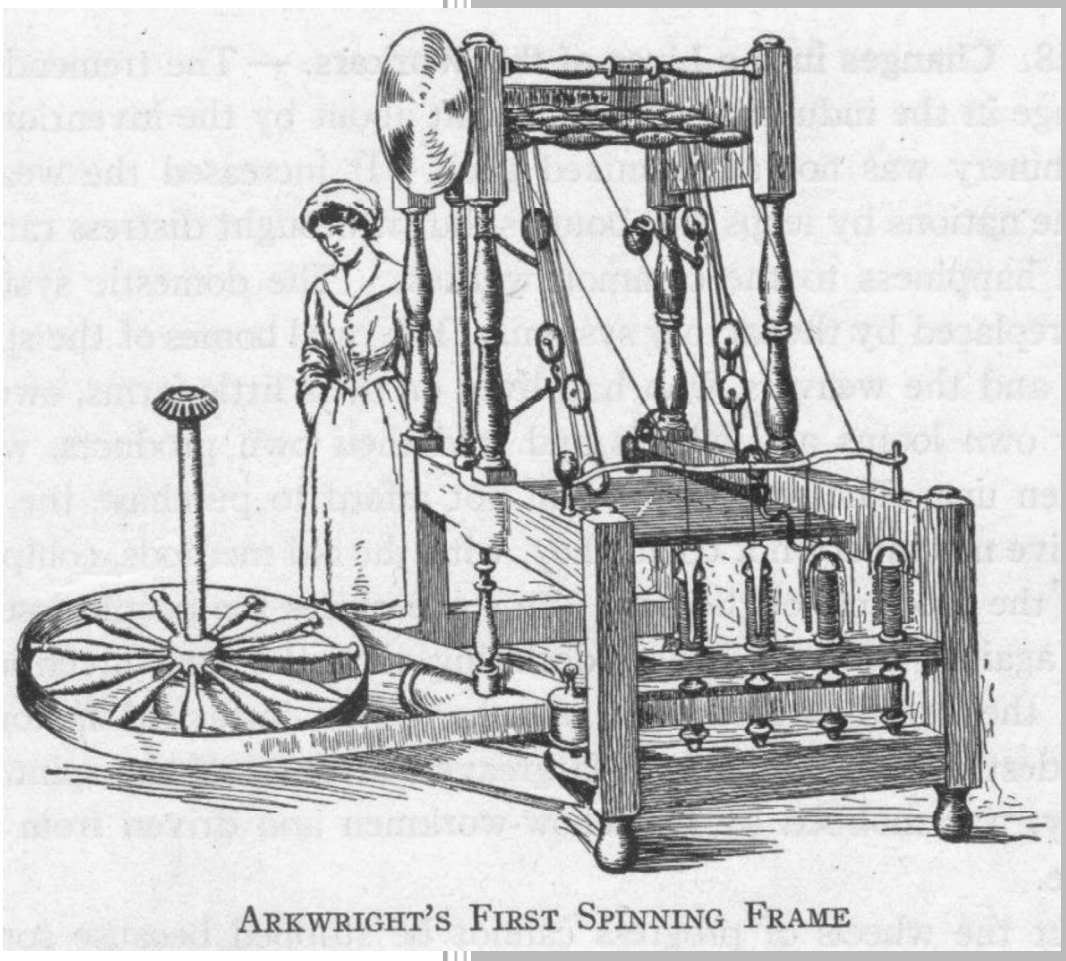
World History
Student Workbook

The First Industrial Revolution



ARKWRIGHT'S FIRST SPINNING FRAME

World History Student Workbook

Historical Significance of the Industrial Revolution

An ancient Greek or Roman would have been just as comfortable living in Europe in 1700 as during ancient times. This is because daily life had not changed much in 1500 to 2500 years. Agriculture and technology were relatively the same.

The Industrial Revolution, which had its earliest beginnings around 1800, changed human life dramatically. More has been created, invented, and produced in the last three centuries than in the entire course of human history prior to the Industrial Revolution.

