

Lesson 2 – Case Study: The 1918 Influenza Pandemic – Factors Beyond the Biological that Influence the Spread of Disease

LESSON QUESTIONS

- How does influenza virus change to cause a pandemic?
- How do social and political factors affect the spread of disease?

LESSON OBJECTIVES

- Recognize that the impact of influenza virus depends in part on how the virus mutates.
- Discuss social and political factors that affected the spread of influenza in 1918.

OVERVIEW

Students learn the different ways that influenza virus can mutate and what impact that has on how rapidly and widely the virus spreads. The class develops a hypothesis regarding the impact of World War I on the spread of influenza. Student groups research topics related to the 1918 influenza pandemic and present their findings to the class for a discussion and assess whether the findings support or reject the class hypothesis. Students then explore the topics in more detail in a writing exercise using the RAFT writing technique.

LENGTH

Up to two 45-minute sessions

GLOSSARY TERMS

antigenic drift, antigenic shift, epidemic, genotypes, hemagglutinin, neuraminidase, pandemic, 1918 influenza pandemic

STANDARDS

Next Generation Science Standards

- Disciplinary Core Ideas in Life Sciences
 - All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins.

- Science and Engineering Practices
 - Asking Questions and Defining Problems
 - Ask questions that arise from examining models or a theory, to clarify and/or seek additional information and relationships.
 - Ask questions to determine relationships, including quantitative relationships, between independent and dependent variables.
 - Planning and Carrying Out Investigations
 - Plan an investigation or test a design individually and collaboratively to produce data to serve as the basis for evidence as part of building and revising models, supporting explanations for phenomena, or testing solutions to problems. Consider possible variables or effects and evaluate the confounding investigation's design to ensure variables are controlled.
 - Constructing Explanations and Designing Solutions
 - Apply scientific reasoning, theory, and/or models to link evidence to the claims to assess the extent to which the reasoning and data support the explanation or conclusion.
 - Obtaining, Evaluating, and Communicating Information
 - Critically read scientific literature adapted for classroom use to determine the central ideas or conclusions and/or to obtain scientific and/or technical information to summarize complex evidence, concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.
 - Gather, read, and evaluate scientific and/or technical information from multiple authoritative sources, assessing the evidence and usefulness of each source.
- Crosscutting Concepts
 - Cause and Effect: Events have causes, sometimes simple, sometimes multifaceted. Deciphering causal relationships, and the mechanisms by which they are mediated, is a major activity of science and engineering.
 - Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.

- Scale, Proportion, and Quantity: In considering phenomena, it is critical to recognize what is relevant at different size, time, and energy scales, and to recognize proportional relationships between different quantities as scales change.
 - The significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs.
- Stability and Change
 - Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible.
- Connections to the Nature of Science
 - Scientific Investigations Use a Variety of Methods
 - Science Knowledge is Based on Empirical Evidence
 - Scientific Knowledge is Open to Revision in Light of New Evidence
 - Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena

Common Core State Standards

- CCSS.ELA-LITERACY.RST.9-10.1
Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.
- CCSS.ELA-LITERACY.RST.11-12.1
Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.
- CCSS.ELA-LITERACY.RST.9-10.5
Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy).
- CCSS.ELA-LITERACY.RST.11-12.5
Analyze how the text structures information or ideas into categories or hierarchies, demonstrating understanding of the information or ideas.

- CCSS.ELA-LITERACY.RST.9-10.9
Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts.
- CCSS.ELA-LITERACY.RST.11-12.9
Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.
- CCSS.ELA-LITERACY.W.9-10.3; CCSS.ELA-LITERACY.W.11-12.3
Write narratives to develop real or imagined experiences or events using effective technique, well-chosen details, and well-structured event sequences.
- CCSS.ELA-LITERACY.W.9-10.9; CCSS.ELA-LITERACY.W.11-12.9
Draw evidence from literary or informational texts to support analysis, reflection, and research.
- CCSS.ELA-LITERACY.SL.9-10.1
Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grades 9-10 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively.
- CCSS.ELA-LITERACY.SL.11-12.1
Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grades 11-12 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively.
- CCRA.R.1
Read closely to determine what the text says explicitly and to make logical inferences from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text.
- WHST.11-12.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.

