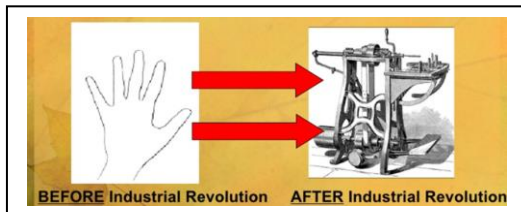
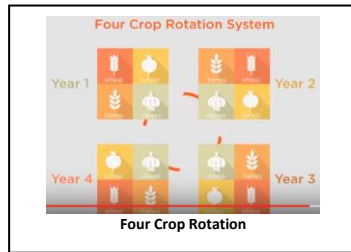
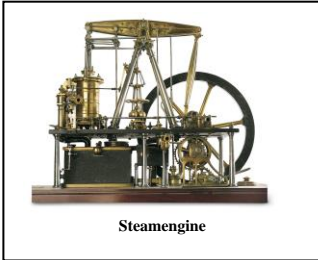
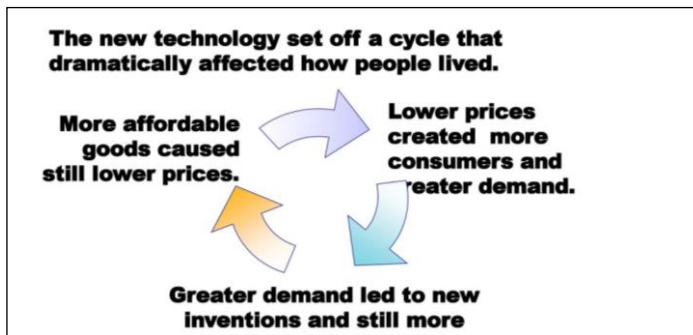


Aim #8: How did the production of goods change during the late 1700s and 1800s?



Category of Life in Great Britain	What changed as a result of innovations during the Industrial Revolution?
Source of Energy	Before the industrial revolution, people and animals were the main source of energy but during the industrial revolution, water and later coal was used to power factories.
How goods were made and where people worked	Before the industrial revolution, goods were created through the domestic system where people made finished goods in their homes and were paid for what they created. During the industrial revolution, goods were made in factories and people came to factories to work.
How people and goods were transported	Before the industrial revolution, people and goods were transported on foot or with the use of horses. Afterwards, roads were improved, canals were created to ship goods and move people, and trains were invented.



Economic Change in Europe	
Pre-industrial Europe	Post-industrial Europe
Serfdom: Peasants are tied to land where they are born and owe their labor to landed nobility.	Capitalism: Working class labors in factories being paid for their time on the job.
Mercantilism: Governments control the economy to encourage exports and discourage imports.	Capitalism: Governments allow business people to compete more freely with one another.
Agriculture: People work on farms, growing food to feed themselves and the landowners.	Industry: People work in factories for wages, which they spend on food and other necessities.
Artisanal production: A highly skilled artisan creates every part of the goods he or she produces and sells.	Mass production: A semi-skilled worker repeats the same task over and over, creating or assembling only one part of a mass produced good.

Mini Lecture

- New technology in agriculture, manufacturing, and transportation resulted in what is now called the Industrial Revolution- an economic revolution that changed the production of manufactured goods by hands to complex power-driven machinery (in urban factories).
- The Industrial Revolution was a major turning point in history-it changed where and how people lived and how they worked and traveled.
- One key factor leading to the IR was a set of ideas & technologies used by farmers (**Agricultural/Agrarian Revolution**)- **Enclosure movement** (combining small plots of farmland into a big farm business), **crop rotation** (more productive farmland w/ no fallow by rotating crops like turnips & clover), & the **seed drill**.
- These innovations led to an increase in food production and decreased the number of people needed to raise food- forcing people to move into urban areas to work in factories. With more food available (along with better medical care), population grew and demand for products rose.
- Innovations in technology and energy were essential to the IR.
- New ideas how to use coal & water power more effectively (steam engine) and how to produce goods more efficiently (new machines) changed life for everyone.
- The IR revolutionized the textile (cloth) industry. By the mid-1700s, inventions like the spinning jenny, water frame, & power loom reduced the time needed to spin yarn & weave cloth. The **cotton gin** cleaned cotton much faster. Production went from hand-made at home to machine-made in factories in mass.
- The system of **Interchangeable parts** was a pivotal contribution to industrial technology. It allowed unskilled workers to specialize in one task of the manufacturing process- repeating tasks faster which led to **mass production**=low priced products.
- The new machinery and methods of work benefited from a new power source (more mobile than rivers/streams)- the **steam engine** which harnessed coal power to create steam, which in turn generated energy for machinery. Steamships later revolutionized transportation.
- The IR began in Britain because it had many geographical advantages in the process of industrialization.
 - Firstly, it's location next to water allowed it to import raw materials and export finished goods.
 - It had a natural network of rivers to transport supplies & products.
 - It had a lot of coal to power machines & railroads.
 - Britain's colonies provided raw materials & markets for manufactured goods.
 - It had a lot of capital to invest in factories & businesses.
 - Finally, Britain had a strong government that promoted economic growth with a strong navy (protected commercial ships & controlled trading ports), built canals & harbors for trade, and protected private property (entrepreneurs not fearful gov't would seize their business).

