THIS MINE OF MINE
MINING FOR ENERGY

Students build plots of land that contain coal deposits, mine the coal, then reclaim the land and explore the uses of coal to produce energy.

GRADE LEVEL
2–6

SUBJECT AREAS
Science
Social Studies
Math
Language Arts

NEED
2009-2010
Putting Energy into Education

NEED Project PO Box 10101 Manassas, VA 20108 1-800-875-5029 www.NEED.org

Teacher Advisory Board

Teacher Advisory Board Vision Statement

NEED Mission Statement

The mission of the NEED Project is to promote an energy conscious and educated society by creating effective networks of students, educators, business, government and community leaders to design and deliver objective, multi-sided energy education programs.

In support of NEED, the national Teacher Advisory Board (TAB) is dedicated to developing and promoting standards-based energy curriculum and training.

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Correlations to National Science Content Standards

(Bolded standards are emphasized in the unit.)

PRIMARY(GRADES K–4) STANDARD–D: EARTH AND SPACE SCIENCE

1. Properties of Earth Materials

a. Earth materials are solid rocks and soils, water, and the gases of the atmosphere. The varied materials have different physical and chemical properties, which make them useful in different ways; for example, as building materials, as sources of fuel, or for growing the plants we use as food.

b. Earth materials provide many of the resources that humans use.

PRIMARY–F: SCIENCE IN PERSONAL AND SOCIAL PERSPECTIVES

3. Types of Resources

a. Resources are things that we get from the living and nonliving environment to meet the needs and wants of a population.

b. Some resources are basic materials, such as air, water, and soil; some are produced from basic resources, such as food, fuel, and building materials; and some resources are nonmaterial, such as quiet places, beauty, security, and safety.

c. The supply of many resources is limited. If used, resources can be extended through recycling and decreased use.

4. Changes in Environments

a. Environments are the space, conditions, and factors that affect an individual's and a population's ability to survive and their quality of life.

b. Changes in environments can be natural or influenced by humans. Some changes are good, some are bad, and some are neither good nor bad.

c. Pollution is a change in the environment that can influence the health, survival, or activities of organisms, including humans.

d. Some environmental changes occur slowly, and others occur rapidly.

5. Science and Technology in Local Challenges

a. People keep inventing new ways of doing things, solving problems, and getting work done. New ideas and inventions often affect other people; sometimes the effects are good and sometimes they are bad. It is helpful to try to determine in advance how ideas and inventions will affect other people.

b. Science and technology have greatly improved food quality and quantity, transportation, health, sanitation, and communication. These benefits of science and technology are not available to all of the people in the world.

INTERMEDIATE (GRADES 5–8) STANDARD–B: PHYSICAL SCIENCE

3. Transfer of Energy

a. Energy is a property of many substances and is associated with heat, light, electricity, mechanical motion, sound, nuclei, and the nature of a chemical.

INTERMEDIATE–D: EARTH AND SPACE SCIENCE

1. Structure of the Earth System

a. The solid earth is layered with a lithosphere; hot, convecting mantle; and dense, metallic core.

INTERMEDIATE–E: SCIENCE AND TECHNOLOGY

2. Understandings about Science and Technology

c. Technological solutions are temporary and have side effects. Technologies cost, carry risks, and have benefits.

f. Perfectly designed solutions do not exist. All technological solutions have trade-offs, such as safety, cost, efficiency, and appearance. Risk is part of living in a highly technological world. Reducing risk often results in new technology.

g. Technological designs have constraints. Some constraints are unavoidable, such as properties of materials, or effects of weather and friction. Other constraints limit choices in design, such as environmental protection, human safety, and aesthetics.

INTERMEDIATE–F: SCIENCE IN PERSONAL AND SOCIAL PERSPECTIVES

1. Personal Health

b. Natural environments may contain substances that are harmful to human beings. Maintaining environmental health involves establishing or monitoring quality standards related to use of soil, water, and air.

