Giant Volcanoes of Mars

Overview:

Olympus Mons on Mars is the largest volcano in the solar system—about 100 times larger than Mauna Loa, Earth's largest volcano. In this lesson, students learn about gravitational forces, and model how the lower gravity on Mars contributes to the volcano's massive size.

Objectives:

The student will:

- observe that gravitational force attracts all objects with mass to all other objects with mass in the Universe;
- show that weight and mass are not the same thing;
- calculate his or her weight on different planets; and
- simulate the effects of lower gravity on the collapse of a structure.

Materials:

- Golf ball
- Ping Pong ball
- Vermiculite
- Aquarium rocks, small size (similar in color to vermiculite), or local pebble-sized rocks
- Paper towels
- Newspaper
- Student Worksheet: "Gravity on Other Planets"
- Student Worksheet: "Giant Volcanoes of Mars"

Answers to Student Worksheets:

Gravity on Other Planets:

1. Answers will vary
2. Answers will vary
3. Answers will vary depending on student's weight, but mass should be the same on every planet
4. Weight is less on Mars.
5. Jupiter
6. Pluto
7. Jupiter

Giant Volcanoes of Mars:

Hypothesis: Answers will vary

Data: Answers will vary

Analysis of Data: Answers will vary

Conclusion:

1. The paper towel holding rock should collapse first.
2. The vermiculite volcano
3. Answers will vary but should indicate that vermiculite is lighter than rock so the paper towel could hold more.

Further Questions:

1. Answers will vary but should indicate that planets with weaker gravity can have larger volcanoes.

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Activity Procedure:

1. Show students the golf ball and the ping-pong ball. Pass the balls around to students so that they can compare the weight difference.
2. Ask students to predict which ball will fall faster when dropped from a height. Ask students to write their prediction on a sheet of paper.
3. Hold the balls high in the air and release them simultaneously from the same height. The balls will drop at the same rate and hit the ground at the same time (the teacher should practice this step in advance). Ask students what force caused the balls to fall to the ground (gravitational force). If necessary, explain that gravitational force attracts all masses to all other masses in the Universe. Earth and the balls both exert an attractive force on each other, but Earth exerts a much greater force because it has more mass.
4. Ask students why the balls fell at the same rate despite the difference in weight. Explain that all objects fall to Earth at the same rate (9.8 meters per second squared, the acceleration of gravity), if they are in "free fall"—that is, gravity is the only force acting on them. Air resistance changes the situation. For example, drop two pieces of paper that weigh the same, one crumpled and one flat, the flat one will fall more slowly due to air resistance.
5. Ask students if they know the difference between mass and weight. Explain that mass is the amount of matter contained in an object, and will be the same everywhere in the Universe, while weight is a measure of the force of gravity acting on a body. Weight will vary depending on the gravitational force of the individual planets.
6. Distribute the Student Worksheet: "Gravity on Other Planets" and allow students to calculate their weight on other planets.
7. For the second part of the activity, ask students to model how gravity affects the collapse of a volcano. Explain that they will use two materials, one lighter material that simulates lava weight on Mars (vermiculite), and one heavier material that simulates lava weight on Earth (aquarium rocks). Students will measure how many scoops of material it takes before a collapse.
8. Distribute the Student Worksheet: "Giant Volcanoes of Mars." Discuss the answers to the questions as a class when the worksheets are completed.

Name:_____ **Student Worksheet**

Gravity on Other Planets

Directions: Read the background information provided, then answer the questions that follow.

Background Information: We often think of mass and weight as the same thing. However, they are different. Mass is the amount of matter contained in an object. The mass of an object will be the same everywhere in the Universe. In contrast, weight is a measure of the force of gravity acting on a body. Weight varies depending on the strength of the gravitational force.

1. Estimate your weight on Earth in pounds _____

2. Mass is usually reported in grams or kilograms. To find your mass on Earth, multiply the weight in pounds by 0.45. My mass in kilograms is: _____

3. Calculate what your weight would be on other planets by multiplying your weight by the gravity relative to Earth on each planet and record the results in the table below.

Planet	Gravity relative to Earth	Weight on Planet	Mass on Planet
Mercury	0.38		
Venus	0.91		
Mars	0.38		
Jupiter	2.34		
Saturn	0.93		
Uranus	0.92		
Neptune	1.13		
Pluto	0.04		

4. Is your weight more or less on Mars compared to Earth?_____

5. On which planet will you weigh the most? _____

6. On which planet will you weigh the least? _____

7. Gravitational force is generally stronger in more massive objects. Based on this information, which planet has the largest mass? _____

Name:_____ **Student Worksheet**

Giant Volcanoes of Mars

Background Information:

Olympus Mons on Mars is the largest volcano in the solar system. A volcano of this size could not exist on Earth because the stronger gravitational force on Earth would cause it to collapse under its own weight. This activity will model how gravity affects the collapse of a volcano. Like human bodies, lava will weigh less on Mars than on Earth. The vermiculite in this experiment represents lava weight on Mars, while the rocks represent lava weight on Earth.

Hypothesis:

Which "volcano" will collapse first, the vermiculite, or the rock? Write your hypothesis as an "if, then" statement.

_____

_____

Materials:

- Vermiculite
- Aquarium rocks, small size
- Paper towels
- Newspaper
- 2 scoops or serving spoons of equal size

Procedure:

1. Divide into groups of four.
2. Spread newspaper under the area where the test will be conducted.
3. Wet a paper towel thoroughly, and wring it out. One student should grip the paper towel firmly on each side to make a flat base, and hold it over the newspaper. The second student should level out a scoop of aquarium rock and place it carefully on the paper towel.
4. At the same time, the third student should hold another paper towel as described in step 3. The fourth student should level out a scoop of vermiculite and carefully place it on the paper towel.
5. The students should continue adding scoops of vermiculite or rocks to the paper towels until one of the paper towels collapses. Tally the number of scoops added in the Data Chart.
6. Add up to ten more scoops to the paper towel that didn't collapse.
7. Answer the questions on the following page.

Data:

	Rock	Vermiculite
Number of scoops before collapse		

Name:_____ **Student Worksheet**

Giant Volcanoes of Mars

Analysis of Data:

1. How many scoops were added before the first paper towel collapsed?

   _____

2. Did the second paper towel collapse? If so, how many scoops did it take?

   _____

Conclusion:

1. Which paper towel collapsed first, the one holding the vermiculite, or the one holding the rock?

   _____

2. Which "volcano" grew the largest before a collapse?

   _____

3. Why did this "volcano" grow larger? Use a complete sentence.

   _____

   _____

   _____

   _____

Further Questions:

1. How does the gravity of a planet affect the size of its volcanoes? Use a complete sentence.

   _____

   _____

   _____

   _____

