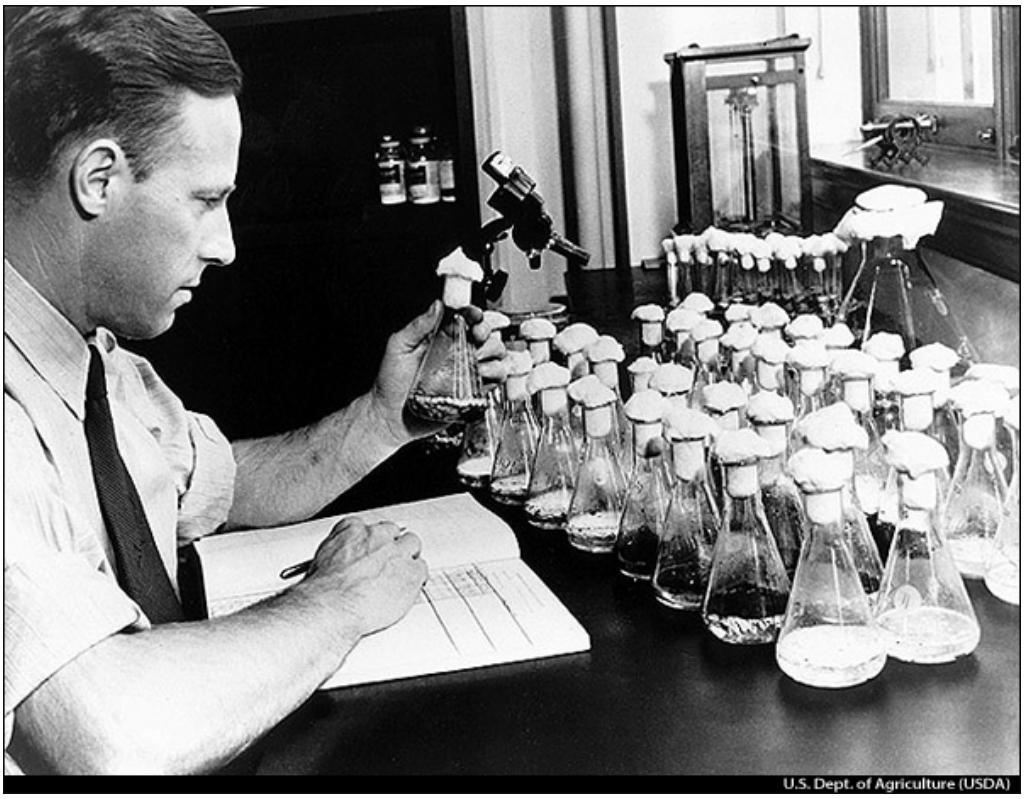
# World War II Home Front

## LESSON PLAN #2:

## COVID-19 PANDEMIC RESPONSE – an Echo of the World War II Home Front and “Arsenal of Democracy”

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# INTRODUCTION

**Title: "COVID-19 pandemic response, an echo of the WWII Home Front and Arsenal of Democracy"**

This multidisciplinary lesson plan includes content and learning activities in Social Studies, English Language Arts, Science and the Arts.

**Science**: Content includes:

- Factual framework for an introduction to prokaryotic cells, eukaryotic cells, bacteria, fungi, and viruses, including COVID-19 the 1918 influenza strain that was reconstructed in 2005.
- Mass production of penicillin and the unique chemistry of penicillin that made it difficult to synthesize.

**Social Studies**: Content includes:

- Public/private partnerships that defined the Arsenal of Democracy are connected to an echo of that time today with the nation's response to the COVID-19 pandemic as private companies either convert or add production lines to make medical equipment and supplies.
- A brief history of the 1918 influenza pandemic is summarized and development of the first influenza vaccines during WWII is discussed.
- History of the mass production of penicillin during WWII; Anchor book: *The Mold in Dr. Florey's Coat* by Eric Lax (2005)

**English Language Arts**: Content includes:

- Current event primary source interview (March 25, 2020) and article (at two reading levels), with video/audio and vocabulary/comprehension support, of a distillery in Holland, Michigan that quickly added a production line making hand sanitizer to supply healthcare communities in western Michigan
- Book recommendation: *The Mold in Dr. Florey's Coat* by Eric Lax (2005)

**Arts**:

- A graphic novel has been developed for this lesson plan: "On the Front Lines with Larry Lather" to communicate the importance of the correct procedure for handwashing, defined by the CDC, to stop the spread of pathogens
- Student participation in designing posters and a public awareness campaign

**Assessment** options include:

- multimedia production of video and/or posters,
- 25-question quiz plus essay (with answer key)
- student debate
- review and inquiry questions following the current event article

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**Grades**: Grades 6-12

**Anchor current event: Full Force of American Spirit – and Spirits – Hitting COVID-19**
Interview with Ali Anderson, national brand manager of Coppercraft Distillery, a distillery in Holland, Michigan now making hand sanitizer to supply healthcare communities in western Michigan.

**Rationale 1**: In this time of national crisis because of the COVID-19 pandemic, students will better be able to cope with drastic changes in their daily lives if they gain knowledge about characteristics of the coronavirus, how it is transmitted, action steps to take to protect themselves and others, and their role in helping to mitigate spread and appropriately assist their community.

**Rationale 2:** As current private-public partnerships are developing to help the nation during this time of crisis that mirror the WWII Home Front and the "great Arsenal of Democracy, albeit on a smaller scale, students will observe in real time how studying history is relevant and important to today's world.

## Themes/Constructs and time needed

1. Importance of handwashing to prevent the spread of pathogens (30 minutes plus extra class time to plan a school awareness campaign and design posters)
2. COVID-19 pandemic and burgeoning public-private partnerships that mirror the Arsenal of Democracy (one, 45-60 minute class period)
3. Introduction to prokaryotic and eukaryotic cells (one, 45-60 minute class period)
4. Introduction to microbes: bacteria, viruses, fungi (one, 45-60 minute class period plus extra time for a debate)
5. 1918 influenza pandemic and development of the first influenza vaccine in 1941 (one, 45-60 minute class period)
6. Discovery of penicillin in 1928 and mass production of penicillin during World War II as one example of the Arsenal of Democracy (one, 45-60 minute class period)

## Goals

1. To summarize the COVID-19 pandemic and actions that will mitigate it
2. To connect WWII Home Front history and the Arsenal of Democracy to current events today
3. To form a factual foundation in basic cell structure and microbial pathogens
4. To foster knowledge construction that supports relevant personal and civic action

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## Objectives

Upon successfully completing this lesson plan, students will be able to:

1. Recall the causative agent of the COVID-19 pandemic and its history infecting humans
2. Perform proper handwashing procedure as defined by the Centers for Disease Control and Prevention (CDC)
3. State why hand washing is important to prevent transmission of pathogens
4. Explain scientific evidence that forms the reasons for CDC's hand washing procedure
5. State two examples of a public-private partnership during WWII that contributed to the Arsenal of Democracy and two examples happening in real time now to mitigate the COVID-19 pandemic.
6. Differentiate prokarytic and eukaryotic cell structure
7. Categorize bacteria, viruses and fungi (yeasts and molds) based on cell/particle structure
8. List common pathogens and their primary route of transmission
9. Critique whether a virus should be considered a living microorganism
10. Compare the mass production of penicillin during WWII with current efforts to formulate a vaccine to COVID-19
11. Cite statistical evidence of the impact the implementation of influenza vaccines has had on society since WWII when the first influenza vaccines were introduced.

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## CONSTRUCTS #1 and #2 (COVID-19 and the importance of handwashing)

### Echo of the WWII Home Front and Arsenal of Democracy

During World War II, the federal government had a clear policy of not forcing companies to begin making wartime materials and munitions. In other words, the federal government did not want to nationalize industries as that would be diametrically opposed to the free market economic system in place since the nation's founding in 1776.

In contrast, Germany nationalized every industry. German businesses were no longer working for their benefit, rather for the benefit of Hitler's Third Reich. Ford and General Motors each had established production in Germany before Hitler came to power. After 1933 when Hitler dissolved the Weimar Republic and consolidated his power as a dictator, he issued a rule that the American car companies could not take any profit outside of Germany. As war became evident, he forcibly took their factories to begin making war machinery for the Third Reich instead of autos for the German consumer market.

In the United States, FDR wanted the federal government to partner with private industry to meet demands for thousands of wartime products. The Jeep is but one example. In 1940, the U.S. Army released specifications for a quarter-ton, 4x4 truck it needed. Invitations to bid on the vehicle were sent to 135 manufacturers. Two companies responded. Willys-Overland Company won the bid on its Jeep design and the rest as they say, is history.

The Arsenal of Democracy was the collective force of thousands of these public-private partnerships between the federal government and private industry. In many cases, the federal government provided the financing for companies to expand and/or build new factories. But the companies could still make a profit although the federal government watched closely that the profit was reasonable at no more than 8 percent. The free market system remained intact throughout the war.

The last consumer auto rolled off the assembly line on Feb. 10, 1942. From that day forward, auto companies made wartime products. In one of the most dramatic transitions, Ford Motor Company built a new factory near Detroit to make B-24 Liberator bombers. Airplanes had never been made on an assembly line. But Henry Ford and his key executives made it happen. At its peak from 1943-1944, one B-24 Liberator was coming off the assembly at the Willow Run Bomber Plant every hour. In total, the Willow Run factory made more than 8,000 of the 12,000 B-24 bombers made during the war.

The auto companies together made about 20 percent of all munitions produced in the United States during the Arsenal of Democracy.

The smallest business that was awarded a defense contract was a tool company based in Cleveland. Clyde Walling operated his company out of his two-car garage. He had three employees.

And in another amazing story, a retired railroad worker from Pennsylvania wrote to the federal government with an idea on how to recycle old boxcar wheels and suspensions without using new steel or materials deemed a priority and thus, not easily obtained. His letter went through the chain of command. He was awarded a contract. He and his five workers were soon sending their recycled wheels and suspensions to the U.S. Army.

"Subcontractors like Walling were the lifeblood of the American free enterprise system, as Bill Knudsen well knew. General Motors alone employed nearly 20,000 of them. Knudsen had aimed to

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make them the lifeblood of defense contracting, as well. They ranged in size from Clyde Walling's garage to major companies like Timken, which was which was also based in Cleveland but had branches in Detroit and other cities, and made everything from machine tools to axles, with a fair number of metal and steel products in between." (Freedom's Forge by Arthur Herman, p. 251.)

