

1 OBSERVING EARTH'S RESOURCES

INVESTIGATION

Humans use a lot of materials found naturally on Earth. There are many materials, including metals such as copper and woods such as pine. Materials that are found on Earth and used by people are known as **natural resources**. Some of these resources are **renewable**, meaning that they are not used up or can be replaced. For example, wood is a renewable resource since more trees can be planted to replace those that are cut down. **Nonrenewable** resources, however, cannot be replaced after being used. Oil, which takes millions of years to form, is a nonrenewable resource.

<1.01 Place art here: IAES Unit B Act 12 page B4 rock quarry>

Art caption: Natural resources such as rocks are mined in rock quarries (KWOR-eez) like this one.

GUIDING QUESTION

What do natural resources look like?

MATERIALS

For each group of four students

- 1 copper strip
- 1 rock containing fossils
- 1 sample of oil shale
- 1 vial of freshwater
- 1 sample of wood

For each pair of students

- 1 magnifying lens
- 1 metric ruler

For each student

- 1 Student Sheet 1.1, “Resource Observations”

PROCEDURE

1. Using the magnifying lens and ruler, work with your partner to carefully examine one of the natural resource samples.

<1.02 Place art here: art from IAES Unit B Act 17 page B26>

2. Record your observations about the sample on Student Sheet 1.1, “Resource Observations.”
3. Repeat Step 1 until you have examined all five natural resource samples.
4. Discuss with your group how valuable you think each sample is and what you think makes it more or less valuable. Remember to listen to and consider the ideas of other members of your

group. If you disagree with others in your group, explain why you disagree.

5. In your table, rank each of the five natural resources with 1 = most valuable and 5 = least valuable. *Note:* You do not need to agree with the other members of your group.
6. Complete the table by writing down why you decided to rank the samples as you did. Be sure to list at least one reason for each sample.
7. Discuss your rankings with the other members of your group. Explain why you ranked each sample as you did.
8. Share your rankings with your class.

ANALYSIS

1. Think about the natural resources you examined.
 - a. What was the most valuable natural resource, according to the class?
 - b. What was the least valuable natural resource, according to the class?
 - c. What reasons did other students have for identifying a natural resource as more or less valuable?
2. What else would you like to know about these natural resources to help you determine their value?
3. Copy the list of words shown below:
oil
natural resource
salt
air
plastic
 - a. Look for a relationship between these words. Cross out the word or phrase that does not belong.
 - b. Circle the word or phrase that includes all the other words.
 - c. Explain how the word or phrase you circled is related to the other words in the list.
4. **Reflection:** What do you think makes a natural resource valuable?

EXTENSION

Do you want to see more natural resources? Bring in any natural resources you may have collected to share with your class, or go the *SEPUP Third Edition Earth's Resources* page of the SEPUP website at www.sepuplhs.org/middle/third-edition to link to sites with photos of more natural resources.

2 WORLD RESOURCE CONSUMPTION

READING

In the past, people treasured natural resources that are not very valuable today. For example, salt was once so valuable that Roman soldiers were paid with it instead of money! Many valuable natural resources were formed in the earth over thousands if not millions of years and are nonrenewable. Because people have been using resources for millennia, most of the easy-to-find, historically valuable natural resources have been collected already.

<2.01 Place art here: photo from IAES Unit B Act 13 page B7)

Art caption: Gemstones used in making jewelry, even these colorful diamonds, come out of the ground looking a lot like other rocks found in the ground. Each pair shown here consists of a rough diamond and a polished diamond of the same color. Gemstones such as diamonds are then cut and polished until they are shiny and beautiful.

GUIDING QUESTION

How has an increase in human population affected resource consumption?

MATERIALS

For each student

- 1 Student Sheet 2.1, “My Ideas about Resource Use”
- 1 Student Sheet 2.2, “Three-level Reading Guide: Population and Consumption”

READING

Use Student Sheet 2.1, “My Ideas about Resource Use,” to prepare you for the following reading. Then use Student Sheet 2.2, “Three-level Reading Guide: Population and Consumption,” to guide you as you complete the reading.

