ipdae INSTITUTE FOR THE PROFESSIONAL DEVELOPMENT OF ADULT EDUCATORS

GED® Preparation Lesson Plan

Module: Science

Lesson Title: Superbugs Are Here!

Standards: GED® Preparation (Adult General Education)

Florida GED® Science Standards	Science Practices

• Describe systems and functions of the human body systems and how to keep healthy. (L.1)
  ○ Transmission of disease and pathogens (e.g., airborne, blood born), and the effects of disease or pathogens on populations (e.g., demographics change, extinction), and disease prevention methods (e.g., vaccination, sanitation). (L.1.d.)
	• Comprehending Scientific Presentations (SP.1)
	  ○ Understand and explain textual scientific presentations (SP.1.a)
	• Reasoning from Data (SP.3)
	  ○ Reason from data or evidence to a conclusion (SP.3.b)
	• Evaluating Conclusions with Evidence (SP.4)
	  ○ Evaluate whether a conclusion or theory is supported or challenged by particular data or evidence. (SP.4.a.)

Objectives of the Lesson

Students will:

- Identify the similarities and differences between bacteria and viruses
- Define antibiotic resistance and discuss the increases in superbugs in today's world
- Provide examples of the interaction between Earth's systems and infectious diseases
- Understand chemical properties and reactions related to bacterial and viral infections and antibiotics

Materials

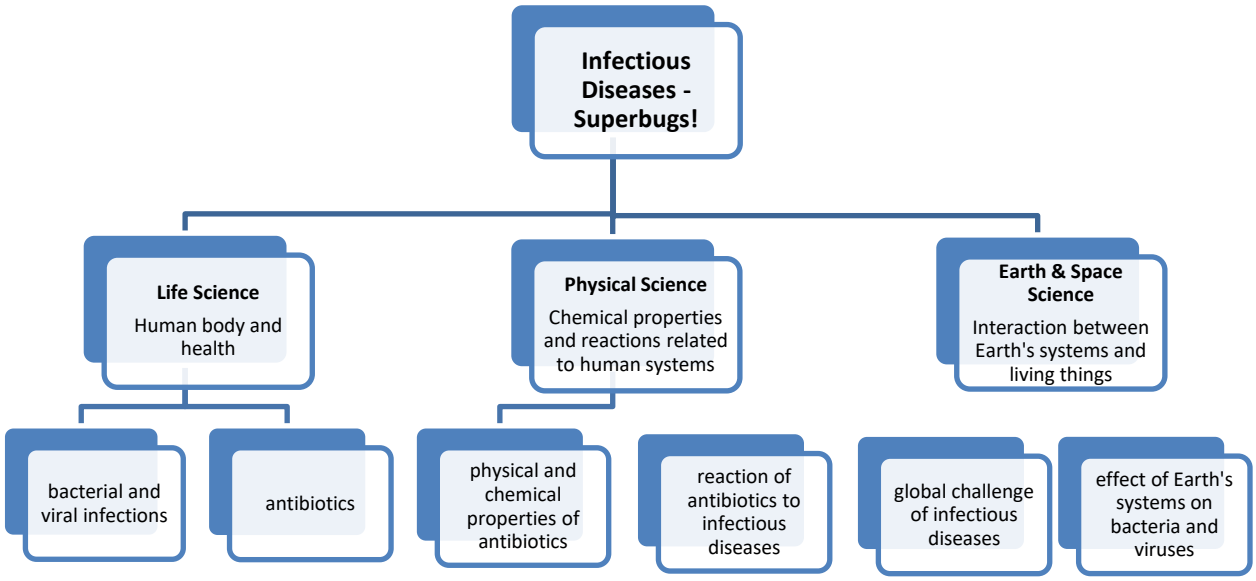
- Handout A: Bacteria and Virus – Let's Compare! (Template and Sample Answer Key)
- Handout B: Differences Between Bacteria and Viruses
- Handout C: A Biography of Alexander Fleming
- Handout D: Diseases Throughout the World
- Handout E: Let's Find Out!
- Handout F: Feeling Sick? Virus vs. Bacteria
- Chart paper/board and markers
- Computer with internet access and projector

Instructional Plan

Overview

In this unit lesson, students will have the opportunity to gain a better understanding of superbugs and how antibiotic resistance can impact their lives. This lesson plan follows the 5 Es lesson plan format. The topic, superbugs, serves as the starting point that revolves around the focusing theme of Human Health and Living Systems. The following chart shows the various areas of life, physical, and earth and space science that are covered by this thematic lesson.

