Background: By the late eighteenth century many Chinese smoked imported opium, a drug derived from the poppy flower. This was the case despite the fact that the Qing imperial government had outlawed opium imports in 1729 and established the Canton trade system to restrict westerners (including traders) to the coastal region of Canton, rather than allow them access to the people and markets of the interior of China.

For centuries, western traders had come to China for its valuable goods, including spices, porcelain, and tea. Chinese tea rapidly gained popularity in Great Britain during the eighteenth century. Indeed, in 1751, China exported 2.7 million pounds of tea and by 1800 the British trading company – the East India Company – bought 23 million pounds of tea. Millions of British pounds went from Britain to China in the process. Because China bought much less from the British than the British bought from China, the British traders and government sought to find a way to make more money in China.

The answer seemed to be opium, which the British produced in India (then a colony of Britain). The British invested heavily in opium production in Patna, India, where they required Indian laborers to produce large quantities of opium balls and prepare them for shipment. During the 1830s the British shipped close to 6 million pounds of opium to China. It is estimated that close to one-quarter of Chinese government officials regularly consumed opium, including many in the Chinese military as well.

The Qing government strongly opposed further opium trade, however, as it understood the social consequences of widespread use and the economic disadvantage of the trade. The Qing government therefore tried to restrict opium imports, but the British government refused to accept the restriction and waged war. The Opium War of 1839 to 1842 ended in defeat for China. As a result, the British enforced a more open trading system, including access to new ports that were administered under European rather than Chinese law, and the annexation of Hong Kong.

The Chinese government continued to try to restrict the opium trade, which led to a second Opium War from 1856 to 1860 in which the French, Russians, and Americans came to the side of the British to force more open trade with China. British victory again led to additional open ports, greater freedom of movement for westerners within China, including permanent embassies in Beijing, and the legalization of the opium trade. The trade in opium only increased in the coming decades, reaching a peak in the 1880s.

Directions: Examine the following images and text. Read the images and words for what they tell you about the relationship between the natural resources and the economic and political developments that led to the Opium Wars.

“The War in China,” 1858. Image from Library of Congress: [https://www.loc.gov/item/2002715026/]
In the Stacking Room the balls are stacked before being packed in boxes for Calcutta en route to China. A number of boys are constantly engaged in stacking, turning, airing, and examining the balls. To clear them of mildew, moths or insects, they are rubbed with dried and crushed poppy petal dust.

In the Drying Room the balls are placed to dry before being stacked. Each ball is placed in a small earthenware cup. Men examine the balls, and puncture with a sharp style those in which gas, arising from fermentation, may be forming.

What does this image tell us about the importance of the opium trade to Great Britain, the demand for opium in China, and the social and environmental impact of the opium trade on India?
The Opium Fleet
Descending the Ganges en route to Calcutta, India

Note: The timber raft shown in the sketch has been floated down from the Nepal Forests, and was used in making packing-cases for the opium.

What does this image tell us about the presence of the British in the Indian economy during the era of the opium trade? How did the British and the Indian peoples rely upon the environment to sustain this trade?
The U.S. Annexation of Hawaii
A Classroom Activity

Students read historic newspapers gathered by the Library of Congress to learn why the United States wanted to bring Hawaii into the Union, how this was achieved, and how native Hawaiians responded to the actions of the United States.

Directions: Create three groups of students and assign one article to each group. While reading, students will take notes of the main points of each article, including who the author/speaker is and who the likely audience is; how is perspective/point of view important to understanding the tone and message; and what current or historic events are important to take note of, according to this article? After each group shares with the class, the whole class makes a timeline of events leading to annexation and analyzes the role of geography and natural resources in the actions of the United States. Finally, students use the example of Hawaii to explore the HSS Framework question: How did America’s role in the world change between the 1870s and 1910s?

- “Hawaii’s Ex-Queen Files a Protest,” 1897: https://www.loc.gov/item/92513972/
- “History Turns the Page on Which Hawaii’s Name is Written: Little Republic of the Pacific is of the Past” The San Francisco Call, August 23, 1898 http://chroniclingamerica.loc.gov/lccn/sn85066387/1898-08-23/ed-1/seq-7/

Directions: in pairs or groups of three, analyze the following quote from Queen Liliuokalani. Before you begin your discussion, first read the quote silently to yourself, circling any words you don’t understand or are unfamiliar with. Next, discuss those words with the others in your group; consult your teacher or a dictionary for any terms you’re still having trouble with. After clarifying unfamiliar terms, read through the quote again to answer the questions below as a group. Be prepared to share your group’s answers with the rest of the class.

