Down to Earth
KS3

Teachers Guide

Making Regolith

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Making Regolith on the Earth and the Moon

Background

All Moon rocks originated through high-temperature processes with little or no involvement with water; they can be divided into three types: basalts, anorthosites and breccias.

Footprint in the Lunar regolith left by one of the Apollo 11 astronauts. *NASA*.

The loose fragments of material on the Moon's surface are called regolith. This regolith, a product of bombardment by meteorites, is the debris thrown out of the impact craters.

The composition and texture of the lunar regolith varies from place to place and depends on the type of rock that has been hit by the meteorites. Generally, the older the surface, the thicker the regolith. Regolith on the young, dark maria (Latin for 'seas') may only be two metres thick, but it may be 20 metres thick in the older, light-coloured, lunar highlands.

By contrast, regolith on Earth (called 'soil' as it contains organic material) is a product of weathering. 'Weathering' describes all the processes that cause rocks to fragment, crack, crumble or decay.

<u>These processes can be</u>:

Physical => freezing water causing rocks to crack

Chemical => the decaying of minerals in water or acids

Biological => plant roots widening cracks in rocks

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

Weathering is the decomposition of rocks and soils through direct contact with the planet's atmosphere. Weathering occurs in situ, with no movement, and should not to be confused with erosion, which involves the movement and disintegration of rocks and minerals by agents such as water, ice, wind, and gravity.

Overview

The students will determine the effects of wind, sandblasting and water on regolith formation and deposition on Earth. After discussing whether or not they think that lunar regolith is formed in the same way, the students will simulate regolith formation on the Moon by meteoritic bombardment.

Key Question

Q. What are the similarities and differences between the way regolith is formed on the Moon and on the Earth?

A. Regolith on the Earth (including soil) is a product of weathering whereas the lunar regolith is a result of meteoritic bombardment.

Materials and Preparation

Each group of students will need:

- Toasted white bread (3 pieces)
- Toasted brown bread (3 pieces)
- Sandpaper
- Margarine container ice cube with sand inside
- Two trays
- Recyclable aluminium roasting tin or shallow cardboard box
- Fist-sized rock

Toast bread as usual with a toaster. You need to have the most crisp, brittle toast possible. Whole wheat bread is generally not crisp enough, normal brown or rye bread work better.

To make the ice cubes, fill a plastic margarine container with sand and water and then freeze until solid. The more sand the better the illusion to a real rock.

Management

This activity should take one lesson to complete.

Students need to be divided into small groups – the size of the groups depends on the number of ice cubes you have been able to make and access to taps.

The groups of students will follow all instructions on their worksheets.

Part 1: Regolith Formation on Earth

The students will investigate the effect that the wind has on regolith formation on Earth.

The toast represents a rock on the Earth, their hand is the wind and the sandpaper is the wind carrying particles of sand.

1. The students need to talk in their groups and predict the effect of rubbing the toast with just their hand and then with the sandpaper.

2. The students will then rub their hand across the toast and observe the bread and the pieces that fall from it. They should record their observations.

3. They then rub the toast with the sandpaper and again record their observations.

4. In their groups, the students need to discuss how the effects were different and how these activities are related to actual processes on the Earth.

Part 2: Regolith Formation on Earth

The students will look at the role that falling or fast flowing water has on regolith formation on the Earth.

1. The ice cube with sand in represents a rock and the water from the tap is falling or fast flowing water.

2. The ice cube is placed on a tray underneath a medium flow of water from the tap. The students will observe what happens to the ice cube and the particles that remain and record their observations on their worksheet.

3. In their groups students will discuss how water contributes to regolith formation on the Earth.

Part 3: Regolith Formation on the Moon

Before doing the actual activity, the students need to consider if regolith on the moon is formed in the same way as on the Earth – they can jot their ideas down on their worksheet.

1. They will then investigate the effects of meteoritic bombardment on regolith formation. 3 slices of brown toast with two slices of white toast on top represents the moon's crust. The students will drop the rock onto the pile of toast twice and then observe the toast and crumbs and record what they see.

2. They then drop the rock onto the toast a further 20 times, record their observations and answer the questions on their worksheets.

3. The students will then consider how bombardment by meteorites makes regolith on the Moon.

Discussion

As a class discussion get the groups of students to describe what they observed during their experiments and to talk about their understanding of the processes of regolith formation on the Earth and on the Moon.

Part 1: Regolith Formation on the Earth

The sandpaper 'erodes' the toast more quickly than the hand alone and dislodges more particles. This illustrates that the wind has stronger erosive effects when it is carrying particles e.g. sand. You could incorporate the illustration of the Sphinx in Egypt – it has suffered from severe erosion due to the desert winds.

Part 2: Regolith Formation on the Earth

Flowing or falling water also acts to erode rocks. If the water falls onto a small point on the rock – the area of erosion is concentrated. The water also carries away the rock debris (in this case the sand), and deposits it somewhere else.

Part 3: Regolith Formation on the Moon

The Moon has no weather (no atmosphere) and no flowing water so the formation of regolith must result from an entirely different process. Meteoritic bombardment is responsible for the production of all the regolith on the moon – the repeated impacts shatter the rock and produce particles of smaller and smaller sizes.

The older lands on the moon (the lunar highlands) have much thicker regolith as they are older and have sustained more meteorite impacts. Also, when the moon was young, the impacts were of greater severity.

Further Activities

1. Get the students to think about regolith formation on other planets, for example Mars and Venus. Which planets wouldn't have a regolith (the gas giants) and why not? How is the regolith on Mars formed (wind erosion, water erosion in past and bombardment) and what is it made of (rocks similar to those on Earth)?

2. Buildings and rock on Earth are also subject to chemical weathering by e.g. acid rain. Get students to research the effects of acid rain on the Internet and make a poster about them. Good websites to use are:

http://www.soton.ac.uk/~engenvir/environment/air/acid.home.html

National Curriculum Links

Geography Key Stage 4 (OCR):	River erosion, transport and deposition
Science Key Stage 3:	Scientific Enquiry; Materials and their Properties
Science Key stage 4:	Scientific Enquiry