You may have heard the word *consume* being used for things that people buy, like televisions or phones. **Consumption** is the purchase or use of things, including natural resources. This activity explores how people consume three valuable resources—copper, petroleum, and freshwater—and how human population growth has affected their consumption.

CONSUMPTION OF COPPER

You observed and described samples of natural resources in the previous activity. What did they look like? How did they feel? The characteristics that make a resource unique are called **properties**. Metals, and in particular copper, are good conductors of electricity and heat. This makes them very useful for products that conduct electricity. Natural resources such as copper are typically consumed in the form of a product or parts in a product. Copper is often made into copper wire and copper tubing. These are then used in household appliances, home construction, and electronics, such as cell phones and televisions.

<2.02 Place art here: Photo of native copper and copper wire

Art caption:

Copper is a nonrenewable resource that is extracted from the earth through mining. It is also one of the most recycled metals; approximately 1/3 of copper consumed is from recycled copper. To gather new copper, people usually have to dig into the surface of the earth. In some cases, they remove large pieces of rock and break them into smaller pieces. This process is known as **mining**. Until the year 2000, the United States was the world's largest copper producer. The Bingham Canyon copper mine in Utah has produced more than 12 million tons of copper. This open-pit mine is more than 4 kilometers (km) (2.5 miles) across at the top and 800 meters (m) (0.5 mile) deep, and is visible from space.

<2.03 Place art here: Photo of Bingham Canyon copper mine>

Art caption: Utah's Bingham Canyon copper mine

Today, the largest producer of copper is Chile, followed by China, Peru, and the United States. Not every country produces copper because copper is not distributed evenly around the world. You can see copper **deposits**—areas containing significant amounts of a resource—in the map **below**.

<2.04 Place art here: map of global copper deposits similar to one shown below from usgs. Do not want different symbols for different types of copper: one symbol only. Would also help to have countries outlined and labeled: US, Chile, Peru and China >

Art caption: Global copper deposits



CONSUMPTION OF PETROLEUM

Another important use of natural resources is for energy production. Energy from natural resources is used to produce electricity, fuel cars, heat homes, and run factories. Natural resources used for energy can be renewable or nonrenewable. Renewable energy sources include sunlight, wind, and biofuels, such as ethanol made from corn. Nonrenewable energy sources include petroleum, coal, and natural gas. Together, they are known as **fossil fuels** because they formed from the remains of marine plants and

animals over millions of years.

<2.05 Place art here: Photo of (a) solar cells on a roof (b) a wind farm (c) oil well on the ocean

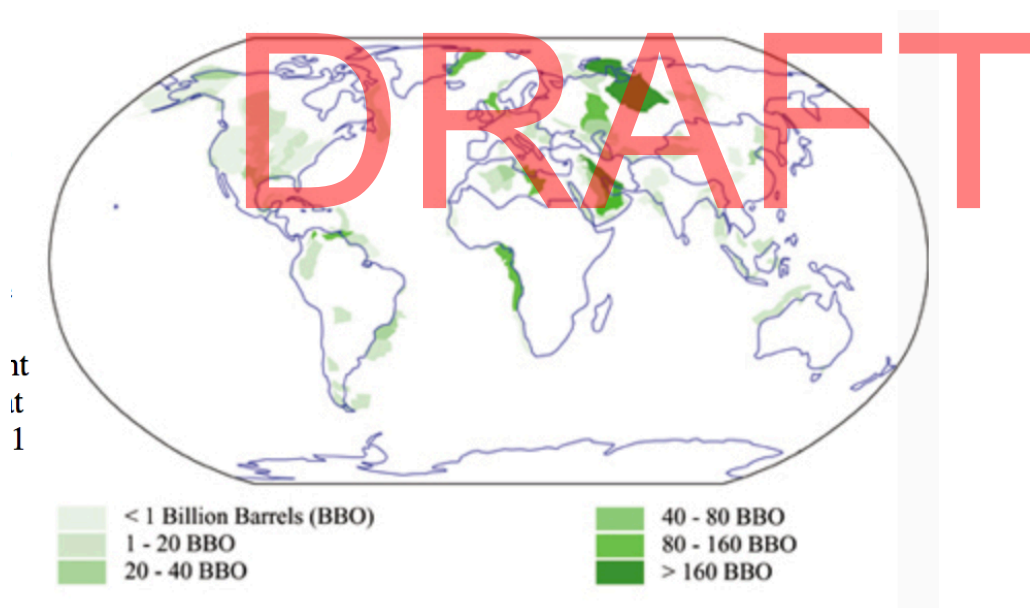
Art caption: Solar cells and wind turbines use renewable energy sources to create electricity. Modern oil wells, which drill for nonrenewable energy, can be built on land or water.