2. Populations, Resources, and Environments

b. Causes of environmental degradation and resource depletion vary from region to region and from country to country.

3. Natural Hazards

a. Internal and external processes of the earth system cause natural hazards, events that change or destroy human and wildlife habitats, damage property, and harm or kill humans.

b. Human activities can induce hazards through resource acquisition, urban growth, land-use decisions, and waste disposal.

c. Hazards can present personal and societal challenges because misidentifying the change or incorrectly estimating the rate and scale of change may result in either too little attention and significant human costs or too much cost for unneeded preventive measures.

4. Risks and Benefits

c. Students can use a systematic approach to thinking critically about risks and benefits.

d. Important personal and social decisions are made based on perceptions of benefits and risks.

Teacher Guide

GOAL

To explore coal mining, reclamation and uses with a hands-on demonstrative activity.

INTRODUCTION

This activity allows students to explore the formation, geology, recovery, and uses of coal, as well as the reclamation of coal mine sites. Using sand, clay, soil, and rocks, students build a miniature plot of land containing coal deposits.

Students then learn about the surface mining method of recovering coal from the earth, and practice the method on their plot of land. After the coal is mined, students reclaim the plot of land and discuss how the coal is transported and used.

GRADE LEVEL

This activity is designed for students in grades 2-6.

TIME NEEDED

Three class periods.

MATERIALS NEEDED (30 STUDENTS)

Read entire procedure before purchasing supplies.

- 36 small plastic bowls
- 36 clear straws
- 36 plastic spoons
- 24 large plastic bowls
- 5 lb. bag of sand
- 5 lb. bag of small gray pebbles
- 5 lb. bag of small white pebbles
- 5 lb. bag of topsoil
- 5 lbs. of clay
- 50-100 small pieces of coal, or large black pebbles representing coal
- 1 small container of grass seed
- newspaper to cover work areas
- grass, leaves, and twigs
- a container to represent a dump truck or coal car
- class set of **NEED Elementary Energy Infobooks**

Supplemental:

- Coal poster and coal samples from the American Coal Foundation (202-466-8630)
- NEED's U.S. Energy Geography—Coal Reserve map at www.NEED.org
- NEED's *Primary Energy Stories and More*

PREPARATION

1. Make a transparency of the **Mining** master (page 14).
2. Make copies of the **Student Guide**, **Coal Chain**, and **Review** for each student (pages 11-13).
3. Set up five work stations so that students will have access to all materials.
4. Cover the student work areas with newspaper.
5. Place one large bowl each of sand, gray pebbles, white pebbles and topsoil at each station, as well as a portion of clay, a small bowl of coal, and a plastic spoon. *Hint: The activity is more successful if the sand is slightly moist–the consistency of brown sugar.*

PROCEDURE–DAY ONE

LAND DEVELOPMENT

1. Have the students read the coal section of the **Elementary Energy Infobook**. Discuss the formation of coal and its significance as an energy source in the United States, especially in the generation of electricity. *(See NEED's **U.S. Energy Geography** for a transparency map of coal reserves in the United States.)*
2. Review the following vocabulary words:

   coal: a black mineral that can be burned for energy
   mine (verb): to remove natural resources from the ground by digging
   surface mining: removing layers of earth to recover a natural resource
   natural resource: something in nature that can be used to improve lives
   reclamation: putting things back the way they were found
3. Explain to the students that they will build their own plots of land that contain coal deposits.
4. Discuss how the earth is made of layers of different materials. *(See Geothermal section of infobook for diagram.)* In this activity, the layers in the crust are represented by sand, clay, soil and pebbles.
5. Provide each student with a small plastic bowl and spoon. Have the students write their names on the bottoms of the bowls with markers, then send them to the work stations.
6. Distribute the **Student Guides** and review them with the students as described below. The guides do not include the explanation of geological layers as described below:

   Get a lump of clay about the size of a lemon.