“I, Liliuokalani of Hawaii, by the will of God, named heir apparent…do hereby protest against the ratification of a certain treaty…

I declare such treaty to be an act of wrong towards the native and part-native people of Hawaii…

Because [it] never received any such authority from the registered voters of Hawaii, but derives its assumed powers from the so-called Committee of Public Safety…largely [composed] of persons claiming American citizenship, and not one single Hawaiian.”

1. In the first sentence, Lilioukalani refers to herself in rather formal and long terms: “Lilioukalani of Hawaii, by the will of God, named heir apparent…” Why do you think that she wrote that all out? Why didn’t she just say, “I do hereby protest…?” What purpose did those extra words serve?

2. In the first sentence, Lilioukalani refers to a “certain treaty.” In the second sentence, she mentions “such treaty.” In the third sentence, the word “[it]” and “its” refers to the same treaty. What treaty is she referring to in all three of these sentences?

3. Underline the words “because,” “do hereby protest,” and “declare.” These words can give you a clue about the purpose of this quote. They signal to the reader two things: 1) that the author is making an argument, and 2) that the text that follow these signal words are the evidence to prove the author’s argument. Based upon these signals and your repeated reading of the text:

   a. What is Lilioukalani’s argument or thesis?

   b. What evidence does she provide for her argument?

   c. Is that evidence compelling? Why or why not?
The U.S. Annexation of the Philippines
A Classroom Activity

Students read the following primary sources from a debate in 1898 to learn about various perspectives held by people in the United States regarding the annexation of the Philippines.

**Directions**: as a class, read through the primary sources and determine where each source belongs - in the “in favor of” or “opposed to” annexation of the Philippines. After sorting, half of the class reads the reasons in favor, and the other half the reasons to oppose annexation. Each group creates a written statement, with evidence, to explain its position and then shares this with the class as a whole. Finally, discuss as a class why it seems the United States went forward with annexation, and what this says about America’s changing global role at the turn of the twentieth century.

**Document #5: Henry Watterson, newspaper editor, interviewed in The New York Herald, June 22, 1898**

“To surrender territory acquired by the outlay of so much blood and treasure would be a wanton and cowardly abandonment of obligations and opportunities literally heaven-sent....We cannot remand the Philippines to Spain, or commit them to a population incapable of self-government, to become a prey of Europe...
The traditional stay-at-home and mind-your-own-business policy laid down by [George] Washington was wise for a weak and struggling nation...But each of the centuries has its own tale of progress to tell....The United States from now on is destined to be a world power...
From a nation of shop-keepers we become a nation of warriors. We escape the menace and peril of socialism and agrarianism, as England has escaped them, by a policy of colonization and conquest...We risk Caesarism, certainly; but even Caesarism is preferable to anarchism...”

**Document #11: Charles Denby, U.S. Minister to China, "Shall We Keep the Philippines?" Forum, Sept. 1898**

“I recognize the existence of a national sentiment...against the acquisition of foreign territory; but...we have to compete with the commercial nations of the world in far-distant markets. Commerce, not politics, is king....There is a boundless future which will make the Pacific more important to us than the Atlantic....The possession [of the Philippines] gives us standing and influence. It gives us also valuable trade both in exports and imports....We are taking our proper rank among the nations of the world.”

**Document #12: Samuel Gompers, President of the American Federation of Labor, Dec. 1898**

“If the Philippines are annexed, what is to prevent the Chinese, the Negritos and the Malays coming to our country? If these new islands are to become ours,...can we hope to close the flood-gates of immigration from the hordes of Chinese and the semi-savage races coming from what will then be part of our own country?”

“Who can estimate in money and men the cost of subduing and keeping in subjection eight millions of people, six thousand miles away, scattered over 1200 islands, and living under a tropical sun?....

Let us consider for a moment the indirect cost of annexation. Grave domestic problems press for solution; can we afford to neglect them...to engage unnecessarily in controversies abroad?...Monopoly can thrive in security so long as the inquiry, ‘Who will haul down the flag?’ on distant islands turns public attention away from the question, who will uproot the trusts at home?’”


