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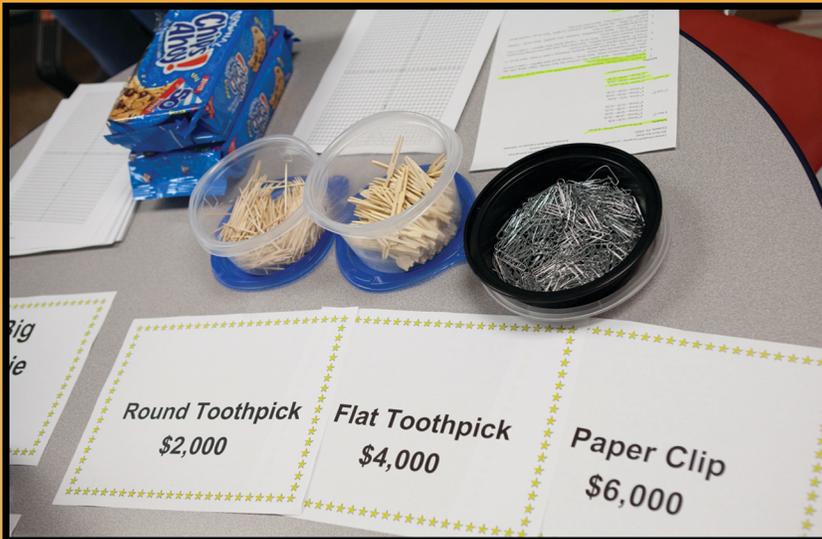
Instructions Background

Introduction

In this activity, use toothpicks and paper clips to extract chocolate chips from cookies to simulate the mining process. Students earn profit from chocolate chips “mined” and must pay for the equipment property (e.g., cookies) using “mining money.” After mining, students calculate the net profit or loss from their operation. This activity provides a fun, interactive venue for students to explore business principles and the mining process, to practice math and fine motor skills, and to discuss the importance of energy production and environmental impact.

Suggested Grade Level

This activity is most appropriate for students from grades 4-8. For younger students, the teacher may omit the questions on the second page of the student worksheet. For older students, the teacher may use enrichment activities to enhance the challenge and peak interest for the students. Examples can be found under “for further study.”



Materials List (Prices Listed in “Mining Money”)

- Flat Toothpick (\$2)
- Round Toothpick (\$4)
- Paper Clip (\$6)
- Pair of Tweezers (\$4)
- Smaller Chocolate Chip Cookies (\$1 for 2 cookies)
- Larger Chocolate Chip Cookies (\$2 for 1 cookie)
- Mining Money (optional)
- Student Worksheet, Square-Grid Graph Paper, and a Pencil

Background Discussion

Teachers may wish to begin this activity with a brief discussion about coal the mining process and its importance in society, how companies make decisions, and the importance of minimizing environmental impacts. This can be done in the context of cookie mining.

Historically, coal mining has played an important role in our nation's development, helping industry grow, providing electricity to homes and businesses, and increasing our standard of living. Coal has also played an important role in the economic and social development of individual states, including West Virginia, Pennsylvania, Kentucky, and Wyoming, and many others. Some examples of specific developments that relied on coal are the development of the power grid, the growth of the railway network, industrialization in cities and the countryside, and the establishment of labor unions.



Here and abroad, the coal mining process involves one of two methods:
underground mining and surface mining.

Underground mining is the predominant form of extraction. Miners descend underground to the level of the coal and dig it out, sending it via conveyor belts and underground rail systems to the surface. Modern techniques utilize massive digging machines called *continuous miners* capable of extracting between 5 and 50 tons of coal per minute.

Surface mining involves blasting and digging into the Earth to access coal seams closer to the surface. The coal is then moved by enormous Earth movers onto giant trucks or conveyor belts to be loaded onto trains or tractor-trailers. Federal law mandates that, upon completion of operations, the land effected by a surface mine be returned to its original state.