   Roll the clay flat and press it into the bottom of your container.

   This represents the clay layer in the earth.

   Place one spoonful of coal on an area of the clay and flatten it. (This coal layer should not be distributed evenly throughout the clay; it should take up only a small area of the clay.)

   This represents a seam of coal on top of the clay layer.

   Spread 6 spoonsful of gray pebbles on top of the coal. Make a hill with the pebbles.

   This represents the shale that typically covers a layer of coal.

   Spread 7 spoonsful of white pebbles on top of the gray pebbles.

   This represents a layer of limestone.

   Spread 8 spoonsful of gray pebbles on top of the white pebbles.

   This represents another layer of shale.

   Spread 10 spoonsful of sand on top of the pebbles.

This represents sandy, rocky soil.

Spread 12 spoonsful of topsoil on top of the sand.

This represents fertile topsoil.

Use cut grass, leaves, and twigs to make fields and forests on your plot of land.

7. After the students have finished their plots of land, have them clean up and store them until tomorrow. The topsoil, grass seeds and spoons will be needed again.
8. Discuss how the earth is made of layers of different types of rocks, topsoil, clay and water. Some of these layers contain natural resources that we use for many different things. Have the students look at the geothermal section in the Infobooks to see the diagram of the earth's layers.

PREPARATION–DAY TWO

1. Again cover the work stations with newspaper and put bowls of topsoil and grass seed at each station. Place clear drinking straws and spoons at each station, also.

PROCEDURE–DAY TWO

GEOLOGY AND MINING

1. Discuss with the students things they use that are made from natural resources found underground, such as:

   pencils made from graphite

   jewelry made from gold, silver, gemstones

   plastic items made from petroleum

   nylon and polyester clothes made from petroleum

   anything metal

   coal used to generate electricity

   natural gas, petroleum and uranium used to generate electricity

   steam from geysers—geothermal energy

2. Discuss how we remove coal and other natural resources buried in the earth, using the mining transparency.
3. Make a **KWL Chart** about mining. On a chart or chalkboard, draw a table with three columns. Label the columns K, W, and L.

   The K stands for Know. Ask what the students know about mining, and record their responses in the K column.

   The W stands for Want to Know. Ask what the students want to know about mining, and record the responses in the W column. Tell the students they can add to this column at any time.

   The L stands for Learned. Leave the L column blank. The students will add to this column during and after the activity as they learn new information.

4. Have students retrieve their plots of land and return to the work stations. Explain that they will be mining the coal from their plots of land.

5. Instruct the students to take core samples of their plots, using drinking straws to carefully probe the soil. Explain how to cover the end of the straw with a finger and carefully remove the straw to look at its contents. *If the pebbles are too large, this step of the activity will not work.*
6. The students must use their spoons to carefully remove each layer of grass, sand, and pebbles, placing each layer in a separate pile on the newspaper. This simulates the use of bulldozers and other machines to move layers of earth.
7. When the coal layer is reached, the spoons should be used to remove the coal. Have the students place the coal in the coal receptacle you designate. *A toy dump truck or train car works nicely.*
8. When the mining is complete, discuss with the students what they have learned in the mining process. Have students add to the W and L columns on the KWL chart.

RECLAMATION

1. Discuss with the students whether or not they should leave the plots of land as they are. Introduce the concept of reclamation. By law, real mine sites must be restored so that they are as much as possible like they were before the mining.
2. Direct the students to reclaim their plots of land. They should replace all of the layers so that they are the same as they were before the land was mined, except for the grass, leaves and twigs, which must be thrown away because they are dead. New growing things must be planted.
3. When they have replaced the dirt layer, have them sprinkle two pinches of grass seed onto the soil, then cover the seeds with a layer of topsoil. Have them water the soil and place the plots of land in a sunny area.
4. After the work stations have been cleaned, bring the class together to discuss the reclamation process and add to the KWL chart. Lead the discussion by asking the following questions:

