

The Pharmaceutical Industry in Indiana

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 examine the growth of the pharmaceutical industry in Indiana and will explore the technology that enabled growth in this field. They will look at Lilly and its production of the polio vaccine as a case study showing how this industry developed in the twentieth century.

Grade Level

Elementary (grade 4)

Academic Standards

Social Studies 4.1.9—Give examples of Indiana's increasing agricultural, industrial, political, and business development in the nineteenth century.

Social Studies 4.1.12—Describe the transformation of Indiana through immigration and through developments in agriculture, industry, and transportation. (Individuals, Society and Culture)

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 4.1.14—Research Indiana's modern growth emphasizing manufacturing, new technologies, transportation, and global connections.

Social Studies 4.4.7—Identify entrepreneurs who have influenced Indiana and the local community.

Social Studies/Historical Concepts

The Industrial Revolution, urbanization, twentieth-century growth in industry and manufacturing, entrepreneurs, and comparison and contrast.

Learning/Instructional Objectives

Students will:

- Examine and analyze four historical photos that show Lilly employees and activities during four different eras.
- Be able to explain that industry in general, and the pharmaceutical industry in particular, made important contributions to the Indiana economy in the twentieth century.
- Be able to identify Eli Lilly as an entrepreneur whose business has had a profound effect on Indiana.

Time Required

One class period

Materials Required

- Copies of the following images shown on pages 11 through 14 of this lesson
 - “Eli Lilly & Company Wagons” (Collections of the Indiana Historical Society, Indiana Historical Society Digital Images Collection Item ID: P0130_N_8X10_096958)
 - “Interior of Eli Lilly Company” (Collections of the Indiana Historical Society, Indiana Historical Society Digital Images Collection Item ID: P0130_P_BOX27_FOLDER1_67008)
 - “Straight-line Production at Eli Lilly and Company” (Photo Courtesy of Eli Lilly and Company Archives, Indiana Historical Society Digital Images Collection Item ID: STRAIGHT_LINE_PRODUCTION_1923)
 - “Polio Finishing Line” (Photo Courtesy of Eli Lilly and Company Archives, Indiana Historical Society Digital Images Collection Item ID: POLIO_FINISHING_LINE_1955)

Background/Historical Context

In 1850 most manufacturing and production in Indiana still took place in the home; however, that was soon to change. The advent of steam power and, after 1900, electricity made new technologies available and allowed for the mass production of goods for regional, national, and international markets. Indiana cities became home to large manufacturing companies, many of which were owned by outside interests in New York, Chicago, or Detroit. A few notable locally owned exceptions were the Ball Brothers Glass Manufacturing Company in Muncie and Eli Lilly and Company pharmaceuticals in Indianapolis.

Colonel Eli Lilly, a veteran of the Civil War and a pharmaceutical chemist, established Eli Lilly and Company in May 1876. Lilly was intent on developing medicines that would be sold through pharmacies rather than by traveling “snake oil salesmen” at sideshows.¹ The original Lilly drug manufacturing company was located in a small, two-story building near Washington Street. Colonel Lilly employed three people, including his fourteen-year old son, Josiah K. Sr. They worked long hours, but their work paid off. “Business grew so quickly that Lilly had to move his business twice in four years, eventually settling in the city’s southern industrial district,” noted a history of the company.² This early success was a harbinger of things to come.

According to historian James H. Madison, “Although the Indianapolis firm was more careful in making and promoting drugs than the patent medicine men of the era, the company remained ambivalent about scientific research.”³ Indeed, the company’s first widely successful product, Succus Alterans, a treatment for diseases as varied as syphilis, rheumatism, eczema, and psoriasis, was “produced from a secret formula, purportedly derived from Creek Indians,” said Madison.⁴ It was not, as would be the case with future Lilly products, the result of sound scientific research. However, the success of this product did provide the funds for Lilly to modernize as a company and to drive modernization in the pharmaceutical industry at large. Colonel Lilly did make some initial attempts at creating a more scientific-minded company. In 1886 he hired a chemist to function as a full-time scientist whose role was to “improve[e] upon the newest techniques for quality evaluation.”⁵ He also hired a botanist to collect plant specimens that might prove useful in drug development. However, it was Colonel Lilly’s son, and particularly his grandson, who vastly increased Lilly’s relationship to the scientific community.