Timken was founded in 1899 by Henry Timken to make roller bearings. In 1898, he was awarded a patent for a tapered roller bearing. He manufactured carriages in St. Louis, Missouri. As automobiles were introduced, his company grew and by the early 1920s, the company was supplying almost all of the roller bearing used by automobile companies. Henry Timken died in 1909. The Timken Company exists to this day with its world headquarters in North Canton, Ohio. John Timken Jr., Henry's great-grandson, is the current Chairman of the Board of Directors.

Herman continues:

> "Turning the productive power of a Timken loose had been Knudsen's plan all along. For all the harping about how large corporations snapped up the biggest contracts and made their fortunes during the war, it was the medium- to small-sized businesses that did much of the actual work – and made the arsenal of democracy work and grow." (IBID)

However, Knudsen did believe that the largest defense contracts should be awarded to companies that had their own staff of engineers. Only very large companies could afford a full time engineering staff. Knidsen wanted to make sure there were people at the factories who could quickly solve problems to keep production running. There was no time to lose during wartime production.

One medium-sized business that contributed to the Arsenal of Democracy was Radio Steel, based in Chicago. Founded in 1917, the company made steel red wagons for children. With their expertise using steel, they were a perfect private partner for the federal government. Antonio Pasin, company owner, told the government he would prefer not making anything that killed people. The government honored his request. From 1942 to 1945, Radio Steel made five-gallon blitz cans for water or fuel that were carried on trucks, jeeps and tanks. In 1945, the company was given the Army-Navy "E" award for excellence in wartime production.

## Response today, an echo of the Arsenal of Democracy

Today as private industry again partners with the federal government to mitigate the COVID-19 pandemic, the format is similar. The federal government is not nationalizing industry. Private companies are calling and offering to help or the government is sending out inquiries for products needed.

## Hand sanitizer

Coppercraft Distillery in Holland, Michigan normally makes premium spirits, custom craft liquor. Upon hearing about shortages of hand sanitizer at hospitals in western Michigan, they quickly added a production line to make hand sanitizer. According to the CDC, hand sanitizers should have at least 60 percent alcohol to be effective. Coppercraft's hand sanitizer is 80 percent alcohol (ethanol).

Other distilleries across the country are also making hand sanitizer in large quantities.

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## Ventilators and respirators

On March 24, 2020, Ford Motor Company announced it is joining forces with firms including 3M and GE Healthcare to quickly expand production of urgently needed medical equipment and supplies for healthcare workers, first responders and patients fighting coronavirus.

In addition, Ford plans to assemble more than 100,000 face shields per week and leverage its in-house 3D printing capability to produce components for use in personal protective equipment.

“This is such a critical time for America and the world. It is a time for action and cooperation. By coming together across multiple industries, we can make a real difference for people in need and for those on the front lines of this crisis,” said Bill Ford, Ford’s executive chairman. “At Ford, we feel a deep obligation to step up and contribute in times of need, just as we always have through the 117-year history of our company.”

## Checks on price gouging

Similar to 1940s war production, the federal government has oversight to make sure companies are not price gouging with windfall profits during times of emergency. Sometimes it’s not the company but a distributor for the company’s products. But already with the COVID-19 crisis, people who try to take advantage of the situation often are met with disdain by the private business community.

Two men from Tennessee recently learned that reality. As the COVID-19 crisis was developing, they purchased 17,000 bottles of hand sanitizer and then tried to sell the products at a huge profit. They were shut down by a large online retailer. Eventually, they donated the bottles as they had no market for their bottles.

## COVID-19 Pandemic

**Author’s note**: The information below is summarized from information posted on the Centers for Disease Control and Prevention (CDC) website; CDC media telebriefings that I began attending on Jan. 24, 2020; information posted on the National Institutes of Health (NIH) website; and the Johns Hopkins University Coronavirus Resource Center.

Coronaviruses infecting humans were first identified in the 1960s. The coronavirus family was identified earlier and named from the Latin word, *corona* (crown or halo) because the protein spikes on the outside of the viral particle resemble a crown. The protein spikes are the viral antigens. When people come in contact with this brand new virus, the human immune system does not recognize the antigens so begins producing antibodies to the proteins. When people say they are “fighting off an infection,” they are referring to the battle between the virus (or other infectious microbe, called a pathogen) and one’s immune system. If that immune system is compromised because of very young age, advanced age or other underlying medical conditions, the virus has an advantage.

People become infected many times with respiratory viruses because protein antigens on the virus change and mutate easily. That is why there is an annual influenza vaccine. It includes three or four influenza strains circulating in the population to offer the most protection against the disease each year. NIH virologists are currently developing and testing a one-time, universal influenza vaccine. In May 2018, they launched a phase 2 clinical trial but mass production of the vaccine is still a few years away.

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Coronaviruses are divided into four main subgroups. Four strains in two of those subgroups cause most human coronavirus infections that result in nothing more than a common cold. Common colds can also be caused by more than 150 types of rhinoviruses, another family of viruses. It's clear why people catch so many colds in their lifetime.

## Serious disease from Coronavirus (SARS, MERS, COVID-19)

Since 2003, other human coronavirus strains have emerged that have caused more serious outbreaks of respiratory disease (SARS in 2003 and MERS in 2012) with serious outcomes such as pneumonia, septic shock and death in some patients. It certainly keeps virologists and epidemiologists burning the midnight oil.

During the CDC's Feb. 5, 2020 telebriefing, Dr. Nancy Messonnier, director of CDC's National Center for Immunization and Respiratory Diseases, said, "The Federal Government and public health systems have been preparing for an outbreak like this for years. All of the pandemic planning that we have done for influenza is the foundation for our response to this virus." More than 800 employees at CDC were working on it, including 200 who were at airports and other locations, she added.

COVID-19 is the most recent example of a new human coronavirus that has emerged and is rapidly spreading around the globe resulting in infections more serious than the common cold in some patients.

The COVID-19 viral genome closely resembles a coronavirus strain isolated from bats so a working theory is that the strain came from a bat but there is not evidence at this time of bat to human transmission. It may have passed through another animal before infecting humans. Scientists are also studying other scenarios. The exact animal origin of COVID-19 is not known at this time. The first cases were reported in December from Wuhan, China where it quickly spread but the virus could have been circulatng in November.

Both SARS and MERS emerged in Asia from an animal host. COVID-19 resembles the SARS outbreak.

As of March 24, 2020, the CDC reported a total of 44,183 cases in the United States and tragically, 544 deaths. Cases have been reported from all 50 states, the District of Columbia, Puerto Rico, Guam, and the U.S. Virgin Islands.

According to the Johns Hopkins University Coronavirus Resource Center, as of March 25, 2020, there have been 435,006 cases reported worldwide, 19,625 deaths and 11,822 people who have recovered.

The CDC has released a paper early that is scheduled for publication in July 2020 in the *Emerging Infectious Diseases Journal.*

The paper is titled, "Early Introduction of Severe Acute Respiratory Syndrome Coronavirus 2 into Europe." It details an introduction and transmission of COVID-19 to Europe in mid January. On Jan. 16, 2020, a tour group of 30 people left Wuhan, China for a 9-day tour of Italy, Switzerland and France. A woman in the tour group was mildly ill and coughing on the Jan. 16 direct flight from Wuhan to Rome. Her daughter became ill on Jan. 21 and on Jan. 23 in Paris, they began wearing masks and sought medical help. A physician came to their hotel room and diagnosed a common cold during a 15-minute face-to-face examination. He had no information that COVID-19 was suspected. Another tour group member in the room to translate became ill 2 days later. The physician became ill, was

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hospitalized and tested positive for COVID-19. Health officials notified 58 of his contacts, including 38 who were considered at high risk. None became ill with COVID-19.

## Symptoms and Incubation period

Common symptoms are cough, fever, and shortness of breath although there is a wide range of symptoms from mild disease to severe pneumonia with respiratory failure and septic shock. There have also been reports of people testing positive for the virus without any symptoms.

The incubation period, the time between exposure to the virus and the first appearance of symptoms, is estimated to be 5-6 days with a range from 2 to 14 days. Scientists are studying if people who test positive for the virus but do not show symptoms are infectious. Many infections have a “prodrome,” a time just before symptoms appear when the person is contagious.

Medical experts are studying data daily to form an overview of the pandemic. According to the CDC, people at greatest risk of infection are persons who have had prolonged, unprotected close contact with a patient with symptomatic, confirmed COVID-19 and those who live in or have recently been to areas with sustained transmission. “Prolonged” still needs to be precisely defined but large gatherings where people are together for a number of hours may be enough time to spread the infection.

The journal article summarized above supports CDC guidance in that transmission seems to depend on prolonged, unprotected close contact.

Risk factors for severe disease from COVID-19 have not yet been defined with precision but it is possible older adults and persons with underlying chronic medical conditions may be at risk for more severe outcomes, according to the CDC. Chronic conditions include heart disease and diabetes.

## Importance of handwashing

Handwashing saves lives, according to the CDC. The simple action of washing one’s hands often, and definitely after using the bathroom, can help stop or slow the spread of many types of infections, not just COVID-19.

It’s very important to note though, that skin has millions of normal bacteria that are essential to its function as the body’s first line of defense against microbial invaders. Intact skin is a protective shield. The goal of handwashing is not to sterilize your hands but to remove pathogens, microbes or germs that cause disease. And be careful not to wash hands so often and vigorously that skin breaks, an open door for pathogens.

Especially during late fall and winter, the spread of upper and lower respiratory tract infections, caused by many different types of viruses, can be significantly reduced by faithful hand washing. For influenza, the single most effective preventive strategy is the annual flu vaccine. But handwashing is always a good practice.
All four seasons are a tough time for tummy bugs. People might say they have the “stomach flu” but what they really have is acute gastroenteritis, often caused by the rapid spread of norovirus, which is spread through a fecal-oral route and requires only a few viruses to make someone miserable with vomiting and diarrhea. The CDC estimates norovirus causes 685 million cases of acute gastroenteritis each year worldwide. That number could be significantly reduced if people simply washed their hands.