When did the First Industrial Revolution begin? _____
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What Was the Industrial Revolution?

The Industrial Revolution was a fundamental change in the way goods were produced, from human labor to machines. The more efficient means of production and subsequent higher levels of production triggered far-reaching changes to industrialized society.

Machines were invented which replaced human labor. New energy sources were developed to power the new machinery—water, steam, electricity, and oil, as well as modern energy sources such as atomic, solar, and wind energy. The Industrial Revolution saw massive increases in the use of metals and minerals like aluminum, coal, copper, and iron.

Transportation improved with the Industrial Revolution. Wooden ships were replaced by iron, and later steel, ships. Wind-powered sails were replaced by steam-powered boilers. Trains, automobiles, and airplanes were invented. Journeys that had taken months were reduced to a few weeks and, eventually, to a few hours.

Communication was vastly improved through the telegraph, telephone, and radio. News spread around the globe within hours, rather than months or years. Inventions such as the camera brought the world into people's homes.

The Industrial Revolution featured the mass production of goods. Manufacturing saw not only an increase in the number of goods produced, but in the diversity of goods produced. Increased production levels were due to the new factory system of production.

Life changed with industrialization. New technologies dislocated farm workers, who migrated to the cities (a phenomenon known as rural-to-urban migration). The jobs and wealth brought by the Industrial Revolution created completely new socio-economic classes—the working class, the middle class

or bourgeoisie, and the rich industrial capitalist class.

Those countries which benefited from the Industrial Revolution were those which had natural resources or access to natural resources. These were countries that were committed to research and development, with people (capitalists) and governments willing to invest in new technologies.

What energy sources powered the Industrial Revolution? _____

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Background of the Industrial Revolution

During the Commercial Revolution of the 15th, 16th, and 17th centuries, Europeans expanded their power worldwide. The Europeans increased their knowledge of world geography as they founded colonies and trading posts around the globe. The Commercial Revolution increased global trade and commerce. However, the existing guild system could not meet the demands for increasing numbers of goods.

The Scientific Revolution took place during the 17th and 18th centuries. Scientists such as Boyle, Lavoisier, and Newton made important discoveries. These discoveries regarding the nature of the physical universe, as well as the new processes scientists developed in chemistry and engineering, laid the groundwork for further research and new inventions.

The Intellectual Revolution, also known as the Age of Reason or Enlightenment, took place in the 17th and 18th centuries alongside the Scientific Revolution. Leading intellectuals of the period included Locke and Voltaire. These thinkers condemned what they believed to be outdated, unfair, and unnatural laws and social conventions.

Overall, the Commercial, Scientific, and Intellectual Revolutions created an atmosphere of discovery and free intellectual inquiry. Superstition and tradition were weakened. Learning and the search for better and newer ways of doing things were encouraged.

Name the three major movements of the 15th, 16th, and 17th centuries which set the backdrop for the Industrial Revolution.

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Why is a spirit of free intellectual inquiry necessary for invention and development?

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Name: _____ Date: _____ Class: ____

The Domestic System of Production

The domestic system of production developed in England between the late 1600s and the late 1800s. It was also known as the "putting out" system.

In the domestic system of production, businesspeople delivered raw materials to workers' homes. Domestic workers owned their own machinery (typically small hand tools). Workers manufactured goods from these raw materials, such as items of clothing. An entire item was crafted by a single person. Businesspeople picked up the finished goods and paid workers wages based on the number of items completed.

The domestic system proceeded demand. That is, an item was not made until someone wanted to buy the item. Each item was custom made for the purchaser. Consumers did not exist beyond the local market. As the demand for goods increased, the domestic system of production could not keep up.

The factory system of production was developed to replace the domestic system. A much faster way of manufacturing goods, the factory system concentrated workers in a set location—the factory. The factory and all of the large machinery was owned by the capitalist. For the first time on a large scale, production preceded demand.

