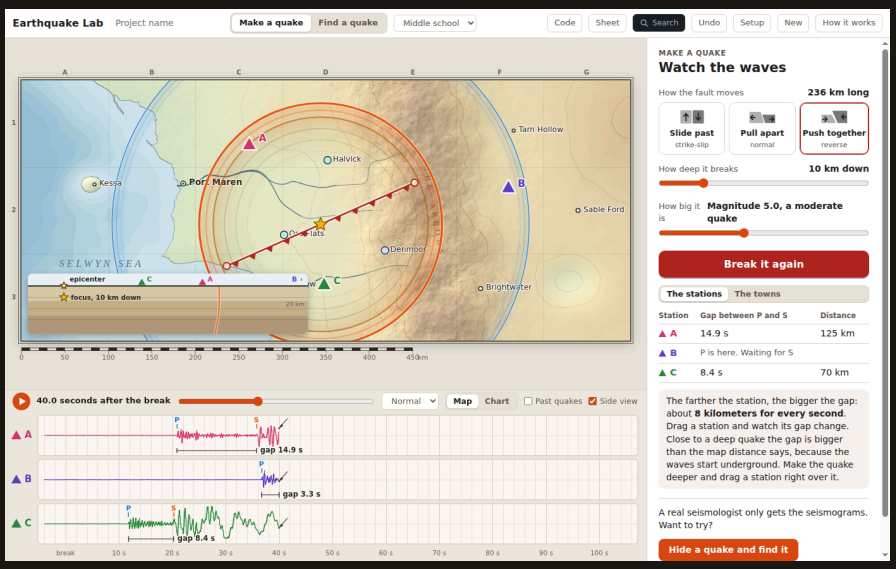
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Earthquake Lab: Two Waves, One Gap

Grades 6-8 · 45 minutes

Earth science



Slides, rubric and answer key **Print and go** **No student accounts**

Chromebook friendly

What's included

- A one-page overview: objectives, essential question, vocabulary, standards and assessment
- A 45-minute lesson sequence: warm-up, direct instruction, guided practice, independent practice, closure
- Slides for the board: a PowerPoint file that also opens in Google Slides
- A student worksheet with a QR code and a gap table
- A 3-question exit ticket, two to a page, with an answer key
- A rubric: 3 criteria, 4 levels, scored out of 12
- Differentiation for English learners, students with IEPs or 504 plans, and students who need more support or more challenge
- Cross-curricular extensions, and notes for teaching it in grade 4 and in high school earth science
- Standards: NGSS

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Students draw a fault on a map and break it. Two waves leave the break together, the fast P wave and the slower S wave, and three seismograph stations record them. The farther the station, the bigger the gap between the two arrivals. Students move the stations, measure the gaps, and find the rule: about one second of gap for every 8 kilometers.

At a glance

ESSENTIAL QUESTION

Two waves leave an earthquake at the same moment. How can the time between them tell you how far away it was?

OBJECTIVES

Students will be able to:

- describe P waves and S waves and which arrives first
- read a seismogram and find the P arrival, the S arrival and the gap between them
- explain why the gap grows with distance
- use the rule of about 8 kilometers per second of gap to estimate a distance

VOCABULARY

Fault, P wave, S wave, Seismogram, S-P gap

STANDARDS

MS-PS4-1, MS-ESS2-2

TIME AND MATERIALS

45 minutes, grades 6-8.

- One computer or Chromebook per student
- A projector
- The worksheet and exit ticket, one copy each per student
- The rubric, one copy per student if you grade the work

PREP

Make copies of the worksheet and exit ticket. Before class, open mytekdev.com/try/earthquakelab?lesson=two-waves-one-gap&ref=tpt-earthquakelab-1 once on a student computer to check that your school's filter allows the app. Run it yourself, about ten minutes: draw a fault across the middle of the map, press Break the fault, read the gaps on the right, then drag station B far from the fault and watch its gap grow.

ASSESSMENT

- Formative: the questions under What to look for, asked while students work, and the exit ticket (answer key included).
- Summative: the worksheet, scored with the rubric.

TECHNOLOGY AND PRIVACY

Runs in any browser, Chromebooks included, with nothing to install. Students need no account and no email: the link works signed out, and nothing they do is stored on our server unless they choose to save.

