

Title: Where do Earthquakes and Volcanoes Occur?

Time: Two 45 minute class sessions

Teacher: Cassy Whitehead

Date: July 3, 2019

Subject / grade level: 4th Grade Science

Resources:

- Alaska Volcano and Earthquake Case Study: <https://www.pbslearningmedia.org/resource/buac17-35-sci-ess-akvolquake/alaska-volcano-and-earthquake-case-study/#.WYHSxjO-Lxs>
- Ruff Ruffman's Ring of Fire Travel Guide: <https://www.pbslearningmedia.org/resource/buac17-35-sci-ess-ruffringfire/ruff-ruffmans-ring-of-fire-travel-guide/#.WYRzPDO-Lxs>
- Earthquakes and Volcanoes Graphic Organizer: https://view.officeapps.live.com/op/view.aspx?src=https://d43fweuh3sg51.cloudfront.net/media/media_files/eea6060d-976b-4536-bcac-cf184717f38b/3d2ef2ea-87cb-4290-a011-fc6a8fcf0abd.docx
- Map of the Earth
- Earthquakes and Volcanoes Lesson Exit Ticket: <https://www.pbslearningmedia.org/asset/buac17-doc-exitticket-handout>

Standards:

NGSS

4-ESS2-2.

Analyze and interpret data from maps to describe patterns of Earth's features.

Science and Engineering Practices

Analyzing and Interpreting Data

- Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used.
- Analyze and interpret data to make sense of phenomena using logical reasoning.

Disciplinary Core Ideas

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 areas of Earth.

Crosscutting Concepts

Patterns

- Patterns can be used as evidence to support an explanation.

Colorado State Standards Fourth Grade, Standard 3. Earth and Space Science

- Earth's physical features occur in patterns.

Common Core ELA Standards

- RI.4.7 Interpret information presented visually, orally, or quantitatively (e.g., in charts, graphs, diagrams, time lines, animations, or interactive elements on Web pages) and explain how the information contributes to an understanding of the text in which it appears. (4-ESS2-2)
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Lesson objective(s):

- Students will be able to analyze different media representations to explain the relationship between earthquakes and volcanoes around the globe.
- Students will be able to use data visualizations, such as maps, to formulate claims about earthquakes and volcanoes.
- Students will be able to recognize and describe patterns in the prevalence and locations of earthquakes and volcanoes relative to mountain ranges and to the edges of continents.

ENGAGEMENT- attributed to exploring earthquakes and volcanoes from <https://www.pbslearningmedia.org/resource/buac17-35-sci-ess-lpexplorequakevolcano/exploring-earthquakes-and-volcanoes-on-earth/#.XRyuVC2ZPPA>

- Ask students “ What are earthquakes? What are volcanoes? Where have earthquakes occurred that you know of? Where are some volcanoes you know of?” Have a map available for students to point to where they think earthquakes and volcanoes occur. Write down their answers on chart paper. Have students create a hypothesis based on what they already know. Ask questions:
 - Do you notice any patterns about where earthquakes and volcanoes occur?
 - Where do you think we’d find more volcanoes or earthquakes?
 - We’ll come back to these questions.
- Show the [Alaska Volcano and Earthquake Case Study](#) . Before showing it explain to students that a case study only looks at one particular instance and is used to learn about a broader topic. Print off the slides so that each student can have one in front of them. Read the text together and have students discuss the questions on the the slideshow. Make sure students understand that there are many earthquakes and volcanic activity in the state of Alaska and that this is only one instance (**ELA Connection**).
- Ask students “ What questions do you have about the locations of earthquakes and volcanoes?” Add their questions to the chart. Explain to them that today we will be focusing on where earthquakes and volcanoes occur on earth.