Petroleum, also known as oil or crude oil, is a liquid found underground. It is extracted by drilling oil wells. The first oil wells were relatively shallow, but over time, people have had to go deeper. Modern oil wells are almost 2 km (over 1 mile) below the surface. Almost 80% of petroleum is refined into gasoline, jet fuel, and other fuels used to power transportation and heat buildings.

While the Middle East is the top oil-producing region of the world, Saudi Arabia, the United States, Russia, and China are the countries that produce the most oil. Not all of these countries are extracting only petroleum. Oil shale, the rock that you examined in the previous activity, can be processed to make a petroleum substitute known as shale oil. The United States has large deposits of oil shale and tar sands, which are only just beginning to be extracted. This is because it is more difficult and expensive to extract these resources than petroleum. As demand for oil increases, it becomes more realistic to gather oil from these sources.

<2.06 Place art here: map of global petroleum estimates similar to one shown below. Would also help to have following countries outlined and labeled: Saudi Arabia, US, Russia, and China

Art caption: Estimated global petroleum deposits



CONSUMPTION OF FRESHWATER

Natural resources like water may seem inexhaustible because they are all around us. However, providing all of the world's population with freshwater is not as simple as it may seem. If you took all of the water at or just below Earth's surface and poured it into a container, about 97% of it would be saltwater from oceans, seas, and salt lakes. The other 3% would be all of Earth's freshwater, including water frozen in ice sheets, icebergs, groundwater, and water vapor in the air. The surface water in lakes, rivers, and streams makes up only 0.03%. This makes the freshwater that people use for drinking, bathing, and washing an important natural resource.

<2.07 Place art here: art from IAES Unit E Act 62 page E59)