Review Questions:

1. What is the Industrial Revolution? Why was it a turning point in history?
2. How did the Agrarian Revolution lead to the Industrial Revolution?
3. Why did the Industrial Revolution begin in England? Explain 3 reasons.
4. How did the Industrial Revolution transform the textile industry?

Enduring Issue:

The importance of human **inventiveness**- changes in **technology** revolutionized how people lived and thought.

Continuity and Change in Textile Manufacturing during the Industrial Revolution

Directions: Read the text below and watch excerpts from [the PBS video Mill Times](#) and then complete the graphic organizers that follow.

Textile is another word for cloth, or woven fabric and the way textiles were made was one of the first changes that came about during the Industrial Revolution. The innovations in textile manufacturing led to more invention and the mechanization and industrialization of other work.

1. How were clothes made before the Industrial Revolution (0:00-1:05, 2:52-6:08)?
2. How were clothes made as a result of the Industrial Revolution (6:08-8:50)?

How did the Agrarian Revolution change Great Britain?

Directions: Using the text, video, and images on the following pages complete the accompanying activities with information about the effects of the Agricultural Revolution.

Watch this [video on the Agricultural Revolution \(1:27-end\)](#) and read the description of the Agricultural Revolution below then fill in the graphic organizer above with information you learn.

The **Agricultural Revolution**: the transformation of agriculture from traditional medieval farming to more productive, efficient, and mechanical methods of farming through scientific innovation and new techniques starting in the mid-1700s.

The **Agricultural Revolution** (mid-1700s- late 1800s) started in **Great Britain** and was the first of two important non-political revolutions that started in the 18th century. It was both a revolution itself and an important **cause of the Industrial Revolution**.

The Agricultural Revolution led to a drastic **increase in population** in Great Britain and elsewhere, and **increased urbanization** because people moved away from their farms to cities.

1. Write a sentence that describes a cause and effect relationship related to the Agricultural Revolution. (you may any of the following to begin your sentence: “as a result”, “for this reason”, “_ led to_ because”, “so”).

Innovations of the Agricultural Revolution: Enclosure Movement

BEFORE the Agricultural Revolution

Common Land



A map of a medieval manor. The green sections were “common land” by Author William R. Shepard image is Courtesy of Wikimedia Commons and is Public Domain

During the Middle Ages and up until the Agricultural Revolution, communities had **“common land” that was used by all of the peasants to farm and hunt on.**

INNOVATION

The Enclosure Movement



Fields in the Imperial Valley, Southern California by Spacenet525 image is Courtesy of Wikimedia Commons and is Public Domain

Enclosure was the **process of making common land into private land, owned by a farmer.** The land was then fenced in, or enclosed. Sometimes an individual bought the land from a town or the government of the town decided to enclose the common itself.

EFFECTS of the Innovation

Peasants Move to the City

The peasants who once used the common land to farm and graze animals either worked for the farmers who owned the enclosed land or they moved to a nearby urban area and got jobs in factories.

Agricultural Innovation on Private Farms

The new owner of the land was able to farm it however they liked since it was theirs. They often used innovative techniques that made the land more productive than it had been before.

2. Write a sentence that describes a cause and effect relationship related to the Agricultural Revolution. (you may any of the following to begin your sentence: “as a result”, “for this reason”, “_ led to_ because”, “so”).

