LESSON 4: Renewable and Nonrenewable Natural Resources

LESSON'S CONCEPTS

- Renewable natural resources are those which can be replaced naturally or through human-assisted actions within a relatively short amount of time (e.g., within a human lifetime). Examples of renewable natural resources are plants, animals, water, air, and some energy resources, such as sunlight.
- Nonrenewable natural resources are those available in limited amounts and take millions of years to be replaced; therefore, people can rely only on those deposits already in existence. Examples of nonrenewable natural resources are most minerals (e.g., iron ore) and some energy resources (e.g., fossil fuels).

PURPOSE

Students learn the difference between renewable and nonrenewable natural resources. They also learn that people in the United States use a large number of nonrenewable resources which are acquired from other countries.

In Part II, older students (grades five and six), will participate in a simulation activity that focuses on the scarcity of some mineral resources.

OVERVIEW

In this lesson students will:

- Determine which natural resources are considered renewable and which are considered nonrenewable.
- Classify items found in the outdoors and in the classroom as being made from renewable natural resources, nonrenewable natural resources, or both types of resources.
- Write a pledge to avoid wasting one specific material at school or at home.
- Design posters or a bulletin board featuring pictures of renewable and nonrenewable natural resources.

For Part I younger students (grade four) will:

- Identify the location of some mineral reserves, such as bauxite, iron ore, and tin.
- Read a chart to determine how long certain mineral resources are likely to last.

For Part II, older students (grades five and six) will:

- Search the classroom for various colored beads that represent finite mineral resources.
- Compare the numbers acquired in a simulation game to the actual global reserve base of specific mineral resources.
- Analyze charts and graphs concerning mineral resources.
- Arrange in order some mineral resources that are most abundant to those that are less abundant.

CORRELATIONS TO CALIFORNIA'S CONTENT STANDARDS AND FRAMEWORKS

- Students compare renewable to nonrenewable natural resources. They classify items outdoors and in the classroom as being made from renewable or nonrenewable natural resources or from both types of resources.
  - "All resources used by humans, including fuels, metals, and building materials, ultimately come from the Earth. Many of these resources are not in endless supply. They have taken many thousands and millions of years to develop and accumulate. They must be used with care, conserved, and recycled." (*Science Framework*, page 97)

- "Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept . . . students will: classify objects . . . based on appropriate criteria . . .." (*Science Content Standards, Grades K–12*; Grade 5; Investigation and Experimentation, Standard 5a)
- "Students know . . . different natural energy and material resources, including air, soil, rocks, minerals, petroleum, fresh water, wildlife, and forests, and classify them as renewable or nonrenewable . . .." (*Science Content Standards, Grades K–12*; Grade 6; Resources, Standard 6b)

• Students work together to gather colored beads and identify what mineral each color of bead represents.
- "To participate effectively in society, students need to: Develop personal skills . . . group interaction skills (and) . . . social and political participation skills." "*History–Social Science Framework*, page 24)

• Students analyze charts and graphs.
- Students "interpret one- and two-variable data graphs to answer questions about a situation." *(Mathematics Content Standards for California Public Schools, Kindergarten Through Grade Twelve*, page 18)

SCIENTIFIC THINKING PROCESSES

observing, communicating, comparing, ordering, classifying, relating

TIME

45 minutes to prepare for the lesson; 60–90 minutes to implement the lesson

VOCABULARY

ecosystem, nonrenewable natural resources, renewable natural resources

PREPARATION

___ **1.** Read the "Background Information for the Teacher" at the end of this lesson.

___ **2.** Make a transparency of "Some of the Earth's Natural Resources" (page 299).

For Younger Students (Grade Four)

For "Part I, Analyzing a Chart"

___ Make a transparency of "Life Expectancies and Main Consumers of Some Nonrenewable Natural Resources" (page 300).

For Older Students (Grades Five and Six)

For "Part II, Simulating the Scarcity of Some Mineral Resources"

___ **1.** Gather beads of different colors and coins to represent mineral resources (see the numbers and colors listed on "A Look at What's Left"). An option to using beads and coins is to use cutout circles from construction paper.

___ **2.** Hide beads and coins throughout the classroom. (Make sure that some of the beads are well hidden, so they will not be found immediately.)

___ **3.** Make transparencies of "A Look at What's Left" (page 301); "Depletion Time for Nonrenewable Resources" (page 302); "Life Expectancies and Main Consumers of Some Nonrenewable Natural Resources" (page 300); and "A World Map" (page 303).