When Colonel Lilly’s son, J. K. Sr., took over control of the company, he focused on growing and professionalizing Lilly by “introduc[ing] uniform standards of manufacture, increas[ing] the sales staff by more than 500 percent, increas[ing] the number of research staff, and open[ing] branch houses in New York and New Orleans, increasing sales and recognition in several states.”⁶ He also established the Lilly tradition of aiding disaster victims, sending medicine to victims of the San Francisco earthquake (1906) and the Saint Patrick’s Day Flood in Johnstown, Pennsylvania (1936).⁷

Ultimately, Colonel Lilly’s grandson, Eli, a graduate of the Philadelphia College of Pharmacy, drove changes that pushed the company into the modern era of manufacturing. “Change came rapidly in

¹ Eli Lilly and Company, “Heritage,” <http://www.lilly.com/about/heritage/Pages/heritage.aspx> (accessed April 24, 2012).

² Indiana Historical Society, “Eli Lilly & Company,” <http://www.indianahistory.or/our-services/books-publications/hbr/eli-lilly.pdf>, 1 (accessed May 4, 2012)

³ James H. Madison. “Manufacturing Pharmaceuticals: Eli Lilly and Company, 1876-1948.” *Business and Economic History*, 2nd ser., 18 (1989): 72.

⁴ *Ibid.*, 72.

⁵ “Heritage.”

⁶ “Eli Lilly and Company,” 2.

⁷ *Ibid.*, 3.

the years just before and after World War I. By 1930 Eli Lilly and Company was a modern industrial corporation, leading the way in bringing revolutionary changes to the pharmaceutical industry. At the center of these changes was Eli Lilly, grandson of the founder,” said Madison.⁸

Eli Lilly spent his first few years at the company observing manufacturing methods and seeking ways to increase production and to cut costs. He developed new gadgets, such as a bottle-filling machine that prevented about \$7,500 a year in spilled drugs.⁹ In addition, he devised a system of “blueprinted manufacturing tickets,” in which the formula for a drug was typewritten on transparent paper and copied via a blueprinting process. The drug could thereby be checked against the formula in each department as it made its way through the manufacturing process.¹⁰ Furthermore, in 1909 Eli Lilly invested in the company’s first Colton automatic capsule making machines. This move sped production to the point that the company produced an excess of capsules and was able to sell them internationally to Russia and Germany.¹¹

However, Eli Lilly’s greatest contribution to the company’s efficient operation came through his devotion to the new field of scientific management, a theory put forth by Frederick Taylor in the early 1900s. Taylor believed that laborers intentionally slowed production through what he called “worker soldiering” in order to prevent management from knowing how fast the work could be done. In order to combat this technique, Taylor set about doing time studies of workers, timing specific actions done in ways he considered to be most efficient. He then put these “elementary” motions into a sequence of complex motions and insisted that all workers use the specific sequence to achieve a particular rate of production. He suggested that bonuses be given for higher rates of production and penalties be enacted for slower rates.¹²

In 1911, after studying the writings of scientific management proponents such as Taylor, Henry Gantt, and Frank Gilbreth, Eli Lilly began conducting his own time studies at the company’s McCarty Street plant. He also implemented a system of bonuses to reward efficient workers. Two years later he brought in a scientific management consultant named Harrington Emerson and, based on his advice, implemented a plan of producing certain popular drugs ahead of demand, thus enabling the company to maintain a stable and experienced workforce year round, not just during periods of peak sales. A 1916 study by Ernst and Ernst resulted in the introduction of a new accounting and inventory system.¹³

Eli Lilly’s insistence on “careful planning, intense supervision, meticulous record keeping, and standard, uniform procedures” led to rapid growth of the company. By 1919 the company was

⁸ Madison, “Manufacturing Pharmaceuticals,” 72.

⁹ Ibid.

¹⁰ Ibid.

¹¹ Ibid.

¹² Patricia Ryaby Backer. “Scientific Management,” http://www.engr.sjsu.edu/pabacker/scientific_mgt.htm. (accessed May 14, 2012).

