# Changing Gears:
# The Birth of American Industry

September 21-November 18, 2012

## Teacher Resource Guide

Lorenzo Cultural Center
44575 Garfield Rd.
Clinton Twp., MI, 48038-1139
586.445.7348

1. Reprinted with Permission

## EXHIBIT INTRODUCTION

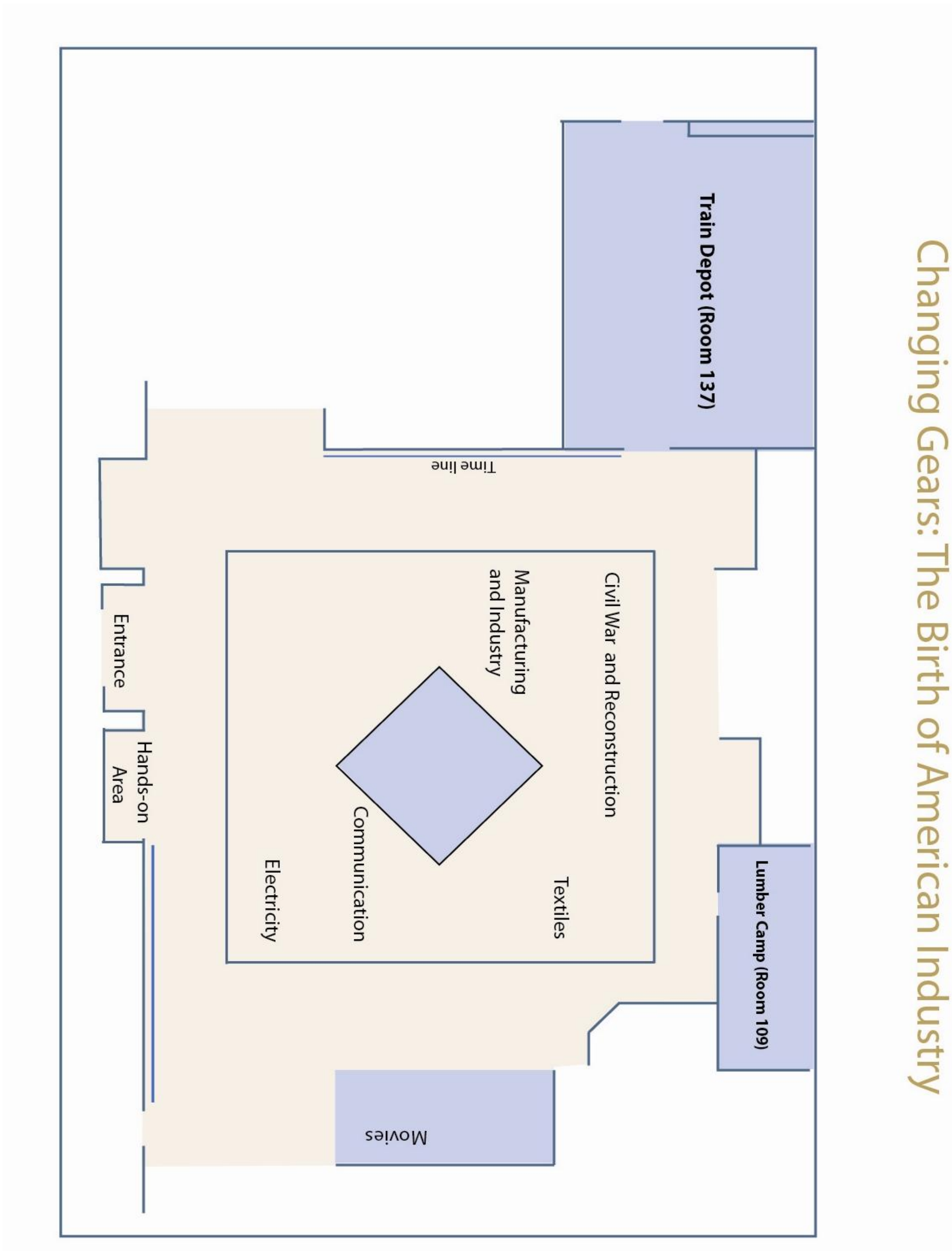
During a visit to ***Changing Gears: The Birth of American Industry*** at the Lorenzo Cultural Center students will explore the country's emergence as an international superpower against the backdrop of great social and technological change.

This packet of information is designed to assist teachers in making the most of their students' visit to the Lorenzo Cultural Center. Contained in this packet are:

1. An outline of the exhibit
2. Facts, information, and activities related to **Changing Gears**
3. Lesson plans related to **Changing Gears**
4. A resource list with websites, addresses, and information

## TABLE OF CONTENTS

## EXHIBIT FLOOR PLAN



## PART I: EXHIBIT OUTLINE

### Introduction

The Lorenzo Cultural Center examines the technology, inventors, innovators, and new industries that shaped the 19th century in the United States and Michigan, including railroads, textiles, steel, agriculture, and the lumber and mining industries.

Visitors can see items manufactured in Michigan, tools used in lumber mills, railroad and steel artifacts and many more items that demonstrate the impact of the industrial revolution.

### Changing Gears

Join us at the Lorenzo Cultural Center as we examine the country's emergence as an international superpower against the backdrop of great social and technological change.

Trace the evolution of the production of goods, from handcrafting in home businesses to machine-aided production in factories.

Discover the big thinkers who not only created a long list of new inventions but also improved existing technology.

Explore the transformation of American daily life and the spread of urbanization, spurred by the developing manufacturing industry and major changes in communications, metallurgy, transportation and energy development.

## PART II: TIMELINE OF CHANGING GEARS

**1701** Jethro Tull invents a horse-drawn seed drill in Great Britain that sowed seeds in neat rows.
**1712** Thomas Newcomen builds first commercially successful steam engine in Great Britain, to keep coal mines free of water.
**1749** Benjamin Franklin invents the lightning rod.
**1750-1800** Three million Africans are brought to America as slaves.
**1764** James Hargreaves invents the spinning jenny in Great Britain, which automates the weaving of cloth.
**1769** James Watt patents a series of improvements on the Newcomen engine, making it more efficient.
**1771** Richard Arkwright patents the water frame for cotton spinning and installs water frames in his factory in Great Britain.
**1774** Great Britain passes a law banning the export of cotton-spinning technology and emigration of cotton workers to America.
**1774** Georges-Louis Le Sage of Switzerland develops an early version of the electric telegraph.
**1775** David Bushnell builds one-man submarine, the *Turtle.*
**1776** Adam Smith, who is considered to be the founder of modern economics, publishes *An Inquiry into the Nature and Causes of the Wealth of Nations*.
**1785-1799** Potomac Company builds the Potomac Canal, the nation's first attempt to link the rich western agricultural lands with the coastal port cities of the East Coast.
**1789** Samuel Slater leaves England and brings British textile technology to the United States. Andrew Jackson would later call him the "Father of the American Industrial Revolution."
**1790-1793** Samuel Slater, Moses Brown and William Almy build the first water-powered cotton mill in the United States in Pawtucket, Rhode Island that uses the system of cotton spinning developed by Richard Arkwright.
**1790** The Patent Act of 1790 is the first patent statute passed by the U.S. Congress.
**1791** The Bank of the United States is established.
**1791** John Barber of Great Britain invents the gas turbine which he plans to use to propel a "horseless carriage."
**1792** The United States adopts the dollar as its official currency.
**1792** The New York Stock Exchange is founded.
**1793-1794** Eli Whitney invents and patents the cotton gin, which makes the cleaning of cotton easier by separating the seeds from the cotton.
**1800** Robert Fulton tests the first practical submarine, named the *Nautilus*.
**1800** Alessandro Volta of Italy invents the battery.
**1801** Eli Whitney demonstrates to President Jefferson the use of interchangeable parts in the making of muskets. The use of interchangeable parts would become known as the American system of mass production.
**1801** Joseph-Marie Jacquard invents an automatic loom that simplifies the process of manufacturing textiles with complex patterns.
**1803** 45 percent of American-grown cotton is exported to Great Britain.
**1807** Robert Fulton launches the first commercially viable steamboat, the *Clermont,* which carried people and freight from New York City to Albany.
**1807** The U.S. Congress enacts the Embargo Act of 1807, which bans imports from foreign countries, forcing Americans to start manufacturing goods in the United States.

**1807** The U.S. Congress ends the importation of slaves into the United States, but the law does not take effect until 1808.
**1808** Secretary of the Treasury Albert Gallatin suggests that the federal government should fund the construction of interstate turnpikes and canals.
**1810** Cornelius Vanderbilt begins operating a ferry service between Staten Island and Manhattan.
**1812** The War of 1812 begins.
**1813** Francis Cabot Lowell and partners form the Boston Manufacturing Company, which builds the first fully steam-powered textile mill in Waltham, Massachusetts.
**1815** The War of 1812 ends.
**1815** Sir Humphrey Davy of Great Britain invents a safety lamp worn by miners that prevents the lamp flame from igniting mine gases.
**1816** The U.S. Congress passes the Tariff of 1816, which places heavy duties on imported manufactured goods.
**1817** The U.S. Congress charters the Second Bank of the United States. Its primary functions are to regulate the public credit issued by private banking institutions and to establish a sound and stable national currency.
**1817** Construction of the Erie Canal begins.
**1819** The U.S. Supreme Court, in *McCulloch v. Maryland*, affirms the constitutionality of the Bank of the United States.
**1819** The first cannery in the United States opens, producing tins of oysters, lobster, and salmon.
**1819** The SS *Savannah*, an American hybrid sailing ship/side-wheel steamer, is the first steamship in the world to cross the Atlantic Ocean, even though it uses steam power for only part of the voyage.
**1819** The Panic of 1819 is the first major financial crisis in the United States. This financial crisis marks the end of the economic expansion that had followed the War of 1812.
**1821-1831** Michael Faraday, a British scientist, discovers electro-magnetic rotation and the electro-magnetic current, making possible the building of generators and electric motors.
**1823** Lowell, Massachusetts, a planned manufacturing center for textiles, is founded.
**1824** In *Gibbons v. Ogden*, the U. S. Supreme Court concludes that the power to regulate interstate commerce was granted to Congress by the Commerce Clause of the U.S. Constitution.
**1824** Joseph Aspdin of Great Britain receives a patent for Portland cement.
**1825** The Erie Canal opens.
**1825** Thomas Blanchard of Massachusetts invents America's first car powered by steam, which he calls a "horseless carriage."
**1829** William Austin Burt of Worchester, Massachusetts invents, patents, and makes the first typewriter in the United States.
**1830-1831** Peter Cooper designs and builds a steam locomotive which is used on the Baltimore and Ohio Railroad. The locomotive is called the "Tom Thumb."
**1830** President Jackson vetoes the Maysville Road Bill, claiming that federal funding of intrastate projects such as roads is unconstitutional, and that such laws violate the principle that the government should not be involved in economic affairs.
**1831** Cyrus McCormick invents the first commercially successful horse-drawn reaper.
**1831-1835** Joseph Henry works on an electromagnetic relay, which was the basis of the electrical telegraph invented by Samuel Morse.
**1832** President Jackson vetoes the chartering of the Second Bank of the United States.

**1833** The Erie and Kalamazoo Railroad is organized in the Territory of Michigan to run from Toledo to Adrian. Trains, pulled by horses, begin operating in 1836. Steam locomotives replace horses in 1837.
**1833** President Jackson withdraws federal deposits from the Second Bank of the United States and deposits federal money into several state-run banks throughout the country.
**1834** Henry Blair invents the seed-planter. He is the second African American to receive a patent.
**1834** The Grand National Consolidated Trade Union, the first national association of trade unions, is formed.
**1834-1835** Hiram Moore invents and builds the first combine harvester in the United States that combines the three separate operations of harvesting—reaping, threshing, and winnowing—into a single process.
**1835** Charles Babbage of Great Britain designs a mechanical computer. He is considered today the "father of the computer."
**1835-1836** Samuel Colt invents the first pistol with a rotating breech, the revolver. With the founding of the Colt's Manufacturing Company, he makes the mass-production of the revolver commercially viable for the first time.
**1837-1838** Samuel F. B. Morse of Massachusetts invents the telegraph and Morse code.
**1837-1842** The Panic of 1837 causes a crisis in the American banking and credit systems.
**1838** John Deere invents the first commercially successful steel plow.
**1838** Chauncey Jerome introduces the first mass-produced brass clock at a price that any American could afford.
**1838** The SS *Great Western*, a paddle-wheel steamship, makes the first regular trans-Atlantic steamship voyage.
**1839** Louis-Jacques-Mandé Daguerre of France invents the daguerreotype process of photography.
**1839-1844** Charles Goodyear invents and patents a process to vulcanize rubber.
**1840** Samuel Cunard of Great Britain begins trans-Atlantic steamship service with the *Britannia*.
**1840** William Grove of Great Britain invents the first incandescent electric light, which was later perfected by Thomas Edison.
**1840** By 1840, over 3,000 miles of canals have been built in the United States.
**1841** Lewis Tappan establishes The Mercantile Agency in New York City, America's first credit rating agency.
**1841** Alexander Bain of Scotland invents and patents the first electric clock.
**1842** In *Commonwealth v. Hunt*, the Massachusetts Supreme Court rules that Boston journeymen boot makers have a right to organize and strike.
**1843** Richard Hoe invents and patents a lithographic rotary printing press that placed the type on a revolving cylinder.
**1844** Samuel Morse sends the first telegraph message from Washington, D.C. to Baltimore. He says, "What hath God wrought."
**1844** William A. Burt and a party of surveyors discover the Marquette Iron Range in Marquette County, Michigan. Mining begins in 1847.
**1845** Female textile workers in Lowell, Massachusetts found The Lowell Female Labor Reform Association, which demands a ten-hour workday.
**1844** Linus Yale Sr. of Connecticut invents and patents the pin tumbler lock.