___ **4.** Make copies for each group of "A Look at What's Left," "Life Expectancies and Main Consumers of Some Nonrenewable Natural Resources," and "A World Map."

MATERIALS

For "Pre-Activity Questions"

___ The transparency, "Some of the Earth's Natural Resources"

For Younger Students (Grade Four)

For "Part I, Analyzing a Chart"

___ Iron nail, lead fishing weight, aluminum can, and a tin can
___ Large map of the world
___ A transparency of "Life Expectancies and Main Consumers of Some Nonrenewable Natural Resources"

For Older Students (Grades Five and Six)

For "Part II, Simulating the Scarcity of Some Mineral Resources"

___ Transparencies of each of the following: "A Look at What's Left," "Depletion Time for Nonrenewable Resources," "Life Expectancies and Main Consumers of Some Nonrenewable Natural Resources," and "A World Map"

___ Charts titled, "A Look at What's Left," "Depletion Time for Nonrenewable Resources," and "Life Expectancies and Main Consumers of Some Nonrenewable Natural Resources," one for each group of students

___ Colored beads and coins in numbers required (See "A Look at What's Left.")

___ "A World Map" handout for each group of students

___ Large map of the world

PRE-ACTIVITY QUESTIONS

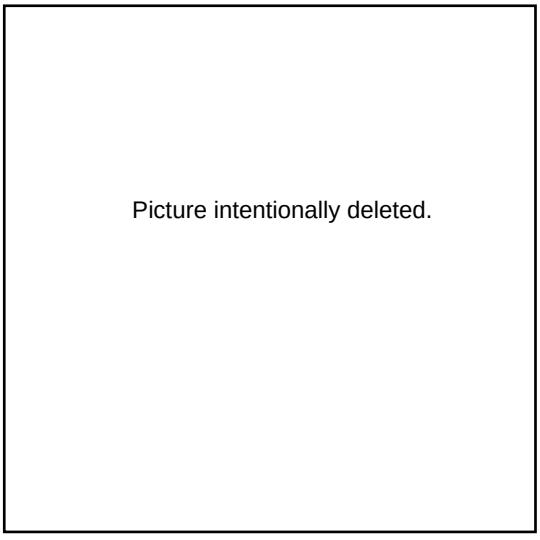
A. Ask students to identify for you the categories of natural resources, as you list them on the chalkboard: plants, animals, minerals, energy sources (e.g., sunlight, fossil fuels), soil, water, and air.

B. Tell students that some natural resources are considered to be renewable. What do they think *renewable* means? *They can renew themselves; they are available forever.* Write down their answers on butcher paper or chalkboard and review them at the end of the lesson. Ask students to give examples of renewable resources.

- Explain to students that scientists consider natural resources to be renewable if they are replaced naturally or through human-assisted actions within a relatively short amount of time, such as a human lifetime. For example, plants, such as trees, can be replanted indefinitely as long as the trees are selectively cut, allowing a certain number of mature trees to remain, and the soil in which these trees grow are protected from erosion. Proper management of the forest to ensure diversity and a healthy, well-functioning ecosystem is also important.
- Ask students to identify other renewable natural resources and why they think these resources are renewable. *Animals, because they can reproduce and have young; water, because the water cycle keeps recycling water; air, because plants and animals recycle the air; sunlight, because the sun is always there.*
- What could people do to make these renewable natural resources less renewable? *They could cause an animal species to become extinct. They could harvest the trees in a forest faster than the time it takes for more trees to grow and not plant any trees to replace the ones they harvested. They could pollute the water faster than the water cycle can clean it. They can pollute air in one area faster than the winds could blow it away.*

C. Ask students to explain what *nonrenewable* natural resources might mean and to give examples of nonrenewable natural resources. (These would be natural resources available in limited amounts.) *Fossil fuels (e.g., coal, oil, natural gas) and many minerals (e.g., iron, gold, bauxite).* Write students' answers on butcher paper or chalkboard. Students will discuss these answers at the end of this lesson. Explain to students that fossil fuels are considered to be nonrenewable natural resources because they take millions of years to form. Most minerals are also nonrenewable natural resources. Although they are continually being formed by geologic processes, the rate is so slow that human beings can rely only on those deposits already in existence.

