

THINKING AND ACTING LIKE A SCIENTIST

TEACHER'S GUIDE

Earth's Features 2 of 2

What is the relationship between Earth's features
and earthquake and volcanic activity?

GRADE 4

Earth & Space





Earth's Features 2 of 2

Grade Level/ Content	4/Earth and Space Science
Lesson Summary	This lesson is the second of a two-lesson sequence on observing and describing patterns of Earth's features. In this lesson, students will identify relationships in the locations of trenches, ridges, and mountain ranges to earthquake and volcano locations.
Estimated Time	1, 45-minute class period
Materials	World Map (Continued from " Earth's Features 1 "), Earthquake Map , Volcano Map , Scissors, Tape, Investigation Plan , Journal
Secondary Resources	(See above maps) Interactive Map of Active Volcanoes and Earthquakes
NGSS Connection	4-ESS2-2 Analyze and interpret data from maps to describe patterns of Earth's features.
Learning Objectives	<ul style="list-style-type: none">• Students will organize data into a graphical display from maps of Earth's features (locations of mountains, continental boundaries, deep ocean trenches, mid-ocean ridges, earthquakes, and volcanoes).• Students will identify relationships by comparing the location of trenches, ridges, and mountain ranges to earthquake and volcano locations.

What is the relationship between Earth's features and earthquake and volcanic activity?

Earth is a dynamic planet that is constantly changing. Volcanic and earthquake activity have plagued our planet since its inception. Early civilizations attributed the power of these forces to come from the gods. It was not until the 1960s that we finally understood that these geological activities were a result of moving plates beneath our feet! In this investigation series, students will discover the patterns of Earth's features, specifically trenches, ridges, and mountain ranges, and how they relate to volcanic and earthquake activity.

Investigation is based on the Van Andel Education Institute (VAEI) Instructional Model for Inquiry-Based Science.

In all investigations:



Students don't know the "answer" they are supposed to get.



Students play a driving role in determining the process for learning.



Teachers and students construct meaning together by journaling.



Students are working as hard as the teacher.

Part 1

INVESTIGATION SETUP

Each team will need the following materials:

- [World Map](#) (Continued from “Earth’s Features 1”)
- [Earthquake Map](#)
- [Volcano Map](#)
- Scissors
- Tape
- [Investigation Plan](#)
- Journal

Part 2

INVESTIGATION FACILITATION



Question

Introduce the investigation question.

What is the relationship between Earth’s features and earthquake and volcanic activity?

STUDENT ENGAGEMENT

Before students begin their investigation, have them reconnect to the observations they made at the beginning of [Earth’s Features 1](#):

....observe volcano and earthquake activity over a few days using the [Interactive Map of Active Volcanoes and Earthquakes](#) to answer the question: What can I learn by observing earthquake and volcanic activity?



Personal Knowledge

Students capture what they already know about earthquakes and volcanoes.

- Find out what students already know about earthquakes and volcanoes.
- Ask the students to think about what they learned during the last investigation when they compared trenches, ridges, and mountain ranges.
- Make a class list of what they come up with. *(List may include: There are different kinds of volcanoes, earthquakes and volcanoes can be dangerous, earthquakes can be big or small.)*

DISCOURSE

Conduct a *Think, Write, Pair, Share* to ensure all students participate. Ask them what they know and give adequate think time. Have them write down three things they know about earthquakes and volcanoes. Have them share their thoughts with a partner, then call on a few pairs to share with the class.



Secondary Knowledge

Students use secondary sources to locate volcanic and earthquake activity around the world.

Use the following images taken from the [Interactive Map of Active Volcanoes and Earthquakes](#):

Volcano Map

Inform students that the volcano map represents a large number of the known volcanoes at varying levels of activity:

- Red = Erupting
- Orange = Minor Activity
- Yellow = Unrest (shows signs of future eruption)
- Green = Dormant
- Black = Extinct

Earthquake Map

Inform students that the earthquake map represents a large number of earthquakes that occurred during 2012. The different sizes of circles represent different magnitudes of earthquakes.



Prediction

Students communicate an expected outcome, based on prior knowledge.

Have students make a prediction based on the investigation question using the following format:

I predict _____ because _____.



Investigation Plan

Students observe maps of volcanoes and earthquakes to identify patterns and relationships.

- Review the materials as a whole class.
- Students return to their teams from “Earth’s Features 1.” Give each team their materials and [Investigation Plan](#).
- Students will use unique symbols and add the locations of volcanoes and earthquakes to their world map.

