sneeze, talk, and sing. The more of the grayish residue that forms on the top, the more bacteria has gone on the agar plate. *Go through each agar plate and ask the students which of the cases the plate belongs to. Reveal the correct answers.*

Let's add 4 more agar plates with the same conditions. In this set of plates, the test subject is masked. *Ask what the students notice.* It is clear that the mask is effective at preventing the spread of germs from you to others.

Activity 3: Hand Washing Experiment

Materials:

1. Glitter
2. Baby oil
3. Paper towel, soap, water (supplied from classroom)

Instructions:

1. Bring half of the students to the front of the classroom.
2. Inform all the students that we are going to spread some "pretend germs" on their hands. Apply a small (pea sized) drop of the baby oil on half of the students' hands. Sprinkle a small amount of glitter on their hands. Glitter represents germs. Have them rub their hands together as efficiently as possible.
3. Bring the other half of students to the front and have them rub their hands with one of the other students who has glitter oil on their hands. Examine how much has transferred.
4. Ask the students to wash their hands without soap.

Tip: You may want to have only half of the class go at once to prevent congestion. If the class has access to a sink, all students may go at once.

5. When the students return, examine their hands. Repeat using soap as needed until all "germs" are gone.

Discussion

- Is there a difference between the students who received the cream versus the students who just rubbed their hands with each other?

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- Just because you can't see the germs doesn't mean they aren't there. It is important to wash well, especially around the nails and between the fingers to get all the germs off.