D. Lead students outside and ask them to identify objects made from renewable and nonrenewable natural resources (or both).



Students from Valley Oak Elementary School identify objects made from renewable and nonrenewable natural resources.

E. Back in the classroom, project the transparency of "Some of the Earth's Natural Resources." Ask students to describe what the illustrations on the transparency are showing.

PROCEDURE

Note: Do "Part I" with younger students (grade four) and "Part II" with older students (grades five and six).

For Younger Students (Grade Four)

Part I, Analyzing a Chart

A. Show students an iron nail, lead fishing weight, aluminum can, and a tin can. Tell students that these represent mineral resources. In this lesson they will learn more about where some mineral resources come from and what country uses the largest amount of these resources.

B. Display a map of the world for students to refer to in part "C."

C. Project on an overhead projector the "Life Expectancies and Main Consumers of Some Nonrenewable Natural Resources." Explain that the natural resources used to manufacture many products are nonrenewable, are in limited supply, and are not found in the United States. Conduct a whole class discussion addressing the questions listed below. You might need to ask additional questions to lead students to specific answers.

- Why are projected rates of use greater than current rates of use? *It is projected that more people will use more natural resources. Increased population increases demand.*
- If we use mineral resources at projected rates, will we use them up faster or slower than if we used them at the current level? *Faster.*
- How will an increase in human population affect the rate of use of mineral resources? *The use of mineral resources will increase.*
- What mineral resources are not found in the United States? *Bauxite (from which aluminum is made) and tin.*
- What country(ies) or area(s) has (have) the greatest overall reserves of these minerals? *Australia, China, and Indonesia.* (Have students find these countries on the large map of the world.)
- How could dependence on other countries for mineral resources become a problem? *The people in the country can decide to stop selling the resources to the U.S.*
- How can we as individuals help stop the depletion of nonrenewable resources? (List the students' ideas on the chalkboard or on an overhead transparency and save for later discussion.)
- Ask students to answer questions "A" and "B" on the transparency. Discuss their answers.
- What did we learn from this chart? *The people in the United States use a lot of mineral resources; many of these mineral resources come from other countries.*

Note: Go to the "Discussion/Questions" section.

For Older Students (Grades Five and Six)

Part II, Simulating the Scarcity of Some Mineral Resources

Note: Make sure that you have hidden the beads and coins throughout the classroom when students were not present.

A. Divide students into teams (which could represent countries).

1. Give teams timed intervals of two minutes and one minute to explore for mineral resources. (The teams will search for two minutes, record their findings, and then search again for one minute and compare their findings with those during the two-minute search.)

2. After the exploration is concluded, provide a copy of "A Look at What's Left" to each group.

- Ask students to separate and identify the mineral represented by each color of bead or coin.
- Have them arrange the mineral resources in order from the largest amount of one resource to the least amount. They should record the numbers in their journals.
- If needed, project the transparency of "A Look at What's Left" and guide students in acquiring the information they need.

- Discuss the greater difficulty in finding mineral resources during the second exploration.
- If students did not locate all of the beads and coins, discuss how some mineral resources are difficult to locate.

3. Have students compare what they found to the actual global reserve base shown on the chart of "A Look at What's Left."

B. Ask students whether the world population is increasing. *Yes.* Discuss with students:

- What effect will rapid population growth have on the future availability of nonrenewable natural resources? *Fewer easily accessible natural resources will be available because more people will be using them. More natural resources will need to be harvested, extracted, or mined.*
- What can people do to try to make the natural resources that are readily available last longer? *Slow down the population growth; conserve what is available through reducing, reusing, and recycling.*

C. Have students mix the mineral resources together and have the students pretend that many products were made from these. Ask them the following questions:

- Where can a mix of products from mineral resources like this be found? (Lead students to say in a landfill.)
- What did it take to get these mineral resources into products in the first place? *Acquiring the mineral resources (digging, drilling, transporting), using energy, refining and separating the minerals, manufacturing these resources into products.*
- What is necessary to keep these natural resources in the cycle of use in order to extend their life and usefulness? *Separate them to reuse or recycle; use fewer of them; use them wisely without wasting them.*
- What are the advantages of extending the life of these mineral resources? *Fewer mineral resources and other natural resources will need to be mined or harvested and transported.*

D. Project the transparency of "Depletion Time for Nonrenewable Resources." Lead students to explain what this graph shows.

