

GRADE LEVEL: 6-8 | TIME REQUIREMENT: 4 HOURS

LIFE SCIENCE: BODY SYSTEMS

2 READINGS | 2 ACTIVITIES

INTRODUCTION

It can be challenging finding ways to teach the function of cells and body systems using a question- or phenomenon-driven approach. The resources in this section provide ways to teach about different cell types and body systems by starting with a story about WWII innovation.

There was a major effort in World War I to fight infections in the military of both sides and to stop the spread of disease. However, the basic science of medicine was not developed enough to make much headway. After World War I and the 1918 Flu Pandemic, scientists learned a great deal about the identity of the microbes and viruses that cause disease. They also learned much more about blood and how to treat trauma with blood products. Armed with more knowledge about human bodies, diseases, and bacteria, there were more possibilities to **apply** that knowledge and find treatments in World War II.

OBJECTIVE

These resources can be used individually or in tandem. Fungus Among Us and Antibiotic Targets can be used together to introduce or review cells, their organelles, and their specializations. Plasma for Trauma and Blood in a Bag can be used to introduce or review organs and organ systems. Together these resources provide experiences to understand body systems, and the research and problem solving of biologists studying body systems.

STANDARDS

NGSS DCI LS1.A
Structure and Function

NGSS DCI ETS1
Engineering Design

NGSS DCI ETS2

Links Among Engineering, Technology, Science, and Society

NGSS SEP

Developing and Using Models

NGSS SEP

Constructing Explanations and Designing Solutions

NGSS CCC

Cause and Effect

NGSS CCC

Systems and System Models

PERFORMANCE EXPECTATIONS

MS-LS1-1

Conduct an investigation to provide evidence that living things are made of cells, either one cell or many different numbers and types of cells.

MS-LS1-2

Develop and use a model to describe the function of a cell as a whole and ways the parts of cells contribute to the function.

MS-LS1-3

Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells.

MS-ETS1-2

Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

READINGS (2)

1. FUNGUS AMONG US

Description

A reading for students on the history of penicillin, the fungal product that became the first antibiotic. It introduces the challenge and basic facts.

2. PLASMA FOR TRAUMA

Description

A reading describing the story of the development of blood plasma as a life-saving, innovative treatment. The reading also shows the role of Charles Drew in that development and asks students to connect the development of basic research to its application as a treatment.

ACTIVITIES (2)

1. ANTIBIOTIC TARGETS

Description

An activity that can be used with or without Fungus Among Us. This activity introduces different types of cells that can cause diseases, and their characteristics, asking students to identify antibiotic targets that could be used to treat diseases.

Supplies

The handout and any additional resources you might want students to use in their research.

Instructions

Have the students look at the table of types of organisms that cause diseases. Assign, or have them pick, one to research and brainstorm. You may want to have students work in groups to pick a target treatment to brainstorm. Use Kagan strategies or other cooperative group structures to support their productive talk. By providing other resources like a textbook you can give them practice at reading to find information and summarization.

2. BLOOD IN A BAG

Description

An activity that has students create and then identify the components of a model of blood. Blood is an organ, though most people don't think of it that way. This activity encourages consideration of the definition of an organ or an organ system.

Supplies (per group)

1 Quart-sized Ziploc bag
2 Cups vegetable oil
20 Skittles
10 Mentos
10 Tic Tacs
1 Tsp candy sprinkles

Instructions

You can use other similarly-sized candies to replace these if the ones listed are not available.

Students will place the oil and the candies in the bag, and then, using the table, determine what each candy is supposed to represent in the model. Because it asks students to identify the parts of the model, it is using a higher domain of knowledge.

ADDITIONAL RESOURCES

To learn more about the development of antibiotics, try these books:

+ *The Mold in Dr Florey's Coat* by Eric Lax, Henry Holt, 2005.

+ *The Demon Under the Microscope* by Thomas Hager, Three Rivers Press, 2006.

READING

FUNGUS AMONG US

When most people think of fungi (plural of fungus), they often think of things like mold or mildew. However, fungi are also needed for things like getting bread to rise. Fungi are in beer, wine, and many cheeses. Fungi also have saved millions of lives over the last century.

The very first drugs to treat bacterial infections were sulfa drugs. In the years after World War II, many people were looking for ways to treat infections. During World War II, many soldiers died because of infections from what should have been treatable wounds. Infections can also cause deaths by diseases like pneumonia or cholera. German scientists had been experimenting with coal tar, a chemical from fossil fuel, to make synthetic dyes to replace ones that had previously come from plants and insects. These scientists also learned that some of these dyes worked well to make bacteria visible under a microscope by attaching molecules in their cell walls. This discovery inspired German researchers to begin looking for dyes that would attach to bacteria and kill them—they called the idea chemotherapy. By the 1930s, German chemical companies had developed drugs to treat diseases including malaria. In 1933, they discovered a sulfa drug that treated common infections, and by 1936, sulfa was being mass produced.

When World War II began, sulfa drugs were the only antibiotics available. Some scientists in England, led by Howard Florey at Oxford University, were trying to develop a fungus into an antibiotic. Florey knew that in 1928 Alexander Fleming had discovered that the fungus *Penicillium* killed bacteria. Florey's lab was growing *Penicillium* and pulling chemicals out of it that

they believed could be used as an antibiotic. They first tested these chemicals to treat the infections in mice. The results were so successful that Florey knew he was on the right track.

However, Florey's work was happening while the Battle of Britain was raging in 1940. The cities, factories, and ports of Great Britain were being bombed. Resources were tight too. Florey communicated with the government of the United States and received permission to travel there and work with a US Department of Agriculture lab to develop an antibiotic. To make a long story short—a story involving moldy cantaloupe, giant incubation tanks, and lots of smelly fermentation—Florey's team developed penicillin into a usable drug in the spring of 1944. That was just in time for the D-Day invasion and also before many of the final battles of the Pacific.

A hundred years ago there were no antibiotics in use, and some scientists today say there might be too many. In the United States, antibiotics are commonly added to products like animal feed to prevent illness and promote growth. Antibiotics work against bacteria, not viruses, but often antibiotics are prescribed "just in case" a patient might have an infection. Since bacteria evolve quickly, there are many bacterial strains that are now immune to common antibiotics. Another problem is that pharmaceutical companies who make medicines and drugs aren't developing new antibiotics to replace the older ones that don't work well enough anymore because of antibiotic resistance. Drug development costs lots of money, and the profits from antibiotics are relatively small. Less than a century after the discovery of the first antibiotics, we are suffering a new bacterial challenge.



Detail from a WWII advertisement in *Life Magazine*.
(Image: *The Education Collection of The National WWII Museum.*)

NAME:

DATE:



Entrance to the military hospital in New Caledonia.
(Image: The National WWII Museum, 2010.087.113.)

1. When was the last time that you took an antibiotic?

2. When was the last time you had a viral disease like the flu or a cold?

3. Dr. Florey took what he learned (that a fungus kills bacteria) and used it to make something useful (a drug to treat infections). Does this follow the pattern of Adoption, Adaptation, or Application? Why does this matter?

4. Since 1940, people have learned a lot about infections and about the viruses and bacteria that cause them. Think of any modern day disease caused by bacteria or viruses. What is something scientists have learned since World War II that you think might be able to be applied as a new way to prevent or cure these diseases?