



LEVEL

2

# Cracked Plates: Earthquake-Prone

from the Geolnquiries™ collection for Earth Science

Target audience – Earth science learners

Time required – 25 minutes

**Activity**

Explore the spatial distribution of earthquakes around the world and their effects on cities in one continent in particular.

**Science Standards**

NGSS: MS-ESS2-2. Earth's Systems: Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales.

**Learning Outcomes**

- Students will investigate the relationship between earthquakes and plate boundaries.
- Students will analyze the affected population of recent earthquakes.

**Level 2 Geolnquiry Requirements**

- A free school ArcGIS Online organization account. Instructors or students must be signed in to the account to complete this activity.
- Approximately 0.78 credits will be used per person in the completion of this activity as scripted.

Map URL: <http://esriurl.com/earthGeolnquiry6>



## Engage

### Where in the world do the most earthquakes occur?

- 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).
- Check the box to the left of the layer, Global Quakes of Large Magnitude 5.8 or Greater.
- Hover the mouse on the layer name and click the button, Change Style.
- Select Heat Map to illustrate the distribution of the earthquakes. Click Done.
- ? Where in the world do the most earthquakes occur? [*The west Pacific Ocean and South America*]
- Turn off the layer, Global Quakes of Large Magnitude 5.8 or Greater.
- ? Which boundary type produces the most earthquakes? [*Convergent*]



## Explore

### What causes the earthquakes in South America?

- Turn on the layer, Global Quakes of Large Magnitude 5.8 or Greater.
- Click Bookmarks. Select South America.
- ? Looking at the distribution of earthquakes around South America, which coast is more geologically active and why? [*The Peru-Chile Trench sits just offshore of the West Coast, while the East Coast is a sizable distance from the Mid-Atlantic Ridge.*]
- Use the Measure tool to compare the distances of each coast to a plate boundary. [*West Coast < 100 miles from a trench. East Coast > 500 miles from Mid-Atlantic Ridge at its closest and > 1,500 miles at its farthest.*]
- ? Observing the map, which South American countries seem to experience the most earthquakes? [*Chile, Bolivia, Argentina, and Peru*]



## Explain

### Where do most of South America's population live?

- Turn on the layer, South American Cities.
- ? Where are most of the cities? [*More are near the coasts, especially north and west, than in the interior.*]
- Hover over the layer name, South American Cities. Click the button, Show Table.
- Click on the field header, Population. Choose Statistics.
- ? What is the total population of all South American cities? [*~129 million*]
- Close the statistics pop-up and table.
- Turn off the layer, South American Cities.

more ►

## Elaborate

### Which cities are within 50 miles of a recent earthquake?

- Select the bookmark, South America. This confirms the proper map extent for analysis.
- See the Find Existing Locations ToolTip below.
- Click the button, Analysis. Expand the Find Locations group. Choose Find Existing Locations.
- In the Find Existing Locations pane, set the following parameters:
  - 1 Choose South American Cities.
  - 2 Click the green Add Expression button, and create the following expression: South American Cities Within A Distance Of **50** Miles From Global Quakes Of Large Magnitude 5.8 or Greater.
  - 3 Ensure that the Use Current Map Extent box is checked. Always click Show Credits to ensure acceptable credit usage (about 0.78 credits).  
Give the new layer a unique name to avoid conflicts. Click Run Analysis.
- Turn on the new layer.

## Evaluate

### Who lives in an earthquake zone?

- Open the new layer's table. (See ToolTip below for details.)
- ? How many cities were within 50 miles of an earthquake? [*42 but slight variation may arise from map extent*]
- Hover over the new layer name. Click the button, Change Style. Symbolize the new layer by Population.
- ? What is the total population of these cities? (Hint: Use table.) [*About 17 million*]
- ? Which city is the most populous? [*Santiago, Chile, with about 5 million people*]

## VIEW AND SORT A TABLE

- Tables are only available for certain map layers.
- In the Contents pane, point to a layer and click the Show Table button that appears under the layer name.
- Click the field name and choose Sort Ascending or Sort Descending.

## 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).

## Next Steps

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

THEN TRY THIS...

- Analyze cities near earthquake zones in the western Pacific.
- Explore the 2015 Nepal earthquakes with a story map at <http://esriurl.com/Geo519>.

## 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 5*
- *Earth Science by McDougal Littell — Chapter 1*
- *Earth Science by Prentice Hall — Chapter 7*
- *Earth Science by Tarbuck and Lutgens — Chapter 7*