For the typical shopper, the shift from the domestic to the factory system marked a massive shift in the way goods were bought and sold. For example, under the old domestic system, a person would enter a dress shop and select a pattern and fabrics. The shop owner would give the pattern and fabrics to a dressmaker. A week or so later, the shopper would pick up the finished article of clothing. Under the new factory system, a clothing manufacturer anticipates what styles will be fashionable, and knows the most popular sizes and fits. A shopper enters a store and chooses from an assortment of clothing items in styles and sizes that anticipate what shoppers will buy.

Describe the domestic system of production in your own words. _____

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Are there any manufacturers today that still use the domestic system of production? Explain. _____

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Describe the factory system of production in your own words. _____

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The Domestic System *vs.* the Factory System

Use the information you have learned to complete the following table graph.

	Domestic System	Factory System
Methods/Tools	□ Hand tools	□ Machines
Location	□	□
Ownership and Kinds of Tools	□	□
Production Output	□ Small level of production □ Sold only to local market □ Manufactured on a per-order basis	□ □ □
Nature of Work Done by Worker	□	□ Worker typically made one part of the item □ Henry Ford's assembly line (early 20th century) kept workers stationary
Hours of Work	□ Worker worked as much as she/he would and could, according to demand	□ Worker worked set daily hours, often 12 hours per day, six days per week in the earliest factories
Worker Dependence on Employer	□ Worker had multiple sources of sustenance—other employers, own garden or farm, and outside farm labor during the harvest and planting seasons	□ Worker relied entirely on the capitalist (factory owner) for her/his income; urban living made personal farming and gardening impractical

England: Birthplace of the Industrial Revolution

There is no concrete starting date for the Industrial Revolution. It is instead marked by gradual, slow changes. After 1750, these changes were first noticeable in England.

The Industrial Revolution began in England for numerous reasons. England (or Great Britain) had the capital for investing in the means of production (factories and machinery). The British had colonies and markets for manufactured goods, raw materials for production, plenty of workers, a strong merchant marine, and geographic knowledge of the world's markets and resources.

The Commercial Revolution made many British merchants incredibly wealthy. These merchants had the capital to invest in the factory system—money to buy buildings, machinery, and raw materials.

The British had more colonies than any other nation. Britain's colonies gave Britain access to enormous markets and to vast amounts of raw materials. Additionally, Britain's colonies and global trading posts existed in those regions which had rich textile industries dating back many centuries. Many popular natural cloths, such as calico and gingham, were originally created in India, while China had a rich silk industry.

Great Britain itself possessed the necessary raw materials to supply its growing industries. The country's vast coal reserves powered steam engines. Britain's iron supply provided the basic building block for large machines, railroad tracks, trains, and ships.

Rural-to-urban migration predated the Industrial Revolution in England. Serfdom and the guild system ended earlier in England than in other countries. The English were free to travel from the countryside to cities. The Enclosure Acts increased rural-to-urban migration by causing many small farmers to lose their lands and relocate to cities.

Great Britain's merchant marine was the world's largest merchant fleet. This merchant marine was built up from the Commercial Revolution. Britain's large number of ships could bring raw materials and finished goods to and from England's colonies and trading posts, as well as to and from other countries.

Great Britain's experience in global trade gave it vast geographical knowledge of the world's ports and resources. The country's own geographic location gave it a distinct advantage in leading the Industrial Revolution. An island located west of mainland Europe, Great Britain did not suffer fighting on its land during the wars which raged throughout Europe during the 18th century. The island of Britain has excellent harbors and ports. Britain's damp climate benefited the growing textile industry, because it helped thread to not dry out. Furthermore, the British government was stable and there were no internal trade barriers.

List five reasons why the Industrial Revolution was so successful in Great Britain. _____
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Necessity Is the Mother of Invention

Once the Industrial Revolution began, there was truly no way of stopping it. Each new invention creates the need or desire for improvements, as well as for additional inventions and developments to increase the productivity of the original invention.

For example, the spinning machine was invented to speed up the process of creating thread from cotton and wool. Once thread was made more quickly, textile manufacturers needed to weave this thread into cloth faster and more efficiently, so the power loom was invented. With the spinning machine and power loom operating at such speed, there was an increased demand for raw cotton. This led to the invention of the cotton gin, a device that separates raw cotton from seeds. Production of cotton gins (made partly with iron) created demands for stronger iron. Demands for stronger iron led to improvements in iron smelting and, eventually, to the development of affordable steel through the Bessemer process.