**1846** Elias Howe of Massachusetts receives the first U.S. patent for a sewing machine using a lockstitch design.
**1847** Cyrus McCormick opens his first factory in Chicago to manufacture his mechanical reaper.
**1847** William Kelly of Kentucky develops a process for making steel from pig iron, the same process that was later independently invented and patented by Henry Bessemer of Great Britain.
**1849** George Corliss of New Jersey develops a four-valve steam engine (Corliss engine), which enabled the expansion of new factories to areas that did not possess reliable or abundant water power.
**1849** Walter Hunt of New York invents and patents the safety pin.
**1849** The Wheeling Suspension Bridge, the longest suspension bridge in the world, opens.
**1851** Isaac Singer invents and patents a practical sewing machine. He founds I. M. Singer & Co. and begins to mass produce sewing machines using interchangeable parts.
**1851** Elias Howe of Massachusetts receives a patent for an "Automatic, Continuous Clothing Closure," more commonly known as the zipper.
**1851** Robert Knight begins producing textiles and founds the Fruit of the Loom Company.
**1852** Smith &Wesson, manufacturer of firearms, is founded in Massachusetts.
**1853** Congress appropriates $150,000 to survey a potential route for a trans-continental railway.
**1853** Elisha Otis invents the elevator safety brake that prevents elevators from falling if the hoisting cable fails.
**1853** U.S. minister to Mexico, James Gadsden, makes the Gadsden Purchase of what is now southern New Mexico and Arizona, for ten million dollars.
**1854** John Tyndall demonstrates the principles of fiber optics.
**1855** Isaac Singer invents and patents a sewing machine motor.
**1855** Henry Bessemer of Great Britain develops the first inexpensive industrial process for the mass production of steel from molten pig iron.
**1856** Ralph Collier invents and patents the first rotary egg beater.
**1856** Alexander Parkes of Great Britain invents the first man-made plastic.
**1857** The Panic of 1857 is an economic depression that results from bad investments made by the New York City office of the Ohio Life Insurance and Trust Company.
**1857** Joseph Gayetty of New York City invents toilet paper.
**1857** The *Dred Scott v. Sanford* case is decided by the Supreme Court. It states that because Scott is black, he is not a citizen.
**1859** Jean Lenoir of Belgium invents the first single-cylinder two-stroke internal combustion engine.
**1859** Edwin Drake discovers oil in western Pennsylvania.
**1859** George B. Simpson invents and patents the first electric stove.
**1859** Nathan Ames of Massachusetts invents the "Revolving Stairs," commonly known as the escalator.
**1860s** More than 30,000 miles of railroad tracks have been constructed in the United States. There are more than 50,000 miles of telegraph wire connecting most parts of the country. Only ten percent of the nation's industrial workers lived in the South.
**1860** Daniel Hess of Iowa invents and patents the first vacuum cleaner.
**1860** Abraham Lincoln is elected the 16$^{th}$ president of the U.S.
**1860** South Carolina secedes from the Union.
**1861** The first trans-continental telegraph line is complete.
**1861** Linus Yale Jr. invents the cylinder lock that is still in use today.

**1861** Mississippi, then Florida, Alabama, Georgia, and Louisiana secede from the Union, and the Confederate States of America is formed.
**1861** The Civil War begins when Confederate forces fire on Fort Sumter.
**1861** Richard Gatling of Indiana invents patents the Gatling gun, the first successful machine gun.
**1861** The American Miners' Association, the first national union of miners in the United States, is founded.
**1862** The U.S. Congress passes the Pacific Railroad Act of 1862, which authorizes a railroad to be built from the Missouri River to the Pacific.
**1862** George Pullman manufactures the Pullman sleeping car.
**1863** President Lincoln issues the Emancipation Proclamation.
**1864** Lincoln wins a second term as president.
**1865** The Thirteenth Amendment abolishes slavery in the U.S.
**1865** Robert E. Lee surrenders to Ulysses S. Grant at Appomattox, ending the Civil War.
**1865** John Wilkes Booth shoots President Lincoln; Lincoln dies several hours later.
**1865** President Johnson develops a policy of Reconstruction in the South, allowing states to rejoin the Union if they abolish slavery and swear allegiance to the Union.
**1865** The first successful oil pipelines are constructed in the Titusville, Pennsylvania area.
**1866** Congress passes, then President Johnson vetoes, the Civil Rights Act of 1866, meant to protect the new rights of black Americans. Congress overturns the veto.
**1866** Cyrus W. Field lays a successful trans-Atlantic telegraph cable.
**1867** Secretary of State William H. Seward buys Alaska from Russia.
**1868** The first refrigerated railroad car is patented in Detroit.
**1868** The Fourteenth Amendment is ratified, granting citizenship to all people in the U.S.
**1869** The Central Pacific Railroad lays ten miles of track in one day, setting a record and completing work on the Transcontinental Railroad.
**1869** George Westinghouse patents the airbrake, which means one engineer can now brake all the railroad cars at the same time.
**1869** Michigan produces more lumber than any other state.
**1876** Thomas Alva Edison opens his Menlo Park laboratory.
**1876** Alexander Graham Bell patents the telephone, and utters the famous words, "Mr. Watson, come here. I want you."
**1876** The U.S. Centennial Exposition is held in Philadelphia, showcasing many of the inventions of recent years.
**1877** Reconstruction ends as President Hayes withdraws all federal troops from the South.
**1877** The Exoduster Movement, or westward migration of formerly enslaved blacks, begins.
**1877** The Bell Telephone Company opens for business.
**1877** Edison records "Mary Had a Little Lamb" on his new phonograph.
**1879** Edison demonstrates the incandescent light bulb.
**1882** Edison opens an electric power plant in New York City, and lights the financial district.
**1883** A shoe-lasting machine is invented to sew the tops of shoes to the soles. It can finish 700 pairs of shoes in one day, while a skilled worker can only finish 50 pairs.
**1883** The U.S. is split into four time zones by railroad companies.
**1884** The first skyscraper is completed. It is ten stories, and has a steel and iron frame.
**1885** George Westinghouse sets up the first Alternating Current (AC) electrical system in Pittsburgh.
**1885** William Burroughs invents an adding machine.

**1888** Nikola Tesla announces his invention of an electric motor that runs on alternating current.
**1888** George Eastman markets his Kodak camera, which comes preloaded with Eastman's new roll film, which can be sent out to be developed.
**1890** Congress passes the Sherman Anti-Trust Act.
**1891** Tesla invents the Tesla Coil, which is used now in many electrical devices.
**1891** Sears Roebuck is founded as a mail-order company.
**1895** The Westinghouse Electric Plant at Niagara Falls begins producing hydroelectric power.
**1896** *Plessy v. Ferguson* is decided by the Supreme Court, declaring "separate but equal" facilities for blacks and whites are legal.
**1896** Henry Ford builds his first car, the Quadricycle.
**1896** George Washington Carver joins the Tuskegee Institute.
**1900** The value of U.S. manufacturing output reaches double its agricultural output.
**1900** Eastman Kodak introduces his Brownie Box Camera for one dollar. The Kodak slogan is "You press the button and we do the rest."
**1903** The Ford Motor Company is established.
**1903** The Wright brothers fly the first successful airplane.

## PART III: BACKGROUND INFORMATION

### "Good Implements": Machines for an agricultural revolution

Cyrus Hall McCormick introduced the first successful grain reaping machine in 1831. It was noisy, awkward - and revolutionary. As horses pulled the reaper forward, a rotating reel brought wheat stalks against a vibrating bar to cut them. In a few hours the reaper harvested as much grain as two or three men could in a whole day.

At first, additional field hands were needed to rake, gather, and bind the cut wheat. By the 1880s, the reaper automatically bound the wheat, allowing a single person to accomplish what had previously required as many as five people. McCormick set up his company in Chicago in order to be close to the rich farmlands of the Midwest.

In 1837, blacksmith John Deere noticed that the heavy cast iron plows used by Midwest farmers would get stuck in the soil, forcing farmers to stop plowing to clean them. He fashioned a highly polished and properly shaped steel plow that scoured itself as it cut rows, allowing farmers to work more quickly. His newly formed company went from manufacturing 10 plows in 1839 to approximately 1,600 in 1850.

These companies, and others like them, increased farms' efficiency dramatically and freed farm laborers to work in factories.
*Sources:* http://www.deere.com/wps/dcom/en_US/corporate/our_company/our_company.page
http://www.pbs.org/wgbh/amex/chicago/peopleevents/p_mccormick.html

### Improvements to Farming Help the Industrial Revolution

During the Industrial Revolution, an increase in food production was necessary to feed the growing number of immigrants and factory workers in urban areas. New techniques and a scientific approach to farming made increased yields possible. For example, instead of letting fields lie fallow to restore fertility, farmers learned to plant clover or beans or to add compost or manure.

Scientific approaches were advocated by men such as Oliver H. Kelley and George Washington Carver. Kelley, a clerk in the Department of Agriculture, took a tour of the South during Reconstruction. He was inspired to found The National Grange of the Order of Patrons of Husbandry, a society for farmers to share improved farming methods and technology. "The Grange" offered camaraderie, classes, and advocacy for farmers and still exists today.

Carver was born into slavery, and was the first African-American to attend Iowa State College, earning a degree in Agricultural Science and a Master's of Science. He is best known for advocating for the planting of peanuts and soybeans, which replaced nitrogen in the soil and added protein to the diets of poor Southern farmers. As a faculty member at the Tuskegee Institute, Carver formulated over 350 uses for peanuts including over 100 recipes, but also cosmetics, insecticides, glue, and more.
*Sources:* http://www.jstor.org/stable/10.2307/2950874
http://www.yale.edu/ynhti/curriculum/units/1981/2/81.02.06.x.html
http://www.jstor.org/stable/10.2307/3740337
http://www.lib.iastate.edu/spcl/gwc/bio.html

**Alexander Graham Bell and the Telephone**
Alexander Bell was born in Scotland in 1847 and immigrated to Ontario with his family in 1870. He was an early student of sound and speech, inspired, perhaps, by his father, who also worked with sound, and his mother, who was almost totally deaf. In 1866, he published a book called "Visible Speech" which showed how to position the mouth and the tongue to form words. In his 20s, Bell gave speech lessons and taught deaf children to speak.

Bell was also a pianist. One day he noticed that if he struck a chord on a piano in one room, a piano in another room would echo it. He realized that sound could be transmitted through the air, vibrating at the other end at the same pitch. He thought that pitch could be transmitted across a wire in a continuous electric current. He eventually realized this idea would also work with human speech, which is made up of sound vibrations.

In 1875, Bell developed his first version of the telephone. He received a patent for it on March 7, 1876. A few days later, he tested it, speaking into the phone to his associate, Thomas Watson, a repair mechanic and model maker. He said, "Mr. Watson, come here. I want to see you."

Bell demonstrated his invention in June at the Centennial Exhibition in Philadelphia. The first telephones worked much the same way that landline phones do today. A microphone converts sound waves into an electronic current which varies in intensity and frequency. The current travels along wires and sound is reproduced on the other end when the electrical current is changed back into sound vibrations.

In 1877, Bell placed the world's first phone call over telegraph wires between two towns in Ontario eight miles apart. Two months later, a telephone call could travel 143 miles, thanks in part to an improved transmitter, patented by Thomas Edison. Bell faced many legal challenges to his patent, but won them all and his American Bell Telephone company still exists today, in part as AT&T (American Telephone and Telegraph Company, founded 1885).

The telephone and telegraph coexisted for many years after the invention of the telephone, eventually giving way to the telephone. The telegraph and the telephone provided the first "paving stones" for what is today the information superhighway.
*Sources:* http://web.mit.edu/invent/iow/graham_bell.html
http://www.corp.att.com/history/history1.html/

**Andrew Carnegie: Scottish Steel Tycoon**
Andrew Carnegie was born in 1835 in Scotland. He immigrated with his family to Pittsburgh in 1848. Carnegie worked many jobs between ages 14 and 24 before earning a position at the Pennsylvania Railroad earning $35 a month. With his extra income, Carnegie invested in railroad and iron companies. In the mid-1870s he realized the potential value of steel manufacturing and built the largest Bessemer process plant in the country.

Carnegie was known to be ruthless in keeping his companies' costs down. He embraced new technologies and was a master of vertical integration. This meant he controlled his operation from the natural resources to the finished product. He owned iron ore mines, coke (coal) fields, the steelworks, and the ships and railroads that transported his raw materials and finished products.

Although he publicly supported workers' rights, employees in his steel plants faced appalling working conditions, long hours, and back-breaking work. Also, in 1892 the Homestead Strike, a violent conflict between labor and management took place at a Carnegie steel mill.

By 1900, Carnegie Steel produced more than all the manufacturers in Great Britain. In 1901, J. P. Morgan bought Carnegie Steel for $480 million, and Carnegie set about giving away his wealth.
*Source:* http://www.pbs.org/wgbh/amex/carnegie/peopleevents/pande01.html

**Civil War Technology**
Civil War inventors and military men devised new types of weapons that forever changed the way wars were fought. Technologies that did not specifically have to do with the war, like the railroad and the telegraph, changed the way people lived. These technological innovations included:

- Rifles and cone shaped bullets called Minié Balls became the standard for soldiers improving shooting range, accuracy, and loading time. By 1863, repeating rifles like the Spencer carbine could fire seven shots in 30 seconds.
- Hydrogen-filled balloons were used by Union spies to float over Confederate camps and send information back via telegraph.
- Iron-clad warships maintained a Union blockade of Confederate ports. Confederate sailors tried to sink these ironclads with some of the first submarines.
- The railroad also showed the Union's advantage. When the war began, the North had substantially more track and most of the nation's locomotive factories.
- The telegraph allowed Abraham Lincoln to be the first president to communicate on the spot with his officers on the battlefield monitoring battlefield reports, leading strategy meetings and delivering orders.
- The advent of photography meant the Civil War was the first war to be documented through the lens of a camera.

Technological innovation had an enormous impact on the way people fought the Civil War and on the way they remember it. Many of these inventions have played important roles in military and civilian life ever since.
*Source:* http://www.history.com

**The Evolution of Electricity and Electrical Power**
Human curiosity about electricity goes back to the Greeks, who noticed that amber, when rubbed, would attract light objects such as feathers or paper (due to static electricity.) Formal study of electricity began in 1600, with English scientist William Gilbert, who used the word elektron, the Greek word for amber. Throughout the 1600 and 1700s, many scientists, including Benjamin Franklin, investigated natural occurrences of static electricity and lightning, and coined the terms positive and negative charges.

In 1800, Alessandro Volta built the first battery, which he called a voltaic pile. It was made from alternating layers of zinc and copper, and generated a current of electrical energy, due to a chemical reaction. Experimenting with a voltaic pile, Hans Christian Ørsted was the first to recognize that a flow of electricity generated a magnetic field, and André-Marie Ampère furthered the knowledge of electromagnetism.

Michael Faraday built on their work when he invented the electric generator, or dynamo, in 1821. Instead of creating a magnetic field with an electric current, Faraday used a moving magnet to generate an electric current. This "electromagnetic induction" remains the principle behind electric generators, transformers, and many other devices.
*Sources: From Faraday to Solar Generators,* istp.gsfc.nasa.gov/earthmag/dynamos.htm

**The Evolution of American Manufacturing**
In 1820, 350,000 Americans worked in factories or mills. Four decades later, that number was 2 million.

The first American factories were rural mills, very different from the factories we know today. They were water-powered, drawing energy from streams. Ice, drought, and floods often stopped production. The machines they used were small and wooden with leather belting to transmit energy from the river to the machines. The work force was made up of families, including children, and owners worked alongside their employees. Many employees continued to farm on the side, and received pay in produce and goods as well as cash.

By the 1840s, a wider variety of products were made in factories: shovels, saws, scythes, stoves, pots, pans, wire, plows, reapers, harvesters, axes and nails. New factories were built in urban areas, and were increasingly powered by steam, unaffected by season and weather. They used large, complex and expensive metal machinery. Workers were mostly men. They no longer farmed, and cash wages were their sole source of income.

