Table Rocks Curriculum

Changes in the Earth's Structure

Objective: Students explore the formation of the Table Rocks identifying factors that cause the Earth's surface to change over time through a classroom demonstration. Students will gain a greater understanding of ***erosion*** and ***deposition*** by completing a hands-on activity.

Benchmarks Targeted: 2 and 3 (Grades 6-8)
Oregon Standards Achieved:

Subject Area: Earth and Space Science

Common Curriculum Goals: The Dynamic Earth: Understand changes occurring within the lithosphere, hydrosphere, and atmosphere of the Earth.

Benchmark 2: Identify causes of Earth surface changes.
Benchmark 2: Identify effects of wind and water on Earth materials using appropriate models.
Benchmark 3: Describe the Earth's structure and how it changes over time.
Benchmark 3: Give examples of landform changes that occur at different rates.

Subject Area: Scientific Inquiry

Common Curriculum Goals: Forming the Question/Hypothesis: Formulate and express scientific questions.

Benchmark 2: Make observations. Based on these observations, ask questions.
Benchmark 3: Based on observations and scientific concepts, ask questions.

Common Curriculum Goals: Analyzing and Interpreting Results: Analyze scientific information to develop and present conclusion.

Benchmark 2: Summarize, analyze, and interpret data from investigations.
Benchmark 3: Summarize and analyze data including possible sources of error.

Length of Lesson: 20-30 minutes

Materials:

- ✓ One large pickle jar (or similar transparent item)
- ✓ Sand (enough to fill the bottom of the jar to about an inch high)
- ✓ Pebbles (enough to cover the sand about three inches)
- ✓ Crushed lava rock or other rock that is a different color than the sand and pebbles (enough to cover the pebbles about and inch)
- ✓ Dirt (just enough to cover the crushed lava rock)
- ✓ Marker (to write on the outside of the clear container)

Note: Different types of dried beans, peas, or lentils can be substituted for the sand, pebbles, lava rock, and dirt if they are easier to obtain.

Key Vocabulary: *andesite, conglomerate, deposition, erosion, igneous rock, sandstone, sedimentary rock, weathering*

Background:
See Chapter Introduction.

Procedure:

Preparation:
Refer to the geology chapter introduction for an explanation of the geological formation of the Table Rocks. This is the process you will be modeling for the students in the demonstration. Gather all the materials listed above. Before the activity begins, fill the bottom of the jar with sand about one inch deep.

Activity:

1) At the beginning of the activity, explain to the class one inch of sand on the bottom of the jar represents deposits in this area left by earlier geologic events. Ask students what they think southern Oregon may have looked like during the time that sand was being deposited.

2) Pour in enough pebbles to cover the sand about three inches. Ask students what might cause sediment to be ***deposited*** on the surface of the earth other than sand ***deposits*** from the ocean. Explain that pebbles represent the Payne Cliffs Formation, ***sandstones*** and ***conglomerates*** (types of ***sedimentary rock***) ***deposited*** by river systems 48 to 35 million years ago.

3) Have students brainstorm events that could cause the land to change rapidly to form rocks. Explain how a volcano erupted about seven million years and spread lava all over the ancestral Rogue River Valley. The lava cooled to form a layer of ***igneous rock***. Pour on the crushed lava rock to cover the sand about an inch high to illustrate.

4) With a marker draw a mesa on the outside of the jar; the top should be level with the lava rock and the sides jut down into the pebble layer. Ask students what could cause the land to change shape as shown on the jar. ***Erosional*** processes should be discussed showing the cut away of most of the lava flow and portions of the Payne Cliffs Formation, leaving the Table Rocks and Castle Rock as remnants of the lava flow. Ask students to name some natural forces that cause rock to break apart and be carried away (e.g., earthquakes, wind, rain, rivers, plants growing in cracks of rocks, water freezing in cracks).

5) Ask students which rock is harder: ***igneous***, or the ***sandstone*** and mudstone of the Payne Cliff formation. If you have some ***sandstone*** and ***igneous rock***, you could bring them in and have students inspect the two rock types before answering this question. Explain to students, ***igneous rock*** on top of the Payne Cliff Formation acts as a protective cap to the softer sedimentary rocks below. The softer rocks are protected from ***erosion*** until the lava cap erodes away to expose the new sediments, then they too begin to erode away.

6) Pour a thin layer of dirt on top of the lava rock so it just covers the top. Ask students what this new layer represents. Explain that ***weathering*** has helped to form the thin layer of soil on top of the Table Rocks. This completes the demonstration of the geological formation of the Table Rocks and represents what is left today.

Scientific Inquiry:
Put students into small groups. Outside of your classroom, each group will build a similar sized ***deposition*** using a variety of materials (sand, dirt, soil, leaves, sticks, rocks, etc.). Once groups are finished, have students observe and hypothesize which material will be subject to higher levels of ***erosion***. To test students' hypotheses pour a specific amount of water on each ***deposition*** and watch the effects of ***erosion*** on the different materials. Describe the effects of water on each ***deposition***, or if desired, take photographs before and after the addition of water for comparison. Discuss why certain materials ***erode*** and why others stay intact.

Discussion Questions:

Which layers of the Table Rocks were formed by slow processes such as *erosion* or *deposition* and which layers were formed by rapid processes?
*The **sandstone** layer (Payne Cliffs Formation) was formed by **deposition** over a period of millions of years. The top layer of soil was formed by **erosion** of the **igneous rock** layer and the break down of organic materials, both of which are slow natural processes. The top layer of **andesite** was formed by a volcanic eruption which was a rapid process.*

The top of the Table Rocks are made of lava rock. How is it that there is soil on the top of the Table Rocks?
*Millions of years of **weathering** by wind and water along with expansion and contraction of the rocks through freezing and thawing have broken down the rocks. Plants and animals have also helped turn the rock into soil.*

Why are many of the plants living on top of the Table Rocks so small?
*Not enough time has passed for a lot of soil to accumulate through **erosion** or **deposition**. Also, soil does not easily accumulate on top of the mesas because of continual exposure to rain and wind. The thin layer of soil is unable to retain sufficient moisture through the hot, dry summer months to support the growth of many plants, large or small. Many smaller plants have overcome this issue by only living for one season during the wet spring months, and then releasing seeds that will grow the next year. Larger plants and trees usually live for many years and therefore cannot avoid the dry summer soil conditions. Aside from the few places on the summits of the rocks, where there are large trees and shrubs growing, there is not enough soil to support the deep root systems of larger plants and trees.*

What are the three basic types of rock and how are they formed? Give examples of each.
***Igneous**: formed from cooling magma. It contains large amounts of silica and oxygen, and can be either extrusive (cools rapidly on the earth's surface) or intrusive (cools slowly under the earth's surface). Examples: basalt, **andesite**, and granite.*

Sedimentary: *formed when an accumulation of little pieces of rock, sand, and/or dirt has piled up and over time become compacted and cemented together. Examples:* ***sandstone*** *and mudstone.*
Metamorphic: *rock that has undergone a change (meta) in form (morph), in most cases from exposure to high temperatures and pressures deep underground. Examples: marble and slate.*

References:

Table Rocks Environmental Education. 2007. USDI BLM. 16 October 2007 <http://www.blm.gov/or/resources/recreation/tablerock/table-rock-geology.php>.