

**Lesson Plan for the Development and Effects of Industrial Technology from  
1799 -1865 Culminating with the Springfield Armory**

**Grades:** First year of high school, U.S. History through the Civil War.

**Time Allotment is optional:** From one to five class periods. A Springfield Armory field trip could be included.

**Curriculum Areas:** History, Language Arts and Vocational Technology

**Rationale:** The history and development of American technology plays a major role in the lives of every American today. Presently, superior technology not only makes the United States the preeminent world military power, technology also makes our daily lives more efficient, convenient and productive. Today, the use of hand tools, cameras and automobiles are just a few examples of adaptive technology, whose foundation was the mechanized processes pioneered at the Springfield Armory. During the first half of the 19<sup>th</sup> century, the Armory developed mechanized processes to create interchangeable parts for fire arms.

**Goal:** The goal of this lesson plan will be for students to know some of the historically important contributions to American technology.

**Objectives:** Using the Armory and the city of Springfield as a springboard, students will read, discuss and work cooperatively to learn about economics, religious beliefs and immigration. Additionally, students will discuss and write about questions relating to war and peace.

**Massachusetts Curriculum Frameworks Standards:**  
**US History**

**US1.27** The emergence and impact of industrial growth throughout antebellum America.

**US1.31** Important religious trends that shaped antebellum America

**US11.1** Various causes of the Industrial Revolution

**US11.2** The important consequences of the Industrial Revolution

**Language Art Standards:**

**4 – Vocabulary and concept development**

**8 – Understanding a text**

**11 – Theme**

**14 – Poetry**

**15 – Style and Language**

**Materials:**

The lesson plan, Tension concerning the use of Armory production from this web site

Ball point pens

Handout questions for activity # 2

Empty soda bottles with one cap that fits all bottles

A micrometer is optional to measure the inside diameter of the cap and the outside diameter of the bottle.

Graphics related to Springfield Armory technology are optional

**Activities # 1:** Place several soda bottles so they can be readily seen by the students and ask a brainstorming question: How is it that one cap is interchangeable – that it can be used on all these different bottles? A discussion and answers should form the pretext for a discussion of how gauges and machines were used to manufacture these bottles and caps precisely the same. A micrometer could be used to measure the inside and outside diameters of the cap and bottles. The next class question: where did this technology come from?

**Activity # 2:** Pass out the handout and questionnaire about the Development and Effects of Industrial Technology and have students answer the questions.

**Activity #3:** After the handouts are finished, divide the class into four or five groups to answer and discuss the following questions: 1. for the techies, why were machines and gauges so necessary for interchangeable production? Also, why was individual specialization of labor needed and not the skilled gunsmith making all the parts? 2. Why were the government and especially the military the ones to develop interchangeable parts? [Possible answers: the government had more money for the research than any manufacturer. Also, there is a critical need for more efficient production of weapons and replacement parts especially in time of war]. 3 Is the situation in Springfield concerning economics, immigration and prejudice similar today? [Yes] Ask for current examples. 4. Are weapons and war necessary and should they be necessary? 5. A class question: Were you aware of these contributions of the Springfield Armory? What about their lasting legacy?

**Activity # 4:** Independent study for extra credit or for Honor and AP students using primary sources. Students could do research at the Connecticut Valley Historical Museum for information relating to tensions between Yankee employees at the Armory and Irish Catholic immigrants. Additional primary sources are available at the Armory and opportunities abound for community service assignments.

**Activity # 5:** Refer to the Middle School through Secondary lesson plan Tensions concerning the use of Armor production just prior to the Civil War. This plan is based on the popular poem, *The Arsenal at Springfield* by Henry Wadsworth Longfellow and can be readily adapted for your students.

**Activity # 6. A field trip to the Springfield Armory would be a culminating activity. This would integrate all lesson plans and activities. A member of the staff will make an informal presentation allowing opportunities to answer question. Demonstrations of model weapons are offered for hands on student inspection. A fine historic video of the Armory is also available as well as a live fire-arm demonstration. The Springfield Armory is an important National historic site. Our students should see it and know about it.**

## The Springfield Armory and the Industrialization of America

The Springfield Armory can take pride in being the most important historic site in the city of Springfield. During the first-half of the 19<sup>th</sup> century, the Armory was one of the outstanding leaders of the Industrial Revolution in the United States.

Before the Industrial Revolution most manufacturing was made by hand in the home or small shops. One result of skilled craftsmen making things by hand was that no two finished products were precisely alike; for example a gunsmith making a rifle would make each part slightly differently. The wooden rifle stock or handle as well as all the metal component parts would be made specially for each rifle and that meant any broken part would require the gun to be transported and custom made by a skilled craftsman thus costing a great deal of time and money.

