

## Earth Egg Model – Teacher Notes



Ancient Greeks tried to explain earthquakes and volcanic activity by saying that a massive bull lay underground and the land shook when it became angry.

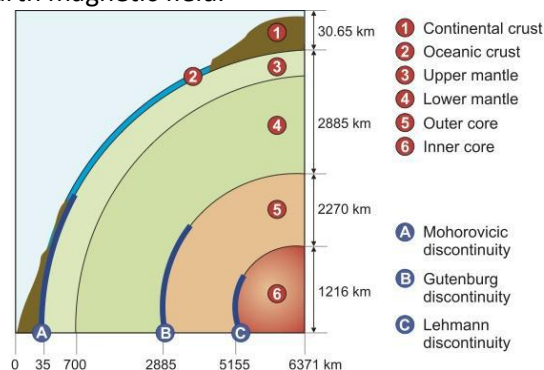
Modern theories rely on an understanding of what happens below the surface. Our Earth is a flattened sphere with an average radius of about 6370 km. The Super pit in Kalgoorlie only penetrates the top 600m of rock. The deepest mine at present is in South Africa and is only 5km deep (0.0007849 of Earth's radius). Movement generated from within our planet causes earthquakes and volcanic activity.

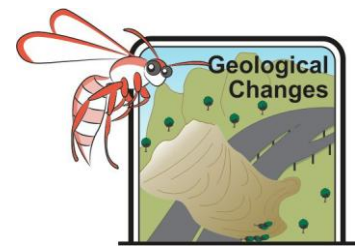
To infer what lies below we need to use information gained from:

- Examining earth processes that we can see happening at present
- Collecting and examining rocks brought to the surface during mountain building and volcanic activity.
- Interpreting geophysical data produced during gravity surveys, electromagnetic surveys, and seismic surveys.
- Interpreting information from seismic waves produced naturally through earthquakes or artificially during seismic surveys.

Collected and collated data infers that our planet is made of three major layers; the outermost crust, the mantle in the middle and the innermost core.

1. **The crust** is a very thin solid outer layer of the Earth. Continental crust lies above denser oceanic crust. Continental crust can be 25-90km thick and consists of silica and aluminium rich rocks such as granite and sediment. Underlying oceanic crust is darker and denser because it contains rocks richer in heavy iron and magnesium such as basalt. It can be 5-10km thick. This is the rock found below most oceans. The crust is broken into about 12 pieces (tectonic plates) that can be pushed together or move apart. Tectonics is the study of Earth movement. These plates move a few centimetres each year, at about the same rate as your fingernails grow. Sometimes they move together to form supercontinents and sometimes they break apart. Most of the world's volcanoes and earthquakes take place at the edge of these moving plates. When plates move together mountains are built and ocean basins form when they move apart.
2. **The mantle** is a 2,900 km thick, dense, mostly solid layer of iron and magnesium rich rock. A thin layer called the asthenosphere lies at the top and can be molten in parts. Movement originating from here causes volcanic eruptions, earthquakes, continental drift and mountain building. These geologically sudden movements can change the surface of the Earth.
3. **The core** consists of a liquid outer core and a solid inner core. It is mostly iron and nickel rich minerals and is very dense. Rare plumes of hot rock rise from here. Movement in the inner core creates Earth magnetic field.





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*There is a common student misconception that the core and mantle of our Earth are liquid and only the crust is solid. This might have been true at the very beginning of planetary formation about 4.54 billion years ago but not so now.*

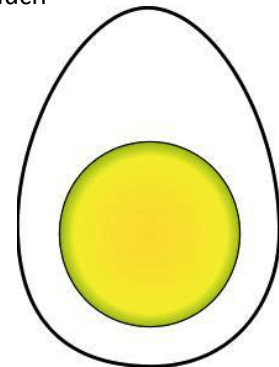
### Earth egg model

### Student activities

Half a boiled egg can be used to demonstrate the approximate proportions of the layers of our planet. The teacher demonstration of separation by gravity should have been performed earlier. (An apple can be cut in half also to represent the layers but the proportions are less accurate and tectonic plates cannot be modelled). Eggs should be prepared earlier and allowed to cool.

### Concepts covered

1. Crust – the eggshell. (Actually the Earth's crust is proportionally much thinner).
2. Mantle – the egg white represents the mostly solid mantle. The area between the crust and underlying mantle is partially melted in places. Movement here can result in volcanic activity, earthquakes and continental drift at the surface. (The bluish ring round the yolk is due to hydrogen sulphides produced by the breakdown of amino acids in the yolk).
3. Core – the egg yolk represents the inner solid core and outer liquid core.