Note: Throughout the lesson, optional resources are provided for use in the classroom when videos are not available.



Process

Engagement

Set the stage for the lesson by asking students the following questions to determine their knowledge of antibiotics. You may wish to record their answers and refer to them throughout the lesson.

- Have you ever taken an antibiotic?
- How and when should antibiotics be used?
- Who was Alexander Fleming?
- What are bacteria?
- Have you ever heard about super-bugs? What have you heard?

Share with students the following facts:

- In the USA, over 2 million people each year become infected with bacteria that are resistant to antibiotics.
- Last year, over 23,000 people died as a direct result of antibiotic-resistant infections.

- By 2050, it is projected that antibiotic resistant infections will cause more deaths annually than cancer – over 10 million people worldwide or one person every three seconds. This results in more deaths annually than cancer.
- Last year, over 23,000 people died as a direct result of antibiotic-resistant infections.
- In 2017, a Nevada woman died from an infection resistant to all available antibiotics (26 different types of antibiotics) in the United States.

Statistics are from the Center for Disease Control

Discuss that with the massive increase of antibiotic-resistant infections worldwide, the topic of infectious diseases is important to everyone's daily life. Show students the following video on superbugs. Prior to the video, review what students stated they knew about superbugs.

- The Battle Against Superbugs: What You Need to Know – Time, Inc. https://www.youtube.com/watch?v=_Qa7sSnG6yI

If you do not have access to this video, you may wish to use a news video, current article, or real-world example of superbugs and antibiotic resistance. Sample materials to use, include:

- Drug-Resistant Superbugs Are 'Fundamental Threat' To Humans, WHO Says – NBC News https://www.youtube.com/watch?v=_YKDyf9p23Y
- NIH News in Health – Stop the Spread of Superbugs (article available in English and Spanish) https://newsinhealth.nih.gov/2014/02/stop-spread-superbugs
- Science News for Students – Scientists watch germs evolve into superbugs https://www.sciencenewsforstudents.org/article/scientists-watch-germs-evolve-superbugs

Explore

Understanding different types of infectious diseases is important to better understanding superbugs and possible treatments. Often times, students think that antibiotics are the "cure" for everything. Ask students if they have ever taken an antibiotic and if so, what type of infectious disease did it treat? Was it a bacterial or viral infectious disease?

Have students use their exploring skills by researching the similarities and differences between bacteria and viruses and share their findings with the class.

For this activity provide students with a blank Venn Diagram (Handout A). Show the video:

- Bacteria and Viruses – http://ed.ted.com/on/q41jt6vp#finally

Have students complete the Venn Diagram and share their ideas with the class. From the information that they have gathered, have students summarize their research by answering the following questions:

- What are bacteria?
- What are viruses? Is there a difference?
- What can we do to fight bacteria?
- How come sometimes medicine we take for infections don't work?
- What is a superbug?

If you do not have access to videos, you may wish to provide students with **Handout B: Differences Between Bacteria and Viruses**. Have students use the information from the article to complete their Venn Diagram.

Note: Handout A also has a sample answer key with possible answers based on a review of different types of media/texts.

Explain

As you begin your class discussion on how antibiotics apply to real-world situations and are supported by evidence, you may wish to start with a short biography on Alexander Fleming. When Alexander Fleming discovered penicillin in 1927, antibiotics were seen as a wonder drug. But as early as 1947 – just four years after the use of penicillin became common – bacteria began to develop a resistance to antibiotics.

Have students read **Handout C: A Biography of Alexander Fleming**. Debrief the reading by asking students to discuss the following questions:

- What was Fleming's major contribution to science?
- Approximately how many years ago was penicillin discovered?
- How do you think Fleming's discovery of penicillin changed how bacterial infections are treated?

Explain the basic concepts of antibiotic resistant infections. Reinforce that antibiotics only work against infections caused by bacteria, fungi, and certain parasites. Antibiotics do not work against the many infections caused by viruses. Viruses cause colds, the flu, and most coughs and sore throats.

