MINING FOR CHOCOLATE

METHOD

After matching everyday products to their natural sources, students "mine" chocolate chip cookies to discover possible impacts of mining operations.

MATERIALS

Part 1:
- Matching Worksheet
- 2-3 items from the Matching Worksheet

Part 2:
- Hard chocolate chip cookies or non-food cookies*
- Toothpicks
- Napkins
- Mining Area Grid (provided)

* Recipe for non-food cookies on page 6

INTRODUCTION

Many of the products we use every day – from televisions to cell phones and crayons to concrete – are produced from rocks mined from the Earth. These valuable rocks are considered a **nonrenewable resource**. There is only a set amount of these resources available on our planet. Once they are used, they will be gone forever (or at least for the next couple of million years that it takes the Earth to make more).

When a rock contains materials valuable to people, the rock is called an **ore**. Extracting ore from the Earth is typically done by mining. Large-scale mining operations exist all over the world. On one hand, selling the ore can create profit, provide jobs, and supply necessary materials to create items people want and need. On the other hand, mining operations can harm animal habitat, introduce pollution into ecosystems, displace animals and people, and impact the health of people who live nearby. Balancing these two extremes is critical for a sustainable future.

COUNTING ON PEOPLE
K-5 Activities for Global Citizenship

CONCEPT
Nonrenewable resources are mined from the Earth to meet the wants and needs of humans. Though mines have economic benefits, there can be environmental costs and impacts on communities.

GRADE LEVEL
Upper elementary

SUBJECTS
Science, Social Studies, Math

OBJECTIVES
Students will be able to:
- Match everyday items with the minerals used to make them.
- Name two nonrenewable resources and describe why they are considered nonrenewable.
- Identify impacts mining can have on surrounding land and communities.
- Examine the opportunity costs associated with mining operations and name two examples.

SKILLS
Using basic economic principles, estimating area, collecting data, analyzing data, identify patterns, adding and subtracting multi-digit whole numbers, multiplying within 100, understanding cause and effect

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PART 1: MATCHING ITEMS

PROCEDURE

1. Bring a few of items from the Matching Worksheet, like a pencil, power cord or can of vegetables, into class. As a class, brainstorm all of the materials needed to make at least one of the items. List the materials on the board. Students may need help figuring out which resources are needed to make some of the materials.

   Pencil: wood (trees), graphite (rocks), paint (dye from chemicals, water, resin from trees), eraser (rubber from trees), metal (aluminum from rocks); Power cord: plastic covering (oil, salt water), wire (copper from rocks), plug (brass from rocks); Can of food: label (paper from trees, ink), can (aluminum from rocks), food (grown on a farm).

2. Ask volunteers to come up to the board and circle all of the materials that come from rocks, metals, or that might be mined out of the ground. Let students know that these are examples of nonrenewable resources.

3. Define the term nonrenewable resource.

   Nonrenewable resource: a resource from the Earth that cannot be replaced or remade within our lifetime (or many lifetimes).

   Explain that once nonrenewable resources are used up, there will be no more on our planet for a very long time. Many of these nonrenewable resources come from rocks buried underground, and we must mine them in order to use them in our daily lives.

4. Distribute the Matching Worksheet to each student. After students have completed the matching, go over the answers as a class.

MATCHING WORKSHEET ANSWERS

1.D; 2.K; 3.L; 4.O; 5.C; 6.M; 7.A; 8.B; 9.N; 10.J; 11.G; 12.E; 13.P; 14.I; 15.F; 16.H

PART 2: HANDS-ON MINING

PROCEDURE

1. Tell students that **ore** is a rock that has enough of a valuable material in it to sell. Let students know that they will be simulating what it is like to mine ore from the ground. You may wish to have the class choose a specific ore from the Matching Worksheet that students will pretend to mine.

2. Distribute the Mining Area Grid to each student. Point out the key at the bottom of the page. Explain that the images on the grid represent various attributes of the environment located in the area where they'll be mining. Distribute the cookies to the students (they must not eat them!). Explain that the cookies represent the land that will be mined and the chocolate chips represent the valuable ore.

3. Students choose a location for their mine by placing their cookie on the grid and, using a pencil, tracing the outline of the cookie. Students should consider which attributes will be covered by their cookie, and therefore will be replaced by their mining operation.

4. Distribute one toothpick to each student. Students will attempt to extract the chips from the cookie using their toothpick. Cookies should stay flat on the paper (in the real world, you can't pick up a chunk of the Earth and dig from the bottom!). Chocolate chips can be gathered off the grid for counting after extracting them from the cookie. Crumbs should remain on the grid where they fall.