“I am not in sympathy with those...who would sacrifice our National honor and the high ideals of the Republic, and who would inflict upon our people the burdens of...militarism for a mere matter of dollars and cents...But I will, for argument's sake,...ask: Will it Pay?

Tropical countries like the Philippines may be field of profit for rich men who can hire others to work for them, but not for those who have to work for themselves....The profits of the trade with the islands...can never amount to the cost of making and maintaining the conquest of the Philippines...[and] many imperialists admit that...”

Document #23: Rev. Josiah Strong, Expansion, Sept. 1900

“Industrial expansion is an absolute necessity to competitive manufacturers...

Wu Ting-fing, Chinese Minister to the United States, said: ‘We all know that China is one of the greatest markets of the world, with a population of 400,000,000 that must be fed and clothed...She wants your wheat, your cotton, your iron and steel...It is a fine field for American industry to fill these wants.’

We [Americans] have become an Asiatic power, close to the Yellow Sea, and we find it easy to believe that ‘There’s a divinity that shapes our ends’.”


“It has been said that the Philippines will be to the United States what India is to England....Do people really know what India is to England? England in India stands today upon a volcano. She has to keep 60,000 British troops there to hold the people in subjection....There is scarcely a statesman of Britain who does not wish privately: ‘Would that we were safely out of India!’

India is the curse of Britain, and the Philippines will be the curse of the United States. If you teach suppressed people at all, you make them rebels. Education is fatal to the government of a superior race. The Declaration of Independence will make every ambitious Filipino a thoroughly dissatisfied subject.”

South Africa is located on the southern tip of Africa. Because of its location, Europeans valued it as a trading port. In the 16th century, European nations started exploring trade possibilities in South Africa, but European influence was minimal until the arrival of the Dutch in the 17th century.

Founded in 1602, the Dutch East India Company traded extensively with South Africa during the 17th century. It developed a trading base at the Cape of Good Hope. The Dutch dominated the slave trade in the early 17th century. The company gave land to its employees and brought slaves from tropical Africa to build roads and a military fort. It enclosed the land surrounding the Cape, at the expense of local African farmers. Within a decade, the Cape had become a large colony.

The presence of Dutch colonizers greatly influenced local South African groups. At first, indigenous groups befriended the traders, but they soon found themselves displaced from their homes by colonial expansion. One tribal group, the Khoikhoi, completely disappeared because of Dutch colonization. They lost their lands, and smallpox, a disease brought to the region by Dutch traders, ravaged their population. By 1713, the indigenous pastoral society around the Cape was declining due to disease.

British Colonization

The British captured the Cape from the Dutch in 1795. As a result, they gained control over many different peoples. The region was populated by tribal Africans and slaves who had been imported from tropical Africa. There were also a large number of Dutch farmers, called Afrikaners. Some Afrikaners were ranchers. As their numbers grew, they forced the tribal Africans off their lands. In many cases, Afrikaners made slaves of the indigenous Africans they had displaced.

At first, the British did not consider the region
valuable. They used it primarily as a stopping point between Great Britain and Asia. Until the late 1860s, South African exports included wine, wool, elephant ivory, and animal hides.

The British exercised indirect control over South Africa, making African chiefs into lesser imperial officials. However, the British presence greatly influenced those living in the region. The British attempted to conquer the surrounding African farm communities many times. In one instance, they set fire to the crops and villages of the Xhosa peoples. Although the Xhosa fought back, they could not defeat the British who had destroyed their crops and thus, their food supply. After making peace with the British, the Xhosa faced another calamity. A lethal cattle disease from Europe spread through their herds. Some villages lost more than 80% of their cattle, their most valuable possessions. The Xhosa believed that their misfortune was a punishment from their gods. In 1857, the Xhosa sacrificed many of their cattle. Historians estimate that they killed 400,000 animals. At least 40,000 Xhosa died of starvation as a result. By 1858, many had left their way of life to become laborers in other villages.

Afrikaners also saw the British as a threat to their way of life. To get away from British control, many Afrikaners migrated north and northeast in what became known as the Great Trek. Between 1836 and 1837, about 14,000 Afrikaners left British-controlled South Africa. They soon came into conflict with the Africans living in the north. The British did not want a war between Afrikaners and local tribal groups, believing that such a war could spread into British territory. As a result, the British allowed the Afrikaners to form two independent republics in northern South Africa. These republics were the Orange Free State and the South African Republic (Transvaal).

