



## Table Rocks Curriculum

### Table Rocks Fudge

**Objective:** Students will explore structures and properties of the three states of *matter*. Using fudge to illustrate the *physical* and *chemical changes* of matter, students will gain a better understanding of the formation of the Table Rocks.

#### **Benchmarks Targeted: 2 and 3 (Grades 4-8)**

#### **Oregon Standards:**

**Subject Area:** Physical Science

**Common Curriculum Goals: Matter:** Understand structure and properties of matter. Understand chemical and physical changes.

**Benchmark 2:** Identify substances as they exist in different states of matter. Describe the ability of matter to change state by heating and cooling.

**Benchmark 3:** Compare properties of specific substances. Compare physical and chemical changes.

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

**Benchmark 2:** Identify effects of rapid changes on Earth's surface features including earthquakes and volcanoes.

**Benchmark 3:** Identify the processes that result in different kinds of landforms.

**Length of Lesson:** 30-45 minutes

#### **Materials:**

- ✓ Ingredients for creating fudge (recipe on page 2)
- ✓ 6-quart stainless steel pot or microwave safe bowl
- ✓ Hot plate or Microwave
- ✓ 9 x 13 pan (can use 8 x 8 for thicker fudge)
- ✓ Stirring spoon
- ✓ Cooling space
- ✓ An ice cube
- ✓ Balloon
- ✓ Small soda bottle
- ✓ A few tablespoons each of vinegar and baking soda

**Key Vocabulary:** *chemical change, erosion, gas, igneous, lava, liquid, matter, physical change, solid, weathering*

## Background:

We commonly encounter three states of *matter* in our daily lives: *solids*, *liquids*, and *gases*. These can be found all around us under normal conditions. *Solids*, such as a pencil or an apple, have a definite volume and shape. *Liquids*, such as water and milk, have a definite volume but no definite shape. *Gases*, such as helium and oxygen, have no definite shape or volume. When exposed to certain environmental conditions such as heat or cold, *matter* may undergo two different types of changes: a *physical change* or a *chemical change*. In the case of a *physical change* no new substances are formed. For example, when water is frozen, it can be easily melted to turn the ice back into water. A *chemical change* involves the formation of a new substance or substances through chemical reactions. If water is combined with flour and other ingredients, and then baked to make brownies, those brownies cannot be converted into water and flour again. A *physical change* is reversible and a *chemical change* is not. The formation of Table Rocks involved both *physical* and *chemical changes*. For additional information on how the Table Rocks were formed, see the Geology Chapter Introduction.

## Table Rocks Fudge

- 2 cups (12 oz.) semi-sweet chocolate chips
- 1 can (14 oz.) sweetened condensed milk
- 1 teaspoon vanilla
- Extra chocolate chips or chopped nuts for the top

**Microwave Directions:** Microwave chocolate chips and sweetened condensed milk in large, uncovered, microwave-safe bowl on high power for 1 minute; stir. Chips may retain some of their original shape. If necessary, microwave at additional 15 second intervals, stirring just until morsels are melted. Stir in vanilla extract. Pour into a greased baking pan. Sprinkle extra chips or nut on top and cool.

**Hot Plate Directions:** Heat condensed milk and chocolate chips over low heat, stirring constantly, until chocolate is melted and mixture is smooth. Remove from heat. Stir in vanilla. Pour into a greased baking pan. Sprinkle extra chips or nut on top and cool.

## Procedure:

### Preparation:

- 1) Explain the three states of *matter* to students and have them brainstorm a list that includes various examples of each.
- 2) Demonstrate the difference between *physical changes* and *chemical changes* using simple examples:
  - To show a *physical change* of state, allow an ice cube to melt, forming water. The water can easily be changed back into ice by refreezing.
  - Demonstrate a *chemical change* that occurs when vinegar, a *liquid*, is added to baking soda, a *solid*, to produce carbon dioxide, a *gas*. Fill a small soda bottle with three or four tablespoons of vinegar. Fill a balloon with two or three tablespoons of baking soda. Secure it to the neck of the bottle making

sure the seal is tight. Lift the balloon so that the baking soda falls into the bottle, allowing the two substances to mix and react. You should see the balloon fill, indicating the presence of a new substance, carbon dioxide *gas*.

### **Activity:**

Using the above (or substituting your favorite) fudge recipe, you and your students will model the process of material in the earth's crust heating up and mixing together to create lava by mixing and heating up the ingredients for fudge. You will then model the process of lava pouring out, and cooling to create the Table Rocks. This is exemplified when you pour out your fudge ingredients and allow them to cool and solidify in the pan. Overall, the fudge represents the layer of *igneous* rock that comprises the top 100-200 feet of both Upper and Lower Table Rocks. When you add the nuts or chocolate chips on top of the fudge, they represent individual lava rocks that protrude from the surface of the Table Rocks.

Discuss the states of *matter* with your students as well as the *physical* and *chemical changes* of the ingredients as you prepare the fudge. The following paragraphs will help guide your explanation:

The application of heat to a combination of ingredients causes a *chemical change* as a new substance, the *liquid* fudge, is formed. The cooling of this new substance demonstrates a *physical change* of state from a *liquid* to a *solid*. The fudge in its *liquid* state represents molten *lava* that originally formed the Table Rocks. Both fudge and *lava* solidify as they undergo rapid cooling upon contact with air. As a *solid*, the cooled fudge symbolizes *igneous* rock.

Explain to students that the land today does not look the same as it did when lava filled the ancestral Rogue River Valley about 7 million years ago. *Weathering* and *erosion* have been at work, breaking apart and carrying away the rocks and soils of the valley. Natural forces such as wind, water, and frost break apart the mass of *igneous* rock and underlying sediments, which then fall or are washed away from the original rock formation. Explain to students that just as they will eat their fudge with different sized bites, causing their fudge to disappear at varying speeds, different forces of nature cause *erosion* to happen differently over the years.

### **Extensions:**

- Have students research the rock cycle and make a diagram. In the diagram have them identify points in which *physical changes* occur.
- Have students research other mesas around the world. Were they all formed like the Table Rocks of southern Oregon? Does the formation process seem to be similar according to geographic location?

### **Discussion Questions:**

**What is the difference between a physical change and a chemical change? Give an example of each type of change.**

*In the case of a physical change no new substances are formed. For example, when water is frozen, it can be easily melted to turn the ice back into water. A chemical change results in the formation of one or more new substances. If water is combined with flour and other ingredients to make brownies, those brownies cannot be melted into water and flour again.*

**Have the Table Rocks gone through significant changes since their creation by the lava flow? Do these changes continue today?**

*Since lava flowed, covering the valley, the Table Rocks have been subject to the process of **erosion**. The power of wind and water continually cause the soft rock below the mass of hard lava rock to break apart below the cliffs. This undermines the cap rock, or the andesitic rock, causing it to break and fall due to a lack of underlying support. This process continues to this day, slowly diminishing the Table Rocks.*

**References:**

Cascade Range Volcanoes Summaries. Lyn Topinka. 2007. USGS/Cascades Volcano Observatory. 6 Feb. 2008  
<[http://vulcan.wr.usgs.gov/Volcanoes/Cascades/volcanoes\\_cascade\\_range.html](http://vulcan.wr.usgs.gov/Volcanoes/Cascades/volcanoes_cascade_range.html)>.

Table Rocks Environmental Education. 2007. USDI BLM. 7 December 2007  
<<http://www.blm.gov/or/resources/recreation/tablerock/index.php>>.