Note: It is not necessary for students to draw every volcano or earthquake if they occur in groups. Encourage students to use continuous loops, lines, or highlighters to represent groupings of volcanoes and earthquakes.

CRITICAL THINKING

Use the [Fair Test](#) checklist to help students think critically about the investigation plan. Help them understand that a good investigation plan must include a test that is repeatable, generates quality data, and minimizes error. The more critically students think about their investigation plan, the more confident they will be in their results.

INVESTIGATION PLAN
EARTH'S FEATURES 2

1. Choose a symbol to represent volcanoes.
2. Use the provided map of the world's volcanoes to add **volcanoes** to the map of ridges, trenches, and mountain ranges used in the last investigation.
3. Choose a symbol to represent earthquakes.
4. Use the provided map of the world's earthquakes to add **earthquakes** to the map of ridges, trenches, and mountain ranges used in the last investigation.

NOTE: It is not necessary to draw every volcano and earthquake if they occur in groups. Decide how you will represent this.

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Investigation Plan

Continued

INTEGRITY AND PERSEVERANCE

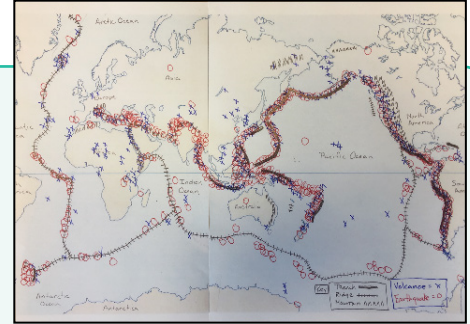
Because of some of the map orientations, it may be challenging for students to accurately record their information. Encourage students to use perseverance as they work through this investigation and integrity to ensure that information is drawn accurately.



Observation

Students document their observations.

Students add volcanoes and earthquakes to their world maps.



Completed Observation

Part 3

INVESTIGATION ANALYSIS AND DEVELOPMENT OF CLAIM



Data Analysis

Students make sense of their data by organizing it and representing it visually.

Have students analyze their data. They may wish to use the [Data Analysis](#) prompt as a guide.

- Have students evaluate their data for trustworthiness. Ask students:
 - Are you confident in how you located the earthquakes and volcanoes on your world map?
 - What data do you wonder about? (Have students identify the data they wonder about on their map.)
 - Do you think the source of the data is trustworthy?
- Then, have them analyze their data to find patterns and trends. The map showing the trenches, ridges, mountain ranges, volcanoes, and earthquakes can serve as the organization and representation of the data.
- Have students interpret what the identified patterns or trends mean.
- Ensure they have enough data that it can be used as evidence to support a claim.



Secondary Knowledge

Students use secondary sources to understand the relationship between the earth's features and earthquake and volcanic activity.

Share what you know (or find a video or article) about the relationship between the earth's features and earthquake and volcanic activity. Looking for media on the Pacific Ring of Fire would be a good place to start. It is not important to get into details about the inner workings of the earth (convection currents, earth layers, subduction zones, etc.) as these topics will be covered in middle school. Students should know that ridges, trenches, and mountain ranges represent zones of activity that are revealed in earthquake and volcanic activity.



Explanation

Students write a claim and provide evidence and reasoning to support it.

- Have students use what they've discovered from their analyzed data to write an explanation that answers their investigation question. Students may wish to use the [Explanation](#) prompt as a guide. Have them write their explanation in their Lab Journal.
- Have students develop a **Claim** to answer the question: What patterns and relationships will I find by comparing Earth's features such as trenches, ridges, and mountain ranges to earthquake and volcanic activity?
- Then, have them add **Evidence** (the analyzed data) to support their claim.
- Finally, have them add **Reasoning** to their claim. Reasoning should include the information obtained from this investigation as well as science principles they have learned.

Claim

We claim that the majority of earthquakes and volcanoes are located on or close to either a ridge, trench, or mountain range. Of those earthquakes and volcanoes we studied, a majority were located on or near the trenches and mountain ranges (fewer were found on or near ridges). The ridges, which have few earthquakes and volcanoes on them, are mostly found far away from the trenches and mountain ranges. Overall most of these features occur in lines, which are mostly connected, stretching in lines around Earth.

Evidence

One example that supports our claim is the large number of earthquakes and volcanoes along Peru-Chile Trench and the Andes Mountains (next to each other). Another example is the Mid-Ocean Ridge, which has both earthquakes and volcanoes along its length. These examples show that fewer earthquakes and volcanoes occur along the ridges than trenches and mountain ranges.