The Discovery of Minerals

Great Britain sought to increase its control over South Africa after two discoveries. In 1867, local miners discovered diamonds near the town of Kimberley. Larger diamond deposits existed deep below the surface of Earth. Mining for these diamonds required advanced technology. As a result, the British easily gained control over the mining business. They placed the diamond fields under their direct control in 1871. The British also conquered the Zulu Kingdom in 1879. The Zulu Kingdom had been the most powerful African state in South Africa until that time.

In 1886, prospector George Harrison discovered the Witwatersrand gold reef near the town of Johannesburg in the Afrikaner state of Transvaal. There, gold stretched for 40 miles. Similar to the diamond mines, industrial operations soon replaced individual miners. By 1890, the gold fields had completely transformed the region from a rural area to the economic hub of South Africa.

The Boer War, 1899–1902

British control over South Africa became unstable after the discovery of diamonds and gold. The diamond and gold mines were located
in the Transvaal region, a region controlled by the Afrikaners. In 1884, Germany gained control of the land next to the Transvaal on the coast of West South Africa. After the discovery of gold, Europeans flooded into the region. The British feared that Transvaal Afrikaners would join with the Europeans to overthrow British rule. As a result, they tried to keep the Transvaal region isolated from other European nations. They also attempted to force the Afrikaners to become part of the British Empire.

In 1895, the British government tried to overthrow the Transvaal government. Their attempt, called the Jameson Raid, was a complete failure, but it made Afrikaners aware of Britain’s goals. As a result, the Afrikaner states declared war on Great Britain in 1899. At first, the British lost many battles. However, in 1900 the British began to capture Afrikaner towns. The British put over 116,000 Afrikaner women and children into concentration camps where about 28,000 of them died from disease. The Afrikaners finally surrendered in 1902.

Even though two white European groups fought the war, it affected black Africans greatly. Under colonial rule, they could not carry weapons. Instead, they had to do labor for each side. Many dug trenches, collected firewood, drove wagons, and acted as guards and scouts. When the British captured Afrikaner farms, black Africans living there also ended up in concentration camps. In these camps, white prisoners received food, but
Africans had to grow their own food and build their own houses. By the end of the war, 107,344 black Africans were in the camps, and 14,154 of them had died.

**Lasting Effects of War**

The British government supported the war, but not all British citizens did. Many viewed the war as a fight for natural resources at the expense of ordinary citizens. Criticism over the war in South Africa led many to question British goals in other areas of the world. As a result, British citizens began to criticize the empire. The Boer War is considered Great Britain’s last “imperial” war.

After the war, Afrikaners gained more rights to South Africa’s resources. Great Britain had problems keeping South Africa under direct control. Then, Afrikaner leaders asked to join the British Empire. As a result, the British and Afrikaners joined territories to form the Union of South Africa in 1910. Great Britain gave this new nation the right of self-government.

Black Africans did not benefit from independence. Instead, the post-war peace increased racial segregation. Prior to the Boer War, Africans could not own mines, and the miners had to live in compounds outside the city. They had to carry passes wherever they went and were often searched. In the new nation, black Africans had no political rights, and they could not enter the city center without a pass. They were forced onto the worst lands. By 1904, skilled jobs were off-limits to black Africans. By denying good jobs to African workers, South Africa’s officials greatly increased the economic gap between blacks and whites in South Africa. In addition, by forcing the African majority to live and farm on poor soil, the South African government contributed to erosion and desertification in the region.
Questions about the South Africa Narrative
Lesson 5 | page 1 of 3

Instructions: Answer the following questions in the spaces provided.