It is important that students are able to integrate reading and writing. Using informational text and having students answer a few basic questions assists them in better comprehending science texts.

Have students explain basic concepts of antibiotics and bacterial and viral infections as part of today's world. Provide students with non-fiction texts in order to build knowledge, as well as discussions and hands-on activities.

Sample questions may include:

- What is one example of a superbug?
- Why is there a war on superbugs?
- What is drug resistance? How does it occur?
- Why are superbugs a silent health emergency?

Sample Resources

- Superbugs: A silent health emergency (Part 1)
  https://www.sciencenewsforstudents.org/article/superbugs-silent-health-emergency

- The War on Superbugs, Part 2
  https://www.sciencenewsforstudents.org/article/war-superbugs
- Agents of Disease (This site has numerous different types of articles and activities for use in the classroom)
  http://infectiousdiseases.edc.org/content/module/1/reading/2

Extend
In this section of the unit lesson, show students how the topic of infectious diseases crosses the different areas of science – from life science to physical science to earth and space science.

Earth Science
Provide students with **Handout D: Diseases Throughout the World**. Because there are many different ways that infectious diseases travel throughout the world, have students extend their knowledge by identifying a bacterial or viral infection and documenting their answers in the chart.

For this activity, you may wish to show the following video and have students select their infectious disease from those covered:

- Changing Planet – Provides an overview of how different types of infectious diseases are spread throughout the world.
  https://science360.gov/obj/video/e84ca228-9df7-4d4e-bfe2-ad4da9965a26/changing-planet-infectious-diseases

Instead of a video, you may wish to have students access their information from one of the following websites in order to extend their learning in the area of disease and earth science.

- RX for Survival
  http://www.pbs.org/wgbh/rxforsurvival/index.html
  http://www.pbs.org/wgbh/rxforsurvival/series/teachers/index.html
- Windows to the Universe - Changing Planet: Infectious Diseases
  http://www.windows2universe.org/earth/changing_planet/infectious_disease.html

Physical Science (Chemistry)
Discuss that the world of chemistry is also a part of infectious diseases as scientists learn more about the chemical and physical properties of viruses vs. bacteria and the reaction of antibiotics in today's changing world. Access photos of different types of viruses and bacteria and discuss how antibiotics are or are not effective and why.

Debrief by having students share the importance that infectious diseases and antibiotics have on their daily lives.

Evaluate

There are many ways to evaluate what students have learned throughout the lesson. You may wish to include both text-dependent types of questions and questions that require students to determine what they personally can do to reduce antibiotic resistance in their lives.

Provide students with questions to evaluate their learning, such as:

- What are the differences between viruses and bacteria?
- Are all bacteria harmful? Explain.
- How does the overuse of antibiotics lead to resistant strains of bacteria?
- When you get a cold, should you take an antibiotic to help you get better? Why?
- What can you do in your life to reduce antibiotic resistance?

Another assessment tool is to have students complete a short research project in order to evaluate their learning. Have your students research five solutions to antibiotic resistance. These can be ways to avoid developing and spreading resistance or possible alternatives to antibiotics. Have students cite their sources for each piece of information found. Make sure that they use reputable sources based on scientific facts. **Handout E: Let's Find Out** provides a template for students to use.

The following is one example:

Example: Overuse of antibiotics increases the chance of bacteria developing antibiotic resistance.

Source: http://emerald.tufts.edu/med/apua/about_issue/about_antibioticres.shtml#2

Notice that this activity does not require that your students write a long essay, but rather that they answer the question and provide reputable sources. After students have completed their research, have them share their solutions with the class. Debrief by discussing why or why not their solutions are viable for the future.

Modifications for Different Levels

To modify instruction for lower level readers, use charts, such as the one from the Minnesota Antibiotic Resistance Collaborative, to summarize the basic ideas of bacteria vs. viruses. This chart is located as **Handout F: Feeling Sick? Virus vs. Bacteria**.

The topic of antibiotic resistance and superbugs is one that is of interest to all students. Therefore, the information can be shared within a class. Differentiate product by orally discussing questions and answers or modifying readings or discussing the information from the readings as a class.

Assessments/Extensions

As with all science, it is important to provide students with the opportunity to explore a scientific concept. Hands-on activities assist students in applying what they have learned about the transmission of an infectious disease.

