

NATURE'S PALETTE

A Field Study of a Hydrothermal Area

SUMMARY: Students will visit an active hydrothermal area in Lassen Volcanic National Park to identify the main features and learn about the chemical processes forming these areas.

GOAL: To introduce students to the features and processes that have shaped and reshaped Lassen Volcanic National Park's hydrothermal areas.

OBJECTIVES: By the end of the activity students will be able to: (1) Identify and describe three common hydrothermal features. (2) Name at least three colors found at the hydrothermal features and use the key to identify the processes which created them. (3) Explain two important safety rules for enjoying and learning about the hydrothermal areas. (4) Explain two reasons why it is important to protect the park's hydrothermal features. (5) Explain two ways an individual can assist in preserving them.

GRADE LEVEL: Fifth through twelfth

TIME REQUIRED: 30 to 60 minutes

LOCATION: Lassen Volcanic National Park hydrothermal areas (Bumpass Hell, Sulphur Works, Devils Kitchen)

MATERIALS: Hydrothermal Area Field Study Page and Color Key Fact Sheet - one each per student. A pencil and note pad, or clipboard to be used at the field site by each student.

SUBJECTS: Earth Science, Geology, Chemistry

KEY WORDS: Volcano, Hydrothermal, Magma, Lava, Fumarole, Mud pot, Boiling Springs, Chemical Compounds, Minerals

BACKGROUND: Volcanic areas do not always die silently. Magma at depths of only a few miles can take thousands of years to cool. The fumaroles, boiling springs, and mud pots in the park's hydrothermal areas testify to the landscape's recent volcanic origin. Rain and melted snow percolate deep into the earth where the water is heated by a mass of hot rocks from magma six to twelve miles below the surface. The Lassen hydrothermal system consists of a lens-shaped reservoir of groundwater deep within the Earth. Steam as hot as 464 degrees F rises and condenses into water again, mixing with percolating ground water nearer the surface. The mixture produces sulfate water that boils at elevated pressure at about 200 degrees F. All of the park's hydrothermal areas are connected underground and fed by the same hydrothermal reservoir. Features such as fumaroles, mud pots, and boiling springs often occur side by side at the same site. These features are in constant change due to groundwater conditions, chemical weathering, and earth movement.

INSTRUCTION SEQUENCE: In the classroom, discuss information about the park's volcanic features and its hydrothermal areas with the students. Discuss why it is important to Preserve and Protect these unique hydrothermal features. Before entering any of the hydrothermal areas, please go over all park rules with the students. It is extremely important that everyone knows the rules and agrees to follow them. Please go over the following rules with the students.

Throwing rocks, sticks, trash, or anything else into the boiling springs, mud pots, or fumaroles is not allowed. In National Parks all natural and cultural features are protected by law. Think Safety! Stay on the trail and boardwalks at all times. No running or fooling around. Do not touch the water or other features in the hydrothermal areas. They may be hot and contain harmful chemicals. Visiting hydrothermal areas like Bumpass Hell or Sulphur Works can be a fun, safe, and educational experience if everyone follows the rules. Breaking the rules could result in severe burns and personal injury.

NOTE: Bumpass Hell is named after Kendall V. Bumpass, the first pioneer to discover the hydrothermal area. The story told is that Mr. Bumpass “walked off the trail,” and fell through some thin crusted ground and plunged his leg into a boiling spring. He was burned severely.

At the trailhead parking area or the entrance to the hydrothermal area make sure all of the students are clear about the rules. Divide the class into small working groups of two to four students, or have them work individually. Tell the class they are going to be geologists studying the hydrothermal area in the park. Pass out the Hydrothermal Area Field Study Page. Read and discuss what the students will do in the field. Explain that each group is to record their observations using the Field Study Page. Set a time limit. When everyone is finished, collect the study pages. Explain that the results of their observations will be discussed back in class.

When back in class, pass out the Study Pages from the field trip. Discuss and review what they saw and experienced. Pass out the Color Key Fact Sheet. Using the Color Key, have the students write down the answers for the colors they observed at the hydrothermal area in the column “How were the colors formed?” on their Field Study Pages. Discuss the results with the class.

EXTENSION/ENRICHMENT: (1) Have students research other national parks that have hydrothermal areas and compare them to the features at this park. (2) Have students write a poem based on their field trip experience. (3) Have students imagine that they are newspaper reporters that have traveled to the hydrothermal area with Mr. Bumpass in 1865. Write a story about that experience.

ASSESSMENT: (1) Have students draw a color picture of the thermal area with the appropriate colors and features. (2) Using the information from the field trip and class activity have the students write a story about the hydrothermal area and the processes that formed the soil colors. (3) Share student experiences at the park's hydrothermal area with another class or parents. (4) Have students write down the rules for visiting the hydrothermal areas and the reasons for the rules. (5) Ask the students to list reasons why it is important to “protect and preserve” National Parks. (5) Develop student questions based on the Field Study Pages and Color Key Fact Sheet.

Color Key Fact Sheet

Read the information below on how the colors were formed at the hydrothermal areas and select the appropriate answer. Copy the correct answer onto your Field Study Page. Add any additional notes and observations from your visit.

YELLOW

The yellow color and crystals are formed from sulfur dioxide gases escaping into the air from a fumarole or vent. As the gas escapes, it leaves behind a deposit of pyramid-shaped sulfur crystals or stains. The rotten egg smell is hydrogen sulfide gas.

WHITE

The soft, white powdery soil is what is left of volcanic rock after it has been completely broken down by sulfuric acids and steam. It is made up of silica and kaolinite minerals.

BLACK OR GRAY

The black and gray colored soils are volcanic rock that has not yet been completely broken down by the sulfuric acid and steam. This results in gray colored clay minerals or black and brown iron mineral compounds. These minerals are spattered out and deposited on the surface near a vent. The black scum on the surface of some of the pools is pyrite an iron-sulfide mineral better known as "Fools Gold."

RED, TAN or BROWN

The ground was stained by red, brown or tan iron-rich mineral compounds that are in the water and steam of the boiling pools and fumaroles. Various chemical reactions with the lava rock in the hot waters of the pools cause the escaping gases to be full of these iron-rich minerals. When the gases escape into the air, some of the mineral compounds they contain are deposited on the ground.

GRAY-COLORED WATER AND MUD

This is was once solid rock. Heat, water, gases, and time along with sulfuric acids have altered the volcanic rock and turned it into clay.

YELLOWISH -ORANGE

The yellow-orange material that covers the ground is sulfate minerals. Sulfate-rich water evaporates at the surface, leaving the colorful sulfate mineral deposits behind.

GREEN

The green color is a plant called alga that grows in the cooler parts of the hot springs, on rocks, in the streams, or on the edges of the hot pools. Other microorganisms including bacteria also live in the hydrothermal features.

Lassen Volcanic National Park Hydrothermal Area Field Study Page

Name _____ Date _____

Location _____

Read the description of each feature; find at least one example of each. Write down the colors you see at each feature. Look for the colors of mud, soil, water, and stains on the ground. Make additional notes on the back. Do not write in the “How were the colors formed?” column; this will be done later using the color key fact sheet.

Hydrothermal Feature	Colors I observed	How were the colors formed?
BOILING SPRINGS Bubbling pools of water with rising steam, often smelly.		
MUDPOT A pool of boiling mud.		
FUMAROLE A volcanic vent with gases hissing out; may be smelly.		
DRY BARREN COLOR STAINED GROUND The ground in and around the hydrothermal area.		
RUN-OFF STREAMS Hot or cool streams flowing away from thermal features.		

