LOOK OUT BELOW! (1 Hour)

Addresses NGSS
Level of Difficulty: 2
Grade Range: K-2

OVERVIEW

In this activity, students will create a model of a sloped hillside using sand, and then they will simulate conditions that can cause a landslide to occur.

Topic: Landslides

Real World Science Topics:

- An exploration of landforms and slope stability
- An exploration of natural disasters such as landslides
- An exploration of the process of erosion

Objective

Students will gain an understanding of how different variables can contribute to a landslide.

Materials Needed for Teacher Demonstration

- images of landslides or severe erosion

Materials Needed for Student Teams

- clear plastic bin
- sand (approximately 1-2 kg)
- container of water
- protractor
- measuring cups or spoons
- spray bottle (optional)

Teacher Preparation

Depending on student ability, you may find it beneficial to create sloped hills of sand within the plastic bins for each group before leading the activity. To do so, use your hands to create a steeply sloped hill of sand within the bin. It is easier if the sand is somewhat damp. If you choose to have your students construct their own slopes, it may still be helpful to have a pre-made slope to provide your students with a model. This will help them as they construct their own slope within the plastic bin.

NGSS Three-Dimensions

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models • Develop a model to represent patterns in the natural world.	**ESS2.C: The Roles of Water in Earth's Surface Processes** • Global movements of water and its changes in form are propelled by sunlight and gravity.	**Energy and Matter** • Within a natural or designed system, the transfer of energy drives the motion and/or cycling or matter.

STEPS FOR *LOOK OUT BELOW!*

1. **Warm-up Activity:** Ask students to visualize the steepest hill they have ever visited. Have several students share their descriptions of the hill. Then, tell students that hills are one type of landform. Explain that a landform is a natural feature on Earth. Ask students to brainstorm things that might change the shape or steepness of a hill. Students may suggest things like erosion or rainstorms. Then, show students one or two images of landslides (or the aftermath of a landslide), such as the image below. If you do not use the below image, a simple Internet search will provide many suitable images. Ask students to describe what they are seeing. Students should recognize that a large section of the hillside has fallen into the water. Have students think about what could have caused the hillside to fall into the water. Then, tell students that in this activity, they will learn more about what causes landslides.

If students are unfamiliar with erosion, review the topic briefly by explaining that erosion is a natural process that causes land to be weathered, or moved away, by water or wind. While most types of erosion occur over hundreds or thousands of years, landslides are a type of erosion that moves large amounts of land relatively quickly.

2. Divide students into groups of three to five students and distribute the materials and **Student Handouts**. Instruct students to use the sand to create a steep slope within their plastic bin. They can use a protractor, as shown below, to aid in the slope creation. For this activity, students should aim to have a slope greater than 50 degrees. If students are unfamiliar with how to use a protractor, model this process for the class with a pre-made sample of a sand hillside. Have students record the slope of the hill on their **Student Handouts**.

3. Once students have constructed a sloped hill within the plastic bin, assign each group one of three variables to investigate. (It is okay if several groups are investigating the same variable.) One-third of the class should investigate how the steepness of the slope contributes to landslides. Another third of the class will investigate the effects of rainfall on the slope. The final third of the class will investigate the effects of earthquakes on slope stability. Tell students that all three of these conditions can cause landslides, but they don't always cause landslides.

4. Explain to students that they will manipulate their assigned variable in order to observe what effect it has on the hill. Give each group the following instructions on how to investigate their assigned variable:

   - Groups varying the steepness of the hill should make their slope steeper and steeper by carefully packing layers of sand onto the side of the hill. After each new layer of sand, they should record the new slope of the hill. They should also record any observations of the stability of the hill. As the slope becomes steeper, they should find that it will begin to crumble more quickly. If the sand is damp, some groups may be able to have the slope hold a near-90-degree angle for a short amount of time. Remind students to keep the moisture level in the sand as constant as possible. (In other words, the sand on the hill should not become wetter or drier as more layers are added.)
   - Groups studying the effects of rainfall on the hill will slowly saturate the sand using a water bottle. Students can either mist the sand using a spray bottle or very slowly pour small amounts of water on the top of the slope. Students should record the total amount of water that has been dropped on the sand each time more water is added. (For example, if they choose to pour water on the hill in 1/4-cup increments, they would record 1/4 cup of water for the first trial, 1/4 cup of water for the second trial, 1/4 cup of water for the third, and so on.) Have students record their observations of the hill each time they pour water on it, and instruct them to end the experiment when a landslide occurs. Students in the rainfall groups should start to see saturated sand collapse away from the slope, as shown in the picture below.

- Groups studying the effects of earthquakes on the hill will shake the plastic bin in order to simulate an earthquake. Students will simulate and investigate the effects of both P waves and S waves. Explain to students that P waves move Earth side to side while S waves will move Earth up and down. Have students think about how they will shake the bins in order to simulate each wave. (Students should observe each separately.) Students should start by shaking the bin gently (from side to side in the case of a P wave and up and down in the case of an S wave). Then, they will gradually shake the bins more forcefully, being sure to keep the duration of the shake constant. They should record their observations of the hill during each trial. Students in the earthquake groups should see the fractures appear in the slope prior to the actual landslide, as shown in the image below.

5. Circulate as groups work to trigger landslides. Make sure that they are only testing their assigned variable (steepness, rainfall, or earthquakes). Answer any questions groups may have as they are completing the activity. You may need to help groups construct simple data tables in which they will record data.

