

# A Hole in the Ground

*Description: Students build models of sinkholes to gain an intuitive knowledge of their physical aspects.*

*Learning Objectives: Students will learn how groundwater creates sinkholes.*

## SCIENCE TOPICS

Geology  
Erosion  
Weathering

## PROCESS SKILLS

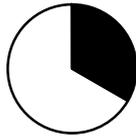
Communicating  
Collecting Information  
Logical Thinking  
Testing

## GRADE LEVEL

5

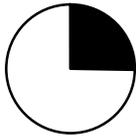
## TIME REQUIRED

### Advance Preparation



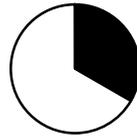
**20 minutes**

### Set Up



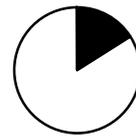
**15 minutes**

### Activity



**20 minutes**

### Clean Up



**10 minutes**

## SUPPLIES

- Small containers (old yogurt containers, Styrofoam cups, or other containers, clear containers work best) (1 per group)
- Large container that the small container can fit into (1 per group)
- 78mm X 78mm Post It™ notes (2 7/8" X 2 7/8") (1 per group plus extras)
- Granular sugar (1 tablespoon per group)
- Abrasive pads (1 per group)
- Large straws or funnel (1 per group)
- Sand (1 cup per group)
- Pump spray-bottles (1 per group)
- Materials to photocopy: Science Background and Student Procedure (1 per student)

### Optional:

- Clay, potting soil, or gravel

## ADVANCE PREPARATION

---

- Cut an opening about the size of a quarter in the bottom of each small container.
- Cut the abrasive pads to the same diameter as the bottom of the small container.
- Use adhesive on Post It™ notes to roll Post It™ notes into hollow cylinders. If necessary, cut cylinders so they are not longer than the height of the small container.
- Remove the pump nozzles from the spray bottles.

## SET UP

---

- Set out materials for each group. Either place the small containers with the sand and sugar at each table, or set out the individual components and have students place the sand and sugar in the bottom of the small containers themselves.

## INTRODUCING THE ACTIVITY

---

*Let students speculate before offering answers to any questions. The answers at the right are provided primarily for the teacher's benefit.*

Ask your students what they think sinkholes are. Ask them if they had ever seen a place where the ground looked like it had collapsed. These are sinkholes.

Tell students that they will do an activity about sinkholes.

Some ground is more likely to form sinkholes. Sinkholes form easily in limestone. Limestone is common in parts of the Northwest, especially in Montana and Idaho. When it rains, some carbon dioxide (the gas people breathe out) is picked up. This makes a very weak acid (carbonic acid). (Carbonic acid is also in soda.) The slightly acidic water dissolves the rocks. This can make caves underground. These caves sometimes collapse to form sinkholes.

Houses, buildings, roads, and bridges can be endangered by sinkholes.

## SCIENCE BACKGROUND

The following is background information on a separate page for students to read before doing the activity.

### Sinkholes

Sinkholes are low spots on land. They are made when limestone is eaten away over time by acid forming underground caves. The acid comes from the rain. The rain becomes a little acid when it picks the carbon dioxide gas that we breathe out. The caves eventually collapse. This leaves a sinkhole.

Sinkholes are different landslides. Both are usually caused by water, but in very different ways. When water causes **erosion**, the **physical** force of the water moves the ground. This is a landslide.

Sinkholes are caused by a **chemical reaction** (acid from the rain).



Waterfall where there was once a limestone cavern.

## TEACHER DEMONSTRATION

You will need to place the sugar and sand in the bottom of the container, or you will need to demonstrate for students how to place the materials in the bottom of the containers.

## CLASSROOM ACTIVITY

*Students should work in groups of two or three.*

Place the smaller container with the sugar and sand into the larger container. Have the students pour water into the larger container until it is about  $\frac{1}{4}$  to  $\frac{1}{2}$  inches deep, depending on the thickness of the pad and the height of the smaller cup while making sure the water flows

### Student Procedure: A Hole in the Ground

- 1** Place a scrubby pad on the bottom of each small container.
- 2** **Build a model of a Limestone Cave.**
  - Stand a sticky note tube on the scrubby pad in the center of your container.
  - Fill the tube almost full of sugar.
  - Have someone hold the tube of sugar.
  - Have a second person pour sand around the tube and fill the container with enough sand to almost reach the top of the paper tube of sugar.
  - Carefully pull the paper tube out of the sand leaving the sugar in the middle of the container surrounded by sand.
  - Pour in enough sand to fill the container and cover the sugar.
  - Carefully place the small container in a big container.
- 3** **Sink the hole.**
  - Slowly pour the water into the big container until it is about 1 cm ( $\frac{3}{4}$ " ) below the top of the sand.

into the bottom of the smaller container and is about the same height as the top of the abrasive pad. Watch what happens to the top of the “ground.”

Have students notice the collapse of the surface above where the sugar was. A depression should form roughly down to the top of the buried sugar. To have a more dramatic effect, the cylinder of sugar should be at least half as long as the smaller container is high.

After the students make the sinkhole, they will use a spray bottle to simulate a well, drawing groundwater out of the system. This is a model of how human activity can cause new sinkholes to appear.

