The internal structure of the earth

Earth structure analogies ***D or TE***

To show the crust, mantle and core cut a hard boiled egg in half. Alternatively ask students to discuss which of the following is the best analogy for the structure (not composition or size) of the earth: apple, peach, avocado, orange, egg with solid white but liquid yolk.

Circles made from hardboard ***D***

If you do not have a board compass these are useful for drawing circles on the board. Cut a circle 60cm in diameter from a sheet of hard board. Stick rubber patches (e.g. cycle repair) to stop it slipping, on the side that goes on the board and a handle on the other side. Mark a point for the focus and points at 103° and 143° from it. Then make another circle 30cm in diameter for the core. Alternatively a dustbin lid will do.

The relative thickness of the crust ***D***

Show students a football with a postage stamp stuck on it. The thickness of the stamp represents the relative thickness of the crust.

Apples and the relative thickness of the crust ***A I 1 min***

Give students an apple each and tell them to take a bite. The thickness of the skin of the apple relative to the whole apple is similar to that of the crust to the whole earth.

Cause of shadow zone ***D***

Draw 25cm diameter circle on an A3 piece of paper and place a 1 litre clear beaker full of water in the centre of the paper. Place a bulb holder with a 100W (or 18W energy efficient) bulb on the edge of the circle. This will produce a shadow zone.

3D Shadow zone ***D***

Place a translucent light shade in the shape of a gold fish bowl on a coffee jar lid. Cut a piece of hardboard to allow a round bottomed flask full of water to hang inside it. If you have a 100W light on one side you will get a circular shadow zone on the other.

Drawing a segment of the earth ***I 15 min***

Students take a plain sheet of A4 paper and draw a segment using a scale of 1mm = 30 km so that the radius should be 21cm. the crust is then

about 1mm thick. Students are given the depths to the Moho, 35km; top of the LVZ, 100km; bottom of LVZ 270km; top of outer core, 2900km; top of inner core 5150km; centre 6371km and must plot these on their segment.

Walking from the centre of the earth G 20 min
Walk in a straight line for 64m or 640m and put in a marker at the start (centre of the earth) and then at each significant boundary, see above. Talk about each section and each boundary of the earth at the appropriate position along your traverse..

Position of shadow zone on earth D
A paper mâché ring is made to fit on a globe. This can be moved around the globe to show the position of the shadow zone for earthquakes in different places.

Shadow Zone E P F 30min
This experiment is to determine how the size of the core and its refractive index control the start and end of the shadow zone. A bulb is placed on the edge of a disc which represents the earth. Beakers of various sizes are placed in the centre of the disc and the positions of the shadow zone recorded. The effect of changing the refractive index is shown by using one beaker partially filled with resin.

Refraction *D*

Show students a pencil in a jar of water and ask why it appears bent. Alternatively show students a shallow bowl with a coin in the bottom. Place it so that students can not quite see the coin. Fill the bowl with water and now they can see it.

Ray paths using a laser pointer *D*

To show how the ray path is refracted place a 1 litre beaker of water in the centre of a large plastic cake container (35cm diameter) with a 1cm hole cut in one side. Point a laser pointer through the hole to show the effect of the ray meeting the water. The position of the dot of laser light suddenly jumps as the laser beam is refracted.

Inside the earth *A P 15 min*

This activity is to help generate discussion on how we can discover what is inside the earth. You will need 7 tennis balls filled as follows:
1 air (normal ball) 2 coffee beans, 3 sand, 4 water, 5 cement, 6 steel ball,
7 ball cast from lead. The numbers are marked on the outside of each ball.
Students are given a list of the contents and are asked to work out which is which and why. It would work with fewer balls.

Tapping the barrel *D*

Show the students two identical tins one of which is full of water and the other empty. Students can tell which is the full one by tapping them. Likewise we can find out about the inside of the earth from seismic waves (sound waves are P waves).

The size of the core *Pa I 15 min*

Students try to work out the size of the core first graphically by drawing a straight line from the focus to 103° then mathematically knowing the radius of the earth and the epicentral angle of the start of the shadow zone. They should then try to explain why the actual radius is slightly different (ray path is curved due to changing speed deeper in the mantle).

Density and pressure ***TE***

Take a sponge ball about 6cm diameter. Ask students how the density changes when you squeeze it and make it into a smaller ball. Then relate it to what happens to rocks as they occur deep in the earth.

Density of the inside of the earth ***A P 30 min***

Students measure the density of a variety of rocks and work out an average for the crust. Students then must draw some conclusions about the density of the rocks forming the mantle and core knowing that the average density for the whole earth is 5.5.

Oranges and the density of the earth and of surface rocks D

Take an orange and place it in a transparent beaker of water. It will float.

Now peel the orange and place the flesh in water and it sinks. So like the earth the peel (crust) must be less dense than the flesh (mantle). Check you have the right type of orange, not all oranges work.

Idea from Abigail Brown

Rheid deformation of the mantle ***D***

Silly putty (bought in toy shops or in larger volumes over the internet) can be used to show how the mantle can deform. Show how it bounces like a solid but if left flows like a very stiff liquid. Ice is also a solid which flows under pressure as in glaciers.

Asthenosphere ***Pa I F 20 min***

Students plot the melting temperature for wet peridotite against pressure and the variation of temperature with depth in the earth on the same graph paper. This shows the zone in which the mantle will be slightly molten.

Moho ***Pa I F 20 min***

Students plot the time to a series of geophones of seismic waves through the crust and via the mantle. From the graph they can work out the thickness of the crust.