- WHST.11-12.2.B Develop the topic thoroughly by selecting the most significant and relevant facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic.
- CCRA.SL.4
Present information, findings, and supporting evidence such that listeners can follow the line of reasoning and the organization, development, and style are appropriate to task, purpose, and audience.

MATERIALS

- Student worksheet
- Computer with internet access

BACKGROUND FOR TEACHER

Influenza viruses are capable of dramatic changes to the viral genome, called antigenic shift. When a dramatically different strain forms, it creates a high level of susceptibility among the world's population. Because virtually no one is immune to this new strain of influenza, it has vast opportunities to spread and under the right conditions, can lead to a pandemic. The words influenza pandemic to ever occur happened in 1918. While the biological nature of the virus set the stage for the pandemic, this lesson gets students thinking about the state of scientific understanding at the time as well as the political role that world affairs, such as WWI, may have played in this historic event.

TEACHER NOTES

Students should have a general understanding that influenza differs from other vaccine-preventable diseases in that people need a yearly vaccine in order to have protection against the virus because the virus undergoes regular small mutations. They should also grasp that when conditions are suitable the virus can change dramatically to cause widespread illness called a pandemic. They should be aware that the worst pandemic occurred in 1918. You may also wish to review how influenza spreads from person to person, specifically, that infection spreads through exposure to respiratory secretions of those who are infected, such as by coughing, sneezing or touching surfaces that have those secretions and then touching one's eyes, nose, or mouth.

LESSON RESOURCES

- Lesson animation:
 - *Antigenic Drift: How the Influenza Virus Adapts*
<https://vimeo.com/227179689>
 - Lesson glossary
 - Reading passage:
 - A Disease Like No Other
 - Additional resources that may be helpful:
 - *Animation Expedition #9 – Antigenic Shift and Drift: How Does Influenza Adapt?*:
<https://vaccinemakers.org/news-events/animation-expedition-9-antigenic-shift-and-drift-how-does-influenza-adapt>
 - *Going Viral: The Mother of all Pandemics* Podcast:
<http://goingviralthepod.libsyn.com>
 - *The Great Influenza: The Story of the Deadliest Pandemic in History* book by John M. Barry:
https://www.goodreads.com/book/show/29036.The_Great_Influenza
 - RAFT writing strategy <http://www.readwritethink.org/professional-development/strategy-guides/using-raft-writing-strategy-30625.html>
 - For Extension activity:
 - Morbidity and Mortality Weekly Report (MMWR), Centers for Disease Control and Prevention,
<https://www.cdc.gov/mmwr/index2018.html>*
- *Note, to access the MMWR for subsequent years, replace 2018 in the URL with the current year, or visit the VMP website to access the most recent teacher lesson plan.

ENGAGE

1. Ask students what they know about how influenza (flu) spreads.
2. Ask students what they know about the difference between an influenza epidemic and an influenza pandemic.
3. Show the animation, *Antigenic Drift: How the Influenza Virus Adapts*
4. After the animation, point out that the virus spreads in the same way, but that during a pandemic because of biological (genetic) changes, virtually everyone is susceptible.
5. Introduce the 1918 influenza pandemic as the worst pandemic in history.
6. Ask students what else was going on in the world in 1918. Once World War I (WWI) has been identified, ask students if they think that the war may have had an effect on the transmission of the virus.

7. Work as a class to create an hypothesis related to the war and its effects on the pandemic. Explain that as a class, you are going to do research to test the hypothesis.
Sample hypotheses:
 - WWI contributed to the spread of flu virus during the 1918 pandemic.
 - WWI did not contribute to the spread of flu virus during the 1918 pandemic.
8. Have students complete the vocabulary table on page 1 of the student worksheet.