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Washing hands after using the bathroom, not preparing food for others while sick, and not touching surfaces unless hands are washed are ways to stop the spread of norovirus. Food workers cannot become complacent about handwashing. If they have norovirus and do not wash their hands, or have another infection such as an open wound infected with Staph bacteria, and then prepare food, they can introduce pathogens to the food. The danger with Staph is that once in a food that is kept warm in the kitchen or on a buffet, Staph have the perfect temperature to produce toxins that once ingested, make people sick very quickly.

Finally, a flu shot protects against respiratory influenza and not the “stomach flu.” There is not a norovirus vaccine.

So running water and soap are powerful tools to prevent infections. Hand sanitizer with at least 60 percent alcohol is considered a back up if running water and soap are not available.

## CDC handwashing procedure

According to the CDC, there are five steps to wash your hands properly. Those are:

1. **Wet** your hands with clean, running water (warm or cold), turn off the tap, and apply soap.
2. **Lather** your hands by rubbing them together with the soap. Lather the backs of your hands, between your fingers, and under your nails.
3. **Scrub** your hands for at least 20 seconds. Need a timer? Hum the “Happy Birthday” song from beginning to end twice.
4. **Rinse** your hands well under clean, running water.
5. **Dry** your hands using a clean towel or air dry them.

The CDC has published scientific evidence to support their recommended handwashing procedure. It’s very interesting. Let’s go through each step with CDC’s scientific evidence.

1. Soap helps lift dirt and microbes from the skin and people tend to wash more thoroughly when soap is used. Standing water can be contaminated so running water is best but when not available, standing water may be okay and help. Studies have not shown warm water is better than cold to remove germs. Turning off the faucet while washing your hands saves water and there has not been evidence that germs are transmitted this way. Finally, for consumers, antibacterial soap is not needed. In 2016, the Food and Drug Administration (FDA) issued a ruling that stated antibacterial soaps are no more effective at removing germs than regular soaps.

2. Ingredients in soap help dissolve grease and lift dirt and microbes from the skin. It’s important to lather both sides of the hand. Microbes are often present in high concentration under the nails so make sure to get soap to those areas.

3. Scrubbing for at least 20 seconds is the recommended time based on studies and protocols followed by many countries. Scrubbing for shorter periods of time (15 seconds or less) will not remove as many germs.

4. After lathering and scrubbing, rinsing hands in clean running water will make sure the germs go down the drain. There is no need to turn off the faucet with a paper towel when finished rinsing. It’s wasteful and has not been shown to improve health.

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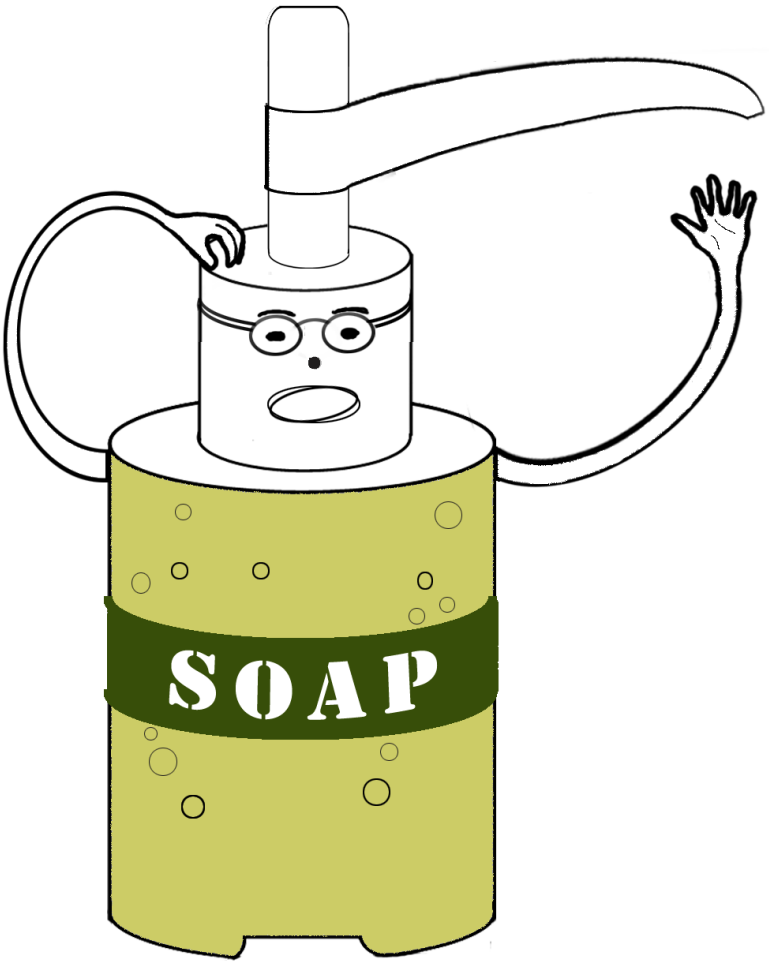
5. Wet hands transfer germs more easily than dry hands. The best way to dry hands has not been thoroughly studied. Remember, the goal is to remove pathogens, not all microbes. The CDC recommends using a clean towel or air to dry hands.

When should you wash your hands? According to the CDC:

1. **Before, during, and after** preparing food
2. **Before** eating food
3. **Before and after** caring for someone at home who is sick with vomiting or diarrhea
4. **Before and after** treating a cut or wound
5. **After** using the toilet
6. **After** changing diapers or cleaning up a child who has used the toilet
7. **After** blowing your nose, coughing, or sneezing
8. **After** touching an animal, animal feed, or animal waste
9. **After** handling pet food or pet treats
10. **After** touching garbage

**Now let's have Larry Lather drive the point home and germs down the drain!**

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## A Graphic Novel: On the Front Lines with Larry Lather*

Posted on Redwood Learning's Word War II Home Front companion website: On the Front Lines with Larry Lather

**Script**
Cell 1: (Scene: sink with soap bottle (Larry), window showing sunrise; handwashing poster on wall) Text bubble: "Larry Lather here – Just waking up and getting pumped for the day. I hear a virus is on the loose!

Cell 2: (Scene: sink, Larry, and hands with purple staph and strep under faucet): Text bubble: "Oh no! Looks like Staph and Strep. Could be nothing bad but could also be a BIG problem" (Level of soap goes down)

Cell 3: (Scene: sink, Larry with neck of bottle raised and end looking a little bit like a periscope; hands showing purple strep) Text bubble: "Just in case, where is that penicillin if it's bad strep? Penicillin saved thousands of soldiers on D-Day." (Level of soap goes down)

Cell 4: (Scene: Larry, sink, hands showing red rods) Text bubble: " Yikes! Rods! Probably ok but could be a bad gastroenteritis germ. If it is, I'll be busy… (Level of soap goes down)

Cell 5: (Scene: Larry, sink, hands with influenza viruses) Text bubble: "Okay, I got this. Looks like seasonal influenza. I hope this guy got the vaccine. (Soap level goes down)

Cell 6: (Scene: Larry, sink, neck of bottle extended over sink, hands with COVID-19) Text bubble: "All points bulletin! COVID-19! Stay calm, read the poster and just do it!" (Soap level goes down)

Cell 7: (Scene: Larry, sink, hands with all germs on them – strep, staph, flu, COVID-19, rods) Text bubble: "Oh boy...this must be a nurse or a doctor on the front lines. Thank you!" (Soap level goes down)

Cell 8: (Scene: Larry, no hands over sink, bottle empty; window showing moon) Text bubble: "Whew! What a day! I need a refill. Over and out – ttyl, Larry" (Soap bottle empty)

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## Learning Activities (Objectives #1, #2, #3, #4 and #5)

1. Instruct students to read and study the introduction to the graphic novel. Then refer students to the CDC pages on handwashing (links #1 and #2 below). After reading and studying this content, have someone take a video of the student explaining in their own words why handwashing is important in preventing the spread of infections and then have the student demonstrate proper handwashing procedure by washing their hands. Have them save the video to show at another time when school is back in session or send the video to their teacher. Or refer to #5 below for another optional assessment with a poster.

2. Read the attached current event article: "Full Force of American Spirit – and Spirits – Hitting COVID-19." (Two reading levels: Main and 800) (Audio of interview on website – https://aodww2.com)

3. Refer students to the CDC's page on "How to Protect Yourself" (link #4 below) and have them read the recommendations. Also refer them to the National Institutes of Health page on "social distancing." (link #5 below) and read that page. Have students write a summary of what they learned from both resources. Have a group discussion on the challenges of social distancing and how to address and meet those challenges.

4. Through link #6 below, have students track the number of COVID-19 cases and fatalities worldwide by visiting the site daily and recording statistics until school is back in session. Graph the results.

5. Form groups of 4-6 students to develop ideas for a school awareness campaign on the importance of handwashing in preventing the spread of infections. Common to all campaigns will be posters designed by students for four grade ranges (K-2, 3-5, 6-8, and 9-12). Assign students in each group with tasks required to organize and implement this campaign. When each group has their ideas formalized, have each group present their ideas. The class as a whole then decides which elements of each group to include in the final campaign. Groups can have different ideas even for the posters so include poster design as an element to be decided. Once the campaign design is finalized, have students volunteer for tasks to implement the campaign. Devise a method to evaluate its success.

6. Through link #7 below, read the Ford Motor Company press release about the partnership making ventilators. During World War II, Ford transitioned from making autos to making airplanes. It's remarkable to think as we approach the 75th anniversary of Victory in Europe (V-E) Day on May 8, 2020, Ford is in a similar role it had in the 1940s.

7. Through link #8 below, review the coronaviruses that cause human disease. COVID-19 resembles SARS, according to the CDC.