In the United States, credit for promoting the development of interchangeable parts goes to Eli Whitney, the inventor of the cotton gin, who in 1799 persuaded Treasury Secretary Oliver Wolcott to sell him a contract to manufacture 10,000 muskets. Whitney assured Wolcott's support by writing him "that machinery....would reduce labor and facilitate the manufacture of this article." In other words, Whitney was suggesting the beginning of interchangeable parts production. During his lifetime (1765-1825) however, Whitney's company never did produce interchangeable parts but he did help develop it in several significant ways: with more effective management he saved money by substituting unskilled for skilled labor and by specializing and simplifying individual work assignments (e.g. one unskilled laborer would make one part instead of a skilled gunsmith making several); he was also the most influential spokesman in winning the government's support for the production of interchangeable parts. Finally, according to the historian Merritt Smith, historians incorrectly gave Whitney credit for making interchangeable parts "and that his contributions to management ...certainly overshadow the mechanical inventions for which he is best but undeservedly remembered."

It was three major arms manufacturers and four men during the 1820's and 1830's who were largely responsible for the development and production of interchangeable parts. Two of the manufacturers were located within forty miles of each other along the Connecticut River. One manufacturer was located in Middletown Connecticut and the other was the national Armory at Springfield, Massachusetts. The third was the national Armory at Harper's Ferry in Virginia. Simeon North (1765-1852) was the most skilled and inventive gunsmith in Middletown. North had produced one of the earliest examples of an interchangeable part in America by 1816 and he partially mechanized his factory and adopted precision standards.

**John H. Hall (1781-1841) was hired by the government to make a breech loading rifle at Harper's Ferry in 1819 (this was a rifle that was loaded at the back of the barrel). Hall promised to make the first complete rifle with interchangeable parts. He succeeded. Hall expanded upon the technology that North developed by building several new machines that milled, drilled and profiled. Additionally, he built the most precise parts to date by using 63 gauges in order to standardize parts making. These gauges could measure up to one-thousandth of an inch. He demonstrated in 1826 that every step in gun making could be mechanized. One problem that Hall confronted however was the limitations placed on the size of his facility. Building his rifles was equivalent to a small-scale pilot project which created only a small amount of weapons that were too costly.**

**The Armory at Springfield picked up where Hall left off. Under the strong leadership of Rosewell Lee from 1815 to 1833, Springfield grew to become the "Grand National Armory" and one of the top and most forward looking manufactures in the United States. Lee worked with Eli Whitney, Simeon North and John Hall and he dedicated himself to make the Springfield Armory acquire, develop and build the latest technology to produce mechanized, uniform parts. Under Lee's leadership Armory employees gathered information about the latest innovations and technology from private manufacturers who were contracted to supply the Armory. This made the Armory like a school for learning new technology that the students could use for their production work. Carrying the school analogy further, the students in turn became teachers who readily shared information with other armories and manufacturers. This made Springfield perhaps the most important teaching center of metal-working technology in America at that time. Because so many manufacturers depended on, or wanted government business, Lee and armory employees insisted that suppliers share their technology. This "technology sharing" among arms manufacturers accelerated the development of interchangeable parts. Through these business relationships Lee hired a brilliant mechanic, Thomas Blanchard, who invented and perfected 14 wood making machines that totally processed all manufacturing of the gunstock. These inventions counted for one-third of all production at the Armory – a remarkable, five year achievement from 1822 through 1826.**

**Lee died in 1833 before reaching his goal of total interchangeability of parts but, his energy and dedication, paved the way for his successors at the Springfield Armory who built the U.S. Model 1842 musket – the first weapon with interchangeable parts ever to be mass-produced. This was one of the greatest achievements in the history of American technology.**

**By 1842, the manufacturing techniques at Springfield started spreading throughout the country to other manufacturers. The Whitney Armory in New Haven, Connecticut and the Ames Manufacturing in Chicopee Massachusetts (just a few miles from Springfield) are just a few examples of manufacturers who hired former Springfield Armory employees to upgrade their technology to improve production and profits.**

**International recognition for the Armory practices came in 1851 at the London Crystal Palace Exhibition. Three U.S. companies won top medals for the quality and precision of their metal work featuring interchangeable parts. The British government was so impressed they followed up the Exhibition by sending a “Committee on Machinery” in 1853 to investigate technology in the northeastern United States.**

