Regolith Formation

Purpose

To compare the process of regolith formation on Earth and on the Moon.

Background [also see "Teacher's Guide" Pages 4, 5]

The loose, fragmental material on the Moon's surface is called regolith. This regolith, a product of meteoritic bombardment, is the debris thrown out of the impact craters. The composition and texture of the lunar regolith varies from place to place depending on the rock types impacted.

Generally, the older the surface, the thicker the regolith. The regolith on young maria may be only 2 meters thick; whereas, it is perhaps 20 meters thick in the older lunar highlands.

By contrast, regolith on Earth is a product of weathering. Weathering encompasses all the processes that cause rocks to fragment, crack, crumble, or decay. These processes can be *physical* (such as freezing water causing rocks to crack), *chemical* (such as decaying of minerals in water or acids), and *biological* (such as plant roots widening cracks in rocks).

The rock debris caused by weathering can then be loosened and carried away by erosional agents -- *running water* (fast-flowing rivers, rain, ocean waves), *high-speed wind* (by itself or sandblasting), and *ice* (glaciers).

In this activity, procedures A and B challenge the students to determine the effects of wind, sandblasting, and water on regolith formation and deposition on Earth. This is followed by prodedure C in which the students simulate regolith formation on the Moon by meteoritic bombardment.

Preparation

Review and prepare materials listed on the student sheet.
Toast, crackers, or brittle cookies can be used in this activity. Toast is the least expensive but most time consuming choice. In any case, students will need two different colors of materials for procedure C; for example, vanilla and chocolate graham crackers. Invariably, students get hungry at the sight of food, so you may want to reserve some clean materials for consumption or use something other than a rock for the projectile.
To prepare bread: use a conventional oven, toaster, or sun-dry method to produce the most crisp and brittle toast. Toast one loaf of white bread and one loaf of golden wheat or rye bread. Note that whole wheat bread does not get brittle enough.

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For procedure B, fill margarine containers (one for each group) with water and sand, then freeze. The more sand, the better the illusion to a real rock.

For procedure C, do not use glass pans. Large plastic tubs are preferred for this procedure, but recyclable aluminum roasting pans or shallow cardboard boxes work as well.

In Class

Divide the students into cooperative groups and distribute materials.

Discuss the definition of regolith. Have students guess how regolith is formed on Earth and on the Moon. Ask students for justification.

If sand paper or nail files are not available, then students can use the edge of a ruler to illustrate the effects of sandblasting in procedure A. Caution students to use a collection tray in the sink in procedure B to avoid sand-clogged drains. An alternative to using a faucet is to have the students pour a steady stream of water from beakers onto their ice-cube rocks to illustrate the effects of falling water.

Have students guess individually, then discuss in groups, what the surface of the Moon is like (hard rocks, fine dust, large boulders). Ask students for justification of their answers.

Refer to a photograph of an astronaut's bootprint on the surface of the Moon. Give students the opportunity to change or confirm their guesses.

Procedure C is best done outside. Drop the rock from waist high. Sometimes the impacting rock causes the pan to bounce so you may want to secure the pan to the ground with tape. Students should stand back as a safety precaution.

Wrap-up

After participating in the activity, have the whole class compare and contrast regolith formation and ask each small group to verify their original guesses.

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Key Words

regolith

meteoritic bombardment

weathering

erosion

Materials

toasted white bread

toasted golden wheat bread

small pan

sand paper, nail file, or edge of ruler

ice cube with sand inside

tray

fist-size rock

Regolith formation on Earth

Procedure A

What effect does wind have on regolith formation?

1. Imagine that the piece of toasted bread is a rock on Earth. Your hand is the wind. The sand paper is wind carrying particles of sand.

2. Predict the effects of rubbing just your hand and then the sand paper across the toasted bread.

3. Now try it. Rub your hand across the toasted bread and observe the bread and the pieces which fall from it onto the pan. Observations:

4. This time rub the sand paper across the toasted bread and observe the bread and the pieces which fall from it onto the pan. Observations:

5. How was the effect different?

6. How is this activity related to processes on Earth?

Procedure B

What effect does falling or fast flowing water have on regolith formation?

1. Imagine that the ice cube with sand is a rock.

2. Place this ice cube on a collection tray beneath the water faucet.

3. Adjust the water flow from the faucet so a medium stream hits the ice cube.

4. Observe what happens to the ice cube and the remaining particles.

5. What happened to the rock (ice cube)?

6. Describe the particles which remain.

7. How does water contribute to regolith formation on Earth?

Regolith formation on the Moon

Procedure C

1. Do you think regolith on the Moon is formed in the same manner as on Earth? Why or why not?

Now we will investigate the effects of meteoritic bombardment on regolith formation.

2. In a small pan, place 2 slices of toasted white bread onto 3 slices of toasted golden wheat bread. This represents the Moon's crust.

3. Drop a rock onto the layers of toasted bread twice. Describe the bread slices and the crumbs.

4. Drop the rock 20 times onto the layers of toasted bread. Describe the bread slices and the crumbs.

5. Which crumbs can be seen at the surface? Why?

6. How does the thickness of the crumb layers compare after 2 hits and after 20 more hits?

7. How does meteoritic bombardment make regolith on the Moon?