EXPLORE

1. Have students read the passage about the 1918 pandemic and answer the questions on page 2 of the student worksheet.
2. Divide the class in to groups so that there are 9 groups.
3. Assign one of the following topics to each group or put each of the following on a slip of paper and have groups each choose one slip:
 - a. When influenza virus was discovered and what was known about it in 1918
 - b. Symptoms of 1918 pandemic, who was getting ill and what illness was like
 - c. Importance of Haskell County, Kansas to 1918 pandemic
 - d. Experience at Camp Devens during Fall 1918
 - e. U.S. Public Health Service during 1918 pandemic
 - f. Origin of nickname “Spanish flu”
 - g. Sedition Act as it related to WWI
 - h. Role of media in 1918 pandemic
 - i. Liberty Loan Campaign during WWI, particularly Liberty Loan Parade in Philadelphia
4. Have groups research their topic and prepare a brief class presentation to share their findings with the class.

EXPLAIN

1. Have all groups share their presentations with the class.
2. After each presentation, have a short class discussion related to whether the presentation provides support for or against the class hypothesis.
3. Add information on a board that the class can see or have students record information in their notebooks.
4. After all presentations, have students discuss whether the findings support or reject the class hypothesis related to the relationship between WWI and the 1918 pandemic.

ELABORATE

Have each student use the RAFT writing strategy to develop an idea from the class discussion.

EVALUATE

Evaluate student understanding based on their RAFT assignment, small group presentations, and class discussions.

EXTENSION

Have students compare and contrast the role of political and social influences on the spread of disease in 1918 and now. Students can be encouraged to search for examples of reports of disease transmission in the media, public health publications (e.g., Morbidity and Mortality Weekly Reports [MMWR]), or by reviewing important historical events for mentions of infectious diseases.

Formats for this activity can be a class discussion, preparation of a written report or class presentation, or a second RAFT writing assignment.

RUBRIC: STUDENT WORKSHEET

Vocabulary table

- Refer to the lesson glossary for correct definitions.

Reading Passage Reflection

1. Why is the influenza vaccine given every year?

Because the influenza virus changes, the immune system does not always recognize it from year to year. Scientists have not yet been able to create a vaccine that provides long-term protection, so in order to be protected, people need to get immunized each influenza season.

2. What causes an influenza pandemic?

The changes to the influenza virus are usually slight, but sometimes the virus changes dramatically. The result is that most people's immune systems don't recognize it.

3. How many waves did the 1918 pandemic have and how did the waves differ?

The 1918 pandemic had three waves. Most people recovered after becoming ill from the first wave. During wave two, the virus changed to become more deadly causing severe symptoms and death, often within hours. Many healthy, young adults died during the second wave. Wave three was less deadly than wave two, due to another change in the virus and the fact that so many people had already been infected. Even so, wave three was more deadly than wave one.

4. List and describe one or two additional facts that you learned from the reading.

Answers will vary but may include:

- The 1918 pandemic is considered the worst in history.
- It is estimated that one out of three people in the world were infected with influenza during the pandemic.
- It is estimated that between 50-100 million people died during the pandemic.
- Many healthy young adults were killed by the pandemic.
- So many people died that communities could not keep up with proper body disposal.

RUBRIC - EXPLORE: Topics for Student Research

Below are examples of facts and information students may find as they research the topics in the list from Explore. Although presentations can be done in any order, the information in the presentations will build more systematically, making it easier for students to see the big picture, if they are shared in the order presented below.

a) When influenza virus was discovered and what was known about it in 1918

At the time of the pandemic, influenza virus had not yet been discovered. Many doctors and scientists thought that *Haemophilus influenzae* type b (Hib), a bacterial infection, was the cause of illness because Hib bacteria were found in some, but not all, autopsies. Type A influenza, the kind that causes pandemics, was not identified until 1933.

b) Symptoms of 1918 pandemic, who was getting ill and what illness was like

Typically, the elderly are most negatively affected by influenza, but during the 1918 pandemic, young healthy adults were dying. It is believed that this was because of overzealous immune responses in younger individuals. Pregnant women always tend to be more negatively affected by influenza and other respiratory infections than non-pregnant women of the same age because of the physical changes to their bodies, such as increased fluid volumes. However, during the 1918 pandemic,

pregnant women were particularly adversely affected, as indicated by estimates that 1 of every 3 or 4 pregnant women infected with the virus died.