   Was it easy to replace each layer exactly as it was? *Reclamation is difficult and expensive. Imagine if the plots of land in our experiment were as big as our playground! It would take time and effort to replace the land.*

   Why is it important to reclaim mined land? *The resources we get from the earth are important to our lives. The environment that surrounds and covers those resources is equally important. It is our responsibility to return the land to a state that is as good as, or better than, it was before we removed the resources.*

   What happens when land is not reclaimed? *What did our room look like right after we had mined our coal? It was a mess! We couldn't use it for the things we needed to do in our room. We needed to clean it up so that it was useful to us again. It is important to respect the earth. Land that is not reclaimed ends up being an empty pit. It is ugly and can't be used. Reclaimed land can be used for farmland, camping, lakes, planting trees, livestock grazing, homes, golf courses, and many other things.*

   Could you plant trees and build homes on the site as soon as the earth is reclaimed? *It depends on many factors. The depth of the mine, the weather and the type of soil in the mine can affect how long it takes before the land to be used for planting trees and building safe structures. Have the students compare how their plots looked before and after they added water.*

PROCEDURE–DAY THREE

1. Have the students add to the W and L columns of the KWL chart the things they learned about reclamation in yesterday's activity, and things the activity made them want to know more about.
2. Discuss and/or demonstrate what happens to coal after it is mined: The coal is transported by train, barge or truck to the power plant; the coal is cleaned of impurities; the coal is burned in the boiler of the power plant; the heat from the burning coal is used to heat water into steam; the steam rushes through a pipe and spins a turbine; the turbine is connected to a generator that produces electricity; the electricity travels by power lines to businesses and homes.
3. Have the students complete the **Coal Chain** activity (page 12).
4. Use *A Cool Coal Story* in NEED's **Primary Energy Stories and More** to have students act out the formation and mining of coal, and its use to generate electricity.
5. Review the KWL chart and have students complete the **Review** (page 13).
6. Evaluate the activity with the students using the **Evaluation Form** (page 15), and mail or fax the evaluation to NEED.

EXTENSIONS:

1. Invite a representative from a local coal company or electric utility to the classroom to discuss the coal industry and help the students answer more of the W questions on the KWL chart.
2. Have the students precisely measure all of the materials used in their plots of land by weight or volume, or both, and record the data before and after the activity.
3. The following children's books are about coal: In Coal Country by Judith Hendershot, Dragonfly Books, 1987, and Mama Was A Miner, by George Ella Lyon, Orchard Books, 1994.
4. Have the students draw maps of their plots, showing where the coal is located.
5. (For older students) Rather than providing copies of page 11, give students blank cross-sections of plots and have them label and color the layers. Instruct the students to use their diagrams during the reclamation activity.

