

EARTHQUAKE CLASSROOM ACTIVITIES

How do seismologists locate an earthquake?

Seismologists compare seismograms from several recording stations and use the difference in arrival times to work out the different distances the seismic wave must have travelled to each of the stations.

This activity uses two microphones to represent two monitoring stations.

Teachers' notes

Students investigate the effect of different 'earthquake' positions on the signals received by two 'seismic stations', using two microphones connected to a PC with sound-editing software.

Resources needed

Each group will need:

- 2 microphones, adaptor and extension lead
- computer with suitable sound-editing software installed

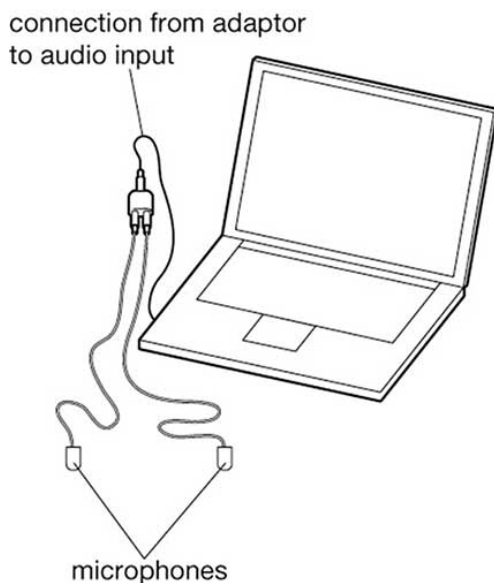


Figure 1 You will need two microphones, stereo adaptor and extension lead, connected to a computer with suitable sound-editing software installed.
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Learning objectives

Students will:

- compare the sound signal traces on the computer screen to a seismogram created by an earthquake
- investigate the effect of source distance from the microphones on signal strength
- investigate the effect of source position on the arrival time of the signal at each microphone

Notes

This is intended to be a relatively short activity to model how the size and arrival times of seismic waves vary with distance from the source. The comparison of traces is meant to be one of overall appearance, and does not need detailed knowledge of what a seismogram shows. There are two aspects to look at: amplitude and arrival time.

- the difference in amplitude should be evident on the default images;
- to look at the difference in arrival time, you need to zoom in on the traces.

Additionally, students might examine the time difference between the two signal peaks and relate this to the different distances travelled (using $\text{distance} = \text{speed} \times \text{time}$, and speed of sound in air is roughly 330 m/s).

The examples in **task 2** introduce a simplified model of how seismologists use the records from several stations to establish exactly where an earthquake occurred. This could be done as a demonstration or as a small-group activity.

It is important to check that the software is already installed on the computer(s) you plan to use and to confirm any further set-up details before you use this activity in class: in this case, you need to be able to see two channels of input on screen (i.e. stereo input). You can find details of how to download and use Audacity (free, open source software) at Mindsets: [Downloading and using the Audacity software](#).

It is important to make sure that the sound is travelling through the air - not through a table - to both microphones, so clapping is preferable to tapping the bench.

Task 1: Exploring the kit

- 1 Connect the two microphones to the adaptor on the extension lead, and plug the lead from the adaptor into your computer's microphone socket.
- 2 Open the sound-editing software: when you are ready to start, you should be able to see two input channels on the screen.
- 3 Get someone to clap once: what do you notice about the trace for each microphone? How is the response to a clap similar to a seismogram? Make sure you know which trace on your screen matches each microphone.
- 4 Now move the microphones so that they are as far apart as they can be without pulling the leads tight.
- 5 Get someone to clap just once again, standing the same distance away from each of the microphones.
- 6 What do you notice about the signal you get from each microphone?
- 7 What happens to the patterns you see on screen if the person who claps is standing much closer to one speaker than another?

Task 2: Interpreting signals

The two diagrams each show simplified images of the two sound traces from microphones X and Y, produced when a student clapped at an unknown position (A, B or C) in the laboratory. Use the sound traces to decide which location of A, B or C is the most likely for the source of the sound. How did you decide this? Why can't you identify with certainty which position the source was at?

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If you could also see the input from a third microphone at position Z, would you have been able to tell where the source was?

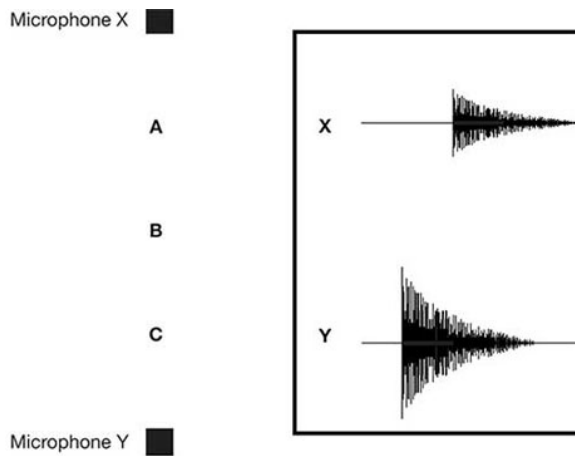


Figure 2 Was the sound source at A, B, or C? BGS ©UKRI

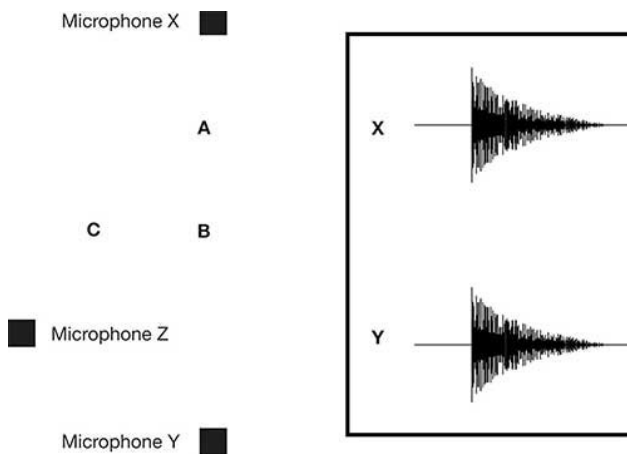


Figure 3 Was the sound source at A, B, or C? BGS ©UKRI

Task 3: Calculating distances

You could work out the difference in distance the sound travelled if you know the time scale on your screen and the speed of sound: suppose the separation of the two sharp peaks is equivalent to 0.005 seconds, and the speed of sound is 330 m/s, what is the difference in distance?