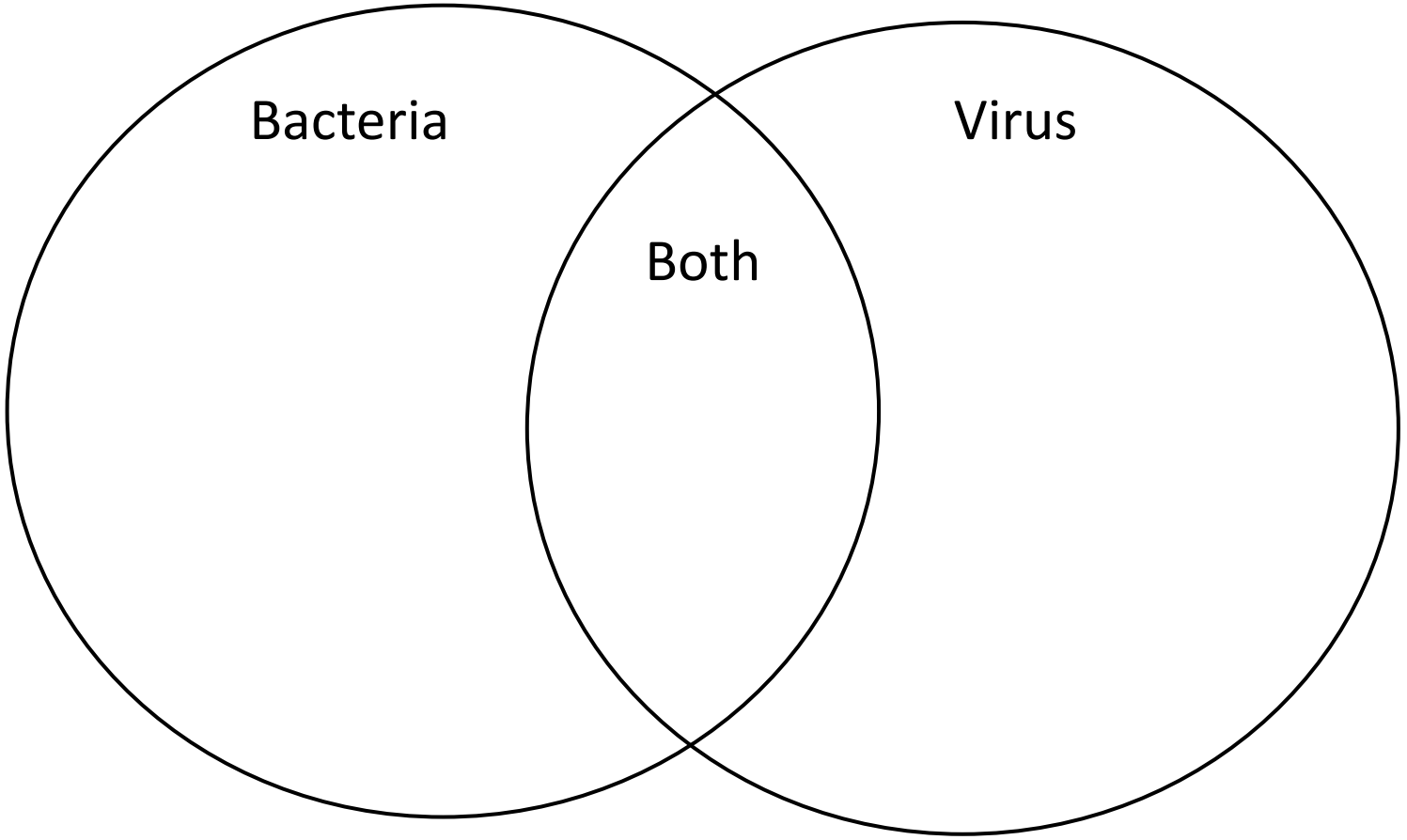
Have students access the Internet and actively engage with fighting infectious diseases by accessing the following websites:

- Antibiotic Attack – http://sciencenetlinks.com/interactives/antibiotic.html
- Nova Disease Detective - http://www.pbs.org/wgbh/nova/body/disease-detective.html
- Superbugs: How long can you hold out against the Superbugs? (a downloadable game) - https://longitudeprize.org/superbugs

