1 Observing Earth's Resources

INVESTIGATION

1 CLASS SESSION

ACTIVITY OVERVIEW

NGSS CONNECTIONS

This activity establishes the basis for investigating the distribution and formation of natural resources on Earth. Students are introduced to the concept of natural resources as they examine resource samples from Earth's land, water, and biosphere. They identify the resources as renewable or nonrenewable. In discussing the relative values of resources, students take part in the crosscutting concept that science can provide knowledge but does not direct the actions that people take.

Prepare to teach the unit by reviewing the unit overview and assessment chart for a summary of the NGSS taught and assessed in this activity and how the standards are woven together throughout the unit. Decide in advance which assessments you plan to emphasize. Also review the NGSS pathways on the SEPUP website, and the phenomena and storyline documents found Teacher Resources IV, "Unit Specific Resources."

NGSS CORRELATIONS

Performance Expectations

Working towards MS-ESS3-1: Construct a scientific explanation based on evidence for how the uneven distributions of Earth's mineral, energy, and groundwater resources are the result of past and current geoscience processes.

Disciplinary Core Ideas

MS-ESS3.A Natural Resources: Humans depend on Earth's land, ocean, atmosphere, and biosphere for many different resources. Minerals, fresh water, and biosphere resources are limited, and many are not renewable or replaceable over human lifetimes. These resources are distributed unevenly around the planet as a result of past geologic processes.

Science and Engineering Practices

Constructing Explanations and Designing Solutions: Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.

Crosscutting Concepts

Connections to Engineering, Technology, and Applications of Science: Influence of Science, Engineering, and Technology on Society and the Natural World: All human activity draws on natural resources and has both short and long-term consequences, positive as well as negative, for the health of people and the natural environment.

Connections to Nature of Science: Science Addresses Questions about the Natural and Material World: Scientific knowledge can describe the consequences of actions but does not necessarily prescribe the decisions that society takes.

Common Core State Standards—ELA/Literacy

RST.6-8.3: Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.

WHAT STUDENTS DO

Students are introduced to Earth's natural resources. They observe samples of five resources and rank them from the most to least valuable. The class discusses what makes natural resources valuable, and the concept of renewable vs. nonrenewable resources is introduced.

MATERIALS AND ADVANCE PREPARATION

- *For the teacher*

* tap water

* additional samples of natural resources, such as minerals or energy samples

- *For each group of four students*

1 copper strip
1 rock containing fossils (marked with a blue dot)
1 sample of oil shale (marked with a yellow dot)
1 vial of freshwater (small, with cap)
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"
  - 1 safety contract (optional)

**not supplied in kit*

Fill the vials with tap water before class begins.

TEACHING SUMMARY

GET STARTED

1. (LITERACY) Elicit student ideas about natural vs. manufactured materials.
   a. Have student groups sort a list of words related to Earth's resources.
   b. Introduce the terms *natural resources*, *renewable*, and *nonrenewable*.
2. If you have not previously done so, introduce safety in the science classroom.
   a. Distribute the safety contract and guidelines you are using, and review your expectations for classroom safety.
   b. Point out the locations of safety equipment in the classroom, and review when and how to use all safety equipment.
   c. Have students sign and take the safety agreement home for a parent or guardian to read and sign.

DO THE ACTIVITY

3. Students are introduced to (or reminded of) the SEPUP model for collaborative work.
   a. If you have not previously done so, introduce SEPUP's 4–2–1 model for collaborative work.
   b. Clarify which situations are appropriate for collaboration and which are appropriate for working independently.
   c. Introduce strategies for effective group interaction.
   d. Explain how you will distribute materials.

4. Students examine the natural resource samples and discuss their values.
    a. Have student groups record observations of five natural resource samples on Student Sheet 1.1, "Resource Observations."
    b. Have students rank the samples according to value.

BUILD UNDERSTANDING

5. The class discusses relative value of the resources.
    a. Have students share their natural resource rankings with the class.
    b. Discuss what factors makes a natural resource valuable.
6. Review the concept of renewable vs. nonrenewable.
7. Introduce crosscutting concepts, and explain how scientists use them to think about the natural world.
    a. Explain that crosscutting concepts bridge disciplines.
    b. Give an example as it relates to the crosscutting concept of connections to engineering, technology, and applications of science.
    c. Introduce another crosscutting concept—connections to the nature of science—and relate it to this activity.

TEACHING STEPS

GET STARTED

1. (LITERACY) Elicit student ideas about natural vs. manufactured materials.
    a. Have student groups sort a list of words related to Earth's resources.

    Explain to students that they will be separating a list of words into two categories. You may want to provide an example first, with a list that includes words such as homework, desks, bed, phone, teacher, and kitchen. This sample list could be split into two categories such as "school" (homework, desks, teacher) and "home" (bed, phone, kitchen). Point out that there is no single correct answer; the list could be split into other categories, with phone and kitchen listed under "school," and so on.