**Related links**

1. handwashing video tutorial (CDC) https://www.cdc.gov/handwashing/index.html (right column)
2. handwashing (CDC) https://www.cdc.gov/handwashing/
3. science behind handwashing (CDC) https://www.cdc.gov/handwashing/show-me-the-science.html
4. COVID-19: How to Protect Yourself (CDC) https://www.cdc.gov/coronavirus/2019-ncov/prepare/prevention.html

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5. COVID-19: Social distancing (NIH) https://directorsblog.nih.gov/2020/03/19/to-beat-covid-19-social-distancing-is-a-must/
6. Johns Hopkins Coronavirus Resource Center https://coronavirus.jhu.edu/
7. Ford Motor Company press release on making ventilators https://media.ford.com/content/fordmedia/fna/us/en/news/2020/03/24/ford-3m-ge-uaw-respirators-ventilators.html
8. human coronaviruses (CDC) https://www.cdc.gov/coronavirus/types.html

**Assessment**

1. Performance-based: Production of a video by students through which they demonstrate the ability to talk about the importance of handwashing in their own words and then demonstrate proper handwashing procedure as defined by the Centers for Disease Control and Prevention (CDC)
2. Quiz (attached)
3. Essay question on Quiz connecting the Arsenal of Democracy to today's similar public-private partnerships to mitigate the COVID-19 pandemic.

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## CONSTRUCTS #3 and #4 (Vaccine development; mass production of penicillin during WWII)

World War I (1914-1918) had a profound effect on the medical community in the United States for two reasons: 1) the influenza pandemic of 1918-1919 claimed at least 50 million lives worldwide, many of them young soldiers serving their countries, and 2) wounded soldiers often died not from their wounds but from secondary bacterial infections and sepsis that followed.

## 1918 Influenza Pandemic

The following is summarized mainly from information on the CDC website with a discussion of early recognition of modes of transmission as recounted in *The Great Influenza: The Story of the Deadliest Pandemic in History* by John M. Barry (2004, 2005, 2009, 2018).

The story of the 1918 influenza pandemic and reconstruction in 2005 of the virus that was the cause of the worst pandemic in world history reads like a spy novel. For decades, the mission was to reconstruct the virus to study why it was so virulent.

At least 50 million people worldwide died and about 500 million people, one-third of the world's entire population at the time, were infected. In 1918, the influenza virus was not yet identified as the causative agent of influenza. Doctors thought the severe lung disease they were seeing in so many patients was caused by a bacteria.

But they did know how it was transmitted.

Doctors in 1918 thought an infected person could "shed" the virus and pass it on to other people. On page 256 of *The Great Influenza*, Barry states: "They also believed, correctly, that people could catch influenza not only by inhaling it but by hand-to-mouth or -nose contact. They rightly thought, for instance, that a sick person could cover his mouth with his hand when he coughed, then several hours later shake hands, and the second person could then rub his chin in thought or touch his nose or stick a piece of candy in his mouth and infect himself. Similarly, someone sick could cough into a hand, touch a hard surface such as a doorknob, and spread it to someone else who turns the doorknob and later brings a hand to face. (In fact, the virus can remain infectious on a hard surface for days.)"

The severe respiratory disease first appeared among military personnel in the United States in spring 1918 and then to communities. Because the United States had entered World War I in spring 1917, thousands of soldiers were moving to bases in the United States for training and then overseas to the front lines in western Europe. As the virus quickly spread around the world, infections occurred in waves.

In fall 1918, the second wave was especially deadly. More soldiers in Europe died of influenza than from battle wounds.

And in Brevig Mission, Alaska, from Nov. 15-20, 1918, influenza claimed the lives of 72 of the 80 adults living there. A mass grave was dug in the permafrost.

In total, about 675,000 Americans died during the 1918 pandemic. Young children younger than 5, adults from 20-40, and elderly persons older than 65 quickly succumbed.

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In 1951, Johan Hultin, a doctoral student in Microbiology at the University of Iowa, traveled to Alaska, was permitted to exhume the mass grave site in Brevig Mission, and obtained lung tissue to bring back to his lab. His attempts to grow the virus were unsuccessful.

Decades later in 1997, Hultin went back to Alaska again after another researcher had been able to extract RNA from a lung tissue sample that had been preserved from a WWI soldier who died of influenza at an Army base in South Carolina.

Hultin again excavated the grave site. Seven feet underground he found the body of a young Inuit woman whose lungs were perfectly frozen. He brought the organ back to his lab and sent the researcher samples.

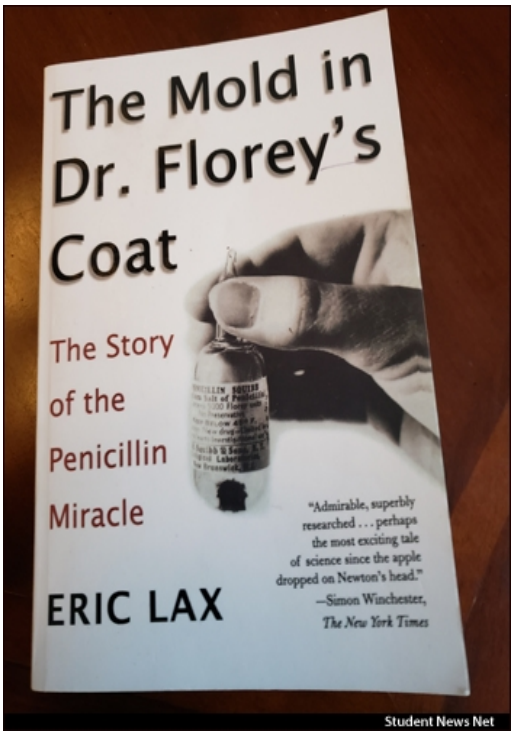
Ultimately, the researchers were able to sequence the entire genome of the 1918 influenza virus, a H1N1 strain. In 2005 at the CDC in a highly secure lab, Dr. Terrence Tumpey reconstructed the virus bringing it back to its infectious state.

He tested the virus, and other influenza viruses as controls, on mice. The 1918 strain was 100 times more lethal than any other strain he tested. The virus replicated at an incredibly fast pace. He concluded it was the unique combination of genes in the 1918 strain that made it so lethal. Its ancestor is believed to have appeared from 1900 to 1915.

Three other influenza pandemics have occurred since 1918 but none as deadly – 1957, 1968 and 2009.

It's important to note that in 1918, there were no anti-viral drugs or mechanical ventilators.

From 1933-1936, both Influenza A and Influenza B strains were identified. In the 1940s, Dr. Jonas Salk and Dr. Thomas, lead researchers at the University of Michigan, developed the first inactivated flu vaccine with support from the U.S. Army. The Army wanted a vaccine to to protect their soldiers in case another pandemic occurred. A 1944 study showed that while the vaccine did reduce illness in patients with temperatures higher than 99 degrees Fahrenheit, the vaccine did not have an impact on clinical outcomes. Fortunately, a strain of influenza as lethal as the strain from the 1918 pandemic did not circulate during World War II.




Also in the 1940s, the first mechanical ventilators became available.

## *The Mold in Dr. Florey's Coat* by Eric Lax (2005)

The following is a summary of the story of penicillin as told in *The Mold in Dr. Florey's Coat* by Eric Lax (2005). The book is excellent!

### Correcting a myth

First, a misconception must be addressed. It's quite a story and one that has been told in countless books and articles for many years.

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The story goes that in 1928, Alexander Fleming accidentally left a petri dish open next to an open window when he went on an extended vacation. A mold spore landed on the dish and germinated. Upon his return, he noticed a plate on which Staph bacteria growing elsewhere did not grow around the fuzzy mold. Fleming determined the clearing must have been from a byproduct produced by the mold that inhibited the bacteria. He saved the plate and tried to extract the mysterious substance.

But the story is not true. In his book, Lax said the story is impossible. (p. 16)

Lax debunks the myth and concludes the true story of how Fleming discovered penicillin has been lost to history. There is no doubt Fleming discovered Penicillium mold had antibacterial properties. He isolated a compound but it was very unstable so he couldn't work with it. He wrote a paper about it in 1929 but by 1932, he had largely abandoned his research with the mold.

## Dunn School of Pathology lab at Oxford University – Dr. Howard Florey

Almost ten years later at Oxford University, Ernst Chain, a researcher in biochemistry at Dr. Howard Florey's lab (the Dunn School of Pathology) read Fleming's 1929 paper. He was curious and interested. The first formal mention of penicillin was in January 1939 when Dr. Florey submitted a grant request to fund its research.

At the time, Britain was preparing for war. Lab employees dug trenches while also conducting penicillin research. They began carrying gas masks after Nazi Germany bombed Edinburgh on Nov. 1, 1939. Germany had invaded Poland two months before.

At the same time, Norman Heatley, a scientist working for Dr. Florey in his lab, figured out how to extract penicillin from the medium on which the mold was growing. It was a pivotal discovery.

On May 25, 1940, lab scientists began testing penicillin on eight mice that had been injected with strep bacteria. Results were dramatic. Infected mice given penicillin survived. Mice not given penicillin died.

News from abroad was unsettling. More than 300,000 British troops were trapped around Dunkirk, France. By June 4, a flotilla of British ships, answering a plea from Winston Churchill, Britain's Prime Minister, safely evacuated 350,000 men from Dunkirk.

France fell to Germany on June 22, 1940.

In July 1940, Dr. Florey's lab tested 50 mice giving 25 of them penicillin after injecting strep. All 25 mice without penicillin died and 24 of the 25 mice given penicillin survived. The one mouse given penicillin that died had another unrelated condition that led to its death.

After France fell in June, Hitler turned his attention to England. Germany's *Luftwaffe*, their air force, began bombing strategic sites along the British coast in July to prepare for a likely invasion.

Fearful of losing their mold cultures if Germany bombed their lab, Dr. Florey and his scientists rubbed Penicillium spores on their clothes so they could again grow the mold if everything else was destroyed.

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## Blitz

The Nazi Blitz began on Sept. 7, 1940 and continued for 57 consecutive nights. London and other major cities in England were bombed but miraculously, Britain's Royal Air Force (RAF) fought off the Blitz. England remained a sovereign country. About 40,000 British citizens were killed during the year of bombing. In June 1941, Germany turned its attention to the Soviet Union.

In late June, Dr. Florey and Norman Heatley traveled to the United States. They needed to grow the Penicillium mold in quantities to support production of large amounts of penicillin. While Dr. Florey visited pharmaceutical companies to find a private partner for large scale production, Heatley collaborated with scientists at the U.S. Department of Agriculture (USDA) Northern Regional Research Lab in Peoria, Illinois. The lab had researched the use of corn steep liquor extracted from cornstarch as a medium to support growth and fermentation.

