SOLUTIONS

Seismic Waves and Seismographs

The surface of the Earth is split up into tectonic plates. Tectonic plates move slowly and can grind past each other, pull apart and crash into each other. Friction can cause the plates to stick together at the edges. Eventually the rocks holding the plates together will break, releasing energy in the form of **seismic waves.**

Seismic waves cause the ground to shake which we feel as an **earthquake**.

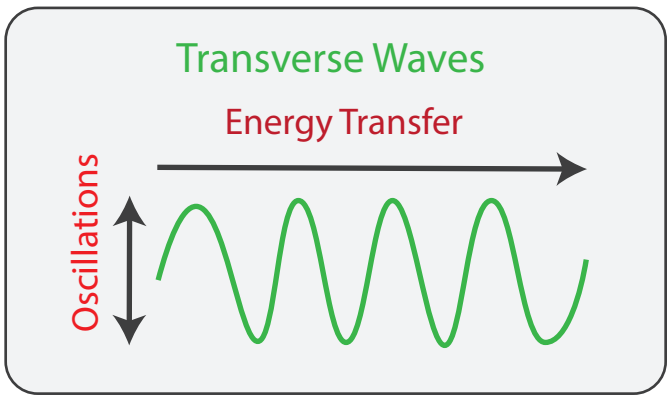
What are waves?

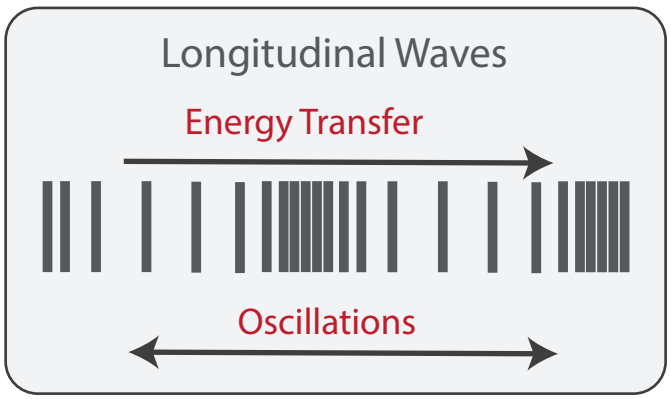
Waves transport energy, not matter.

How many different types of wave can you think of? Sound, light ...? All of these waves transfer energy from one place to another. When you speak and produce sound waves, you vibrate air particles, which causes the particles next to them to vibrate and so on (electromagnetic waves such as light behave quite differently). In both cases, it is the energy that is being transferred not the particles (matter).

There are two types of waves: **transverse and longitudinal**.

Use the Seismic Keywords at the bottom of the page to fill in the gaps below and show the differences between transverse and longitudinal waves.

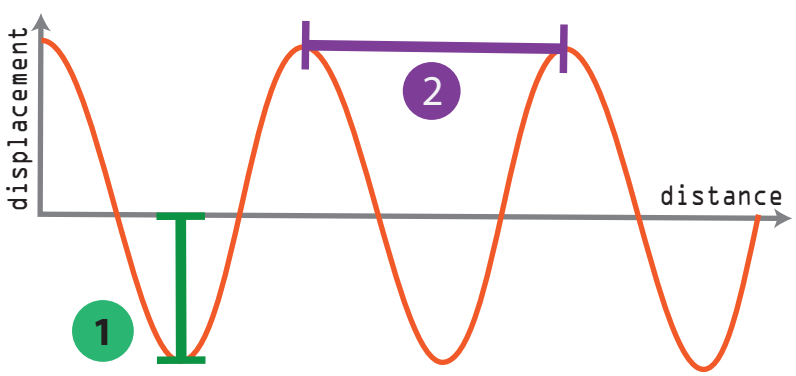




There are two types of seismic wave; P (primary) and S (secondary) waves.

P waves are longitudinal waves.
S waves are transverse waves.

Don't forget that all waves have the same set of terminology. Use the Seismic Keywords to identify the wave properties in the diagram below.



1 Amplitude

2 Wavelength

Seismic Keywords

energy transfer oscillations
amplitude wavelength

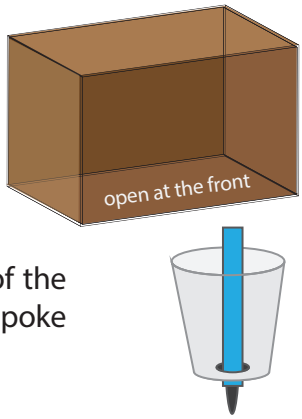
How do we measure seismic waves?

Earthquakes are an unpredictable and dangerous natural hazard that can affect millions of people. Scientists that study earthquakes and seismic waves are called **seismologists.** They use seismometers to detect and measure seismic waves.