The Dutch Traders
1. Why did the Europeans want to colonize South Africa? (3 points)

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

2. How did Europeans affect the native people in South Africa? (5 points)

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

British Colonization
3. Which two European countries wanted control over South Africa? (2 points)

________________________________________________________________________

4. What type of control did the British use, direct or indirect? How did they interact with the South African peoples? (5 points)

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

5. How did the Xhosa people respond to British control? (3 points)

________________________________________________________________________
________________________________________________________________________
6. How did the Afrikaners respond to British control? (5 points)

7. Where did miners first discover diamonds in South Africa? (2 points)

8. How did the discovery of diamonds and gold transform the region? (5 points)

9. What were the intent and the result of the Jameson Raid? (5 points)

10. What was the outcome of the Boer War? (5 points)
Name: _________________________________

Lasting Effects of War
11. Who ultimately gained control of the land and resources of South Africa? (2 points)

________________________________________________________________________________________
________________________________________________________________________________________
________________________________________________________________________________________
________________________________________________________________________________________

12. How did the Boer War and imperialism affect the native African peoples and their control of natural resources? (5 points)

________________________________________________________________________________________
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Answer Key and Sample Answers

Evaluating the Need for Natural Resources in Industrial Economies
Lesson 2 | page 1 of 5

Name: _________________________________

Background
The Industrial Revolution greatly increased the need for natural resources. As countries expanded their economies and modernized their infrastructures, they required more raw materials. Limited natural resources at home motivated industrial powers such as the United States, Japan, and many European nations to look elsewhere to get the materials needed to industrialize. Industrialization included such tasks as manufacturing goods, building factories, railways, and ships, and constructing communication lines. Additionally, industrialization led to urbanization as increasing numbers of workers moved to cities where there were factories and work.

Most of the natural resources discussed in this lesson are ecosystem goods. These materials are essential to people because they provide such necessary items as food and fuel. Ecosystem goods are made possible by ecosystem services, which are natural processes that support or produce the goods that help sustain human life, economies, and cultures. Without ecosystem services like pollination and the water cycle, people would not have the natural resources needed for their survival.

Industrializing nations desired specific ecosystem goods to satisfy their growing populations' needs and to promote economic growth. Each of these goods depended in turn on specific ecosystem services. Natural resources were needed to:

1. Provide fuel to run industrial machines
   - ecosystem goods desired: coal, wood
   - related ecosystem services: pest and disease control, water cycle, decomposition

2. Provide raw materials for manufacturing
   - ecosystem goods desired: wood, latex (natural rubber), cotton, palm oil, iron ore
   - related ecosystem services: nutrient cycling, maintenance of diverse varieties of plants, water cycle

3. Provide food for growing populations in imperial countries
   - ecosystem goods desired: wheat (grains), tea, cacao, coffee, sugar
   - related ecosystem services: nutrient cycling, pest and disease control, seed dispersal, water cycle

4. Provide medicinal remedies for epidemic diseases
   - ecosystem goods desired: quinine (medicinal plants)
   - related ecosystem services: water cycle, nutrient cycling, maintenance of diverse varieties of plants, carbon sequestration

5. Provide a “laboratory” for scientific exploration (tropical medicine, map making, forestry, agriculture, geology, botany, zoology)
   - ecosystem goods desired: plants, soils, animals
   - related ecosystem services: water cycle, nutrient cycling, maintenance of diverse varieties of plants, pest and disease control

Natural resources became the primary need of the industrial nations. Access to such resources, ecosystem goods, and ecosystem services, then, became a necessary part of industrialization.
Answer Key and Sample Answers

Evaluating the Need for Natural Resources in Industrial Economies
Lesson 2  |  page 2 of 5

Name: ____________________________________________

Making a Chain

Instructions: Your group has a stack of cards. There are four categories of cards: industrialization cards, ecosystem goods cards, ecosystem services cards, and potential problems cards. Your task is to show relationships between industrialization, the environment, and challenges that might arise because of increased industrialization.

Follow these steps in order to demonstrate the relationships:
1. Separate your cards by category.
2. Read through the cards and discuss the ways in which some of them are related.
3. Make a “chain” by placing the cards next to each other to show the relationship between three or more of the cards.
4. On your worksheet, record the chain that your group creates by writing the title of each card.
5. Place arrows between each title. Underneath the chain, briefly describe the relationship between the cards.
6. Repeat until you create three chains. You may use the same card for more than one chain, and you do not have to use a card from each category for each chain.

For example, you might choose to link the following:

Example 1

Telegraph networks → copper → transportation networks

Explanation: Telegraph networks require copper because of its ability to conduct electricity, which requires a transportation network to access the copper mines in Africa.
Evaluating the Need for Natural Resources in Industrial Economies
Lesson 2 | page 3 of 5

Answer Key and Sample Answers

Example 2

Cotton → large-scale irrigation → desertification and salinization → carbon sequestration

Ecosystem Goods: Cotton
- Cotton was a catalyst for the Industrial Revolution in Britain.
- Mechanized cotton spinning and weaving increased the need for raw cotton.
- Britain’s need for access to Indian and African markets to sell cotton influenced its role as an imperial sea power and led to colonization efforts in both regions.
- Cotton cultivation requires temperate climates and well-distributed rainfall. Where these conditions do not exist, irrigation is required.

