Geology

Class Overview

1. Introduction
    a. Ask the students if anyone can define the word geo?
    b. If geology is the study of the earth and its components, what things do you think we will be talking about today?
    c. What are the three different types of rocks?
2. Progression of Activities
    a. Rock Cycle Activity
    b. Raindrop Run
    c. Gulley Exploration
3. Learning Standards Addressed
    a. 4.A.2b , 4.A.2c , 4.A.3a , 4.A.3d 4.B.2b
    b. 7.A.2a , 7.A.3b , 7.B.2a , 7.B.3
    c. 10.A.2c
    d. 11.A.2b , 11.A.2d , 11.A.3a , 11.A.3c
    e. 12.E.2a , 12.E.2b , 12.E.3a , 12.E.3b
    f. 17.B.2a , 17.B.3a , 17.C.2c
    g. 19.C.2a , 19.C.3a
4. Vocabulary
    a. Sedimentary Rock: Rock that has formed through the deposition and solidification of sediment. Sedimentary rocks are often deposited in layers and frequently contain fossils.
    b. Igneous Rock: Rock formed by the cooling and solidifying of molten materials.
    c. Metamorphic Rock: Rock that was once one form of rock but has changed to another under the influence of heat, pressure, or some other agent, without passing through a liquid phase.
    d. Magma: Molten material beneath or within the earth's crust, from which igneous rock is formed.
    e. Erosion: The process by which the surface of the earth is worn away by the action of water, glaciers, winds, waves, etc.
    f. Tectonic Plates: The dozen or so plates that make up the surface of the earth.
    g. Glacier: A large mass of ice formed over many years that does not melt during the summer. Glaciers move slowly over an area of land, such as a mountain valley.
    h. Avalanche: A large mass of snow, ice, etc., detached from a mountain slope and sliding or falling suddenly downward.
    i. Subduction: Taking away; subtraction.
    j. Crystallization: A process that occurs as magma is cooled and hardens into an igneous rock.
    k. Lithification: The cementation or compaction of sediments over time to create rock.

l. Weathering: The breakdown of rock over time due to natural (wind, rain, ice, fungus growth, etc.), human, or chemical processes.
m. Gully: A small valley or ravine originally worn away by running water and serving as a drainage way after prolonged heavy rains.

5. Wrap Up
    a. What are the three different types of rock?
    b. What is erosion?
    c. What are some of the changes you predict will happen in the gully?

Rock Cycle Activity

Objective: Students will learn the various stages of the rock cycle.

Method: Students will play an interactive game involving movement from one station to the next.

Location: Outside or inside with area to move around

Time: 30/40 minutes

Materials: Wood block dice, signs for stations, sign for cycle, rock cycle worksheet, markers, and clipboards

Vocabulary: Sedimentary rock, igneous rock, metamorphic rock, magma, erosion, tectonic plates, glacier, avalanche, subducted, crystallization, weathering, lithification

Background Info: The rock cycle is a process by which rocks are formed, altered, destroyed, and reformed by geological processes. Students will take on different parts of the rock cycle and learn how rocks and sediments are transformed into one another.

Procedure:

1. Start with the students in a circle. Ask them if they know the different types of rocks. Hand out signs to the students with the correct answers. Ask the students where magma and sediments fit into the process.
2. Ask the students if anything else might affect the process of the rock cycle. Introduce erosion, lithification, heat and pressure, melting and crystallization. Discuss how these things affect the cycle. (*Crystallization* occurs as magma is cooled and hardens into an igneous rock. *Erosion* is the movement of the material from one area to the next. *Weathering* is the breakdown of rock over time due to natural [wind, rain, ice, fungus growth, etc.], human, or chemical processes. *Lithification* is the cementation or compaction of sediments over time to create rock. *Heat and pressure* have the ability to change the composition of the rock over time. *Melting* will recycle the rock and turn it into magma. This only occurs under extremely high temperatures and pressure.)
3. Explain that the students are about to become a part of the rock cycle. Point out the various stations for them: mountain, earth's interior, soil, clouds, volcano, river, and ocean. (*There are two versions of this game. One uses wooden dice and the other uses envelops with cards in them. Beyond this point the movement of both games is exactly the same.)*
4. Each student will be given a rock cycle worksheet and marker. Assign the students to a station at this point. Once they get to their starting station, they will write where they are starting on their worksheet. They will roll the dice or pull a card from the envelope and write down what happens to them and where they need to go next. Once they get to the next station they need roll the dice or pick another card and continue on.
5. Give the students 10 to 15 minutes to continue on their journeys.