Tasks in factories became more and more subdivided. New factory owners were uninvolved, leaving managers to look after the day-to-day operations. Companies also began examining cost accounting and internal organization, trying to save money and increase efficiency, driving modern business practices.
*Sources:* http://www.jstor.org/stable/10.2307/3113503
http://www.digitalhistory.uh.edu/database/article_display.cfm?HHID=609

**The Wizard of Menlo Park**
Thomas Edison changed our world! His genius gave us electric lights and an entire system that produced and delivered electrical power. He was the first to record sound, developed the first movie camera and produced the first movies. By the end of his life, "Wizard of Menlo Park" had 1,093 patents to his name. To this day, no one has topped his record. From his first laboratory on the baggage car of the railroad connecting his boyhood home in Port Huron to Detroit to his famous Menlo Park laboratory, Edison's inventions were vast.

- His first big success in 1874 was his quadruplex telegraph system for which he received the $40,000 necessary to become a full-time inventor.
- In 1877 he made the first recording of the human voice on his new phonograph.
- His kinetoscope became the first movie projector in 1888.
- He even touted the benefits of electric cars in 1899 by working on a better storage battery which he said was more efficient than gasoline!
- And he perfected the light bulb!

When Edison died, President Herbert Hoover requested a minute of silence and darkness. At 10 p.m. on October 22, 1931, the United States turned off their electric lights.
*Source:* The Lemelson Center for the Study of Invention and Innovation

**Eli Whitney, American Innovator**

In 1794, American inventor Eli Whitney patented the cotton gin, a machine that revolutionized the production of cotton. This revolutionary device was easily copied, however, and several patent infringement lawsuits gained little to no financial reward for Whitney and his partners. Still, Whitney received credit for what Thomas Jefferson claimed was the dawn of the machine age with his next invention.

In 1797, when Congress voted to prepare the nation for war with France, including the appropriation of a large amount of funds for new weapons, the young inventor Whitney—already known for his invention of the cotton gin—seized an opportunity to try to make his fortune. In mid-1798, he obtained a government contract to manufacture 10,000 muskets within an extraordinarily short time frame of less than two years.

Whitney proved to be an effective businessman and manager, dividing labor efficiently among his largely unskilled work force and building precision equipment that enabled the production of large numbers of identical parts quickly and at a relatively low cost. The last of the 10,000 muskets that Whitney had promised in his original contract came in eight years late, but were judged to be of superior quality, and he produced 15,000 more within the next four years.
*Source:* http://www.history.com/topics/interchangeable-parts

**Elias Howe, Inventor of the Sewing Machine**

Interested in machinery since childhood, Howe learned the machinist trade and worked in a cotton machinery factory in Lowell, Mass., and later in Cambridge. During this time it was suggested to him that the man who invented a machine that could sew would earn a fortune. For five years Howe spent all his spare time in the development of a practical sewing machine, and in 1846 he was granted a patent for it. The machine attracted little attention in the United States at first, and, when a fortune was not forthcoming, Howe sold the patent rights in England for £250 ($1,250).

He moved to England and worked for £5 a week to perfect his machine. As his financial condition worsened, he managed to send his family back to the United States, but when he finally returned destitute, he found his wife dying. Disappointed and discouraged, he found that while he had been abroad sewing machines were being widely manufactured and sold in the United States in violation of his patent. After much litigation, his rights were finally established in 1854, and from then until 1867, when his patent expired, he received royalties on all sewing machines produced in the United States.
*Source:* http://www.britannica.com/EBchecked/topic/273503/Elias-Howe

**Great Thumb Forest Fire**

In September 1881, Michigan experienced a massive forest fire which devastated almost a million acres and several hundred people died. The fire engulfed Huron, Sanilac, Saint Clair, Tuscola and Lapeer Counties. This was the second fire in a ten year span which affected the area. The first fire in 1871 was highly unpublicized due to major fires in Chicago and Wisconsin.

While not as extensive as the 1871 fire, the fire of 1881, commonly known as the Thumb Fire, was more severe and did more damage since settlers had begun pouring into the region and logging had gotten underway. As a result, more people were rendered homeless and the loss was greater. It is estimated that this fire burned well over one million acres, cost 282 lives, and did more than $2,250,000 worth of damage.

September 4, 1881 was the first response by the American Red Cross as a relief effort to help those affected by the fire. Clara Barton took the devastation to prove to government and the public that an active American Red Cross was needed. The fire was also the major catalyst for the creation of Michigan's first forest fire act in 1903.
*Source:* http://michiganfireservice.com

**Henry Ford: His Early Years**
Henry Ford, born July 30, 1863, was the first of William and Mary Ford's six children. He grew up on a prosperous family farm in what is today Dearborn, Michigan. Henry enjoyed a childhood typical of the rural nineteenth century, spending days in a one-room school and doing farm chores. At an early age, he showed an interest in mechanical things and a dislike for farm work.

In 1879, sixteen-year-old Ford left home for the nearby city of Detroit to work as an apprentice machinist, although he did occasionally return to help on the farm. He remained an apprentice for three years and then returned to Dearborn. During the next few years, Henry divided his time between operating or repairing steam engines, finding occasional work in a Detroit factory, and over-hauling his father's farm implements, as well as lending a reluctant hand with other farm work. Upon his marriage to Clara Bryant in 1888, Henry supported himself and his wife by running a sawmill.

In 1891, Ford became an engineer with the Edison Illuminating Company in Detroit. This event signified a conscious decision on Ford's part to dedicate his life to industrial pursuits. His promotion to Chief Engineer in 1893 gave him enough time and money to devote attention to his personal experiments on internal combustion engines.

These experiments culminated in 1896 with the completion of his own self-propelled vehicle—the Quadricycle. The Quadricycle had four wire wheels that looked like heavy bicycle wheels, was steered with a tiller like a boat, and had only two forward speeds with no reverse. Although Ford was not the first to build a self-propelled vehicle with a gasoline engine, he was one of several automotive pioneers who helped this country become a nation of motorists.
*Source:* http://www.hfmgv.org/exhibits/hf/

**Electrifying America**
Many of us cannot imagine a world without electricity. Think back on your day so far . . . did an alarm wake you? Did you flip a switch to turn on lights in your bedroom? Is your milk kept cold in a refrigerator? Did you watch television, talk on a telephone or use a computer? Did you get to the Lorenzo Cultural Center in a car? None of these activities would be possible without electric power.

In the late 1800s, researchers, inventors, and scientists such as Thomas Edison, Nikola Tesla, and George Westinghouse transformed electricity from a scientific curiosity into an essential tool for modern life, becoming a driving force for the American Industrial Revolution.

**Electrical Circuits**

Electricity is a form of energy, caused by the movement of electrons. An electric circuit allows electrons to flow along a conductor (often metal wires), through a device, and back to the power source. As the electrons pass through the device, the electrical energy transfers to it, lighting a bulb or heating a curling iron, for example.

A circuit must be a complete circle in order for the electrons to flow. Most electric devices have a switch to break the circuit in order to shut the device off. When the switch is off, it makes a gap in the circuit and the electrons are not able to flow. When the switch is turned on, it closes the gap and the electricity is able to move through the loop.

Now try these! Make sure you've read the other panels on electricity. You'll know you've found the right answer when the light bulb lights up, showing you've completed the circuit.

1. Who built the first battery? **B**
2. What kind of electricity comes from a battery? **E**
3. Who was the Wizard of Menlo Park? **A**
4. What type of electricity did George Westinghouse advocate for? **D**
5. Who invented the electric dynamo? **A**

A. Thomas Edison
B. Michael Faraday
C. Alessandro Volta
D. Alternating Current (AC)
E. Direct Current (DC)

A wire behind connects the question to the answer, and by touching one wire to the question, and the other the answer, you make a complete circuit for the electricity to flow through, and light up the bulb.

**Interchangeable Parts**

During the Industrial Revolution of the 19th century, machines took over most of the manufacturing work from men, and factories replaced craftsmen's workshops. The event that laid the groundwork for this monumental change was the introduction of interchangeable parts, or pre-manufactured parts that were identical, into the firearms industry. Interchangeable parts, popularized in America when Eli Whitney used them to assemble muskets in the first years of the 19th century, allowed relatively unskilled workers to produce large numbers of weapons quickly and at lower cost, and made repair and replacement of parts infinitely easier.

By the time the War of 1812 broke out between the United States and Great Britain, leading weapons producers like Colt and Smith & Wesson had made the doctrine of interchangeable parts established practice in the American gun industry. The U.S. introduced the first large-scale assembly of weapons with its adoption of the Model 1842 musket, and the new arms industry would produce hundreds of thousands of rifles for Civil War soldiers, all from interchangeable parts. By the 1850s, arms makers around the world were following what had become known as the American System of Manufacture, which had helped the United States out-produce traditional industrial powers such as Great Britain and Germany.The impact of this new system spread quickly to other industries and other products, from sewing machines and typewriters to the first automobiles.

*Source:* http://www.history.com/topics/interchangeable-parts

**Isaac Singer, Sewing Machine Manufacturer**
Isaac Singer invented the first practical, commercially-successful sewing machine and the first multinational company.

In 1850, a machinist asked Singer to help him improve a sewing machine made by the modestly successful Lerow and Blodgett Company. Instead of repairing the machine, Singer redesigned it. It was the first practical replacement for hand-sewing, and it could sew 900 stitches per minute, a dramatic improvement over an accomplished seamstress's rate of 40 stitches a minute on simple work.

While the first Singer machines were relatively expensive and bulky, the inventor soon adopted a mass-production system of interchangeable parts, and worked to reduce the machines in size and weight. From the start, he looked past the commercial market into households, aiming to sell to housewives. After a series of refinements, Singer was able to sell his machines for $10 each, making them accessible symbols of status and self-reliance for the average American family. His partner, Edward Clark, pioneered installment purchasing plans and accepted trade-ins, causing sales to soar.

Singer supported its sales with beautiful showrooms, repair mechanics, sewing instructors, and rapid parts distribution, creating a nationwide service network. And it expanded into foreign manufacturing of its products. By 1863, the Singer had become America's most popular sewing machine and was on its way to a worldwide monopoly. Singer died a wealthy man in 1875.
*Source:* http://www.pbs.org/wgbh/theymadeamerica/whomade/singer_hi.html

**Francis Cabot Lowell**
Francis Cabot Lowell was born in Massachusetts in 1775. On a trip to England in 1811, he was impressed by British textile mills. Like Samuel Slater, Lowell wanted to bring British textile technology to the United States. He founded the Boston Manufacturing Company, and worked to make improvements to the machines he had seen in England. His mills also expanded on Slater's Rhode Island System by converting raw cotton into cloth all in one location. This became known as vertical integration. Lowell used water-powered spinning frames to make thread, but also introduced a power loom to make thread into cloth.

Children were too small to work the power looms, so instead of hiring families, Lowell hired young women. He paid them lower wages than men, but offered benefits that many girls were eager to earn. The girls lived in clean company boardinghouses with chaperones, were paid cash, and participated in religious and educational activities.

Lowell's Waltham mill, located on the Charles River, became the model for the American factory system of the nineteenth century. Lowell died at the age of 42, and in 1822 his partners named the site of their new mill town "Lowell" in his honor. By 1850, Lowell's 40 mill buildings employed more than 10,000 workers. His practice of employing young women, and vertical integration of cloth-making became known as the Waltham-Lowell System.
Source: http://www.pbs.org/wgbh/theymadeamerica/whomade/lowell_hi.html
http://www.gilderlehrman.org/history-by-era/jackson-lincoln/essays/women-and-early-industrial-revolution-united-states

**Lowell: Good Girls do Good Work**
Between 1830 and 1860, rural American women were the primary labor force for the growing textile industry. Farmer's daughters traded rural, seasonal agriculture work for life in a densely settled mill town, the greatest example of which was Lowell. Many young women worked to help support their families, to save for marriage, or to have new opportunities. Women earned $3.00 to $3.50 per week, and the average time of employment was four years.

The Lowell Mill Girls also became one of the first examples of labor organizing in the United States. In the 1830s, the mills reduced wages by 15%. Some workers organized a strike, or "turn-out" as it was called. That strike did not have large support, and did not succeed. However, two years later, the mills proposed an increase in rent for the girls living in the boarding houses, and the girls again organized a turn-out, with support from the community of Lowell. After several weeks, the company was found to be in violation of its contract with the girls, and the rent was not raised. In the 1840s, mill girls organized in support of the Ten-Hour movement, and a large turn-out was successful in reducing the workday from 14 hours to 11. During the 1840s, American women workers were increasingly replaced by immigrant women.
*Sources:*
http://www.digitalhistory.uh.edu/database/article_display.cfm?HHID=609
http://www.gilderlehrman.org/history-by-era/jackson-lincoln/essays/women-and-early-industrial-revolution-united-states
http://www.lowell.com/lowell-mill-girls/

**Michigan's Lucrative Lumber Industry**
By 1840, sources of white pine in Maine and New York were unable to supply a growing demand for lumber, so Michigan became the logical place to turn. The first commercial logging ventures in the state utilized eastern techniques, capital, and labor, but Michigan lumbering soon expanded beyond the scope of anything previously known and established itself as one of the state's most important industries.

Between 1840 and 1860 the number of mills in operation throughout the state doubled, and the value of products increased from $1 million to $6 million annually. By 1869 Michigan was producing more lumber than any other state, a distinction it held for thirty years. Greater efficiency and increased lumber production during the era were aided by changes in machinery and techniques. Improvements included the substitution of the cross-cut saw for the axe and the replacement of oxen with horses as sled teams. Rutters and water sprinklers helped maintain the sled tracks and enabled woodsman to haul heavier loads. Big wheels and narrow gauge railroads also helped.

Between 1840 and 1900, lumbering changed from a small, speculative business to an efficient industry. Michigan, a top producer for much of the period and cradle for industry innovations, was key to the industry's development.
*Source:* http://www.michigan.gov/dnr

**Lumber Barons in Michigan**
Lumbering in Michigan made the fortunes of men such as David Whitney of Detroit, Charles Hackley of Muskegon, Louis Sands of Manistee, Perry Hannah of Traverse City, and local men like William Atwood and Henry Stephens, and one notable women baroness, Martha Hay from

Saginaw. These entrepreneurs were exceptions to the rule, however. The vast majority of those employed in the lumber industry worked long hours for low pay.

Nevertheless, the lumber barons in Michigan amassed great wealth and helped establish communities throughout the state. Hackley, for instance, donated over $6 million to the city of Muskegon, giving it to a hospital, an art museum, a library, a park, schools, and churches. David Whitney was eventually dubbed "Mr. Woodward" and his mansion on the avenue is now one of Detroit's finest restaurants, The Whitney.