EXPLORATION- attributed to exploring earthquakes and volcanoes from <https://www.pbslearningmedia.org/resource/buac17-35-sci-ess-lpexplorequakevolcano/exploring-earthquakes-and-volcanoes-on-earth/#.XRyuVC2ZPPA>

- Inform students that they will play a game in which they explore the locations of earthquakes and volcanoes in the Ring of Fire, an area in the Pacific Rim that has a lot of volcanic and earthquake activity both on land and in the ocean. [Ruff's Ring of Fire Travel Guide](#) game, produced by WGBH, includes PBS Kids character Ruff Ruffman, with whom some students may be familiar. Students progress through the game by using their knowledge and analytical and research skills to distinguish between some accurate and inaccurate information about earthquakes and volcanoes on land that Ruff's grandmother found when using his travel guide. Students cross-reference information about the phenomena in Ruff's travel guide with the four sources he used to create the guide. In addition to using and testing their current knowledge about the phenomena, students should notice relationships between earthquakes and volcanoes and interpret patterns regarding their relative locations to each other as well as to nearby mountain ranges (**ELA Connection**).
- Students should play the game independently, if possible. Distribute the [Earthquakes and Volcanoes Graphic Organizer](#) to all students. Explain that as they play the game, they should use the "Observations" and "Questions" sections on page 1 to record what they notice and wonder about earthquakes and volcanoes in different locations.

EXPLANATION- attributed to exploring earthquakes and volcanoes from <https://www.pbslearningmedia.org/resource/buac17-35-sci-ess-lpexplorequakevolcano/exploring-earthquakes-and-volcanoes-on-earth/#.XRyuVC2ZPPA>

- Break students up into groups of 2-4. Have them tell their group the observations and questions they recorded on page 1 of their graphic organizer prior to class discussion. Instruct students to listen critically to their partner and ask questions of him or her to ensure they understand each other's ideas. Ask these questions if students do not provide such details within the course of their discussion:
 - What patterns did you notice about the locations of volcanoes?
 - What patterns did you notice about the locations of earthquakes?
 - What relationship between the locations of volcanoes and earthquakes did you notice? (This question connects to the focus question.) If further prompting is needed, ask: How did your explorations in the game help you gather information about the locations of earthquakes and volcanoes on Earth?
- Students should write answers to any questions that can be answered from the discussion. Then have them work together to complete page 2 of the graphic organizer; they will write at least one claim based on what they have learned after having explored both the case study and the game.

ELABORATION- attributed to exploring earthquakes and volcanoes from <https://www.pbslearningmedia.org/resource/buac17-35-sci-ess-lpexplorequakevolcano/exploring-earthquakes-and-volcanoes-on-earth/#.XRyuVC2ZPPA>

