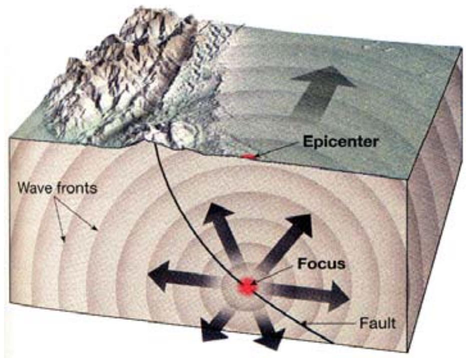
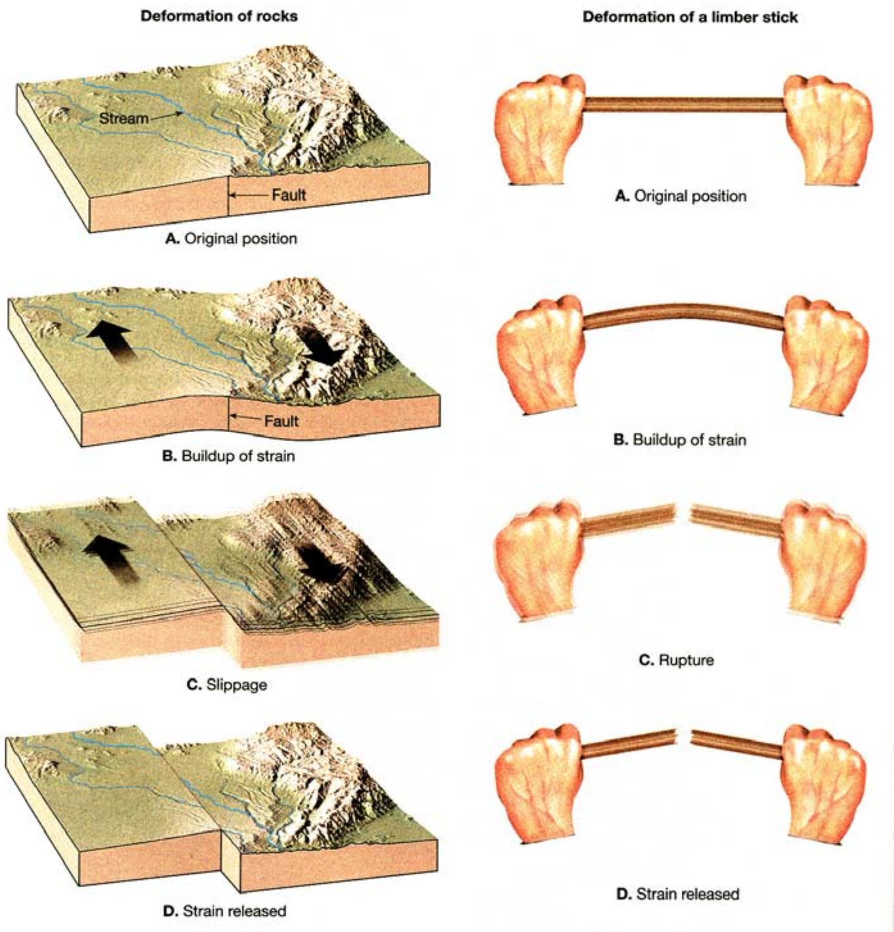
A—What is an earthquake?

An earthquake is the **vibration** of the earth produced by the quick release of energy. Most often, earthquakes are caused by **movement** along large fractures in the earth's crust. Such fractures are called **faults**. The energy that is released radiates in all directions from its origin in the form of waves. These waves are similar to the waves that occur when you drop a stone into water. Just as the stone sets the water in motion, the energy released in an earthquake produces **seismic waves** that move through the earth.

What is the mechanism that produces earthquakes? Earth is not a static planet: in the earth's crust, tectonic forces are constantly at work pushing rocks on both sides of a fault in different directions. In this process, the material is deformed. As rocks don't slide past each other very easily, strain is built up, just as if you bend a stick. At a certain level, the rocks can no longer resist the strain and slip past each other into their original shape. This "springing back" of the rock is called **elastic rebound**. It is this quick movement that we feel as an earthquake. The elastic rebound usually happens a few kilometres deep in the crust. This location is called the **focus** of the earthquake. The place on the surface directly over the focus is called the **epicentre**.