Innovations of the Agricultural Revolution: Seed Drill

BEFORE the Agricultural Revolution

Hand Sowing Seeds

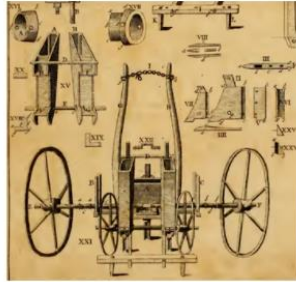


Medieval Farmers plowing a field and sowing seeds by hand.
Labors of the Months: September, from a Flemish Book of Hours
[Image](#) is Courtesy of Wikimedia Commons and is in the Public Domain

Before the Agricultural Revolution, **farmers used a plow to create furrows (ditches)** then scattered seeds into them and covered them back up with dirt. This method was ineffective because birds and other animals could easily eat the seeds and they were planted with little accuracy.

INNOVATION

Jethro Tull's Seed Drill



Components of Jethro Tull's Seed Drill.
[Image](#) is Courtesy of Wikimedia Commons and is in the Public Domain

Jethro Tull Invented his horse-drawn **seed drill** in 1701. The machine **drilled holes for three rows of seed at a time** to the correct depth, planted the seeds, and covered them in dirt in one action.

EFFECTS of the Innovation

Higher Agricultural Yields More Food, More Time, Fewer Workers

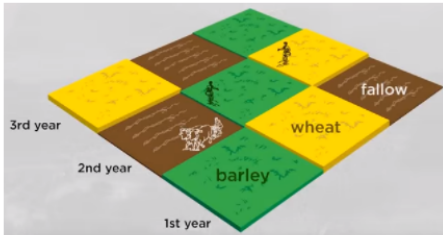
Tull's seed drill **increased crop yields** [the amount of food grown] five times. In addition, planting with the seed drill was much quicker than hand planting and required fewer workers. As a result, **farmers could plant and grow more crops**. The workers who were no longer needed on the farm had to find work elsewhere, usually in a nearby town or city where factories employed many people.

3. Write a sentence that describes a cause and effect relationship related to the Agricultural Revolution. (you may any of the following to begin your sentence: "as a result", "for this reason", "_ led to _ because", "so").

Innovations of the Agricultural Revolution: Four Crop Rotation System

BEFORE the Agricultural Revolution

Three Crop Rotation System

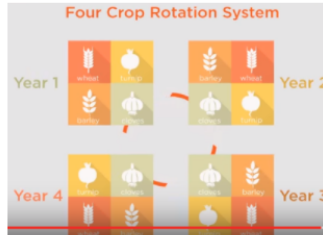


Three Field System used in medieval agriculture
[Image](#) by MScharwiles and is courtesy of Wikimedia Commons and is licensed under the [Creative Commons Attribution-Share Alike 4.0 International license](#).

Since the Middle Ages, farmers in Europe used the **three-crop rotation system which involved leaving one field fallow [empty] every year**. This meant that they could not grow as much food and that livestock only had one field to graze on.

INNOVATION

Dutch Four Crop Rotation System



During the Agricultural Revolution, a new method of crop rotation used by the Dutch in the Netherlands was introduced in Great Britain. The Dutch discovered that plants called **legumes** (ie-peas, alfalfa, and beans) and **cover crops** like turnips, could **replenish a field's nutrients just as well as leaving it fallow**.

EFFECTS of the Innovation

More Food and Livestock

As a result of the four-crop rotation system, British farmers could be **more productive**. The turnips replenished the soil with needed nutrients, provided another crop for farmers to eat and sell, and gave their livestock something to live on during the winter.

4. Write a sentence that describes a cause and effect relationship related to the Agricultural Revolution. (you may any of the following to begin your sentence: "as a result", "for this reason", "_ led to _ because", "so").

What historical circumstances and geographic context led to the Industrial Revolution in Great Britain?

Directions: Read through the following documents to help you answer the following question (be sure to explain with details): **What historical circumstances and geographic context led to the Industrial Revolution in Great Britain?**

Cause #1: Geography- Location, Geographic Features, and Natural Resources

Location

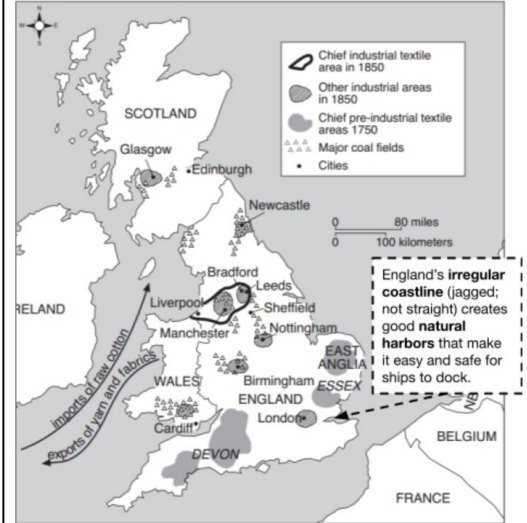
Great Britain is the main island of the modern-day country called the United Kingdom and is located northwest of mainland Europe. The Atlantic Ocean is to the west, the North Sea is to the northeast and the English Channel separates Great Britain from France. Because of its location close to mainland Europe and surrounded by major bodies of water, Great Britain was a leader in overseas trade with connections to the Mediterranean Sea and the rest of Europe and to the Americas across the Atlantic Ocean and to Asia around the tip of Africa. As the Industrial Revolution progressed, Great Britain's location made it easy to ship raw materials to factories and finished goods to other places to be sold.