- Inform students that they will continue to explore the locations of earthquakes and volcanoes using another resource: an interactive global map. Have students work with a partner to explore the [Global Earthquakes and Volcanoes Map](#) media resource. If no computers available print of maps. Provide each student with another copy of the Earthquakes and Volcanoes Graphic Organizer to complete for the interactive map exploration.
- Display the interactive map for the class. Review the sidebar that has the data layers and how to use the map. Instead of describing the media to students, ask:
 - What does this map represent? (Sample answers: The locations of earthquakes on land and in the ocean; the locations of volcanoes above sea level; the number of earthquakes and volcanoes on Earth; topography of Earth.) How do you know?
 - Note: The data for volcanoes above sea level (volcanoes also occur under water), shown as red dots, includes eruptions from 1900–2016. The data for earthquakes, shown as green dots, includes events with magnitudes 5 through 9 on the Richter scale from 2000–2016. Magnitude 5 describes a moderate earthquake that can be felt and causes damage to buildings. As the magnitude increases, the intensity of the earthquake increases tenfold. For example, a magnitude 6 earthquake is 10 times stronger than a magnitude 5 earthquake. A magnitude 9 earthquake causes severe damage over a larger area and can completely destroy a community near the epicenter.
- As students use the map, have partners collaborate to gather information about earthquakes and volcanoes. Have them interpret and analyze the map together and tell each other what they notice. For example, are there patterns in the interactive map that also appeared in the case study and the Ruff game? Do they notice new patterns? They should write their observations and questions on page 1 of the graphic organizer. Also, make sure that both students in a pair have the opportunity to use the interactive features of the map as they work together.
- Have students create their own map using the provided map.
- After pairs have explored the interactive map and completed page 1 of the graphic organizer, ask them to review their notes and discuss ideas about the locations and relationships of earthquakes and volcanoes. Instruct pairs to think about the relationship between the locations of volcanoes and earthquakes as well as their relationship to any other Earth features. For example, in addition to noticing that many volcanoes and earthquakes occur along the borders of continents and oceans and that they tend to occur within close proximity to each other, some students might suggest that earthquakes and volcanoes often occur in or near mountain ranges, which also mostly occur along the borders of continents and oceans.
- After pairs discuss the observations that they recorded on page 1, they should write additional questions and/or answers to previous questions. Then students should write at least one claim on page 2 based on their work with the interactive map. Inform students that they should prepare to share their observations and claims with the class.
- Reconvene as a class and have pairs share their findings. Prior to the discussion, remind students to listen critically to each other's explanations and to ask questions as appropriate to the content. Encourage them to critique each other's explanations by asking questions such as:
 - What is your evidence?
 - Why do you think that?
 - I wonder if that's enough evidence to make a strong claim?
- To begin the discussion, you might ask:
 - Did you notice any new patterns regarding earthquake locations? Volcano locations? Explain.
 - How do the patterns that you noticed using this media compare with the patterns you saw when exploring Ruff's Ring of Fire Travel Guide game and the Alaska Volcano and Earthquake Case Study? Students should be noticing patterns such as:
 - Earthquakes and volcanoes occur mostly along borders of continents and oceans.
 - Earthquakes and volcanoes often occur near each other.
 - Earthquakes and volcanoes are not as prevalent in the interior of continents as they are along continental edges.
 - What relationship between volcanoes and earthquakes did you notice? What evidence supports that relationship?
 - How does using different media, like the case study, the Ruff game, and the interactive map, help support a scientific claim? (Sample answer: The more evidence you have from different, reliable sources, the stronger your claim is.)

EVALUATION- attributed to exploring earthquakes and volcanoes from <https://www.pbslearningmedia.org/resource/buac17-35-sci-ess-lpexplorequakevolcano/exploring-earthquakes-and-volcanoes-on-earth/#.XRyuVC2ZPPA>

- Help students gauge new learning and understand how their thinking has changed by asking them to write their final claim on the [Earthquake and Volcanoes Lesson Exit Ticket](#). You may also choose to discuss and record any answers to questions on the class chart that was created at the start of the lesson.

References:

Wgbh. (2018, September 28). Exploring Earthquakes and Volcanoes on Earth: Lesson Plan. Retrieved from <https://www.pbslearningmedia.org/resource/buac17-35-sci-ess-lpexplorequakevolcano/exploring-earthquakes-and-volcanoes-on-earth/#.XRyuVC2ZPPA>

Wgbh. (2018, November 02). Ruff Ruffman's Ring of Fire Travel Guide. Retrieved from <https://www.pbslearningmedia.org/resource/buac17-35-sci-ess-ruffringfire/ruff-ruffmans-ring-of-fire-travel-guide/#.WYRzPDO-Lxs>

Wgbh. (2018, November 02). Global Earthquakes and Volcanoes Map. Retrieved from <https://www.pbslearningmedia.org/resource/buac17-35-sci-ess-quakevolmapint/global-earthquakes-and-volcanoes-map/#.XSNBoy2ZMnU>

Wgbh. (2018, November 02). Alaska Volcano and Earthquake Case Study. Retrieved July 8, 2019, from <https://www.pbslearningmedia.org/resource/buac17-35-sci-ess-akvolquake/alaska-volcano-and-earthquake-case-study/#.XSNGFi2ZMnV>

World Map Projections Printable, Blank Maps, Royalty Free. (n.d.). Retrieved July 8, 2019, from http://freeusandworldmaps.com/html/World_Projections/WorldPrint.html

World Mercator Projection Map with Country Outlines



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