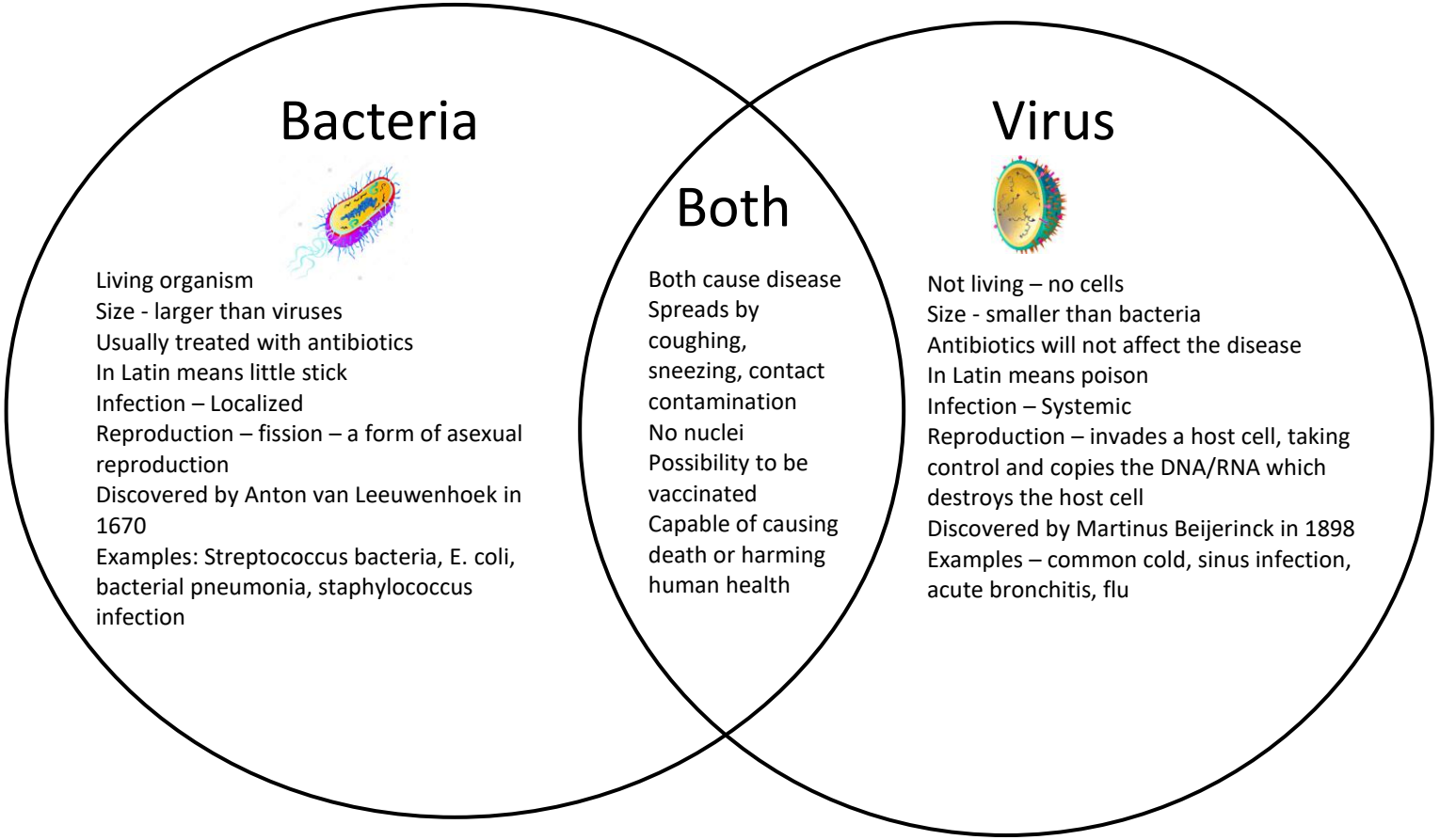
Debrief the activity by having students share what they learned.

Handout A

Bacteria and Virus – Let's Compare!

