



LEVEL

2

Earth Moves: Seismic Stations

from the GeolInquiries™ collection for Earth Science

Target audience – Earth science learners

Time required – 40 minutes

Activity	A case study in analysis, exploring the 2011 Virginia earthquake.
Science Standards	NGSS: MS-ESS2-1. Earth's Systems. Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process.
Learning Outcomes	<ul style="list-style-type: none">• Students will triangulate the epicenter of an earthquake.• Students will rank earthquakes by magnitude.
Level 2 GeolInquiry Requirements	<ul style="list-style-type: none">• A free school ArcGIS Online organization account. Instructors or students must be signed in to the account to complete this activity.• Approximately 0.75 credits will be used per person in the completion of this activity as scripted.

Map URL: <http://esriurl.com/earthGeolInquiry7>

Engage

Where are the nearest seismic stations to you?

- 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).
- Ensure that only one layer is turned on: Global Seismographic Network.
- Use the Measurement tool to determine your approximate distance to the nearest seismic station.
- Identify two additional local seismic stations to be used if there was an earthquake in your region.



Explore

Is Virginia prone to earthquakes?

- Although Virginia is not on an active tectonic plate boundary, earthquakes are possible due to ancient faults far beneath the surface.
- Above the map, in the Find Address Or Place field, type **Virginia, USA** and press Enter.
- Turn on the layer, Earthquake Faults.
- Click both symbols in Virginia to view the pop-ups.
- ? Which regions of Virginia are most prone to earthquakes? [*The Central Virginia Seismic Zone west of Richmond and Pembroke Faults near Blacksburg in southwest Virginia.*]
- Close the pop-up.



Explain

Who felt the 2011 Virginia earthquake?

- Turn on the layer, Who Felt VA 2011 Quake.
- Click the button, Bookmarks. Select Virginia to set the proper map extent for analysis.
- The polygon over the East Coast is the area where most people felt the Virginia 2011 earthquake.
- ? Name some U.S. states where citizens felt the 2011 Virginia Earthquake. [*21 states – ME, VT, NH, MA, CT, RI, NY, NJ, PA, MD, DE, VA, WV, NC, SC, GA, TN, KY, OH, IN, MI*]

Elaborate

How do we find the epicenter of an earthquake?

- The closest seismic stations to the Virginia earthquake were: Fredericksburg, VA (CBN/35.7 miles), Blacksburg, VA (BLA/145.4 miles), and Mont Chateau, WV (MCWV/157.3 miles).
- Write down the Station Codes and distances of these three stations on a whiteboard.
- See the Find Existing Locations ToolTip below.
- Click the button, Analysis. Expand Find Locations. Choose Find Existing Locations.
- In the Find Existing Locations pane, set the following parameters:
 - 1 Choose Global Seismographic Network.
 - 2 Click Add Expression, and add the following expression that looks for the first station, Fredericksburg: Global Seismographic Network Where (Attribute Query) Station_Code Is **CBN** (case-sensitive).
 - 3 Name the resulting layer **CBN_<your initials>**, leave the Use Current Map Extent box checked, check the credits used, and then click Run Analysis.
- The resulting layer is a single point, the CBN station, added to your map.
- Repeat the process above for the other two stations: BLA and MCWV.
- See the Create Buffers ToolTip below, and then click Analysis, expand Use Proximity, and choose Create Buffers.
- In the Create Buffers pane, set the following parameters:
 - 1 Choose CBN.
 - 2 Set Distance to **35.7** miles.
 - 3 Uncheck the Use Current Map Extent box. Ensure the resulting name is unique. Click Show Credits (0.001 credits), and then run the analysis.
- A resulting layer, a buffer of the station measure at the radius that you entered, is added to the map.
- Using the distances listed at the beginning of this section, repeat the process above for the other two stations.

Evaluate

How are earthquakes ranked?

- ? Where do your three new buffers intersect? This is the location of the earthquake's epicenter. [*Approximately 5 miles southwest of Mineral, Virginia*]
- The Mineral, VA, earthquake measured a 5.8 on the Richter Scale. Each whole number on the Richter Scale is 32 times stronger than the previous number. (Example: A 6.0 is 32 times stronger than a 5.0. A 6.0 is 32x32 [1,024 times] stronger than a 4.0.)
- Add a new layer from ArcGIS Online: Recent Earthquakes owner:esri.
- Find the closest recent earthquake to your location, and click the earthquake marker.
- ? How does the recent earthquake nearest to you compare to the 2011 Mineral VA earthquake? [*Answers will vary.*]

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).

CREATE BUFFERS

- A buffer is an area that covers a given distance from a point, line, or area feature.
- Result layer name must be unique, so consider adding three initials, school code, and a number before or after the layer name (example: FileName_REED_ABC1).

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...

- Find populated places nearest recent earthquakes and provide statistics about their populations.
- Examine recent earthquakes in relation to local fault zones.

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 11
- *Earth Science by McDougal Littell* — Chapter 7
- *Earth Science by Holt* — Chapter 7
- *Earth Science by Prentice Hall* — Chapter 6