Eli Lilly and Company and the Salk Polio Vaccine

Introduction

This lesson coordinates with the You Are There 1955: Ending Polio component of the Indiana Experience at the Eugene and Marilyn Glick Indiana History Center. In this experience, visitors are invited to become a part of the action as Eli Lilly and Company employees work to package and ship vials of Jonas Salk’s polio vaccine to devastated communities nationwide. Visitors interact with assembly-line workers and learn how this Indiana company helped end America’s polio panic. The curriculum is intended to provide historical context for the nationwide public health crisis of polio, the celebrated creation of the polio vaccine, and the importance of the pharmaceutical industry to Indiana’s economy. The lesson may be used to prepare students for a visit to the You Are There 1955: Ending Polio experience or it may be used as a follow-up to a visit. In addition, the historical context and themes will be relevant to classroom instruction even if a visit is not possible. You Are There 1955: Ending Polio will remain open through September 14, 2013.

Overview/Description

In this lesson students will learn about the race to create a polio vaccine, the science behind the Salk polio vaccine, and Eli Lilly and Company’s production of the Salk polio vaccine.

Grade Level

Elementary (grade four)

Academic Standards

Social Studies 4.1.13–Identify and describe important events and movements that changed life in Indiana from the mid-twentieth century to the present.

Social Studies 4.4.7–Identify entrepreneurs who have influenced Indiana and the local community. (Example, Eli Lilly)

Science 4.4.11 2000–Explain that there are some diseases that human beings can only catch once. Explain that there are many diseases that can be prevented by vaccinations so that people do not catch them even once.

Health and Wellness 4.1.5–Explain how to prevent illness by seeking care from medical personnel. (ex. Immunizations)

Health and Wellness 4.5.1–Explain situations that may require a thoughtful health-related decision.

Health and Wellness 4.7.3–Describe behaviors to reduce health risks.
Math 4.1.4–Order and compare whole numbers using symbols for “less than” (<), “equal to” (=), and “greater than” (>).

Math 4.6.2–Interpret data graphs to answer questions about a situation.

CCS Informational Texts 1.4.2–Determine the main idea of a text and explain how it is supported by key details; summarize the text.

CCS Informational Text 1.4.7–Interpret information presented visually, orally, or quantitatively (e.g., in charts, graphs, diagrams, time lines, animations, or interactive elements on Web pages) and explain how the information contributes to an understanding of the text in which it appears.

CCS Informational Text 1.4.9–Integrate information from two texts on the same topic in order to write or speak about the subject knowledgeably.

CCS Informational Text 1.4.10–By the end of year, read and comprehend informational texts, including history/social studies, science, and technical texts, in grades 4 to 5 text complexity band proficiently, with scaffolding as needed at the high end of the range.

CCS Writing 1.4.3–Write narratives to develop real or imagined experiences or events using effective technique, descriptive details, and clear event sequences.

a. Orient the reader by establishing a situation and introducing a narrator and/or characters; organize an event sequence that unfolds naturally.

b. Use dialogue and description to develop experiences and events or to show the responses of characters to situations.

c. Use a variety of transitional words and phrases to manage the sequence of events.

d. Use concrete words and phrases and sensory details to convey experiences and events precisely.

e. Provide a conclusion that follows from the narrated experiences or events.

Science and Social Studies/Historical Concepts

Scientific innovation, the polio pandemic of the 1940s and 1950s, industry in Indiana, and entrepreneurs in Indiana

Learning/Instructional Objectives

Students will be able to:

• Name Eli Lilly and Company as one of the five American companies that manufactured the Salk polio vaccine.

• Describe the role of the vaccine in eliminating polio in the United States.
• Describe the way in which a vaccine works to prevent infection.
• Recognize the sense of urgency that surrounded the race to develop a vaccine for polio.

