

## Procedure

### Fire and Ice

Students use ice cream glaciers and hot wax to simulate the interaction of ice-age glaciers and lava flows. They observe results and relate this to actual processes and features at Mount Rainier.

### What to do Before Class Begins:

1. Decide whether you will conduct this activity as a demonstration or with student groups. Student groups will require multiple amounts of items listed in “**Materials,**” and additional time for setup. Students build their model, and then make repeated trips to the source of the molten wax on a stove top or hot plate.
2. A demonstration can be accomplished in less time, but will require you to assemble the wax papered tray and volcano model, and to break crayons and melt the wax prior to the beginning of class. If conducting the demonstration with several classes, consider constructing ice age glaciers with the first class and adding one or more layers of wax “lava” with each successive class, followed by examination of the model the next day.
3. Decide whether to assign students with homework that investigates glaciers, ice ages, and glacier-ice interactions ( Procedure Part I number 2) prior to performing the activity.
4. As you prepare for post-activity discussion, keep in mind that no two completed volcanoes models will be alike. On these models, both ice cream glaciers and the older clay lava flows can influence the route of young wax lava flows. Students might observe that successive pourings of wax cause “stacking” of lava flows, as produced at Mount Rainier during the ice ages. Remind students that they should make general observations about melting of ice cream glaciers, the size, shape and overlapping nature of lava flow layers, and any interactions of wax lava flows with the tray rim. Be prepared for a variety of results.

## Fire and Ice

### Part I: Preparing Students for the Activity

1. Display the graphic “*Glaciers on Mount Rainier*” and point out that the glaciers are large; they show crevasses and are visible in white. Small discontinuous white areas are snow or ice patches. These do not flow and are not considered glaciers.
2. Instruct students to hypothesize about ways that the volcano and the glaciers influence one another. (You might wish to assign this as homework on the day previous to the volcano model.) Diagram their answers on the classroom whiteboard. Refer to the “*Teacher Background*,” and to the graphics “*Columbia Crest Summit*,” “*Glacier-Volcano Interaction*,” and “*Glacier Scratches (Striations) on Lava Rock at Mount Rainier*.”
3. Display the graphic “*Maximum Extent of Glaciers on Mount Rainier During the Ice Ages*” which illustrates the maximum extent of glaciation during the ice ages and today. Tell students that the volcano model in the activity represents glaciation during the last ice age; some older ice ages had even more extensive glaciers.

### Part II: Setup of the Volcano and Glacier Model

1. **Begin preparation of the volcano model by covering a tray and cereal bowl with wax paper.**

Use masking tape to hold paper in place.  
Less surface area exposed to hot wax means reduced time spent on messy cleanup.



2. **Turn bowl upside down on the tray as a volcano model.**

The inverted bowl will represent the existing volcano that formed previously by the accumulation of volcanic rocks. Newer lava flows made of wax will be poured over the top of it.



## Fire and Ice continued...

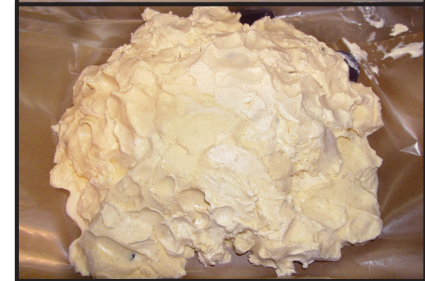
### 3. Make clay strips that represent previous accumulations of lava rock as ridges that radiate from the volcano.

Remove clay from its container and shape into strips 1.5 cm (0.5 inches) thick and approximately 13-17 cm (5-8 inches) in length. Drape clay strips over the volcano model in a variety of configurations. Some strips should be longer than others; some should diverge and others converge at their toes. Cover the top of the bowl completely with a thin layer of clay. Optionally, obtain additional clay in other colors, and stack multiple lava layers on top of each other. Remind students that each strip represents accumulations of volcanic rock from previous lava flows.



### 4. Cover volcano model with vanilla ice cream to represent enormous ice-age glaciers.

Scoop the ice cream onto the volcano model. Press it tightly against the clay and the waxed paper to reduce leakage. Stuff the ice cream into the deeper spaces between the clay strips to represent thick glaciers. Cover the clay strips (existing lava flows) with a thin layer approximately 1 centimeter, (~1/3 inch) of ice cream. Alternatively, leave some of the clay strips exposed so that the students observe how existing ridges can influence lava flow speed and direction



### 5. Melt the wax.

Obtain a stove top heat source and double-boiler system. Place 454 grams (1pound) of wax into the double-boiler carefully and melt it, following all product safety instructions. Monitor temperature with a candy thermometer. Temperature should never exceed 90 degrees C (200 degrees F). Wax takes about 15 minutes to melt, but remains fluid for about 45 minutes after removal from heat. Cooler wax makes thicker, more obvious wax lava flows.