E. Hand out to each group of students the chart of "Life Expectancies and Main Consumers of Some Nonrenewable Natural Resources." Ask students to complete "A" and "B." When students have completed their assignment, discuss:

- How long are the minerals that are used widely today predicted to last?
- How old will your children or grandchildren be when these resources might be exhausted?
- What effect could the depletion of mineral resources have on your life?

F. Display a large map of the world and/or provide a copy of the handout, "A World Map," to each group. Project on an overhead projector the "Life Expectancies and Main Consumers of Some Nonrenewable Natural Resources." Discuss:

- Why are projected rates of use greater than current rates of use? *It is projected that more people will use more resources.*
- If we use mineral resources at projected rates, will we use them up faster or slower than if we used them at the current level? *Faster.*
- How will an increase in human population affect the rate of use of mineral resources? *The use of mineral resources will increase.*
- What mineral resources are not found in the United States? *Bauxite (from which aluminum is made) and tin.*
- What country(ies) or area(s) has (have) the greatest overall reserves of these resources? *Australia, China, and Indonesia.*

  (Have students find these countries on a large map of the world and/or the handout, "A World Map.")
- What is the United States' present relationships with some of the countries which have these resources? Answers will vary, depending on the country.
- How could our dependence on other countries for mineral resources become a problem? *The people in the country can decide to stop selling the resource to the U.S.*

- What did we learn from this chart? *The people in the United States use a lot of natural resources; many of these natural resources come from other countries.*

DISCUSSION/QUESTIONS

Discuss with students:

- What are the advantages of recycling nonrenewable natural resources? *We can make these last much longer; there will be more for future generations.*
- What are the advantages of recycling renewable natural resources? *Fewer resources will need to be harvested and fewer products will need to be manufactured from raw materials.*
- What are the disadvantages of recycling renewable or nonrenewable natural resources? *People think it is too much trouble to separate their garbage; there may not be nearby markets for some recyclable materials, and transporting these materials may cost too much.*
- What impacts on the environment might the extraction of minerals produce? *Ecosystems, including habitats of plants and animals, are disrupted; there might be air and water pollution.* (Consider having students conduct further research on the impact of mineral extraction.)

APPLICATION

A. Ask students to reread the definitions and examples of renewable and nonrenewable natural resources. Is each accurate? How could you improve the definition?

B. Ask students to name objects in the classroom made from renewable natural resources, nonrenewable natural resources, and those made from both types of resources. *A metal desk is made from nonrenewable minerals; a wooden ruler, from renewable trees; plastic container, from nonrenewable fossil fuels.*

C. Discuss with students:

- What clothing materials come from renewable natural resources? *Cotton, silk, wool, rayon.* Nonrenewable resources? *Polyester, nylon.*
- What packaging materials come from renewable natural resources? *Cardboard.* Nonrenewable resources? *Plastic.*
- How can we as individuals help stem the depletion of nonrenewable resources?

D. Have students write a pledge in which they promise to avoid wasting one specific material at school or at home.

Project Idea: Have students write a class pledge that describes how to avoid wasting natural resources. Organize a school assembly and share the pledge along with information about natural resources.

Project Idea: Have students design posters or a bulletin board showing pictures of renewable and nonrenewable natural resources and ways they can be conserved. (If posters will be done, then this can be assigned as homework.) These can be displayed at school and in other public areas.

EXTENSIONS

A. Assign students to come up with substitutes for resource materials that are in short supply. Ask them to identify what characteristics substitutes would have to have to replace aluminum, iron ore, lead, plastics, paper, and tin.

B. Assign students to research the potential for mining minerals beneath the oceans. Who "owns" these minerals?

RESOURCES

Video

Conserving Our Natural Resources. Chatsworth, Calif.: AIMS Media, 1979 (15 minutes)

Describes natural resources and the importance of conserving them.

Videodisc

Windows on Science: Physical Science. Volumes 2 and 3, Energy Resources. Atlanta, Ga.: Optical Data School Media, 1993.