    Place the words listed below on the board, and have students group them into two categories. Tell them to be prepared to explain their categories.

rocks	air
cars	airplanes
trees	water
soil	plastic

After students have categorized their words, discuss students' categories. While there are multiple ways in which the words can be divided, many of them are similar to categories such as "natural" (found on Earth) and "manufactured" (made by people).

b. Introduce the terms *natural resources*, *renewable*, and *nonrenewable*.

Use the introduction to the activity to introduce the terms *natural resources*, *renewable*, and *nonrenewable*. When words are formally defined in an activity, they appear in bold type in the Key Vocabulary list. Encourage students to use these words when talking or writing about science. During discussions listen for these words to see if students are using them correctly. Decide how you will support students' understanding of the vocabulary—perhaps by setting up a word wall in the classroom. For more suggestions on ways to develop students' understanding of and proficiency with scientific vocabulary, see the section on Vocabulary Development in Teacher Resources II, "Diverse Learners."

Point out that some of the words that students categorized, such as trees, are renewable natural resources. Ask students to name some natural resources that they use every day. Possible responses include air, water, wood, gasoline (produced from crude oil), and metals. Explain that students will now have the opportunity to examine some samples of natural resources.

2. If you have not previously done so, introduce safety in the science classroom.

a. Distribute the safety contract and guidelines you are using, and review your expectations for classroom safety.

For a sample safety contract and guidelines, see Teacher Resources I, "Course Essentials."

b. Point out the locations of safety equipment in the classroom, and review when and how to use all safety equipment.

Demonstrate how to use emergency safety equipment, including the safety eyewear, eye-and-face wash, fire blanket, and fire extinguisher.

c. Have students sign and take the safety agreement home for a parent or guardian to read and sign.

Tell them to return the signed agreements before the date you plan to conduct the next laboratory activity.

DO THE ACTIVITY

3. Students are introduced to (or reminded of) the SEPUP model for collaborative work.

   a. If you have not previously done so, introduce SEPUP's 4–2–1 model for collaborative work.

      Explain that many of the activities in this book use the SEPUP 4–2–1 cooperative learning model. Students work in groups of four or in pairs to share, discuss, compare, and revise their ideas and to conduct investigations and activities. In all cases, each individual student is responsible for contributing ideas, listening to others, recording and analyzing their results, and monitoring their own learning.

   b. Clarify which situations are appropriate for collaboration and which are appropriate for working independently.

      In science, collaboration is essential to the development of new ideas and a better understanding of scientific concepts. However, scientists must publish only their own work and must give others credit when they build on others' ideas.

   c. Introduce strategies for effective group interaction.

      Explain or model what productive group interactions (both agreement and constructive disagreement) look like and sound like. For more information about group work, including two Student Sheets to help support students' interactions, see the Facilitating Group Interaction section of Teacher Resources II, "Diverse Learners."

   d. Explain how you will distribute materials.

      The materials management reflects the 4–2–1 structure of the classroom activities. The equipment kit typically contains materials in either sets of 16 (for each pair of students in a class of 32 students) or 8 (to be shared among groups of four), depending on how the activity is organized.

      You might wish to distribute the materials in numbered containers. This will allow you to quickly check the contents of the containers and hold groups accountable for ensuring their materials are returned in good shape.

4. Students examine the natural resource samples and discuss their values.

   a. Have student groups record observations of five natural resource samples on Student Sheet 1.1, "Resource Observations."

      There are a total of 40 samples (8 of each natural resource). This activity is designed to facilitate discussion about the samples and is intended to

be done in groups of four, with a set of five samples for each group. If your class size is larger than 32, you may be able to provide additional samples—especially of wood or water—for students to examine, or have groups trade samples after examination.

Hand out the natural resource samples to each group. Pairs of students can work together to examine a sample by sharing a magnifying lens and discussing their observations. Students should record their observations on Student Sheet 1.1.

b. Have students rank the samples according to value.

Ask students to rank the samples by their value. Be sure that students are aware that they do not need to agree with other members of their group. If students are having difficulty discussing and ranking the samples, ask, "Why is an item valuable?" If they say that it is because the item costs a lot of money, ask, "Why does it cost a lot of money?" Encourage students to consider factors such as beauty, rarity, usefulness, and demand. Then have them apply these factors to the natural resources that they are examining. Ask them which natural resource they think is the most beautiful, rare, useful, and so on, and let them know that it is based on such criteria that they can determine which natural resource they consider the most valuable.