Improvements were not limited merely to products. Methods of doing things improved, as well. As more steam-powered machines were built, factories needed more coal to burn to create this steam. Mining methods improved to meet this demand for more coal.

The process of inventing new things and improving operational methods never ends. Each invention and new technique inevitably leads to improvements upon it and to more inventions and methods.

List an item that you use regularly today. How is it an improvement on an earlier item used for the same purpose? What could be done to this item to make it even more useful? _____
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The Textile Industry

Textiles are cloths or fabrics. The textile industry was the first industry to be industrialized.

In 1733, John Kay (English) invented the flying shuttle. This hand-operated machine increased the speed of weaving.

James Hargreaves (English) invented the spinning jenny in 1765. The spinning jenny is a home-based machine that spins thread

eight times faster than spinning thread by hand.

The water frame was invented by Richard Arkwright (English) in 1769. This water-powered spinning machine was too large to be used in a person's home. The water frame led to the creation of factories.

Samuel Crompton (English) created the first spinning mule in 1779. The spinning mule combined the spinning jenny and the water frame into a single device, and increased the production of fine thread.

The power loom was invented in 1785 by Edward Cartwright (English). The power loom is a water-powered device that automatically and quickly wove thread into cloth.

Eli Whitney, an American, invented the cotton gin in 1793. This device separates raw cotton from cotton seeds, increasing the cotton supply while lowering the cost of raw cotton.

Another American, Elias Howe, invented the first sewing machine in 1846. The sewing machine allowed people to make clothing garments and other items at incredible speed.

In just a little more than a hundred years, the textile industry underwent a revolution. In the early 1700s, it took at least a week, along with a lot of hand labor, to produce an article of clothing. By the mid-1800s, the process took very little hand labor, cost a fraction of its earlier cost, and was done much more quickly. In the early 1700s, the average person owned only around two outfits. By the end of the 1800s, stores in every city and town offered a range of styles and sizes, and the average person owned many more items of clothing.

Industrialization continues to spread around the globe today. Just as with the First Industrial Revolution, the manufacture of clothing is typically the first industry for an industrializing nation to adopt. Examine the labels on at least five textile items you possess. Where were they made? What do you know about the state of industrialization in these places of origin?

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Early Water Power

Early water power involved mills built over fast-moving streams and rivers. Essentially, the river or stream turned a water wheel. This water wheel was connected to machinery, and each turn of the water wheel caused the machinery to function by turning its levers and rotating its belts.

This early water power had problems. There were not enough rivers to provide the power needed to meet growing demand. Some days, the river or stream moved too slowly or too quickly. Streams and rivers are prone to

seasonal flooding and drying. Waterways might be far removed from raw materials, workers, and markets.

Name three problems of relying on water wheels. _____
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and iron mines. The most important British cities to grow during the Industrial Revolution were Manchester and Liverpool.

In your own words, explain why the Industrial Revolution brought the first practical need for steam-powered engines.

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Steam Power

Before the Industrial Revolution, humans had worked at harnessing steam power for millennia. In the first century B.C.E., Hero of Alexandria, Egypt, created a steam-driven device. However, without large machinery to operate, there were no practical applications for steam power in the ancient world.

The eighteenth-century witnessed the first manufacturing applications of steam power. In 1704, Englishman Thomas Newcomen created a steam engine to pump water from mines. Scotland's James Watt improved Newcomen's steam engine in order to power machinery in 1769.

By 1800, steam engines were replacing water wheels as sources of power for factories. No longer were capitalists forced to locate their factories near rivers and streams. Factories were relocated near raw materials, workers, and ports. Cities grew around the new factories which were built near England's coal

Coal and Iron

Iron ore must be smelted to burn out its impurities. Vast amounts of fuel are needed to smelt iron ore. During the First Industrial Revolution, coal became the leading fuel for both powering steam engines and smelting iron ore.

