What were the effects of fossil fuel use during the Industrial Revolution in Great Britain?
Topic: Industrialization, urbanization, fossil fuels, environment.
By: UC Irvine History Project. Updated in 2022.

Guiding Question: What were the results of the Industrial Revolution?
What were the effects of fossil fuel use during the Industrial Revolution?

History Standards and Framework Excerpt:
10.3 Students analyze the effects of the Industrial Revolution in England, France, Germany, Japan, and the United States.
10.3.1 Analyze why England was the first country to industrialize.
10.3.2 Examine how scientific and technological changes and new forms of energy brought about massive social, economic, and cultural change (e.g., the inventions and discoveries of James Watt, Eli Whitney, Henry Bessemer, Louis Pasteur, Thomas Edison).

Common Core State Standards/ Literacy Skill Addressed:
Reading:
1. Cite specific textual evidence to support analysis of primary and secondary sources, attending to such features as the date and origin of the information.
2. Determine the central ideas or information of a primary or secondary source; provide an accurate summary of how key events or ideas develop over the course of the text.
4.Determine the meaning of words and phrases as they are used in a text, including vocabulary describing political, social, or economic aspects of history/social science.
6. Compare the point of view of two or more authors for how they treat the same or similar topics, including which details they include and emphasize in their respective accounts.
9. Compare and contrast treatments of the same topic in several primary and secondary sources.

Writing:
1. Write arguments focused on discipline-specific content.
2. Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.
3. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
4. Use technology, including the Internet, to produce, publish, and update individual or shared writing products, taking advantage of technology's capacity to link to other information and to display information flexibly and dynamically.
5. Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.

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Framework Excerpt (p. 329-330): The Industrial Revolution shifted the center of the world economy from Asia to Western Europe in the nineteenth century. From a broad global perspective, industrialization has arguably been one of the most dramatic transformations in human history, making available vast stores of underground coal, oil, and gas energy and altering patterns of work, settlement, international relations, consumption, family relations, and values. […]The Industrial Revolution was energized by coal and eventually by petroleum and natural gas. Fossil fuels that drive steam and electrical engines made possible a huge increase in the amount of productive energy available to humans. As students will learn later in the course, this revolution facilitated the development of European imperialism in the late nineteenth century.

In addition to its historical significance, the Industrial Revolution also provides rich opportunities for students to develop geographic and economic literacy. Students can consider **What were the results of industrialization?** in order to come away with a broad overview of how many aspects of life were transformed by industrialization. Britain was the first nation to industrialize, benefiting from many strengths.

Overview of Lesson: In this lesson, students will learn about the energy revolution that emerged in Great Britain through the increased use of fossil fuels and the development of technology that harnessed these new types of power. Students work in groups to read and analyze the sources allowing them to answer the lesson questions: **What were the results of the Industrial Revolution?**
What were the effects of fossil fuel use during the Industrial Revolution?

Sources:

Please note that some of the content and source materials we will cover uses violent and sexist language, and includes outdated and offensive terms and images not in use today. We welcome all discussions about what is, is not, or could be appropriate for classroom instruction. Images are high resolution and may be resized for classroom use.

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Assessment:
For a culminating activity, teachers can assign students an informational writing response. Students summarize the information they have learned to create a textbook excerpt describing energy use during the Industrial Revolution. They can also create an infographic to accompany their description using the Easelly program found at: https://www.easel.ly/ or infogram.com
Some examples you can show them are:
https://infogram.com/the-industrial-revolution-1gdk8pdxqze1mq0
or
https://infograph.venngage.com/p/208208/infographic-on-industrialization

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Civic Engagement:

Students can link this to today by doing online research to identify charts, graphs, articles, and/or maps that compare energy use in our contemporary world to the Industrial revolution through one of these topics: fossil fuels vs. renewables, pollution, technology resulting from renewable energy use, global trade in renewable energy technology and sources.

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Part 1: Fossil Fuels and the Energy Revolution

Source 1: **Fossil fuels and the Energy Revolution. Secondary Source.**
Citation: J.R. McNeill and William H. McNeill, *The Human Web: A Bird's-Eye View of World History* (New York: W.W. Norton and Company, 2003), 230-32.

For the students: The Industrial Revolution was energized by coal and eventually by petroleum and natural gas. Fossil fuels that drive steam and electrical engines made possible a huge increase in the amount of productive energy available to humans. Read sources 1 and 2 below and answer the guiding questions.