Geographic Features

Two of Great Britain's common geographic features made it a good place to manufacture goods and ship them. First, the island has many gently-flowing rivers which early factories used as energy sources by placing water wheels in the rivers which turned the gears in their factories to run the machines that made goods. The rivers were also used to ship goods to and from factories. The second geographic feature, is an irregular coastline which often creates safe places for ships to dock, called harbors. Great Britain's natural harbors led to the creation of cities that were centers of shipping. Boats carrying goods and people came from the Atlantic Ocean, the North Sea, and English Channel to Great Britain's harbors where their cargo was sold or shipped inland on rivers.

Natural Resources

Great Britain was rich with a natural resource that became very important later in the Industrial Revolution and is still important today, coal. Coal is a rock that is combustible, meaning that it burns easily when set on fire. Coal fueled engines that replaced water wheels as the main source of energy for factories and since it was prevalent in Great Britain, there was an inexpensive source that could be used to power factories and later, trains.



Source: Adapted from Holt and O'Connor, *Exploring World History Workbook*, Globe Book Company (adapted from the NYS Global History and Geography Regents Exam, August 2007)

Cause #2: Agricultural Revolution

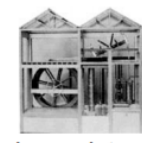
New tools, fertilizers, and harvesting techniques during the **Agricultural Revolution** increased productivity which resulted in an increase in population. Innovations, such as the seed drill, made the process of planting seeds easier and more efficient which meant that fewer farmers were needed to produce the same amount of food. Since there were fewer jobs in rural areas, many **farmers and their families migrated to cities** where factories hired large numbers of workers.

Cause #3: New Technology

New technological innovation in machinery meant that factories could produce more goods in less time, for less money. The cheaper goods were produced, the more money factory owners made and the faster the Industrial Revolution grew and spread.

... Four great inventions altered [changed] the character of the cotton manufacture; the **spinning jenny**, patented by Hargreaves in 1770; the **water-frame**, invented by Arkwright the year before; **Crompton's mule** [spinning machine] introduced in 1779, and the self-acting mule, first invented by Kelly in 1792, but not brought into use until Roberts improved it in 1825. None of these by themselves would have revolutionised the industry. But in 1769...**James Watt** took out his patent for the **steam-engine**. Sixteen years later it was applied to the cotton manufacture. In 1785 Boulton and Watt made an engine for a cotton-mill at Papplewick in Notts, and in the same year Arkwright's patent expired. These two facts taken together mark the introduction of the factory system. —Arnoold J. Toynbee

Invention



Improved steam engine (James Watt)

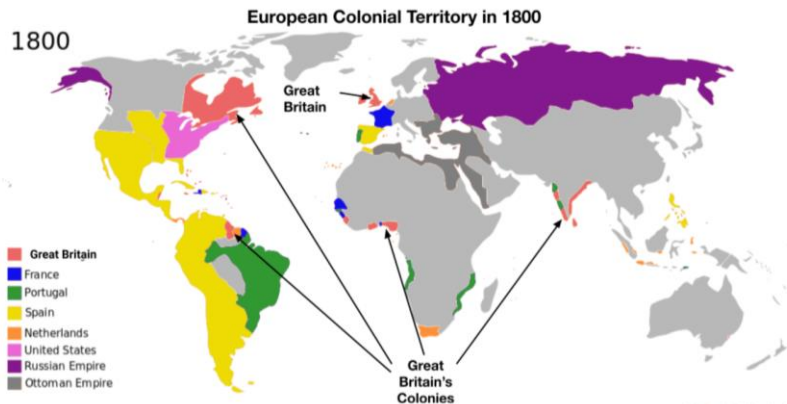
Description

Improved version of steam engine that used coal rather than water power. First used to pump water from mines and to forge iron. By the late 1780s, powered machines in cotton mills.