Time Required

One class period

Materials Required

• Copies of “Case and Death Rates for Polio in United States–1915-1952” from 1954 National Foundation for Infantile Paralysis Speaker’s Handbook (Courtesy, Eli Lilly and Company Archives; see page nine of this lesson)
• Copies of “Polio Age Pattern –1952” from 1954 National Foundation for Infantile Paralysis Speaker’s Handbook (Courtesy, Eli Lilly and Company Archives; see page ten of this lesson)
• Copies of excerpts of the Indianapolis Star article, “Thrilled by Salk Success, Indiana’s Doctors Act to Immunize 270,000” (Wednesday morning, April 13, 1955) (Courtesy, Indianapolis Star, see page 12 of this lesson)
• Copies of Student Worksheet for “Thrilled by Salk Success, Indiana’s Doctors Act to Immunize 270,000” (see page 14 of this lesson)

Background/Historical Context

Refer to the “Polio and Lilly Background Essay” for more information.

Teacher’s Instructional Plan

Introduction

Introduce the lesson by reviewing with students how polio outbreaks in the 1940s to 1950s constituted a public health crisis (see “What is Polio?” Lesson plan). In order to reinforce this concept, distribute copies of the “Case and Death Rates for polio in United States–1915-1952” from the 1954 National Foundation for Infantile Paralysis speaker’s guide (see page nine of this lesson). Together as a class, analyze the chart.

• Ask students to identify the three years with the highest number of cases of polio (1916, 1949, and 1952).
• Ask them to determine whether or not these were also the years with the highest rate of polio cases per 100,000 people and the highest number of deaths (yes, they are).
Do these years have the highest “case fatality rate” (meaning the number of deaths divided by the number of cases)? (No, they don’t.) Ask students to speculate as to why that might be. In order to assist students with this last question, point out the general pattern of decreasing case fatality rates as time progressed (the exception occurs in the mid-to-late 1930s). Ask students if they think that advances in technology and medical knowledge might have led to lower death rates/higher recovery rates.

Discuss with students the different types of polio and explain how the disease could be fatal if the muscles controlling breathing and swallowing were paralyzed:

- Spinal polio is the most common form of paralytic polio. The virus produces inflammation of nerve cells, causing the muscles to no longer receive signals from the brain or spinal cord. Fever and muscle pain can quickly lead to paralysis, the severity of which depends on the region of the spinal cord affected.

- Bulbar polio accounts for nearly 2 percent of polio cases. It occurs when the poliovirus invades and destroys nerves within the bulbar region of the brain stem, leading to a host of symptoms including difficulty breathing, speaking, and swallowing; muscle weakness; facial weakness; and respiratory arrest. This type of polio can be fatal.

- Bulbospinal polio makes up approximately 19 percent of cases and results from a combination of symptoms from both spinal and bulbar infections. Here, the virus affects the upper part of the cervical spinal cord and causes paralysis of the diaphragm, which interferes with the ability to breathe. It can lead to paralysis of the arms and legs and also affects the heart.

Now that students have examined the “Case and Death Rates for Polio in United States–1915-1952” chart, ask them if they would qualify the polio outbreaks in the twentieth century as a public health crisis (see glossary for definition of “public health”). Students should justify their answers.

Also, distribute to students the “Polio Age Pattern–1952” chart from the 1954 NFIP speaker’s guide (see page ten of this lesson). Again, analyze the chart together as a class, or have the students work together in small groups to analyze it.

Ask students to identify the four ages that had the highest admission rate per 100,000 population in 1952. (Ages three, four, five, and six)

In addition, ask students to look at the very bottom of the chart. There, percentages of all admissions are listed for age ranges. Ask students to identify what percentage of all admissions was accounted for by admissions of children ages zero to nine? Ask students if
that information would make them more likely to classify the polio outbreaks in the twentieth century as a public health crisis. Why or why not?

Tell students that these facts and figures represent the reasons why the NFIP, which was founded in 1938 by President Franklin D. Roosevelt, battled polio by raising money to support research into a vaccine that could prevent polio.

Even before the NFIP was founded, scientists had been working to develop a polio vaccine that would prevent this dreaded illness. However, the early vaccines all had problems—one was believed to have caused several cases of polio and another caused severe allergic reactions.

The work of scientists in the 1940s paved the way for the development of a safe and effective vaccine in several ways. Scientists John Enders and Thomas Weller, for example, figured out how to grow the poliovirus outside of the human body in non nervous system tissue. This meant that a lot of poliovirus could be made and used to create a vaccine.