Industrialization: Large-Scale Irrigation
- Irrigation is the artificial supply of water to crops, such as cotton.
- By the end of the 19th century, large-scale irrigation projects were completed that tripled the area irrigated by the Indus River in India.

Challenges: Desertification and Salinization
- Desertification (derived from the word "desert") is the degradation of dry land. This process is caused by climatic factors and human activities, including over-cultivation, water diversion practices, overgrazing, deforestation, and poor irrigation practices.
- Salinization is the buildup of mineral salts in soil. In excess, salts can become toxic to plant life. Salinization can also result from poor irrigation practices and other human activities. Salinization can make the soil infertile because plants cannot cope with the high levels of salt in the soil.

Ecosystem Services: Carbon Sequestration
- Carbon sequestration is the process in which carbon in Earth’s atmosphere is absorbed and stored in forests, soil, and the ocean.
- Oceans, forests, and soil “clean” Earth’s atmosphere of extra carbon. Scientists therefore call these systems carbon “sinks.”
- Deforestation and desertification can reduce the effectiveness of carbon “sinks.”
- Fossil fuel-based industrialization has produced a surplus of carbon dioxide in Earth’s atmosphere, contributing to global warming.

Chains of Causality
Please list your group’s three chains following the examples above. (5 points each chain)

Chain #1: Urbanization → Coal → Air and Water Pollution

Explanation: Urbanization leads to increased demands for coal, which can lead to air and water pollution.
Evaluating the Need for Natural Resources in Industrial Economics

Name: ____________________________________________

Chain #2: Maintenance of Biodiversity → Medicinal Plants → Urbanization → Disease

Explanation: Maintenance of biodiversity can lead to the natural growth of medicinal plants. Medicinal plants are needed to provide ingredients for medicines that treat human illness. As urbanization increases, people come into contact with more people, and disease can spread, which means more medicinal plants will be needed.

Chain #3: Coal → Transportation Networks → Air and Water Pollution → Carbon Sequestration

Explanation: Coal is burned in steam engines that power transportation networks. The burning of coal causes air and water pollution, and releases carbon dioxide. Some carbon dioxide can be regulated by carbon sequestration.

Instructions: Read and respond to the following questions. (5 points each)
1. How do ecosystem services and ecosystem goods work together to produce resources that people need?
   Ecosystem services create a healthy environment in which many ecosystem goods are available.
2. Why did industrializing nations seek natural resources in other countries?

*Industrializing nations sought natural resources in other countries because they either did not have the desired natural resources, were exhausting their supply of desired natural resources, or allocated the land to uses other than harvesting the desired natural resources.*

3. Why do you think providing medicines for diseases is considered a major role of natural resources in fueling industrialization?

*Industrial nations had booming populations living in crowded conditions and so they were always under threat of epidemic disease. Without the right medicines from natural resources, disease would have wiped out much of the population in the industrializing nations, slowing their growth.*

4. Explain the relationship between industrialization and ecosystem goods and services that you discovered in your group activity.

*Industrialization relies heavily on natural resources to succeed. Ecosystem goods depend heavily on ecosystem services to help produce the necessary natural resources. Increased extraction of natural resources for use in industrialization can diminish the effectiveness of ecosystem services and create problems that lead to fewer natural resources.*
Ecosystem Goods: Coal
- Coal was used in smelting iron ore to make steel, an essential ingredient for industries like shipbuilding and railways.
- Coal is a fossil fuel—meaning that it is formed by natural processes over a long period of time. Coal is considered nonrenewable because it takes such a long time for nature to make more.
- Coal mining increased a hundredfold during the 19th century. Coal was primarily used in steam-powered ships and railroad engines.
- Burning coal often causes air pollution.
- Burning coal releases carbon dioxide into Earth’s atmosphere and can increase the rate of global warming and lead to global climate change.

