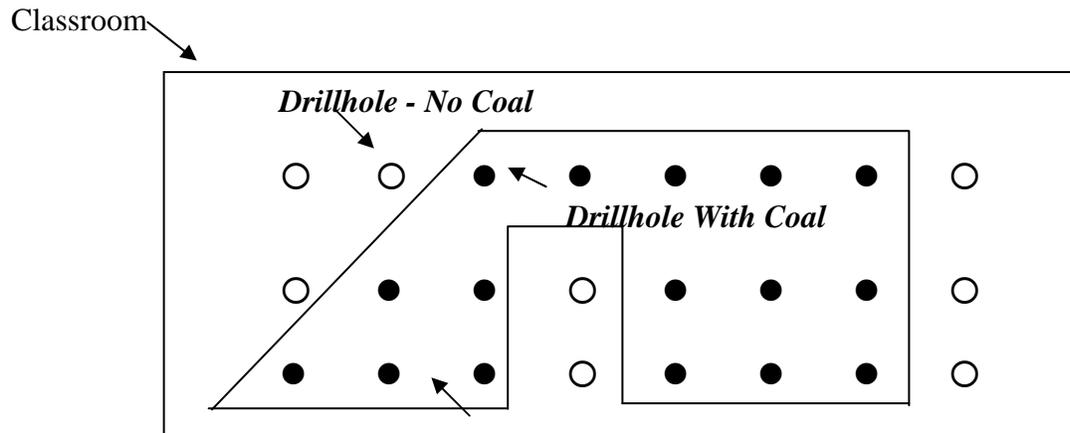


Geology Drilling Activity

This exercise allows the teacher to use the classroom as a potential mining property with each student becoming a potential drilling site. Hand each student a sheet of paper face down with either the words "COAL" or "NO COAL" written on them. Do not let the students turn over the sheets. The diagram below gives an example of where to hand out the "COAL" and "NO COAL" sheets. The teacher can modify this diagram to fit his/her actual classroom. Have the students decide where to drill the first hole and have the student turn over his sheet. Use a blackboard with a diagram of the room to show the location and if the student found coal. Ask where the students will drill next. As holes with and without coal are encountered, draw a line showing where the edge of the coal is. Until the first "NO COAL" hole is encountered, there should be coal everywhere. Modify the edge of the coal line as more drillholes are selected. The students should soon realize that as more drilling is completed, the edge of the coal line becomes more defined. Also, "NO COAL" areas within the field as shown in the diagram below can be identified.



Cookie Mining Activity

Purpose: The purpose of this exercise is to give the player an introduction to the economics of mining. This is accomplished through the player purchasing "property" and "mining equipment," paying for the mining of the "ore," and for any reclamation costs. In return, the player receives income from the "ore" mined. The objective of the game is to make as much profit as possible.

Instructions:

1. Each player receives a Mining Income and Expense Sheet and a sheet of grid paper.
2. Each player purchases his/her mining property (Cookie). Available properties include:

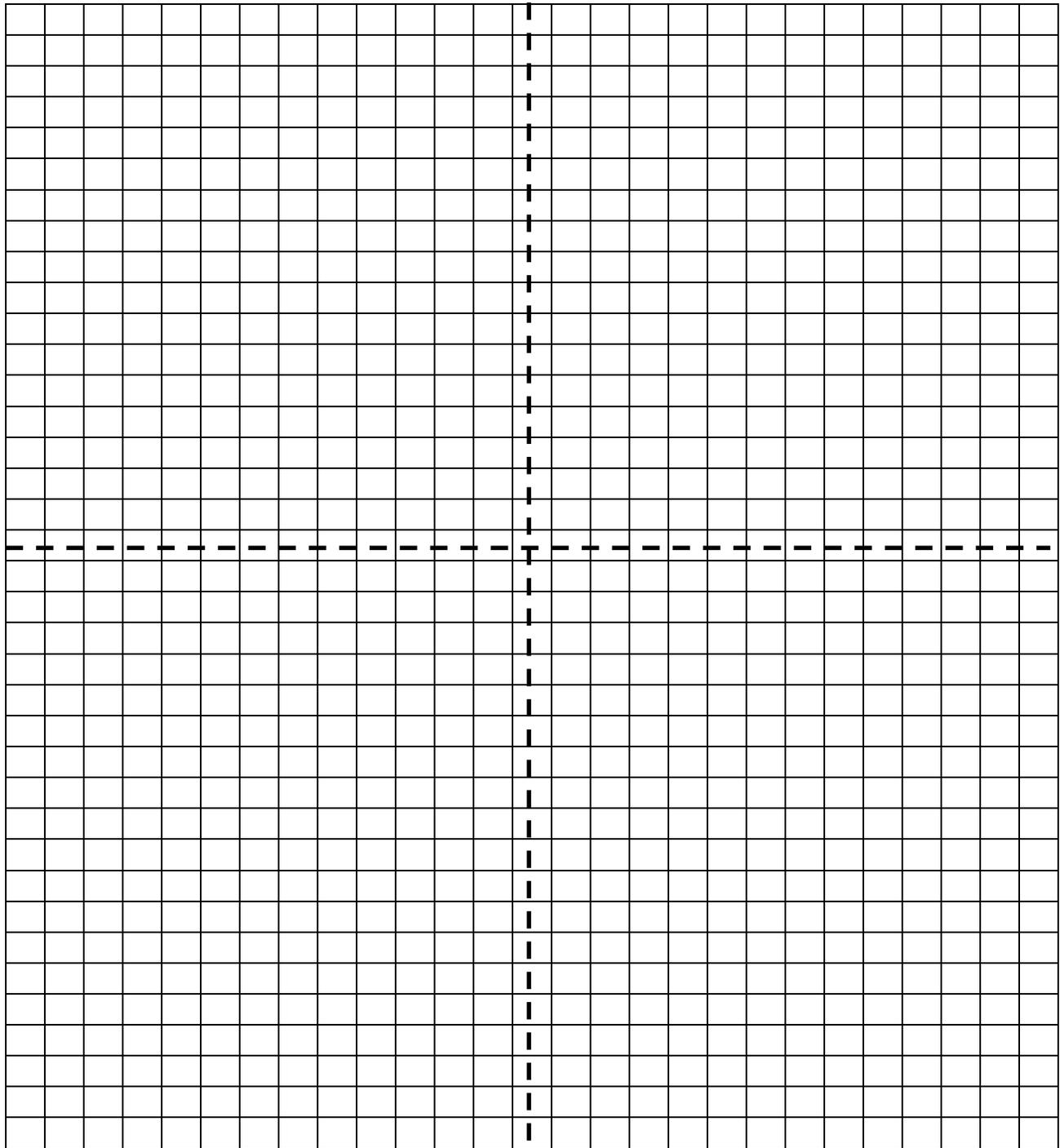
Brand X Cookie	\$2.00
Chips Ahoy	\$4.00
Chips Deluxe	\$6.00
3. The cookie is placed on the grid paper and the outline traced with a pencil. This outlines the limit of mining.
4. Each player then purchases his/her mining equipment. More than one piece or type of equipment may be purchased. Available mining equipment includes:

Flat Toothpick	\$1.00
Round Toothpick	\$2.00
Paper Clip	\$3.00
5. Each player uses his/her own equipment; equipment cannot be shared. Also, broken equipment cannot be replaced.
6. Mining costs are \$2.00 per minute. Each player declares when mining is complete at which time an inspector will state actual mining time. Before declaring mining complete, player should reclaim the mining area by moving all waste inside the cookie circle or a reclamation penalty of \$1.00 per grid square will be assessed.
7. "Ore" Chips should be moved outside the mining limit then counted for sale. Regular chips bring \$2.00 per chip while Deluxe chips bring \$3.00 per chip. Broken chips may be combined to make 1 whole chip.
8. Mining must be completed utilizing tools only, no hands or fingers are allowed to touch the "property" or "ore."
9. After completion of mining, player tallies up his/her income and expenses to determine if a profit or loss was made. Player may then consume all ore and waste.

Review: The game provides the player an opportunity to make a profit utilizing a mining property and the resources provided. Decisions are made by the player to determine which property to buy and which piece or pieces of mining equipment to purchase.

The player will learn a simplified cash flow for an operating mine. Also, the player will learn about the difficulty of reclamation, especially in returning the cookie back to its original size rather than be assessed a penalty.