## Fire and Ice continued...

### 6. Color the wax lava with crayons.

Remove the paper wrappers from 5 or 6 different colored non-water soluble crayons and break each crayon into fingernail-sized pieces. Melt one colored crayon for each pouring of a wax lava flow, starting with the crayon lightest in color, and progressing to darker colors with each new lava flow (example: clear, orange, red, purple, black). With this method, you need melt only one pot of wax to obtain multiple colors of lava flows. There is no need to subdivide the melted wax into separate containers.



### Part III: Fire & Ice Simulation

#### 1. To be sure that students understand the volcano model, ask them the following questions:

- What does the bowl represent?
- What do the clay strips represent?
- What do the areas of ice cream represent?
- What does the wax represent?
- Describe the appearance of the landscape beneath the glaciers.

- Ask students to hypothesize about what happens when hot lava and glacier ice interact. What will happen to the glaciers? To the lava flows?

#### 3. Add half of a colored crayon to the melting wax.

Point out to students that each colored wax batch represent a new series of lava flows. Slowly pour approximately one-fifth of the melted colored wax over the summit area and upper slopes of the volcano model. Allow the wax to cool and solidify for a number of minutes. Meantime, add the next color crayon to the wax in the pot and allow several minutes for melting. This also provides valuable time for student observations and discussion of glacier-lava flow interactions.



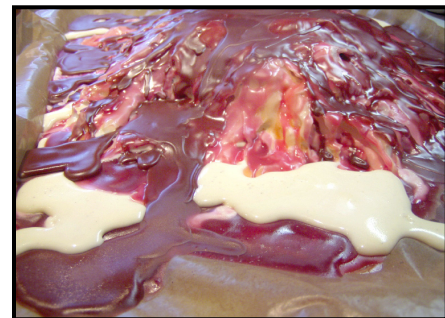
## Fire and Ice continued...

4. **Instruct student to observe where the lava travels faster.** Where does the wax lava travel the farthest? Where does the wax lava pool? Do students observe melting of the ice cream glaciers? How does the lava interact with the walls of the tray?

5. **Repeat the pouring of wax lava flows and student observations until all wax has been poured.** Use cooling times for discussion of energy transformation that occur when hot lava meets glacier ice.

6. **Instruct students to make additional observations and to relate them to an actual volcano.**

For example, students might note that melting of the ice cream represents melting of glaciers; wax lava flows travel fastest on steep slopes and they form pools and solidify at the base of the volcano; wax lava solidifies against tray walls as real lava flows would pool against valley walls. Students might note that wax lava flows that travel off the volcanic cone, and over glaciers are thin and breakable.



## Part IV: Explore Lava Flows at Mount Rainier

1. Review the graphic **“How Lava Ridges are Made”** with the students. Was this process of ridge formation one of the processes noted in the **“Fire and Ice”** demonstration?
2. Look at the **“Volcanic Rocks of Modern Mount Rainier”** graphic with students and locate the more than a dozen lava flow ridges at Mount Rainier such as Rampart, Paradise, and Mazama Ridge. Optionally, instruct students to find these ridges on a topographic map of Mount Rainier. What type of features are located adjacent to ridges? (**answer is glacial valleys**). These ridges were formed during successive ice ages 500,000–11,000 years ago.
3. Further examine the graphic **“Volcanic Rocks of Modern Mount Rainier.”** Look at the general “spoked-wheel” pattern of the lava flows. Ask students if they observed a similar process in the **“Fire and Ice”** simulation. Ask students why there are gaps in the spokes of some of the wheels. Refer back to the **“Fire and Ice”** volcano model for clues. Ask students how weathering and erosion could have changed the ridges over the course of the last 10,000 years.
4. Make the process relevant to the situation today. In the absence of glaciers that envelop the entire volcano, and recent lava flows, are the current valleys at Mount Rainier being built or carved by glaciers? **Glaciers are eroding the valleys. Students should also recognize that today’s glaciers are small and constrained within valley walls, and are incapable of routing the course of lava flows as in the days of the ice ages.**

## Adaptations

- ◆ Use modeling clay on a relief map to simulate large glaciers from the ice age. Lift the modeling clay and examine the shapes on the underside. Students note that the clay glaciers are thicker in valleys between the ridges.
- ◆ Take time-lapse photographs of your experiment.