Henry Stephens came to America in 1845, and operated a hardware and lumber supply business in Almont, Michigan. Mr. Stephens made a fortune by cornering the supply of iron nails in Michigan during the Civil War, and added to his wealth by requiring builders to buy lumber from his mill in order to obtain the nails.
*Sources:* http://www.tricitytimes-online.com
http://www.michigan.gov/dnr
http://apps.detnews.com

**Michigan Lumbering Innovations**
Two Michigan-initiated innovations of the 1870s were responsible for the largest increases in logging production. The Big Wheels invented by Silas Overpack of Manistee enabled cutting to continue in the snowless seasons by providing an alternative to sled transportation. This device consisted of a set of enormous wheels drawn by a team of horses. Logs were chained beneath the axle, and once the inertia of the load had been overcome, it was relatively easy to keep the wheels moving.

Like the logging wheels, the narrow gauge railroad helped to make lumbermen independent of the weather. Trains could be used in place of sleds year round and the river drive could be ended by carrying the logs to a mainline railroad depot. They could also cut in areas that had been considered too far from the nearest stream. Michigan lumbermen were not the first to use railroads to carry logs, but the idea of using temporary narrow gauge track did originate within the state. And the widespread publicity given the successful experiment of Winfield Scott Gerrish during the winter of 1876-77 in Clare County, provided the impetus for the development of small railroads industry-wide.
*Source:* http://www.michigan.gov/dnr

**Mining in Michigan**
In 1837, Douglas Houghton was appointed the 1st State of Michigan Geologist. His survey of the state set off national interest in mining in Michigan, particularly in the areas of abundant copper ore. Houghton also identified many salt springs in the Lower Peninsula. Michigan led the nation in salt production for many years. The state still has sufficient salt deposits to supply the world's needs for centuries. Although Houghton reported coal mining in Jackson County in 1840, the greatest production came from mines in the Saginaw Valley which were developed after 1890.

A second wave of mining in Michigan began when iron was found. Michigan also supplied limestone, salt, gypsum, oil, natural gas, coal, stone, sand and gravel to the nation as mining expanded after the Civil War. Michigan limestone has been important for smelting iron and making cement. The world's largest limestone quarry is located at Rogers City on Lake Huron.

Underground mining of gypsum began in the 1840s near Grand Rapids. Gypsum quarrying began in 1861 near Saginaw Bay.

In the late 19th century, quarries at Grindstone City, near the tip of the Thumb, supplied grindstones for sharpening tools. Sandstone, from Hillsdale and Jackson counties and the south shore of Lake Superior, was used as a building material.

Michigan accounts for nearly 4% of the value of the U.S. non-fuel minerals production.
*Source:* http://www.detroitsalt.com/mining-history.htm

**Made in Michigan before the Automobile**
Have you heard of Vernors, Sanders, D. M. Ferry & Co., Parke-Davis, Hudson's, Stroh's, Kresge, Kellogg's, or Post? All these companies were founded in Michigan in the 1800s, during the American Industrial Revolution.

Detroit was also home to large businesses that later closed, including the Berry Brothers Varnish Co, shipping nationwide and based near Jefferson, and the Garland Stove factory, which made the city the center of the American stove industry by 1881.

Iron mined in the Upper Peninsula was used to make stoves, but was also used by steel manufacturers and Detroit's railroad industry, which in the 1890s produced over 100 railroad cars per day. Inventors such as William Davis (refrigerated railroad car) and Elijah McCoy (lubricating cup for steam locomotives) also hailed from Michigan.

Timber was another abundant natural resource in northern Michigan. Boards were shipped east for building houses, and lumber was also used to make carts and carriages in Romeo, furniture in Grand Rapids, and paper in Kalamazoo.

Michigan companies made leather and fur goods and clothing, cigars and tobacco products, boots and shoes, soap and candles and even ships before the automobile industry took hold in the early 1900s.
*Sources:* http://detroithistorical.org/buildingdetroit/index.php
http://www.legislature.mi.gov/documents/Publications/PortraitsofMI.pdf

**Origins of the Industrial Revolution**
The Industrial Revolution (1820-1870) was of great importance to the economic development of the United States. The first Industrial Revolution occurred in Great Britain and Europe during the late $18^{th}$ century. The Industrial Revolution then shifted to the United States and Germany.

The Industrial Revolution itself refers to a change from hand and home production to machine and factory. The first industrial revolution was important for the inventions of spinning and weaving machines operated by water power which was eventually replaced by steam. This helped increase America's growth. However, the industrial revolution truly changed American society and economy into a modern urban-industrial state.

The real impetus for America entering the Industrial Revolution was the passage of the Embargo Act of 1807 and the War of 1812. Americans were upset over an incident with the Chesapeake whereby the British opened fire when they were not allowed to search the ship. They also seized four men and hung one for desertion. This resulted in much public outrage and the passage of the Embargo Act which stopped the export of American goods and effectively ended the import of goods from other nations. Eventually, America went to war with Great Britain in 1812. The war made it apparent that America needed a better transportation system and more economic independence. Therefore, manufacturing began to expand.

Industrialization in America involved three important developments. First**,** transportation was expanded. Second, electricity was effectively harnessed. Third, improvements were made to industrial processes such as improving the refining process and accelerating production. The government helped protect American manufacturers by passing a protective tariff.
*Source:* http://americanhistory.about.com

**Pacific Railway Act**
The Pacific Railway Act, passed July 1, 1862, was instrumental in getting the Transcontinental Railroad built. Congress had commissioned several topographical surveys across the West to investigate a railroad, but private corporations were reluctant to risk their own money building it.

The Pacific Railway Act designated the 32nd parallel as the route and authorized two companies to build it. The Central Pacific would build from California to the east and the Union Pacific would build west from the Missouri River. The bill also provided huge federal land grants and loans for construction. Each company got 200 square miles on both sides of the track they laid, which they sold to settlers to help finance the building of the railroad. They could also borrow up to $16,000 per mile on flat land and $48,000 in the mountains at very low interest rates.

Due to the large subsidies, corruption on the railroad was rampant. The notorious Thomas Durant, vice-president of the Union Pacific, made a fortune for himself by awarding the construction contract to his own company, Credit Mobilier. It charged the Union Pacific millions of dollars more than the actual cost of construction, all of which went to Durant and his friends, while the Union Pacific nearly went bankrupt.
*Sources:* http://www.ourdocuments.gov/doc.php?flash=true&doc=32 - *includes images of Act*
http://www.pbs.org/wgbh/americanexperience/features/timeline/tcrr-timeline/

**The Day of Two Noons: Railroad Time**
In the early 1800s, each community kept time according to the sun. Noon truly meant "high noon" - when the sun was high in the sky overhead. The telegraph and railroad changed the concept of time. A message sent on the east coast would arrive hundreds of miles away almost instantly. People could move with the sun very quickly into the west. Passenger and freight trains needed to keep regular schedules to meet passengers and avoid accidents.

"Time Zones" were proposed in the 1860s, but it wasn't until November 18, 1883 that the country experienced "The Day of Two Noons." On that day, railroad companies split the country into four time zones, to standardize their schedules from coast to coast. On that day, communities observed their own noon, and reset their watches to the Railroad Time of noon, based on the clock rather than the natural rhythms of life.

Detroit, on the border of the Eastern and Central time zones, did not adopt the railroads' time

zones right away. In 1900, the area joined the Central Standard Time for a few years before moving back to local time. In 1915, a local ordinance regulated a move to Eastern Standard Time. The city was still on Eastern Standard Time in 1918, when a federal law ordered that all localities join a time zone.
*Source: Key Concepts in American History: Industrialism*

**Reconstruction – Part I**
The Union victory in the Civil War in 1865 may have given some 4 million slaves their freedom, but the process of rebuilding the South during the Reconstruction period (1865-1877) introduced a new set of significant challenges. The most difficult task confronting many Southerners during Reconstruction was devising a new system of labor to replace slavery. The economic lives of planters, former slaves, and non-slaveholding whites were transformed after the Civil War.

During Reconstruction, many small white farmers entered into cotton production after being thrown into poverty by the war. This was a major change from prewar days when self-sustenance (growing food for their own families) was the focus.

Out of the conflicts on the plantations, new systems of labor slowly emerged to take the place of slavery. Sharecropping dominated the cotton and tobacco South while wage labor was the rule on sugar plantations.
*Sources:* www.history.com ; http://www.digitalhistory.uh.edu

**Reconstruction - Part II**
The postwar South remained overwhelmingly agricultural. Work implements were the same as before the war, but relations between planters, laborers and merchants changed forever.

As under slavery, most rural blacks worked on land owned by whites. But they now exercised control over their personal lives, could come and go as they pleased, and determined which members of the family worked in the fields. In early Reconstruction, many black women sought to withdraw from field labor in order to devote more time to their families.

Children, whose labor had been dictated by the owner under slavery, now attended school. As a result, landowners complained of a persistent 'labor shortage' throughout Reconstruction, another way of saying the free labor could not be controlled as rigidly as slave labor.

Under the sharecropping system which emerged as the dominant labor system in the rural South, black families rented individual plots of land. The system placed a premium on utilizing the labor of all members of the family.
*Source:* http://www.digitalhistory.uh.edu/reconstruction/section3/section3_01.html

**Samuel Morse and the Telegraph**
Samuel Morse was born in Massachusetts in 1791. While at Yale College, he was interested by the new field of electricity, but began working as a painter. He became a well-known and respected portrait artist.

In 1832, Morse was on a ship traveling home from studying painting in France. He overheard a conversation about electromagnetism that inspired his idea for an electric telegraph. A telegraph, or a machine to communicate electronically over a distance, was first proposed in 1753 and first built in 1774. The early models used 26 separate wires, one for each letter of the alphabet. A five-wire model was invented, but Morse wanted to reduce the wires to one.

Morse constructed an experimental telegraph in 1835, but the magnet did not have enough voltage to send a message more than about 40 feet. Morse had limited knowledge of electricity, so he enlisted the help of others, including Leonard Gale, a science professor; Joseph Henry, a scientist and researcher of electromagnetism; and Alfred Vail, who eventually became Morse's assistant and partner. Vail was a machinist and his family owned an iron works that he and Morse used to build their models. With their help, he increased the power of the battery and magnet and devised a system of electromagnetic relays so messages could travel further.

In 1837, Morse demonstrated a telegraph using just one wire which produced a raised line on tickertape. By 1838, he had created a code of dots and dashes (Morse Code) to represent letters of the English alphabet and the ten digits. The dots and dashes were defined by either short or long electrical pulses sent by the telegraph.

In 1842, Morse convinced Congress to provide $30,000 for a telegraph line from Baltimore to Washington, DC. In 1844 he sent the first public message, "What hath God wrought!" Private companies used Morse's patent and built telegraph lines across the US even more quickly than railroads had spread. By 1854, there were 23,000 miles of telegraph wire in operation. In 1866, the first successful trans-Atlantic cable was laid.

The telegraph completely revolutionized American communications. Messages could be sent instantly and as a result, newspapers, businesspeople, and ordinary citizens embraced it. The telegraph also played a key role in the Civil War. Distant officer—including President Lincoln—could receive timely reports from the battlefield.
*Sources:* http://web.mit.edu/invent/iow/morse.html
http://lcweb2.loc.gov/ammem/sfbmhtml/sfbmhome.html

**Samuel Slater: Father of the American Factory System**
Samuel Slater was born in England in 1768. A farmer's son, he went to work at a young age as an apprentice at a cotton mill. Eventually he became a superintendent, and very familiar with the machines designed by Richard Arkwright, a British businessman who was the first to use water power to drive his spinning machines, or water frames, to make thread.

In 1789, Slater immigrated to the United States in secret. He arrived in New York with the details of British textile machines in his head.

Slater reconstructed a water frame with an investment from three Providence merchants. Their company pioneered machine production of cotton yarn, using a waterwheel to drive machinery that carded and spun cotton into thread. Following British practices, Slater employed entire families, including children, to live and work at the mill. The site included a large, modern mill, tenement houses for workers, and a company store. Slater's organization became known as the Rhode Island System. This meant employing families, spinning thread in the factory and "putting out" the yarn to be made into cloth at workers' homes. The system was imitated and improved upon by innovators like Francis Cabot Lowell throughout New England.

*Sources:* http://www.pbs.org/wgbh/theymadeamerica/whomade/slater_hi.html
http://www.gilderlehrman.org/history-by-era/jackson-lincoln/essays/women-and-early-industrial-revolution-united-states

**Steel: The Backbone of American Industry**

People have been using iron and steel for thousands of years. Wrought (worked) iron was the most commonly used metal at the beginning of the Industrial Revolution. At that time, making steel from iron was a complicated and time consuming process, taking 7 to 10 days to make just 100lbs.

Steel is an alloy (blend) of iron ore from which carbon and other impurities are removed. This leaves a stronger and more flexible metal. In the Bessemer process, developed in England by Sir Henry Bessemer in 1855, "pig iron" is heated until it melts. Then air is blown through the molten iron ore to remove impurities. This process allowed iron ore to be converted into steel much more quickly and cheaply than before.

Due to its increased strength, rust resistance, and ability to hold a sharp edge, steel quickly replaced iron in products such as railroads, oil and gas pipelines and farm tools. Steel also made new types of construction possible. Skyscrapers grew taller; bridges grew longer, and automobiles, battleships, and tractors were produced.

In the late 1800s, the steel industry was centered near Pittsburgh, where Andrew Carnegie's plants were located, and Pittsburgh is still associated with the steel industry today.
*Source:* http://www.anselm.edu/homepage/dbanach/h-carnegie-steel.htm

**Textile Mills**

In the early 1700s, most clothing was made at home, and the making of cloth was a specialized trade. Cotton or wool had to be brushed or carded, spun into thread, then woven into cloth by hand or with simple machines.

The Spinning Jenny, invented by James Hargreaves in England in the 1760s, was the first machine to assist in textile production. It allowed eight threads to be spun at once instead of just one, but was turned by hand and made only weak thread. The water frame, developed by Richard Arkwright in the 1770s, made tighter thread. However, it was too large to be powered by hand and was instead powered by a waterwheel. Even children could operate it.

Textile technology moved slowly to the United States, partly because British textile workers were forbidden to leave the country. The first use of water-powered spinning frames was at Slater's Mill, in Rhode Island. Later, textile mills of the Waltham-Lowell system sprang up across northern New England. In the mid-1800s, textile mills were the nation's leading industrial employers, with 85,000 people employed, producing cloth goods valued at $68 million annually.
*Sources:* http://www.cottontown.org/page.cfm?pageid=602&language=eng
http://www.gilderlehrman.org/history-by-era/jackson-lincoln/essays/women-and-early-industrial-revolution-united-states

**The Cotton Gin**

The cotton gin is a machine designed to remove cotton from its seeds. The process uses a small screen and pulling hooks to force the cotton through the screen. It was invented by Eli Whitney on March 14, 1794, one of the many inventions that occurred during the American Industrial Revolution.