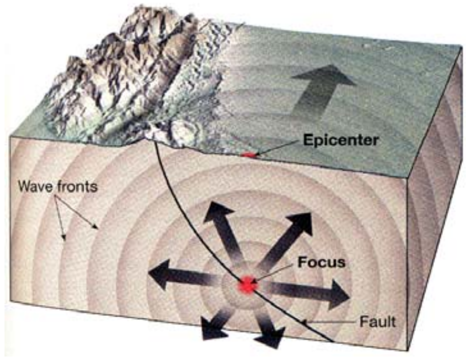
Tasks

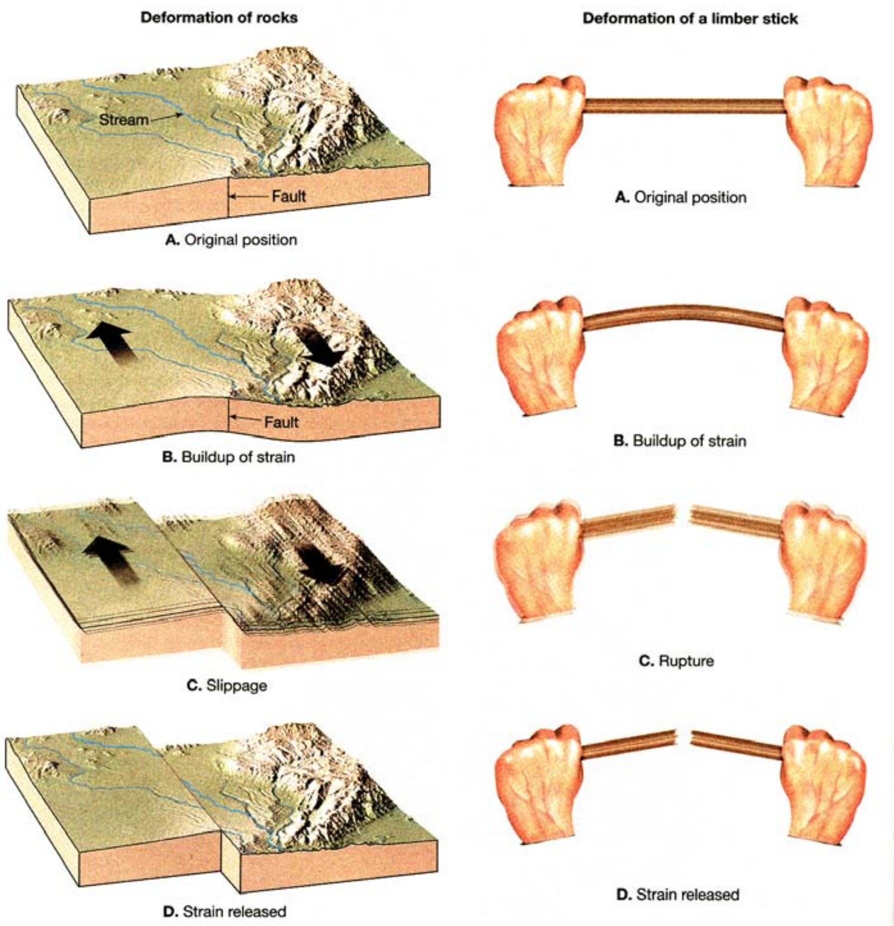
1. Read the text and highlight the most important points.
2. Explain to your partner the principle mechanism of earthquakes.
3. Listen to your partner's explanation and take notes of it on worksheet 2.

Source: Tarbuck, E. & Lutgens, F.: *Earth Science*, pp.154ff

A—What is an earthquake?

Listen to your partner's explanation and take notes about it. The illustration can help you understand the explanation better.





Source: Tarbuck, E. & Lutgens, F.: *Earth Science*, pp.154ff

B—How can the energy of an earthquake be felt?

The energy that is released in an earthquake travels in **waves** through the materials of the earth. **Two types** of waves can be distinguished.