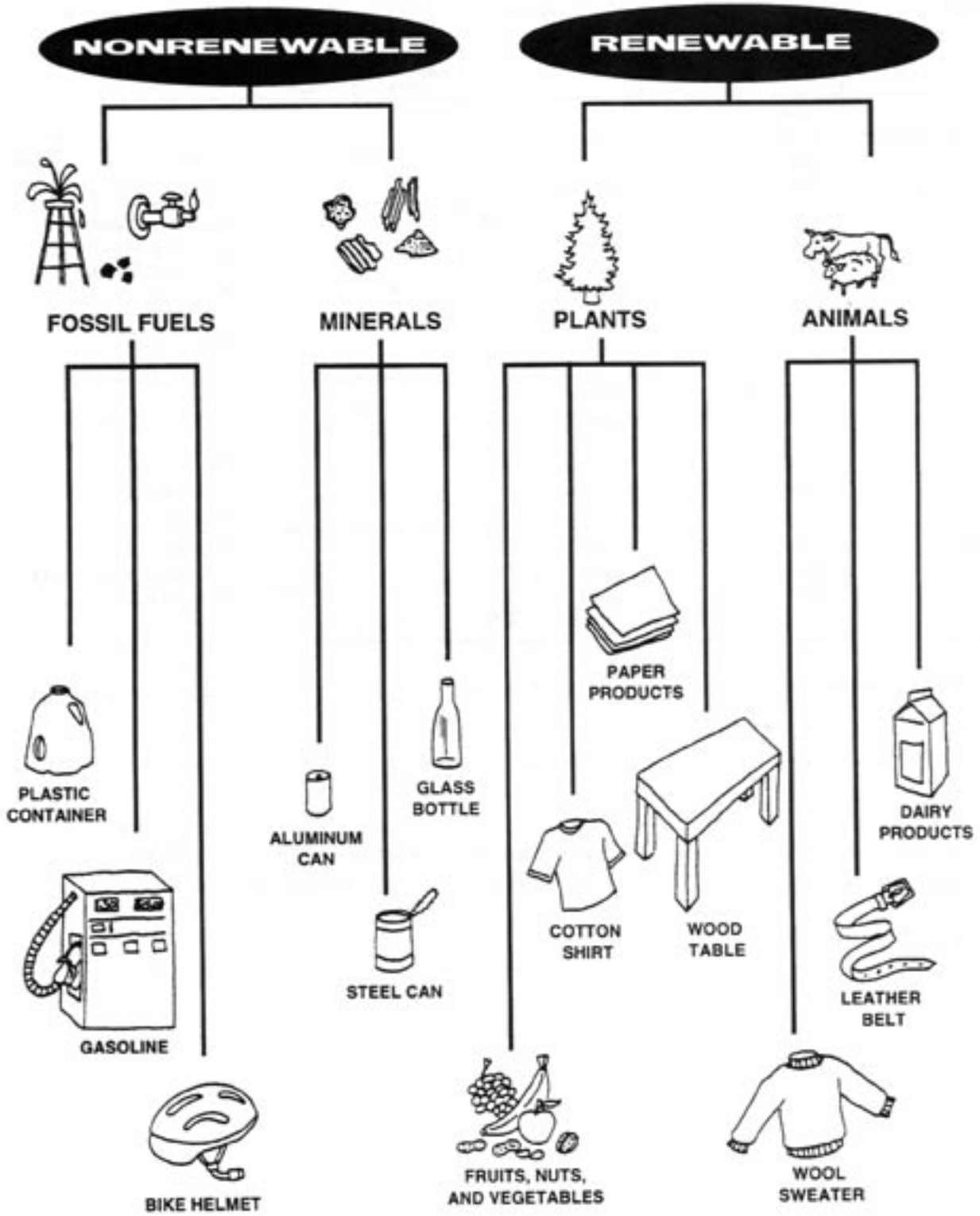
A multimedia science program that guides students to compare various renewable and nonrenewable resources.

Web sites

See "Appendix F–IV, Natural Resources Web sites."

Transparency

SOME OF THE EARTH'S NATURAL RESOURCES



Transparency and Student's Page

LIFE EXPECTANCIES AND MAIN CONSUMERS OF SOME NONRENEWABLE NATURAL RESOURCES[1]