The cotton gin made the cotton industry of the south explode. Previous to its invention, separating cotton fibers from its seeds was a labor intensive and unprofitable venture relegated to slaves. However, after Eli Whitney unveiled the cotton gin, processing cotton became much easier and resulted in greater availability and cheaper cloth. However, the invention also had the by-product of increasing the demand for slaves needed to pick the cotton. Many used this to strengthen the argument for continuing slavery. Cotton as a cash crop became so important that it was known as King Cotton and affected politics up until the Civil War.

Interesting Trivia:

•Eli Whitney made very little money off of his invention. Many farmers duplicated his cotton gin without paying royalties.

•Whitney did not intend to sell the cotton gin. Instead, he planned to make a profit by separating the cotton for farmers.

*Source:* http://americanhistory.about.com/od/industrialrev/p/cotton_gin.htm

**The Light Bulb Goes On!**

Thomas Edison's most famous invention was the light bulb. Edison didn't conjure up the idea for a light bulb from thin air, but he did perfect its design, giving birth to the country's electric industry in the process. Edison's bulb lit up the world, one block at a time, beginning with his laboratory's street in New Jersey in 1879. It has taken well more than a century, and the intense demand for more energy efficient lighting, to begin to displace the incandescent bulb as the standard.

Edison didn't invent electric lights—there were arc lights already, which were similar to today's street lights. Edison didn't just invent a light bulb, either. He put together what he knew about electricity with what he knew about gas lights and invented a whole system of electric lighting--light bulbs, electricity generators, wires to get the electricity from the power station to the homes, fixtures and more. It was like a big jigsaw puzzle for which Edison made up the pieces and fitted them together.

The first large-scale test of the system in the United States took place when Edison's Pearl Street station in New York City's financial district sent electricity to lights in 25 buildings on September 4, 1882.

*Sources:* Department of Interior, National Park Service, Edison National Historic Site and The Lemelson Center for the Study of Invention and Innovation

**Saws and Mills**

The sawmill was the first unit of the lumber industry to achieve increased output through technological change. Although water-powered mills were still common in the 1860s, steam saws, whether up-and-down or circular, were rapidly replacing them. Steam saws so increased the capacity of the mills that it became necessary to devise faster methods of handling both logs and sawn lumber in order to avoid pile-ups and delays. By the end of the 1870s virtually every mill operation had been mechanized to some degree.

In addition to increased speed of mill sawing, mechanical innovations were eventually also able to reduce waste. The first circular saws of the 1860s had wide blades that produced mountains of sawdust. They wobbled as they cut through the timber, so that the boards that were turned out "more nearly resembled washboards than lumber." Within a few years, however, these problems had been almost totally eliminated. The widespread adoption of the band saw in the 1880s further reduced waste. Metal technology now made it possible to build a saw with a thin band of steel operating as a continuous belt that cut both rapidly and efficiently.
*Source:* http://www.michigan.gov/dnr

**Powered by Steam**
The shaping technology of the nineteenth century was steam power. The steam engine, developed first in England and later refined in the United States and other industrializing nations, provided a more reliable and powerful source of power than water or wind. The impact of steam power is evident in the growth of iron industry to build engines and steam-driven machinery and in the expansion of coal mining to provide fuel. American cities became centers of steam-powered manufacturing and by 1900 nearly 40 percent of the population lived in urban areas, a seven-fold increase from 1800.

The most significant innovation in the Age of Steam was the development of railroads. The first American railroad was the Baltimore and Ohio that began service in 1828. By 1840 there were 2,818 miles of track in the United States. The number of track mileage grew to more than 30,000 miles by the Civil War and almost 200,000 miles by 1900—40 percent of the world's total. The railroads symbolized America's technological ambitions, and the completion of the first transcontinental rail link in 1869 was one of the defining moments in the history of the nation, a prodigious feat of engineering, finance, and labor.

Steam power eventually pervaded life in the post-Industrial Revolution era.
*Sources:* http://www.gilderlehrman.org/history-by-era/jackson-lincoln/essays/technology-1800s

**Michigan Railroads**
The first railway car in Michigan was pulled by horses and ran from Toledo to Adrian in 1836. In 1837, the first steam locomotive arrived. In the following years, money for railroads poured into the state, helped by government land grants. In the mid to late 1800s, 8,600 square miles of Michigan land were awarded to railroad companies, mostly in rural areas. In 1914, at the height of railroad operations in Michigan, there were 9,000 miles of track in use.

Railroads contributed greatly to Michigan's economic development. They allowed people access to undeveloped areas, increased the population and workforce, and later drove the tourism industry. Lines including the Michigan Central, the Pere Marquette, and the Grand Trunk allowed Michigan products such as timber, minerals, agriculture, fish and even ice to reach ports and markets far beyond the state's borders.

Michigan also helped build the railroad industry. Detroit was the largest producer of Pullman sleeping cars until World War One. Eureka Processing in Wyandotte opened in 1865 and was the

first plant in the country to use the Bessemer process for steel railroad ties. The first refrigerated railroad car was patented in Detroit, and Bay City Industrial Works made a fortune building railroad cranes.
*Sources:* http://apps.detnews.com/apps/history/index.php?id=203#ixzz1xELSHvT0
*Tracks Through Time: Michigan Railroads*

**All Aboard! The Transcontinental Railroad**
In the mid-1800s, railroad lines connecting the Midwest and the Industrial Northeast developed quickly but the area west of the Missouri River remained isolated. The prospect of building a transcontinental railroad faced problems: severe weather, hostility of Native Americans, the Sierra Nevada Mountains, and a lack of monetary support.

In 1860, Theodore Judah, an engineer and railroad supporter, solved one problem by surveying a route through the Sierra Nevadas using the Donner Pass. The Pacific Railway Act of 1862 provided financial support. In 1863, construction on the railroad began.

The Union Pacific started building west from Omaha, employing more than 8,000 men, mostly Irish, German, and Italian immigrants. The Central Pacific at first excluded Chinese immigrants from working, but they eventually made up 80% of the workforce. They handled dangerous jobs, using nitroglycerin to blast through the mountains.

On May 10, 1869, the last rails were laid in Promontory, Utah and a ceremonial golden spike connected the ties. A telegraph line attached to the track sent a message to both coasts indicating the railroad was complete. It spanned 2,000 miles, and the four to six months' travel time across the country was reduced to six days.
*Sources:* http://www.sfmuseum.org/hist1/rail.html
http://www.pbs.org/wgbh/americanexperience/features/timeline/tcrr-timeline/
http://www.pbs.org/wgbh/americanexperience/features/introduction/tcrr-intro/

**"The Commodore" Cornelius Vanderbilt**
Cornelius Vanderbilt was born on Staten Island in 1794. He got his start in business running a ferry service. He eventually built a fleet, switching to steam ships in the 1830s. The size of his operations earned him the nickname "Commodore" from the press. He even had lines going to San Francisco by way of Nicaragua (traveling over land by stagecoach) for the gold rush in 1849.

He earned a reputation for efficient management practices and ruthless business practices. When two of his business partners tried to cut him out of a venture, he discovered their plot and wrote them a letter, which said, "Gentlemen: You have undertaken to cheat me. I won't sue you, for the law is too slow. I'll ruin you. Yours truly, Cornelius Vanderbilt."

By the 1860s Vanderbilt saw that the railroad industry was growing more than shipping. Instead of building new railroads, he simply bought existing ones. Cornelius' son William Henry Vanderbilt influenced his father to expand their railways into the Midwest. He consolidated smaller lines and built one of the first giant corporations in American history. One of the smaller lines they bought was the Michigan Central. The town of Vanderbilt in Otsego County north of Gaylord is named for the Vanderbilt family.

*Source:* http://apps.detnews.com/apps/history/index.php?id=203#ixzz1xhgDDLri
http://www.gilderlehrman.org/history-by-era/gilded-age/essays/robber-barons-or-captains-industry

**Nikola Tesla**
Nikola Tesla was a Serbian-American inventor and engineer whose discoveries and patents are the basis for alternating current (AC) power transmission and many other modern technological devices.

When Tesla first immigrated to the United States he worked for Thomas Edison. However the relationship did not last long due to differences in backgrounds and methods. He ended up working for George Westinghouse and being opposed to Edison's push for Direct Current (DC) power transmission.

One of Tesla's other inventions, the induction coil or "Tesla coil" is widely used today in radio, TV and other electronic devices. He also developed technology to transfer electricity wirelessly and was able to light 200 lamps at a distance of 25 miles away without wires.

Tesla had a photographic memory and an incredible mind. He claimed that he could imagine a device, test it, and work out all the flaws in his mind before building it. He was so rich with ideas that he couldn't even bring them all to fruition.
*Sources:* http://www.britannica.com/EBchecked/topic/588597/Nikola-Tesla.
Cheney, Margaret (2001) [1981]. *Tesla: Man Out of Time.* Simon and Schuster.

**George Westinghouse**
George Westinghouse was an American inventor and industrialist who was chiefly responsible for the adoption of alternating current (AC) for electric power transmission in the United States. Westinghouse's interest in railroads led to his first major invention, an air brake, which he patented in 1869. It became widely accepted, and the Railroad Safety Appliance Act of 1893 made air brakes compulsory on all American trains. Westinghouse saw the advantages of standardizing all air-brake equipment. He thus became one of the first to adopt the modern practice of standardization.

Westinghouse then turned his attention to the problems of railroad signaling. By purchasing patents to combine with his own inventions, he was able to develop a complete electrical and compressed-air signal system.

Although the electrical system being developed in the United States in the 1880s used direct current, Europe favored alternating current systems. Westinghouse thought AC was better and imported a set of transformers and a generator from England setting up an electrical system in Pittsburgh. He purchased the patents of Nikola Tesla's AC motor and hired him to help develop his system. When it was ready for the American market, the advocates of DC power immediately set out to discredit AC power. However, in 1893 the Westinghouse company was retained to light the World's Columbian Exposition at Chicago. In addition, Westinghouse secured the rights to develop the great falls of the Niagara River with AC generators. AC is still the standard today.
*Source:* http://www.britannica.com/

**The War of the Currents**

In 1887 direct current (DC) was king. At that time there were 121 Edison power stations scattered across the United States delivering DC electricity to its customers. But DC had a great limitation -- namely, that power plants could only send DC electricity about a mile before the electricity began to lose power. So when George Westinghouse introduced his system based on high-voltage alternating current (AC), which could carry electricity hundreds of miles with little loss of power, people naturally took notice. A "war of the currents" ensued. In the end, Westinghouse's AC prevailed.

AC/DC: What's the Difference?

The difference between the two is in the way the electrons flow. In direct current electrons move in a single direction while in alternating current they change directions, switching between backwards and forwards. Alternating current was shown to be more efficient as it minimizes power loss across great distances. The electricity use in your home is AC, while DC comes from sources that include batteries.

*Sources:* http://www.pbs.org http://www.teslasociety.com
http://www.sciencekids.co.nz/sciencefacts/electricity.html

## PART IV: LESSON PLANS FOR THE CLASSROOM

**Was There an Industrial Revolution?**
**New Workplace, New Technology, New Consumers**
*Grades 9-12*
*Social Studies, English Language Arts*
http://edsitement.neh.gov/lesson-plan/was-there-industrial-revolution-new-workplace-new-technology-new-consumers

*Pair this activity with the following Lorenzo Cultural Center presentations:*

- *What Was New and Different About the American Industrial Revolution?* by Merrit Roe-Smith, Leverett Howell and William King Cutten, Professor of the History Technology at the MIT, Saturday, September 22 at 1pm
- *Concept and Challenges of the Industrial Revolution*, by Daniel Clark, Associate Professor of History at Oakland University, on Thursday, September 27 at 11 am
- *Francis Cabot Lowell and the Start of the American Industrial Revolution*, by Chaim M. Rosenberg, biographer of Francis Cabot Lowell, on Wednesday, October 3 at 11 am
- *The One Indispensable Technology*, by Maury Klein, Professor Emeritus at the University of Rhode Island and Pulitzer Prize finalist, on Friday, October 5 at 11am and 1 pm
- *George Westinghouse, Gentle Genius*, by Quentin R. Skrabec Jr., PhD, Professor at the University of Findlay, on Wednesday October 17 at 11 am

### Overview

This dynamic lesson from EDSITEment! utilizes **hands-on anticipatory sets**, numerous **primary documents**, and census data for students to study **change over time**. Students will **make a judgment supported by evidence**: should the Industrial Revolution be described as a revolutionary or evolutionary process?

**Michigan Curriculum Content Standards** – Social Studies and English Language Arts HSCEs
*Social Studies*
**6.2.3** – Analyze the origins, characteristics and consequences of industrialization across the world by comparing and contrasting the process and impact of industrialization in Russia, Japan, and one of the following: Britain, Germany, United States, or France; describing the environmental impacts of industrialization and urbanization
**6.3.1** – Social Issues - Describe at least three significant problems or issues created by America's industrial and urban transformation between 1895 and 1930 (e.g., urban and rural poverty and blight, child labor, immigration, poor working conditions).
*English Language Arts*
**CE 1.4.7** – Recognize the role of research as a contribution to collective knowledge, selecting an appropriate method or genre through which research findings will be shared and evaluated.

**CE 4.1.3** - Use a range of linguistic applications and styles for accomplishing different rhetorical purposes (e.g., persuading others to change opinions, conducting business transactions, speaking in a public forum, discussing issues informally with peers).

**Time Frame:** 4-5 class periods, plus optional extension activities

**Materials**
Activity worksheets, media, and images from EDSITEment address above
United States Historical Census Browser (see instructions below)

**Lesson Activities**
*This lesson requires that students use a computer to access the statistics available from the United States Historical Census Browser, a link from the website History Matters.Take a few minutes to become familiar with what could be a useful tool for other lessons in your classroom. Any articles or images mentioned can be retrieved at the EDSITEment address listed at the start of this lesson.*

Activity 1: Hand-made and Store-Bought Goods

1. Establish an anticipatory set; share with the class the following 1840 Newspaper Ads:
    a. Look at the ad above the circled ad on Clues to the Past - Geo. L. Ward
    b. See all of the ads on Clues to the Past - Iron Goods
    c. Look at all three ads on Clues to the Past - Stoves
2. By 1840, goods people had previously made for themselves were sold cheaply enough at stores to make the purchase worthwhile.

Activity 2: A New Mode of Production: the “American system of manufactures”

1. One of the reasons store-bought goods became inexpensive was the development of the American system of manufactures: individual workers made only part of a finished product. Earlier practices involved someone skilled in a craft, toiling at home or in a shop, starting with raw materials and working through the entire creative process alone.
2. Share with the class the article “The Two Countries That Invented the Industrial Revolution.”
3. By 1851, the U.S. began to be known internationally for its manufacturing. If desired, share with the class the article “Engines of Change” which expands on this fact.