Source: Ellis and Esler, *World History: Connections to Today*, Prentice Hall, 1999 (adapted)

Cause #4: Colonial Markets for Raw Materials and Goods

As a result of the **Age of Exploration**, Great Britain became wealthy and powerful, and gained **colonies** in North and South America, Africa, and South Asia. During the Industrial Revolution, English traders brought raw materials like cotton from its colonies to the factories in Great Britain where they were turned into finished goods. These manufactured goods were then sold throughout Great Britain, Europe, the United States, and back to people living in the British colonies. The money made from selling manufactured goods to Britain's colonies fueled the expansion of industry at home.



Colonial empires in 1800 by George Tsipogiannis
 (CC) Courtesy of Wikimedia Commons and is Public Domain

How did innovations during the Industrial Revolution change life in Great Britain in the 19th century?

Directions: Examine the innovations on the following pages and respond to the accompanying questions.

1. Innovations in Energy Sources: Human, Animal, Wood and Water Power to Coal

Before the Industrial Revolution

Before the Industrial Revolution, the main sources of energy were **human, animal, wood, and water** power. In addition to using animals to push and pull, they were also used to power machines. A modern version can be seen in the video below. Water power had been used for centuries to power mills, but this limited where someone could put a factory because it needed to be near fast moving water. In the early years of the Industrial Revolution, factories were located near rivers and streams to use the water power to move gears that powered the machines inside. Wood was also used as fuel once steam engines were invented but it took time to replenish after the trees were harvested and it was heavy and bulky to transport.

[Click to watch a modern animal-powered sawmill in Belize.](#)



[Click to watch a restored water-powered sawmill in Ireland.](#)



Industrial Innovation: Coal

Coal is a black or brownish-black sedimentary rock. It is extracted from the Earth by underground mining or by digging large pits until the coal is unearthed. Coal is a common rock in many parts of the world and with improved mining technology in the 18th century, it became easy to get. Because it can be set on fire and it burns at a high temperature for a long period of time, it is an extremely powerful fuel for the generation of heat and electricity. Today, approximately 40 percent of the world's electricity production depends on coal, making it the largest single source of electricity worldwide.

Watch this [BBC Video on the Industrial Revolution \(2:22- 5:08\)](#) to learn about the importance and power of coal as a source of energy.



Fireman shovels coal into the engine of a steam-powered train.
Image courtesy of Wikimedia Commons and is public domain.

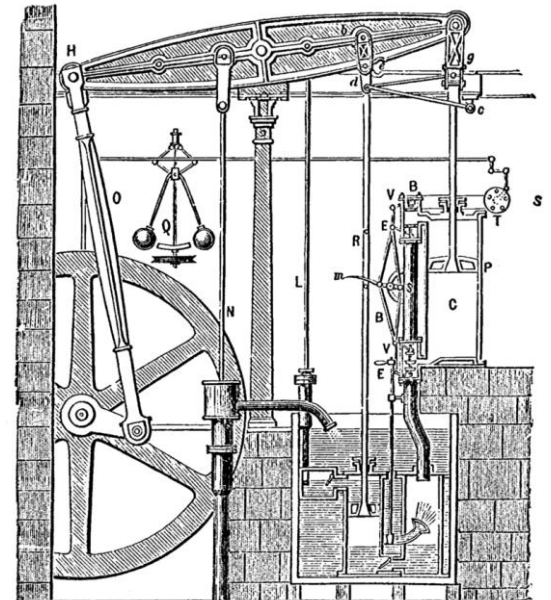
- 1a. What were the disadvantages to using wood and water power?
- 1b. Why was the use of coal an improvement on using human, animal, wood or water power for energy?

2. Innovations in Engines: James Watt's Steam Engine

James Watt (January 19, 1736 – August 25, 1819) was a Scottish inventor and engineer whose improvements to the **steam engine** provided much of the force behind the Industrial Revolution. His invention turned heat from burning coal into movement through a series of valves and gears. His invention made it possible to use coal for energy in areas far away from coal fields. The steam engine was used in manufacturing to run machines at great speeds for long periods of time so work could be performed on large scales, almost year-round, with vastly higher efficiency. The steam engine was also used in the **locomotive [train]** and **steamboat**, thus **leading to a revolution in transportation**.

How do steam engines work?

