Tides and Earth Volcanoes

Overview:

In this activity, students learn that the gravitational force of the moon is the main reason for the tides. The teacher demonstrates how the movements of the moon lead to tidal bulges and explains the periodicity of Earth and moon movements. Students model how tidal forces can distort objects and perhaps trigger volcanic eruptions.

Objectives:

The student will:

- observe that the moon rotates around the Earth in a predictable monthly pattern, causing a tidal bulge;
- observe that Earth spins on its axis in a 24 hour cycle;
- explain that gravitational pull is responsible for tidal forces;
- model how gravitational pull from the moon causes a tidal bulge; and
- investigate how pressure can help trigger an "eruption."

Materials:

- 5 inch Styrofoam ball
- Tennis ball
- Pencils
- Marking pen
- Foam "squeeze" balls
- Plastic zip baggies (sandwich size)
- Whipped cream
- Pins or tacks
- Transparency: "Moon and Tides"
- Student Worksheet: "Tides and Volcanoes"

Answers to Student Worksheet:

All answers may vary, but should include these concepts:

1. Gravitational pull of the moon on Earth causes the ocean water to be pulled towards the moon, causing a bulge.
2. There are two bulges rather than one because the water on the opposite side of Earth is less attracted to the moon than the center of Earth. The water that gets "left behind" creates a second bulge.
3. The moon would be in line with the widest part of the bulge.
4. The whipped cream will not emerge from the holes until the bag is squeezed because pressure is not forcing it out.
5. In the whipped cream model, the student's hands create pressure on the bag, just as the gravitational pull of the moon "squeezes" Earth.
6. The whipping cream model is different in that pressure is applied directly, from above and below. The "squeezing" of Earth by the moon occurs because gravitational pull causes a slight distortion in shape.

 ©2001, 2007 UAF Geophysical Institute

Tides and Earth Volcanoes

Activity Procedure:

1. Ask students what causes the tides (gravitational pull of moon on Earth). Write ideas on the board.
2. Show the Transparency: "Moon and Tides" and discuss tidal bulging.

Note: While the tidal bulge is almost exactly in line with the moon, it is slightly offset. The effects of friction cause the bulge to point slightly "ahead" of the moon.

---

3. Use the Styrofoam sphere to model Earth and the tennis ball to model the moon. Stick a pencil about 2 inches into "Earth." The pencil represents Earth's rotational axis. Draw a large dot near the "Equator" with a marking pen. Hold "Earth" by the pencil, and hold the "moon" 1-2 feet away from "Earth."
4. Ask a student to show where the tidal bulge should be when the moon and Earth are stationary. They can cup their hand on the Earth in the appropriate spot (should be on the side closest to the moon, and the side farthest away).
5. Now, ask another student to come forward and rotate Earth on its axis.
6. The first student should keep his or her hands in the same spot (closest to and furthest from the moon) while Earth rotates. Students will see the marking pen dot rotating.
7. Point out the tidal bulge looks stationary, but is actually constantly changing its location on Earth because Earth is spinning.
8. Ask students how long it takes for Earth to complete one rotation on its axis (24 hours/one day). Ask students how many times a day the location on Earth marked by the dot will experience high tide (2 times a day, every 12 hours).
9. Now, rotate the "moon" around "Earth." Ask a student to show where the tidal bulge travels during this process with their hands.
10. Ask students how long it takes for the moon to travel once around Earth (27.5 days, about one month). Ask how the tides might change for the location represented by the dot over one month (they will be lower or higher depending on the location of the moon).
11. Tell students that the gravitational pull of the moon not only influences the oceans on Earth, but also "squeezes" Earth a little bit. The effect is subtler than the effect on the oceans because Earth is more rigid.
12. Explain that volcanoes are more likely to erupt at times of high tide because Earth is "squeezed" very slightly at these times. Emphasize that high tide alone does not predict when a volcano will erupt. This effect is only observed if a volcano is close to eruption anyway.
13. Distribute the Student Worksheet: "Tides and Volcanoes" and ask students to complete it.

 ©2001, 2007 UAF Geophysical Institute

Name:_____ **Student Worksheet**

Tides and Volcanoes

Background Information:

Recently, scientists have found that a volcano is more likely to erupt during times of high tide than times of low tide. Why is this? Earth gets "squeezed" by the gravitational force of the Moon, triggering an eruption of a volcano that is already almost ready to blow. This activity will model the squeezing of Earth from tidal pull.

Materials:

- Foam "squeeze" ball
- Plastic baggie
- Whipped cream
- Pin or tack

Procedure:

1. Hold a foam squeeze ball in one hand. Draw the shape of the ball in the "observations" section.
2. Squeeze the ball slightly. Draw the shape of the squeezed ball in the "observations" section. Imagine that the ball is Earth, and the new shape is the result of the moon pulling on Earth's oceans. Label which part of the ball represents the tidal bulge.
3. Lay a plastic baggie flat on a table or desk. Using a pin or tack, poke a hole through the center of each side of the bag.
4. Stand the bag on end. Open the bag and fill it half full of whipped cream. Carefully close the bag, without putting pressure on the bag.
5. Pick up the bag and squeeze simultaneously from the top and the bottom. Record what happens in the "observations" section.

Observations:

Draw the ball before squeezing:

Draw the ball after squeezing:

Draw what happens when the bag of whipped cream is squeezed:

 ©2001, 2007 UAF Geophysical Institute

Name:_____ **Student Worksheet**

Tides and Volcanoes

Questions:

1. Explain why the moon causes a tidal bulge on Earth. Use complete sentences.

_____

_____

_____

2. Explain why there are two bulges rather than just one bulge. Use complete sentences.

_____

_____

_____

3. In the drawing of the "ball after squeezing," where would the moon be located in relation to the bulge, if the ball were Earth? You may draw or write your answer below.

4. Did whipped cream emerge from the holes before the bag was squeezed? Why or why not?

_____

_____

5. How is the whipped cream model similar to the way the moon acts on Earth to help trigger a volcanic eruption?

_____

_____

_____

6. How is the whipped cream model different from the way the moon acts on Earth?

_____

_____

_____

 ©2001, 2007 UAF Geophysical Institute