Wrap Up:

1. Where did the students go on their journey? What happened to them?
2. At what points were they a sedimentary rock? Igneous rock? Metamorphic rock? How could they tell?
3. If there is time, the students could write a story about their journey or create a comic strip that describes what they went through.

Adapted from: Illinois State Museum Geology Online. Ride the Rock Cycle. http://geologyonline.museum.state.il.us

Raindrop Run

Objective: Students will understand factors that influence erosion by demonstrating the effect of moving water on sediment.

Method: Students play an active game to show erosion.

Location: A large open area

Time: 15-20 minutes

Materials: 2-3 hula-hoops or ropes tied to form a circle

Vocabulary: Erosion

Background Info: Erosion is the movement of soil or sand or rocks. It is created because of rain, rivers, wind, animal movement, or plants. The gully, which winds through Taft campus, is an example of how several factors influence erosion. As water flows through the gully, it carries sand, silt, and clay particles. After a heavy storm, there is evidence of soil erosion along the trail. Fallen trees and other plants cause the particles to slow down. These features are debris dams. As water moves from the gully to the Rock River, it slows down. The sand, silt, and clay are deposited on the delta.

Procedure:

1. In this activity there are four different parts: trees (two students), raindrops (two students), rocks and dirt (half should be dirt, half rocks).
2. Students who are trees must have their feet placed within the two rope circles, and the ropes must not move.
3. To distinguish between the rock and dirt particles, ask the rocks to flex and act big.
4. Students who are dirt and soil should find a place between the start and the trees. Students who are raindrops should line up behind the start.
5. The objective is for the raindrops to bring all the dirt and soil particles to the finish line
6. As a raindrop runs downstream, they may collect a dirt or rock particle. A raindrop collects a particle by tagging only one student at a time and linking arms. The raindrop and dirt or rock must now move together. Rocks and dirt may not move without a raindrop.
7. If a raindrop is carrying a dirt particle, they may run downstream. If a raindrop is carrying a rock, they must continue to walk downstream.
8. The trees' goal is to stop the rocks and dirt from moving downstream. While keeping their feet in the hula-hoop, trees may tag pairs as they move pass. If either in the pair is tagged, the dirt or rock is deposited (student must stop) where the tag occurred. The raindrop continues to move downstream. Once the raindrop crosses the finish line, he/she may return to the start cone and go again. The game continues until all the dirt and sand are brought to the finish area.

Wrap Up:

1. What was difficult for the raindrops? Trees?
2. What was the role of the trees? Raindrops?
3. Why could dirt run downstream and rocks only walk?
4. If the trees prevented things from moving downstream, what might happen?

5. What feature was formed at the finish line?
6. What was realistic? What was unrealistic?
7. While hiking trough the gully, look for similar erosion and deposition features.

Created by: Jake Murphy, former Lorado Taft Education Program Specialist

Side note: The designated shape for the boundaries of the raindrops to run can be shaped into different shapes to show different affects. For instance, water may get held up in a curved section, just as you would see backflow in a river or creek.

Gully Exploration

Objective: Students will discover Taft Campus' geologic history first-hand and gain an understanding of the natural forces at work in shaping the landscape yesterday and today.

Location: Anywhere in the gully

Time: 30-45 minutes

Materials: Clipboards with guide sheets and pencils (1 for every 2-3 students)

Vocabulary: Gully

Background Info: The Taft campus is rich in geologic history, the most obvious evidence of this beginning between 550 and 300 million years ago. During this 250 Million-year period, warm shallow seas encroached upon this area and then receded several times. With each encroachment, as the waters approached from the south, the Taft campus became a beach or shoreline area. Over millions of years, well-sorted sand was deposited by wave action. As the waters and beaches slowly moved further north, however, mud's and silts were deposited above the layers of sand by deepening waters. Both the sands and the mud's/silts had been transported to the sea via rivers flowing south through Canada. As the sea continued to move further northward, sediments transported by rivers no longer reached what is now Taft Campus. Instead, the deeper waters cleared and became home to millions of shelled creatures, whose calcareous bodies began to accumulate on top of the layers of mud and silt. As the layers piled higher and the pressure increased, each type of sediment in its turn became sedimentary rock. The sand became sandstone, the mud and silt became a relatively thin layer of shale, and the shells of ancient sea creatures became limestone and dolomite, some of the layers interspersed with chemically precipitated chert. These rock layers are several thousand feet thick and contain some fossil evidence of the corals, shellfish and other creatures that lived in the Ordovician Sea.