Resource	Countries or areas with highest mine production 1998		Main consumers 1997		Life expectancy in years		Amount recycled in US in 1997
					If used at current level (1997)	If used at projected rates	
Aluminum in bauxite	Australia Guineas Jamaica Brazil	38% 12% 10% 8%	USA Japan China Germany	26% 12% 10% 7%	276 years	63 years	No bauxite recycled in US; 67% of aluminum cans are recycled.
Iron in ore	China Brazil Australia Russia India USA Canada	25% 18% 14% 7% 7% 6% 3%	China Japan USA Russia	36% 12% 8% 7%	150 years	62 years	There is no significant recycling of iron ore. However, 58 million metric tons of steel were made from scrap metal.
Lead	Australia China USA Peru Canada	18% 15% 15% 8% 6%	USA China United Kingdom Germany	27% 8% 6% 6%	23 years	15 years	1.1 million tons recovered from old (post-consumer) scrap; 990,000 tons were recovered from used batteries.
Tin	China Indonesia Peru Brazil	30% 20% 14% 10%	USA Japan China Germany	18% 16% 13% 10%	35 years	25 years	11,000 tons from old and new scrap were recycled in 1997.

A. List the main consumer of each resource. Aluminum: _____

Iron ore: _____ Lead: _____ Tin: _____

B. If consumption grows at projected rates, which mineral resource will be the first to be depleted? List the next three mineral resources in order of depletion rate. Bonus: Next to each number, list how old you will be when the mineral resource is depleted.

1. _____

2. _____

3. _____

4. _____

[1]"Mineral Commodity Summaries 1998." USGS Minerals Information. From Web site: http://minerals.er.usgs.gov/minerals/pubs/mcs/1998; World Bureau of Metal Statistics, Metal Statistics 1986–1996.

Transparency and Student's Page

A LOOK AT WHAT'S LEFT

Color	No. of beads	Finite resource	1998 estimate of global reserve base*
Red	420	Iron in ore	112 billion metric tons
Blue	105	Bauxite	28 billion metric tons
Yellow	1	Tin	12 million metric tons
Silver coin	1	Silver	420,000 metric tons
Copper coin	3	Copper	630 million metric tons
Orange	1	Lead	120 million metric tons
Purple	30	Chromium	7.5 billion metric tons
Green	1	Platinum	77,359 metric tons

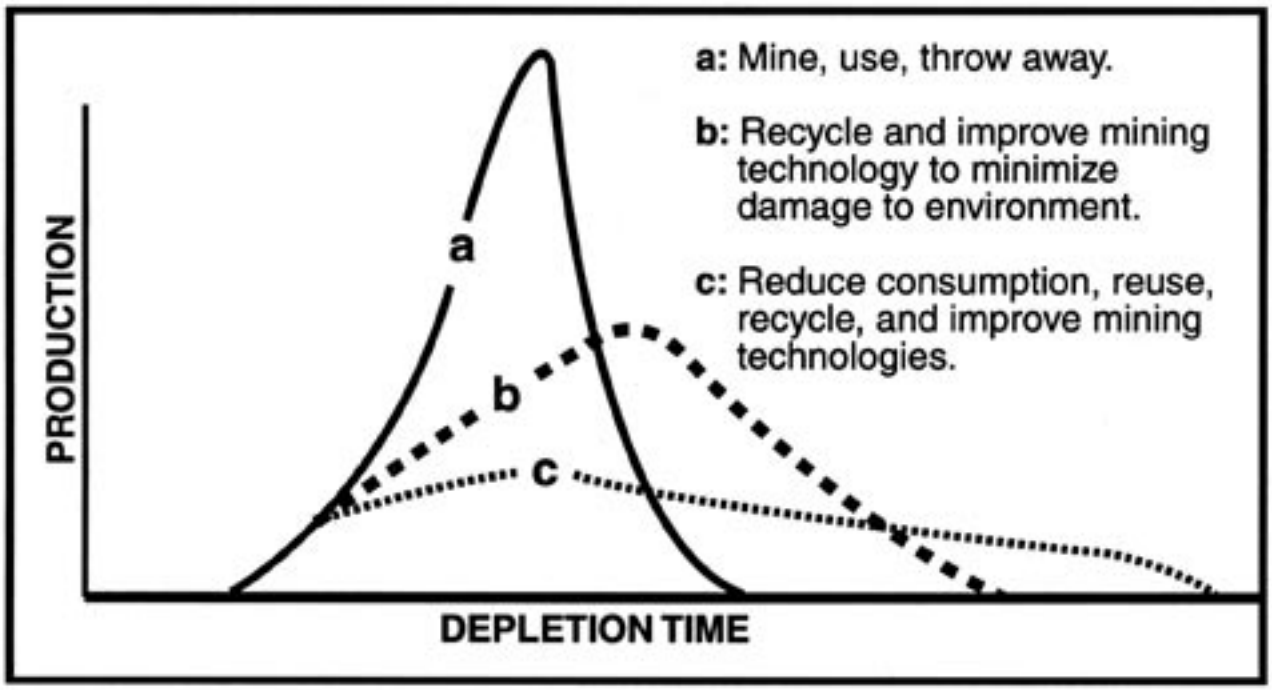
*"The reserve base includes those resources that are currently economic (reserves), marginally economic (marginal reserves), and some that are currently subeconomic (subeconomic resources). Source of figures is: "U.S. Geological Survey, Mineral Commodity Summaries, January 1998."