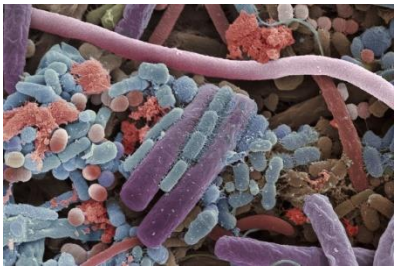


Sample Answer Key for Bacteria and Virus – Let's Compare! (Answers may vary dependent on the source text(s) or videos)



Differences Between Bacteria and Viruses

Handout B



This colored scanning electron micrograph (SEM) shows bacteria on the surface of a human tongue. The mouth contains a large number of bacteria, most of which are harmless or even beneficial. Credit: Steve Gschmeissner/Getty Images

Bailey, Regina. "Differences Between Bacteria and Viruses." ThoughtCo, Aug. 18, 2016, thoughtco.com/differences-between-bacteria-and-viruses-4070311. (Updated March 08, 2017)

Bacteria and viruses are both microscopic organisms that can cause disease in humans. While these microbes may have some characteristics in common, they are also very different. Bacteria are typically much larger than viruses and can be viewed under a light microscope. Viruses are about 1,000 times smaller than bacteria and are visible under an electron microscope. Bacteria are single-celled organisms that reproduce asexually independently of other organisms.
Viruses require the aid of a living cell in order to reproduce.

Where Are They Found?
Bacteria: Bacteria live almost anywhere including within other organisms, on other organisms, and on inorganic surfaces. Some bacteria are considered to be extremophiles and can survive in extremely harsh environments such as hydrothermal vents and in the stomachs of animals and humans.

Viruses: Much like bacteria, viruses can be found in almost any environment. They can infect animals and plants, as well as bacteria and archaeans. Viruses that infect extremophiles such as archaeans have genetic adaptations that enable them to survive harsh environmental conditions (hydrothermal vents, sulpuric waters, etc.). Viruses can persist on surfaces and on objects we use every day for varying lengths of time (from seconds to years) depending on the type of virus.

What Is Their Structure?
Bacteria: Bacteria are cells that display all of the characteristics of living organisms.
Bacterial cells contain organelles and DNA that are immersed within the cytoplasm and surrounded by a cell wall. These organelles perform vital functions that enable bacteria to obtain energy from the environment and to reproduce.

Viruses: Viruses are not considered cells but exist as particles of nucleic acid (DNA or RNA) encased within a protein shell. Also known as virions, virus particles exist somewhere between living and non-living organisms. Viruses rely solely on a host for replication.

What Is Their Size and Shape?
Bacteria: Bacteria can be found in a variety of shapes and sizes. Bacteria typically range in size from 200-1000 nanometers (a nanomerter is 1 billionth of a meter) in diameter. The largest bacterial cells are visible with the naked eye.

Viruses: Viruses are much smaller than bacteria. They generally range in size from 20-400 nanometers in diameter. Viruses also have many different shapes, many of them very complex.

How Do They Reproduce?

Bacteria: Bacteria commonly reproduce asexually. In this process, a single cell replicates and divides into two identical daughter cells. Under proper conditions, bacteria can experience exponential growth.

Viruses: Unlike bacteria, viruses can only replicate with the aid of a host cell. The virus injects its genetic material into a cell. Once the newly formed viruses mature, they break open the cell and move on to infect other cells.

What Are Some Diseases Caused by Bacteria and Viruses

Bacteria: While most bacteria are harmless and some are even beneficial to humans, other bacteria are capable of causing disease. They can cause food poisoning and other serious illnesses, including meningitis, pneumonia, and tuberculosis. Bacterial infections can be treated with antibiotics, which are very effective at killing bacteria. Due to the overuse of antibiotics however, some bacteria (E.coli and MRSA) have gained resistance to them. Some have even become known as superbugs as they have gained resistance to multiple antibiotics. Vaccines are also useful in preventing the spread of bacterial diseases. The best way to protect yourself from bacteria and other germs is to properly wash and dry your hands often.

Viruses: Viruses cause a range of diseases including chickenpox, the flu, rabies, Ebola virus disease, Zika disease, and HIV/AIDS. Viruses can cause persistent infections in which they go dormant and can be reactivated at a later time. Antibiotics do not work against viruses. Treatment for viral infections typically involves medicines that treat the symptoms of an infection and not the virus itself. Typically the immune system is relied upon to fight off the viruses.