¹³ Madison, “Manufacturing Pharmaceuticals,” 74.

expanding its plants and embarking on an experiment with straight-line production. Inspired by the use of mechanical conveyor systems in plants such as Henry Ford's River Rouge factory, Lilly planned for Building 22. Completed in 1926, the building utilized straight-line production processes in which raw materials entered one end of the building and a finished drug exited the other end. The process involved a complicated system of conveyors, lifts, pipes, and chutes. It also had to be versatile, enabling the production of about 2,800 different pills, tablets, ointments, elixirs, and syrups. It was, according to Madison, "probably the most sophisticated production system in the American pharmaceutical industry" and it increased efficiency while lowering production costs, enabling for the mass production of more drugs.¹⁴ Straight-line production at the company was reflective of scientifically-based manufacturing innovations of the period, while at the same time providing a model of such innovations for other industries. According to an editor of *Chemical and Metallurgical Engineering*, "those engaged in other process industries in which the diversity factor is assuming difficult proportions, will do well to examine the Lilly system and adapt its features to the solution of their own problems."¹⁵

The company flourished in the 1920s. During this decade, the company produced its first nationally recognized product, insulin, making a huge stride in combating the deadly disease of diabetes. Insulin had been the product of a cooperative effort between the company and the University of Toronto. The company used the university's research to find a cost-effective way of mass producing the drug. This university-company relationship became a signature of the way that the firm functioned.

Also during the 1920s, the company established a relationship with City Hospital (later Marion County General Hospital, then Wishard Memorial Hospital, and soon to be called Sidney and Lois Eskenazi Hospital) whereby the company conducted clinical studies at the hospital "in order to test medicines before introduction on the market."¹⁶ This relationship helped the company to become more efficient and also cemented its reputation for sound medical and scientific practices.

The many successes of the 1920s put the company in a good place to weather the Great Depression. While the stock market crash did affect the company's bottom line, it continued to see profits and managed to maintain full employment at its facilities, reducing hours and repurposing employees for work such as painting and cleaning floors when necessary in order to keep them employed. During the 1930s the Lilly Endowment was created with family-owned company stock. By 1998 the Endowment owned close to 20 percent of all company stock and was the wealthiest philanthropic foundation in the world.

World War II provided another boost for the company. Again working with university scientists who had studied penicillin, company scientists and engineers figured out how to mass produce

¹⁴ Madison, "Manufacturing Pharmaceuticals," 74.

¹⁵ Ibid., 75.

¹⁶ IHS, "Eli Lilly and Company," 4.

penicillin while maintaining its stability. As a result, the company was able to fill hundreds of government orders during World War II. The company also supplied hundreds of other products to soldiers during the war. By the end of the 1940s, Lilly's annual sales reached \$100 million.¹⁷

The postwar years not only brought prosperity and growth for the Indianapolis firm, but also for the pharmaceutical industry in general and the American economy at large. "New antibiotics and other drugs combined with a growing and more affluent population to cause rapid expansion and high profits for the industry, especially for the handful of large companies that now dominated in pharmaceuticals," said Madison.¹⁸ At times, the company could not keep up with the demand, and it expanded its operations to include a plant on Kentucky Avenue, where it moved most of its production. It also expanded its overseas operations, but with these expansions came a growing concern that the company was becoming too large to be managed effectively by one Lilly family leader. Other large companies had faced this problem as well, and most of them had shifted away from control by the founding family to a model of salaried managers.¹⁹ The company did not transition fully to non family management for several years, but the process began in the late 1940s.

Annual sales numbers continued to grow in the 1950s as the company leveraged its relationships with universities to achieve contracts such as the one for production of the polio vaccine developed by Jonas Salk in 1954.

Teacher's Instructional Plan

Introduction

Introduce the lesson by reviewing the industrial era with students and reminding them that Indiana was experiencing industrialization in the nineteenth and early twentieth centuries. Tell them that as factories strove to produce more and more goods, they looked for more efficient ways of making their product. Eli Lilly and Company provides an example of this trend.