Emphasize that there are no correct answers; the value of an object depends on which criteria (beauty, rarity, usefulness, etc.) a person considers the most important, and different people will consider different criteria more or less important, resulting in different individual rankings.

BUILD UNDERSTANDING

5. The class discusses relative value of the resources.

a. Have students share their natural resource rankings with the class.

Use Analysis item 1 to have students share their rankings. Be prepared for a variety of responses. Water may be ranked as the most valuable by students who are thinking about what is needed to sustain life. Students who know that fuel can be extracted from oil shale are more likely to rank oil shale as the most valuable. Students who consider the numerous uses of wood (buildings, paper, furniture) are more likely to rank wood as the most valuable. Students who reflect on the relative rarity of fossils are more likely to rank the rock with fossils as the most valuable. Students who take into account the use of metals in everyday life are most likely to rank the copper as the most valuable.

As for least valuable, some students are likely to rank the more common resources, such as wood or water, as the least valuable in terms of monetary value. Others may consider oil shale simply a rock and rank it as least valuable.

Determine the most and least valuable resources that students most often identified.

b. Discuss what factors makes a natural resource valuable.

Many factors can be used to determine an object's worth, and not every person would weigh these factors the same. Someone concerned about the needs of living organisms may identify water as the most valuable, whereas someone evaluating the beauty of the sample might consider copper the most valuable. Ask, "Which factor(s) did you consider the most important when determining the value of a natural resource?" Have students share their perspectives.

Some students may say that resources are valuable because they cost a lot of money. Encourage students to consider that the monetary value of an object is determined by numerous factors, such as beauty, rarity, usefulness, and demand. Point out that the cost of an item is an indicator of its value, and encourage students to be more specific by asking why the item costs a lot of money.

6. Review the concept of renewable vs. nonrenewable.

Use Analysis item 3 to discuss renewable vs. nonrenewable. One factor that limits the use of natural resources (and often increases their value) is their availability. Discuss whether there is any limit to the amount of each of the natural resources that they studied. Students may realize that wood is a common natural resource, in part because new trees can be planted when old ones are cut down. Students who are familiar with the water cycle may know that the water that is now on the ground was once in the atmosphere.

Wood and water are generally considered renewable resources, but the other samples are not. Renewable resources are those that can be replenished, either through earth processes or through human intervention. While trees take time to grow, they are often managed by humans as a renewable resource. (Note that not all trees are equally valuable; trees that take hundreds of years to grow or are rare are often more valuable than trees that grow quickly or have a wide distribution.)

Other resources are nonrenewable, meaning that their quantity is finite, and they cannot be replaced. Over time (in some cases, extremely long periods of time), nonrenewable resources become increasingly less available. In this unit, students will investigate why copper, oil, and fossils are essentially nonrenewable resources.

7. Introduce crosscutting concepts, and explain how scientists use them to think about the natural world.

   a. Explain that crosscutting concepts bridge disciplines.

      They can be a lens or touchstone through which students make sense of phenomena and deepen their understanding of disciplinary core ideas. Refer students to Appendix G, "Crosscutting Concepts," in the Student Book, and point out the symbols and definitions provided.

   b. Give an example that relates to the connection to engineering, technology, and applications of science.

      For example, students use the crosscutting concept of connections to engineering, technology, and applications of science: scientific knowledge can describe the consequences of actions but does not necessarily prescribe the decisions that society takes. In this activity, students use science to make reproducible observations of the samples, but science does not provide information about their value. Understanding connections to engineering, technology, and applications of science helps scientists across disciplines think about the role of science in the larger context.

   c. Introduce another crosscutting concept—connections to the nature of science—and relate it to this activity.

      This crosscutting concept relates to how scientific knowledge can describe the consequences of actions but does not necessarily prescribe the decisions that society takes. Science can be used to describe natural resources. Science does not prescribe whether these resources should be extracted, in what quantities, and by what methods.

      As students will learn in the next few activities, the use of natural resources has consequences for the environment. Yet natural resources are essential to meeting basic and modern quality-of-life standards.

SAMPLE RESPONSES TO ANALYSIS

1. Think about the natural resources you examined.

   a. What was the most valuable natural resource, according to the class?

      Student responses may vary depending on your particular class's discussion. One sample response is shown here:

      Overall, more students in our class voted that water was the most valuable because without it, there would be no life on Earth, and without life on Earth, all the other resources would be unnecessary.

b. What was the least valuable natural resource, according to the class?

Most students in the class felt that wood was the least valuable resource because it was plentiful and renewable (at least some kinds of wood).

c. What reasons did other students have for identifying a natural resource as more or less valuable?

Some students placed little value on resources they thought had no use to many people. Or sometimes it didn't have value because it was so readily available.

2. What else would you like to know about these natural resources to help determine their value?

Student responses may vary. One sample response is shown here:

I would like to know how much these resources cost, how common they are on Earth, where they are found, and how they are used in everyday life.