A Biography of Sir Alexander Fleming

Handout C

Fleming was a Scottish bacteriologist and Nobel Prize winner, best known for his discovery of penicillin

Alexander Fleming was born in Ayrshire on 6 August 1881, the son of a farmer. He moved to London at the age of 13 and later trained as a doctor. He qualified with distinction in 1906 and began research at St Mary's Hospital Medical School at the University of London under Sir Almroth Wright, a pioneer in vaccine therapy. In World War One Fleming served in the Army Medical Corps and was mentioned in dispatches. After the war, he returned to St Mary's.

Early in his medical life, Fleming became interested in the natural bacterial action of the blood and in antiseptics. In 1928, while studying influenza, Fleming noticed that mold had developed accidentally on a set of culture dishes being used to grow the staphylococci germ. The mold had created a bacteria-free circle around itself. Fleming experimented further and named the active substance penicillin. It was two other scientists however, Australian Howard Florey and Ernst Chain, a refugee from Nazi Germany, who developed penicillin further so that it could be produced as a drug. At first supplies of penicillin were very limited, but by the 1940s it was being mass-produced by the American drugs industry.

Fleming wrote numerous papers on bacteriology, immunology, and chemotherapy. He was elected professor of the medical school in 1928 and emeritus professor of bacteriology at the University of London in 1948. He was elected fellow of the Royal Society in 1943 and knighted in 1944. In 1945 Fleming, Florey, and Chain shared the Nobel Prize in Medicine. Fleming died on March 11, 1955.

British Broadcasting Network
http://www.bbc.co.uk/history/historic_figures/fleming_alexander.shtml

Diseases Throughout the World

Handout D

Diseases are everywhere! Just listen to the news. Identify a bacterial or viral infection and find the answers to each of the following questions. Document your answers in the chart. Be prepared to share your findings with the class.

Disease	How is it spread?	Where is it found?	What are the symptoms?	How is it prevented?

Let's Find Out!

Handout E

Research five solutions to antibiotic resistance. These can be ways to avoid developing and spreading resistance or possible alternatives to antibiotics. Site your sources for each piece of information that you find. Make sure to use reputable sources based on scientific facts.

Example: Overuse of antibiotics increases the chance of bacteria developing antibiotic resistance.
Source: http://emerald.tufts.edu/med/apua/about_issue/about_antibioticres.shtml#2

Solutions to Antibiotic Resistance	My Sources
1.	
2.	
3.	
4.	
5.	

Feeling Sick? Virus vs. Bacteria **Handout F**

Feeling Sick?

Do you ever wonder what is causing your illness?

It could be a virus or a bacteria... and the differences are important.

Virus vs. Bacteria

Virus	Bacteria
Viruses are particles that invade your body's cells. Viruses contain genetic material (DNA or RNA) and a protein coat. Viruses take many shapes and are much smaller than bacteria.	**Bacteria** are one-celled organisms that take several shapes - spheres, rods, spirals. They are found everywhere - in food, dirt, and on our bodies. Bacteria can live outside our body's cells. Most bacteria are good -such as those that help with digestion, but some can cause infections.
Viruses cause diseases such as the common cold, many sinus infections, acute bronchitis and most sore throats. The body fights against viral infections by producing a fever or inflammation.	**Bacteria** cause infections such as strep throat by invading the body's cells. The body fights against bacteria by producing a fever or inflammation. Symptoms of bacterial infections are similar to those caused by viral infections.
Antibiotics cannot kill viruses. Antibiotics will not help a viral infection or stop the spread of a viral infection to others. Taking antibiotics for viral infections can increase the chance of an antibiotic-resistant infection later. · Rest, drink fluids · Relieve symptoms with over the counter medications · Call your doctor if your symptoms worsen	**Bacterial** infections usually need to be treated with an antibiotic - medications that kill bacteria. If you are prescibed an antibiotic, follow instructions closely: · take all the medication as directed even if you feel better · do not share antibiotics or save them for the next time you are sick

When antibiotics are misused, bacteria can develop resistance to the antibiotics over time.
Antibiotic resistance affects everyone. YOU can help keep antibiotics working!

www.MinnesotaARC.org