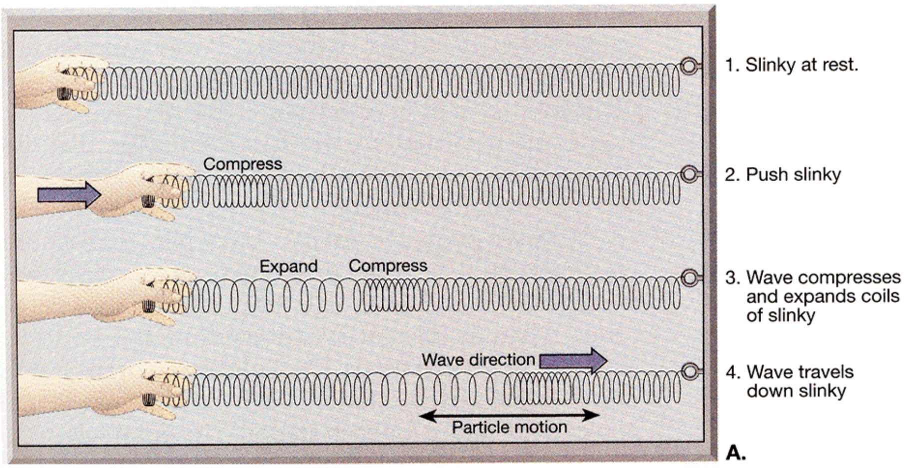
1. Some travel along the earth's outer layer and are called **surface waves**.
2. Others travel through the earth's interior and are called **body waves**.

- **surface waves**
- **body waves**
  - P waves
  - S waves

Body waves are further divided into **primary waves** (**P waves**) and **secondary waves** (**S waves**). We're going to look more closely at these two types of body waves.

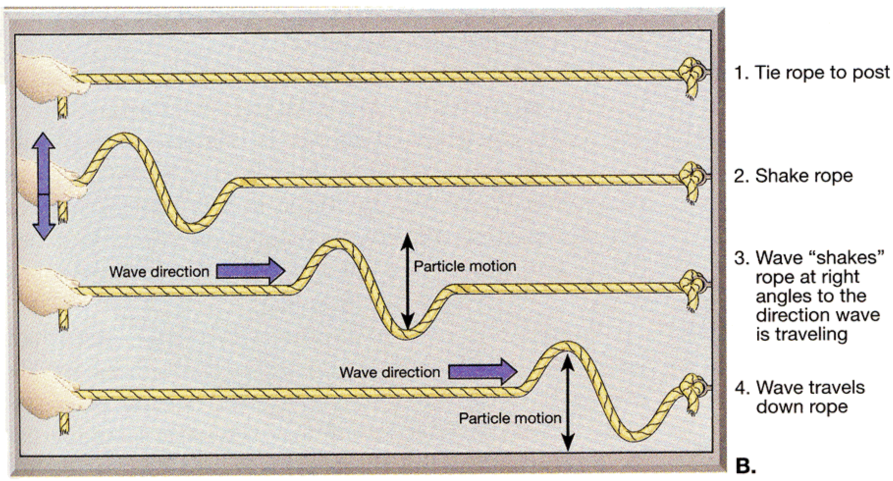
P waves (primary waves)

P waves are "push-pull" waves—they push (compress) and pull (expand) rocks in the direction the wave is travelling. Imagine holding someone by their shoulders and shaking them. This push-pull movement is how P waves move through the earth. **Solids, liquids and gases** resist a change in volume when compressed and will elastically spring back once the force is removed. Therefore, **P waves can travel through all these materials**.



S waves (secondary waves)

S waves, on the other hand, "shake" the particles at right angles to their direction of travel. This can be illustrated by holding one end of a rope steady and shaking the other end (see illustration below). In contrast to P waves, which for a moment change the *volume* of the material, S waves change the *shape* of the material they travel through. Because **liquids** and **gases** do not respond elastically to changes in shape, they will **not transmit S waves**.



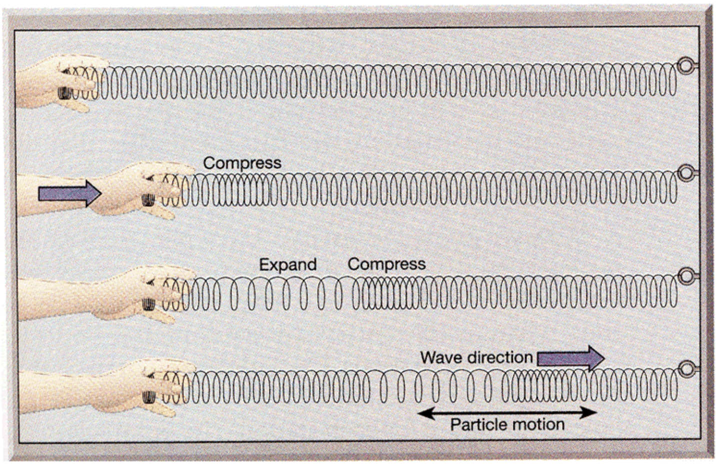
Tasks

1. Read the text and highlight the most important points.
2. Explain to your partner the principles of earthquake waves.
3. Listen to your partner's explanation and take notes of it on worksheet 2.