Activity 3: Craft and Factory Simulation Activities

1. Now, students will attempt to gauge the level of change in pre-Civil War America. How great was the change from the craft system to the factory? To demonstrate to the class the differences between the craft approach typical of colonial manufacture and the American system of manufactures developed by Eli Whitney and others, conduct the following simulation taken from the lesson "Workers on the Line"

2. Cottage Industries to Factory Production
   Before the Industrial Revolution, most goods were created by hand by craftsmen classified into three categories:
   a. Apprentice: young boys who spent many years under the direction of a master craftsman.
   b. Journeyman: a craftsman who had completed apprenticeship but did not yet have the experience or skill to be designated a master.
   c. Master craftsman: a person who had mastered all the techniques and skills of a given craft. After many years of practice, he was regarded as an expert who then passed along his knowledge and skills.

   With the advent of the Industrial Revolution, the job of creating an object became broken down into many steps each done by a different person. In the case of the wooden chair, one person might lathe the legs, another would create the seat, another would make the arms and back, and all the parts would then go to yet other people who would assemble them. The advantages were that single tasks could usually be done over and over faster than when one person did everything start to finish.
3. Download, copy, and distribute to students the "In-line Skate" sheet on page 1 of the PDF. Set standards for what is an acceptable finished product.
4. Explain that they are each a craftsperson who will assemble the skates start to finish. Each will be asked to track the amount of time it takes to complete the task. After everyone has completed the skates, compile and average the different times it took all the students to complete the task. This will be the "standard" time it takes to produce in-line skates by hand. Point out the differences in "quality" among the hand-created skates. Are there some who have apparently mastered the craft and some who still need some time as apprentices?
5. Next, conduct the Factory Simulation Activity. Divide the class into three to five efficient groups to create five production lines. Assign tasks to different students on the line. Depending on the group size, divide the following amongst students:
   a. Cutting out the right blade, cutting out the left blade, cutting out the right boot, cutting out the left boot, gluing the blade to the right boot, gluing the blade to the left boot, coloring the boots, Inspecting the final product/putting aside rejects/keeping the line moving.
6. Using the "standard" of time determined during the craft lesson, see how many skates can be created during the same amount of time. Do the same activity again and see which of the production lines can produce even more skates after allowing the groups to meet briefly to discuss improving efficiency. Now, have each student complete the "Craftsmen Versus Factory Line Chart" on page 2 of the PDF.
7. Discuss the results and the personal feelings students had about the two methods. Here are some guiding questions:
   a. What were some of the major differences between the two methods?
   b. Why was the factory method so attractive from a business standpoint?
   c. How would consumers be affected by this new method?

d. How would workers accustomed to the craft method feel about working in a factory? Why?

8. Bringing it all together: What are the connections between the way factories at the height of the Industrial Age were structured and the process the class just simulated? What are the differences between an assembly line and the American system of manufactures? What would the students say was the greater change—from craft to factory (perhaps the essential change of the First Industrial Revolution), or from factory to assembly line (one of the essential, though later, innovations of the Second Industrial Revolution)?

Activity 4: Analyzing the Products of Industry

1. Talk about the "in-line skates" students created in Activity 3. How many students own them? How many have ever tried them? When did such skates become popular? When do students think they were invented? Share with the class an image of an early version of inline skates. Ask students if they recognize the object. Tell them these skates were created in 1823. Inline skates have not changed that much in almost 200 years! That would seem to indicate that the greatest change in inline skating took place in 1823, when they were invented (albeit in England), or perhaps in 1863, when an American innovation started a craze in roller skating. When students take a look at some inventions and innovations of the First Industrial Revolution, will they find that the greatest changes took place then or between then and the height of the Industrial Age?
2. Divide the class into five groups. The students' task is to identify essential similarities and differences between the technology of the pre-Civil War period and that of the height of the Industrial Age, using EDSITEment links as well as other materials available in the classroom or library. To summarize their findings, groups can use the chart "Two Technologies: The First Industrial Revolution Versus the Industrial Age" on page 3 of the PDF.
    **1.** Factories and Machines: Armory, Mill, Sewing Machine, Furniture,
    **2.** Transportation: Steam Engine, Trains, Steamboats
    **3.** Scientific/Commercial Instruments and Innovations: Medical Technology, Watches, etc.
    **4.** Agriculture
    **5.** Communication: Photography, Printing, Telegraph

5. Have groups share their results. Did most ratings indicate great or small change since 1860 (with "small change" implying that the greatest change occurred before 1860)? This exercise had a built-in bias in that all of the objects existed prior to 1860. What contemporary inventions and innovations would students say represent the most significant change from the pre-Civil War era? Which of these belong to the Industrial Age (which began to end sometime after World War II), and which belong to the current Information Age?

Activity 5: Analyzing Census Data

*Comprehensive instructions for using the United States Historical Census Browser can be found as a link on the EDSITEment website listed at the beginning of this lesson. In brief:*

1. Review with students the proper use of the United States Historical Census Browser, available via a link from the EDSITEment resource History Matters. Introduce the census browser and allow students to practice with it until they are able to use it on their own.
2. Use the drop-down menus to choose groups to graph and re-sort the data or add new categories as desired.
3. Working in their groups, students should obtain data on each topic indicated below, using the census years shown:
   a. Longevity, 1800-1860
   b. Literacy/Education, 1840-1860
   c. Manufacturing, 1820, 1840-1860
   d. Agriculture, 1820, 1840-1860
   e. Slave and Free Black Populations, 1790-1860, and Slave Ownership, 1790, 1860
4. Before they get to work, have students decide how a radical change in the economy (expected to be seen as an improvement in quality of life) might be reflected in their topic area. For example, if the standard of living is improving, we would expect an improvement in longevity. Changes in slave population and ownership is a thorny category, because slave owners might consider possession of more slaves an improvement in standard of living, while those enslaved certainly would not. Students need to take such matters into account as they work with the data.
5. Each group should explore the data for some time and then form research questions. What are they going to look for and how will they work with the data? Students can expect their questions to change a bit as they become more familiar with the census browser.
6. Does the census data indicate that great change occurred between 1790 and 1860? Does the data indicate that a large number of people benefited from the changes that took place?
7. Students should organize their information in terms of findings and conclusions. If desired, provide each group with the appropriate chart from the following list of charts, available on pages 4-9 of the PDF:
   a. Longevity Findings, Literacy Findings, Manufacturing Findings, Agriculture Findings, Slave/Free Black Findings, Slave Ownership Findings
   b. Ample room has been provided on each charst for questions, but let students know that not every space for every year must be filled.

Activity 6: Class Discussion and Debate

1. Have each group share its findings with the class. After all have finished, everyone should take a stand—was the First American Industrial Revolution really a revolution? If desired, let any disagreement among students lead to a class debate.

**Lesson Plan: The Transcontinental Railroad**
*Grades 5-12*
*Social Studies*
PBS
http://www.pbs.org/weta/thewest/lesson_plans/lesson01.htm

*Pair this activity with the following Lorenzo Cultural Center presentations:*

- *The One Indispensable Technology*, by Maury Klein, Professor Emeritus at the University of Rhode Island and Pulitzer Prize finalist, on Friday, October 5 at 11am and 1pm
- *Uniting America: The Transcontinental Railroad, an 1870 Journey*, by Michael P. Deren, historical re-enactor, on Friday, October 19 at 11am and 1pm
- *Early Street Cars of Detroit and the Interurban Railway* System by Ken Schramm, transportation historian, on Sunday, November 4, at 2 pm

**Overview**
Students will **analyze primary documents** and **use maps** to assess the need for a transcontinental rail road. They will view clips from a documentary and **adopt a historical point of view**. Finally, using the suite of materials presented, they will **assess the total effect** the rail road had on American life.

**National Center for History in the Schools Standards**
**Era 4 Standard 2E** – The Student understands the settlement of the West. Therefore the student is able to: Analyze cultural interactions among diverse groups in the trans-Mississippi region.
**Era 6 Standard 1C** – The student understands how agriculture, mining, and ranching were transformed. The student is therefore able to: Analyze the role of the federal government — particularly in terms of land policy, water, and Indian policy — in the economic transformation of the West.
**Standard 2A** – The student understands the sources and experiences of the new immigrants.

**Time Frame:** Selected aspects of this lesson can be implemented in 1 or 2 class periods. Completing all phases of the lesson would require approximately one week.

**Necessary Materials**
Computers with internet access
Index cards, a large bulletin board, and a few art materials (markers, large sheet of paper)
A variety of materials for writing facsimile 19th century letters, diaries, and brochures
Episode V ("The Grandest Enterprise in the World") of the PBS documentary **The West**

**Procedure**
Activity I: Map Work

1. With your class view a political map of the United States in 1860, such as: http://www.lib.utexas.edu/Libs/PCL/ Map_collection/united_states/US_Terr_1860.jpg.

2. Ask the class to imagine that they are living in 1860 when a political map of the United States looked like this. Ask the class the following questions:
    a. In 1860 did the United States encompass land from the Atlantic to the Pacific coasts?
    b. How many states existed in 1860?
    c. Was there any land which was owned by the United States government but which was not yet admitted into the Union as a state?
    d. What is the difference between a state and a territory?
    e. How did a territory become a state? (Have students review the Northwest Ordinance.)
    f. Why do students think so few Easterners settled in between the states fronting the Mississippi River and the states of California and Oregon? (The exception here is Texas whose history you may wish to discuss separately.) In other words, why did people cross the continent to settle California and Oregon in great enough numbers to entitle them to become states, but bypass settling the Great Plains? To answer this question, ask students to turn to a classroom atlas. Looking at a variety of maps (vegetation, relief, rainfall etc.), help students gain a picture of the Great Plains. Remind students that the sod covering prairies at this point had never been plowed.
3. Then ask students to consider the following:
    a. Were there good water sources on the plains?
    b. If there were few trees, with what would settlers build? What would they use for fuel?
    c. What means of transportation existed at this time to either transport settlers and goods onto the plains, or transport the goods they produced to markets elsewhere?
    d. What means of communication existed to connect those settling the plains with people on either the eastern or western seaboards?
    e. What American Indian tribes lived in these areas, and how might they have survived?

    For a map see:
    http://www.lib.utexas.edu/Libs/PCL/Map_collection/united_states/Early_Indian_West.jpg
4. Now ask students the final two interrelated questions of this part of the lesson:
    a. How could the government play a role in enticing people to settle the Great Plains?
    b. While a map of the United States would show many railroads in the North (fewer in the South) in 1860, none reached across the Great Plains to link the country coast to coast. How could railroad companies be encouraged by the government to build a railroad in a part of the country where there were as yet no significant numbers of citizens? Conversely, why should settlers come when there was no railroad?
    c. Remind students that the government could not fund efforts to settle the plains with cash, especially in light of the expenses needed to fight the war that erupted in 1861. What other kinds of help could it offer? Let students brainstorm various "deals." List them on the board to contrast their plans with the ones actually offered by Congress.
5. At this point show the first five minutes of *The West* Episode 5, "The Grandest Enterprise Under God" It introduces the time period, the need for a continental railway, and some of its consequences.

Activity 2: Document Analysis

This activity involves reading government documents. The language used means this activity is best suited for high school students. You could summarize the documents for younger students.

1. Distribute copies of "The Homestead Act" and "The Pacific Railway Act." to students.
2. Have students answer the following questions on the Homestead Act of 1862:
   a. What is the purpose of this act?
   b. What is meant by the term "public domain"?
   c. Who is entitled to secure a grant of land from the Federal Government? Can women secure such a grant in their own names, and if so, how?
   d. What is the largest amount of land a person can secure from the Federal government through this act?
   e. How would one go about applying for land under the act (filing the affidavit)?
   f. How long would one have to wait in between filing an affidavit and securing final title to the land one settled? What did a settler need to do in the meantime?
   g. How much per acre did land under the Homestead Act cost?
   h. The Homestead Act was meant to insure that United States citizens who actually wanted to farm land were the recipients of the government's largess. Who else might have wanted to profit from this deal, and how? How is the law trying to prevent various abuses?
3. Place students in pairs. Ask one person to play a government official at a land office. Ask the second person to play a head of household. Then have each pair write and enact a script in which the settler registers for a land grant.
4. Have students answer the following questions on the Pacific Railway Act of 1862:
   a. What is the purpose of this act?
   b. What is the Union Pacific Railroad Company empowered by this act to do?
   c. Map the route that the transcontinental railroad will follow. What will be the most difficult terrain on which to lay track? What other difficulties do you foresee in terms of crews of men living and working in a variety of environments as they lay tracks?
   d. Why do you think the government is building telegraph poles along the railroad?
   e. The act is giving the railroad the right of way on public lands. How much land on either side of tracks does this include? What does the government promise to do if American Indian tribes claim title to this land?
   f. In Section 3 the act provides the railroad with more land than what is needed to give it a right of way. Why will this land fronting the railroad tracks be even more valuable than land given to homesteaders at a distance from the railway?
   g. What method of financing the railway does the bill propose in Section 5?
   h. Under what terms is the Central Pacific Railroad Company of California authorized to build a railway headed east? Since the bonds will be awarded based on completed mileage of railway track, which company would ultimately be awarded the most money? How does this set up a competition between the two railways?

i. The Central Pacific Railroad had to lay track in the mountainous region of the Sierra Nevada, one of the most difficult endeavors of the entire enterprise. This will obviously take much more time than laying tracks on the flat plains. How does the government plan to compensate the companies for the laying of track over mountainous terrain? (If the last two questions are difficult to answer based on the document, the answers are provided in Episode 5 between 5 and 14 minutes into the film, a segment which is shown later in the lesson.)
j. What month and year did Congress pass each of these two acts? Why do you think they were passed within months of each other?
k. In what ways are these acts mutually beneficial both to settlers and the railways?

5. Divide the class into three groups and ask each group to do the following:
    a. **Railway owners:** You will want to maximize your profits. Your lawyers are ready to look over both acts to see how your company can make the most money. With your group, plan whatever strategies you can to do so.
    b. **Land Speculators:** You are neither settlers nor railway owners, but people who want to buy land as cheaply as possible and then re-sell it at a much higher rate. Your lawyers will look at both these acts to find as many loopholes as possible for ways in which you can purchase land for re-sale.
    c. **Settlers:** You are people who want to purchase land for farming. The Homestead Act seems like the bonanza you have been waiting for. However, profiting from both these acts may be harder than you imagine. Discuss the various difficulties you may face in terms of staking your claim to land, holding on to it, and making it profitable.
6. Now have each group present their strategies to the class. What conflicts are evident? What problems do students foresee, if any?

Activity 3: The Building of the Railway: Viewing Segments of the Documentary

1. What other groups of people (besides the US government and the people it wanted the railroad to serve) were affected by this enormous undertaking and why?
2. Show Episode V of <u>The West</u> at approximately 7:00 minutes in from "Grandest Enterprise" to 20:38, "The Artillery of Heaven." This portion discusses the workers for the Union Pacific who were often immigrants, and the effect of the railway on the American Indians.
3. Next show "<u>The Artillery of Heaven</u>" beginning at 20:39 and ending at approximately 28:00 (when the film shifts focus to the cattle men of Texas). This portion deals with the Chinese workers imported to build the railway for the Central Pacific.
4. In discussing these sections of the film pose the following questions:
    a. How did the building of the railway change the life of the plains Indians in ways that would prove to be unalterable?
    b. Were the Chinese at first considered to be suitable workers on the railway? Why were they eventually chosen in such large numbers? What credit is due them for building the railway?

