Geology

Class Overview

1. Introduction
    a. What is geology?
    b. There are three common types of rocks. What are they?
    c. What is erosion? What is weathering? How are these two forces different?
2. Progression of Activities
    a. Rock Charades
    b. Breakdown!
    c. Soil Sampling
    d. Gully Exploration
3. Learning Standards Addressed
    a. 11.A.2b, 11.A.3c, 11.A.2d, 11.A.2e
    b. 12.E.2a, 12.E.3a, 12.E.2b, 12.E.3b
    c. 17.A.2a, 17.B.2a
4. Vocabulary
    a. Geology: The scientific study of the origin, history, and structure of the earth.
    b. Igneous rock: Igneous rocks are formed from the cooling and solidfication of magma or lava.
    c. Sedimentary rock: Sedimentary rocks are formed when sediments accumulate over periods of time. Sediments are smaller particles of rock formed when existing rocks are broken down by means of weathering and erosion. They are then transported by winter, water, or glacial activity.
    d. Metamorphic rock: Metamorphic rocks are rocks that have gone through a change in form. The existing rock is subjected to intense heat and pressure, causing physical or chemical change.
    e. Magma: Molten material beneath or within the earth's crust, from which igneous rocks are formed.
    f. Glacier: A large mass of ice formed over many years that does not melt. Glaciers move slowly over an area of land, such as a mountain valley.
    g. Weathering: The breakdown of rocks, soils, and minerals through contact with Earth's atmosphere, water, or living organisms. Weathering occurs without movement ("in situ").
    h. Erosion: The process by which materials are removed from an area and deposited elsewhere, usually due to transport by wind, water, ice, gravity, or living organisms.
    i. Gully: A small valley or ravine originally worn away by running water and serving as drainage after prolonged heavy rains.
5. Wrap-Up
    a. Rock Review Game
    b. What are the three types of rocks? What are the three types of soil?
    c. What is erosion? What is weathering?

Rock Charades

Objective: Students will learn to identify the three rocks in the rock cycle.

Method: Students will play a game similar to charades, in which they represent the three rocks in the rock cycle with body movements.

Location: Outside or inside.

Time: 15 minutes

Materials: None

Vocabulary: igneous rock, sedimentary rock, metamorphic rock

Background Information: The rock cycle is the process by which rocks are formed, altered, destroyed and reformed by geological processes. Students will become parts of the rock cycle and act out each simple rock formation.

Procedure:

1. Have students spread out and stand up. Ask for two student volunteers to help you demonstrate the game. Ask how many students have played charades? What's the most important rule? No talking!
2. With one student volunteer, demonstrate Igneous Rocks. Hold your hands up over your head and in front of you at a 45 degree angle. Have the student do the same. Put your palms together, forming a steeple or volcano shape. This is Igneous Rock because igneous rocks come from volcanoes.
3. Next, demonstrate Sedimentary Rock. Hold out one hand in front of your body, palm down. Have the student place his/her hand over yours. Cover their hand with your hand. Continue in this way, making layers with your hands. This is Sedimentary Rock because sedimentary rocks are made by layers of sediment.
4. Finally, demonstrate Metamorphic Rock. Have your two student volunteers stand on either side of you. This rock is the only rock that is allowed to speak during the game. Squishing together, they should gently bounce up and down and say "Heat and Pressure! Heat and Pressure!" This is the only rock formation that needs three people to be complete. This is Metamorphic Rock because metamorphic rocks are formed by heat and pressure.
5. Rules: Students must form these rocks with each other, without speaking. Students must switch partners when each new rock is called. Students are out if they do not switch partners, if they form the wrong rock, or if they speak out of turn. If the caller yells "Earthquake!," all players may rejoin the game. Play until you have only two players (or three) remaining.
6. **Extra Rock Formations:** If you explain extrusive and intrusive igneous rocks to your students, you may include them in your game. Intrusive igneous rocks are formed by the slow cooling of magma within the crust of the Earth (an example is granite). Have three students huddle together, crouch near the ground, and stand up

slowly. Extrusive igneous rocks form from the rapid cooling of lava such as when a volcano explodes (like pumice). Have two students stand back to back, their elbows linked together. The students bounce around as if they're being thrown from a volcano.

Breakdown!

Objectives:

1. Students will learn the difference between weathering and erosion.
2. Students will learn the two types of weathering: chemical and mechanical.
3. Students will learn the four types of erosion: gravity, water/ice, wind, bioerosion.

Method: Students will play a simulation-like game that will help them to act out weathering and erosion forces.

Location: Outside or Inside

Time: 20-25 minutes

Materials: Breakdown! Cards, 3 cones, Water, Wind, and Gravity cards

Vocabulary: mechanical weathering, chemical weathering, erosion, earthquake, gravity

Background Info: Weathering is the breakdown of rocks, soils, and minerals through contact with the Earth's atmosphere, water, or living organisms. Weathering occurs without movement ("in situ"). An example of mechanical weathering might be a rock cracking, freezing, and expanding over a period of time. An example of chemical weathering might be acid rain dissolving rock over a period of time. Erosion is the process by which materials are removed from an area and deposited elsewhere, usually due to transport by wind, water, ice, gravity, or living organisms.