Note: Metric ton = 2,200 lbs.

Note: The number of beads reflects a mineral's relative, estimated total abundance—not the ease of extraction or potential availability of that mineral. The beads are not distributed in exact percentages to allow for hypothetical and undiscovered resources.

Transparency

DEPLETION TIME FOR NONRENEWABLE RESOURCES



Transparency and Student's Page

A WORLD MAP

BACKGROUND INFORMATION FOR THE TEACHER

Natural resources used by humans can be classified as renewable and nonrenewable. Renewable natural resources are those which can be replaced within a human lifetime over and over again. Nonrenewable natural resources are those that may take millions of years to be replaced; therefore, people can rely only on those deposits already in existence.

Scientists consider natural resources to be renewable if they are replaced naturally or through human-assisted actions within a relatively short amount of time. For example, plants, such as trees, can be replanted indefinitely as long as the trees are selectively cut, the soil in which these trees grow are protected from erosion, and the diversity of the forest is kept in tact.

Other renewable natural resources are animals, because they can reproduce and have young; water, because the water cycle keeps recycling water; and air, because plants and animals recycle the air through respiration.

Renewable natural resources, such as water and trees, can last indefinitely if people (or natural disasters) do not disrupt the systems that sustain them. For example, water sources need to be protected from pollution and from depletion that exceeds replenishment by the water cycle. Trees must have their life requirements met—healthy soil, stable climatic conditions to which species have adapted, adequate carbon dioxide and water to perform photosynthesis, and conditions that foster reproduction of new trees. However, trees can become finite resources if the demands for them outpace the period needed for natural regrowth and the balance with other components in their ecosystem is disrupted.

Nonrenewable resources are those replenished through extremely slow natural cycles (fossil fuels) or which for all practical human purposes are not replenished at all (some mineral deposits). "Although mineral resources are continually being formed by geologic processes, the rate is so slow that we can rely only on those deposits already in existence. The current rate of mineral use far exceeds the rate of formation. Mineral resources are thus considered nonrenewable."[2]

World mineral use increased tenfold from 1750 to 1900. Since 1900 world mineral use has increased thirteenfold.[3] The future supply of nonrenewable natural resources depends on the actual or potential supply and the rate at which the supply is used.[4]

Some people believe that the Earth is so rich in natural resources that there are actually plenty of natural resources available—but for a price. That price may be using even more energy and more equipment and contributing to even greater environmental degradation to get less easily obtained natural resources from the Earth (e.g., drilling for oil or other extracted materials in natural parks or fragile ecosystems). Other people believe this is not a reasonable choice, because the cost to the environment exceeds the benefit of the relatively small amount of material that would be extracted.

Before we would run out of a nonrenewable natural resource, it is likely that the economic costs of extracting it would become greater than the extracted material would be worth. Alternate materials would need to be discovered.

Potential desirable strategies for extending the life expectancy of nonrenewable resources include:

- Using recycled materials rather than raw materials whenever possible in the manufacturing process
- Substituting products made from renewable resources for products made from nonrenewable resources
- Having consumers examine the necessity for their use of natural resources and reducing their use wherever possible

Waste can be considered both renewable and nonrenewable. Waste contains many materials that can be reused or recycled. It also contains materials that cannot be put to any useful purpose again.

The proper management of both waste and natural resources will help to keep our environment healthy and provide a continuous supply of natural resources we and other living things need in order to live.

[2]Melissa Ballard and Mamata Pandya, *Essential Learnings in Environmental Education*. Washington, D.C.: North American Association for Environmental Education, 1990, p. 78.

[3]G. Tyler Miller, Jr., *Environmental Science: Working with the Earth* (Fifth edition). Belmont, Calif.: Wadsworth Publishing Company, 1995, p. 313.

[4]*Ibid.*, p. 312.