Ecosystem Goods: Wood
- By the end of the 18th century, coal replaced wood as the primary fuel for iron smelting. Iron and steel replaced wood as main building materials.
- The use of paper products, such as newspaper, books, and toilet paper greatly increased as a result of the Industrial Revolution.
- Urbanization led to more demand for wood for the construction of homes and to make paper products.
- Machinery made from iron and powered by coal (such as steamboats and railroads) increased access to forests. This revolutionized transportation of timber to manufacturing centers and the delivery of finished products to markets.

Ecosystem Goods: Cotton
- Cotton was a catalyst for the Industrial Revolution in Britain.
- Mechanized cotton spinning and weaving increased the amount of cloth that could be produced. This increased the need for raw cotton.
- Britain’s need for access to Indian and African markets to sell cotton fabric influenced its role as an imperial sea power and led to colonization efforts in both regions.
- Cotton cultivation requires temperate climates and well-distributed rainfall. Where these conditions do not exist, irrigation is required.

Ecosystem Goods: Copper
- The use of electrical power in the 1880s increased demand for copper. It is an excellent conductor of electricity and is a logical element to use in power lines.
- Copper smelting techniques used into the 20th century released sulfur into the atmosphere. This created “copper smoke” that damaged crops and animals.
- Groundwater flowing through abandoned copper mines can become tainted with acid. This can affect animal and plant life that comes in contact with the water. It also affects water quality in underground reserves.
- The Second Industrial Revolution made European and U.S. factories reliant on copper, which was not available locally in Europe.
Ecosystem Goods: Medicinal Plants

- Medicinal plants are used to treat human illnesses.
- About half of all prescriptions in the United States and Europe contain at least one ingredient derived from plants.
- Deforestation dramatically reduces the varieties of plants in a specific area. It can directly eliminate medicinal plants, some of which might not have been catalogued yet.
- Quinine comes from the bark of the *Cinchona* tree from tropical South America. It was an important treatment for malaria when European countries colonized Africa in the 19th century.

Industrialization: Large-Scale Irrigation

- Irrigation is the artificial supply of water to crops, such as cotton.
- By the end of the 20th century, 40% of food worldwide was watered by irrigation.
- Nineteenth-century irrigation was the first to use large-scale dams and irrigation canals.
- Between 1870 and 1900, the British tripled the area irrigated by the Indus River in India.
- Industrial irrigation can lead to the buildup of salts in the soil to damaging levels, a process called salinization. This can result in degraded soils and reduced agricultural productivity.

Industrialization: Electricity

- Electricity was a new source of cheap energy in the 19th century.
- Prior to the use of electricity, factories needed to be near running water. With electricity, manufacturers no longer had to be close to an energy source.
- The transport of electrical power long distances required power lines made of copper.

Industrialization: Transportation Networks

- Steamships, railways, and telegraph networks increased the movement of people, goods, and money all over the world.
- Railways and rivers allowed trains and steamships to break into the interior regions of Africa, Asia, and Latin America. This made natural resources in the colonies more available to imperial powers.
**Industrialization Links**

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**Industrialization: Telegraph Networks**
- The telegraph was a revolutionary way to communicate over long distances.
- Telegraph lines were often built next to railway lines for ease of construction.
- A telegraph cable was used successfully in the mid-19th century to relay messages between North America and Europe.
- The cable required copper, hemp, iron, and a natural latex from a tropical tree native to Southeast Asia.
- The telegraph was used throughout the industrial nations; use extended to some of the colonies as well.

**Industrialization: Urbanization**
- Urbanization is the process in which increasing numbers of people live in cities rather than rural areas.
- The Industrial Revolution required increased human labor, so people migrated from farms to cities throughout northern Europe.
- Technological advances in the cotton and iron industries contributed to urbanization in Europe.
- By 1900, 80% of Britain's population, 60% of Germany's population, and 50% of the U.S. population lived in cities.
- Urbanization increases human pressures on the local environment, such as air and water pollution.
- Today, more than 50% of the world's 6 billion people live in cities.

**Challenges: Air and Water Pollution**
- Nineteenth century industrialization produced record amounts of air pollution from burning coal in textile mills and steel plants.
- In the 20th and 21st centuries, air pollution is closely associated with urbanization because of the high use of automobiles in cities.
- Severe air pollution can make some environments too toxic to support vegetation.
- Water pollution in the 19th century was largely the product of natural resource exploitation, industrialization, urbanization, and agriculture.