[T]he Industrial Revolution transformed the energy base of human society. Energy is essential for making things, for transport, and for bodily survival. Before the use of fossil fuels, people could harness only a tiny fraction of the energy available on earth... Wind and water power, available only in favorable locations, also harnessed a fraction of the annual energy delivered to the earth from the sun…By burning wood or charcoal, people could tap energy stocks accumulated in trees over a century or two. But ultimately all these methods provided a very limited energy harvest, which meant that almost all people would always be poor, dependent upon grinding toil for their rice or bread. Fossil fuels changed all that…People around the world had known of coal's uses for a long time, and Song China had used it on a large scale in its iron industry. London had burned coal for home heating from at least the thirteenth century. Britain had abundant coal deposits… With cheap British coal it became easier to stay warm in winter and to stoke the energy intensive industries.	**toil** - labor
Guiding Questions: What types of energy were available to people to use before the Industrial Revolution? What type of fossil fuel is mentioned in the text? How did energy use change after the use of fossil fuels?	

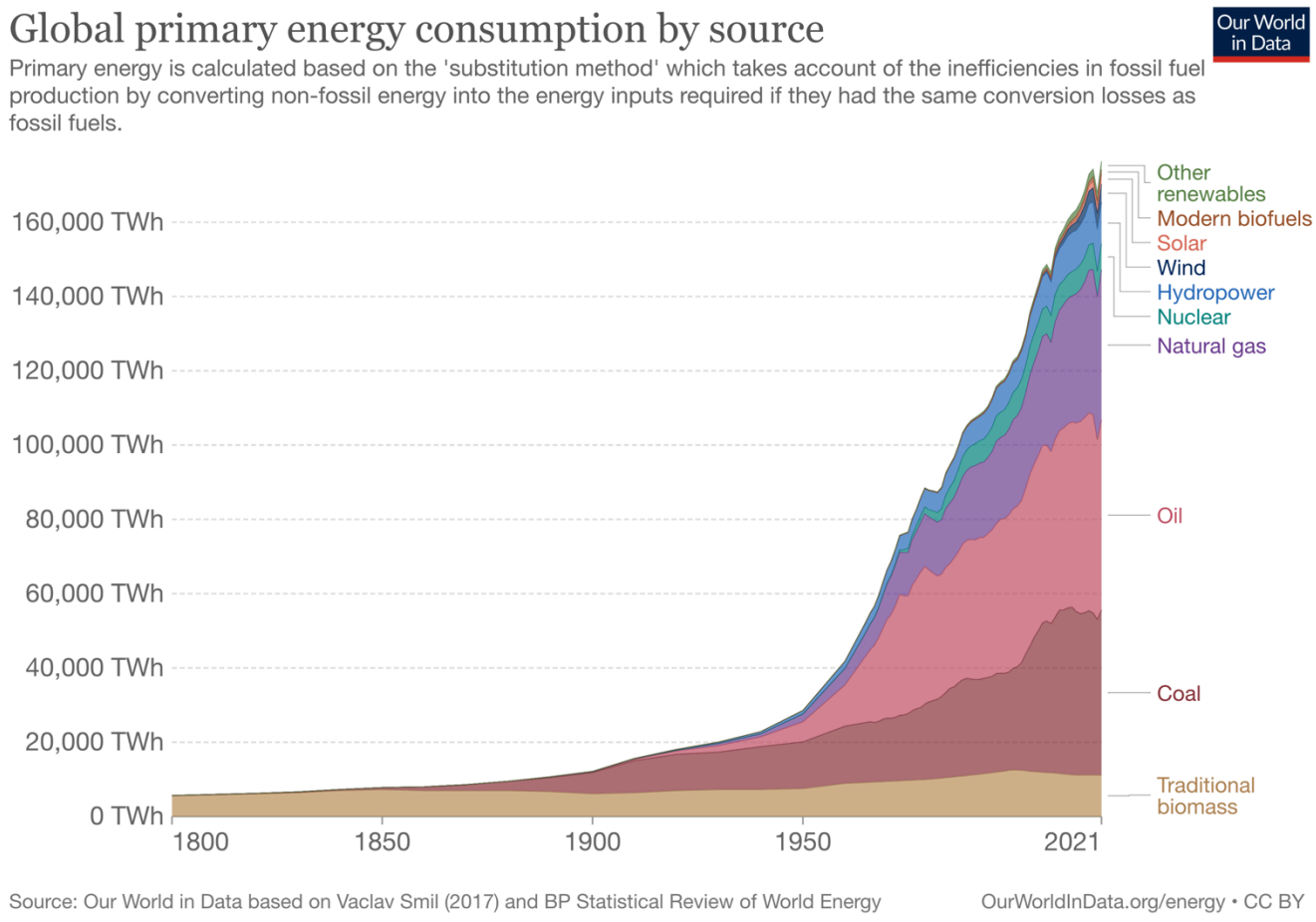
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Source 2: **1834 "Report of a Select Committee of the House of Commons on Steam Carriages"**
Citation: Richard G. Wilkinson, "The English Industrial Revolution," in *The Ends of the Earth*, edited by Donald Worster (Cambridge: Cambridge University Press, 1988), 90.