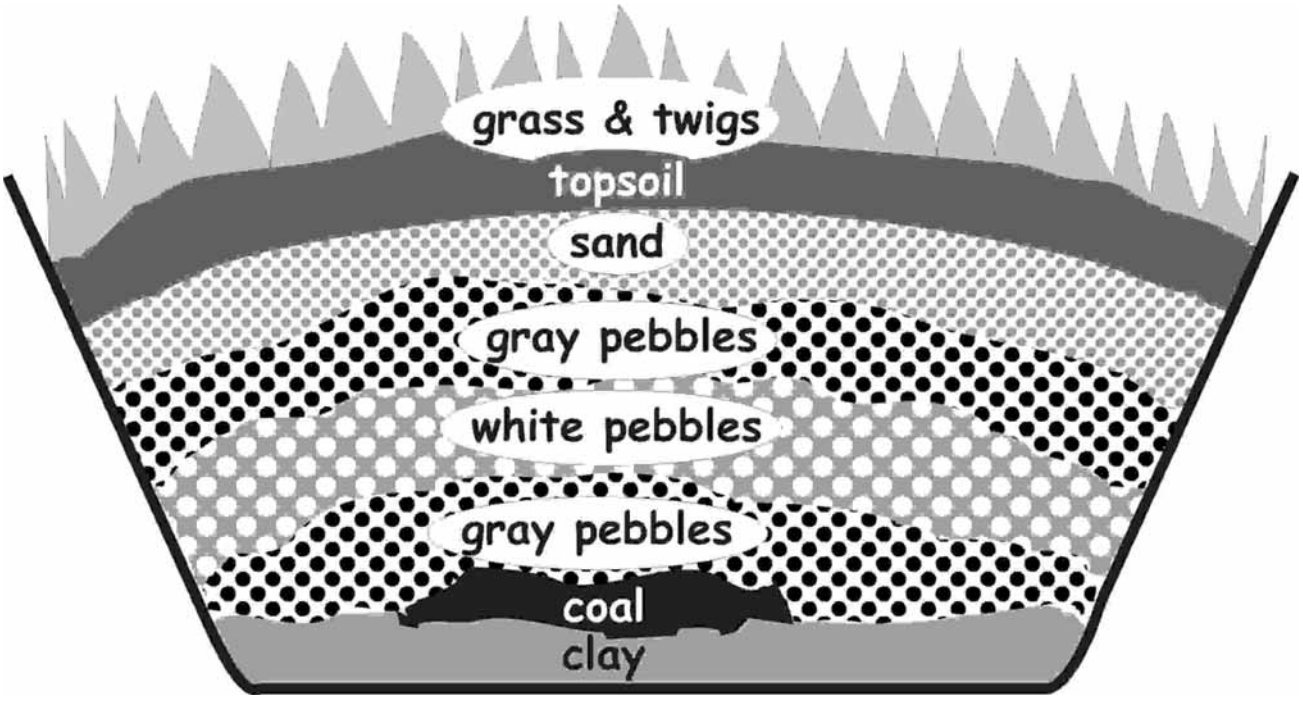
STUDENT GUIDE

THIS MINE OF MINE

Follow these steps to build your plot of land. Check off each step in the box on the left as you do it.

- ☐ **Get a lump of clay about the size of a lemon.**
- ☐ **Flatten the clay into the bottom of your container.**
- ☐ **Put 1 spoonful of coal in any area of the clay and spread it flat.**
- ☐ **Spread 6 spoonsful of gray pebbles over the coal, making a small hill.**
- ☐ **Spread 7 spoonsful of white pebbles evenly into the container.**
- ☐ **Spread 8 spoonsful of gray pebbles evenly into the container.**
- ☐ **Spread 10 spoonsful of sand evenly into the container.**
- ☐ **Spread 12 spoonsful of topsoil evenly into the container.**
- ☐ **Use cut grass, leaves and twigs to make fields and forests on the top.**

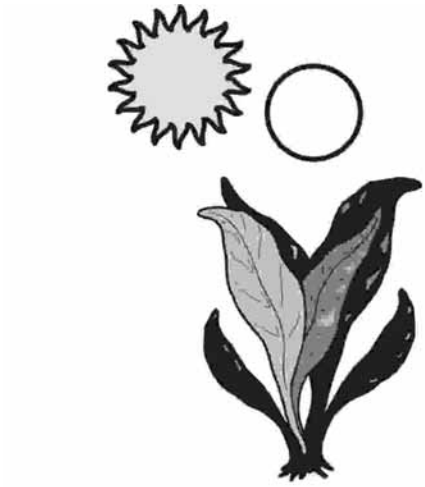
This is what your plot of land should look like:

