Family edition

Earthquake Lab: Seconds of Warning

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

Your child breaks an earthquake in Earthquake Lab, sees how hard each town shook and how many seconds of warning it got, and watches a tsunami cross the sea.

What you need

- A computer or Chromebook with a current browser.
- The lesson link: mytekdev.com/try/earthquakelab?lesson=seconds-of-warning&ref=fam-earthquakelab-3. No account, no email and nothing to install.

Before you start: try it once yourself

Open mytekdev.com/try/earthquakelab?lesson=seconds-of-warning&ref=fam-earthquakelab-3. A short guide opens over the app, with a fault already drawn across the middle of the map and set to magnitude 6.5.

1. **The break.** Press `Break the fault` and let the clock run to the end.
2. **The towns.** Press `The towns`. The line on top says when station C felt the P wave (11.8 seconds) and when the alert went out (16.8). Oru Flats shakes strong with no warning; Port Maren gets 30 seconds, Kessa 59. Towns that shake too little are marked no alert needed.
3. **A better station.** Drag station C close to the fault and break again: the alert goes out sooner.
4. **The sea.** Drag across the sea near Kessa to draw a new fault, choose `Push together`, set the magnitude to 7.5, and break it. In The towns a card says the sea floor moved and lifted the water into a wave; press `Watch the sea`. The wave crosses in minutes, slows where the sea is shallow, and bends round the island; the strips become gauges at three coast towns.

> The moment that lands is the town next to the quake getting none, while a town far away gets most of a minute.

The ideas, in plain words

Magnitude is one number for the size of a quake. Intensity is how hard the ground shook at one place, and it falls with distance; the app uses the words USGS uses, from not felt to extreme, from a relation fit to California quakes (Bakun and Wentworth, 1997).

Early warning is not prediction: nobody can say ahead of time when a quake will come. Once one starts, the station nearest it feels the fast, weak P wave; a center works out what is coming and sends an alert, which outruns the slower, stronger S wave to places farther away. Places close to the quake shake before the alert can reach them. In the app the alert goes out five seconds after the nearest station feels the P wave; real systems use several stations.

A tsunami comes when a big quake under the sea lifts or drops the sea floor and the water above it; most big ones come from faults that push together. It travels at a speed set by the depth of the water, far slower than the shaking. At a coast, a strong or long earthquake is the warning: drop, cover and hold on until the shaking stops, then go to high ground or inland right away, without waiting to be told. The app shows no wave heights, flooding or damage. 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.

Do it together

1. Open mytekdev.com/try/earthquakelab?lesson=seconds-of-warning&ref=fam-earthquakelab-3 together. A short guide opens over the app. Press `Break the fault`, then `The towns`.

   > **You'll know it worked when:** Each town has a shaking word and a number of seconds, or none.

2. Find the town with the most warning and the one with none. Ask: why the difference?

   > **If you get stuck:** Look at the line above the table: when did the alert go out?
   >
   > **You'll know it worked when:** Towns close to the quake shake before the alert can reach them.

3. Drag station C right next to the fault and break it again.

   > **You'll know it worked when:** The alert goes out sooner, and most towns gain warning.

4. Draw a new fault in the sea, choose `Push together` and magnitude 7.5, break it, open `The towns` and press `Watch the sea`.

   > **If you get stuck:** The wave button appears only for a fault under the sea at 6.5 or more that pushes together or pulls apart.
   >
   > **You'll know it worked when:** The shaking arrived in seconds; the wave takes minutes.

Talk about it

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

- The quake has one magnitude. Why do the towns have different shaking?
- When did the alert go out: before or after the quake started?
- Why did Oru Flats get no warning?
- Why did moving station C help every town?
- How long did the shaking take to reach a coast town, and how long the wave?

> The second question is the real test: a child who says after, once a station had felt the P wave, knows warning is not prediction.

For younger and older kids

Younger: For a younger child, set the level menu at the top to its youngest choice and talk about drop, cover and hold on.

Older: For a teenager, find where to put station C to give the most towns warning.

Keep going

- Find the place for station C that gives Port Maren the most warning.
- Turn the magnitude down to 5: which towns now need no alert at all, and why?
- Under the sea, compare Pull apart and Push together at the same size. What does the card say about most big tsunamis?

Bring it into other subjects

- Health and safety: practice drop, cover and hold on, and find your school's plan.
- Math: the S wave travels 3.5 km a second. How far does it get in 30 seconds of warning?
- Geography: find a real coast with tsunami evacuation route signs, and where they point.
- English: write a short alert message for a phone that tells people exactly what to do, in under 90 characters.

For your records

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

LESSON	Earthquake Lab: Seconds of Warning
SUBJECTS	Earth science
TIME	45 minutes
WHAT WE DID	Modeled an earthquake's shaking at nine towns, explained how early warning works and why it is not prediction, and watched a modeled tsunami.
SKILLS PRACTICED	Natural hazards; Early warning; Earthquake and tsunami safety

Activity sheet (optional)

Name: _____ Date: _____

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

Essential question: Nobody can predict an earthquake. How can people still get a warning?

Warm-up: How could a phone know about shaking before it arrives? _____

1. **Vocabulary.** Magnitude, intensity, early warning, prediction, tsunami: write each in your own words.

2. **The towns table.** For four towns: distance from the star _____ km; shaking _____; warning _____ s. Then with station C moved: warning _____ s. For a coast town: shaking arrived _____ s; wave arrived _____ min.

1. Why do towns close to the quake get little or no warning?

2. You feel a strong, long earthquake at the beach. What do you do first, and what next?

Quick check

Name: _____

1. An early warning is sent (A) days before a quake (B) after a quake starts, before the strong shaking arrives (C) only after the shaking stops

2. One quake makes strong shaking in one town and light shaking in another. The quake has (A) one magnitude (B) two magnitudes (C) no magnitude

3. Explain why a town far from the quake can get more warning than a town close to it.

Answers

QUESTION	ANSWER	WHY
1	B	Nobody can predict a quake; the alert goes out once a station has felt the P wave.
2	A	Magnitude is the size of the quake; shaking is different at each place.
3	The strong S wave takes longer to reach it	The alert travels almost at once, but the S wave is slow, so the farther away, the more time between the alert and the shaking. Saying only that it is farther 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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