Lesson sequence

MINUTES	STAGE	WHAT YOU DO	WHAT STUDENTS DO
0 to 5	**Warm-up** Hook	Show the title, essential question and Today I can slides (about 1 minute). Then the warm-up: count from lightning to thunder. Take a few answers on how the count tells distance.	Answer the warm-up on the worksheet.
5 to 12	**Direct instruction (I do)** Model it	Project the app. Draw a fault across the middle of the map and press Break the fault. Narrate: the star is where it broke, two rings leave together, the inner one falls behind. Point at the strips: a small twitch, then a bigger swing. Show One quake, three gaps. > **It's working when:** Ask which station's pen twitched first, and which waited longest between its twitch and its big swing. Both answers point at distance.	Watch, and fill in the vocabulary on the worksheet.
12 to 22	**Guided practice (We do)** Break a fault together	Students open the link or scan the QR code. A short guide walks them through drawing a fault and breaking it. Everyone reads the three gaps and distances on the right. > **Watch for:** Students who read the big, slow swings at the end as the S wave. Those are surface waves; the S wave is the first jump before them.	Fill in the first three rows of the gap table: station, distance, gap.
22 to 38	**Independent practice (You do)** Move a station	Students drag one station to five places, near the fault and far from it, and record the distance and gap each time. Then they divide distance by gap. Walk the room with the What to look for questions. > **If they ask:** "Your station is right over the star, but the gap is still more than a second. Why?" Right on top	Fill in the gap table and divide each distance by its gap.
38 to 45	**Closure** Showcase and exit ticket	Show the Showcase slide. Two students work out the 20-second gap aloud. Ask whether one station can tell the direction. Hand out the exit ticket.	Answer the exit ticket.

Before you teach: a ten-minute walkthrough

Open mytekdev.com/try/earthquakelab?lesson=two-waves-one-gap&ref=tpt-earthquakelab-1. A short guide opens over the app: a made-up map with a coast, mountains, nine towns and three seismograph stations, A, B and C. Under it, three strips of paper, one per station.

1. **The fault.** Drag across the map. A fault line draws, and the right side shows how it moves, how deep it breaks and how big it is.

2. **The break.** Press `Break the fault`. A star marks where it broke. The P ring leaves first and the S ring falls behind it. Each pen twitches when the P wave arrives and swings wider when the S wave does, then the big, slow surface waves.
3. **The table.** The right side lists each station's gap and distance as the S wave arrives, and says the rule: about 8 kilometers for every second.
4. **A station moved.** Drag a station. Its seismogram and its gap change as it goes.
5. **The side view.** The panel inside the map cuts the ground open: the focus underground, the epicenter on the map above it.

> The moment that lands is dragging a station away and watching its gap stretch while the quake stays put.

Background for the teacher

When a fault slips, waves leave the break in every direction. The P wave pushes and pulls the rock along its path and is the fastest, about 6 kilometers a second near the surface. The S wave shakes the rock side to side and travels about 3.5. Both start at the same moment, so the S wave falls further behind the farther they go: about one second for every 8 kilometers.

That makes the S-P gap a distance, like counting from lightning to thunder. One station gives a distance but not a direction; the next lesson uses three. 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.

Common mistakes: thinking the waves travel along the fault; marking the big surface waves as the S wave; and thinking a bigger quake sends faster waves (it sends bigger ones, at the same speed).

What to look for

Ask these while students work. A student who has understood the lesson can answer them without help:

- Which wave arrived first at every station? Why?
- Which station had the biggest gap, and where is it?
- Point to the S wave on a strip. How do you know it is not the surface waves?
- What number did you get when you divided distance by gap?
- Could one station tell you which direction the quake was?

> The second question is the real test: a student who links the biggest gap to the farthest station has the idea.

Cross-curricular extensions

- Math: graph distance against gap for your five stations. What is the slope of the line?

- Physics: the P wave covers 125 km in about 21 seconds and the S wave in about 36. Work out each speed.
- English: write the trip of the two waves from the fault to the farthest station, as a race.
- History: find out how the first seismographs worked, with a pen, a drum and a heavy weight.

Vocabulary

Fault	A crack in the Earth's crust where the rock on each side can slip.
P wave	The fastest earthquake wave, and the first to arrive. Small, quick wiggles.
S wave	A slower earthquake wave that arrives after the P wave, with bigger swings.
Seismogram	The record a seismograph draws of the ground shaking over time.
S-P gap	The time between the P wave and the S wave arriving at one station.

Differentiation

ENGLISH LEARNERS

- Keep the vocabulary slide up, and point at the screen as you say each word: the rings, the flags and the circles carry the meaning.
- Pair each learner with a partner for the station moves; the table on the right fills in by itself.
- Accept the gap table with numbers only, without sentences.

STUDENTS WITH IEPS OR 504 PLANS

- Pair students for the independent part, one dragging and one filling in the table.
- Zoom the browser to 125%; the table and the strips stay readable.
- Allow three station moves instead of five, where the IEP allows a modified assignment.

