

Title: M&M Moon Mining (*Adaptation of a NASA Lunar Prospector Mission Education Lesson*)

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Subject(s): Mathematics, Science

Topic: Geology, Moon, Mining, Multiplication

Grade/Level: 5-6

Objective:

By the end of this lesson, students will be able to:

- demonstrate multiplication of numbers ending in zero.
- identify key factors in determining a mining location.
- identify key tools used in removing M&Ms from cookie and lunar samples from the Moon.
- determine if the mine was able to produce a profit or not.

Summary of Lesson:

The Moon is the only location in our Solar System that astronauts have set foot on. Of the many astronauts NASA has employed, only 12 astronauts were gathered and retrieved samples of the Moon and returned them to Earth. This lesson allows students to mine for M&Ms as a comparison to the astronauts mining for Moon samples. Students will have to use math skills to determine if their mine was profitable.

Time Allotment: 45 minutes

Procedures/Instructions:

1. Discuss what was learned from the Apollo missions about the Moon and the rocks found on it.
2. Show students the images and have them imagine what it would be like to set foot on the Moon or Mars.
3. Review multiplication by numbers ending in zero.
4. Explain to students that they will pretend to be geologists on the Moon. They will each be given a piece of the Moon to mine. Their job is to get as much rock out of the piece, without tearing the pieces into bits. Their part of the Moon will be represented by a M&M cookie. The M&Ms will be the rocks.



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5. Distribute the Student Sheets. Read over the instructions. They can only use the toothpicks in their bag to mine the rocks. If the toothpicks break they will have to work with what is available among the pieces.
6. Have the students complete steps one and two. When everyone is finished, inform the students that they will have 5 minutes to mine their rocks. After the five minutes they should complete the Student Sheet as instructed.
7. After the 5 minutes, have the volunteers time students to determine the cleaning time of their M&M rocks.

Discussion/Wrap-Up:

- Ask students to share how many chips they found before mining.
- Whose mine made the most money? Did this have anything to do with how many chips were in the cookie in the first place? Or, did it have more to do with someone who was careful when they were digging?
- Did anyone go bankrupt?
- Would your mining plan change if there were no fines for breaking apart your Chip Mine? What if you used a different brand of cookie or a softer one? Would this make a difference?

Extensions:

- Have students research and report on the experiments and findings of the studied lunar rocks.
- Have students record the colors and amount of each color found in their M&M mine. Then, research the types of minerals found in the lunar samples. Have the students compare the percentages of minerals found with the different colors of M&Ms in their cookie and determine which colored M&M represents the mineral.

Materials:

- Cookies made with M&M candies
- Toothpicks (round are stronger/flat scoop better)
- Paper towels
- Ziplock Bags
- Student Sheets (one per student)
- Pencils
- Stop Watches
- [Student Worksheet](#)
- Moon rock images
 - <http://www.lpi.usra.edu/education/timeline/gallery/images/015.jpg>
 - <http://lunar.arc.nasa.gov/education/teacher/images/6Breccia.gif>

- Astronauts on the Moon images
 - <http://www.jpl.nasa.gov/images/moon/reflec-astronauts-browse.jpg>
 - http://www.psr.d.hawaii.edu/WebImg/apollo_sampling.gif

Additional Resources (Web Links, File Attachments):

- Top Ten Scientific Discoveries Made During Apollo Exploration of the Moon
<http://www.lpi.usra.edu/expmoon/science/lunar10.html>

National Science or Mathematics Standards:

Science

Earth and Space Science

CONTENT STANDARD D:

As a result of activities in grades 5-8, all students should develop an understanding of

- Earth in the solar system

Science in Personal and Social Perspectives

CONTENT STANDARD F:

As a result of activities in grades 5-8, all students should develop understanding of

- Risks and benefits

History and Nature of Science

CONTENT STANDARD G:

As a result of activities in grades 5-8, all students should develop understanding of

- Science as a human endeavor

Assessment Plan:

5 Points

- Table portion of the student worksheet is complete and accurate.
- Answers to questions of the student worksheet reflect thought and consideration
- Writing is clear and understandable.

4 Points

- Table portion of the student worksheet is complete and mostly accurate.
- Answers to questions of the student worksheet reflect thought and consideration.
- Writing is clear and understandable.

3 Points

- Table portion of the student worksheet is mostly complete.
- Answers to questions of the student worksheet reflect some thought and consideration.
- Writing is understandable.

2 Points

- Table portion of the student worksheet is mostly complete.
- Some of the answers to questions of the student worksheet reflect some thought and consideration.
- Writing is difficult to understand.

1 Point

- Table portion of the student worksheet is less than half complete.
- Answers to questions of student worksheet do not reflect thought and consideration.
- Writing is not understandable.

0 Points

- No work completed.

M&M Moon Mining Student Worksheet

Situation: You are on the Moon. Your job is to find the best way to get rocks out of the dirt. The cookie is a part of the Moon you will be mining. It will be called an M&M Mine. These are the rules and guidelines of the mine:

- Your mine will make \$500 for each complete/whole M&M piece you mine.
- You will pay \$100 for every minute it takes to clean your rocks. This means getting out all the crumbs.
- You will have to pay \$100 for each cookie piece that breaks off.

Procedure:

1. Put your M&M Mine on a paper towel. Look at it. How many M&Ms can you see? _____
2. Make a drawing of your M&M Mine.



3. When the instructor says to begin, use a toothpick to dig out the M&Ms. Be careful! You may look at the bottom of your cookie. But, you have to take the M&Ms from the top.

4. When the instructor says to stop mining, clean the M&Ms. Get the crumbs off of the M&Ms. You will need to tell the instructor when you are done cleaning the crumbs before continuing to the next step. Write the number of minutes in your chart under #3. Cleaning Time. Calculate the answer and write it under #4.
5. Count only the whole M&Ms. Write the number of M&Ms under #5. M&Ms Mined in the following chart. Calculate the answer and write it under #6.

6. Count the cookie pieces. If your cookie is whole, that is one piece. Write the number of pieces on your chart under #1. Land Damage. Calculate the answer in dollars and write the total amount under #2.
7. Calculate your total costs (answers to #2 and #4) and write in on your chart under #7. Discover if you are bankrupt or have made a profit by following the instructions on the next two lines.

1. Land Damage: _____ pieces x \$100 =	2. \$ _____
3. Cleaning Time: _____ minutes x \$100 =	4. \$ _____
5. M&Ms Mined: _____ whole M&Ms x \$500 =	6. \$ _____
Total Costs: (#2) _____ + (#4) _____ =	7. \$ _____
Is the answer to number 7 more than the answer to number 6? If it is, you lost money.	Bankrupt
Is the answer to number 7 less than the answer to number 6? If it is, you made money! To find out how much, do this: Total made: (#6) _____ - (#7) _____ =	8. \$ _____

8. How easy/difficult was it to remove the M&Ms from the cookie?

9. What would be three ways to make mining for M&Ms easier?

10. What concerns may an astronaut have while working on the Moon?