Procedure:

1. Assign Breakdown! Cards to students. Students may have one of the following roles: gravity, water/ice, wind, living organism, chemical weathering, mechanical weathering, rock. Rock students will gather together in one formation. Have the students stand in a bunch, rather than in a circle.
2. Students that are not rocks will demonstrate how weathering and erosion work by wearing away at the Rock Formation and depositing individual rocks around the playing field.
3. Have Weathering and Erosion students approach the Rock Formation one at a time.
    a. Chemical Weathering taps 2-3 students on their shoulders. When a Rock is tapped, the student will get down on one knee or crouch down, signifying chemicals eating away at geological formations.
    b. Mechanical Weathering gets into the middle of the bunch and nudges everyone out of the way, making a larger, more spread out "bunch" effect. This signifies mechanical weathering like ice, salt, and vegetation breaking apart geological formations.
    c. Wind Erosion spins like a tornado up to the Rock Formation and takes two students away. The two students are taken to the orange cone with

the Wind sign attached to it. This signifies wind carrying away soil and sediments.

d. Water Erosion walks up to the Rocks and takes two students to the orange cone with Water attached to it. This signifies water carrying away soils and sediments.
e. Living Organism Erosion (or Bioerosion) runs up to the remaining Rocks and "burrows" between them. It splits the remaining rocks into two groups, similar to the way a burrowing animal moves soil to create a tunnel system.
f. Gravity Erosion creates an earthquake by stomping his/her feet. It takes away two rocks to the Gravity cone. This signifies gravity carrying away soils, sediments, and rocks.
g. Without letting the students move, count how many rock formations exist now.

4. Wrap up:
    a. How many rock formations did we start with? How many did we finish with?
    b. What is the difference between weathering and erosion?
    c. What types of erosion and weathering are most common at Taft? How do we know?

Soil Sampling

Objective: Students will be given the opportunity to explore soil.

Method: Students will be split into groups and given soil cores samplers to help them identify the three components of soil and their prevalence in Taft's geological landscape.

Location: Outdoors. (Recommended areas: Taft Gully, North Field Trail, Delta)

Materials: Soil core samplers

Time: 20-30 minutes

Procedure:

1. Break students into groups of two, three, or four depending on the number of samplers available. Explain boundaries to students.
2. Demonstrate how to use a soil core sampler. The sampler is shaped like a "T". The shaft of the "T" is hollow to allow the viewer to see the layers of soil the same way they look in the ground. Each inch of soil may have taken up to a thousand years to create. Looking into a soil core is like looking back in time. To use the soil core sampler, twist the toothy end into the earth, using the top of the "T" as a handle. When the core sampler is secure in the ground, use your hand or foot to push the sampler as far into the ground as you can. Remove the sampler carefully, holding as much soil in the viewing "window" as possible.
3. Pinch the soil in different parts of the viewer and examine it in your hands. What does the soil look like? Is it sandy, silty, or full of clay? Where was the soil found? What sorts of geological or erosion activities are occurring in your sample spot that account for its components? (For instance, the delta has lots of sand deposits. Why might that occur?)
4. Empty the soil core sampler by pushing the soil out of the viewing window. Remember to fill in holes so that no one trips!
5. Have students take at least three samples in three different areas to get a sense of the soil around Taft.

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 students up into groups of 2 or 3.
2. Give each group a clipboard, gully exploration sheet, and writing utensil.
3. Explain the group boundaries (you should be able to see them) and let them work on the sheet.
4. Give the groups 20-30 minutes to complete the worksheet. Make sure to check on each group and their progress as the activity goes on.
5. After students have completed sheets, go through the answers with the group.

Wrap-Up:

1. How different are each group's answers? Is another right or wrong? Why?

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 erosion 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 erosion 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 the 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?

It is unlikely that the width will be the same at all three points. 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 the 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 were caused by an obstruction, or rocks stopped by a curve in the stream bed. There is a slight slope to the west which can be tested with a level and a ruler.

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

Rock Review Game

(Wrap Up)

Objective: Students will review the concepts and material covered in the lesson.

Method: Students will play a learning-based running game.

Location: Inside or Outside. Room to run.

Time: 15 minutes

Materials: True/False cards, boundary markers/cones (optional)

Vocabulary: List of terms covered in the lesson.

Procedure:

1. The entire group begins in the middle of the playing field. A true or false question is read aloud. If the answer is true, students cross a line to one side of the playing field. If it is false, students cross to the other end of the playing field.
2. Students that run in the wrong direction are out for the round.

Variations:

1. Instead of calling students out, the entire group must work together to come up with the correct answer. If they are incorrect, the group gets a letter (similar to the assignment of letters in a game of HORSE). The first wrong answer gets an “R,” the second an “O,” the third a “C,” and the final wrong answer a “K.” If students accumulate four wrong answers, they’re all out.
2. This game can be turned into Jeopardy if you’re stuck indoors.