[It has been said that in Great Britain there are above a million of horses engaged in various ways in the transport of passengers and goods, and that to support each horse requires as much land as would upon an average support eight men. If this quantity of animal power were displaced by steam-engines, and the means of transport drawn from the bowels of the earth [coal], instead of being raised upon its surface [food for horses], then… as much land would become available for the support of human beings as would suffice for an additional population of eight millions; … The land which now supports horses for transport or turnpike roads would then support men, or produce corn for food, and the horses return to agricultural pursuits.	**Guiding Questions:** How does horsepower compare to steam power? What does this report say the benefits of coal use would be?

Source 3: **Global primary energy consumption by source. Chart**
Citation: Hannah Ritchie, Max Roser and Pablo Rosado (2022) – "Energy." Published online at: https://ourworldindata.org/energy

For the students: The energy system has transformed dramatically since the Industrial Revolution. We see this transformation of the global energy supply in the chart shown below which measures energy in terrawatt hours. The chart graphs global energy consumption from 1800 onwards.



Guiding Questions:

How did the use of fossil fuels change over time?

What types of fossil fuels were used during the Industrial Revolution?

Describe the changes of energy use over time.

Part 2: Energy Powers Technology

Source 4: **Technical Innovations. Secondary Source**
Citation: J.R. McNeill and William H. McNeill, *The Human Web: A Bird's-Eye View of World History,* New York: W.W. Norton and Company, 2003, page 232.

For the students: The ability of Britons to harness the power of fossil fuels allowed for the development of inventions that facilitated the use of these new power sources. As these inventions led to the increase of coal production, new technologies emerged that allowed people to better use coal and the steam that it generated. Read the excerpt below and answer the guiding questions.

Most coal seams were of no use to the iron industry because coal's impurities made iron brittle. But after 1709 this no longer mattered, because an ironmaster named Abraham Darby figured out that coke, a purer carbon derived from coal, served admirably. This resolved an energy bottleneck in iron production, allowing an expansion that could not have happened using the traditional fuel, charcoal. The second technical innovation came in the form of steam engines, which had existed in rudimentary forms in China and France as well as in England. The problem of draining water from coal mines inspired several advances in steam engine design, the most important one credited to the Scotsman James Watt in the 1770's. Where coal was almost free, at pitheads, coal-powered steam engines pumped out groundwater, which allowed miners to dig deeper and deeper. By 1800, Britain had about 2,000 steam engines, most of them employed pumping water out of coal mines. This made coal cheaper still…Mobile steam engines, on locomotives and ships, eventually became standard…This was the technological heart of the Industrial Revolution in Britain.	**Guiding Questions:** What inventions allowed for the expansion of coal mining? What inventions resulted from the expansion of coal mining?

Source 5: ***In the Nineteenth Century the Northumbrians Show the World What Can be Done with Iron and Coal*, by William Bell Scott. Oil painting on canvas, 1861.**

Citation: Wallington, The Trevelyan Collection (National Trust).
https://www.nationaltrustcollections.org.uk/object/584372

For the students: The painting depicts industry workers in one of the workshop in the Tyneside region of Great Britain. Look closely at the details of the painting. The artist visited a railway-engine works to see a locomotive wheel being forged which he depicted in the center of the painting. As a whole, the painting shows all industries of the region: a gun barrel and a shell, a locomotive wheel, barges carrying coal, a train crossing newly completed High Level bridge.



Guiding Questions:
Describe the types of technology that are represented in the image.

What is the girl in the left corner doing there?

Why do you think it was important for the artist to make the painting so busy with so many different industries?

Source 6. ***Rain, Steam, and Speed -The Great Western Railway*****, by J. M. W. Turner. Oil painting on canvas, 1844.**

Citation: The National Gallery, London.
https://www.nationalgallery.org.uk/paintings/joseph-mallord-william-turner-rain-steam-and-speed-the-great-western-railway

Video Source. Smarthistory
https://www.youtube.com/watch?v=pPsqUFuysbU watch until 2:11

For the students: The painting depicts the Maidenhead Railway Bridge (completed (1838) looking east towards London, across the River Thames between the cities of Taplow and Maidenhead. Watch the linked video about the painting and answer the questions below.



