LESSON PLANS, READINGS & ACTIVITIES

LIFE SCIENCE: BODY SYSTEMS

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?

READING

PLASMA FOR TRAUMA

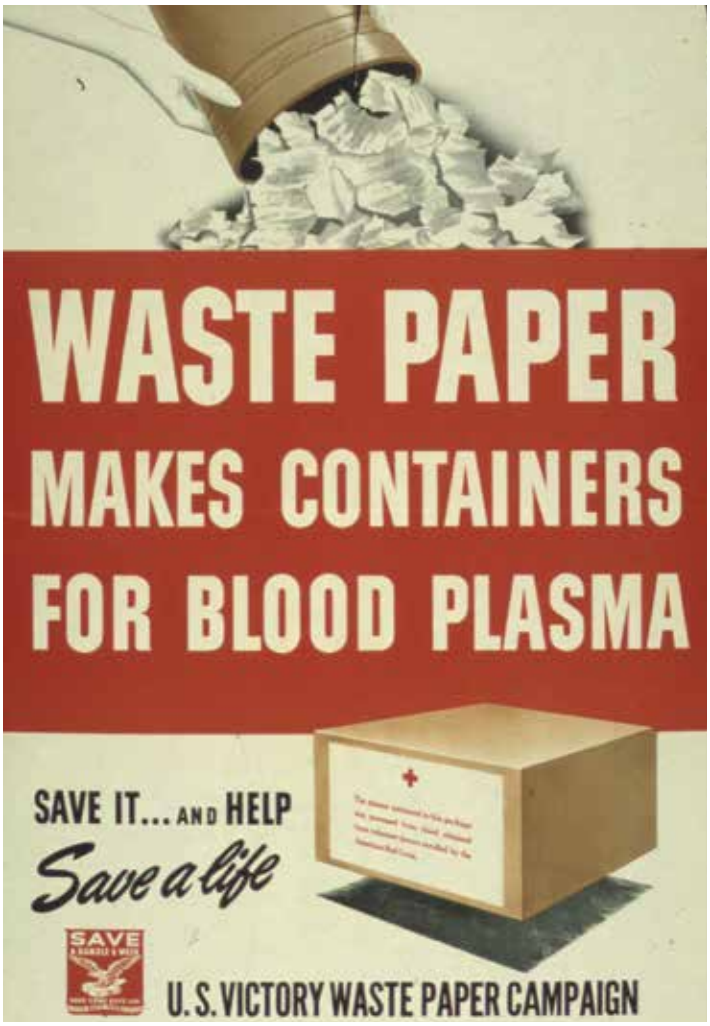
Charles Drew was studying to be a medical doctor and researcher at Columbia University, one of the best teaching hospitals in the world. With his advisor, John Scudder, Drew studied how to diagnose and treat shock. Shock, a result of trauma due to wounds or severe disease, affects the circulatory system. Drew was the first African American scientist Scudder had agreed to mentor, and his achievements impressed his advisor.

In the late 1930s, when Drew was doing his research, it was possible to preserve blood and set up blood banks. However, the process depended upon the region in which a blood bank was set up. Because of this, the quality of blood to treat patients often was different from place to place, sometimes even between different hospitals in the same city. Drew decided to develop a system to make sure that blood was collected and stored in the best way possible. He developed screenings for donors—the best ways to draw and store blood—and with his advisor, developed a new blood bank at their hospital.

The entry of the United States into World War II may have surprised some, but it did not surprise everyone. When the Germans invaded Poland in 1939, the National Research Council began an investigation into our country's ability to provide blood for injured soldiers. During the Battle of Britain the following year, the United States began a program called Blood for Britain. The plan to collect, store, and then send blood for transfusions was written by Drew and Scudder.

After writing the plan, Drew went to Howard University where he became a professor. Because he was African American, Howard was the only university that would hire him in the United States. Drew continued his research on treatments using blood. His research included separating plasma from blood and using it to treat shock and that finding had led him to develop a procedure to dry plasma.

Dried plasma could be stored without refrigeration and could be transported more easily than blood. Because of his success in leading the Blood for Britain program, Drew was recruited to lead a similar effort to mass produce dried plasma for the Red Cross in New York. Drew was again successful in setting up a program that saved thousands of lives from death after trauma. Blood plasma kits became widespread in Allied medical centers and field hospitals in Europe, Africa, and Asia.



A US government poster encouraging recycling.
(Image: The Education Collection of The National WWII Museum.)

Wounded Marine treated by medics on Guam.
(Image: The National WWII Museum, 2010.130.080.)

NAME: **DATE:**

One tragic part of history is that segregation affected all parts of life in the United States during World War II, including the blood program. In spite of its complete irrelevance, race was a factor in who received what blood and what plasma. Supplies were segregated just like bathrooms and dining rooms. In his acceptance speech in 1944 for a medical award recognizing his efforts, Drew said, "It is fundamentally wrong for any great nation to willfully discriminate against such a large group of its people. . . . One can say quite truthfully that on the battlefields nobody is very interested in where the plasma comes from when they are hurt. . . . It is unfortunate that such a worthwhile and scientific bit of work should have been hampered by such stupidity."

