

THINKING AND ACTING LIKE A SCIENTIST

TEACHER'S GUIDE

Earth's Features 1 of 2

What patterns and relationships will I find by comparing Earth's features such as trenches, ridges, and mountain ranges?

GRADE 4

Earth & Space





Earth's Features 1 of 2

Grade Level/ Content	4/Earth and Space Science
Lesson Summary	This lesson is the first of a two-lesson sequence on observing and describing patterns of Earth's features. In this lesson, students will identify patterns and relationships in the locations of trenches, ridges, and mountain ranges.
Estimated Time	1, 45-minute class period
Materials	World Map , Trench Map , Ridge Map , Mountain Range Map , scissors, tape, journal, Investigation Plan , Observation Form
Secondary Resources	(See above maps) Interactive Map of Active Volcanoes and Earthquakes , Ridge Image , Trench Image , Mountain Range Image
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, and mid-ocean ridges).• Students will identify patterns and relationships by comparing the location of trenches, ridges, and mountain ranges.
Cross-Curricular Project Connections	Bon Voyage, Pompeii

What patterns and relationships will I find by comparing Earth's features such as trenches, ridges, and mountain ranges?

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 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

Provide students with the following materials:

- [Blank World Map](#) (ideally printed on 11x 17 paper)
- [Trench Map](#)
- [Ridge Map](#)
- [Mountain Range Map](#)
- [Investigation Plan](#)
- [Observation Form](#)
- Scissors
- Tape
- Journal

Part 2

INVESTIGATION FACILITATION

Before students begin their investigation, have them conduct a **Messing About** to encourage their engagement and build curiosity. Have students 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?



Question

Introduce the investigation question.

What patterns and relationships will I find by comparing Earth's features such as trenches, ridges, and mountain ranges?



Personal Knowledge

Students capture what they already know about trenches, ridges, and mountain ranges.

- Find out what students already know about trenches, ridges, and mountain ranges.
- Generate a class list. (*List may include: Mountains are high areas or tall areas on land, ridges are bumps in the land, trenches are dug out areas in the land, etc.*)

DISCOURSE

Conduct a *Pass the Paper* with students working in groups of three. One student writes "Trenches," one student writes "Ridges," and one student writes "Mountain Ranges" at the top of their respective papers. Each student writes something they know about the word and passes it to the next student. They then add ideas to their group member's list. Students continue to pass within their group until the time is up.

RISK-TAKING

Add all ideas, even misconceptions, to the class list. If something is questionable, place a question mark next to it and explain that it should be revisited later. Do not tell students their personal knowledge is incorrect because this will not cause them to change it. Instead, confront misconceptions at the appropriate time in the investigation. Often, this is during data analysis and explanation.



Secondary Knowledge

Students use secondary sources to understand the terms: Mountain ranges, ridges, and trenches.

Use the following image links (or your own) to help students understand the meaning of a mountain range, ocean ridge, and ocean trench. Have students compare the ridge, mountain range, and trench images with the maps included in the materials. At this time, there is no need to discuss how these features are formed. Students should have a mental picture of these features as they begin to look for patterns using the information/data provided in the maps.

[Ridge Image](#)

[Trench Image](#)

[Mountain Range Image](#)



Investigation Plan

Students observe maps of trenches, ridges, and mountain ranges to identify patterns and relationships.

Introduce the investigation.

- Review the maps as a whole class.
- Divide students into teams of 2 or 3. Give each team their materials.
- Have students add the following islands to their trenches map before they begin:
 1. [Kermadec Islands](#)
 2. [Tonga Islands](#)
 3. [Mariana Islands](#)
 4. [Iza and Bonin Islands](#)
- Using the reference maps provided, have the students record (on the [Observation Form](#)) the location of ridges, trenches, and mountain ranges as indicated in the [Investigation Plan](#). Complete at least one example for each feature type as a class before teams begin on their own. (Juan de Fuca Ridge, Kermadec Trench, Atlas Mountains)

Note: It is important that there is only one "1" for each feature in their observation table. If the feature doesn't obviously fit in one category, instruct students to mark the category that "best fits" and record additional observations about the location under "other observations."

- Once they have identified the location of all the features, instruct students to move on to **Part II** of the **Investigation Plan**.
- Have students label the major continents and oceans of the world on the blank world map provided.
- Instruct students to use symbols to accurately draw the identified ridges, trenches, and mountain ranges.

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.

INTEGRITY AND PERSEVERANCE

Because of some of the map orientations 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 was drawn accurately.

INVESTIGATION PLAN EARTH'S FEATURES 1

Part I:

1. Using the provided maps, record the location of ridges, trenches, and mountain ranges in the **Observation Form**.
 - If most of the feature is in water and away from land, record a 1 under "water" and 0's under "land" and "boundary."
 - If most of the feature is on land and away from water, record a 1 under "land" and 0's under "water" and "boundary."
 - If the feature is located close to the boundary of where land and water meet or close to an island, record a 1 under "boundary" and 0's under "water" and "land."

