

GCSE Physics

P and S waves

Instructions and answers for teachers

These instructions should accompany the OCR resource 'P and S waves' activity which supports OCR GCSE Physics.

OCR
Oxford Cambridge and RSA

GCSE Physics
Lesson Element

GCSE Physics
P and S waves

Task 1 – Earthquake detectors

Around the world, there are millions of earthquakes each year. Many of these are small, or happen in a remote place, so you don't always hear about them. At least once a year, however, there is a great earthquake (measuring 8 or 9 on the Richter scale). This can be disastrous if it happens near a place where people live.



This photo shows the damage caused by a powerful earthquake.

1. What instrument is used to measure the size of earthquakes?

The Activity:

Learning Outcomes:

- To be able to recall what P and S waves are able to travel through
- To be able to describe how seismic waves move and locate the epicentre
- To research and evaluate the social and economic impact of earthquakes



This activity offers an opportunity for English skills development.

Associated materials:

'P and S waves' learner activity sheet.

Introduction

These activities are designed to be used after the content relating to P and S waves has been taught. You could split up the tasks and use each one after each section has been taught, or use them as a consolidation exercise at the end of the taught segment. Learners are expected to have prior knowledge of structure of the earth, waves, and how waves travel.

Common misconceptions held by learners are that earthquakes are rare events and that all earthquakes happen at the Earth's surface and not beneath it. This is probably due to limited media coverage. There is often confusion between the two types of waves. Learners also do not always realise that the energy of the waves pulls and pushes the rock particles and that seismic waves involve the long distance net motion of these particles.

Notes for teachers

Tasks 1 and 2 are short consolidation activities about the properties of P and S waves and locating epicentres. Task 3 is an investigative task that allows learners to find out about the real world implications of earthquakes and tsunamis. It encourages them to identify the effects that these have had on millions of people around the world. This has links to how science works.

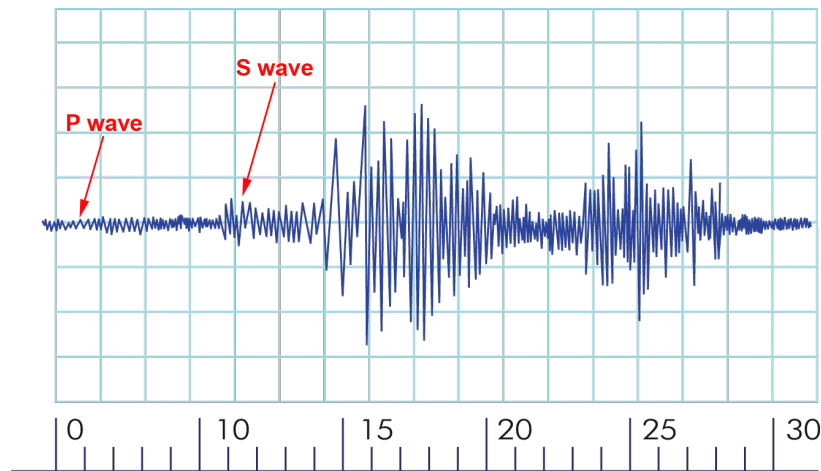
Task 1 – Earthquake detectors

This task requires learners to remember the basic facts about P and S waves, and to compare their properties. It is a task sheet that requires learners to research and answer questions. You may need learners to have access to books or the internet if they have not covered this before.

1. What instrument is used to measure the size of earthquakes?

Seismometer

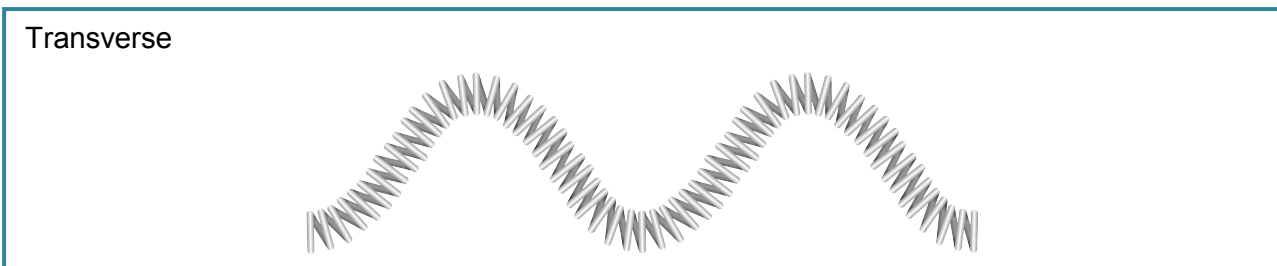
2. This seismograph shows the pattern of waves detected by the instrument.