3. Which resource(s) did you identify as renewable? Explain your thinking.

Student responses may vary. One sample response is shown here:

Wood and water are renewable resources. Wood comes from trees, and more trees can be planted to replace those that are cut down. Water is renewable because it evaporates into the air and comes back down as rain or snow.

4. Copy the list of words shown below:

oil

natural resource

salt

air

~~plastic~~

a. Look for a relationship between the words. Cross out the word or phrase that does not belong.

b. Circle the word or phrase that includes the other words.

c. Explain how the word or phrase you circled is related to the other words in the list.

Oil, salt, and air are all natural resources.

5. **Reflection:** What do you think makes a natural resource valuable?

   Student responses may vary. One sample response is shown here:

   A natural resource may be valuable if it is hard to find, useful to a lot of people, limited in number, and/or very beautiful. Some things are valuable because they're necessary for people to live but are sometimes in short supply. Water is an example of this kind of resource.

EXTENSION

Have students bring in any natural resources they may have collected, or bring in some of your own to share with your class. Also, students can go to 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.

REVISIT THE GUIDING QUESTION

What are natural resources?

Highlight that natural resources can be a part of the land, water, air, or life on Earth. Students examined samples from land, water, and life. Mineral, energy, and groundwater resources from Earth's land and water will be the focus of the unit.

ACTIVITY RESOURCES

KEY VOCABULARY

natural resources

renewable

nonrenewable

BACKGROUND INFORMATION

FOSSILIFEROUS LIMESTONE

Limestone is a sedimentary rock that often has fossils in it. It is made up of at least 50% calcium carbonate (in the form of calcite) but can also contain other minerals, such as iron oxide, carbon, silica, and clay. Fossil-containing limestone was formed when marine animals died millions of years ago, and their skeletons settled onto the ocean floor. While sediments covered the skeletons, water seeped through the sediments and caused the skeletons to be gradually replaced by silicon. At the same time, the bones (or shell) of the animals broke down into calcium carbonate, binding with the sediments surrounding the skeletons. Eventually, these sediments became limestone, with the fossils of the animals embedded inside.

Limestone is a very abundant rock and is found worldwide, making up 10% of all sedimentary rocks. It is used to make cement, stone for buildings, lime (which has industrial applications), and chalk. It also is widely used in ore refining.

OIL SHALE

Oil shale, shale oil, and oil-bearing shale are three different substances. Oil shale is a sedimentary rock containing an organic-rich solid called kerogen. Oil shale can be processed so that the kerogen is transformed into liquid shale oil. Shale oil is similar to petroleum and can be refined into different substances, including diesel fuel and gasoline. Oil-bearing shale is a sedimentary rock containing trapped petroleum, often referred to as tight oil.

Like traditional petroleum, natural gas, and coal, oil shale is a fossil fuel. It is found all over the world, including China and Russia, though the United States contains the most known quantity of this resource. Oil shale developed from the remains of plants and other organisms that lived millions of years ago in ancient lakes, seas, and wetlands. When these organisms died and drifted to the seabed, they were buried under new layers of plants and sediment. Under intense pressure and heat, they slowly transformed into an organic substance known as *kerogen*. Kerogen consists mainly of hydrocarbons, with smaller amounts of sulfur, oxygen, nitrogen, and minerals. Oil shale contains kerogen, and heating it to high temperatures in the absence of oxygen releases shale oil.

The process of extracting shale oil is expensive, more expensive than the cost of extracting petroleum. For this reason, the use of shale oil in the United States has depended on the price of petroleum. Companies have only mined for oil shale when the price of petroleum is high.

Name_____ Date_____

STUDENT SHEET 1.1

RESOURCE OBSERVATIONS

Natural resource	Observation	Ranking	Reason for ranking	Renewable or nonrenewable?

Name *Sample student response* Date

STUDENT SHEET 1.1

RESOURCE OBSERVATIONS

Natural resource	Observation	Ranking	Reason for ranking	Renewable or nonrenewable?
Copper	*Shiny, smooth, copper-colored, 3 cm long*	*1*	*It is used to make other products.*	*Nonrenewable*
Oil shale	*Slightly smooth with rough edges, gray, 4 cm wide*	*5*	*It looks like rocks found all around.*	*Nonrenewable*
Rock containing fossils	*Partial indentation of a leaf in a rock, indentation about 1.5 cm*	*2*	*Fossils are rare.*	*Nonrenewable*
Water	*Clear, colorless, odorless*	*3*	*It is important for life.*	*Renewable*
Wood	*Smooth, brown, light in weight, 3.5 cm long*	*4*	*It is useful, but you can grow more trees.*	*Renewable*