In 1709, Abraham Darby discovered that heating coal turned it into more efficient coke. John Smeaton, in 1760, smelted iron ore by using water-powered air pumps to create steam blasts. In 1783, Henry Cort developed the puddling process which purifies and strengthens molten iron.

Between 1770 and 1800, coal production doubled from 6,000,000 to 12,000,000 tons. Production of pig iron increased 250% to 130,000 tons by 1800. Great Britain produced as much coal and iron as every other country combined.

Describe an invention that increased the amount and quality of fuel available to manufacturers during the First Industrial Revolution. _____
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Bessemer Process and Steel

Prior to the Industrial Revolution, steel was difficult to produce and expensive. This changed in 1856 when Henry Bessemer developed a new process for creating steel from iron. The Bessemer process brought on the "Age of Steel." Steel is the most important metal used over the past more than 150 years.

Beyond the Bessemer process, other improvements in production have increased the availability and quality of steel. These include the open-hearth furnace, which was followed by the electric furnace. Additionally, other metals have been used to produce various types of steel.

Who developed the Bessemer process?

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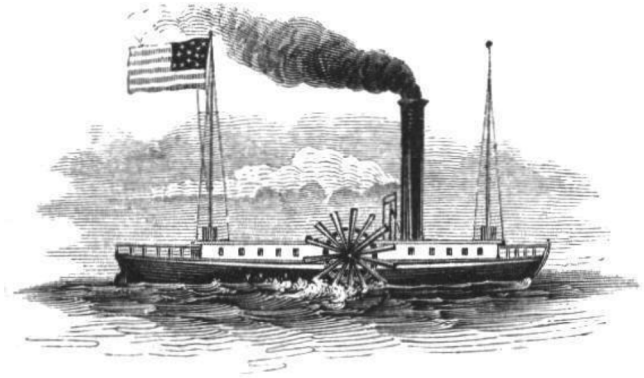
Transportation

Increased production led to searches for even more markets and sources for raw materials. These searches required better and faster means of transportation.

At the start of the First Industrial Revolution, transportation was slow. Transportation of goods from one location to another could take several months. There were canals with barges pulled by mules. Ships were powered by sails. Land transportation consisted of horse-drawn wagons, carts, and carriages.

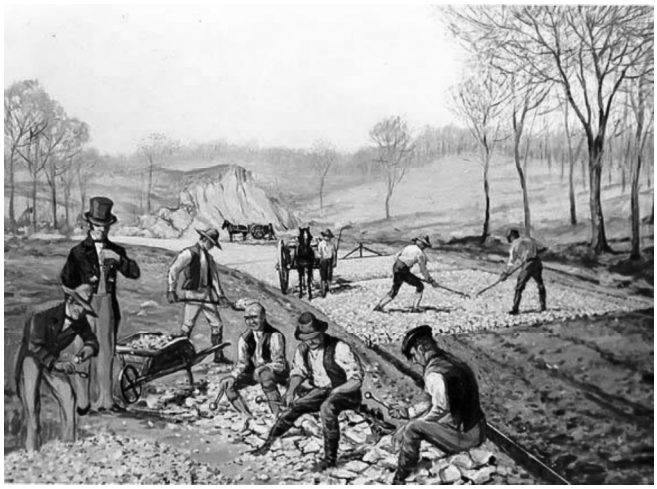
The Industrial Revolution brought faster and more efficient modes of transportation. Trains were made possible by improvements in iron and steel, as well as by steam-powered engines. Also built of iron were the first steam-powered ships. Trolleys and automobiles followed.

Robert Fulton, an American, created the first steamboat in 1807. Fulton's steamboat, the *Clermont*, operated the first regular steamboat route, which ran between Albany, New York, and New York City, New York. In 1819, the *Savannah* used a steam engine as auxiliary power for the first time when it sailed across the Atlantic Ocean. In 1836, John Ericsson invented a screw propeller to replace paddle wheels. In 1838, the *Great Western* became the first ship to sail across the Atlantic on steam power alone, completing the trip in a record fifteen days. The steamboat greatly sped up water transportation.