(a) What type of wave are P waves? Draw a diagram to show what this kind of wave looks like.



(b) What type of wave are S waves? Draw a diagram to show what this kind of wave looks like.



3. Complete the table comparing P and S waves.

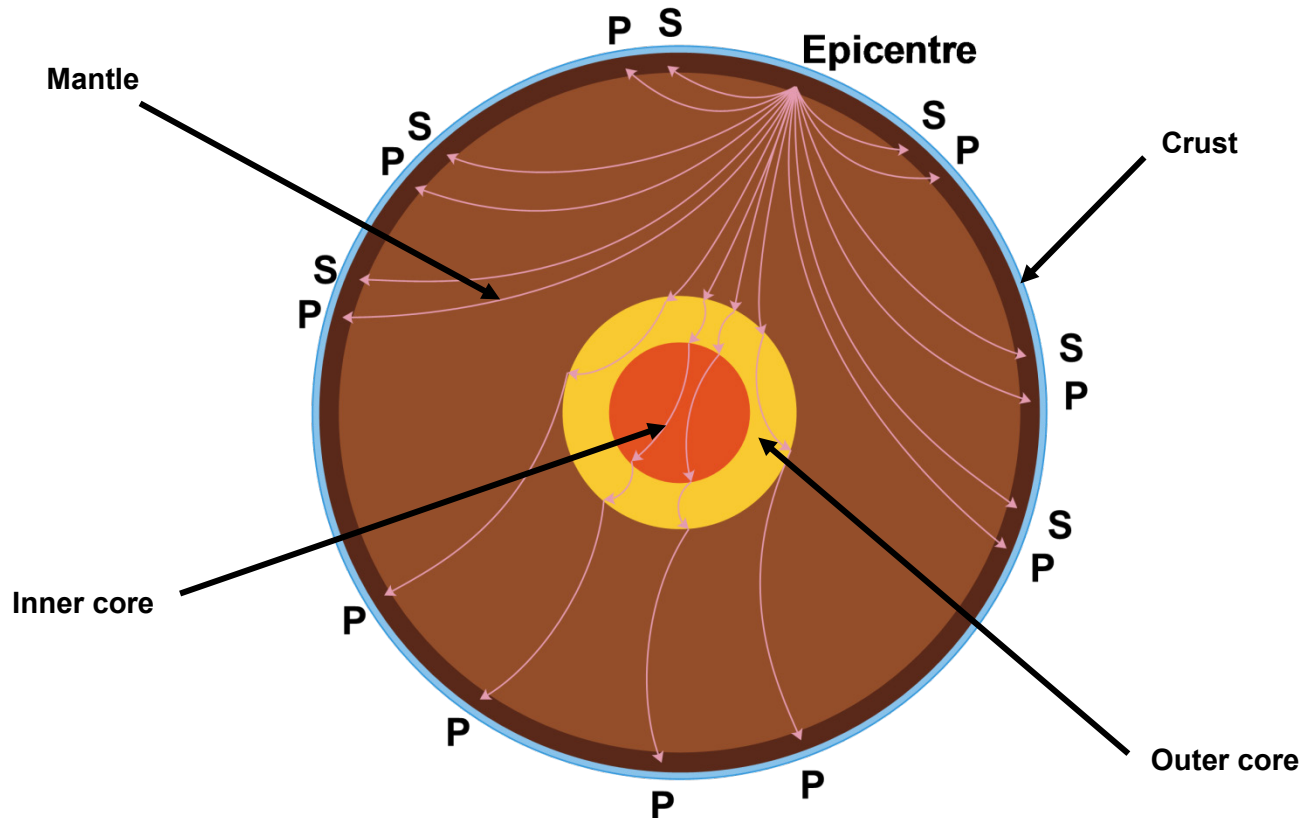
	P wave	S wave
Pressure wave (Y/N)	Yes	No
Material wave travels through	Solid and liquid	Solid only
Relative speed	Faster	Slower