### Part 1 - The Layers of the Earth

#### Materials

- One cold half hardboiled egg. (For easy to handle eggs, allow them to warm to room temperature before cooking. This minimises cracking and loss of albumen/egg white. Then place them in cold water, simmer for 8 minutes and allow them to cool).
- A sharp knife and cutting board (to cut eggs in half for students)
- If students are doing this activity it is a good idea to cover their desk with old newspaper to collect bits of egg and shell
- A ruler

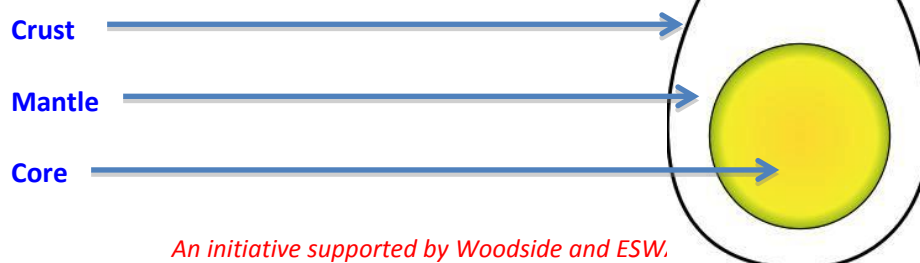
#### Method

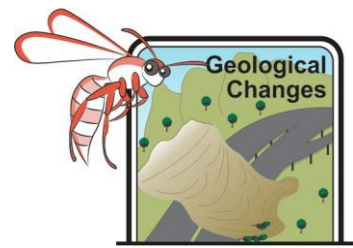
(Prepare the eggs and provides halves to students).

1. Draw your egg to scale in the space provided below.
2. Label the layers of the egg in your diagram. The outermost layer represents the crust of the Earth, the middle layer represents the mantle and the innermost layer represents the core.
3. Measure the thicknesses of the layers of the egg and enter this in the table provided.
4. Calculate the percentage of the whole for each layer and also enter this in the table provided

#### Observations

Diagram of the layers of the egg Earth (to scale 1:2)





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## Calculations

Earth			Egg		
	Thickness	Percentage		Thickness	Percentage
<b>Radius</b>	6370km	100%	Radius	Will vary	
<b>Crust</b>	25-90km	0.4 to 1.4%	Shell (crust)	Will vary	
<b>Mantle</b>	2,900km	45.53%	White (mantle)	Will vary	
<b>Core</b>	3,380km	53.07%	Yolk (core)	Will vary	

\*Don't forget the radius will be half the thickness of the Yolk (core)

Is the egg a reasonably good model for the layers of the Earth? Explain your answer. **YES**  
 The egg layers thickness proportions are roughly similar to those of the Earth.

In what way is the egg a poor model for the layers of the Earth? **The Earth's shape is a slightly flattened sphere whilst the egg is ovoid.**

## Part 2 - Tectonic Plates of the Crust

### Method

1. With your fingernails press the eggshell to break it into about four pieces. These represent the tectonic plates of the Earth's crust.
2. With your fingers gently push two plates together. Describe what happens.
3. With your fingers gently pull two plates apart. Describe what happens.
4. With your fingers gently try to slip one plate along the edge of another. Describe what happens.

### Observations

What happens when two eggshell plates are pushed together? **They buckle upwards or one slips under the other pushing it up.**

What do you think would happen if two hard crustal plates were pushed together? **The same thing would happen. This explains how some high mountains ranges such as the Himalayas or the mountains in Papua-New Guinea are formed. The Australian Plate is moving north pushing up the mountains of New Guinea. Similarly the Indian Plate is moving north pushing up the Himalayas ahead of it. This is called a zone of convergence.**

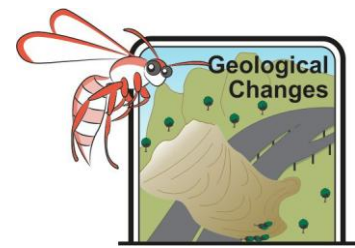
The Himalayan Mountain Range was pushed up when India pushed into Asia.

What do you think would happen if a plate were forced down into the Earth? **Heat and pressure would make it molten. It might rise and erupt from a volcano.**

The volcano Mt Fujiyama is created where the Pacific Plate is forced under the Eurasian Plate.