5. Next show the section of the film that covers the completion of the tracks and the meeting of the two railways at Promontory. It begins at approximately 33:15, "One People" The sequence ends at approximately 40:00.
    a. How was the joining of the rails at Promontory a national rather than local event?
    b. How did technology itself play a role in transmitting the event to the nation?
    c. Envision yourself a citizen of the U.S. in 1869. How would this event make you feel about your country? About technology? About the future?

Activity 4: Team Projects That View the Railway from Four Different Perspectives

1. Divide the class into four teams. Explain that each team will have a task to complete about the Transcontinental Railroad from one of four perspectives. After each group receives instructions, including some relevant Web links, allow it at least several days to research.
2. Final Instructions For all 4 Teams: Exchange what you have written with another member of your team. Edit each other's work and give suggestions for improvement. Write a final draft of your own work. Meet as a team to choose five words or phrases which best express your team's attitude toward the Transcontinental Railroad. Write the words down on index cards and decorate with appropriate images. Later, put the cards up on a class bulletin board.

Activity 5: The Transcontinental Railroad From All Four Perspectives

1. Re-Grouping Activity: This is an optional but potentially interesting exercise. Create new teams, each new team to be composed of one member of the original four groups. Now each team will contain at least one representative from the Railroad promoters, passengers, Chinese workers, American Indians. Each new team member should bring whatever he or she has written for the original group and one of the index cards expressing his or her old team's view of the railway. After the new group has shared what each group member has written, ask the new group to create one new index card with a word or phrase which best expresses a combination of everyone's point to view. (This may be well-nigh impossible, but they will learn a great deal in the attempt.)
2. Creating a Transcontinental Railroad Bulletin Board: Ask several artistically talented students to create a large image representing the Transcontinental Railroad. Divide the board in quarters and place the image of the railroad in the center. Assign one quarter to each of the original four teams and ask each team to post their index cards Discuss with the class the multiple perspectives the bulletin board represents.
3. Now pose these questions:
    a. Given everything the class has learned, what are their predictions for how the Transcontinental Railway will change America?
    b. How could the contributions of Chinese Americans be better recognized today?
    c. Was the destruction of traditional Indian life on the Plains inevitable? If not, why not? What restitution can be made today for what was lost as a consequence of events over 100 years ago?

4. Memorializing the Transcontinental Railroad
    a. Now ask students to look at how the building of the Transcontinental Railroad has been memorialized in the American consciousness through the classic photos and paintings of the event.
    b. Have them look at and analyze the following:
    "Joining of the Rails, May 10 1869, Promontory, Utah," a stereoview from the Central Pacific Railroad Photographic History Museum.
    "The Last Spike" by Thomas Hill from the Central Pacific Photographic History Museum.
    "Joining the tracks for the first transcontinental railroad," Promontory, Utah, Terr., 1869.
    c. Help students analyze the photographs by asking them to fill in the Photograph Analysis Worksheet from the National Archives and Records Administration.
    d. Ask students:
        1. What is missing from these images?
        2. What would a fitting monument to the building of the Transcontinental Railroad look like? (Ask interested students to design one.)
        3. Is it important to consider historical events from multiple perspectives? Is there ever one interpretation of events that represents the truth?

Activity 6: Extension/Adaptation Ideas

1. Investigate the history of the railroads in America. At what point in time did they become the monopolizing and strangling "octopus"? Why was their power ultimately short-lived?
2. We are on the cusp of various technological advances today. Ask students to choose one or two to discuss in terms of what they learned about the Transcontinental Railroad (e.g. the Internet, genetic engineering). Will all Americans reap equal benefits? How can we insure that big business will serve the public well? In what ways does the new technology threaten the environment?
3. Compare the fate of the Chinese in America to American Indian nations in the decades following the building of the Transcontinental Railroad.
4. Compare the building of the Transcontinental Railroad to various projects currently being advanced in the Brazilian rainforest. What are the benefits of these incursions into the rainforest? What are the possible losses in terms of conserving the habitat of indigenous peoples?

**Lesson Plan: Mining in Michigan**
*Upper Elementary*
*Social Studies, Michigan History*
Michigan Department of Natural Resources
*http://www.michigan.gov/documents/hal_mhc_mhm_mining_tg_08-08-2001_92685_7.pdf*

*Pair this activity with the following Lorenzo Cultural Center presentation:*

- *Michigan's Iron. The History and impact of Michigan's Iron Ore Mining Industry 1845-Present*, by Terry Reynolds, Professor Emeritus at Michigan Technical University, on Wednesday, October 24, at 11 am
- *The Survivor: Cleveland Cliffs and the Mining of Iron Ore*, by Terry Reynolds, Professor Emeritus at Michigan Technical University , Wednesday, October 24 at 1pm
- *Iron Opportunity in a UP Town: Fayette 1880,* Michel P. Deren, historical re-enactor, on Friday, November 2 at 11 am

**Overview**
In this upper elementary lesson, students will **discuss** the job of a miner, **reflect** on Michigan's contribution to the industrial history of our nation, and **use maps to study the relationship** between the distribution of natural resource and cities. Finally, students will study the hazards of mining jobs, **make connections** to the dangerous jobs of today, and **brainstorm real-world solutions** for keeping workers safe.

**Michigan Curriculum Content Standards** – Social Studies GLCEs
**3 – G1.0.2** – Use thematic maps to identify and describe the physical and human characteristics of Michigan.
**3 – G5.0.1** – Locate natural resources in Michigan and explain the consequences of their use.
**3 – G5.0.2** – Describe how people adapt to, use, and modify the natural resources of Michigan.
**4 – H3.0.3 –** Describe how the relationship between the location of natural resources and the location of industries (after 1837) affected the location and growth of Michigan cities.
**3/4 – P4.2.1 –**Develop and implement an action plan and know how, when, and where to address or inform others about a public issue.

**Time Frame**: 2 class periods

**Procedure**
Activity 1: Opening Discussion of Mining

1. A Day in the Life of a Miner
    a. What kinds of clothes did the miner wear?
    b. What did you learn about the conditions underground that influenced his choice of clothing?

    c. In later years, mines had steam-powered man engines—a type of underground "escalator." How did the 1860s miner get to his work station?
    d. What did he eat for lunch? (A pasty ["pass-tee"] an individual meat, potato, rutabaga and onion pie that looks similar to a calzone.)
    e. If the underground miner worked 10 hours a day, 6 days a week, how much did he earn an hour in 1868? What did the surface worker earn an hour?
2. A Day's Work
    a. Describe some underground jobs.
    b. How did the above-ground workers contribute to the mining activity?
3. Important Dates In Michigan's Early Mining History
    a. What were some inventions and improvements that helped the mining industry advance? (Sioux Locks, diamond drill, dynamite)
    b. What states eventually passed Michigan in copper and iron production?

Activity 2: Where Does Michigan's Mining History Fit in National History?
1. Trace the advancements of Michigan's early mining history. The 19th century was the period of Michigan's greatest production of iron and copper. It was also a time of great expansion for the United States. The goal of this activity is to appreciate the role of these state resources in the growth of the nation.
2. Use milestone inventions and incidents in U. S. history and assign each event to a student or groups of students. Ask them to research the event and then report about how the state's iron and/or copper may have contributed to that aspect of the nation's growth.

Activity 3: Upper Peninsula Map Activity
1. During the copper and iron booms of the 19th century, miners rushed to the Upper Peninsula. Many mining communities were larger than they are today. Have students find the cities that mining built on a current Michigan map. (Copper Range cities: Calumet, Champion, Copper Harbor, Gwinn, Hancock, Houghton, Ontonagon. Iron Range cities: Bessemer, Caspian, Iron Mountain, Iron River, Ironwood, Ishpeming, Marquette, Negaunee. Cities important to shipping: Escanaba, Sault Ste. Marie.)
2. Provide each student with a copy of the outline map of the Upper Peninsula. Ask students to complete their maps by adding the cities and labeling each copper and iron range.

Activity 4: Dangerous Jobs
1. Mining is dangerous work. The student handout on page 4 (see website listed at beginning of lesson, also reproduced below) lists accidents in one Michigan mine in 1891-92. Study and discuss the chart with your students.
    a. Ask students to put the accidents into categories. Chart them on the board. (Likely categories include: blasting, objects falling on miners, miners falling, miners injured by moving skips/cars.)
    b. What was the most frequent type of accident? (objects falling on miner)

c. What safety steps might a miner or mine owner take to prevent each of the accidents on the chart? (wearing helmets, shoring up loose rock with timbers, being alert and careful around loose rock or moving equipment, proper explosive handling, others)

2. With students, develop a list of occupations with inherent dangers, especially those mentioned in recent media stories. Examples: road and building construction workers, law enforcement officers, prison guards, commercial fishers, professional sports athletes, fire fighters, sports mascots, amusement park characters, computer workers, fast food workers. Include jobs for both adults and teens.
3. Ask students to choose an occupation and research its hazards, both from the daily routine (e.g., hot grease in a restaurant) and from external elements (e.g., a robbery at a restaurant).
4. Assign: write a report about the selected job, its dangers, and how (1) the worker, (2) the employer and (3) the general public (e.g., slowing down in a road construction zone) should try to prevent each of the dangers. See the DNR website for an assignment rubric.

LIST OF THE FATAL ACCIDENTS AT THE MINES OF HOUGHTON COUNTY.

| **DATE** | **NAME** | **MINE** | **MANNER OF ACCIDENT** | **OCCUPATION** | **NATIONALITY** |
|---|---|---|---|---|---|
| 1891 | | | | | |
| Oct. 13 | Thomas W. Waters | Tamarack Mine | Fall of vein rock | timberman | English |
| Nov. 13 | Stephen Sterbenz | Hecla Mine | Riding on skip | trammer | Austrian |
| Nov. 30 | John Lockso | Tamarack Mine | Blasted | miner | Finlander |
| Nov. 30 | Jacob Wamzen | Hecla Mine | Caught by ascending skip | trammer | Polander |
| Dec. 9 | Olaf Hendrickson | Tamarack Mine | Explosion of dynamite | miner | Finlander |
| Dec. 9 | Mattheas Flenk | Tamarack Mine | Explosion of dynamite | miner | Finlander |
| **1892** | | | | | |
| Jan. 2 | James Taylor | Centennial Mine | Fell down stairs in Rock house | mining captain | English |
| Jan. 26 | Wm. Goeshoe | Calumet Mine | Struck by rock from dump car | laborer | German |
| Feb. 9 | Michael Sheehan | Atlantic Mine | Struck by car | lander | Irish |
| Feb. 29 | John Kurtitch | Tamarack Mine | Struck by timber falling down shaft | miner | Austrian |
| Mar. 12 | John Matthews | Hecla Mine | Fell down mill | timberman | English |
| Mar. 26 | Joseph Julio | Hecla Mine | Fall of vein rock | laborer | Italian |

| | | | | | |
|---|---|---|---|---|---|
| Apr. 11 | Issac K. Mackey | Peninsular Mine | Explosion of dynamite and box of caps | miner | Finlander |
| June 25 | Erick Saary | Tamarack Mine | Pried rock down on himself | trammer | Finlander |
| July 11 | John Hanley | Franklin Mine | Fall of hanging-wall rock | miner | Irish |
| July 13 | Thomas Alatala | Atlantic Mine | Struck by rock from blast | trammer | Finlander |
| July 25 | Richard Thomas | Tamarack Mine | Fall of vein | rock miner | English |
| Aug. 12 | Matt Garinen | Atlantic Mine | Fall of earth in exploring pit | laborer | Finlander |
| Sept. 5 | Michael Sullivan | Huron Mine | Blasted | miner | Irish |
| Sept. 29 | Sylvester Ambrusitch | Tamarack Mine | Fall of hanging-wall | rock trammer | Austrian |

**Selected Mining Terms**

**Adit:** an entrance into a mine that is nearly horizontal

**Drift:** an underground tunnel that follows a vein in the mine; a crossways tunnel in a mine that connects two larger tunnels

**Hanging-wall rock:** rock that lies above the vein of ore in the underground tunnel.

**Lander:** a person who moves mine cars (skips) on and off the cage so that loaded cars go to surface and are replaced with empty cars or supply cars to go underground. The lander signals the hoist operator with a bell or buzzer when the cage is to be moved up or down the shaft.

**Level:** a horizontal passage in a mine intended for regular working and transportation

**Mill:** a machine in which ore is crushed; the building that contains the mill

**Mucker:** a worker who moves or loads muck (rock, dirt) in a mine

**Pasty:** a meat pie

**Pit:** a hole or shaft in the ground. Some copper mines were developed around pits dug by Native Americans thousands of years ago.

**Raise:** a vertical or inclined opening or passageway connecting one mine working area with another at a higher level

**Shaft:** a vertical entrance to a mine from the surface

**Tram:** a boxlike wagon running on rails (as in a mine). Also called a skip.

**Trammer:** a worker who handles movement of the trams to bring empty trams to the work area and remove and empty the full trams

**Vein:** a bed of useful mineral matter in rock

**Lesson Plan: Making Log Marks**

*Upper Elementary*

*Michigan History, Civics, Geography*

Michigan Department of Natural Resources

*http://www.michigan.gov/dnr/0,4570,7-153-54463_18670_18793-53130--,00.html*

*Pair this activity with the following Lorenzo Cultural Center presentations:*

- *Martha Hay: Female Lumber Baron and Remarkable Woman*, by Mary Beth Looby, Professor of English, Delta College and coordinator for Mid-Michigan Remembers: Stories About Us, on Friday October 12 at 11 am
- *William Atwood: From Slave to Saginaw African American Lumber Baron*, by Mary Beth Looby, on Friday October 12 at 1 pm
- *When the Big Trees Fell: Michigan Lumber Camp* Life, by Al and David Eicher, historians and filmmakers, on Thursday, October 18, at 11 am
- *Sheepshank Sam: Life in a Michigan Logging Camp, by* Ben Thomas as Sheepshank, on Thursday, November 1, at 11 am

**Overview**

Students will **explain the purpose** of 19th-century log marks during logging drives, **tell how** the marks were applied, describe the parts that make up the unique designs, and **design a personal log mark**. Students will then **map Michigan rivers** and make connections between the locations of rivers, towns, and logging camps.

**Michigan Curriculum Content Standards –** Social Studies GLCEs

**3 – G1.0.2 –** Use thematic maps to identify and describe the physical characteristics of Michigan

**3 – G5.0.2 –** Describe how people adapt to, use, and modify the natural resources of Michigan.

**4 – C1.0.2** – Explain probable consequences of an absence of government and of rules and laws.

**3/4 – H3.0.1 –** Identify questions historians ask in examining the past in Michigan to investigate the development of Michigan’s major economic activities (including lumbering).

