LEVEL 2

Oceans: Hot Spots

from the GeoInquiries™ collection for Earth Science

Target audience – Earth science learners **Time required – 25 minutes**

Activity	Analyze the distribution of volcanic hot spots and their role in island formation.
Science Standards	**NGSS: HS-ESS2-3.** Earth's Systems. Develop a model based on evidence of Earth's interior to describe the cycling of matter by thermal convection.
Learning Outcomes	• Students will examine the Hawaiian Island-Emperor Seamount Chain in relation to an active hot spot. • Students will identify other volcanic hot spots around the world.
Level 2 GeoInquiry Requirements	• A free school ArcGIS Online organization account. Instructors or students must be signed in to the account to complete this activity. • Approximately 0.143 credits will be used per person in the completion of this activity as scripted.

Map URL: http://esriurl.com/earthGeoInquiry11

Engage

What features make up the Hawaiian Islands?

→ Click the link above to launch the map.
→ In the upper-right corner, click Sign In. Use your ArcGIS Online organization account to sign in.
→ With the Details button underlined, click the button, Content (Show Contents of Map).
→ Turn off all the layers, and then change the basemap to Imagery With Labels.
→ Click the button, Bookmarks. Select Hawaii.
? Using the Measure tool (see the ToolTip on page 2), what is the width of the largest Hawaiian island? *[<100 mi]*
? What is the approximate distance from the biggest island to the smallest island? *[~400 mi]*
? Which Hawaiian island do you think is the volcanically active one? *[The big one, Hawai'i]*
? Why are the inactive Hawaiian Islands smaller? *[Millions of years of erosion have worn them down.]*
→ Change the basemap to Oceans.
? What features immediately surround the Hawaiian Islands? *[Seamounts]*
? Zoom to the Hawaiian Ridge bookmark, and measure the length of the Hawaiian Ridge. *[~1,300 mi]*
? Zoom to the Emperor Seamount Chain bookmark and measure the length of the chain. *[>3,500 mi]*
? Noticing the change in direction of the seamount chain, how far is this from the Big Island? *[~2,100 mi]*

Explore

How did the Hawaiian Island-Emperor Seamount Chain form?

– The Hawaiian Island-Emperor Seamount Chain was formed by the movement of the Pacific Plate over a hot spot, an area of long-duration, intense rising of magma.
→ Turn on the two layers, Volcanic Hotspots and Plate Motions.
? Which direction is the Pacific Plate moving near the Hawaiian Islands? *[Northwest]*
? The Pacific Plate moves on average about 3 inches per year. How long ago did the island chain change direction? *[2,100 mi = 11,088,012 in. 11,088,012"/3" = 3,696,004 million years ago.]*

Explain

How prevalent are volcanic hot spots?

→ Zoom out to the whole world.
→ Hover over the layer name, Volcanic Hotspots. Click the button, Show Table.
? How many volcanic hot spots are there? *[95]*

more ▶

Elaborate

Where are volcanic hot spots located?

- Turn on the layer, Continents.
- See the Find Existing Locations ToolTip below.
- Find how many hot spots are located within landmasses.
- Click the button, Analysis. Expand Find Locations and choose Find Existing Locations.
- In the Find Existing Locations pane, set the following parameters:
  1. Choose Volcanic Hotspots.
  2. Click the green Add Expressions button and add the following expression: Volcanic Hotspots Intersects Continents.
  3. Provide a unique name for the resulting layer. Uncheck the Use Current Map Extent box. Check credit usage (about .143 credits). Run the analysis.
- Turn off the layer, Volcanic Hotspots.
- Hover over the new layer's name. Click the button, Show Table.
- ? How many of the hot spots appear within a landmass? *[30 hot spots are directly beneath continental landmasses.]*

Evaluate

Were all hot spots over continents equally distributed?

- ? Which continent contains the most volcanic hot spots? *[Africa with 8]*
- ? Which continent contains no volcanic hot spots? *[South America]*
- ? Do you find the answers to the previous two questions surprising? Why or why not?

FIND EXISTING LOCATIONS

- This tool selects existing features in your study area that meet a series of criteria that you specify.
- These criteria can be based on attribute queries and spatial queries (for example, within 1 mile of a river).

USE THE MEASURE TOOL

- Click Measure, select the Distance button, and from the drop-down list, choose a unit of measurement.
- On the map, click once to start the measurement, click again to change direction, and double-click to stop measuring.
- Hint: Position the area of interest on the map so that it is not obscured by the Measure window.

Next Steps

Continue using an ArcGIS Online organizational account (www.esri.com/schools) to dig deeper into data using the analysis tools, and save your maps to your account.

THEN TRY THIS...

- Symbolize the hot spots as a heat map. What is the spatial distribution of the world's volcanic hot spots?
- Add the TectonicPlateBoundaries layer by Esri_TESS. Perform an analysis to find those nearest a plate boundary versus those not near a plate boundary.

TEXT REFERENCES

This GIS map has been cross-referenced to material in sections of chapters from these high school texts.

- *Earth Science by Glencoe McGraw Hill — Chapter 19*
- *Earth Science by Holt — Chapter 13*
- *Earth Science by McDougal Littell — Chapter 3*
- *Earth Science by Prentice Hall — Chapter 14*

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