Geology
Lancaster High School

Name
Date
Block

Slope Stability and Landslides

Background:
The purpose of this exercise is to investigate both slope stability and landslides. Although the term landslide is often used somewhat loosely to mean any fairly rapid movement of rocks and sediment down-slope, it is actually more accurate to use the term mass wasting to refer to the wide variety of mass movement processes that wear away at the Earth's surface. In this activity you will create sand "mountains", measure slopes, and test the effects of water and rock layering on slope stability. Rocks are deposited on the Earth over millions of years. Sometimes they are deposited rather quickly and other times it may take millions of years. Mass Wasting occurs when a rock is not strong enough to resist the forces of gravity that pull it closer to the center of the Earth.

Equipment Needed:
- Sand (400 mL)
- 1 400 mL (or larger) beaker
- 1 100 mL graduated cylinder
- 1 pie plate (shallow, approximately 8 inch container) or plastic storage container
- 1 compass
- 1 ruler

Part I. Build a Dry-Sand Mountain.
Hypothesis:
When building a sand mountain, would you expect a difference in the slope of the mountain if the sand were piled up slowly or quickly? Why?

Procedure

A. Create a dry-sand mountain by <u>slowly</u> pouring sand.
   1. Measure 400 mL of dry sand into a beaker.
   2. <u>Slowly</u> pour the sand into the center of a pie plate. Be careful, *you are trying to achieve a sand mountain with the MAXIMUM slope*.
   3. Measure the slope of the mountain as a ratio (Slope = Rise/Run). Repeat the procedure 4 times to average out errors in measurement. Record your measurements in the table below.
   4. Measure the angle of repose of the sand mountain (Angle of Repose = degrees from the horizontal). Repeat the procedure 4 times to average out errors in measurement. Record your measurements in the table below.

Dry Sand Slow Pouring Trial	1	2	3	4	Average
Slope					
Angle of Repose					

B. Create a dry sand mountain by <u>quickly</u> pouring sand.
   1. Measure 400 mL of dry sand into a beaker.
   2. Quickly, *but under control*, pour the sand into the center of a pie plate. (Do not worry about achieving a sand mountain with the maximum slope.)

3. Measure the slope of the mountain as a ratio (Slope = Rise/Run).
4. Measure the angle of repose of the sand mountain. (Angle of Repose = degrees from the horizontal). Repeat the procedure 4 times to average out errors in measurement.

Dry Sand Fast Pouring Trial	1	2	3	4	Average
Slope					
Angle of Repose					

Compare your results. Is there a significant difference between the answers in section A as compared to section B? Briefly discuss your results.

Part II. Build a Wet-Sand Mountain.
Hypothesis:
How do you think the sand will behave if it is wet with water? Will the slopes be steeper or shallower? Why?

Will there be any other changes?

Procedure

1. Measure 400 mL of dry sand into a beaker.
2. Pour the sand into a pie pan and add 50 mL of water. Mix the sand and water so that the sand grains appear wet.
3. Put the wet-sand back in the beaker and pack it down tightly. Record the total volume of sand and water below.

   400 mL sand + 50 mL water = _____ mL of sand and water mixture.

4. Carefully pour the sand into the center of a pie plate. You are trying to achieve a wet sand mountain with the MAXIMUM slope.
5. Measure the slope of the mountain as a ratio.
6. Measure the angle of repose of the sand mountain.

Wet Sand No Packing Trial	1	2	3	4	Average
Slope					
Angle of Repose					

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Part III. Compressed Wet-Sand Mountain
Hypothesis:
How do you think the wet sand will behave if you pack it lightly? Will the slopes be steeper or shallower? Why?

Procedure

1. Using your hands on your final wet sand mountain from Part II, compress the sand and form a somewhat symmetrical sand mountain with the maximum slope that you can achieve.
2. Measure the slope of the mountain as a ratio.

   Slope = _____

3. Measure the angle of repose of the sand mountain.

   Angle of Repose = _____

Discussion:

What changes did you observe in the volume of the sand and water when they were mixed together?

What process might cause this change?

What changes did you observe in the maximum slope angle for the wet and dry sand? How might the water affect the sand to cause this change?

Part IV. Mass-movement and the Effects of the Addition of Water

Using the 100 mL graduated cylinder, slowly pour water onto the top of your wet sand mountain (make sure you record how much water you pour). After pouring enough water, you should first see a settling, and then you should see mass-movements.

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Sketch the shape of the mass-movement. Be sure you show the texture of the landslide at the toe of the slide. This texture is the same texture you should look for prior to purchasing property on or at the base of a hill.

Keep adding water until the sand mountain collapses. Record the total amount of water added to the dry sand. Don't forget the initial 50 mL.

Total Amount of Water Added To Sand _____

Analysis and Conclusion Questions

1. What are landslides?

2. What factors affect the mass wasting process?

3. When water is added to hillsides in southern California they tend to have mass movements. Why then is wet sand better at making sand-castles than dry sand?

4. If you were investigating the purchase of land on a hillside, what visible geological evidence would dissuade you from investing?

5. Why was it that when you added 50 mL of water to 400 mL of sand the volume was less than 400 mL rather than 450 mL?