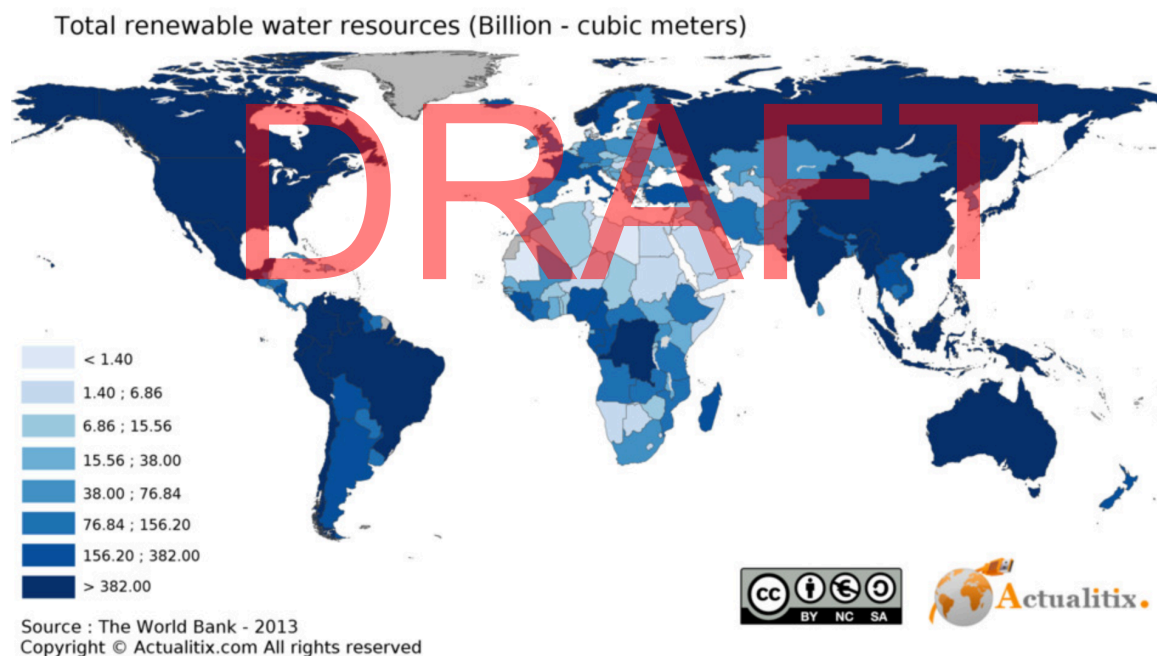
Art caption: World's freshwater

Freshwater is essential to producing food. In most of the world, over 70% of freshwater is used for agriculture. Some of the irrigated crops are for human consumption, whereas other crops are used to feed livestock. Freshwater is also used to make products like clothing. On average, it takes 2,700 liters (L) (713 gallons) of freshwater to make one cotton shirt and 9,800 L (2,600 gallons) to make one pair of blue jeans. Growing cotton on farms uses most of that water; a smaller amount is used in the factories that make the clothes.

Brazil, Russia, the United States, and Canada are countries with a lot of freshwater resources. Although water is a renewable resource, it is not distributed evenly over Earth's surface. Some areas have large reservoirs of freshwater, such as the Great Lakes in the United States. Other areas, like Brazil, receive high levels of precipitation in the form of rain or snow. Parts of the world that have large populations but do not have these freshwater resources often face severe water shortages.

<2.08 Place art here: map of global water similar to one shown below. Would also help to have following countries labeled: Brazil, Russia, United States, and Canada

Art caption: Global Freshwater Resources



CONSUMPTION AND WORLD POPULATION GROWTH

The consumption of natural resources is increasing as the world's population increases. In 1800, the world's population was approximately 1 billion people. By 1900, it had almost doubled to 1.9 billion people. The population of the world today is close to 8 billion people, almost four times what it was over 100 years ago. The United Nations estimates it will be over 11 billion people by the year 2100. You can observe this growth in the graph "World Population Growth over Time."

<2.02 Place art here: world population growth over time graph from at least 1900 to the present>

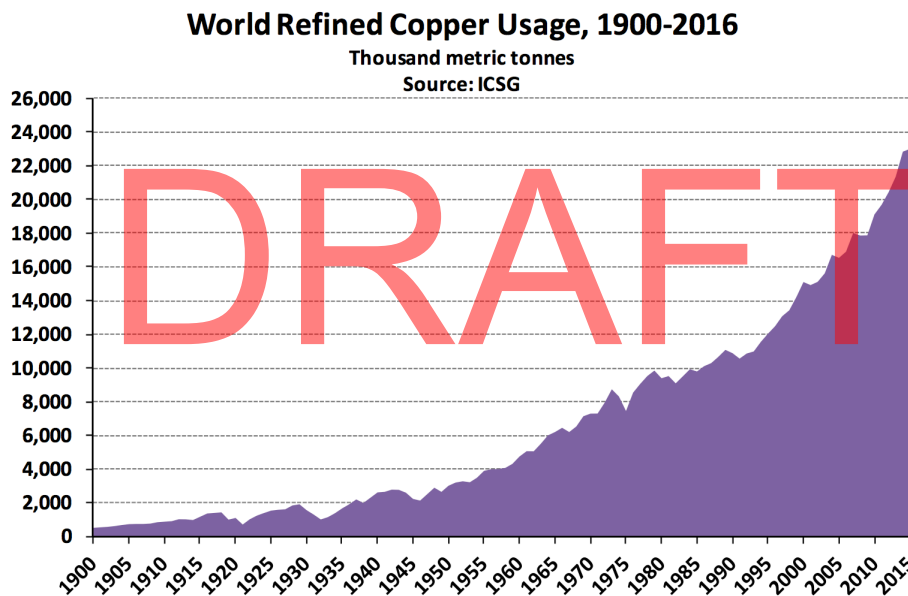
Art caption: World population growth over time

Natural resource extraction—including metals and fossil fuels—more than tripled from 1970 to 2010, from 22 billion tons to 70 billion tons. This is in part because standards of food, clothing, shelter, and recreation have improved for growing numbers of people. There has been a rise in the consumption of goods such as cars, with a resulting increase in the burning of fossil fuels. You can see these trends in the consumption of copper, petroleum, and freshwater in the graphs [on the opposite page](#).