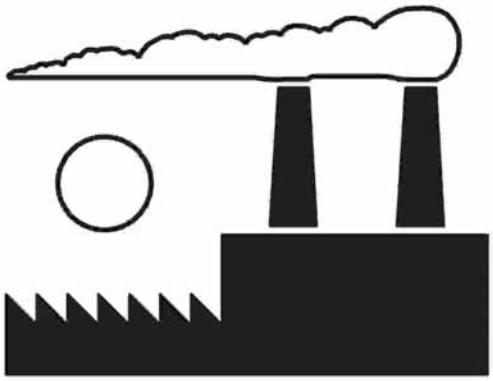


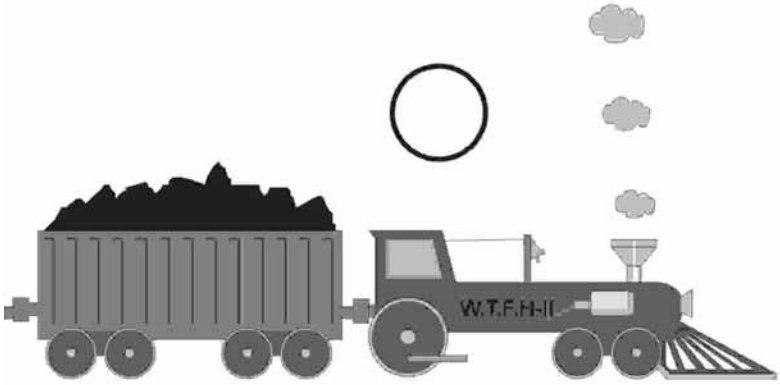
COAL CHAIN

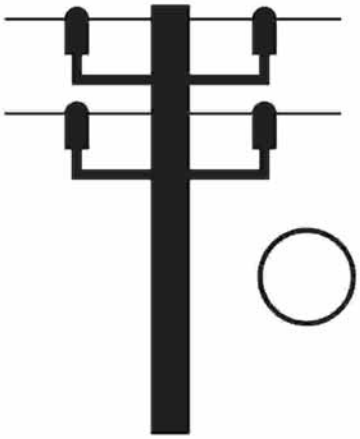
THIS MINE OF MINE

Number the circles from 1 to 6 to show the chain of coal from its formation to its use in your home. On the back of the page, write a sentence to explain each number.









REVIEW

THIS MINE OF MINE

Answer each question with a complete sentence.

