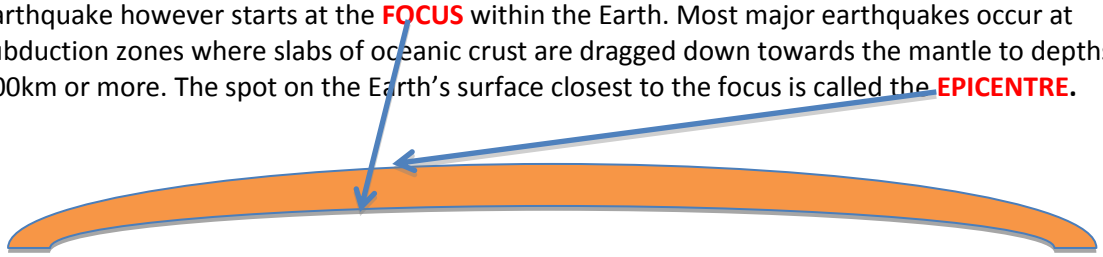
# Locating an Earthquake – Teacher Notes

Being human we tend to think of an earthquake only as it affects us on the surface of the Earth. The earthquake however starts at the **FOCUS** within the Earth. Most major earthquakes occur at subduction zones where slabs of oceanic crust are dragged down towards the mantle to depths of 700km or more. The spot on the Earth's surface closest to the focus is called the **EPICENTRE.**



Humans only usually feel earthquakes registering above magnitude 3. Other animals and birds are more sensitive and will display changed behaviour because they can feel early tremors.
Australia lies well away from its plate boundary but we still register seismic movement as our plate adjusts to external seismic movement.

*This might be a good time to remind students of your school's rules for handling emergencies (such as earthquakes). Most schools have a system of bells, whistles or hooters which signal evacuation to an open space such as the sports grounds. Another system of bells etc. signal "All clear".*

*The cliffs behind collapsed into the Redcliffs school's back yard during the 2011 Christchurch earthquake. Rock rolled and crashed right up to the back door. There was no damage to the fabric of the school and nobody was at school at the time*

What are your school's rules about safety during earthquakes? Local rules apply

How much time do you have to reach the safe assembly point after feeling the first P waves arrive? Teachers may choose to send a couple of fast walking students with watches or estimate the time themselves.

## *Seismic scenario*

We know

1. P waves are the fastest waves to arrive. Their average speed is 7km/s.
2. S waves arrive next. Their average speed is 4km/s.
3. Very destructive surface waves may arrive later.

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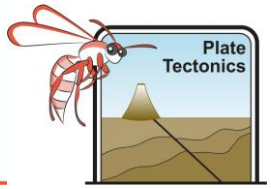


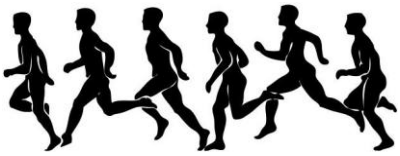

**Materials** per student

- An atlas or map of the Indo-Pacific region
- A pencil (Not 2B)
- A ruler
- A pair of compasses
- A calculator
- An eraser
- Scrap paper

An earthquake is triggered at a plate boundary near Indonesia 3,500km away.

How long will it take for the P wave to reach your school? 3,500 ÷ 7 = 500 s

How long will it take for the S wave to reach your school 3,500 ÷ 4 = 875s



Being a sensible science student you know that you should evacuate before the S wave arrives.

How much time do you have to get from the classroom to the evacuation point before the S wave hits? Use the space below for your calculations
875 – 500 = 355s or 5 minutes and 55 seconds

How long would it take you to get safely to your assembly point?
Local time. Students are often surprised that they should move in a quiet orderly fashion in an emergency, leave their bags and support less able students.

If you do not have sufficient time to get out of the classroom, what should you do to remain as safe as possible?

Take shelter under desks (best option), doorways and in toilet cubicles.
Switch off gas, water and electricity at mains.
Keep away from windows, shelving, glassware and chemicals.
Keep calm and support others
Stay interested in what is happening and time everything. This can be useful to estimate how far away the earthquake might be

The distance from an earthquake's epicentre can be roughly inferred by the interval in time between the arrival of P waves and S waves.

| Interval in minutes | Distance in kilometres |
|---|---|
| 1.5 | 900 |
| 3 | 1,800 |
| 5 | 3,300 |

An earthquake was registered on your school's seismograph. The interval between P and S wave arrivals was 4 minutes. Estimate the distance to the epicentre using the information in the table and the graph paper provided.

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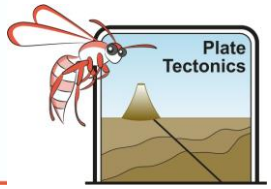


What kind of graph should this be? A line graph

What should be on the horizontal axis? Time

What should be on the vertical axis? Distance to epicentre

What should the title be? Graph comparing distance to epicentre with interval between P & S waves

Answer 2,550km

You now know the distance to the epicentre. Can you use this to find its location? No. It could lie anywhere on a circle of that radius centred on your school

Students will have to get information from at least two other places and use this to calculate their distance from the epicentre. They then use compasses to draw circles that should intersect close to the epicentre.

You quickly call your cousin's school in Auckland New Zealand 5,360km to your east. They estimated that the epicentre was 3,500 km away.

Can you now locate the epicentre with these two pieces of information? Explain your answer.
Information from two places would give two circles that would intersect in two places. We need a third location to find which one of these is the epicentre.

As luck would have it your adventurous aunt was doing scientific research on the Malaysian Peninsula 4,000 km to your north. Data from her seismometer inferred that the epicentre was 2,500km away.

Draw up you data with your cousin's data and your aunt's data to infer where the epicentre is.

Why do the arcs not intersect at exactly the same spot?
The map in the atlas is a flat projection of a curved surface. This distorts distance.

Only some of the seismic waves caused ripples in your aunt's flask. Explain why?
S waves do not trave through liquids and would not cause ripples.