* It is important that there is only one "1" for each feature. If the feature doesn't obviously fit in one category, mark the category that "best fits" and record additional observations about the location under "Other Observations."

2. Record additional observations about the location of the ridge, trench, or mountain range under "Other Observations."

Part II:

1. Using the blank World Map, label the major continents and oceans of the world.
2. Using symbols, accurately draw the identified ridges, trenches, and mountain ranges.

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Investigation Plan

Continued

COLLABORATION

An option would be to assign each team member a different feature (ridges, trenches, or mountain ranges). This student would be responsible for reporting to the team.



Observation

Students document their observations.

Students record their findings on the **Observation Form** and [World Map](#).

OBSERVATION FORM				
EARTH'S FEATURES 1				
NAME: _____				
DATE: _____				
Ridges, Trenches, and Mountain Range Locations				
Name	Water	Land	Boundary	Other Observations
Southeast Indian Ridge				
Pacific Antarctic Ridge				
East Pacific Rise Ridge				
East African Ridge				
Mid-Atlantic Ridge				
Southeast Indian Ridge				
Central Indian Ridge				
East African Ridge				
Tonga Trench				
Stagnation Trench				
Java Trench				
Marianas Trench				
Philippine Trench				
Ryukyu Trench				
Chuuk Trench				
Japan Trench				
Kuril Trench				
Albatross Trench				
Mid-Atlantic Trench				
Puerto Rico Trench				
Puerto Rico Trench				
South Sandwich Trench				
Rocky Mountains				
Cascade Range (mountains)				
Alps Mountains				
Alps Mountains				
Andes Mountains				
Great Dividing Range (mountains)				
Kolyma Range (mountains)				

Observation Form



World Map

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 your data (location of trenches, ridges, and mountain ranges)?
 - What data do you wonder about?
 - Do you think the source of the data is trustworthy?
- Then, have them analyze their data to find patterns and trends. They **organize** the data and **represent** it visually to construct meaning. One way to help re-organize the data would be to cut the world map into strips and piece the map back together in a different view to help identify patterns. One way to quantitatively represent the data would be to add up the number of each feature found on water, land, and a boundary, and create a bar graph.
- 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.



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?
- 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:

- *most ridges are connected into a system that runs between continents.*
- *trenches occur at continent boundaries and in the ocean, and are mostly found away from the ridges.*
- *most mountain ranges occur near continent boundaries (on land).*

Evidence

We found that all seven ridges are found in the ocean. Six of the ridges are found away from the continents with one close to a continent (Juan de Fuca). We also discovered that all fifteen trenches are found in the ocean near continents (including their surrounding islands) and six of seven mountain ranges are found near the boundaries of continents.

Reasoning

Investigation: We looked at many of the major ridges, trenches, and mountain ranges: 7 ridges, 15 trenches, and 7 mountain ranges. We were careful to record data accurately.

Science: We learned from the maps and class discussion that ridges are generally out in the oceans and trenches and mountain ranges are near the edges of continents. This supports our claim and evidence.

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

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.

- Students demonstrate a deeper understanding of the patterns found in Earth's features by completing the follow-up investigation, [Earth's Features 2](#).

Assessment

Students provide:

- a graphical representation of the locations of ridges, trenches, and mountain ranges.
- an explanation (**claim, evidence, and reasoning**) that describes the patterns and relationships found from comparing the locations of trenches, ridges, and mountain ranges 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 1

Part I:

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2. Record additional observations about the location of the ridge, trench, or mountain range under “Other Observations.”

Part II:

1. Using the blank World Map, label the major continents and oceans of the world.
2. Using symbols, accurately draw the identified ridges, trenches, and mountain ranges.

OBSERVATION FORM

EARTH'S FEATURES 1

NAME: _____

DATE: _____

Ridges, Trenches, and Mountain Range Locations

Name	Water	Land	Boundary	Other Observations
Southeast Indian Ridge				
Pacific Antarctic Ridge				
East Pacific Rise (ridge)				
Juan de Fuca Ridge				
Mid-Atlantic Ridge				
Southwest Indian Ridge				
Central Indian Ridge				
Kermadec Trench				
Tonga Trench				
Bougainville Trench				
Java (Suda) Trench				
Marianas Trench				
Philippine Trench				
Ryukyu Trench				
Izu Bonin Trench				
Japan Trench				
Kuril Trench				
Aleutian Trench				
Middle America Trench				
Peru-Chile Trench				
Puerto Rico Trench				
South Sandwich Trench				
Rocky Mountains				
Cascade Range (mountains)				
Atlas Mountains				
Alps (mountains)				
Himalaya (mountains)				
Great Dividing Range (mountains)				
Kolyma Range (mountains)				