## CLASS DISCUSSION

*Ask for student observations. Let students guide the discussion and present their hypotheses before discussing explanations.*

**How does the amount of water pumped out affect the water table?**

*In this case, the water table goes down because there is no recharge.*

**Did lowering the water table cause any observable changes in the surface?**

*It may cause a sinkhole to form or it may speed up its formation if one has already begun to form.*

**What do you think happened in your container to form the sinkhole? What could you do to test if you are right?**

*The sugar dissolved in the water leaving a void that was filled in by the sand that collapsed from above. Some ways to test would include checking the water to see if it was sugary.*

**SAFETY PRECAUTION:** This lab uses food items, however it is not safe to eat any food in a lab. Students should not taste the water to see if it is sugary.

## OPTIONAL EXTENSIONS

**Extension A—Use different materials or use a more complex combination of materials.**

You can give students clay, soil, or gravel to experiment with along with the sand to see how different soils collapse in different ways. Have different containers of individual materials, one container of sand, one container of gravel, and one of clay, if possible.

How does different material such as sand or gravel affect the ability to use the well?

**Extension B—Use several pumps in the system.**

Use several spray-bottle sprayers. Place them at different locations and at different proximities to each other.

**Extension C—Have a point-source contamination.**

Have the whole container of water be one color and place another color of water in one spot away from the sprayer. Watch what happens to the point of contamination.

## CROSS-CURRICULAR CONNECTIONS

| SUBJECT        | Activity                                                                                                                                                                              |
|----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| SOCIAL STUDIES | Have students research where their local drinking water comes from. Have them find out how deep the water table is in their area—how deep would they have to dig a well to get water? |
| MUSIC          | Sing the song “Hole In the Bottom of the Sea.”                                                                                                                                        |

## RESOURCES

<http://ga.water.usgs.gov/edu/sinkholes.html>

Great images of very big sinkholes at this USGS site.

[http://sjr.state.fl.us/programs/outreach/pubs/order/pdfs/fs\\_sinkhole.pdf](http://sjr.state.fl.us/programs/outreach/pubs/order/pdfs/fs_sinkhole.pdf)

More detailed information about how sinkholes are formed.

## GLOSSARY

- Acid:** A substance that reacts with a base. The more acidic something is, the more strongly it reacts. Something with a pH less than 7 is an acid, more than 7 is a base.
- Chemical reaction:** Reactions between two substances that create new material, release stored energy, or change colors.
- Physical:** Things that move, dealing with forces and energy.

# Sinkholes

Sinkholes are low spots on land. They are made when limestone is eaten away over time by **acid**, forming underground caves. The acid comes from the rain. The rain becomes a little acidic when it absorbs the carbon dioxide gas that we breathe out. Over time the weakened limestone can cause the caves to eventually collapse. This leaves a sinkhole.

Sinkholes are different from landslides. Both are usually caused by water but in very different ways. When water causes **erosion**, the **physical** force of the water moves the ground. This is a landslide. Sinkholes are caused by a **chemical reaction** (acid from the rain and soils).



*Waterfall where there was once a limestone cavern.*



*A typical limestone cave.*

Sinkholes are often formed in a certain type of rock called limestone. Limestone is made up of calcium, carbon, and oxygen. Over time, the acid from rain and soils removes more and more rock. This also makes it easy to form caverns, cracks, and caves in limestone where water moves through the rock.

Sinkholes are not common in Washington or Oregon due to the limited amount of limestone in the area. Limestone is found around Eastern Oregon in the Wallowa Mountains. It is also common in Montana, Idaho, the Midwest, and the Southwest of the United States. Sinkholes usually form with little warning. A geologic study can help to find places at risk for sinkholes. Geologists who study sinkholes can do chemical tests of the ground and the water to help people decide where to build safely.



# Student Procedure:

## A Hole in the Ground

**1** Place a scrubby pad on the bottom of each small container

**2** Build a model of a limestone cave

- Stand a sticky note tube on the scrubby pad in the center of your container.
- Fill the tube almost full of sugar.
- Have someone hold the tube of sugar.
- Have a second person pour sand around the tube, filling the container with enough sand to almost reach the top of the paper tube of sugar.
- Carefully pull the paper tube out of the sand, leaving the sugar in the middle of the container surrounded by sand.
- Pour in enough sand to fill the container and cover the sugar.
- Carefully place the small container in the larger container.

**3** Sink the hole

- Slowly pour water into the larger container until it is about 1 cm (3/4") below the top of the sand in the smaller container.
- Observe and record your observations. Record what you see as it changes over time.

**4** Add a well

- Place the end of the spray bottle pump into the water between the small and the big containers.
- Pump at least half of the water out. This models pumping water from a well and lowering the water table.
- Continue to make observations.
- Record what you see as it changes over time.



Name of Scientist: \_\_\_\_\_ Date: \_\_\_\_\_

# Questions:

## A Hole in the Ground

Define “sinkhole.” What are the characteristics of a sinkhole?

How do sinkholes form?

What type of material does a sinkhole form in?

How does water affect sinkholes? Is there anything special about the water?