5. After mining is complete, ask students to outline the area on their grid paper that is covered by cookie crumbs. A rough estimate is fine; this doesn't need to be exact.

6. Challenge students to "reclaim" the land. Using just the toothpick (no hands!) instruct them to try and get the cookie crumbs and pieces back inside the original circle. The chocolate chips can remain off to the side of the grid.

7. Ask the students to count the number of chips they extracted. If you wish, you can assign a value of $100 to each chip that was extracted, and students can calculate how much money they made. Broken chips can be combined and counted as one chip.

8. Ask for a couple of volunteers with different amounts of chips extracted to bring their cookie mines to the front. Or, alternatively, all students line up with their mines according to the amount of chips they extracted (or the amount of money they made) and allow students to do a gallery walk. You want students to see a variety of outcomes from the mining simulation.

DISCUSSION QUESTIONS

1. What observations can you make of the cookie mines? What do you notice when comparing different mining techniques? What mining strategies made the most money? Which mines impacted the environment the most (had the largest outline of crumbs)?

   Observations may include how intact or broken the cookies are, how spread out are the crumbs, that mining tools (the toothpicks) may have broken, etc. Often mines that extracted the most ore (chocolate chips) had the biggest impact on the surrounding environment (crumbs spread over more of the grid). The mines that extracted the most ore also made the most money.

2. What do you think it symbolized when a square on your grid had cookie crumbs on it? What is a real-life example of how a mining operation might impact the types of things on your grid: trees, bobcat habitat, rich top soil, water, and neighborhoods?

   If a grid square had crumbs on it, then it was changed or damaged. Some examples might include: trees – cutting down trees to make space for the mine; water – mining waste entering a river and making it unsafe for fish; neighborhoods – a family having to move because of pollution near the mine; bobcat habitat – bobcats moving because their natural habitat is no longer safe.

3. Consider the squares that have been “reclaimed” – those located between the original circle and the new outline that were cleared of crumbs? After removing the crumbs, are those areas back to normal? What are some real-world ways a mining company can restore land?

   Even the reclaimed squares still have some crumbs and grease spots; they are forever changed. In the real world, a mining company might try to replant trees or clean waste from a river. Even if they try to clean up, it will take years for the trees to regrow and all the animals to return. The new forest might look different from the original forest. And pollution might stay in the ground, water, or air long after the mining is done, and continue to harm people and animals. So while mining companies can help, the land won’t be exactly the same as it was before mining.

4. What were some ways that the impacts of mining might spread beyond the outer circle?

   If pollution from mining enters a river or stream, the water could carry it further away from the mine. Wind can pick up air pollution and spread it far away. Animals or people might eat or drink some pollution and carry it to other places or pass it on to offspring.

5. Ask students to brainstorm some pros and cons that came from their mining operation. What were some of the benefits from their mining operation? What was lost during the mining operation?

   Pros may include: made money; got ore that people want for things they use in their lives; created jobs. Cons may include: the mine impacted a lot of the grid; there’s pollution in some neighboring communities; pollution entered the water and went downstream; animal habitat was destroyed.

6. Define the concept of opportunity cost and provide an example.

   Opportunity cost: the value of the next best choice that one gives up when making a decision.

   Example: You choose to go to a movie on a school night. If you had not gone to the movie, you would have stayed home and finished a homework assignment. Since opportunity cost is the value of what you did not do, the opportunity cost of going to the movie would be the value of completing your homework.

   What were opportunity costs of your mining? What did you give up in order to mine in your grid?

   If no mining had occurred, the land could have been used for animal habitat, for people to live, for trees to make more air to breathe, or a farm to grow food. The opportunity cost of the mine is the value of what the habitats, farms, forests, and communities could have provided. It’s really difficult to measure the value of some of the things that were lost.

7. In what ways was your cookie mine similar to real mining operations? In what ways did your cookie mining not match real life?

   Answers may include: just like the cookie, real mining operations can change the surrounding environment and impact wild habitats and people; unlike my cookie, there are many different ways to mine; sometimes mines do not destroy all of the top layer of ground to get at the rocks below; usually mining companies do not relocate entire communities in order to mine; there are laws that mines have to follow to protect and restore the surrounding land.

Math Extension Bank

Working with Whole Numbers:

- Calculate how much money you would have if you could sell your ore for: $1 on Monday, $10 on Tuesday, and $100 on Wednesday.