Fulton's *Clermont*.

Thomas Telford and John McAdam of Great Britain first macadamized roads between 1810 and 1830. Macadamizing roads involved giving roads (previously made of dirt and gravel) a smooth coating which made them more durable and less dusty. This made road transport cleaner, faster, and easier on wheeled conveyances.

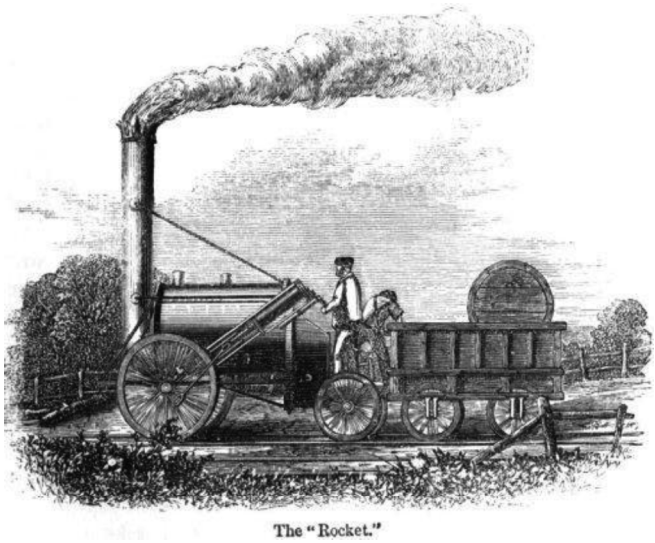


Workers laying macadamized roads.

Englishman George Stephenson revealed the first locomotive in 1825. Called the "Rocket," Stephenson's locomotive traveled the forty miles between Liverpool and Manchester in one and a half hours.

Between 1830 and 1870, railroad tracks grew from 49 miles of track to over 15,000 miles. Soon, steel rails replaced iron rails.

In 1869, Westinghouse's air brake made train travel safer. Additional improvements made train travel more comfortable—including heavier train cars, improved road beds, and sleeping cars.



Stephenson's "Rocket."

The first gasoline engine was built by Gottlieb Daimler (German) in 1885. The gasoline engine led to the invention of the automobile.

Rudolf Diesel, also a German, built the first diesel engine in 1892. Diesel is a cheaper fuel than gasoline. Even today, large trucks typically run on diesel fuel.

In 1903, two brothers from Ohio, Orville and Wilbur Wright, successfully built and flew the first airplane. Today, airplanes can transport people and cargo around the world in a day.

Why did the Industrial Revolution create a need for faster and more efficient modes of transport? _____
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Communications Revolution

The Industrial Revolution brought massive changes in global communications.

The telegraph was invented by an American, Samuel F.B. Morse, in 1844. The telegraph provided rapid communication across continents. Messages were sent using a series of dashes, dots, and stops, a format that became known as Morse code.

Alexander Graham Bell, another American, invented the telephone in 1876. The telephone allowed human speech to be heard over great distances.

In 1866, Cyrus W. Field (American) laid the first trans-Atlantic cable. This cable allowed for fast communication between North America and Europe.

Guglielmo Marconi, an Italian, invented the wireless telegraph in 1895. The wireless telegraph was an early form of the radio. Without the need for wires, the wireless telegraph allowed for the sending of messages through the air.

The radio tube was invented by Lee de Forest, an American, in 1907. The radio tube expanded the reach and reception of broadcasts, which could now be sent around the world.

Vladimir Zworykin, an American, invented the first television in 1925. The television provided a simultaneous audio and visual broadcast.

Describe the contributions of three Americans to the revolution in communications. _____
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Printing Revolution

During the nineteenth century, printing underwent its most dramatic changes since the invention of Gutenberg's printing press during the European Renaissance. The iron printing press and steam-driven press were developed between 1800 and 1830. In 1870, Richard Hoe's rotary printing press allowed both sides of a page to be printed at once.