1. **What is a natural resource?**

2. **Why is coal a natural resource?**

3. **How was coal formed?**

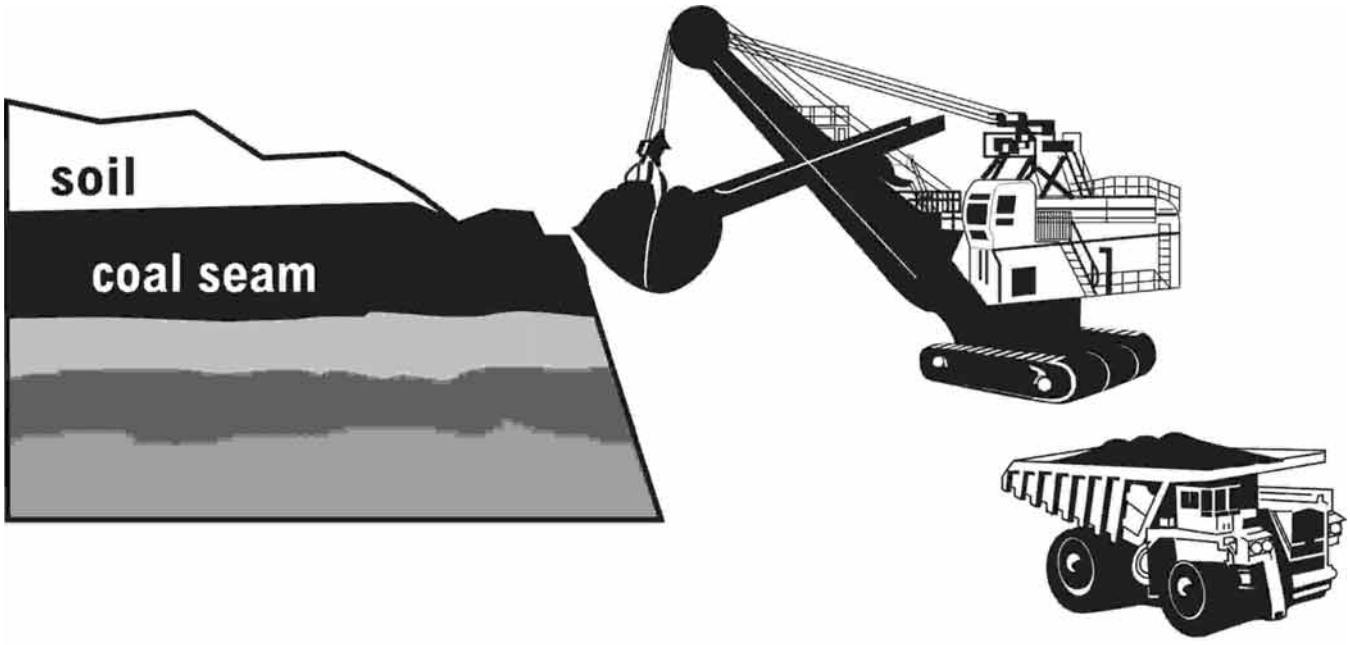
4. **Where do we find coal?**

5. **How do we get coal?**

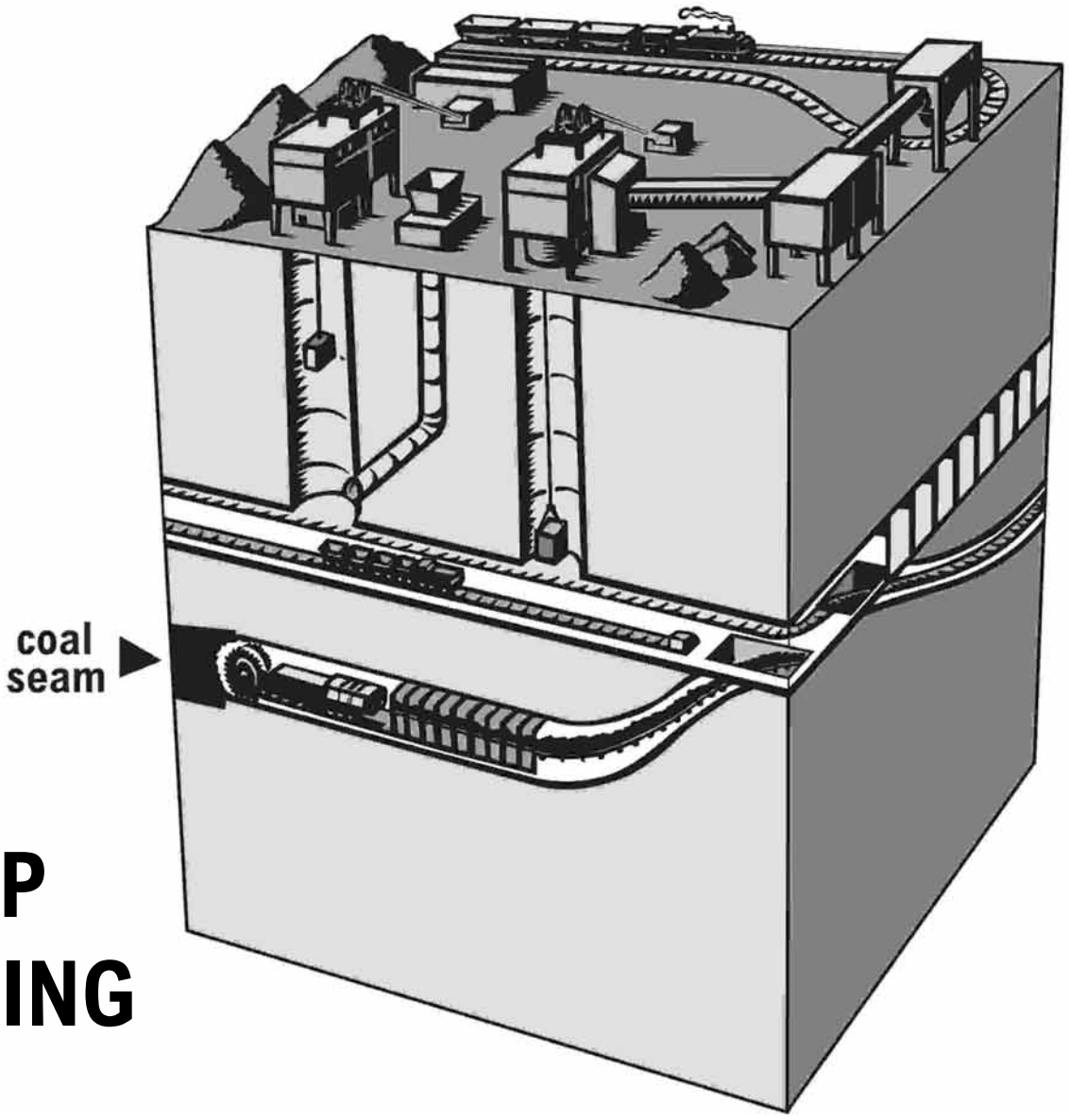
6. **Why is it important to reclaim land after it is mined?**