Put your seismology skills to the test and follow the instructions carefully to **build your own seismometer.**

Equipment:

Pen or Pencil
Coins/Pebbles
Scissors
String (or twine, shoe lace)
Cardboard box
Paper
Sticky Tape
Paper or plastic cup

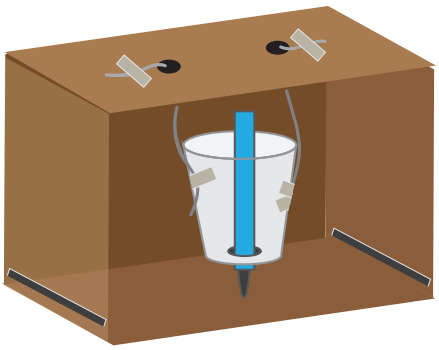


Step 1: Take a cardboard box (roughly square, although a cereal box works well too) and turn it onto its side so that the opening is at the front (or cut off the front side if using a cereal box).

Step 2: Cut a small hole in the bottom of the cup, large enough that the tip of your pen can poke through.

Step 3: Cut two holes in the top of your box.

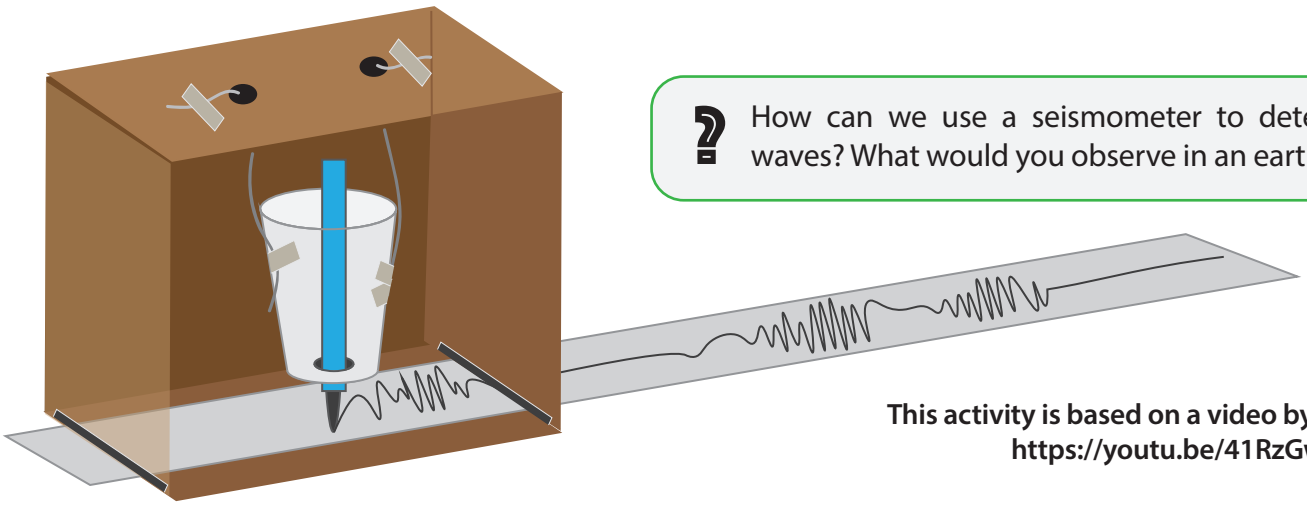
Step 4: Secure a piece of string to either side of your cup using sticky tape. Thread the two pieces of string (attached to either side of your cup) through holes in the top of your box and secure using sticky tape. The cup will need to hang low enough such that your pen will lightly touch the bottom of the box. Once your pen is in place, add coins/pebbles/weights to your cup to weigh it down and keep it steady.



Step 5: Finally, using scissors, carefully cut small slits in either side of the box (wide enough to thread strips of paper through). Your seismometer is now ready to go!

Step 6: It's time to measure an earthquake. Cut an A4 piece of paper into long strips and stick them together to create one long strip. Thread the paper through the two slits in your box, making sure your pen is resting on the paper. Slowly pull the strip of paper past the pen at the same time as shaking the box forward and back. You'll notice the pen starts to jump around and draw a wave pattern on the paper!

When the box is stationary the line of pen will stay flat. As soon as the box starts to shake, the pen will swing back and forth and creates waves on your paper. If you shake the box more, the amplitude of the wave will increase.



? How can we use a seismometer to detect seismic waves? What would you observe in an earthquake?