Florey was able to interest Merck, Squibb, and Pfizer in penicillin production. In October, the U.S. government coordinated a meeting with those companies to discuss a strategy going forward.

After Pearl Harbor and America's entry into the war, penicillin production became an urgent necessity.

Pfizer acquired an old ice factory in Brooklyn, New York where it researched deep tank fermentation to produce large quantities of penicillin. It eventually installed 14 tanks each holding 7,500 gallons.

## First clinical trial

In spring 1942, the first clinical trial in the United States was performed on a critically ill woman with bacterial sepsis following a miscarriage one month before. Given a course of penicillin, she recovered.

At the USDA lab in Peoria, scientists were testing thousands of strains of Penicillium to find one that would produce large quantities of penicillin. Mary Hunt, a lab assistant, was told to look often at local markets for decaying fruit with mold. One day she returned to the lab with a moldy cantaloupe. The mold Pencillium chrysogenum. The researchers struck gold. That specific species would end up producing most of world's early supply of penicillin.

As pharmaceutical companies continued their research into large scale production, penicillin supplies were still low in early 1943 in both England and the United States but that was about to change.

Pfizer perfected deep tank fermentation. Four other companies began producing penicillin. Eventually, another 21 companies began penicillin production through financing from the War Production Board.

In May 1943, Dr. Florey traveled to North Africa where he tested penicillin on injured soldiers. Back at the Oxford lab, Ernst Chain unraveled the chemical mystery of penicillin. At its base was a beta-lactam ring of three carbon atoms and one nitrogen atom, a chemical structure never before seen in a naturally occurring product. Chain immediately realized penicillin would be very difficult to synthesize.

By the end of 1943, penicillin production was the War Production Board's second highest priority. The combined effort of the pharmaceutical companies, the USDA lab in Peoria, the War Production Board, and British scientists had paid off. Production soared.

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The U.S. Army wanted millions of doses available by June 6, 1944, D-Day.

By D-Day, the more than 20 companies producing penicillin were making 100 billion units of penicillin per month, enough to treat 40,000 infections. (*The Mold in Dr. Florey's Coat* by Eric Lax, p. 223)

Most of the penicillin used on D-Day was produced by Pfizer in Brooklyn. By the end of the 1940s, Pfizer was supplying about one-half of the world's supply of penicillin.

**1945 Nobel Prize**
Sir Alexander Fleming, Sir Howard Florey and Ernst Chain were jointly awarded the 1945 Nobel Prize in Physiology and Medicine for the discovery of penicillin.

On June 12, 2008, the American Chemical Society declared Pfizer a National Historic Chemical Landmark for its production of penicillin through the deep tank fermentation the company developed.

In the evolving COVID-19 pandemic, many Americans are learning for the first time that most of the antibiotics currently used in the United States, including penicillin which is still effective against strep infections, are made overseas in Asia. It's likely antibiotic production will return to the United States.

## Related links

1. History of influenza vaccine:
   https://www.nvic.org/vaccines-and-diseases/Influenza/vaccine-history.aspx

2. American Chemical Society: Penicillin Production through Deep-tank Fermentation (Pfizer):
   https://www.acs.org/content/acs/en/education/whatischemistry/landmarks/penicillin.html

3. Reconstruction of the 1918 pandemic influenza virus
   **https://www.cdc.gov/flu/pandemic-resources/reconstruction-1918-virus.html**

4. 1918 pandemic (CDC):
   https://www.cdc.gov/flu/pandemic-resources/1918-pandemic-h1n1.html?CDC_AA_refVal=https%3A%2F%2Fwww.cdc.gov%2Ffeatures%2F1918-flu-pandemic%2Findex.html

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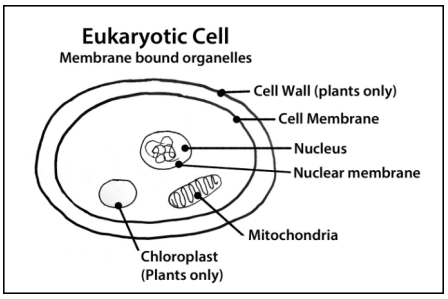
## CONSTRUCTS #5 and #6 (prokaryotic/eukaryotic cells, introduction to bacteria, viruses and fungi)

### Microscopic Cells

In the microscopic world of cells and microbes, size is difficult to comprehend. The following is a list, from largest to smallest of cells and microbes that will be introduced in this section.

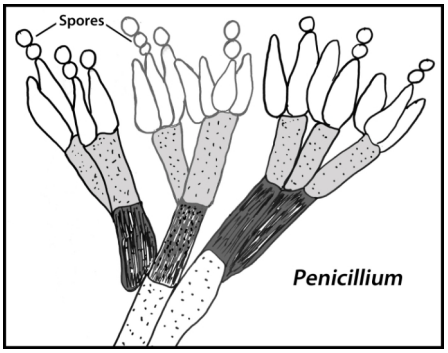
1. **eukaryotic cell:** cell with membrane-bound organelles: examples include animal, human, and plant cells
    - **SIZE RANGE**: 10-100 microns (one micron or micrometer = 1/1,000,000 of a meter, m, or 1/1,000 of a millimeter, mm)



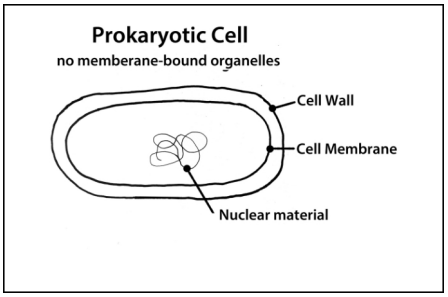

2. **fungi** (yeasts and molds) have eukaryotic cell structure
    **a.** yeast cells are unicellular.
    - **SIZE RANGE**: 4-12 microns (example: Saccharomyces cerevisiae – bread yeast)

    **b.** Molds have both spores and a vegetative state with exotic looking structures

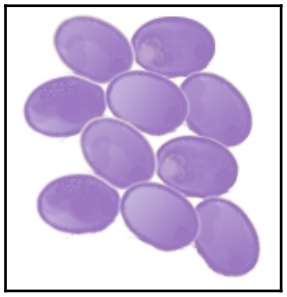
    **c.** **Spores** of the genus, Penicillium (mold that produces penicillin, an antibiotic) range from 3-5 microns. Penicillin was discovered in 1928 by Alexander Fleming in his London lab. It was very difficult to harvest and produce so not much work was done on his discovery until the late 1930s when Dr. Howard Florey's lab at Oxford University in England began working with it. Refer to the next section on mass production of penicillin during WWII.




3. **prokaryotic** cell (most bacteria)
    - **SIZE RANGE**: 0.1 to 5 microns [comes in different shapes: round (cocci), rods, and spirals]




    **a.** **Staph** bacteria: responsible for wound infections, boils, cellulitis, food poisoning following the production of toxins and potentially life threatening sepsis; many species are not pathogens
    - **SIZE RANGE**: about 1 micron in diameter; found in tetrads or clusters as the bacteria divide (binary fission) along two planes



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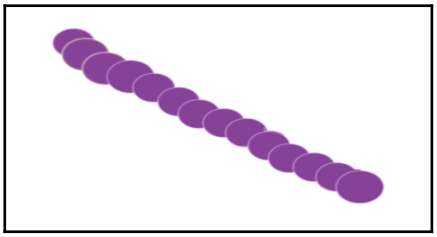
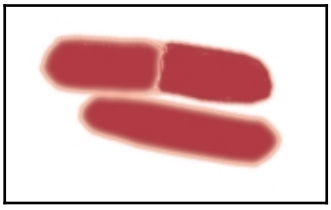
b. **Strep** bacteria: responsible for strep throat, rheumatic fever, pneumonia, sepsis and other infections but there are also many species that are not pathogens

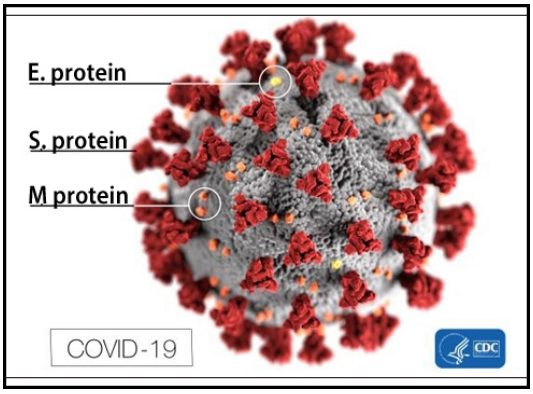


- **SIZE RANGE**: about 1 micron in diameter; found in chains as the bacteria divide (binary fission) along one plane

c. **Escherichia coli** (E. coli) bacteria: about 2 microns long by 0.5 microns wide (rods); billions of normal E. coli live in the intestinal tract and are necessary for normal function but a few species can be pathogenic, producing toxins that cause mile to serious infections; these strains are usually passed to people through contaminated food; many food recalls involve toxin-producing E. coli.



4. **Viruses** (e.g. influenza, common cold, norovirus and COVID-19)
   - Viruses are smaller than eukaryotic and prokaryotic cells. One virus particle is called a virion. Viruses are so small they cannot be seen with a regular microscope. A high-powered electron microscope is needed to see virions.
   - Viral size is noted in nanometers (nm). One nm = One billionth of a meter or 0.000001 millimeter (mm) ---- Remember, one micron is one millionth of a meter.
   - Viruses vary in size. The following viruses are mentioned in this lesson plan. The list below is ordered from largest to smallest:
     a. Coronavirus (COVID-19) family: each virion ~ 120 nm
     b. Influenza (the respiratory flu) family: each virion from 80-120 nm
     c. Norovirus (acute gastroenteritis) family: each virion ~35 nm
     d. Rhinovirus (common cold) family: each virion ~30 nm




## What is the difference between a prokaryotic and eukaryotic cell?

**Prokaroytic cells** (most bacteria) have a simple cell structure with a cell wall, cell membrane, cytoplasm and nuclear material (DNA). There are no membrane-bound organelles. Metabolism is carried out in the cell through the oxidation of proteins, lipids and carbohydrates at the direction of bacterial DNA. Bacteria divide by binary fission so can grow exponentially.