What happens when two tectonic plates are pulled apart? **A gap is created. When two tectonic plates move apart an ocean basin is created. Sometimes the crust thins and weakens and molten rock bubbles up to form a line of volcanoes along the centre of the ocean. This is called a zone of divergence. Undersea volcanos were found in the Indian Ocean during the search for the lost Malaysian Airways aeroplane MH370.**

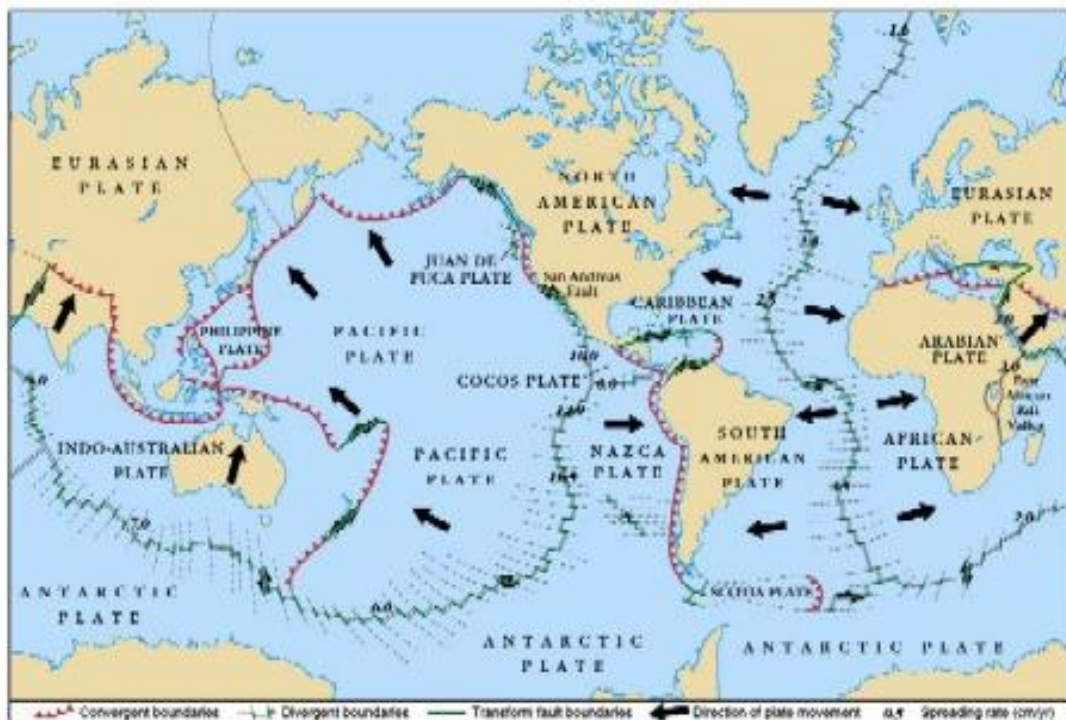
The Indian Ocean formed when the Australian plate pulled apart from the African plate.



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What happens when two plates are slipped past each other? They stick and get cracked before moving on. They do not move smoothly. This build up and release of stress creates earthquakes along fault lines which can be devastating such as at San Francisco (San Andreas Fault) and more recently, Christchurch (New Zealand). This is called a transform zone.

The Christchurch earthquakes were caused by stress when the Indo-Australian Plate grated alongside the Pacific Plate.



Look at the position of the Australia on the map above. How does its position explain why we do not have many earthquakes and recent active volcanic activity? **Australia lies in the middle of a large tectonic plate. Most tectonic action happens at the edges of plates. This explains why Australia does not have many earthquakes and volcanoes.**

### Topic - Sudden geologic events can shape the surface of the Earth

What have we learned today?

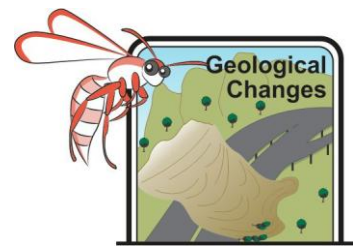
Name the layers of the Earth from outside to inside. **Crust, mantle and core.** (3 marks)

The crust is broken into? **Tectonic plates.** (1 mark)

What happens if two of these tectonic plates move towards each other? **Mountains and volcanoes are created. Earthquakes can also occur.** (3 marks)

What happens if two of these tectonic plates are moved apart? **Basins/oceans and volcanoes are formed.** (2 marks)

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What happens if one plate grates alongside of another? [Earthquakes!](#)

(1 mark)

Score \_\_\_\_\_/10

**Vocabulary** Core, crust, earthquakes, mantle, tectonic plates and volcanoes