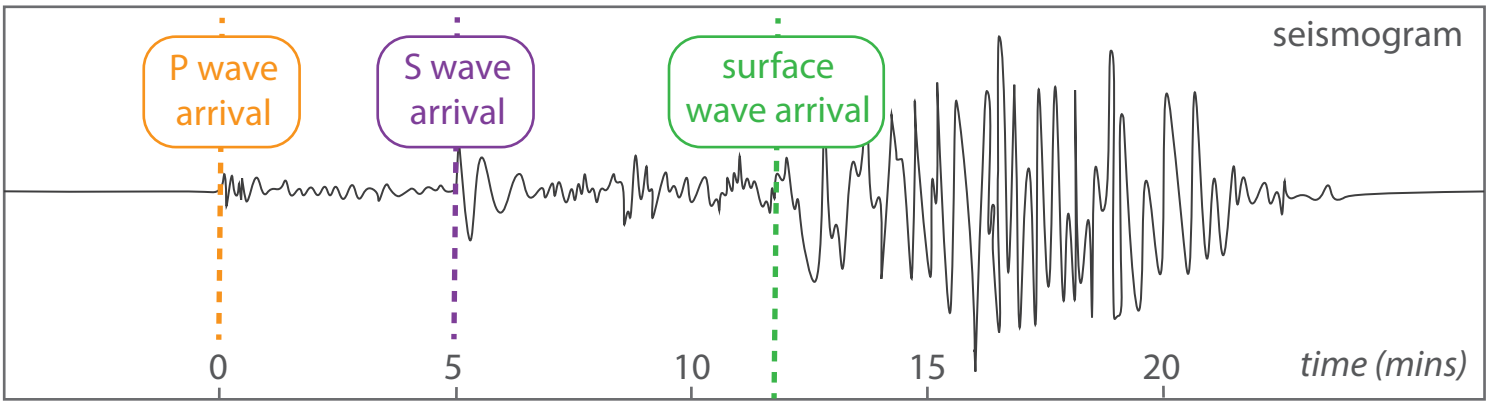
This activity is based on a video by Science Buddies!
https://youtu.be/41RzGwZINOk

What does a seismic wave look like?

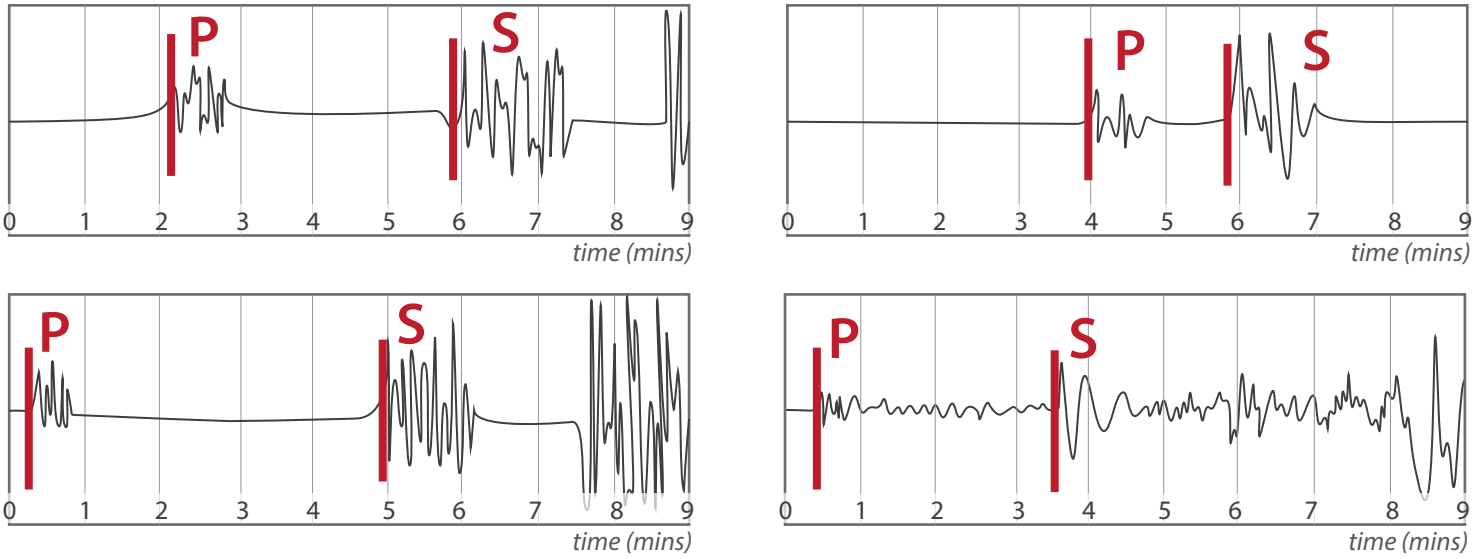
Seismograms can not only be used to detect if an earthquake is happening, but can also be used to locate the epicentre of an earthquake. Different seismic waves arrive at different times. There are many types of seismic wave (not just P and S) such as surface waves.

Use the seismogram below to answer the following questions:

1. Which wave arrives first? P Wave
2. What is the time difference between the arrival of the P and S waves? 5 minutes
3. Which wave is fastest? P waves - as this one arrives first.



4. Identify the P and S wave arrival times on the seismograms below.



5. Summarise everything you've learnt so far by filling in the gaps in the paragraph below.

The shaking experienced during an earthquake is caused by seismic waves. Seismic waves travel outwards from the epicentre through the Earth in all directions. The first wave to arrive is a **P** wave (primary wave). Primary waves are **longitudinal** . The second wave to arrive is a transverse wave called **S** or secondary waves.

? Why might P waves travel faster through the Earth than S waves?
Could this be due to differences in transverse and longitudinal waves?