Source: Tarbuck, E. & Lutgens, F.: *Earth Science*, pp.154ff

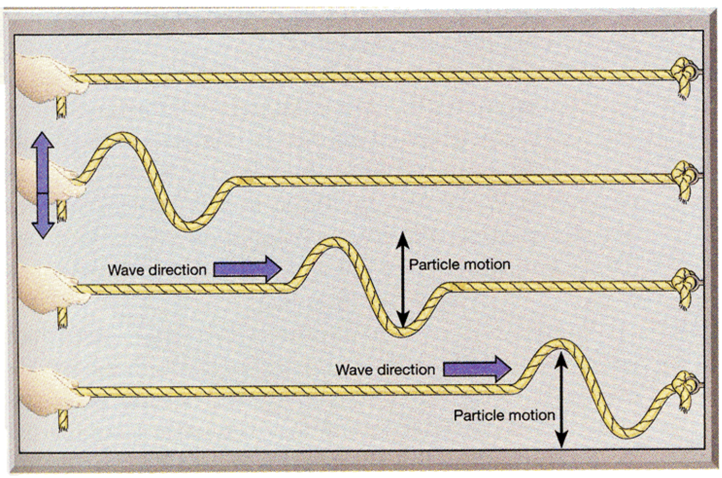
B—How can the energy of an earthquake be felt?

Listen to your partner's explanation and take notes about it. The illustrations can help you understand the explanation better.



1. Slinky at rest.
2. Push slinky
3. Wave compresses and expands coils of slinky
4. Wave travels down slinky

A. ....



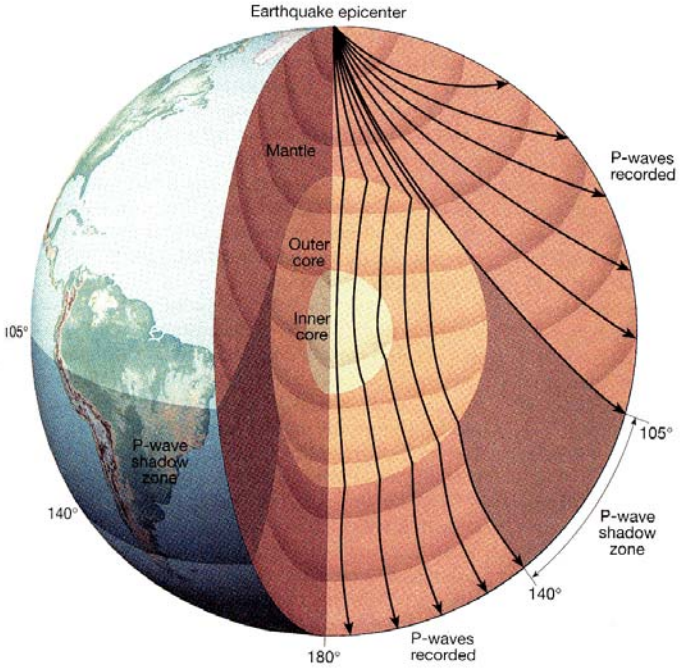
1. Tie rope to post
2. Shake rope
3. Wave "shakes" rope at right angles to the direction wave is traveling
4. Wave travels down rope

B. ....

Source: Tarbuck, E. & Lutgens, F.: *Earth Science*, pp.154ff

What can earthquakes tell us about the earth's inner structure?

As the waves of earthquakes travel through the earth's material, scientists can <u>measure</u> them even if the earthquake occurred far away. In the early 20th century, it was discovered that the two types of body waves (……………………. and …………………….) from distant earthquakes **did not always move straight** through the earth but that they sometimes **moved in unexpected ways**.



For example, ……… waves from earthquakes often "<u>disappeared</u>" completely on their way through the earth. As they cannot travel through liquids, it became clear that the part of the core had to be liquid.