Procedure

- Distribute copies of the "Eli Lilly & Company Wagons" image found on page 11 of this lesson to students. Soliciting input from the class as a whole, model the analysis of this historic image using the "Photos/Film Observe Reflect Question" Worksheet available at http://www.rockford.edu/resource/resmgr/docs_tps/jackie_lutzow_slides.pdf (accessed May 21, 2012), have the students analyze the photo. This analysis tool was created by Jacki Lutzow, a nationally board-certified third-grade teacher at Marsh Elementary School in Rockford, Illinois, who also served as an implementer for the Library of Congress Teaching with Primary Sources Program at Rockford College.

¹⁷ IHS, "Eli Lilly and Company," 6.

¹⁸ James H. Madison. *Eli Lilly: A Life, 1885-1977* (Indianapolis: Indiana Historical Society, 1989), 110.

¹⁹ Ibid., 116.

- After you have completed the analysis worksheet, ask students if they have any questions about how to use the worksheet.
- When you feel that students are ready to try using the worksheet on their own, distribute copies of the “Interior of Eli Lilly Company,” “Straight-line Production at Eli Lilly and Company,” and “Polio Finishing Line” images found on page 12 through 14 of this lesson to students. Do not share the dates of the photos with students. Working in pairs, students will examine these images for evidence of manufacturing processes.
- Again using the “Photos/Film Observe Reflect Question” Worksheets available at http://www.rockford.edu/resource/resmgr/docs_tps/jackie_lutzow_slides.pdf (accessed May 21, 2012), have the students analyze the photos. Allow approximately 45 minutes for students to complete the worksheets.
- When students have completed their analysis, gather the class together and ask students to share the responses they wrote on their analysis worksheets for the three photos they analyzed in pairs. Project the analysis worksheet on an overhead projector, LCD projector, or digital whiteboard and use it to record pertinent responses from student pairs for the three photos.
- Have students note the similarities and differences in the photographs and help them synthesize the information they gleaned from these photographs by noting that all of the photos show pharmaceuticals being packed for shipment at Eli Lilly and Company in Indianapolis, but the photos were taken at different dates. Ask students to predict which photo has the earliest date, which one was taken most recently, and which one was taken in the interim. If they need some scaffolding help, remind them that industrialization was characterized by the increasing mechanization of the workplace—in other words, machines were used to do jobs that had previously been done by humans. The photograph showing the most machinery in use would therefore be the most recent photograph, while the one showing the least machinery in use would be the earliest photograph.
- When you have helped students to establish the chronological order of the photographs, you can tell them that the first photograph was taken in 1919, before the company used a system of conveyor belts to move products through various stages of production. The second photograph was taken in the 1920s, when straight-line production was coming into use at the company. Straight-line production used a line of conveyor belts to move raw materials starting at one end of the line through all stages of production until a finished product was created at the other end of the line. The last photograph was taken in 1955, when the processes for production were quite automated or mechanized, but also separated by various functions. In this photograph, workers are packaging the polio vaccine for shipment. The vaccine was researched and developed by scientists in one space, produced and tested for safety in another, and packaged and shipped in yet another. This shows the increasing specialization of space in addition to specialization of labor.

- Tell each student to pretend that he or she worked on the company's packing and shipping line, packaging medicines for shipment. As they look at each of the three photos, ask them to write three short journal entries in which they speculate about what their typical workday would have been like, and what their feelings about the use of machines in their work space would have been. For example, perhaps in the 1919 photo, the workers are wishing there was some kind of machine to help them with their work, whereas perhaps the workers in the 1955 photo wish that the conveyor belt moved more slowly so they could keep up.

Glossary

Pharmaceuticals—A medical drug product

Industrialization—The introduction of or conversion to large scale manufacturing practices in order to bring economic activity to an area.

Mechanization—The introduction of machinery in order to replace manual labor (work done by hand).

Straight-line Production—A method of production in which an unfinished product moves along a straight line from one station to the next. Along the way, parts are added or actions taken that bring the product closer to completion. This method of production was designed to improve efficiency and reduce the time required to manufacture and assemble the product.

Conveyor Belt—An endless belt or chain that moves along on rollers to carry products from one part of a factory to another.

Specialization of Labor—Breaking down a complex job into a series of simpler, smaller steps that are then performed by “specialists” in each step.