By the early 1950s several researchers were experimenting with polio vaccines. Jonas Salk from the University of Pittsburgh was one of them. His work was funded by the NFIP. Salk used his experience in creating an influenza vaccine to help him develop the polio vaccine. His vaccine was made with killed poliovirus. When injected, the killed virus caused the body to create antibodies that attacked the killed poliovirus. In the future if the subject contracted polio the body would recognize the poliovirus and have antibodies to fight it off.

Salk began testing his vaccine in a huge field trial in 1954. Millions of school children in the second through fourth grades either received doses of the vaccine or a placebo shot that was a saline (salt and water) solution. The children receiving the saline shots were the “control group” and provided data against which to compare the results of what happened to the children who received the actual vaccine. Eli Lilly and Company produced Salk vaccine to supply the field trials, but also to stockpile so that it could be ready if and when the government approved the vaccine for use by the general public.

On April 12, 1955, Salk announced the results of the field trials. The vaccine had been successful in preventing at least 68 percent of paralytic polio cases.¹

Salk was not the only researcher working on a polio vaccine. Another scientist, Albert Sabin, was developing a polio vaccine at the same time. However, Sabin’s vaccine was an “attenuated” vaccine that used a weakened form of the live poliovirus to produce antibodies in the subject. Eight years after Salk’s success, Sabin finished work on his vaccine. Although the Salk vaccine

hit the market first, the Sabin vaccine was commonly used beginning in the 1960s until fairly recently. Today, doctors use a version of Salk’s original product.

Procedure

• Distribute copies of excerpts of the *Indianapolis Star* article titled, “Thrilled by Salk Success, Indiana’s Doctors Act to Immunize 270,000,” from the morning of April 13, 1955. Also distribute the accompanying student worksheet (see page 12 of this lesson). A copy of the complete article is also included for your reference (see pages 13-14 of this lesson).

• Allow twenty minutes for students to work in small groups to complete the student worksheet in which they analyze the newspaper article.

• After analyzing the newspaper article, have students write a letter from the perspective of an employee of Eli Lilly and Company. Have the students address the news about the vaccine’s approval—is this a historic moment or not? Do they feel that their work producing the vaccine at the company is important work? Why or why not? Do they have any worries about working with a vaccine that contains the poliovirus, even though it has been killed? If they have children, will they vaccinate their children with this new vaccine? Do they feel hopeful that the vaccine will help eliminate the yearly polio epidemics?

Glossary

Public Health—The science and practice of improving the health of a community through preventive practices such as immunizations, health education, sanitation, disease control, etc. A crisis of public health happens when a disease is not controlled for one reason or another.

Antibodies—Antibodies are proteins in the blood that our body produces in response to the presence of antigens (toxins, bacteria, or diseases such as the poliovirus). They are part of our immune system’s response to disease and help to fight off the disease.

Killed virus vaccine—A vaccine made from killed, or inactivated, virus that still has the ability to cause the production of antibodies in the blood, leading to immunity against a disease. The virus is usually killed by heating it or adding a chemical called formaldehyde.

Attenuated vaccine—A vaccine made from a weakened form of virus that causes the body to produce antibodies in the blood, leading to immunity against a particular disease.
Assessment

Use a teacher-developed rubric to assess student analysis of primary sources, participation in class discussions, and journaling activity.

Suggested Modifications

- Distribute copies of the image of a doctor giving a girl the polio vaccine (see page X of this lesson). Tell students that this image shows a doctor giving a young girl the Salk polio vaccine. Hold a think-aloud discussion about vaccines. Ask students if they have ever received a vaccine before? How did they feel about getting a shot? What are the benefits of vaccines? How can they keep you and others around you healthy? Some people do not like to use vaccines because they fear the vaccine can give them the very disease it is meant to prevent. Why do you think people would have this fear? (Hint: some people feared that the killed poliovirus in the polio vaccine might still have the power to give them or their children polio.) Others fear that vaccines can leave them at risk for other diseases. This has generally been proven to be false.