UCI History Project

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Guiding Questions:
Why was the train a symbol of the Industrial Revolution?

How did people ride on and use trains during the Industrial Revolution?

How did the train transform transportation of the period?

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Part 3: Energy, Population, and the Environment

Source 7: Growth of Manchester. Secondary Source
Citation: *Modern World History* textbook, 616-617

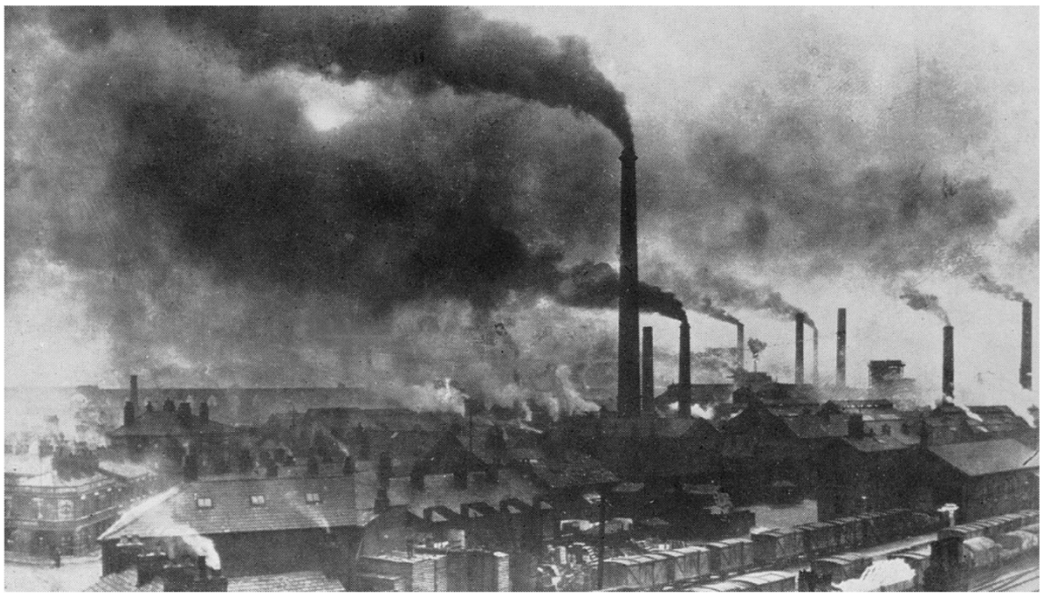
For the students: Industrialization, particularly large-scale factories powered by steam created from the burning of large amounts of coal, changed the face of cities all across the world in the nineteenth century. While coal-fired factories were engineering marvels and considerably increased efficiency and manufacturing output in a number of industries, coal-fired factories also produced a number of negative side effects as well. The sky lines, not to mention daily life, of many cities came to be dominated by coal-fired factories. More than that, the smoke that spilled out of the factories' smoke stacks resulted in nasty forms of air pollution that created health problems for those that worked in, or lived near, the factories. Read the sources below and answer the guiding questions keeping in mind our main question:
What were the effects of fossil fuel use during the Industrial Revolution?

The British market town of Manchester numbered 17,000 people in the 1750's. Within a few years, it exploded into a center of the textile industry. Its population soared to 40,000 by 1780 and 70,000 by 1801. Visitors described the "cloud of coal vapor" that polluted the air, the pounding noise of steam engines, and the filthy stench of its river. This growth of industry and rapid population growth dramatically changed the location and distribution of two resources—labor and people.	**Guiding Questions:** How did Manchester's population change during the Industrial Revolution? What were the consequences of fossil fuel use in Manchester?

Source 8: **Air pollution in Widnes, late 19th century. Photograph**

Citation: Hardie, D. W. F., A History of the Chemical Industry in Widnes, Imperial Chemical Industries Limited, 1950. https://ourworldindata.org/london-air-pollution#note-10

For the students: Many industrial cities across Great Britain (and other nations) experienced air pollution problems throughout the 19th century. In the photograph below, we see pollution in Widnes, an industrial town close to Liverpool, in the late 19th century.



Guiding questions:
Describe what you see in this photo.

What were the consequences of fossil fuel use in Windes?

Can you think of modern examples of extreme pollution?