

Targeted Age:

Elementary to High School

Activity Structure:

Group Activity (2 to 4 students)

Indiana Standards and Objectives:

4.ESS.2, 7.ESS.3, 7.ESS.4, ES.6.7\,
ES.6.8, Env.3.4

Introduction

This activity allows students to observe a small-scale model of liquefaction, a hazard associated with strong-magnitude earthquakes. The sand, water, and ping pong ball(s) represent the composites of soil: sediment, water, and air, respectively. Shaking will be simulated in order to demonstrate the relationship between seismic waves and soil strength.

Background Information

Liquefaction is a physical process that causes soils to temporarily lose strength and behave more like a viscous fluid than a solid. Once liquefaction has occurred, the soil is no longer able to support the foundations of structures such as buildings and bridges. High-energy seismic waves that pass through saturated, silty, or sandy soils can increase the pore water pressure and allow air contained in the sediment to escape. This increase can exceed the strength of the soil column, causing liquefaction. The change in pressure allows soil particles to easily move with respect to each other. Dynamite blasts can trigger a similar effect on a much smaller scale. Liquefaction is typically limited to relatively loose, silty or sandy soil deposits where groundwater is within 9 meters (30 feet) of the surface.

Structures, known as “sand volcanoes” or “sand blows,” are often associated with liquefaction events. Increased pressure causes a mixture of sand and water to be forced upward through fractures in the soil. This mixture can be ejected up to several dozen feet into the air. Evidence of sand blows are visible in river banks in southwestern Indiana. These structures indicate that seismic activity occurred during prehistoric times.

MATERIALS NEEDED

- Container, at least 3 inches deep
- 1-2 large spoons
- 1-2 ping pong balls
- Building replica or small wood block
- Playground sand
- Water

Vocabulary

Earthquake – the shaking or vibration of the ground surface in response to the sudden release of energy caused by fault movement

Fault – a fracture in the Earth's crust where one side moves relative to the other

Liquefaction – a physical process that causes soils to temporarily lose strength and behave more like a viscous fluid than a solid

Preparedness – a set of actions taken to prepare for and reduce the effects of a natural disaster, such as an earthquake

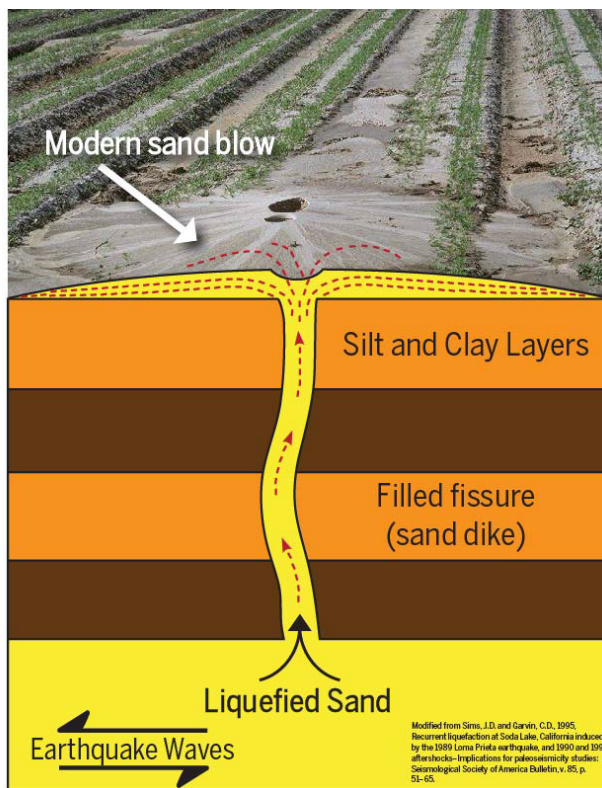


Figure 1: Illustration of a sandblow

Procedure

1. Fill the container with playground sand to a depth of at least 2.5 inches.
2. Pour water into the container to moisten the sand grains completely, without flooding the surface of the sand. Carefully drain any excess standing water, if needed. Use a large spoon to periodically mix the water and sand.
3. Once all sand grains are moistened, bury the ping pong ball(s). Make sure the ball is completely covered with sand.
4. Gently smooth the surface of the sand with a spoon and place the building replica or wood block on the center of the sand.
5. Shake the container up and down for several seconds to simulate an earthquake. Continue shaking the container until water begins to appear on the surface of the sand and the ping pong ball emerges.
6. Instruct students to record their observations on the student data sheet. Repeat the activity if necessary.
7. Ask the class what relationship exists between seismic waves and soil strength. Discuss liquefaction potential of relatively loose, silty or sand soil deposits where groundwater is within 30 feet of the surface.
8. Allow students to review the activity through the reflection questions.



Figure 2: Model of surface area prior to liquefaction



Figure 3: Appearance of the surface area once liquefaction has occurred

To repeat the activity, remix the water and sand until the surface water is no longer visible.

Name:

Class Period:

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Observations

Record your observation of the liquefaction demonstration in the space below.

Reflection Questions

1. What does the sand and water represent in this model? What naturally occurring event does the shaking represent?
2. What causes the water and the ping pong ball(s) to rise to the surface?
3. What happened to the building once liquefaction was visible? Does this accurately reflect the response of structures during liquefaction?
4. After the earthquake shaking stopped, describe the appearance of the surface. Look at the surface again after 30 minutes. Explain any changes that have been observed.
5. What can you do to prepare for an earthquake? List 3 preparedness actions in the space below.