National Aeronautics and Space Administration

Mars Rover Celebration

Curriculum Module

Week 3: Designing the Mission

Lesson 7: How Do I Measure This?

Educational Product	
Educators & Students	Grades 6-8

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Week 3: Designing the Mission

LESSON 7: HOW DO I MEASURE THIS?
GRADE LEVEL: 6-8
LENGTH: 2 DAYS

VOCABULARY:
crater
impact
inference
standardized

MATERIALS:

- Student Science Notebooks
- Short Story *How the Foot Came to Be: A Kindermärchen* by Terence Kuch
- Flour or white sand (enough to fill 1" deep in each foil pan)
- Cake sprinkles (enough to scatter onto the surface of each foil pan)
- Cocoa powder or chocolate cake mix (enough to completely cover the surface of each foil pan)
- Goggles, gloves, and other safety equipment as needed
- Rulers (metric)

For each team:

- Aluminum foil pan (preferably 10" x 13" casserole size)
- Cinnamon imperial candies (2-3)
- Gumball (1)
- Marble (1)
- Dried peas (2-3)
- Golf ball (1)
- Ping pong ball (1)
- Tongs or large tweezers
- Meter stick

ESSENTIAL QUESTION:

Why are taking accurate measurements critical to your Mars rover mission?

LESSON OBJECTIVE(S):

Students will be able to:

- Learn the importance or standardized units of measure
- Learn and be able to explain the importance of taking accurate measurements
- Work collaboratively to conduct a scientific experiment
- Collect and record data to draw logical and scientific conclusions
- Learn and review using a ruler to make metric measurements
- Learn or review how to make inferences and draw reasonable conclusions

ENGAGEMENT

1. At the beginning of this lesson, and using the attached documents, present the Essential Question and Key Vocabulary for students to consider during the lesson.
2. Next, introduce the "Making Inference and Drawing Conclusions" mini-lesson and tell students that they will need to use these skills as they read today's reading selection and when they conduct today's lab.
3. Before introducing the reading selection, discuss with students the importance of taking accurate measurements by reading *How Big is a Foot?* by Rolf Myller. For more advanced students, the teacher may wish to substitute the short story *How the Foot Came to Be: A Kindermärchen* by Terence Kuch.
4. After students have considered the questions in their Science Notebooks, have students share to clarify the importance of having and using standardized measurements.

EXPLORATION

NOTE: Prior to the Exploration, the teacher will need to prepare an aluminum pan for each team. (Any of these items can be substituted as needed as long as the replacement products are similar in consistency and there is a noticeable contrast in color between the layers.)

1. Pour flour into each pan. Spread it around evenly so that it is about 1" deep.
2. On top of the flour, evenly distribute a thin layer of cake sprinkles.
3. Last, sprinkle a layer of cocoa powder on top so that the entire surface is covered.
4. Once students have an understanding for why making accurate measurements is important, students will conduct an investigation. Remind students of proper lab safety procedures and equipment.
5. As students conduct their experiment, they will drop three of the designated items (marble, gumball, cinnamon imperial, golf ball, dried pea, ping pong ball) from a designated height (team selected) and record their results.
6. During the investigation, the teacher should circulate for assistance as needed and ask students to consider:
    - Would your results be different if you dropped your items from a different height? How?
    - How does the result of dropping a _____ compare with the result of dropping the _____?
    - What effect does the drop height have on the impact crater?
    - How might this experiment illustrate how craters are formed?
    - Why is it important to take an accurate measurement of the diameter of the impact crater?

EXPLANATION

1. After students have finished the experiment and gathered their results, construct a table containing all of the results for each item. Ask students to analyze the class' data and briefly draw some conclusions about the data they collected.
2. Now that students have taken part in designing an experiment, students will work on designing their own experiment that their rover will conduct on Mars. To help accomplish this task, students will need to recall their team's scientific question and the solutions they brainstormed in Lesson 6.

ELABORATION

1. If time allows, students may select two of the designated items (marble, gumball, cinnamon imperial, golf ball, dried pea, ping pong ball), construct graphs displaying the class' information for those items and conduct an analysis/summary of the results. As students analyze their data, students should focus on determining similarities and differences of their results to engineer the best solution for success.
2. Students may also further examine craters using Google Earth to view craters on Mars or the moon.

EVALUATION

1. During this lesson, the teacher is encouraged to use formative assessments to determine and deepen student understanding. Teachers may wish to grade students' science notebooks to establish student understanding or assess student graphs and analyses/summaries.
2. Teachers are encouraged to create their own grade-level and ability-level assessments so as to best meet the needs of their students.

SUPPLEMENTAL RESOURCES

How Big is a Foot
http://www.youtube.com/watch?v=bWhWL1MET7A

How to Make a Crater
http://www.jpl.nasa.gov/education/videos/playVideo.cfm?videoID=14

Explore mars: Gale Crater
http://mars.jpl.nasa.gov/explore/galecrater/

Mars Science Laboratory Landing Site: Gale Crater
http://www.jpl.nasa.gov/video/index.php?id=1005

Landing Site Selection
http://mars.jpl.nasa.gov/msl/mission/timeline/prelaunch/landingsiteselection/

Exploring Meteorite Mysteries
http://ares.jsc.nasa.gov/ares/education/program/expmetmys.cfm

Measuring Impact Craters (Google Earth Mars)
http://lcogt.net/book/measuring-impact-craters-mars

Craters on the Moon- Space Math @NASA
http://spacemath.gsfc.nasa.gov/**moon**/4Page45.pdf

Impact Craters on Mars
http://csivc.csi.cuny.edu/supernova7/files/google_mars[1].pdf

Development of this lesson plan and supporting materials was made possible by NASA EPOESS Grant NNX12AB56G