Once Drew had the system for plasma production established, he returned to Howard where his wife and young daughter were living. He said his most important ambition was to set up a great surgical education program at Howard. Sadly, Drew died young, at age 45, in 1950, of trauma from a car accident.

Do you know your blood type?

Do you know the blood types of your parents or siblings?

Do you know someone who has been treated with a blood transfusion or blood plasma?

Drew took his knowledge of medicine (how blood is made, and how it is involved in shock) and used it to develop something very necessary for World War II (blood banks, and kits to administer powdered plasma). **Does this follow the pattern of Adoption, Adaptation, or Application? Why is this important?**

People have learned a lot about blood since World War II: what's in it; what diseases are involved in it; and what can cause these diseases. **What have scientists learned since World War II that you think might be able to be applied as a way to prevent or cure one of these diseases of the blood or other parts of the body?**

A medic administers blood plasma to a wounded soldier.
(Image: The National WWII Museum, 2000.325.010.)

ACTIVITY

ANTIBIOTIC TARGETS

INTRODUCTION

Why do antibiotics affect bacteria and not human cells?

Why do antibiotics affect some bacteria and not others?

Why don't antibiotics work on viruses?

Why don't antibiotics work on diseases like malaria?

The answer to these questions is in the details of cells and how they are made. Examine this table describing single-celled organisms and their makeup:

CELL (TYPE)	CELL WALL	ORGANELLES	NOTES
Plasmodium (eukaryote, protozooan)	None (has protein coat)	Nucleus, mitochondria, ribosomes, microneme	Parasite that causes malaria
Gram positive bacteria (prokaryote)	Thick peptidoglycan wall	None	Streptococcus, Staphlococcus, (more succeptible to antibiotics)
Gram negative bacteria (prokaryote)	Thin peptidoglycan inside a membrane	None	E. coli, Pseudomonas (less succeptible to antibiotics)
Yeast (eukaryote, fungus)	Chitin	Nucleus, mitochondria, ribosomes	Candida (can cause infections)
Algae (eukaryote, plants)	Cellulose	Nucleus, mitochondria, ribosomes, chloroplasts	
Viruses (not really cells)	Protein Coat		Rhinovirus and Coronavirus (DNA and proteins inside)

NAME: **DATE:**

Directions: Use the table to answer the questions below. Before answering consider the following:
Do you have enough information to fully answer the questions? What else would be helpful to know?

1. Why do antibiotics affect bacteria and not human cells? Why do they affect some bacteria and not others?

2.Why don't antibiotics work on viruses?

3. Why don't antibiotics work on diseases like malaria?

4. In a group, pick one of the disease-causing organisms in the table and propose a way to fight it. Use the organism's characteristics and its differences from the others in the table to guide your brainstorming.

ACTIVITY
BLOOD IN A BAG

INTRODUCTION

Even though it might not seem like it, our blood is an organ.

WHAT IS BLOOD MADE OF?

First, there's plasma, which is most of human blood by volume. Plasma is water with proteins, clotting factors, and antibodies suspended in it, and with ions dissolved in it.

Then there are blood cells, both white and red. Red blood cells bind oxygen and carry it through the body. Red blood cells have markers on their surface which determine which type of blood you have. White blood cells are part of the human immune system. There are many fewer white than red blood cells. Finally, there is another kind of cell called platelets, which help in healing and blood clotting. There are even fewer platelets than there are white blood cells.

An organ is defined as a bunch of different cells that work together for a function. By that definition blood is an organ.

When people are injured badly, they can go into shock. Shock is a bodily response to injury that helps conserve blood. One of the best ways to treat shock is to give the injured person a transfusion of blood.

However, blood combines lots of immune cells and can cause problems when one person receives another person's blood. A transfusion is like a transplant, and so it can only work if the blood types of the two people match. Blood also needs to be preserved at a low temperature (refrigerated) until it is used and also needs to be in a liquid form, which makes it difficult to transport.

In World War II, doctors learned how to use just blood plasma to treat shock. Because plasma doesn't have types and can be dried, it is easier to use in the field. Eventually the patient would need a blood transfusion, but until then plasma would help the injured person stay alive.

Your teacher will give your group the following:

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

NAME: **DATE:**

Directions: Put the ingredients together to make a model of blood. Use the proportions above in the description of blood to decide which candies to use for each role. Make sure the proportion and size of the blood components match between your model and the description of blood. Fill in the table below to show what each component in the model represents:

COMPONENT	REPRESENTED BY	FUNCTION
Plasma		
Red Blood Cells		
White Blood Cells		
Platelets		
Clotting Factor		
Antibodies		
Ions		

1. Which model components would an injured person receive in blood plasma?

2.Why doesn't plasma have blood types?

3. How might plasma prevent shock?