Also, there was always a sector of the globe where ……… **waves** could not be measured. This sector was called the ………**-wave shadow zone** (see illustration). The best explanation was that the these waves were <u>deflected</u> on the <u>boundary</u> between two layers. So there had to be two main layers inside the earth—core and mantle.

In this way, earthquakes made it possible to understand the earth's inner structure by studying in detail how the waves they produce travel through the earth's interior.

▶ **Task:** Fill in the blanks with the help of what you learned today and the illustration above.

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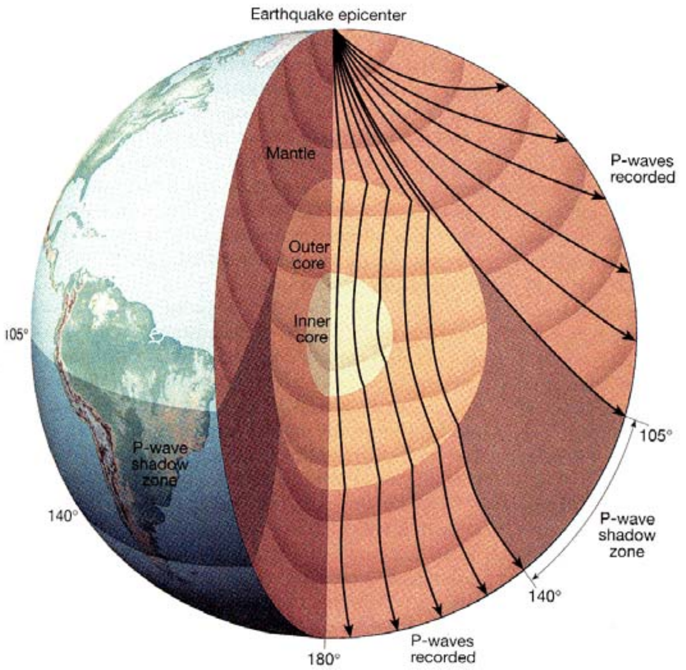

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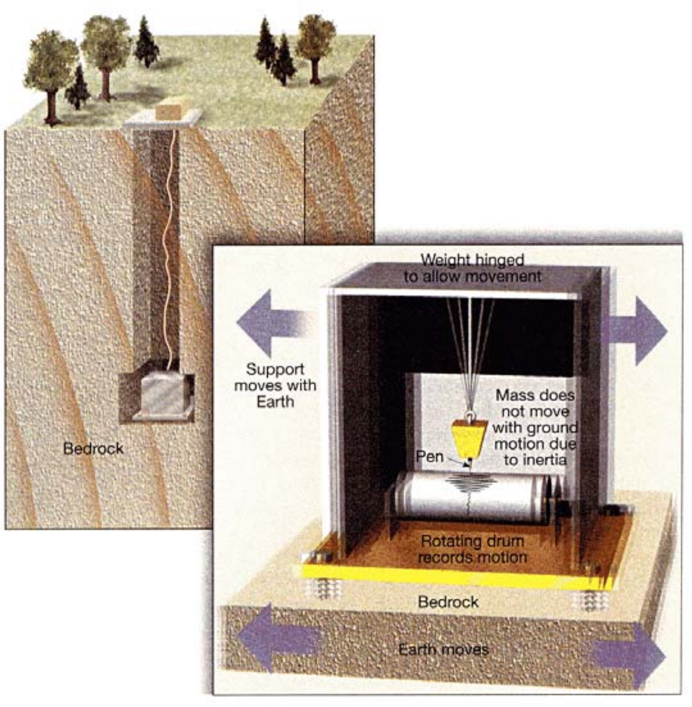
Source: Tarbuck, E. & Lutgens, F.: *Earth Science*, pp.154ff