Additional Resources

Publications


For grades 6-10; this book covers Salk’s early years and the struggles he faced as he developed the polio vaccine. It also discusses other scientists whose work contributed to discovering pieces of the puzzle necessary to produce the polio vaccine. Finally, the author addresses Franklin D. Roosevelt’s struggle with polio and his creation of the National Foundation for Infantile Paralysis.


Breedson’s book describes the polio epidemics and explains the concepts of virus, bacteria, vaccine, and antibody to students with little science background. It also discusses Salk’s discovery of the polio vaccine and devotes text to his research projects since the 1950s, particularly his work on an AIDS vaccine. For grades 5-9.

De la Bédoyère’s book explains what vaccinations are and how they work, discusses how Salk created the polio vaccine and how his work was received by the public and fellow scientists, and investigates other scientists that worked on developing a polio vaccine. It also looks at what the discovery of the polio vaccine has meant for medical science up until the present day.


Written in comic-book style, this book’s dialogue is nevertheless fairly sophisticated and includes quotes or other primary source materials. The book also offers summary fact pages, further reading suggestions, recommended Internet sites, a bibliography, and a glossary.


This book addresses both Salk’s personal biography and his scientific achievement. It includes an extensive bibliography, a list of recommended Web sites, and an afterword that provides detailed information about polio. For grades 5-8.


Tocci addresses Salk’s scientific achievement in creating the polio vaccine and the public acclaim it brought him. He also touches on the criticism Salk received from other scientists. According to a Booklist review, “Tocci does a good job of showing how the fear of polio affected the public during the 1950s, an aspect of social history that sets the stage for Salk’s story.” Furthermore, the author touches upon the science of creating a vaccine and challenges particular to creating a polio vaccine. Includes a foreword by Salk’s son, a chronology, a glossary, chapter notes, and a list of recommended books and Web sites.


For grades 5-9, this book discusses the causes of polio and the infection process. Subsequent chapters use primary sources to address the history of the disease and the search for a cure, focusing on the United States from 1900 to the 1960s.

Web sites


This Web site was created in conjunction with a temporary gallery exhibition, installed at the Smithsonian’s National Museum of American History from April 2005 to April 2006. The online
exhibit highlights the science and history of polio, its legacy, Salk’s development of a vaccine, and its subsequent field trials. It also looks at the state of polio today.


This Web site gives a brief description of polio and offers information about the polio vaccine. It also offers links to other Web sites with more in-depth information about the history of the disease, development of the vaccine, and modern-day efforts to eradicate polio.


This Web site offers biographical information about Jonas Salk and Albert Bruce Sabin, an overview of their work, and a synopsis of the race to be the first to create a polio vaccine.
### Case and Death Rates for Polio in United States – 1915-1952

#### Table 2 (continued)

<table>
<thead>
<tr>
<th>Year</th>
<th>Cases Reported</th>
<th>Deaths Reported</th>
</tr>
</thead>
<tbody>
<tr>
<td>1951</td>
<td>140</td>
<td>53</td>
</tr>
<tr>
<td>1952</td>
<td>167</td>
<td>57</td>
</tr>
</tbody>
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### Notes:
- A partial impression
- Some data may have been lost or not recorded accurately.
- Rates may vary due to changes in reporting methods.

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**Polio**

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**Aftermath**
Thrilled By Salk Success, Indiana’s Doctors Act To Immunize 270,000

The Salk, historic news that the Salk vaccine works was announced after long months of secret research. by Dr. Thomas Francis Jr., University of Michigan epidermologist, who headed the task of determining its effectiveness.

Children, kept living and well, tell the full import of his story:

Only 71 children were paralyzed by polio last summer, out of the 440,000 vaccinated.

But 443 children were paralyzed among the 1,400,000 surveyed who didn’t receive vaccine.

A total of only 113 youngsters were stricken by polio—paralytic and non-paralytic types—among those vaccinated.

But a total of 750 were killed by polio among the non-vaccinated.

None died among the children who took the full series of shots.

But 18 died among those not vaccinated.

There was one death from polio in a child—not named—who had taken only two shots and had a tonsillotomy during an epidemic of polio in his community.