[How a Steam Engine Works Animation](#), [A Working Glass Model of a Steam Engine](#), [Britain's Greatest Machines with Chris Barrie \(5:00- 8:07\)](#)

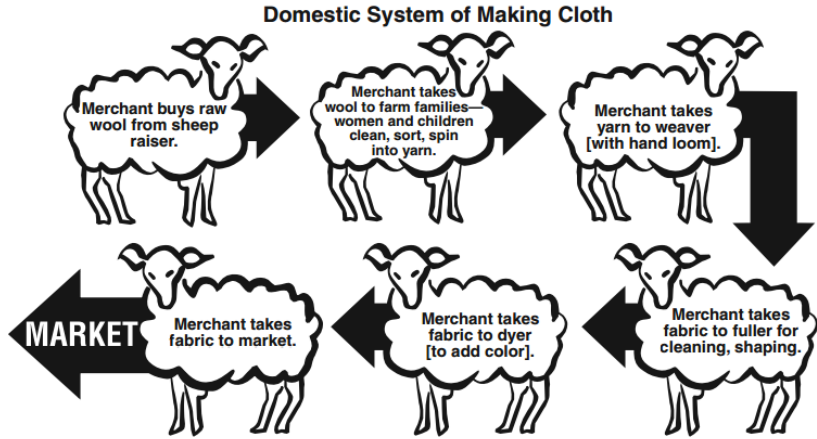
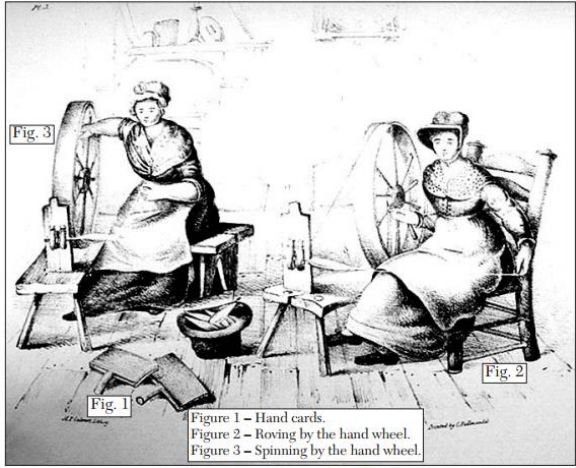


- 2a. What uses did Watt's steam engine have during the Industrial Revolution?
- 2b. How did the steam engine improve manufacturing and transportation?

3. Innovations in Manufacturing: Putting Out System to the Factory Model

Before the Industrial Revolution: Domestic/Putting Out System

The **Domestic system**, also called the **Putting-out System**, was a system used in 17th-century western Europe in which merchants provided materials, like cotton, to workers in rural areas who usually worked in their homes to produce goods like clothing. Workers returned finished products to the merchants and were paid for each finished product they produced. The merchants bought the raw materials like cotton and then sold the finished products, so they only paid workers for their labor. The advantages to the merchant were the lower wage costs and increased efficiency due to the **division of labor**. Division of labor is the separation of steps in the process of making something into different jobs. For example, the merchants were in charge of getting cotton, and the rural workers were responsible for turning the cotton into yarn.



Industrial Innovation: Factory System

The **factory system** of manufacturing that began in the early 18th century was based on

- requiring workers to come to a factory to produce goods
- division of labor (separating the steps of making something into separate jobs)
- keeping the cost of making something as low as possible
- mass production (making a lot of the same good)

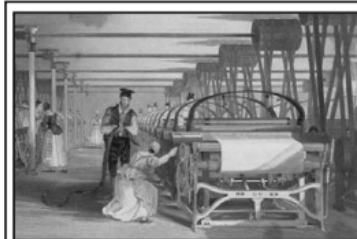
The factory system **replaced the domestic system**. The use of **waterpower** and then the **steam engine** to **mechanize** processes such as cloth weaving in England in the second half of the 18th century marked the beginning of the factory system. The introduction of **interchangeable parts** made the factory system even more efficient. Interchangeable parts were first introduced to the production of guns, but later applied to other goods. Prior to this, each part of a gun (or anything else assembled from multiple components) had been individually shaped by a workman to fit with the other parts which took a long time and made it difficult to create replacement parts for the gun if something malfunctioned. In the new system, the gun parts were created so precisely that a part of any gun could be replaced by the same part from any other gun of the same design. This advance signaled the start of **mass production**, in which **standardized parts** could be assembled by relatively **unskilled workmen** into complete finished products.

