Cookie Mining

Use delicious cookies to practice your mining skills! Calculate your economic profit to determine if mining for chocolate chip "mineral deposits" is worth the environmental cost.

TEKS:

MATH 4.4 D: The student is expected to use strategies and algorithms, including the standard algorithm, to multiply up to a four-digit number by a one-digit number and to multiply a two-digit number by a two-digit number. Strategies may include mental math, partial products, and the commutative, associative, and distributive properties.
SCI 4.7 C: The student is expected to identify and classify Earth's renewable resources, including air, plants, water, and animals; and nonrenewable resources, including coal, oil, and natural gas; and the importance of conservation.
MATH 4.10 B: The student is expected to calculate profit in a given situation.
MATH 5.9 A: The student is expected to represent categorical data with bar graphs or frequency tables and numerical data, including data sets of measurements in fractions or decimals, with dot plots or stem-and-leaf plots.
MATH 6.1 A: The student is expected to apply mathematics to problems arising in everyday life, society, and the workplace.

Materials:

- Calculator
- 3 chocolate chip cookies, each one a different type (1 should be chewy)
- 3 clear straws
- Cookie Mining Activity Sheet (attached)
- Graph paper (attached)
- Paperclip (unfolded)
- 3 paper plates
- Pencil
- Timer or watch
- 3 toothpicks

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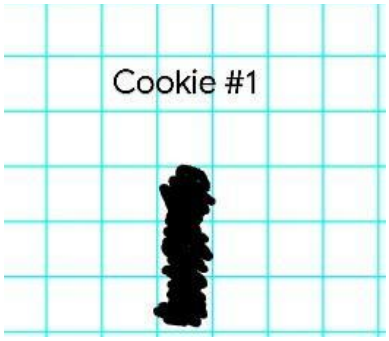
How To:

1. To begin, use a pencil to number your paper plates #1-3.
2. Next, set one cookie on top of each paper plate.
3. Observe the top surface of each cookie. Count how many chocolate chips you see and record the number on the Cookie Mining Activity Sheet (attached). These chocolate chips represent minerals!
4. Make a hypothesis for which cookie will be the most profitable on the Cookie Mining Activity Sheet.
5. Set a timer for three minutes. Using toothpicks and an unfolded paper clip, carefully dig out the "minerals" from cookie #1, starting at the top of the cookie and working your way down. "Process" these mineral deposits with your mining tools by separating the chocolate chips from the cookie crumbs. Don't forget to stop working after three minutes! NOTE: The 'Mining and Processing Fee' is calculated on the Cookie Mining Activity Sheet based on the three minutes of mining, but this would change if you mine for more or less time.
6. Next, count the number of broken pieces of cookie from your "processing" in Step 5 and calculate the 'Land Damage Fee.' Do this by multiplying the number of broken pieces by $100.00.
7. Using a clear straw, pick up each mine mineral so that you see the chocolate chips stacking up inside of the straw.
8. Line the bottom of the straw up with the bottom of the grid on the graph paper (attached). Use your pencil to shade in the squares of the graph paper up to the height of the minerals in your straw. Label this cookie #1. For example:



9. Count the number of squares shaded in and record this on the Cookie Mining Activity Sheet. Multiply this number by $500 to get the 'Value of Minerals.'
10. Finally, determine your overall 'Profit.' Add the 'Mining and Processing Fee' and the 'Land Damage Fee' together to get your 'Total Cost.' Then, subtract the 'Total Cost' from the 'Value of Minerals' to see how much you profited off of your mining skills!
11. Repeat steps #5-10 for cookies #2 and #3.
12. Review and compare the results of your cookie mining by answering the final questions on your Cookie Mining Activity Sheet.

STEM Explanation:

The cookies that you just mined represent mineral deposits, or, rocks that contain large amounts of minerals. Mineral deposits are also known as ore, and certain ores like silver and gold are very valuable! Minerals are used in many different products, including powerful batteries, smartphone screens, and hybrid cars. As the demand for these technologies increases, so will the demand for expensive and rare ores. Ores are nonrenewable resources, meaning that once they are used up, they cannot be replaced within our lifetime. In fact, mineral deposits can take *billions* of years to form!

To get these precious ores, they must be extracted, or mined, from the earth. You may have noticed that mining the minerals (chocolate chips) from your cookies caused the cookies to break into pieces. The same thing happens to our earth. Mining can be a very expensive process and may even hurt the environment. Mines typically reach deep into the ground, destroying valuable resources. They sometimes even cover a very large area that damages animal habitats. Engineers always consider how to maximize profits while minimizing the negative impacts that ore extraction and processing has on the environment. Mineral process engineers must analyze the cost and benefits of ore mining, just like you did while extracting chocolate chips!

Career Connection:

Mineral process engineers extract and refine valuable minerals from raw ores. As worldwide demand for minerals and metals soars, they use the latest technologies in an effort to protect the environment while mining for minerals.