**Context**

Loggers cut Michigan's white pine during the winter when the swampy forest ground was frozen. They piled the logs on the banks of rivers to wait for the spring thaw. When the rivers rose with water from the melting snows, the loggers floated the logs to sawmills. Logs from different owners were jumbled together. As a result, owners used a heavy marking hammer to mark each end of their logs with a special design, a "log mark." It was first used near Muskegon in 1842. Each owner registered his mark with the county government. Log piracy was one of the earliest types of "industrial" crime in Michigan. Thieves sometimes waited for spring, pulled logs from the river, cut off the log ends and remarked the logs with their own mark.

**Time Frame:** 2 class periods

**Materials**

Michigan log marks (copy for each student or drawn on poster or chalkboard)

Pencil and paper

Optional: 1/4" craft cork, wood blocks or potatoes cut in half, knife, stamp pad or tempera paint (to make own designs)

**Procedure**

Activity 1: Log Marks

1. Ask students to examine the different log marks used by Michigan lumbering companies. Discuss the different designs used: words, initials, symbols, figures, and combinations of these. Make connections between log marks in Michigan and cattle brands of the west. How were brands applied to cattle? How were marking hammers used to emboss log marks in the cut ends of logs? Compare and contrast log piracy and cattle rustling.
2. Ask students to draw their own personal "log mark" using pencil and paper. Is there a special design related to their name, personal characteristics, or favorite things that would have a special meaning to them?
3. Optional: Have students transfer the "log mark" design to 1/4" craft cork and cut out. Glue the craft cork to a wooden block. Permit students to stamp the design on their papers using an ink pad. Or, have all students stamp their designs on one large piece of Kraft paper to make a classroom poster. Each design may also be cut into the cut side of a potato, then stamped using tempera paint. Carefully supervise any use of knives.
4. Questions for discussion or research:
    a. Why did lumbermen mark their logs?
    b. What different designs do you see in the log marks?
    c. What meanings might the designs have had to the lumbermen who owned them?
    d. Why should the log buyers purchase logs from the honest lumber company rather than from the log thief, even though the thief might sell the stolen logs for less money?
    e. Why might we still find ends of logs with log marks from the 19th century in or along Michigan rivers? (They were cut off and left there by log thieves.)
5. Vocabulary
    a. Log mark: Design composed of words, initials, symbols, figures, and combinations of these stamped into the end of a log to identify its owner
    b. Piracy: Robbery

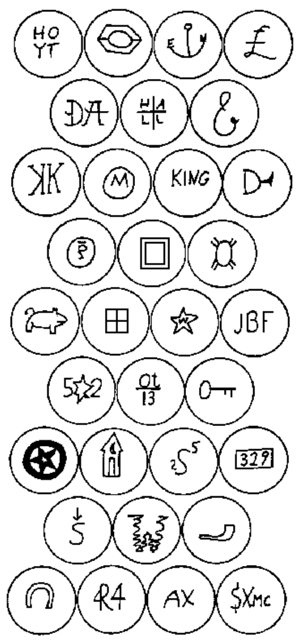
Activity 2: Rivers and Watersheds

1. Give each student a map of Michigan and/or project a map on the classroom screen. Trace and highlight the following rivers and watershed areas:
    a. Upper Peninsula: Menominee/Brule/Paint/Michigamme/Sturgeon/Little Cedar Rivers, Ontonagon River, Escanaba River, Manistique River

b. Lower Peninsula: Cheboygan/Black/Pigeon/Sturgeon Rivers, Pere Marquette River Thunder Bay River, Muskegon/Little Muskegon Rivers, Boardman River, Black River, AuSable River, Betsie River Basin ,Manistee River, Saginaw/Tittabawassee/ Shiawassee/Flint/Cass Rivers, Grand/Rogue/Flat/Maple/Looking Glass/Red Cedar/Thornapple Rivers

2. Discuss the settlement of towns and cities along one or more of the rivers. How does the river help you understand the settlement pattern? Find out which towns had sawmills.

**Some Michigan Log Marks:**




Additional Lumbering Activities:

1. How Large Were the Logs?
   a. The white pine trees found by the first loggers in Michigan were hundreds of years old, tall and straight. Most trees grew 80-120 feet tall with a diameter of three to four feet. But loggers reported finding some trees as tall as 150 to 200 feet. The diameter of the trunk of these trees was five to seven feet.
   b. Cut Kraft paper (tape several pieces together if necessary) to represent the cut end of a five foot or wider diameter white pine log. Draw circles on it to represent the tree rings. Tape the "log end" on the wall with one end at floor level. Have students stand next to the log and mark their height on it.
   c. Discuss the length of time needed to grow trees of the size of Michigan's original white pines. Learn ways today's loggers are trying to cultivate renewable forests for long-term use and enjoyment.

**Lesson Plan: Tesla - How Do We Convert Mechanical Energy into Electrical Energy?**

*Grades 6-8*

*Physical Science*

PBS

*http://www.pbs.org/tesla/tt/tt02.html*

*Pair this activity with the following Lorenzo Cultural Center presentation:*

- *The Machine that Changed Everything*, by John Bowditch, Director of Exhibits Emeritus at the Ann Arbor Hands-on Museum, Saturday, October 13, at 1 pm
- *George Westinghouse, Gentle Genius*, by Quentin R. Skrabec Jr., PhD, Professor at the University of Findlay, on Wednesday October 17 at 11 am
- *Thomas Edison and Nicolas Tesla, Inventors in Conflict*, by John Bowditch, Director of Exhibits Emeritus at the Ann Arbor Hands-on Museum, on Saturday, October 27 at 1 pm

**Overview**

This lesson begins with an **in-class discussion** of magnets and magnetism and the idea of changing one kind or form of energy into another. Students will **conduct and experiment** and investigate magnetic fields and conclude by **creating a diagram** of a simple generator.

**Michigan Curriculum Content Standards** – Science GLCEs

**P.EN.M.4 Energy Transfer –** Energy is transferred from a source to a receiver by radiation, conduction, and convection. When energy is transferred from one system to another, the quantity of energy before the transfer is equal to the quantity of energy after the transfer.

**S.IP.E.1** – Inquiry involves generating questions, conducting investigations, and developing solutions to problems through reasoning and observation.

**S.IP.06.13, S.IP.07.13** – Use tools and equipment (spring scales, stop watches, meter sticks and tapes, models, hand lens, thermometer, models, sieves, microscopes, hot plates, pH meters) appropriate to scientific investigations.

**Context**

Energy can neither be created nor destroyed. However, it can be changed from one form to another. This important idea is called the Law of Conservation of Energy. When water trapped behind a dam is channeled to push on the blades of a turbine, the potential energy of the still water changes form. When the water starts to move, the potential energy becomes kinetic energy. When the turbine starts to spin, the kinetic energy becomes a specific kind of kinetic energy called mechanical energy. The spinning motion of the turbine is used to rotate a coil of copper wire between two opposite magnetic poles. This starts electrons moving down the wire. When the coil of copper wire rotates past the North magnetic pole, the electrons move down the wire in one direction. When the coil rotates past the South magnetic pole, the electrons reverse direction. This back-and-forth flow of electricity through a wire is called alternating current-otherwise known as AC. A device in which coils of copper wire are rotated through magnetic fields to generate electric current is called a dynamo.

**Time Frame**: 1 class period

**Materials -** Each student or each group will need the following to perform this experiment:
compass
powerful magnet
100' small-gauge insulated copper magnet wire (#25)

**Procedure**
*View the illustrated instructions from the PBS address above for a visual overview of the project.*

1. First, use the wire to make a coil of about 40 turns and about 3 or 4 inches in diameter. Next, wrap about 25 turns of the wire around a compass. Connect the two coils together at both ends to make a complete circuit. Pass the magnet back and forth through the center of the first coil. Watch the compass needle.
2. What happens when you move the magnet in one direction? In the other direction? (The needle is deflected, first in one direction, then in the other.)
    a. Why does this happen? (As the magnet moves through the coil, electrons move in the coil. This is an electric current, of course. When this current is passed to the winding around the compass, it causes a magnetic field to surround the compass winding. This magnetic field causes the compass needle to move, just in the same way that Earth's magnetic field causes a compass needle to move.)
3. Ask students to create a diagram showing the transformations of energy that occur when water trapped behind a dam is used to generate electricity.
4. For more fun, you could connect the two ends of the first coil to a microampere meter that measures electrical current and repeat the experiment.
    a. What happens to the meter's needle? (As one pole of the magnet moves through the winding, the needle moves in one direction. When the other pole of the magnet passes through the winding, the needle moves in the opposite direction.)
    b. Why? (The purpose of the microampere meter, which measures very, very small amounts of current, is to indicate a flow of current in one direction or the other. This kind of meter is a more sophisticated version of a compass wound with magnet wire.)
5. Optional Extension: Explore the World Outside
    a. Ask students to list places where an electrical generator might be needed during a power failure, or places where they have seen portable generators in use. (Emergency generators are used in homes, hospitals, and apartment houses; portable generators are used to run farm equipment and amusement park rides, etc.)
6. Optional Extension: Explore the Film and Web Site
    a. Present related clips from the film Tesla: Master of Lightning to the class. The following are some suggestions:

04:30 - 11:41 My Early Years: Tesla's early education
11:41 - 18:36 New Land: Tesla's arrival in America
23:21 - 27:40 Niagara: Overview of the first hydroelectric plant

b. After viewing select clips from the film, direct students through the interactive tour of Tesla's Niagara power system on this site. Ask students to locate the stage at which the kinetic energy inherent in flowing water is changed into mechanical energy. (When the flowing water hits the turbines.) Ask students to locate the dynamo in the Niagara power plant.

7. Optional Extension: Dynamic Dynamos
   a. Guide students through a discussion of what happens inside an electrical generator or dynamo. A coil of many turns of copper wire is rotated between the North and South poles of a very powerful magnet. As the rotating coil of wire passes one pole of the magnet, electrons in the wire are pushed in one direction. When the rotating coil of wire passes the other pole of the magnet, these electrons are pulled in the opposite direction. Because the electrical current keeps reversing direction, it is called alternating current.

**Lesson Plan: A House Divided: Reconstruction**

*Grades 8, 11*

*U.S. History, Art*

Smithsonian American Art Museum

*http://americanart.si.edu/education/pdf/Reconstruction.pdf*

*Pair this activity with the following Lorenzo Cultural Center presentations:*

- *Punishing Traitors and Protecting Freedman: Michigan Contribution to Reconstruction*, by Roger Rosentreter, Professor of History at Michigan State University, on Thursday, October 25 at 1 pm
- *Slavery by Another Name: The re-enslavement of Black People in America from the Civil War to War World II*, by Douglas Blackmon, Pulitzer Prize-winning author , on Saturday, November 10 at 1 pm
- *George Washington Carver and the Effort to Transform Southern Agriculture: Challenges and Consequences*, by Gary R. Kramer, Executive Director of the State Historical Society of Missouri, on November 15 at 11am and 1 pm
- *African Americans and the History of Invention and Innovations*, by Rayvon Fouche, Associate Dean and Professor of History at the University of Illinois, Chicago, on Friday, November 16 at 11 am

**Overview**

The period after the Civil War was a tense time. Students will **observe period artwork** to learn how the plans drawn up by political leaders and parties **affected the relationships** in the South (and North) of people of different races and geographic regions.

**Michigan Curriculum Content Standards** – Social Studies GLCEs and HSCEs

**8 – U5.3.1** – Describe the different positions concerning the reconstruction of Southern society and the nation, including the positions of President Abraham Lincoln, President Andrew Johnson, Republicans, and African Americans.

**P2.3 –** Know how to find and organize information from a variety of sources; analyze, interpret, support interpretations with evidence, critically evaluate, and present the information orally and in writing; report investigation results effectively

**Procedure**

Activity 1: Visual Analysis Exercise

1. Use the images from the American Art Museum's collection shown online.
2. Review key differences in plans for Reconstruction proposed by Abraham Lincoln, the Radical Republicans, and Andrew Johnson (see summary on Smithsonian website listed above).
3. Display one image at a time. Ask students to "read" each one as they would a written story and then analyze it as an interpretation of history.

4. Ask the students which Reconstruction plan each image most closely represents, especially in terms of mood and the physical relationship between the figures.
5. Suggested questions for each painting:
   *Lee Surrendering to Grant at Appomattox*
   a. How are the winning and losing sides depicted in this painting? Is it clear which is which?
   b. How do you think the two generals feel toward one another?
   c. Why do you think the artist decided to depict a scene without much celebration?
   d. How do you think this representation compares with the real event?

   *Visit from the Old Mistress*
   a. What is going on in this scene?
   b. If you were to divide these people into two groups, how would you divide them? Why? How does this artist divide the two groups? What is the relationship between them?
   c. What do you think each character might be thinking/feeling?
   d. What do you think the women hope for the child?

   *Taking the Oath and Drawing Rations*
   a. Who do you think these people are? Compare their clothing.
   b. Describe each person and his or her actions to form an idea of the individual. How does each person feel about the other?
   c. What has brought them together in this scene?

Activity 2: Hands-on
1. Ask students to recreate and restage the scenes from the two paintings and sculpture to reflect the various plans for Reconstruction. For example, they could change the location, arrangement of figures, inclusion of figures, etc.
2. As students make changes to each scene, discuss their significance.
3. Offer students the opportunity to suggest and stage additional scenarios.
4. Possible scenarios include:
   *Lee Surrendering to Grant at Appomattox*
   a. North has no desire to reconcile with the South.
   b. How can you make the scene less equal? How can you make the scene less respectful?

   *Visit from the Old Mistress*
   a. Before the Civil War
   b. What rules did slaves have to follow in the presence of their mistress? How might the attitudes or expressions be different? Where would interaction between the two groups typically have taken place?

   *Taking the Oath and Drawing Rations*
   a. Radical Reconstruction is in effect or Johnson’s Plan is in effect.
   b. How would the mood of the scene change? How can you show the change? Who would be swearing the oath?

## PART V: OTHER RESOURCES

**DNR-Michigan Historical Museum**
702 W. Kalamazoo Street
Lansing MI 48915
517. 373. 3559
http://www.michigan.gov/dnr/0,4570,7-153-54463_18595_18596

**Detroit Historical Museum**
5401 Woodward Avenue
Detroit, MI 48202
313.833.7935
http://www.detroithistorical.org/

**Gratiot Valley Railroad Club**
281 North Avenue
Mount Clemens, MI 48043
586.468.4877
http://www.gvrr.org/

**Port Huron Museum**
1115 6th Street
Port Huron, MI 48060
810.982.0891

**Romeo Arts & Archives Museum**
290 N. Main Street
Romeo, MI 48065
586.752.4111, 586.752.7646

**The Historical Society of Saginaw County** Castle Museum and the Annex
500 Federal
Saginaw, MI 48607
989.752.2861

**Wolcott Mill Metropark Historical Center**
63841 Wolcott Road
Ray, MI 48096
586.749.5997