Reasoning

Investigation: We represented over 100 earthquakes and volcanoes. We spent extra time to be sure we recorded their locations accurately.

Science: The maps and class discussion support our claim that the majority of earthquakes and volcanoes occur along trenches, mountain ranges, and ridges. These areas represent places that have a lot of activity. We learned that the area around the Pacific Ocean is sometimes called the Ring of Fire.

- Once the explanation is written, have students discuss their results using a [Present and Defend](#).

Continued

DISCOURSE

Have students conduct a [Present and Defend](#) to develop presentation skills and promote audience participation. Research teams present a summary of their investigation to the class. The class analyzes the information presented and asks clarifying questions, challenges and/or supports the arguments made, and even presents alternative explanations as appropriate. Research teams defend their explanation with evidence and reasoning. If students are doing the same investigation plan, choose 1 or 2 groups to share.



Evaluation

Students reflect on the investigation.

- Ask students how confident they are in their results.
- Ask students what surprised them.
- Ask students what questions they have as a result of this investigation.

Part 4

INVESTIGATION ASSESSMENT AND EXTENSION



Application

Students demonstrate understanding by determining if earthquakes or volcanoes could be possible in their location.

- Have students apply their learning by answering the following question: Do you think we will have earthquakes and volcanoes where we live? Why or why not?

Assessment

Students provide:

- a graphical representation of the locations of ridges, trenches, mountain ranges, volcanoes, and earthquakes.
- an explanation (**claim, evidence, and reasoning**) that describes the patterns and relationships found from comparing the locations of trenches, ridges, and mountain ranges to earthquake and volcanic activity using evidence and scientific knowledge.

Take This Lesson Across the Curriculum

Bon Voyage

You have been hired to take photographs of volcanoes around the world. You are leaving by boat from San Francisco, California and will need to determine the best route to see the most volcanoes before you return to San Francisco two months later.

Reading/Language Arts	Math	Science	Social Studies
<p>Letters Home</p> <p>Choose a volcano to visit on your trip and write a letter home describing your experience at that volcano.</p> <p>CCSS.ELA-LITERACY.W.4.3</p>	<p>Esti-Mate</p> <p>On your journey, you decide to stop in Australia to visit a friend (mate). Your friend asks you to estimate how many volcanoes you will plan on seeing on your journey.</p> <p>CCSS.MATH.CONTENT.4.OA.A.3</p>	<p>Observing Earth's Features 1 & 2</p> <p>Use the map you create to identify where you will need to travel to see the most volcanoes on your journey.</p> <p>NGSS: 4-ESS2-2</p>	<p>Best Path</p> <p>Plan your trip by identifying the 6-8 major cities/countries you will be visiting on the way.</p> <p>NCSS: D2.Geo.1.3-5</p>

Pompeii

You have been asked to share your knowledge of Mount Vesuvius and Pompeii with the 2nd grade class. You can choose how you want to share this information (poster, video, poem, song, etc.).

Reading/Language Arts	Math	Science	Social Studies
<p>Volcano Vacation</p> <p>Read <i>Magic Tree House #13: Vacation Under the Volcano</i>, and discuss how life in Ancient Rome compares to life today.</p> <p>CCSS.ELA-LITERACY.RL.4.9</p>	<p>Eruption!</p> <p>Use your sense of numbers to determine if it would be possible to outrun the pyroclastic flow that erupted from Mount Vesuvius, burying the ancient city of Pompeii.</p> <p>CCSS.MATH.CONTENT.4.NBT.A.2</p>	<p>Observing Earth's Features 1 & 2</p> <p>Use your knowledge of mountain range, volcano and earthquake locations to help inform your presentation.</p> <p>NGSS: 4-ESS2-2</p>	<p>Where in the World?</p> <p>Identify the location of Mount Vesuvius and Pompeii (using ancient maps) on your world map.</p> <p>NCSS: D2.Geo.1.3-5</p>

For additional lessons or to customize this lesson, go to www.nexgeninquiry.org.



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INVESTIGATION PLAN

EARTH'S FEATURES 2

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3. Choose a symbol to represent earthquakes.
4. Use the provided map of the world's earthquakes to add **earthquakes** to the map of ridges, trenches, and mountain ranges used in the last investigation.

NOTE: It is not necessary to draw every volcano and earthquake if they occur in groups. Decide how you will represent this.