The linotype machine was invented in 1884 by Ottmar Mergenthaler. With Mergenthaler's linotype machine, a machine operator could operate a "line of type" all at one go, rather than having to individually set each letter.

Name: _____ Date: _____ Class: ____

Advances in printing techniques made newspapers much less expensive to produce. The cost of a newspaper plummeted, and the number of newspapers increased. Thanks to the revolution in global communications, newspapers had plenty of information to print.

Print media vastly increased people's general knowledge of the world. Name a more modern invention that is rapidly overtaking print media, and describe why it is replacing print media. _____

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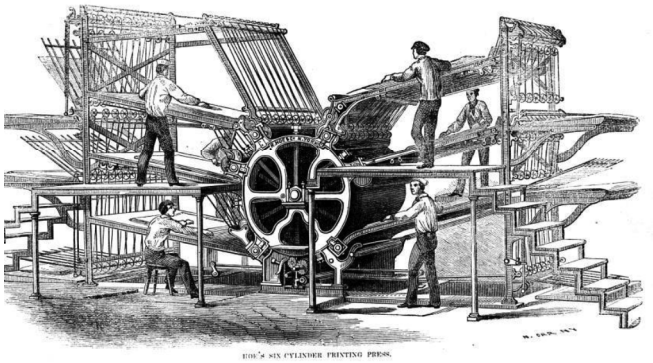
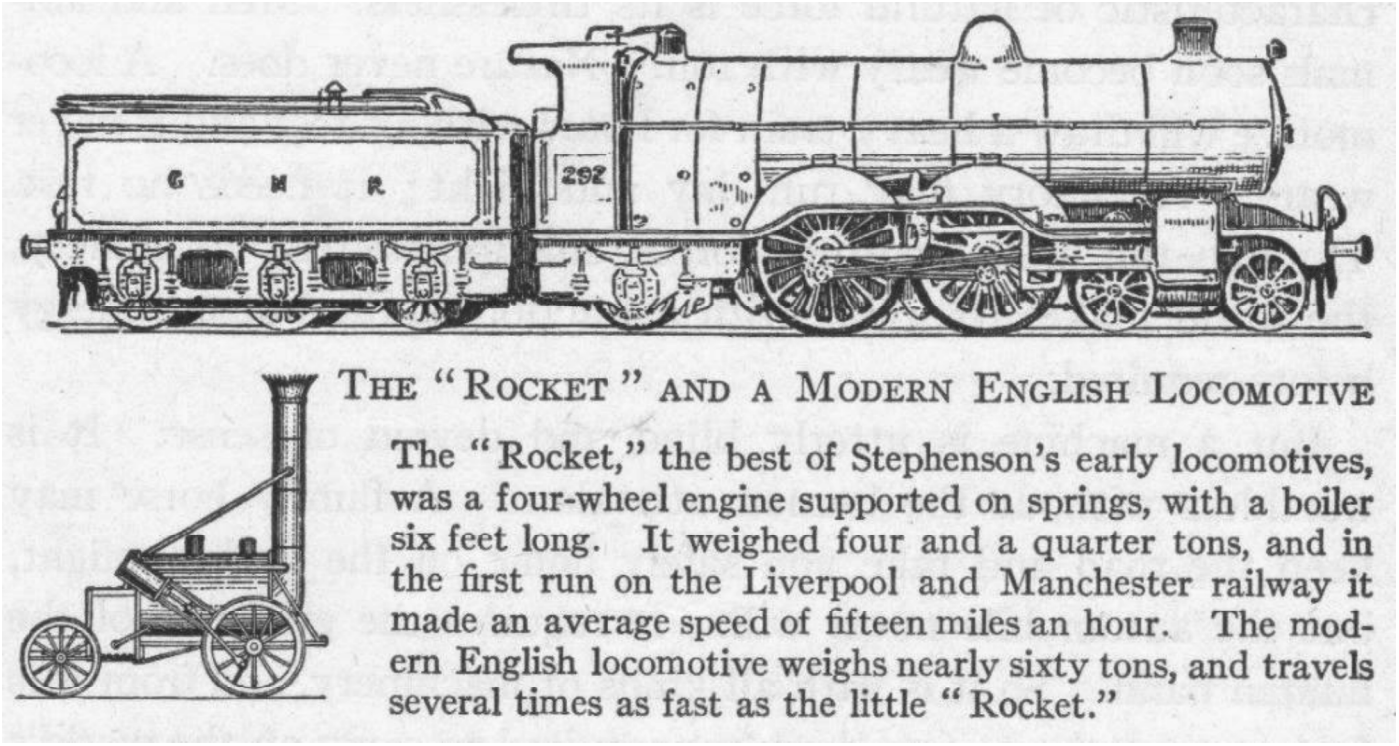