  [(Number of chips) x $1] = Value of ore on Monday
  [(Number of chips) x $10] = Value of ore on Tuesday
  [(Number of chips) x $100] = Value of ore on Wednesday

- Compare your answers. What do you notice about them? Do you see any patterns?

  Answers may include: the number of zeros goes up each day, the numbers get bigger each day, the answers go from the ones place to the tens place to the hundreds place.

- If you sold your ore on Wednesday instead of Tuesday, how much more money would you have?

  [(Number of chips) x $100] – [(Number of chips) x $10] = Difference in price

- If you sold your ore on Monday instead of Tuesday, how much less money would you have?

  [(Number of chips) x $10] – [(Number of chips) x $1] = Difference in price

- After you finish mining, you must pay a "reclamation fee." This fee will be used to plant trees, restore soil, and clean up the land. If the fee is $2 per chip mined, and you want to make a profit, on which days should you sell your ore?

  You should sell on Tuesday or Wednesday. If you sold on Monday, you would pay more in fees ($2) than you would earn by selling each chip ($1).

Geometry and Area:

- Assume that each square on the Mining Area Grid represents land that is 1 km wide, 1 km long, and has an area of 1 km². Estimate the area of your original mine by counting the number of grid squares inside your original circle. Because the circle cuts through a part of some grid squares, decide how you will estimate the area along the border of your circle.

  Answers will vary and will likely be around 15 km².

- Estimate the area impacted by your mining operation by counting the grid squares inside your second, bigger circle.

- Compare the area impacted by mining (the second, bigger circle) with everyone else's area impacted by mining. Represent the area impacted by mining of everyone's mining operation using one or more of the following tools: frequency table, bar graph, line plot, or picture graph.

NON-FOOD COOKIE RECIPE

2 cups corn starch
1 cup flour
1 ½ cup water
¾ cup of small beads (such as Perler© beads)

Mix corn starch and flour together. Slowly add water until a smooth dough forms (you may not need all of the water). Fold in beads. Roll into small balls and flatten into cookie shapes. Set on wax paper or plastic wrap. Cookies can air dry overnight or cook in a 200º oven for 1.5 hours. Cookies may still be moist inside. Seal in an airtight container. If you're not using them in the next few days, store in a refrigerator. Recipe makes about 2 dozen cookies.

MEASURING LEARNING

Students write a journal entry where they answer the following questions:

1. In your own words, describe a nonrenewable resource.
2. What are two nonrenewable resources you use in your everyday life?
3. Give an example of a time when you had to make a choice. What did you choose to do, and what was the opportunity cost of that choice?

FOLLOW-UP ACTIVITIES

1. Call for inventors! Challenge students to pick one of the everyday items from the Matching Worksheet and "reinvent" it sustainably. Can the nonrenewable resource in this object be replaced with a renewable resource? Can the object be redesigned so that it does not need nonrenewable resources? Students use their imaginations and sketch out a plan for their sustainable invention. Students describe and display their proposal, or build and demonstrate a prototype. Examples might include jewelry made from clay rather than metal or writing with ink made from nuts rather than graphite.

2. Because ores are nonrenewable resources, they need to be conserved and recycled so that we don't run out. Divide students into groups, and have each group choose an ore listed on the Matching Worksheet. Groups should research one way that individuals or businesses can decrease how much of their ore is used. Groups also research one way to repurpose, reuse, or recycle items that contain the ore. Students create posters of what they learned and share their posters with the class.

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MINING FOR CHOCOLATE
MATCHING WORKSHEET

Name: _____ Date: _____

Everything listed below is produced using from ore found in rocks mined from the ground. In the blank to the left of the items listed, write the letter of the ore from which these items were made. The ores are listed at the bottom of the page.

1. _____ Soup cans

2. _____ Matches, gunpowder, rubber

3. _____ Watches, radios, televisions, computer monitors

4. _____ Pencil

5. _____ Bricks, pottery, tennis courts

6. _____ Pennies, power cords, brass instruments

7. _____ Wedding band, first-place medal, nuggets

8. _____ Soda pop cans, foil wrap, baseball bats, house siding

9. _____ Horseshoe, hammer, steel products (cars, nails, swords)