Once the coal is removed, regardless of the method of extraction, it is sent to a refinery to remove debris and contaminants and to standardize the coal particles, as approximately 30% of the coal mined is dirt and rocks. The coal is sorted by size on conveyor belts and then put in large water baths. The coal floats to the surface and the debris sinks. To dry the coal, operators put it in massive spinning dryers, similar to those found in your own home. The coal is then crushed down to a uniform size and either burned at an on-site power plant or shipped via train to other power plants. The refining process, incredibly, only takes 15 minutes.

Background Discussion cont.

Surface mining requires a significantly smaller ratio of man power to coal mined than underground mining does. Both methods involve safety issues, as well as, environmental impacts. Over the last century, federal and state regulations have been put into place to better protect the people who carry out mining activities and our environment. In response, researchers in government and have developed countless technologies and techniques that protect miners and reduce impact to our air, land, and water.



In the context of cookie mining, minimizing environmental impact looks like this: not making a mess! It is here that teachers can present the metaphor of the cooking mining site. In a real-world scenario, the goal of the coal industry is to return the land back to its original state after the mining process, if not, improve it. This process is called *land reclamation*, and it is mandated by law. During this activity, students can contribute their ideas about the difficulties of land reclamation, both in the world of coal and cookies, as well as, discussing its importance.

With regard to business decisions, students can discuss trade-offs, the concept of net profit, and different costs of the cookie mining industry. These costs, in our context, are accrued property, equipment, labor, and land reclamation. Trade-offs and net profit are important to discuss before-hand, as students may not understand the concept of paying more capital for a more efficient and lucrative outcome, eg., buying the more expensive paper clip because it is a more effective mining tool and will save money in labor costs.



Activity Description

1. Hand out the Cookie Mining Student Worksheet to each student
2. Introduce ideas and facilitate an involved discussion from the Background Discussion topics
3. Explain the process of the activity to the students
4. Give each student 20 Mining Money Dollars. This can be in the form of printed "mining" money or can simply be recorded as credit on the worksheet.
5. Students, then purchase individual mining equipment (toothpicks and paper clips) and mining property (cookies), prices for which are found in the Materials List. Have students record their purchases on the Cookie Mining Student Worksheet. Students can purchase additional replacement tools during the mining process as needed. Students may not use broken tools.
6. Each student takes their cookie(s) and traces a circle around it on a piece of square-grid graphing paper. All squares that touch the line will be considered "inside" the mining area, which is important to note for reclamation.
7. The students now choose to mine their cookies for 1 to 4 minutes. Explain that the mining cost of each minute is \$1 and that each chocolate chip mined yields \$2. The students may use only the tools purchased and may not touch the cookie with their fingers or hands or use other student's tools.
8. The students now record the number of chocolate chips mined and the amount of time taken for the mining process on the Cookie Mining Student Worksheet.
9. After the Mining Process, the students choose to have either one or two minutes to reclaim their property. In this time, students should only use their tools to attempt to replace all the cookie crumbs back into the original drawn circle.
10. The students now record the time taken for land reclamation and the number of squares outside the circle with cookie crumbs present. Again, note that any square touching the drawn line is considered inside the circle.
11. The students now calculate their net profit or loss and complete the questions on the Cookie Mining Student Worksheet.
12. Debrief the activity as a group.



For Further Study

Here are some ideas for further developing NETL's cookie mining activity.



1. Challenge students to develop techniques for extracting the chocolate chips using other methods. An example of this could be water baths. For example, the cookies could represent the coal extracted for refining, where $\frac{1}{3}$ of the 'coal' is debris. The activity would then represent the refining process.



2. Have the students write a research or opinion paper discussing an aspect of this activity as it relates to the real-world activity of mining. Investigations can cover topics such as the science behind the coal mining process (e.g., specific gravity: how does coal "float" on "water" during the refining process?); the stages of coal formation, types of coal and how they differ; the chemistry and reactions of air, water, and the minerals and gasses in coal resulting from underground mining; coal's affects on social or economic systems; coal gasification technology; or how coal is transformed into energy. Encourage the students to get creative and to follow their interests when choosing a topic for development.