Cookie Mining (continued)
cut this grid paper in four parts



Mining Income and Expense Sheet

_____ Mining Company

Expenses

Mining Claim

Brand X * \$2.00 = _____

Chips Ahoy * \$4.00 = _____

Chips Deluxe * \$6.00 = _____

Total Mining Claim Expense:

Capital Equipment

Flat Toothpick * \$1.00 = _____

Round Toothpick * \$2.00 = _____

Paper Clip * \$3.00 = _____

Total Equipment Expense:

Total Capital Required:
(Mining Claim + Equipment Expense)

Total Equipment Expense:
(Total Capital Required * 10%)

Mining and Reclamation

Minutes Mining Time * \$2.00 =

Squares Reclaimed * \$1.00 =

Total Mining and Reclamation Expense:

Total Expenses: -

Income

Chip Production:

Regular Chips * \$2.00 =

Deluxe Chips * \$3.00 =

Total Income: +

Net Profit/Loss:

Making Coal Activity

Overview:

Students conduct a simulation of the formation of coal and practice the essential laboratory skills of hypothesizing, observing, and explaining their findings.

Objectives:

Students will:

1. observe change over time through the simulation of forming coal through fossilizing plant materials, and

practice the skills of hypothesizing, observing, and describing the process and results of an experiment.

Time Needed:

Approximately four class periods, over four or five weeks

Materials:

- One small aquarium for classroom setup, or several 2-liter soda bottles with the tops cut off, for multiple small-group experiments
- Enough fine- to medium-grain sand to cover 2 inches of each aquarium
- Fern fronds (leaves)
- Twigs
- Plant leaves
- Screen(s) or sifter(s)
- Fine silt or mud
- Student science journals

Procedure:

1. Explain to students that to simulate a process is to imitate it or create a model that shows how that process occurs. When we simulate a process like coal formation, for example, we study what conditions exist for coal to form from fossilized plant materials. A simulation does not need to be an exact replication of a process for it to demonstrate how something happens in the natural world.
2. Tell students they will create their own (or a classroom) "fossil fuel" over the course of the next four weeks and will observe how that fossil forms.

3. Explain that coal is an example of a fossil fuel. Remind students that a fossil fuel is a fuel that has formed in the earth from the remains of plants or animals that lived as long as 400 million years ago. Ask students: Can you think of other fossil fuels (e.g., oil, natural gas)? Coal is formed from a combination of plant material, heat, pressure, and time. The process of coal formation takes millions of years to complete and is still taking place today. Although students will not actually create coal in this activity, they will see how the fossilization process occurs.
4. Begin the experiment by separating students into small groups or by creating a single aquarium for the class to study. Line the aquarium(s) with plastic wrap so that you can lift the entire formation out when it is dry. Next, pour water into each aquarium to a depth of 4 to 6 inches. Then spread about 2 inches of sand on the bottom, followed by small leaves, sticks, and pieces of fern.
5. Once each aquarium is set up, have students record their observations in their journal. Students should describe what the aquarium looks like, as well as what textures and colors they notice in the sand and foliage. Ask them what changes they think might occur over a few weeks if the aquarium is left untouched. Have them record their hypothesis in their journal. Tell them to watch the aquarium change over the course of the next four weeks. Each day, have them record any changes in color and water level.
6. After two weeks, use the screen or sifter to gently sift fine silt or mud on top of the plant layer to a depth of 2 inches. This replicates the natural fossilizing process of contributing heat and pressure to the vegetation. Make sure students continue to document any changes they see. They should adjust their hypotheses if necessary.
7. Wait another two weeks and drain any water that remains. Let the formation sit and dry for another week or two. Once it is dry, carefully lift the entire formation out of the container(s). Tell the students they have simulated the early stages of coal formation. Gently break the formation into layers to reveal the fossil-like imprints from the plants.

Assessment:

Have students prepare a summary of the simulation, including how it was set up and how it changed (before and after intervention). Then have each student determine whether his or her hypothesis was correct.

Differentiation:

To make the most of each student's strengths, arrange the teams so that each consists of students with good observational skills and students with good writing skills. Allow them to discuss their observations and prepare their journal entries together.