10. _____ Food seasoning and preserver

11. _____ Five-cent coins, paper clips

12. _____ Baby powder, crayons, soap

13. _____ Jewelry, drill bits

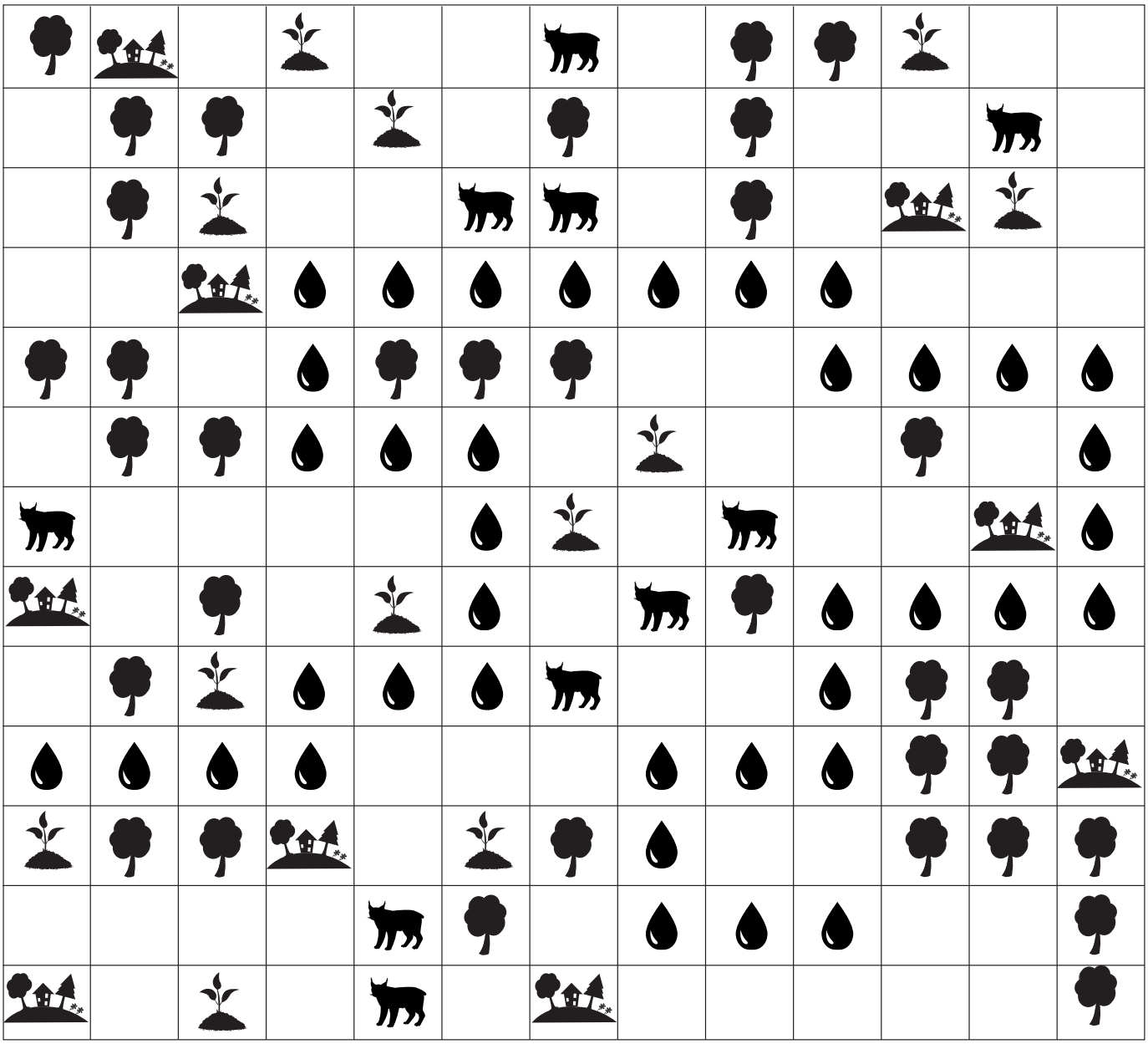
14. _____ One of the most common sources of electricity in the U.S.

15. _____ Pipes, old paint, X-ray shields

16. _____ Flatware (forks, knives, spoons), jewelry, second-place medal

A. Gold	E. Talc	I. Coal	M. Copper
B. Aluminum	F. Lead	J. Salt	N. Iron
C. Clay	G. Nickel	K. Sulfur	O. Graphite
D. Tin	H. Silver	L. Quartz	P. Diamond

MINING FOR CHOCOLATE
MINING AREA GRID



Natural Attributes:

Tree

Bobcat habitat

Rich top soil

Water

Neighborhood