Over the past two million years, the planet has experienced the Great Ice Age. Great ice sheets have repeatedly advanced into the northern United States from Canada, many of the covering the Taft Campus. The glacial advances caused three very significant changes in Northern Illinois. First, they deposited a blanket of glacial till (scraped up rocks, mud and other materials) up to 300 feet deep over the land. Granite and basalt are two igneous rocks commonly found in the gully due to glacial transport. Secondly, the last of the glaciers to actually enter this area some 18,000 years ago, crossed the ancient Rock River Valley (which ran south from Rockford to the east of Rochelle) causing the waters to divert and take a new course around the edge of the glacier. When the ice sheet receded, the old river valley had been so filled with glacial deposits that the river remained in its new course where we find it still today. Lastly, as ice sheets flowed over the land, strong winds blew ahead of them generating dust storms, which caused a mantle of silt to be deposited across the land. It is this silt that today supports the very rich soil of the area.

Procedure:

1. Once you have found a comfortable place in the gully, split the group up into groups of 2 or 3.
2. Give each group a clipboard, gully exploration sheet, and something to write with.
3. Tell the group about the boundaries (you need to be able to see them), and let them get to work on the sheet.
4. Give the groups about 20 -30 minutes to complete the worksheet. Make sure to check on each group and their progress as the activity goes on.
5. After the groups have completed the worksheet, go through the answers and ideas with the group.

Wrap-up:

1. How different were each group's answers? Is anyone right or wrong?

Resources:

Bowden, Kenneth L. (1957) The Geology of Lorado Taft Field Campus and Vicinity Northern Illinois University: unpublished master's thesis

Flemal, Ronald C. and Douglas E. Wade (1971) Some Natural History of the Chana-Oregon, Illinois Area Northern Illinois University: unpublished document

Koetje, Cynthia (1997) Gully Exploration Lorado Taft Field Campus: unpublished guide sheet

Gully Exploration

1. Are the sides of the gully the same height and shape on both sides? Why do you think this might be the case?

2. What are some erosional forces at work here in the gully? In other words, who or what is moving soil and rocks.

3. Develop a method for measuring the width of the gully and take measurements at three different points. What method of measurement did you use? Was the width of the gully the same at all three points? Why do you think this may be?

4. Is there any water in the gully? Why or why not?

5. Where does water in the gully travel to? Can you identify which direction the gully flows? What evidence supports your theory?

6. Based upon all of the observations you have made in the gully, develop a hypothesis that describes how and when the gully was formed. Use the back of this sheet and include the following information in your hypothesis:

   How was the gully formed?
   Was it formed all at once or over a long period of time?
   Is it still being formed?
   Do you predict that it will look any different in 10 years, 100 years, or 1000 years?
   How?

Gully Exploration

Teachers Guide

1. Are the sides of the gully the same height and shape on both sides? Why do you think this might be the case?

The outer curve (cut bank), is being eroded as water swings out around the curve. This results in a steep, high bank. On the inner curve (point bar) water is forced to slow down, thereby dropping some of its load and resulting in a lower, gradual, sloping bank.

2. What are some erosional forces at work here in the gully? In other words, who or what is moving soil and rocks?

Water caused much of the initial erosion, however, once a channel is cut, it is opened up to wind as well. Freeze and thaw of water in cracks will also cause rock to break away. To a smaller extent, lichens release a chemical which allows them to use minerals from the rock and causes weathering.

3. Develop a method for measuring the width of the gully and take measurements at three different points. What method of measurement did you use? Was the width of the gully the same at all three points? Why do you think this may be?

Probably not. The curves of the stream, the gradient (or steepness of the slope), and the rocks underneath could all affect the width of the gully.

4. Is there any water in the gully? Why or why not?

This gully is an intermittent stream which only carries water in times of high rain or snow melt. There was probably a time when it carried more water, perhaps as glaciers were receding.

5. Where does water in the gully travel to? Can you identify which direction the gully flows? What evidence supports your theory?

The water flows west to the Rock River. Look for piles of dead wood and debris that have piled up on the back side of an obstruction, or rocks which were stopped by a curve in the stream bed. If you brought a level and ruler there may be a slight slope to the west.

6. Based upon all of the observations you have made in the gully, develop a hypothesis that describes how and when the gully was formed. Use the back of this sheet and include the following information in your hypothesis:
   How was the gully formed? Was it formed all at once or over a long period of time? Is it still being formed? Do you predict that it will look any different in 10 years, 100 years, or 1000 years? How?

The gully has been formed by erosion primarily due to water over thousands of years. It will continue to change as more rocks and soil are moved. Most likely, curves will continue to become more pronounced as erosion occurs on cut banks and deposition occurs on point bars.