3. Have small groups of students develop the most efficient cookie mining scheme. Require tests for efficiency to statistically validate their methods. Efficiencies can measure weight of product versus waste (an accurate scale is required), area of unaffected land before and after mining, or the time required to mine the same number of cookies using different tools. An example of these formulas could be (weight of chips mined to total weight of cookie before or after) and (total squares after to total squares before). Time comparisons will vary, depending on whether reclamation is included or calculated separately. Students should be encouraged to devise formulas as needed, or use variations of the above.

For Further Study cont.

4. Technological advances can have profound effects on society. At the beginning of the 20th century most people outside large metropolitan areas in the United States did not have power to their homes, businesses or communities. As a social studies activity students can research the government and industrial partnerships that were put in place to bring electricity to rural areas. How did rural electrification change life in America? Some countries still do not have electricity outside of large cities. How do efforts to get power to their people differ from when we did it a century ago? How is it the same?

5. Water is a necessity for human life. It is also a requirement for industrial processes, including the mining industry. Ask students to prepare a report or presentation examining the uses and complications water presents to coal mining. The research should explore the environmental advances that have taken place over the last 50 years because of government research and regulation.



6. Students can conduct a brainstorming session centering on an analogy between our bodies' need for calories and our country's energy needs. This can permit comparisons of healthy foods and a healthy environment. There is potential here for creating an activity that incorporates use of the chocolate chips after the mining operations are completed. Also, it allows the students to eat the chocolate chips in the name of science!



7. The majority of electricity enters the grid from generation plants powered by coal, in the United States and across the world. This is referred to as "coal by wire." Students can research the growing use of alternative and sustainable power resources and prepare forecasts of possible energy futures based upon their research.



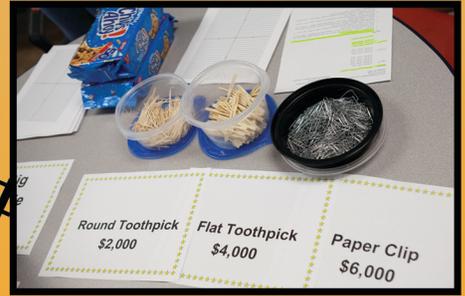
8. Coal is found in certain types of sedimentary and metamorphic geological formations, which scientist hypothesize relate to specific conditions on the ancient earth. The time they associate with coal is referred to as the Carbonaceous Era. Students can research this hypothesis to explain the name, how long ago the era occurred, hypothesized conditions of the time, and what evidence these scientists base their theories upon.



Cookie Mining Student Worksheet

Name: _____

Company Name: _____



Property Costs

Property Type: _____ Quantity: _____ Cost: _____

Property Type: _____ Quantity: _____ Cost: _____

Equipment Costs

Paper Clip Quantity: _____ x \$6 = Cost: _____

Round Toothpick Quantity: _____ x \$4 = Cost: _____

Flat Toothpick Quantity: _____ x \$2 = Cost: _____

Labor Costs

Mining Time: _____ minutes x \$1 = Cost: _____

Reclamation Time: _____ minutes x \$1 = Cost: _____

After Extraction Costs and Profits

Chips Mined: _____ chips x \$2 = _____

Profit: _____

Reclamation Impact: _____ squares x \$1 = Cost: _____

Totals

Initial Funds: _____ Dollars

-Total Costs: _____ Dollars

+Profit: _____ Dollars

=Net: _____ Dollars



Cookie Mining

Name: _____

Questions are to be completed in full sentences on a separate sheet of paper.



1. What led you to choose the tools and property you chose, and would you choose differently if repeating this activity?

2. What unforeseen challenges did you find during this activity?

Could these be similar to challenges faced by the coal mining industry?



3. How does this activity compare to the real coal mining process? What are some differences and similarities?

4. What roles does technology play in the coal mining process?

5. What affects does coal mining have on our society, environment, and economy? What are some trade-offs of this process?

6. Are chocolate chips a renewable or non-renewable resource? How do they compare with real-life resources?

7. Explain the role of reclamation in the coal mining process. Is it necessary?

8. How does the cookie compare to the land around us?

How do we preserve the cookie/the land?

Must we sometimes choose to leave some chocolate chips in order to preserve the cookie?

What if we don't, in a real-life scenario?

9. Why might net profit decrease with time?







References

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