



Rock! Pattern! Systems!

A Geology Investigation at the Marin Headlands

Overview

How can maps change the way we think about land and sea?

This Essential Question frames Rock! Pattern! Systems! (RPS) and is meant to allow students to engage in place-based inquiry science at the Marin Headlands.

The Essential Question:

1. Reflects the essence of what they will study without directing them to one correct answer.
2. Provokes discussion and critical thinking.
3. Applies to places beyond the Marin Headlands.
4. Invites discussion from everyone based on both experience and understanding.

Students explore patterns of geologic features on the Earth's surface, including the locations of earthquakes, volcanoes, and underwater mountain ranges. Using tangible models and maps, students explore how scientists made the first global ocean floor map, and how the longest mountain chain on the planet teaches us about oceans. Students find ancient underwater volcanoes in the Marin Headlands and construct a narrative about the formation of underwater volcanoes.

Program Goals

- Students will enrich their understanding of a place through inquiry.
- Students will experience National Parks as places for learning and recreation and develop a personal connection with their local National Parks.
- Students will gain first-hand experience in the Marin Headlands with the geologic features of underwater volcanoes.
- Students will appreciate how an individual scientist can impact our way of thinking about the Earth.

Program Objectives

- Students will be able to analyze and interpret data from maps.
- Students will be able to recognize patterns of rock formations on Earth's surface.
- Students will be able to pose questions and construct evidence-based explanations.
- Students will recognize the challenges in getting new scientific evidence widely accepted.



Ties to the Curriculum

Next Generation Science Standards:

4-ESS1-1: Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time.

4-ESS1.C: The History of Planet Earth: Local, regional, and global patterns of rock formations

reveal changes over time due to Earth's forces, such as earthquakes. The presence and location of certain fossil types indicate the order in which rock layers were formed.

4-ESS2-2: Analyze and interpret data from maps to describe patterns of Earth's features.

4-ESS2.B: Plate Tectonics and Large-Scale System Interactions: The locations of mountain ranges, deep ocean trenches, ocean floor structures, earthquakes, and volcanoes occur in patterns. Most earthquakes and volcanoes occur in bands that are often along the boundaries between continents and oceans. Major mountain chains form inside continents or near their edges. Maps can help locate the different land and water features on Earth.

Crosscutting Concept: Patterns can be used as evidence to support an explanation.

California Common Core Standards

Speaking and Listening:

1.4: Engage effectively in a range of collaboration discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 4 topics and texts, building on others' ideas and expressing their own clearly.

Writing:

4.2: Write informative/explanatory texts to examine a topic and convey ideas and information clearly.

4.9: Draw evidence from literary or informational texts to support analysis, reflection, and research.



Program Description

The program has three elements: pre-visit classroom lessons conducted by the teacher and NPS staff, a Marin Headlands field program facilitated by NPS staff, and post-visit lessons guided by the teacher.

Classroom Lessons

Before NPS staff come to the classroom:

Teacher facilitates the lesson “What Do Maps Do?” The teacher distributes the maps for the activity (included in the teacher’s kit) to groups of students. For each map, student groups discuss what they see and what information they can learn from the map. The purpose of the activity is to acquaint students with a variety of maps and to realize that different maps contain different kinds of information.

NPS staff-led classroom presentation:

NPS staff facilitates an exploration of the ocean floor and underwater volcanoes, using a map of the world’s oceans, transparency overlays of global distribution of earthquakes and volcanoes, and a “sounding box” model of sonar data collection. NPS staff will bring all materials for the hour-long presentation. During the presentation, students examine the patterns of mountain ranges found on the ocean floor and pose questions about how these patterns form. They share their prior knowledge of volcanoes, and then consider the characteristics of underwater volcanoes.

Field Program in the Park

NPS staff, teacher and chaperons guide students along the Point Bonita Lighthouse trail, or the Rodeo Lagoon trail. Students use their pattern-identifying skills to find ancient underwater volcanoes or deep ocean rocks and mark their observations on a map.

Post-visit activities

Students show their learning by:

1. Explaining, in the form of an illustrated story, poem, or scientific narrative, how underwater volcanoes form or how they appear on land.

and by doing one of the following:

3. Explain, in an informative text, how the Tharp-Heezen ocean floor map changed people’s understanding of the Earth.

3. Use evidence to answer their own question about patterns of ocean floor structures or underwater volcanoes.

NPS staff will provide the teacher with a postage-paid envelope with student reflection worksheets, to be completed by each student back at school, then mailed to us. These reflections will help us make improvements to the curriculum.



Curriculum Resources:

The files on the curriculum CD include:

- maps used in *What Do Maps Do* activity
- a printer-ready version of the Tharp-Heezen ocean floor map
- maps of volcanoes and earthquakes of the world
- a short biography of Marie Tharp
- the “zoom” images of a trip to the ocean floor
- A Trip to the Ocean Floor graphic narrative activity
- list of “characters” in the graphic narrative

- Franciscan Rock cycle poster
- rock cycle vocabulary (in three languages)
- annotated list of additional web resources

A teacher’s kit is loaned to participating Bay Area teachers. The kit includes:

- a beach ball Earth globe with tectonic plate boundaries
- laminated copies of maps used in *What Do Maps Do* activity
- several copies of Marie Tharp biography booklet
- one copy of Tharp-Heezen map and earthquake/volcano overlays
- one copy of A Trip to the Ocean Floor graphic narrative activity
- samples of pillow basalt, radiolarian chert, and graywacke sandstone

National Park Service web pages:

Rock! Pattern! Systems! curriculum materials can be found at <http://www.nps.gov/goga/learn/education/rock-pattern-systems.htm>

Rocks on the Move middle school program materials can be found at <http://www.nps.gov/goga/learn/education/secondary-02.htm>

To explore more Franciscan geology resources for teachers and students, go to <http://www.nps.gov/goga/learn/education/park-teachers-home.htm>