6. **Wrap-up Activity:** Once all groups have triggered a landslide in their plastic tub, bring the class back together as a large group to discuss the activity. Encourage students from different groups to compare and contrast the results of experimenting with different variables. Stimulate discussion by asking the following questions:

   - How did your group trigger a landslide?
   - What did the landslide look like? Was it a large amount of sand or just a small part of the slope? Did it contain water? Did the sand crack?
   - What challenges did you encounter in this activity? How did you overcome those challenges?
   - After listening to other groups share their experiences, which variable do you think creates the most dangerous landslide and why?
   - If you were going to build a house, where would you want to build it? What types of places should you avoid when building a house and why?

Look Out Below! Extension Activities

1. Instruct students to test two of the three variables in their experiment. For example, students can heavily saturate a slope and then simulate an earthquake. They should compare the results of testing two variables to their earlier experiments. Students will find that landslides are more easily triggered when more than one variable is present.
2. Encourage students to experiment with different slope materials. For example, one group could work with a clay hillside, another with a grassy hillside, and another group with a hillside made of large gravel and small rocks. Then, students can test the original variables (steepness, rainfall, and earthquakes) on their slopes and compare their results with their earlier experiment.

What is a landslide?

A landslide is a dramatic event that occurs when a mass of rock, soil, or other material moves down a hillside. Landslides often occur on steep or unstable slopes. Landslides usually need a trigger, such as a heavy rainfall or an earthquake. Landslides can also be caused by human activities, such as loading a slope with heavy buildings or undermining a slope with excavation. In this lesson, students will study the natural factors that can trigger a landslide. When a landslide occurs, gravity moves the loosened rock or soil to the bottom of the slope. Landslides can be relatively slow moving, or they can move at a speed of hundreds of miles per hour. Landslides have the potential to be extremely dangerous.

What is the difference between a landslide and erosion?

Erosion is a natural process of weathering. Erosion can be caused by water, wind, or chemical agents. Most erosion is a slow and gradual process. Erosion can occur on flat land, rocks, hillsides, beaches, and so on. Landslides, while related to erosion, are much more dramatic because they involve the failure of a slope. Landslides are caused by unstable slopes, and they cause land to shift more rapidly than erosion.

What are the variables that can trigger landslides?

First, a slope must be unstable enough to have a landslide. Generally, steep hillsides are more prone to landslides than are gentler hills. The geological composition of the slope can cause it to be unstable, as can human activities such as excavation. There are several variables that can trigger a landslide on an unstable slope. Three of the more common variables are discussed in this activity.

The first variable is steepness of slope. Naturally, the steeper the slope, the more susceptible it is to a landslide. This is especially true if other variables are also introduced. For example, a steep hillside might seem stable until a heavy rainfall occurs. The same rainfall, on a gentler hillside, may not trigger a landslide, but it can on the steeper hill.

The second variable in this activity is rainfall. When a slope becomes saturated, more weight is placed on the slope. The water can also act as a lubricant, causing the layers of Earth to slip across each other.

The final variable discussed in this lesson is earthquakes. Earthquakes are destructive because they send seismic waves through Earth. The first type of wave, a P wave or compression wave, causes Earth to move from side to side, compressing and releasing with the movement of the wave. The second type of wave, called an S wave, causes Earth's surface to move up and down, much like a water wave. Both types of waves can move though solid rock, causing it to move. In the case of an unstable hillside, earthquakes can cause large portions of the hillside to dislodge and fall.

Key vocabulary

erosion: the natural process of weathering, caused by wind, water, or natural agents such as minerals

landform: any natural feature of Earth's surface

landslide: the movement of rock, soil, or other matter down a slope

slope: a surface where one side is higher than the other side, such as a hillside

P waves: Waves of movement (as in an earthquake, for example) that move Earth side to side

S waves: Waves of movement (as in an earthquake, for example) that move Earth up and down

1. Draw a picture of your model hillside. Label your drawing with the angle of the slope.

   [Images will vary.]

2. What are the three variables that can trigger a landslide in this investigation? Which variable will your group investigate?

   [Sample answer: The three variables are the steepness of the slope, rainfall, and earthquakes. My group will investigate rainfall.]

3. Describe how your group will test your variable. Draw a data table in which you will record your observations.

   [Sample answer: To test the effect of rainfall on a slope, we slowly added water to the sand in the tub. It took a while, but eventually the sand couldn't hold any more water. When this happened, the slope collapsed and a landslide happened.]

aMOUNT Of w aTer POUre D ON Sa ND	OBSer vaTiONS
1 tablespoon	*The water was absorbed into the top of the hill.*
2 tablespoons	*The water caused the top of the hill to sink down a little.*
3 tablespoons	*The water triggered a landslide and the hill collapsed.*

4. Draw a picture of your hillside after it experienced a landslide. Be sure to show where the landslide started and how the sand moved in the plastic tub.

   [Images will vary.]

5. In your own words, describe why it is important to understand what causes landslides. Hint: Think about the places where people build homes and buildings.

   [Sample answer: It is important to know that landslides can occur on steep slopes, or with earthquakes or heavy rain. If people understood where landslides can occur, they might not build homes on top of steep hills or underneath steep hills.]

STUDENT HANDOUT *LOOK OUT BELOW!*

Name:

Date:

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2. What are the three variables that can trigger a landslide in this investigation? Which variable will your group investigate?

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4. Draw a picture of your hillside after it experienced a landslide. Be sure to show where the landslide started and how the sand moved in the plastic tub.

5. In your own words, describe why it is important to understand what causes landslides.
Hint: Think about the places people build homes and buildings.