Bacteria are divided into two groups based on different chemical composition of the cell wall. Gram positive bacteria (staph and strep) have thicker layers in their cell wall and retain a purple dye when stained. Gram negative bacteria have thinner layers in the cell wall, cannot retain the purple dye and appear red because of application of a red dye as the last step in the process of Gram staining bacteria.

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**Eukaryotic cells** have membrane-bound organelles including a nucleus, chloroplasts (in plant cells for photosynthesis), vacuoles with a special type of membrane, and mitochondria (power center for cell). Plant cells have cell walls giving rigidity to plants. Human eukaryotic cells do not have cell walls and come in many shapes relevant to function. Nerve cells are long and thin. Skin, the largest organ in the body, is comprised of multiple layers of skin cells as the first line of defense against germs. The outermost layer, the epidermis, resembles a brick wall with each brick an individual eukaryotic cell tightly joined to give skin its protective qualities.

Prokaryotic and eukarytic cells are both found in the human body. E. coli bacteria are essential to normal function of the intestinal tract. It's an example of symbiosis (mutualism) in that both organisms benefit from the relationship.

## What are viruses?

Viruses are not only too small to be seen with a regular microscope but also nothing more than a protein coat surrounding nuclear material, either DNA or RNA but never both. However, this very simple structure is incredibly complicated when it comes to explaining how viruses cause infections. By definition, viruses are "obligate, intracellular parasites." In other words, for viruses to replicate, they must be (obligate) inside (intracellular) another living cell (prokaryotic or eukaryotic) and take over that cell's metabolism to the detriment of the normal cell. (parasitic relationship).

In the current COVID-19 pandemic, the coronavirus that has caused hundreds of thousands of infections and thousands of deaths around the world is a new type of coronavirus never seen before. Human coronaviruses were first identified in the 1960s.

Early indications are that COVID-19 originated in a bat and then was able to infect humans but the exact way it did that is unknown at this time. Other viruses, such as influenza, can also jump from animals to humans and may or may not cause human infections.

The protein spikes on the outside of COVID-19, a RNA virus, are key to developing a vaccine against it. It's the same principle used to make annual seasonal flu vaccines, which are made by targeting the proteins on the outside of the virus circulating in the population months before the vaccine is made.

Clinical trials have already begun on a COVID-19 vaccine and more are being developed in record time that will also be tested before being approved for millions of people. The hope is that a vaccine will be ready in one year.

## How does a virus get inside a human cell?

Proteins on the exterior spikes poke holes in the cell membrane and gain entrance. An article in *Science Daily* (link below) likened this ability to a grappling hook and a can opener allowing the virus to first attach and then open the cell.

Once inside the human cell, the virion's protein coat dissolves. Its nuclear material then takes over and tells the cell to stop making normal cell components. Instead, the cell is directed to make viral components. Time-lapse photography can capture these components appearing and then assembling into new viral particles. When complete, the new viruses burst out of the cell often killing the normal cell. It's pretty crazy and scary, isn't it? Yes, it is.

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Although there are exceptions, COVID-19 appears to cause the most severe disease in elderly persons with underlying medical conditions. Many infections are mild. Because it is a respiratory disease, people who smoke or vape or have asthma are at an increased risk of infection.

Virologists and epidemiologists are scrambling to learn everything they can about COVID-19 to stop its spread. From the thousands of cases that have occurred around the world, epidemiologists believe transmission is from prolonged close contact so that is why dramatic measures have been taken to keep people at home and away from large crowds. “Social distancing” is recommended to keep people 6 feet or more apart when together.

## How to classify viruses

Viruses are grouped as either DNA or RNA viruses. Should viruses be considered living organisms? The particles can survive for hours on inanimate surfaces but cannot replicate unless inside another living cell. It’s a good debate to have but regardless, viruses are nasty packets of protein, spikes and nucleic acid!

## Related links

1. Science Daily: https://www.sciencedaily.com/releases/2020/03/200317175442.htm

## Learning Activities (Objectives #6 and #7)

1. Complete the attached worksheet.
2. Divide the class into two groups. One group is assigned to take the position that viruses are living organisms. The other group is assigned the position that viruses are not living organisms. After each group prepares for the debate, conduct a debate.

## Assessments

1. Summative Quiz
2. Debate

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# ALIGNMENT – National and State of Georgia Standards

## National: Social Studies

The National Council for the Social Studies has published the "National Curriculum Standards for Social Studies, A Framework for Teaching, Learning and Assessment" that outlines ten themes of study. This lesson plan aligns with four themes: 1) Time, Continuity, and Change 2) People, Places and Environments 3) Production, Distribution and Consumption and 4) Civic Ideals and Practices.

In addition, this lesson plan supports the C3 (College, Career, and Civic Life) Framework for Social Studies Standards in all four dimensions: 1) developing questions and planning inquiries, 2) applying disciplinary concepts and tools; 3) evaluating sources and using evidence; and 4) Communicating conclusions and taking informed action.

## National: English Language Arts

Anchored by a primary source, current event article, written in two reading levels, as a springboard to inquiry-based learning, this lesson plan meets multiple standards in Informational Text in the areas of Key Ideas and Details, Craft and Structure, Integration of Knowledge and Ideas, and Range of Reading and Level of Text Complexity.

## Applicable State of Georgia Standards of Excellence: Social Studies

1. Grade 7: S7L1 a and b
2. Grade 7: S7L2 a and b
3. Grade 7: S7L4 a and c
4. High school: SMI1 a and b
5. SMI2 a and b
6. SMI3 b and c
7. SMI6 d
8. SMI8 a, b, and c

**References**

1. *Freedom's Forge: How American Business Produced Victory in World War II* by Arthur Herman ( 2012) ISBN: 978-0-8129-8204-6

2. *Miracle of World War II: How American Industry Made Victory Possible* by Francis Walton (1956)

3. *The Mold in Dr. Florey's Coat: The Story of the Penicillin Miracle* by Eric Lax (2005) ISBN: 978-0-8050-7778-0

4. *The Arsenal of Democracy: FDR, Detroit, and an Epic Quest to Arm an America at War* by A.J. Baime (2014) ISBN: 978-0-544-48387-3 (pbk.)

5. *The Great Influenza: The Story of the Deadliest Pandemic in History* by John M. Barry (2004, 2005, 2009, 2018) ISBN: 978-0-1430-3649-4 (pbk.)

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# Full Force of American Spirit – and Spirits – Hitting COVID-19

**by Judy Stanford Miller**

Reading level 1

March 26, 2020 - Businesses large and small are stepping up to help solve shortages of vital medical equipment and supplies needed by millions of nurses and doctors at hospitals to treat tens of thousands of COVID-19 patients in all 50 states, the District of Columbia and U.S. Territories. Coppercraft Distillery is making hand sanitizer. And Ford Motor Company is using parts from its F-150 truck to make ventilators. The American spirit today is an echo of the WWII Home Front and the Arsenal of Democracy.


*Hand sanitizer being made and bottled at Coppercraft Distillery on March 24, 2020. (Photo: Coppercraft Distillery)*

**Hand sanitizer: Coppercraft Distillery**

Coppercraft Distillery, founded in 2012 in Holland, Michigan, makes premium spirits, bottles of custom craft liquor. Their guiding philosophy is there are no substitutes for superior ingredients, proper aging, and barrel size.

As the COVID-19 pandemic worsened, the spirit of the spirits company drove them to help. Hearing of severe hand sanitizer shortages, their "can do" attitude took over. They are experts in making ethanol, a key ingredient in liquor - and hand sanitizer. It's a perfect fit.

Ali Anderson, Coppercraft national brand manager, said during a March 25, 2020 phone interview they had two procedures from which to choose to make hand sanitizer. One used ethanol so the choice was an easy one. Hand sanitizer has a minimum of 60 percent alcohol to be effective, according to the CDC.

After sourcing other ingredients needed (glycerol, hydrogen peroxide and distilled filtered water), the distillery added a production line this week that can produce 800 gallons of sanitizer per batch. They

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have enough ingredients to make 10,000 gallons of sanitizer, Ali said. Their final formula has 80 percent alcohol. Bottling sanitizer in 32-ounce, half gallon and one gallon containers, they are meeting needs of healthcare communities in Holland and surrounding areas.

Ali said the reaction from across the country has been overwhelmingly positive. They will keep making sanitizer as long as needed or as long as they can obtain ingredients.

**Ventilators and face shields**

On March 24th, Ford Motor Company announced it is joining forces with firms including 3M and GE Healthcare to quickly expand production of urgently needed medical equipment and supplies for healthcare workers, first responders and patients fighting coronavirus. In addition, Ford will be assembling more than 100,000 face shields per week by leveraging its in-house 3D printing capability to produce components for use in personal protective equipment (PPE).

“This is such a critical time for America and the world. It is a time for action and cooperation. By coming together across multiple industries, we can make a real difference for people in need and for those on the front lines of this crisis,” Bill Ford, Ford’s executive chairman, said. “At Ford, we feel a deep obligation to step up and contribute in times of need, just as we always have through the 117-year history of our company.”

Ford team members are working with 3M to increase the manufacturing capacity of their powered air-purifying respirator (PAPR) designs. They are also working jointly to develop a new design leveraging parts from both companies to meet the surge demand for first responders and health care workers.

To go as fast as possible, the Ford and 3M teams have been resourcefully locating off-the-shelf parts like fans from the Ford F-150’s cooled seats for airflow and 3M HEPA air filters to filter airborne contaminants. Airborne contaminants include droplets that may carry virus particles.

“Working with 3M and GE, we have empowered our teams of engineers and designers to be scrappy and creative to quickly help scale up production of this vital equipment,” Jim Hackett, Ford’s president and CEO, said. “We’ve been in regular dialogue with federal, state and local officials to understand the areas of greatest needs. We are focusing our efforts to help increase the supply of respirators, face shields and ventilators that can help assist health care workers, first responders, critical workers as well as those who have been infected by the virus.”