Early symptoms of disease were those typical of influenza: fever, sore throat, and headache. As symptoms progressed, victims had trouble breathing and many would turn blue and exhibit bleeding from the nose and mouth. The darker people's skin became, the less likely they would survive. Often, people died within hours.

c) Importance of Haskell County, Kansas to 1918 pandemic

It is unclear where the influenza virus that caused the 1918 pandemic originated; however, many believe that it started in Haskell County, Kansas. Other theories suggest France or China as possible locations of origin. In early March, soldiers from Haskell County traveled to central Kansas. Within 2 weeks, thousands were ill. Around 1,100 soldiers were hospitalized, and 38 died. The disease spread quickly throughout the U.S. as soldiers exposed to the virus traveled to and from home and between camps.

d) Experience at Camp Devens during Fall 1918

In September 1918, the second wave of the pandemic started. Soldiers at Camp Devens, outside of Boston, became ill with influenza. Because of travel to and from camp into the community and to other camps, the virus spread rapidly. Illness during the second wave was more severe than during the earlier wave, causing hospitals to quickly become overwhelmed.

e) U.S. Public Health Service during 1918 pandemic

Unlike today's Centers for Disease Control and Prevention (CDC), in 1918 the U.S. Public Health Service (PHS) was not a federal coordinating body, and doctors and clinicians were not required to report disease. One of the main tasks of the PHS was monitoring and maintaining the health of military personnel. However, once public health officials realized the severity and scope of the pandemic, the Surgeon General at the time, Rupert Blue, spearheaded measures to address the crisis. Actions included instituting weekly reporting, assigning state coordinators, identifying volunteer forces, conducting educational campaigns, and closing public gathering places.

f) Origin of nickname “Spanish flu”

During World War I, when the pandemic struck, countries engaged in the conflict did not openly share reports about influenza. Leaders feared the opposition might view the disease outbreaks as a sign of weakness. Since Spain was neutral in the war, they more openly shared information about the illness spreading in their communities, such as through news reports. As a result, the story that emerged was that the virus started in Spain, leading to the nickname, “Spanish flu.” Even though the virus did not originate in Spain, the nickname stuck.

g) Sedition Act as it related to WWI

The Sedition Act of 1918 was in effect between April 1917 and March 1919, which made any spoken or written word against the U.S. government or the war a prosecutable crime. The position of the government at the time was that the country’s strength in the war was more important than the truth, as depicted in this quote from an advisor to the president, “Truth and falsehood are arbitrary terms....The force of an idea lies in its inspirational value. It matters very little if it is true or false.”

h) Role of media in 1918 pandemic

Because of the Sedition Act, media reports did not accurately account the situation related to influenza. Public health officials also shared limited information or lied about the severity of outbreaks. Newspaper headlines and public reports tended to minimize the seriousness of the situation, claiming that the disease was “plain la grippe,” – the 1918 version of “just the flu” – when in reality disease was widespread and severe. The U.S. was not the only country downplaying the effects of influenza in media reports; other countries were also hiding the severity of the situation.

i) Liberty Loan Campaign during WWI, particularly Liberty Loan Parade in Philadelphia

Liberty Loans were bonds sold to raise money for the war effort. Purchasing these war bonds was viewed as a patriotic act. In September 1918, the Liberty Loan Parade was scheduled to be held in Philadelphia. Even though officials were aware of widespread disease in nearby army camps, they opted to hold the parade as scheduled. They did this for a few reasons, such as not wanting to cause public panic about the disease and to meet bond quotas. More than 200,000 people attended the parade. As a result, the virus spread rapidly throughout the city. Within a week, 2,600 people had died. In an attempt to control the spread of disease, the city shut down public spaces including schools, churches, and theaters.