STUDENTS WHO NEED MORE SUPPORT

- A sentence starter: "The farther the station, the ___ the gap, because ___."
- A check-in after the guide: every student has one fault broken and three gaps read before anyone moves on.
- Give the rule, about 8 kilometers for every second, and ask them to check it on two stations.

STUDENTS READY FOR MORE

- Make the quake 30 kilometers deep and put a station right over the star: why is the gap bigger than the map distance says?
- Turn the magnitude up one step and break again: what changes on the strips, and what stays the same?
- Open the Chart: each arrival is a dot. Why are the P dots and the S dots on two straight lines?

Adapting for other grades

Younger students: In grade 4, pick 4th grade in the header: the app makes quakes and shows the towns and Past quakes, with no chart, compass or Code. Do the guide together and stop there; skip the third rubric row; total 8, and 6 meets the objectives.

Older students: In high school, pick High school: students work out the rule from the speeds, gap = d/3.5 - d/6, so d = 8.4 times the gap, and explain why it stops holding for far quakes, where waves dive into faster rock.

Student worksheet

Name: _____ Date: _____

Open the app: scan the QR code, or go to mytekdev.com/try/earthquakelab?lesson=two-waves-one-gap

Essential question: Two waves leave an earthquake at the same moment. How can the time between them tell you how far away it was?

Warm-up: You count six seconds from lightning to thunder. How far away was it, and how do you know?

_____

1. **Vocabulary.** Fault, P wave, S wave, seismogram, S-P gap: write each in your own words.

2. **The gap table.** For each place you put the station: its distance _____ km; its gap _____ s; distance divided by gap _____. One place on each line.

1. Which station had the biggest gap, and why?

2. A station records a 20-second gap. About how far away was the quake? Show your work.

Earthquake Lab: Two Waves, One Gap

Exit ticket

Name: _____

1. Which wave reaches a seismograph first? (A) the S wave (B) the P wave (C) the surface waves

2. Station X has a gap of 5 seconds and station Y a gap of 30. Which is farther from the quake? (A) X (B) Y (C) you cannot tell

3. Explain why the gap between the P and S waves is bigger at a station far from the quake.

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Answer key: exit ticket

QUESTION	ANSWER	WHY
1	B	The P wave is the fastest, about 6 km a second.
2	B	The bigger the gap, the farther the waves traveled: about 8 km per second of gap, so Y is about 240 km away and X about 40.
3	The S wave falls further behind	Both waves leave together, but the S wave is slower, so the longer the trip the more time it loses. Saying only that the station is far away is half.

Rubric

Score each row from 1 to 4.

Name: _____

CRITERIA	4 EXCEEDS	3 MEETS	2 APPROACHING	1 BEGINNING
The gap table	Five or more positions recorded with distance and gap, and each distance divided by its gap.	Five positions recorded with distance and gap.	Some positions recorded.	No positions recorded.
Explaining the gap	Explains that both waves start together and the S wave falls further behind the farther they travel, using the two speeds.	Explains that the P wave is faster, so the gap grows with distance.	Says far stations have bigger gaps, with no reason.	No explanation.
Using the rule	Uses about 8 km per second of gap to estimate a distance, and says one station gives distance but not direction.	Uses about 8 km per second of gap to estimate a distance.	Estimates a distance with the wrong rule.	No estimate.

Total: ____ / 12. A score of 9 or more meets the objectives.

Standards

The lesson is built for MS-PS4-1, two waves with different speeds, and touches MS-ESS2-2, the sudden events in slow geological processes.

FRAMEWORK	CODE	GRADES	STANDARD	HOW THE LESSON MEETS IT
NGSS	**MS-PS4-1**	6-8	Use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave.	Students use speed, distance and time to describe two waves; a seismogram is not a standard repeating wave, so this is a link rather than the assessed boundary.
NGSS	**MS-ESS2-2**	6-8	Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales.	A fault that slips in seconds, after years of strain, is the clarification's "punctuated by catastrophic events".

Checked November 2026 against: NGSS MS-PS4-1, Waves and Their Applications, NGSS MS-ESS2-2, Earth's Systems.

Optional: save student work in a free class

The whole lesson runs at the link on the worksheet, with no accounts and no sign-up.

To keep students' work, and see it all in one place, make a free class. It takes about ten minutes, once, and covers every lesson in this series: mytekdev.com/tools/class-setup

Students in a class open mytekdev.com/tools/earthquake-lab/lessons/two-waves-one-gap/start instead of the worksheet link. Each one gets their own copy of the starter, and the same link reopens it next time.

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