Richard Hoe's six-cylinder printing press.



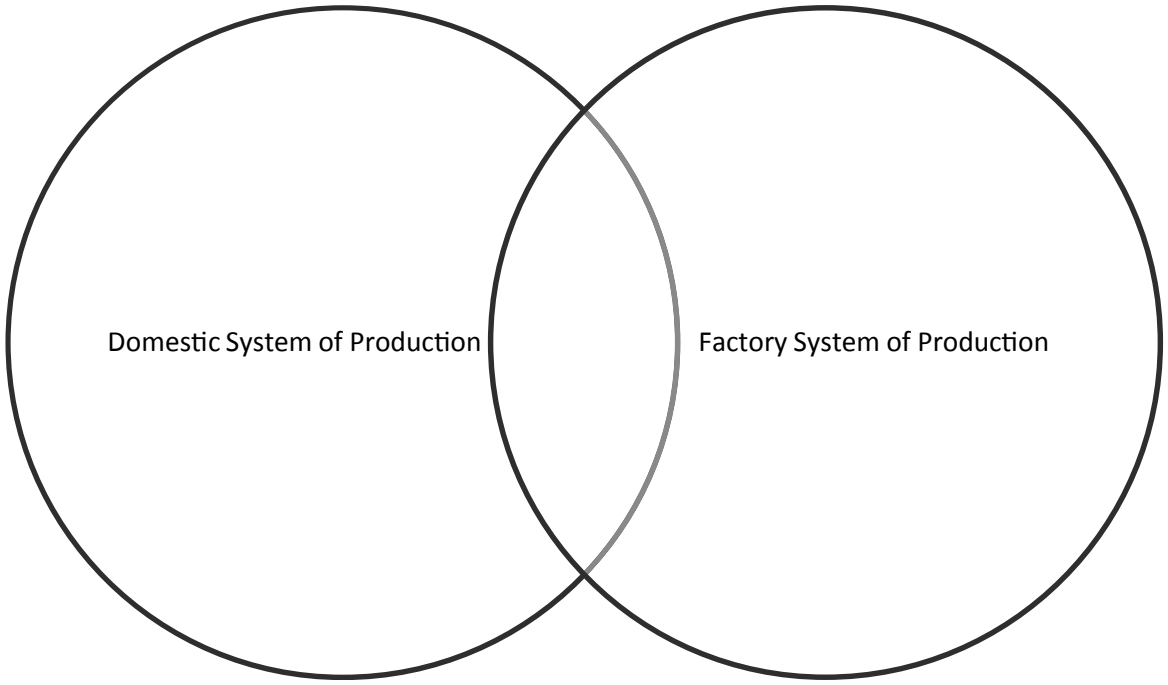
Name: _____ Date: _____ Class: ____

Review Questions

1. What was the Industrial Revolution?

2. Describe at least three developments of the Industrial Revolution.

3. Compare and contrast the domestic and factory methods of production using this Venn diagram.



4. Why did the Industrial Revolution begin in England?

5. Explain why one invention or development leads to another.

6. Explain how developments in the textile industry sparked the Industrial Revolution.

7. Describe at least three developments in the area of transportation.

8. Describe at least three developments in the field of communications.

9. Considering the conditions necessary for industrialization to occur, how well equipped is the undeveloped world for becoming industrialized? Are modern undeveloped nations in a better or worse position than 18th- and 19th-century England? Explain your answer.