Resources:

https://mineralsmakelife.org/blog/technology-increases-our-need-for-minerals-and-metals/
https://www.teachengineering.org/activities/view/ncs-2031-cookie-mining-cost-benefit-analysis-analysis-profit
https://www.calacademy.org/educators/lesson-plans/fossil-fuels-chocolate-chip-mining
https://www.msichicago.org/science-at-home/hands-on-science/cookie-mining/

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Cookie Mining Activity Sheet

1. How many chocolate chip "minerals" can you see on the surface of your cookie?

Cookie #1	Cookie #2	Cookie #3

2. Make a hypothesis. After looking at the surface of the cookies, which cookie do you think will have the most total minerals and be the most profitable? _____

3. Mining and Processing Fee: $20.00 for every minute of mining.

   3 minutes x $20.00 = $60.00 Mining and Processing Fee (per each cookie)

4. How many broken pieces did you count for each cookie after mining and processing?

Cookie #1	Cookie #2	Cookie #3

5. Calculate the Land Damage Fee for each cookie below.

Cookie #1	_____ pieces x $100.00 = _____ Fee
Cookie #2	_____ pieces x $100.00 = _____ Fee
Cookie #3	_____ pieces x $100.00 = _____ Fee

6. How many squares of the graph paper did you shade in for each cookie?

Cookie #1	Cookie #2	Cookie #3

7. Calculate the Value of Minerals for each cookie below.

Cookie #1	_____ squares x $500.00 = _____ Value
Cookie #2	_____ squares x $500.00 = _____ Value
Cookie #3	_____ squares x $500.00 = _____ Value

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8. Determine your overall Profit for mining each cookie's minerals below.

	Cookie #1	Cookie #2	Cookie #3
Value of Minerals			
Mining and Processing Fee (per cookie) + Land Damage Fee Total Cost:	$60.00 +	$60.00 +	$60.00 +
Value of Minerals - Total Cost Total Profit:	-	-	-

Review Your Results:

9. Was your hypothesis for your most profitable cookie correct? Why or why not?

10. Look at the bar graph you created as you shaded in your mining results. Did it reveal your most profitable cookie? Or, did the land damage fee create a bigger change in the profit than you expected?

11. Could you have reduced your impact and land damage in any way to lower your costs?

12. Do you think your results would have been different if you had mined for more or less time?

13. How do you think this represents mining in the real world? Are different land environments better for mining?

14. Imagine your chocolate chip cookies represented a mountain, canyon, or forest ecosystem. What would the mining process mean for the plants and animals that use those ecosystems as a habitat?

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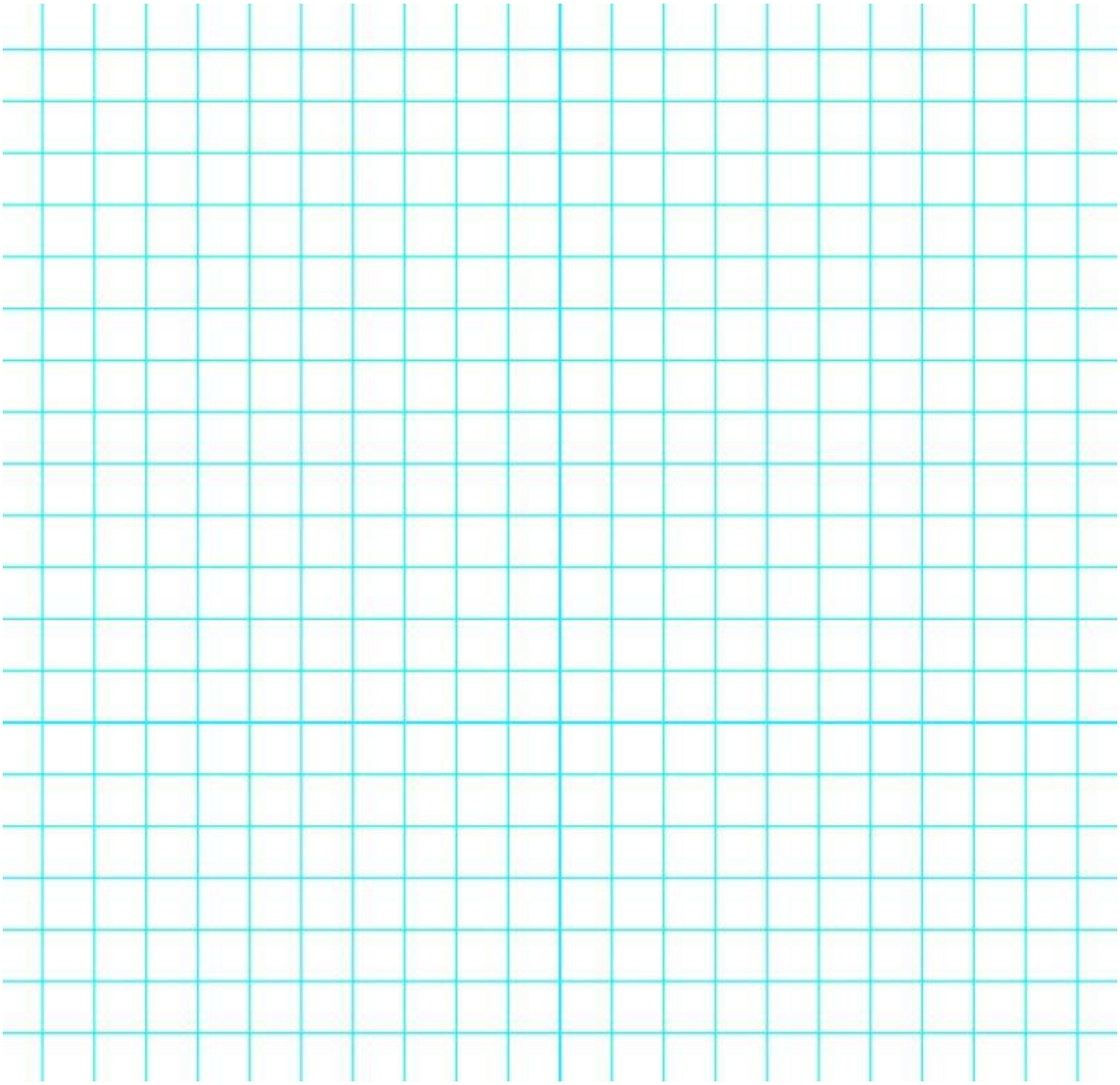
Cookie Mining Graph Paper



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