Task 2 – Earthquake detectives

Learners should recap the layers of the Earth before starting this activity. This task can be done independently, but might work better if learners are working in pairs to encourage discussion. You may wish to give learners a mini whiteboard and pen so that they can work out the shapes of the lines before committing them to paper. The lines should be curved as shown in the suggested answer below. Learners may need access to textbooks or the internet as this may be challenging.

Extension ideas:

Learners could investigate how scientists use the properties of P and S waves to find out about the layers of the earth, or find the location of oil beneath the rocks.



The layers are (from outermost first): crust, mantle, outer core, and inner core.

Key points to make learners aware of:

- The lines of the P waves and the S waves are not straight because they are reflected and refracted as they pass into different rocks.
- This causes the line to curve.

- This effect is more pronounced at the boundaries between layers, for example, as the wave goes from the mantle to the outer core.
- P waves can pass through solids and liquids, so they are present on the other side of the Earth's liquid core.
- S waves can only pass through solids, so they cannot pass through the core. This is why they are not present on the opposite side of the Earth to the earthquake.

Task 3 – Investigating earthquakes

This final activity involves learners writing a report on earthquakes and their effects. Learners will need access to books or use of the internet. Learners may wish to work independently, or in small groups. There are different suggestions for the way learners may like to present their information. This may need to be amended based on equipment you have in your centre. You could, if you wish, get the learners to present their findings to the rest of the class and it could be peer assessed.

You may want to ensure that learners have considered the following:

- What is an earthquake?
- What causes earthquakes?
- How earthquakes are measured?
- The physical effects of an earthquake on the land and people living there?
- The economic, environmental and social effects of an earthquake.
- The effect of tsunamis on the people and the land?

Extension ideas:

This work links well into discussing social, moral and ethical subject matter. You could get learners to research what happened at the Fukushima nuclear plant after the tsunami that hit Japan in 2011.

Learners could discuss the social implications for the people who had to leave their homes because of the high levels of radioactivity. They could also discuss the ethical implications of building nuclear power plants in an earthquake zone and potentially endangering lives.

Supporting information

A good rule to help to remember how the waves move are that **S** waves only move through **S**olids, while **P** waves move through **P**retty much anything! Know that P waves are longitudinal waves that move particles from side to side. S waves are transverse waves and move particles up and down.

Finally ensure learners know that seismic waves go from crust to core, but not core to crust and that S waves do not reach other side of Earth from where earthquake originated because they cannot pass through the sea. This will be important information to complete Tasks 1 and 2.

Some of this subject matter should be handled delicately. Some learners may become upset at discussing natural disasters, especially if they or their family have been directly involved in one. Other learners will find the subject matter quite exciting and think it is like a Hollywood blockbuster and you will have to correct their misconceptions about what exactly happens during an earthquake.

There are many excellent websites on the Internet that will give good factual information about P and S waves. Here are some good places to start:

http://www.bbc.co.uk/schools/gcsebitesize/science/21c/earth_universe/seismic_wavesrev1.shtml

<http://www.geo.mtu.edu/UPSeis/waves.html>

There are also some good animations of P and S waves and how they travel through the earth, for example:

https://www.classzone.com/books/earth_science/terc/content/visualizations/es1002/es1002page01.cfm?chapter_no=visualization

There are also many good websites giving information about earthquakes and tsunamis:

http://www.bbc.co.uk/schools/gcsebitesize/geography/natural_hazards/earthquakes_rev1.shtml

<http://www.bgs.ac.uk/discoveringGeology/hazards/earthquakes/home.html>

If learners want to watch video, guide them towards new sites such as the BBC, which will be factual rather than sensational. If you wish to show video these might be some good ones to start with:

<http://www.youtube.com/watch?v=xyKqamiegtQ>

<https://www.youtube.com/watch?v=BC0njxu-FM0#t=21>

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