Assessment

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

Additional Resources

Publications

Frader, Laura L. *The Industrial Revolution: A History in Documents*. Pages from History Series. New York: Oxford University Press, 2006.

The Industrial Revolution: A History in Documents uses a wide variety of primary source documents (e.g. diaries, advice books, poems, business reports, letters, photos, and essays) to chronicle the Industrial Revolution.

Madison, James H. *Eli Lilly: A Life, 1885-1977*. Indianapolis: Indiana Historical Society, 1989.

A biography of Eli Lilly, grandson of the founder of Eli Lilly and Company. This book also chronicles a period of intense change and growth for the company.

Madison, James H. *Manufacturing Pharmaceuticals: Eli Lilly and Company, 1876-1948. Business and Economic History*, 2nd Ser., 18 (1989), 72-78.

Provides a modified version of chapters 2, 3, and 5 of *Eli Lilly: A Life, 1885-1977*, and discusses scientific development at Eli Lilly and Company. Discusses Lilly's fascination with scientific management and how it influenced changes at the company.

Marsh, Carole. *Industrial Revolution: From Muscles to Machined!* American Milestones Series. Peach Tree City, GA: Gallopade International, 2004.

Discusses how the Industrial Revolution caused major changes in agriculture, manufacturing, and transportation. This 28-page, reproducible book includes ideas for lesson plans, hands-on activities, biographies, fascinating facts, and stories. Meets national and social studies standards.

Mooney, Carla. *The Industrial Revolution: Investigate How Science and Technology Changed the World with 25 Projects*. Build It Yourself Series. White River Junction, VT: Nomad Press, 2011.

This activity book chronicles the development of the Industrial Revolution and introduces young readers to its leaders. The book covers societal changes, developments in transportation and communication, and other elements of history, biography, and civics. It includes enrichment projects such as creating a water-powered wheel, designing a steamship, building a telegraph machine, or making a pinhole camera.

Web sites

“Childhood Lost: Child Labor during the Industrial Revolution.” Eastern Illinois University.
<http://www.eiu.edu/eiutps/childhood.php> (accessed May 25, 2012).

Primary sources and primary source analysis tools related to the use of child labor during the industrial revolution in America.

“Eli Lilly and Company.” Indiana Historical Society. <http://www.indianahistory.org/our-services/books-publications/hbr/eli-lilly.pdf> (accessed April 24, 2012).

Brief history of the company.

“Eli Lilly and Company: Pharmaceutical Manufacturer.” Library Fact Files, *Indianapolis Star*. <http://www2.indystar.com/library/factfiles/business/companies/lilly/lilly.html>

Brief history of the company.

“Heritage.” Eli Lilly and Company. <http://www.lilly.com/about/heritage/Pages/heritage.aspx> (accessed April 24, 2012)

Read about the company’s corporate history and milestones in its medical research.

“Indiana History: Indiana through Change (1920-1940).” The Center for History (South Bend, IN). <http://centerforhistory.org/learn-history/indiana-history/indiana-through-change-1920-1940> (accessed April 25, 2012).

Summary of important events, issues, and people in Indiana history from 1920 to 1940.

Ryaby Backer, Patricia. “Scientific Management.” <http://www.engr.sisu.edu/pabacker/scientific.mgt.htm> (accessed May 14, 2012).

A summary of the scientific management movement as well as its leaders, primarily Frederick Taylor.



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“Eli Lilly & Company Wagons” (Collections of the Indiana Historical Society, Indiana Historical Society Digital Images Collection Item ID: P0130_N_8X10_096958)



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“Interior of Eli Lilly Company” (Collections of the Indiana Historical Society, Indiana Historical Society Digital Images Collection Item ID: P0130_P_BOX27_FOLDER1_67008)



STRAIGHT_LINE_PRODUCTION_1923

“Straight-line Production at Eli Lilly and Company” (Photo Courtesy of Eli Lilly and Company Archives, Indiana Historical Society Digital Images Collection Item ID: STRAIGHT_LINE_PRODUCTION_1923)



“Polio Finishing Line” (Photo Courtesy of Eli Lilly and Company Archives, Indiana Historical Society Digital Images Collection Item ID: POLIO_FINISHING_LINE_1955)