The resulting system, in which **work was done on machines powered by water or coal** and **goods were produced on a large scale** had important social effects: formerly, workers had been independent craftsmen who owned their own tools and designated their own working hours, but in the factory system, the **employer owned the tools and raw materials** and set the hours and other conditions under which the workers labored. The location of work also changed. Whereas many workers had lived in rural areas under the domestic system, the factory system **concentrated workers in cities and towns** because the new factories had to be located near waterpower and transportation (alongside waterways, roads, or railways). Also, many of the new **unskilled jobs could be performed equally well by women, men, or children**, so factory owners hired whoever would work for the least amount of money which **lowered wages**. Factories tended to be poorly lit, cluttered, and unsafe places where workers put in **long hours for low pay**.

Use of Inventions in the Factory System

Merchant buys raw wool from sheep raiser and sells to factory

Carding machines comb the raw wool and Samuel Crompton's spinning machine, called the mule, is powered by water and spins thread



Source: Drawn by T. Allom

Fabric is shipped to markets

Ink rollers are used to add designs to fabric

Edmund Cartwright's automatic power loom weaves thread into cloth

3a. Describe the Domestic System of manufacturing goods.

3b. Who benefited the most from the Domestic System (merchant or rural worker)? Why?

3c. Who benefited the most from the Domestic System (merchant or rural worker)? Why?

Industrial Innovations in Manufacturing

[PBS video on water frame](#)

Watch an excerpt of the video [“Factories and Machines” from Timelines.tv](#) (start- 1:22)

Industrial Innovations in Manufacturing

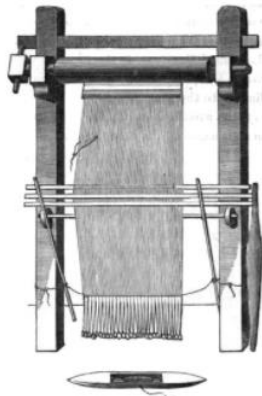
Before Industrial Revolution

Wool was spun in homes and made into yarn




Source: The Costume of Yorkshire, Richard Jackson, Publisher from the NYS Global History and Geography Regents Exam, August 2005.

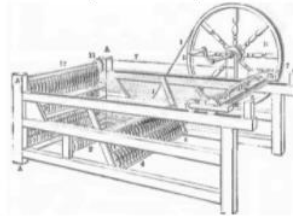
Yarn was turned into fabric by people in their homes using hand looms.



[image](#) is courtesy of wikimedia commons and is public domain

Early Industrial Revolution

 [PBS video on water frame](#)
Spinning Jenny, invented in 1764, and the **water frame**, invented in 1769 mechanized the process of spinning wool into yarn and improved the quality and speed of the process.




Workers used more complex frame looms. They used an invention called a **flying shuttle** to pass yarn from one side of the fabric to another with ease.



Hand Loom Weaving by Hogarth
[image](#) is courtesy of wikimedia commons and is public domain

Late Industrial Revolution

The **power loom** spun wool into yarn and weaved that yarn into thread

 Watch an excerpt of the video [“Factories and Machines” from Timelines.tv](#) (start- 1:22) to observe the effects of the **POWER LOOM**.



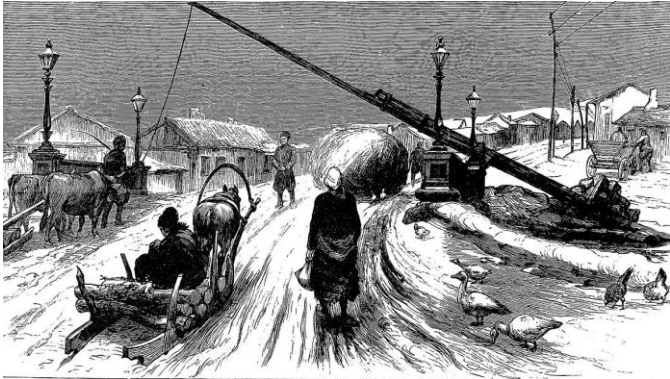
Sketch of a power loom (1892).
[image](#) is courtesy of wikimedia commons and is public domain

3e. Identify three innovations in manufacturing that took place during the Industrial Revolution?