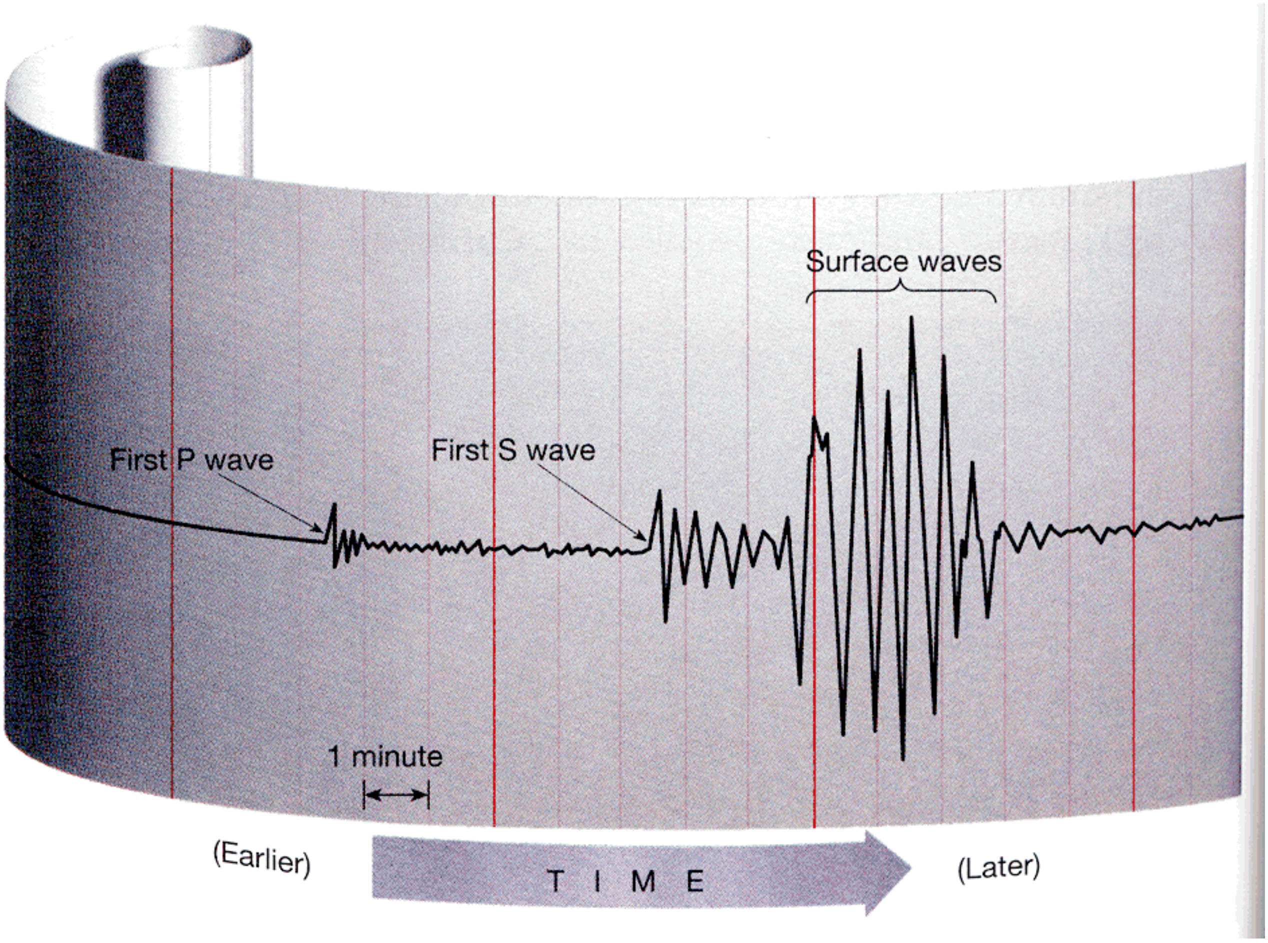
What is a seismograph and how does it work?

A **seismograph** is an instrument that records earthquake waves (also called *seismic waves*). The principle is simple: A weight is freely suspended from a support that is attached to bedrock. When **waves** from an earthquake reach the instrument, the inertia of the weight keeps it stationary, while the earth and the support vibrate. The movement of the earth in relation to the stationary weight is recorded on a rotating drum. (*Inertia* is the tendency of a stationary object to hold still, or a moving object to stay in motion). What is recorded on the rotating drum is called a **seismogram**.



Seismograms show that there are two types of seismic waves generated by the movement of a mass of rock. Some travel along the earth's outer layer and are called **surface waves**. Others travel through the earth's interior and are called **body waves**. Body waves are further divided into primary waves (**P waves**) and secondary waves (**S waves**).

Seismogram



Source: Tarbuck, E. & Lutgens, F.: *Earth Science*, pp.154ff