**The metal working techniques and processes at Springfield and throughout the arms industry had spread to other manufacturers by the 1850’s. Factories made pocket watches, sewing machines, padlocks and hand tools – all using Armory technology. Later this technology was expanded and adapted to produce typewriters, bicycles, cameras and automobiles. Today, American technology owes a great debt to the cooperation of inventors at the Springfield Armory and the arms manufacturers during the first half of the 19<sup>th</sup> century.**

**As the city of Springfield’s largest employer, the Armory was to play an essential role in the economic and cultural life of its citizens. One of the main reasons for prejudice and racism against immigrants is economic. Between 1846 and 1851 most of the 1.5 million Irish immigrants fleeing the potato famine came to the United States. An influx of French-Canadians along with the Irish placed a great deal of stress on the job markets throughout the U.S. and at the Armory in particular. These immigrants were willing to work for less money than the Protestant Yankees who had jobs. Adding further stress to immigrants and Yankees – the newcomers to Springfield shared different religious beliefs from the dominant protestant Congregational church members. Roman Catholics, Baptists, Methodists and Unitarians among others, all increased tensions as well as diversity in the city of Springfield. These economic and religious tensions created difficult confrontations at the Armory for management, Yankee employees, and new immigrants seeking jobs.**

**In dealing with any history of the Armory, the terrible potential for destruction and death must come up. After all, fire-arms are instruments of death in the hands of people and nations who are willing to use them. This concern raises a serious question. Are weapons necessary? Recent events like 9/11 and the threat of terrorism make this question especially meaningful today.**

**Henry Wadsworth Longfellow visited the Springfield Armory in 1843. Later, he wrote a poem, *The Arsenal of Springfield*, in which he expressed his deep regret of a world history plagued with wars and suffering. His alternatives to war were changes in the human condition that emphasized peace, love and religion. This question of war or peace is finally left to each individual and nations to decide. Ultimately, the fate of the human race is determined by individuals and nations answering this question.**

**An American historical decision for war was made in 1861 when the northern and mostly southern states fought over the issues of slavery, Union, states' rights and secession. The Springfield Armory and the numerical and qualitative superiority of manufacturing facilities in the North played a major role in the defeat of the Southern states and in the preservation of the Union.**

**The city of Springfield also prospered during the Civil War mainly because of the Armory. As the major employer in Springfield, one quarter of the city work force was tied up making weapons for the war. Up to 1861, the Armory was producing 1000 weapons per month. By 1864, 3400 employees assisted the Armory by working 24-hour shifts making 1000 weapons a day. Springfield's population also increased an astonishing 65 percent from 1855 to 1865.**

**Other city businesses related to the Armory and war effort also prospered. Smith and Wesson struggled to keep up with demand for its .22 caliber pistol. The ammunition maker, C.D. Leet also tried to keep up with demand. Additional businesses in Springfield and the surrounding areas made huge profits making leather saddles, holsters, gun carriages, railroad coaches, bayonets, cannons, uniforms plus several other war-related products.**

**After the Civil War, employment at the Armory dropped from 2300 to 300. A predictable "boom to bust" economy should have followed. Not so. The surplus armory employees with their "high tech" skills and effective working backgrounds were quickly absorbed into civilian employment and newly formed businesses.**

**The effects of the Armory on Springfield were to last well through the 20<sup>th</sup> century. The city evolved into an urban manufacturing center during that time and that urban environment was mainly shaped by the Armory, its employees and the technical innovations which they so effectively developed. The reach of the Armory, arms manufacturers and inventors extends far beyond the borders of Springfield however. Every person today whose life is made more convenient or efficient by something that is machine made of metal and wood owes some gratitude for the work, genius and cooperative dedication of the 19<sup>th</sup> century arms makers. This is truly their most lasting legacy.**

Name \_\_\_\_\_ Date \_\_\_\_\_ Period \_\_\_\_\_

**SPRINGFIELD ARMORY QUESTIONNAIRE**

1. Why was making rifles by hand so inefficient?
2. What were Eli Whitney's contributions to the development of interchangeable parts?
3. Who were the three major arms manufacturers that developed interchangeable technology?
4. Name the first inventor of a rifle with complete interchangeable parts?
5. What were the most important inventions at the Springfield Armory during the 1820's?
6. Name two special contributions of the Springfield Armory?
7. How did the practice of Armory technology gain international recognition?
8. What were two of the main reasons for the prejudice of Yankee, Springfield Armory workers against Irish Catholic immigrants?
9. Are weapons and war necessary? Should they be necessary? Give a **SHORT** explanation for your answer.
10. What is a lasting legacy of the Springfield Armory and the arms manufacturers during the 19<sup>th</sup> century?