7. **How do we use the energy in coal?**

SURFACE MINING



DEEP MINING



THIS MINE OF MINE

Evaluation Form

State: _____ **Grade Level:** _____ **Number of Students:** _____

1. Did you conduct the entire activity?	Yes	No
2. Were the instructions clear and easy to follow?	Yes	No
3. Did the activity meet your academic objectives?	Yes	No
4. Was the activity age appropriate?	Yes	No
5. Were the allotted times sufficient to conduct the activity?	Yes	No
6. Was the activity easy to use?	Yes	No
7. Was the preparation required acceptable for the activity?	Yes	No
8. Were the students interested and motivated?	Yes	No
9. Was the energy knowledge content age appropriate?	Yes	No
10. Would you use the activity again?	Yes	No

How would you rate the activity overall (excellent, good, fair, poor)?

How would your students rate the activity overall (excellent, good, fair, poor)?

What would make the activity more useful to you?

Other Comments:

Please fax or mail to:
NEED Project
PO Box 10101
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FAX: 1-800-847-1820

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Maine Energy Education Project
Maine Public Service Company
Marianas Islands Energy Office
Maryland Energy Administration
Massachusetts Division of Energy Resources
Michigan Energy Office
Michigan Oil and Gas Producers Education Foundation
Minerals Management Service – U.S. Department of the Interior
Mississippi Development Authority–Energy Division
Montana Energy Education Council
Narragansett Electric – A National Grid Company
NASA Educator Resource Center–WV
National Alternative Fuels Training Center–West Virginia University
National Association of State Energy Officials
National Association of State Universities and Land Grant Colleges
National Hydropower Association
National Ocean Industries Association
National Renewable Energy Laboratory
Nebraska Public Power District
New Jersey Department of Environmental Protection
New York Power Authority
New Mexico Oil Corporation
New Mexico Landman's Association
North Carolina Department of Administration–State Energy Office
Offshore Energy Center/Ocean Star/OEC Society
Offshore Technology Conference
Ohio Energy Project
Pacific Gas and Electric Company
PECO
Petroleum Equipment Suppliers Association
Poudre School District–CO
Puerto Rico Energy Affairs Administration
Puget Sound Energy
Roswell Climate Change Committee
Roswell Geological Society
Rhode Island State Energy Office
Sacramento Municipal Utility District
Saudi Aramco
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