**Challenges: Deforestation**
- Deforestation is the process of clearing an area of trees.
- Although the deforestation of tropical regions is a large problem today, most of the world's deforestation took place before 1950.
- In tropical forests, harvesting tree crops like the rubber tree (used to tap latex to make rubber products) eventually led people to clear the land and replace the original forest with plantation crops such as sugar and coffee.
- In southeast and southeastern Asia between 1860 and 1950, 278,000 square kilometers (approximately 273 square miles) of forests were destroyed for cropland.
### Challenges: Desertification and Salinization

- Desertification (derived from the word “desert”) is the degradation of dry land. This problem can be caused by climatic factors and human activities. These activities include over-cultivation, water diversion practices, overgrazing, deforestation, and poor irrigation.
- Salinization is the buildup of mineral salts in soil. In excess, salts can become toxic to plant life. Salinization happens naturally but can also result from poor irrigation practices and other human activities.
- Salinization can make the soil infertile because plants cannot cope with the high levels of salt in the soil.

### Challenges: Disease

- Urbanization in the 19th century brought with it crowd-related disease problems.
- Irrigation techniques can also create breeding grounds for disease-carrying organisms.
- Malaria is transmitted by mosquitoes. The use of quinine to treat malaria greatly reduced the impact of the disease on humans in the 19th century.

### Challenges: Global Climate Change

- Global climate change refers to long-term changes in weather patterns, most recently resulting from increases in Earth’s average temperature (global warming).
- Most scientists believe that Earth’s climate is changing due to human actions such as burning fossil fuels (for example, coal), which is accelerating the natural process of global warming.
- Global warming can result in flooding, severe droughts, and storms. It can also affect agricultural production as well as threaten human populations in the path of extreme weather events.
- Population growth, and thus the increased consumption of resources like fossil fuels, has contributed to global warming.

### Ecosystem Services: Carbon Sequestration

- Carbon sequestration is the process in which carbon in Earth’s atmosphere is absorbed and stored in forests, soil, and the ocean.
- Oceans, forests, and soil “clean” Earth’s atmosphere of extra carbon. Scientists therefore call these systems carbon “sinks.”
- Deforestation and desertification can reduce the effectiveness of carbon “sinks.”
- Naturally occurring carbon storage can reduce greenhouse gases that contribute to global warming.
- Fossil fuel-based industrialization has produced a surplus of carbon dioxide in Earth’s atmosphere, contributing to global warming.
Ecosystem Services: Nutrient Dispersal and Cycling
- Nutrient cycling is the process whereby nutrients, such as carbon and nitrogen are recycled within a natural system.
- Soil, for example, recycles and retains nutrients from decomposition and makes them available for plant growth.
- Soil takes hundreds of years to build up this fertility and only a few years to lose it.

Ecosystem Services: Pest and Disease Control
- Pests compete with humans for food, timber, and cotton and other fibers. Pests include insects, rodents, viruses, and fungi, among other organisms.
- Perhaps 99% of potential crop pests are controlled by natural enemies, such as birds, ladybugs, fungi, and other types of organisms.
- Monoculture, or the planting of a single crop over a large area, can reduce the controlling effects of natural pest enemies. Thus, humans have tried to control pests artificially through the use of pesticides. These pesticides can accumulate in water, soil, and the air, where they can threaten human and animal health.

Ecosystem Services: Maintenance of Biodiversity
- Biodiversity is a measure of the variety of life forms within a given natural system.
- The tropical regions and Africa and Latin America are the most biologically diverse places in the world. They have therefore attracted the attention of outsiders for centuries.
- Many goods, such as natural rubber, spices, Cinchona and other medicinal plants, woods, and fibers are found in tropical regions.

Ecosystem Services: Mitigation of Floods and Droughts
- Most rainwater is soaked up by soils and gradually distributed to plants and waterways (for example, streams, rivers, lakes).
- The roots of plants and trees hold the soil in place and shield it from the harmful effects of flooding, such as erosion.
- When the land is cleared of vegetation, rain turns soil to mud that “clogs” drainage, leading to erosion.
- Vegetation acts as a giant pump, returning water from the ground to the atmosphere.
- Erosion can damage natural and human-made waterways (for example, irrigation systems) and can disrupt nutrient cycling and dispersal.