**Reminiscent of WWII Home Front and the Arsenal of Democracy**

It's unbelievably reminiscent of the WWII Home Front and Arsenal of Democracy. Hundreds of millions of Americans are doing their part to defeat an enemy. In 2020, the enemy is a new coronavirus with person-to-person transmission that has rapidly spread around the world. Virologists have already mapped its genome to develop a vaccine, which is currently in clinical trials. In World War II, the first vaccines against the influenza virus were developed. And private pharmaceutical companies played a major role in saving thousands of soldiers' lives on D-Day through mass production of penicillin. Pfizer devoted enormous resources to produce large quantities of penicillin through deep-tank fermentation at a converted ice factory in Brooklyn, New York. Ford brilliantly applied their assembly method of making autos to manufacturing airplanes at their Willow Run Bomber Plant near Detroit. Few people thought it possible. But American spirit and ingenuity did it and today, the nation is doing it again!

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**Vocabulary**

1. shortages: (noun) – situation in which there are not enough of a product or other thing needed
2. vital: (adj.) - needed, important, critical
3. sanitizer: (noun) – chemical compound that cleans, sanitizes
4. ventilators: (noun) – machines that breathe for a patient who cannot breathe on their own
5. substitutes: (noun) – something that is used in place of something else, alternatives
6. superior: (adj.) - better than anything else, the best
7. ingredients: (noun) – items or components that go together to make a product or food
8. attitude: (noun) – the state of how someone feels about something, either positive or negative
9. effective: (adj.) - noted by working and having an impact or effect on something else
10. surrounding: (adj.) - around in a geographic context; nearby
11. urgently: (adverb) – critical, must be addressed right away to fix or cure
12. assembling: (verb) – putting pieces together to make a whole
13. leveraging: (verb) – using something to help or make another process easier or possible
14. capability: (noun) – the state of being capable, able to do something so that it works or meets goals
15. critical: (adj.) - vital, needed, very serious
16. cooperation: (noun) – the state of people working together, cooperating
17. multiple: (adj.) - many
18. obligation: (noun) – promise, need to do something
19. jointly: (adverb) – together
20. resourcefully: (adverb) – creatively, with resources
21. airborne: (adj.) - noted by being in the air
22. contaminants: (noun) – particles that contaminate or make something not clean, pure or ideal
23. empowered: (verb) – given what is needed to get something done
24. dialogue: (noun) – talk, conversation
25. unbelievably: (adverb) – cannot believe, amazing
26. reminiscent: (adj.) – having the quality of jogging the memory because of similar events or time
27. virologists: (noun) – people who are experts in viruses
28. pharmaceutical: (adj.) - related to medicine, pharmacy that dispenses medicine
29. ingenuity: (noun) – state of being creative, innovative, able to solve problems with new ways of doing things

**Review Questions**

1. Why did Coppercraft Distillery decide to make hand sanitizer?
2. What product does Coppercraft Distillery normally make?
3. What product is Ford Motor Company making by using its 3D printers?
4. What are the ingredients in hand sanitizer?

**Inquiry Questions**

1. Why is the work of Coppercraft and Ford reminiscent of the WWII Home Front and the Arsenal of Democracy?
2. Even though both companies are based in Michigan, why is this story national in scope?
3. How is Ford meeting the urgent need for face shields with creative solutions when normally, designing a new product would take months or years?
4. What figure of speech is used in the headline? Discuss.

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# Full Force of American Spirit – and Spirits – Hitting COVID-19

**by Judy Stanford Miller**
Reading level 2

March 26, 2020 - Businesses large and small are stepping up. They are solving shortages of vital medical equipment and supplies. The supplies are needed by millions of nurses and doctors at hospitals. They are caring for tens of thousands of COVID-19 patients. Coppercraft Distillery is making hand sanitizer. And Ford Motor Company is using parts from its F-150 truck to make ventilators. The American spirit today is an echo of the WWII Home Front and the Arsenal of Democracy.


*Hand sanitizer being made and bottled at Coppercraft Distillery on March 24, 2020. (Photo: Coppercraft Distillery)*

**Hand sanitizer: Coppercraft Distillery**
Coppercraft Distillery was founded in 2012 in Holland, Michigan. The company makes premium spirits, bottles of custom craft bottles of liquor. Their guiding philosophy is there are no substitutes for superior ingredients, proper aging, and barrel size.

As the COVID-19 pandemic worsened, the spirit of the spirits company drove them to help. They heard about severe hand sanitizer shortages. Their "can do" attitude took over. As experts in making ethanol, a key ingredient in hand sanitizer, it’s a perfect fit.

Ali Anderson is Coppercraft’s national brand manager. During a March 25, 2020 interview, via phone, she said that they had two procedures from which to choose to make hand sanitizer. They had never made the product before. One procedure used ethanol so the choice was an easy one. Hand sanitizer must have a minimum of 60 percent alcohol to be effective, according to the CDC.

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Other ingredients were needed. Those include glycerol, hydrogen peroxide, and distilled filtered water. Production began this week. They make 800 gallons of sanitizer per batch. They have enough ingredients to make 10,000 gallons, Ali said. Their final formula has 80 percent alcohol. Sanitizer comes in 32 ounce, half gallon and one gallon containers. The distillery is supplying the healthcare communities in Holland and surrounding areas.

Ali said the reaction from across the country has been overwhelming. They will keep making sanitizer as long as needed or as long as they can obtain the other ingredients.

**Ventilators and face shields**

On Tuesday, Ford Motor Company announced it's joining forces with 3M and GE Healthcare. They are expanding production of urgently needed medical equipment and supplies. In addition, Ford will be assembling more than 100,000 face shields per week. Ford will use its in-house 3D printers.

"This is such a critical time for America and the world. It is a time for action and cooperation. By coming together across multiple industries, we can make a real difference for people in need and for those on the front lines of this crisis," Bill Ford, Ford's executive chairman, said. "At Ford, we feel a deep obligation to step up and contribute in times of need, just as we always have through the 117-year history of our company."

Ford team members are working with 3M to increase the manufacturing capacity of their powered air-purifying respirator (PAPR) designs. They are also working jointly to develop a new design with parts from both companies. The new design is needed to meet the surge in demand for first responders and health care workers.

To go as fast as possible, the Ford and 3M teams have been resourcefully locating off-the-shelf parts. Those parts include fans from the Ford F-150's cooled seats for airflow and 3M HEPA air filters. The filters will keep people safe from airborne contaminants such as droplets. Droplets carry virus particles.

"Working with 3M and GE, we have empowered our teams of engineers and designers to be scrappy and creative to quickly help scale up production of this vital equipment," said Jim Hackett, Ford's president and CEO. "We've been in regular dialogue with federal, state and local officials to understand the areas of greatest needs. We are focusing our efforts to help increase the supply of respirators, face shields and ventilators that can help assist health care workers, first responders, critical workers as well as those who have been infected by the virus."

It's unbelievably reminiscent of the WWII Home Front and Arsenal of Democracy. Hundreds of millions of Americans are doing their part to defeat an enemy. In 2020, the enemy is a new coronavirus with person-to-person transmission that has rapidly spread around the world. Virologists have already mapped its genome to develop a vaccine, which is currently in clinical trials.

In World War II, the first vaccines against the influenza virus were developed. Private pharmaceutical companies played a major role in saving thousands of soldiers' lives on D-Day through mass production of penicillin. Pfizer devoted enormous resources to produce large quantities of penicillin through deep-tank fermentation at a converted ice factory in Brooklyn, New York. And Ford brilliantly applied their assembly line method of making autos to making airplanes at the Willow Run Bomber Plant near Detroit. Few people thought it possible. But American spirit and ingenuity did it and today, the nation is doing it again!

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**Vocabulary**

1. shortages: (noun) – situation in which there are not enough of a product or other thing needed
2. vital: (adj.) - needed, important, critical
3. sanitizer: (noun) – chemical compound that cleans, sanitizes
4. ventilators: (noun) – machines that breathe for a patient who cannot breathe on their own
5. substitutes: (noun) – something that is used in place of something else, alternatives
6. superior: (adj.) - better than anything else, the best
7. ingredients: (noun) – items or components that go together to make a product or food
8. attitude: (noun) – the state of how someone feels about something, either positive or negative
9. effective: (adj.) - noted by working and having an impact or effect on something else
10. surrounding: (adj.) - around in a geographic context; nearby
11. urgently: (adverb) – critical, must be addressed right away to fix or cure
12. assembling: (verb) – putting pieces together to make a whole
13. leveraging: (verb) – using something to help or make another process easier or possible
14. capability: (noun) – the state of being capable, able to do something so that it works or meets goals
15. critical: (adj.) - vital, needed, very serious
16. cooperation: (noun) – the state of people working together, cooperating
17. multiple: (adj.) - many
18. obligation: (noun) – promise, need to do something
19. jointly: (adverb) – together
20. resourcefully: (adverb) – creatively, with resources
21. airborne: (adj.) - noted by being in the air
22. contaminants: (noun) – particles that contaminate or make something not clean, pure or ideal
23. empowered: (verb) – given what is needed to get something done
24. dialogue: (noun) – talk, conversation
25. unbelievably: (adverb) – cannot believe, amazing
26. reminiscent: (adj.) – having the quality of jogging the memory because of similar events or time
27. virologists: (noun) – people who are experts in viruses
28. pharmaceutical: (adj.) - related to medicine, pharmacy that dispenses medicine
29. ingenuity: (noun) – state of being creative, innovative, able to solve problems with new ways of doing things

**Review Questions**

1. Why did Coppercraft Distillery decide to make hand sanitizer?
2. Where is Coppercraft located?
3. How long has Coppercraft been in business?
4. What product does Coppercraft Distillery normally make?
5. What product is Ford Motor Company making by using its 3D printers?
6. What are the ingredients in hand sanitizer?

**Inquiry Questions**

1. Why is the work of Coppercraft and Ford reminiscent of the WWII Home Front and the Arsenal of Democracy?
2. Even though both companies are based in Michigan, why is this story national in scope?
3. How is Ford meeting the urgent need for face shields without following their normal design process that can take months or years?
4. What figure of speech is used in the headline? Discuss.