This increase in consumption has resulted in both deliberate and unintended environmental changes, including the damming of rivers, larger areas of cropland, increased soil erosion, a loss of forested land, and an increase in some gases, such as carbon dioxide. As the number of people continues to grow, there will likely be further effects on Earth's air, land, and water.

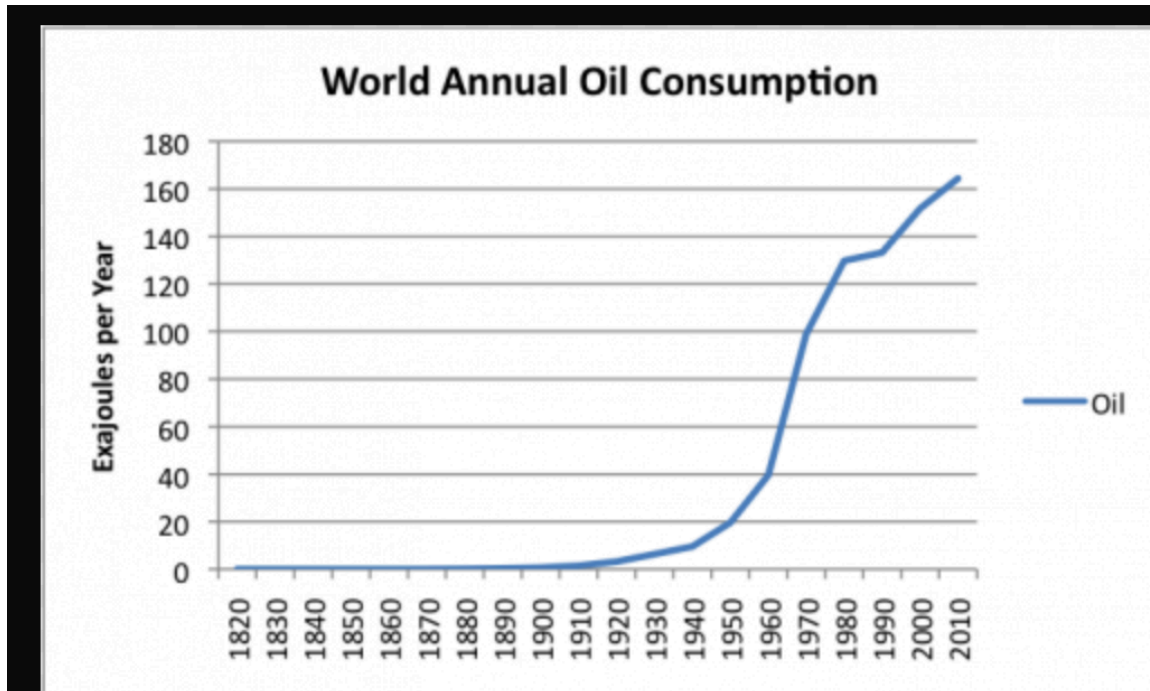
Natural Resource Use over Time

Global Copper Consumption, 1900–2016



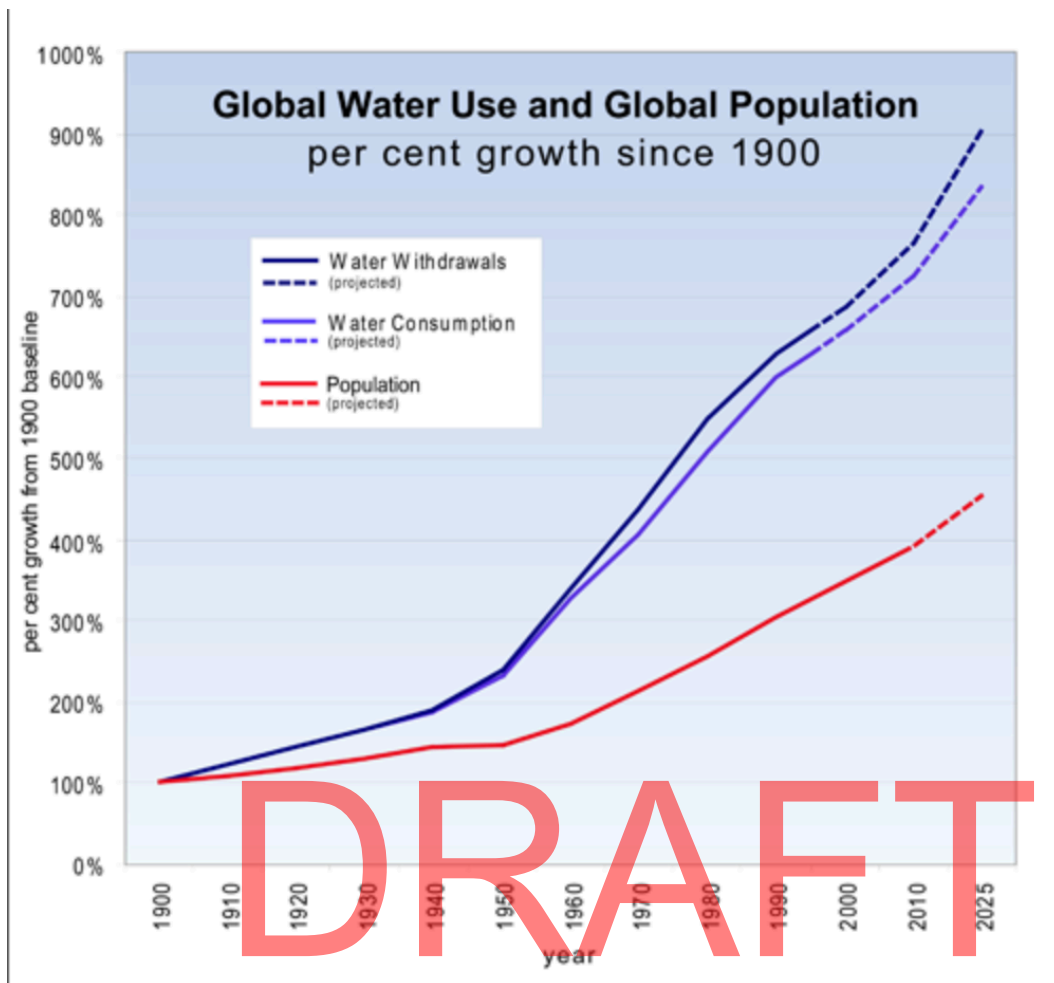
Since 1900, apparent usage for refined copper has increased from less than 500 thousand tonnes to 23.5 million metric tonnes in 2016 as usage over the period grew by a compound annual growth rate of 3.4% per year.

Global Oil Consumption, 1900–2016



Global Freshwater Consumption, 1900-2016

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ANALYSIS

1. Create a concept map.
 - a. Use the following 10 words:

water	deposits
mining	renewable
petroleum	consumption
copper	nonrenewable
population	natural resources
 - b. Add at least five more words related to natural resources to your concept map. Choose words that show what you now know about natural resources.
2. As a class, brainstorm a list of natural resources. Copy the list in your science notebook.
 - a. Which three resources do you think are the most valuable? Explain your answer.
 - b. What properties make a natural resource valuable? Explain your reasoning.

3. Examine the graphs of world population growth, global copper consumption, global petroleum consumption, and global freshwater consumption.
 - a. Based on the trend in the graphs, what do you predict will happen to the consumption of each of the following resources in the future:
 - metal ores such as copper
 - energy resources such as petroleum
 - freshwater
 - b. Support your answer with evidence from this activity. **Evidence** is information that supports or refutes a claim.
4. What actions could people take to change this trend in resource consumption?
5. Examine the maps showing the global distribution of copper, petroleum, and freshwater. What do you predict similar maps with updated information will look like in 100 years? Explain your thinking.

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