Brothers and sisters were spared when polio virus insidiously struck down one member of a family. Only one of 233 vaccinated children developed polio from contact within the family. But eight out of 244 getting the dummy shots, picked up the nerve destroying virus this way.

The vaccine reportedly is incredibly safe and amazingly free from the kick of reactions which always affect some people no matter what the drug is.

Q. Exactly what is the Salk vaccine?
A. The Salk vaccine contains viruses of all three types of paralytic polio. This virus has been “killed” by chemical treatment to render its polio causing qualities inactive. The vaccine was named for its director, 40-year-old Dr. Jonas E. Salk, of the University of Pittsburgh.

Q. How is it made?
A. The viruses are grown in monkey kidney tissue cultures and “fed” with a nutrient mixture. Using this method sufficient quantities are produced to manufacture a vaccine. The vaccine is then treated with chemical formalin to ensure safety. It is pre-tested on monkeys before any children are given shots.

Q. How does the vaccine work?
A. It works on the principle of giving a mild infection in order to stimulate the cells to produce disease-fighting antibodies. A high level of antibodies should insure immunity in most people.

“Thrilled by Salk Success, Indiana’s Doctors Act to Immunize 270,000” (Indianapolis Star, Wednesday morning, April 13, 1955) (Courtesy, Indianapolis Star)
Thrilled By Salk Success, Indiana's Doctors Act To Immunize 270,000

Two Phimex-Moore Company workers begin loading packages of Salk vaccine with help of a chain truck for delivery to health centers throughout Indiana. In the background, the firm's new Demonstrator Company, the "real" creator of the vaccine that comes from the field next spring will be made available immediately for com-

By RENARD W. WYNN

Hampered by the immediate need for vaccine, Indiana physicians and health agencies are making preparations for the first use of 270,000 Salk vaccine sold by the State health board. More than 2,000 doctors and nurses are needed to help in the work.

"State health board officials are pressing for more vaccine," said Dr. H. M. Nelson, assistant health commissioner. "We need a larger supply now, but the vaccine will be available soon." Dr. Nelson said the first load of vaccine will arrive in Indiana on April 12.

"The vaccine will be used in the following manner," he said. "The first load will be used to immunize the children in the 10 largest cities in the state." The second load will be used to immunize the children in the 10 smallest cities in the state.

"The vaccine will be sent to the doctors," he said. "They will be responsible for the immunization of their patients." The vaccine will be sent to the doctors in the following manner:

1. The doctors will be sent a letter from the state health board.
2. The letter will explain the procedure for the immunization of their patients.
3. The doctors will be given a list of the children who need the vaccine.
4. The doctors will be given a list of the children who have received the vaccine.

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Thrilled by Salk Success, Indiana’s Doctors Act to Immunize 270,000

Indianapolis Star, Wednesday morning, April 13, 1955

(Courtesy, Indianapolis Star)
1) According to the article, how many children, out of all those vaccinated in the field trials, “were stricken by polio” (both paralytic and non paralytic)?

2) According to the article, how many children, out of all those not vaccinated in the field trials, contracted polio (both paralytic and non paralytic)?

3) Is the answer for question one greater than, less than or equal to the answer for question two? Write this relationship using one of the following symbols: >, <, or =.

4) If 440,000 children were vaccinated in the field trials, what is the percentage of those vaccinated who were stricken by polio (both paralytic and non paralytic)? (Hint: The answer will be your answer to question number one divided by 440,000).

5) Do you think that the evidence given in the newspaper article shows that the vaccine works? Why or why not?

6) A section of this article is devoted to “Polio Questions, Answers.” In this section, one question is devoted to describing how the Salk vaccine is made. According to the answer to this question, the poliovirus is grown in what kind of tissue cultures?
7) The viruses grown in the lab are then used to create the vaccine. What tests or steps are used to make sure the vaccine is safe before giving it to children?

8) Another question addresses how the vaccine works. Summarize the answer given in the article to describe in your own words how the vaccine works to prevent people from contracting polio.

9) If you were a child in 1955, would you have any worries about being vaccinated with a vaccine that contained poliovirus, even if it had been killed? Why or why not?