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# WORKSHEET– Lesson #2

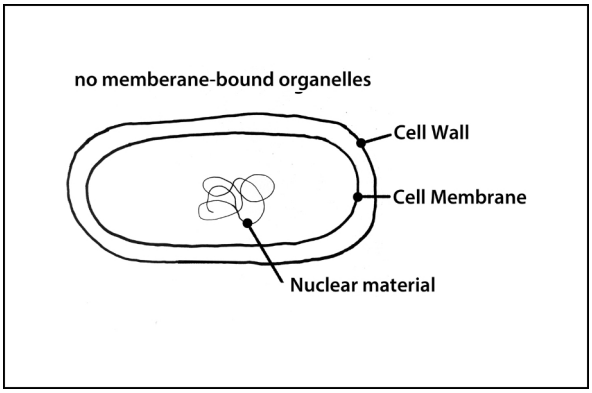
**Name:**_____

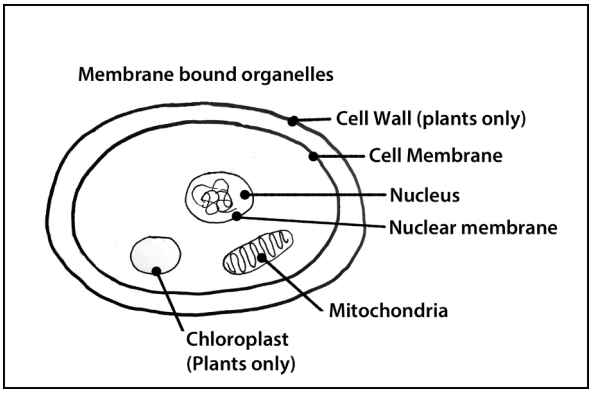
**Class:** _____

**COVID-19 Pandemic Response, an echo of the WWII Home Front and Arsenal of Democracy**

**Constructs #3 and #4**

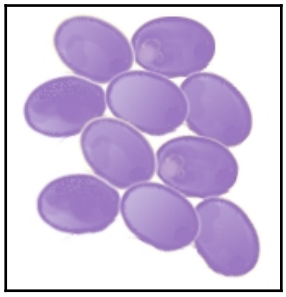
1. Label the following diagrams

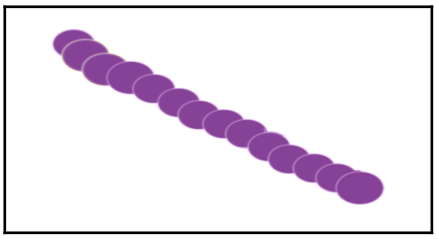



a. _____

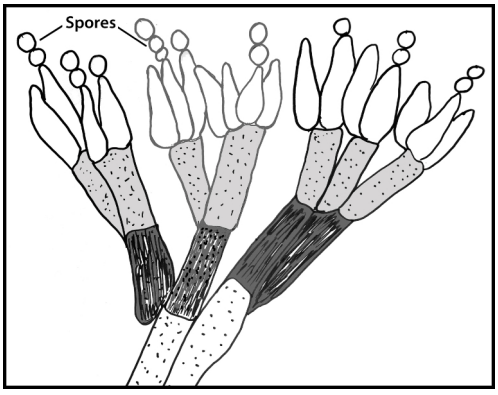
b. _____

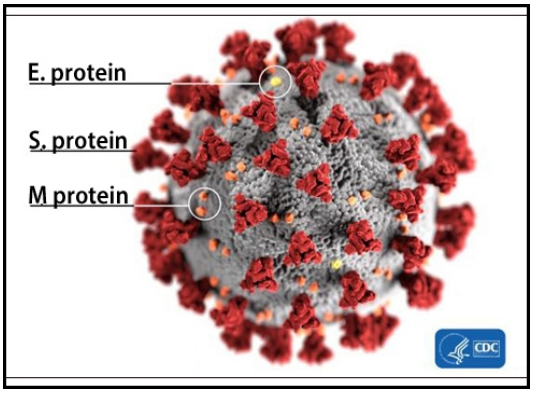




c. _____

d. _____




e. _____

f. _____

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2. Order the following microbes from largest to smallest with #1 being the largest.

_____ strep

_____ COVID-19

_____ rhinovirus

_____ norovirus

_____ E. coli

3. What fraction of a meter is a micron (mm)? _____

4. What fraction of a meter is a nanometer (nm)? _____

5. Name two viruses that cause respiratory diseases:

a. _____

b. _____

6. What is the definition of a virus? _____

7. Describe the process of how the COVID-19 virus enters a human cell?

| |
|---|
| |
| |
| |
| |

8. What is the name of the relationship between normal E. coli bacteria and cells in the intestinal tract?

_____

9. What is the name of the relationship between toxin-producing E. coli bacteria and cells in the intestinal tract?

_____

10. Name the bacteria that divides along two planes. Draw an example below.

Bacteria: _____

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**Answers**

1. Labels
   a. Prokaryotic cell
   b. Eukaryotic cell
   c. Streptococci bacteria (Strep)
   d. Staphylococci bacteria (Staph)
   e. Penicillium mold
   f. virus – COVID-19 (coronavirus)

2. 2,3,5,4,1

3. 1/1,000,000

4. 1/1,000,000,000

5. rhinoviruses, influenza viruses or coronaviruses

6. obligate, intracellular parasites

7. Protein spikes on the surface first allow the virus to attach to a human cell and then are able to poke holes in the human cell membrane to gain entrance into the cell. Once inside, the virion takes over the cell and directs the cell to make more viral components. Normal cell function is shut down.

8. symbiotic or mutualistic

9. parasitic

10. Staph (look like a bunch of grapes)

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# QUIZ: Lesson Plan 2

**COVID-19 Pandemic Response: an Echo of the WWII Home Front and Arsenal of Democracy**

1. Of the following microbes, which one is the smallest?
   **a.** Staph
   **b.** Strep
   **c.** Norovirus

2. Of the following microbes, which one is the largest?
   **a.** E. coli
   **b.** Coronavirus
   **c.** Rhinovirus

3. What is the primary difference between prokaryotic cells and eukaryotic cells?
   **a.** the type of nucleic acid in the nucleus
   **b.** membrane-bound organelles
   **c.** type of cell wall

4. During the 1918 influenza pandemic, what world event had a major impact on the transmission of the virus around the world?
   **a.** World War I
   **b.** World War II
   **c.** Spanish-American War

5. How was the virus that caused the 1918 influenza pandemic reconstructed in 2005 at the CDC?
   **a.** from scientists finding the complete virus in frozen lung tissue
   **b.** from scientists synthesizing the viral genome
   **c.** from scientists working together with separate tissue samples

6. What is the definition of a virus?
   **a.** obligate, intracellular parasite
   **b.** obligate, intercellular bacterial
   **c.** obligate, extracellular virion

7. From what microbe is penicillin produced?
   **a.** Mold
   **b.** yeast
   **c.** staph

8. In the public-private partnership that resulted in the mass production of penicillin, what was the private company that ultimately produced about one-half of the world's penicillin?
   **a.** Merck
   **b.** Pfizer
   **c.** Lederle

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9. Of the following, what best describes how a virus enters a cell?
   **a.** the virus inactivates the cell first and then gains entry
   **b.** the virus attaches and pokes holes in the cell membrane
   **c.** the virus is able to absorb the cell and use its parts

10. What world event was happening at the same time Howard Florey, Ernst Chain, and Norman Heatley were researching and testing penicillin on mice?
   **a.** World War I
   **b.** German Blitz during World War II
   **c.** Japanese attack on Pearl Harbor

11. What gives plants their rigid structure?
   **a.** cell wall
   **b.** cell membrane
   **c.** mitochondria

12. If you have a culture of 4 strep bacteria and the bacteria divide every 20 minutes, how many strep bacteria will you have in two hours?
   **a.** 64
   **b.** 128
   **c.** 256

13. From what portion of a virus are vaccines made?
   **a.** protein spikes
   **b.** RNA
   **c.** cytoplasm

14. About how many people died from influenza during the 1918 pandemic?
   **a.** 5 million
   **b.** 50 million
   **c.** 500 million

15. How did researchers find the strain of Penicillium mold that produced large quantities of penicillin?
   **a.** on a moldy cantaloupe at a food market
   **b.** by accident when a window was left open
   **c.** by combining two different species

16. What did British researchers do in 1941 to make sure their Penicillium mold cultures survived the Blitz?
   **a.** they froze the cultures
   **b.** they transferred portions to glass slides
   **c.** they rubbed spores on their clothes

17. What innovation did Pfizer develop that solved the problem of producing penicillin in large quantities?
   **a.** tube fermentation
   **b.** deep-tank fermentation
   **c.** gas fermentation

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18. What is the main difference between gram positive bacteria and gram negative bacteria?
    **a.** one has a cell wall and the other does not
    **b.** one has membrane-bound organelles and the other does not
    **c.** one has thicker layers in the cell wall than the other

19. What award was given jointly to Alexander Fleming, Dr. Howard Florey and Erst Chain for the discovery of penicillin?
    **a.** Nobel Prize in Physiology and Medicine
    **b.** Congressional Medal of Freedom
    **c.** Legion of Honor

20. Of the following, what best describes the discovery of penicillin?
    **a.** It was a concentrated effort over 5 years that yielded purified penicillin.
    **b.** It was an effort that took many years of work by many scientists.
    **c.** It began as a formal research project that evolved from a research paper.

21. Of the following, which action is recommended by the CDC for handwashing?
    **a.** scrub for at least 15 seconds and preferably 20 seconds
    **b.** lather with soap and rinse with warm water
    **c.** lather with soap and rinse with cold water

22. The new COVID-19 virus has a genome that is similar to a coronavirus isolated from what animal?
    **a.** Monkey
    **b.** camel
    **c.** bat

23. What is the preliminary evidence about how COVID-19 is mainly transmitted?
    **a.** prolonged close contact
    **b.** breathing contaminated air
    **c.** hard surfaces

24. What did scientists conclude to explain the highly virulent nature of the 1918 influenza virus?
    **a.** due to crowded barracks as soldiers trained and were deployed
    **b.** due to many features of the viral genome
    **c.** due to the lack of medicine to treat it

25. What is the chemical foundation of penicillin?
    **a.** benzene ring
    **b.** carbon-sulfur ring
    **c.** beta-lactam ring

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## ESSAY

In the space below, cite one example of a public-partnership during WWII and one from the current COVID-19 pandemic. How are the two similar? How are the two different?

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**Answers**

1. c
2. a
3. b
4. a
5. c
6. a
7. a
8. b
9. b
10. b
11. a
12. c
13. a
14. b
15. a
16. c
17. b
18. c
19. a
20. b
21. a
22. c
23. a
24. b
25. c

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