4. Innovations in Transportation

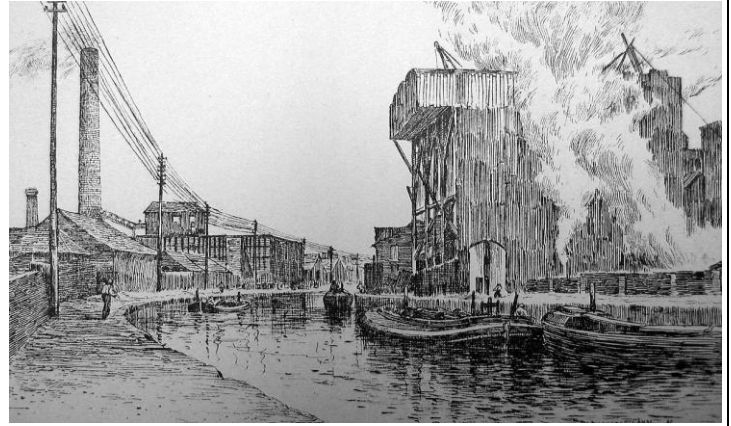
Industrial Innovation in Transportation: Turnpikes

As trade increased in the mid-1700s, merchants needed better roads to travel on. To pay for new and improved roads, the Parliament in England started to issue local governments the right to create **turnpikes**, roads that required users to pay tolls. The tolls were used to pay for road repairs and upgrades. A pike was a barrier laid across the road that prevented people from using it until they paid. The operator then turned or lifted the pike to allow them to pass.



Industrial Innovation in Transportation: Canals

Canals are **man-made waterways** used to transport people and goods from one place to another that usually connect to a larger body of water like a river, lake, or sea. As manufacturing increased during the industrial revolution, the need to transport heavy fuel like coal and more finished products made transporting over land less effective. As a result, large canal systems were built all over England and other countries.



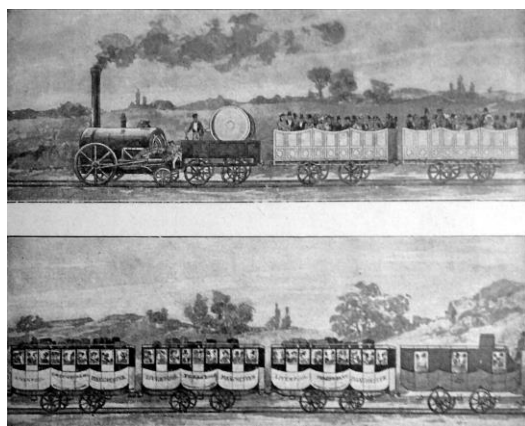
Industrial Innovation in Transportation: Locomotives (Trains)

Watch an excerpt from [Britain's Greatest Machines with Chris Barrie \(16:44- 18:35 the first locomotive, 24:00- 27:45 the first passenger locomotive, 34:43-39:43 early locomotive competition, 41:34-end\)](#) for a brief history of early trains in Great Britain.

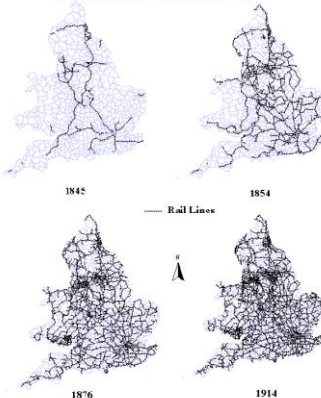
In the 1500s, 1600s, and for most of the 1700s, railroad tracks were used to move goods from one place to another over short distances but they were pushed or pulled using human muscle or animal power. **James Watt's steam engine** (1774) breathed new life into the railroad when it was adapted to pull railcars for the first time by English inventor Richard Trevithick's **locomotive** in 1804. Innovators throughout Great Britain, the United States, and Europe improved upon Watts and Trevithick's technology creating faster, more powerful, more efficient, and safer trains.

The speed and power of trains transformed the lives of those who used them to travel and ship goods. Before the locomotive, the fastest way to travel overland was on horseback which averaged around 30 mph, but was uncomfortable, required frequent stops for rest, and could carry very little weight. In contrast, by 1829 George Stephenson's locomotive, *Rocket*, could travel 29 mph and one hundred years later trains were traveling at speeds over 120 mph. Locomotives only required fuel, like coal to keep moving and could pull massive loads.

Railroad lines quickly spread throughout Great Britain and all over the world bringing people and goods closer to one another than they had ever been before.



The Extension of the Railway System in England and Wales, 1845-1914



- 4a. Explain how turnpikes and canals improved transportation during the Industrial Revolution?
- 4b. What earlier innovation of the Industrial Revolution was used to create the first locomotive?
- 4c. Based on the map of the railway system in England and Wales (1845-1914), how did the state of rail lines change during the period represented in the maps?
- 4d. What were the benefits of using locomotives to transport people and goods over horsepower?