Family edition

Earthquake Lab: Find the Epicenter

Ages 11-14 · about 45 minutes, in one sitting

Your child finds a hidden earthquake in Earthquake Lab the way seismologists do: from three seismograms, a travel-time chart and a compass.

What you need

- A computer or Chromebook with a current browser.
- The lesson link: mytekdev.com/try/earthquakelab?lesson=find-the-epicenter&ref=fam-earthquakelab-2. No account, no email and nothing to install.

Before you start: try it once yourself

Open mytekdev.com/try/earthquakelab?lesson=find-the-epicenter&ref=fam-earthquakelab-2. A short guide opens over the app. Press `Find a quake`: a quake breaks where nobody can see it, the three strips fill, and the right side shows five steps.

1. **Mark the arrivals.** Drag the P flag to where the quiet line first wiggles and the S flag to where the wiggles jump. A loupe magnifies the strip; the arrow keys nudge the last flag.
2. **Find the gap.** Type S minus P for each station. The app checks the subtraction and ticks it.
3. **Read the distance.** Click a distance blank: the chart opens. Move the paper along the P line until its top mark touches the S line, and type the distance under its edge.
4. **Draw the circles.** Drag the compass pencil along the ruler under the map to a distance, click that station, and swing the pencil round. Three times.
5. **Mark and check.** Click where the circles cross and press `Check my answer`. The star appears with how far off you were, and if you missed, which step to look at again.

> Setup in the header decides whether every child gets their own quake (the default) or everyone shares the same ones, and prints an answer key.

The ideas, in plain words

A seismograph station knows how far away a quake was from its S-P gap, but not which way. All it can say is that the quake is somewhere on a circle around it. A second station's circle crosses the first in two places; a third passes through only one of them. That is the epicenter, the point on the map above the focus.

Real circles rarely meet at one point. Readings are a little off, and the waves started underground, so each distance is really to the focus, a little longer than along the map. Children click the middle of the small triangle. The map is

made up, and so is every quake on it. The waves travel at 6 and 3.5 kilometers a second in straight lines; in the real Earth they speed up with depth and bend, so the 8 km rule works best within about 200 kilometers.

The check names the classic mistakes from the child's own numbers: the S flag on the surface waves, an arrival time written as the gap, the chart read along one line only, a compass set to another station's distance, a circle drawn wrong on the ruler.

Do it together

1. Open mytekdev.com/try/earthquakelab?lesson=find-the-epicenter&ref=fam-earthquakelab-2 together. A short guide opens over the app. Press `Find a quake`.

   > **You'll know it worked when:** Three seismograms fill in. The quake itself is hidden.

2. On each strip, drag the P flag to the first wiggle and the S flag to where the wiggles jump. Type each gap: S minus P.

   > **If you get stuck:** Hold a flag to see a magnifier. The S wave is the first jump, not the biggest waves at the end.
   >
   > **You'll know it worked when:** Each gap gets a check mark.

3. Follow the steps on the right: read each distance off the chart, and draw a circle round each station with the compass.

   > **If you get stuck:** Drag the compass pencil along the ruler to the distance first, then click the station and swing.
   >
   > **You'll know it worked when:** Three circles cross near one spot.

4. Click where they cross and press `Check my answer`. Ask: how close did you get?

   > **You'll know it worked when:** The real star appears and the app says how many kilometers off you were.

Talk about it

Ask these while you work together. A child who has understood it can answer them without help:

- How did you decide where the S wave starts?
- Why does the paper have to touch both lines on the chart?
- With only station A's circle, where could the quake be?
- With two circles, how many places are possible?
- Why did your circles leave a triangle and not a point?

> The fourth question is the real test: a child who says two places, and that the third circle picks one, has triangulation.

For younger and older kids

Younger: For a younger child, do the flags and gaps together and let them draw the circles.

Older: For a teenager, pick High school and work out when the quake happened, too.

Keep going

- Find a second quake without the guide and beat your first distance off.
- Hide a quake for someone else to find: make one in Make a quake and press Hide this one for a friend.
- Pick High school: work out when the quake happened from one station's P time and the chart.

Bring it into other subjects

- Math: GPS finds a phone the same way, with distances to satellites. Why does it need a fourth one in three dimensions?
- Geography: look up the most recent earthquake on the USGS map and how many stations recorded it.
- English: write the check's note for a mistake you made, in your own words, as advice to a friend.
- Technology: in Code, write the rule that turns a gap into a distance and let the lab try it on forty quakes.

For your records

Ready to copy into an hour log, a portfolio or a transcript.

LESSON	Earthquake Lab: Find the Epicenter
SUBJECTS	Earth science
TIME	45 minutes
WHAT WE DID	Located a hidden earthquake from three seismograms by marking P and S waves, reading a travel-time chart and drawing circles with a compass.
SKILLS PRACTICED	Reading seismograms; Travel-time charts; Triangulation

Activity sheet (optional)

Name: _____ Date: _____

Open the app: scan the QR code, or go to mytekdev.com/try/earthquakelab?lesson=find-the-epicenter

Essential question: Scientists cannot see where an earthquake started. How do three seismograms find it?

Warm-up: A friend is 5 km away, direction unknown. Where could they be? _____

1. **Vocabulary.** Epicenter, focus, travel-time chart, triangulation, seismograph station: write each in your own words.

2. **The station table.** For stations A, B and C: P at _____ s; S at _____ s; gap _____ s; distance _____ km. Then: how far off was your epicenter? _____ km.

1. Why do you need three stations? What would one tell you? Two?

2. Your circles left a small triangle. Give two reasons.

Quick check

Name: _____

1. One station's S-P gap tells you (A) the direction of the quake (B) the distance to the quake (C) the size of the quake

2. Two stations' circles cross in (A) one place (B) two places (C) no places

3. Explain why the epicenter is where three circles cross.

Answers

QUESTION	ANSWER	WHY
1	B	The gap grows with distance; it says nothing about direction.
2	B	Two circles usually cross twice, so a third station is needed.
3	It is the only place the right distance from all three	Each circle is every place at that station's distance; only the crossing point is on all three. Saying only that the circles cross there is half.

If your state or umbrella school asks, this lesson covers NGSS MS-ESS3-2.

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The app this lesson uses is free and runs in the browser, with nothing to install and no account needed. It is at mytekdev.com.

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