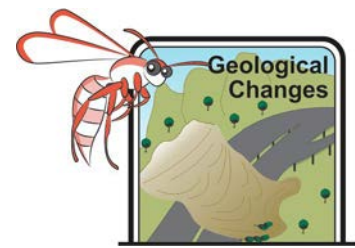


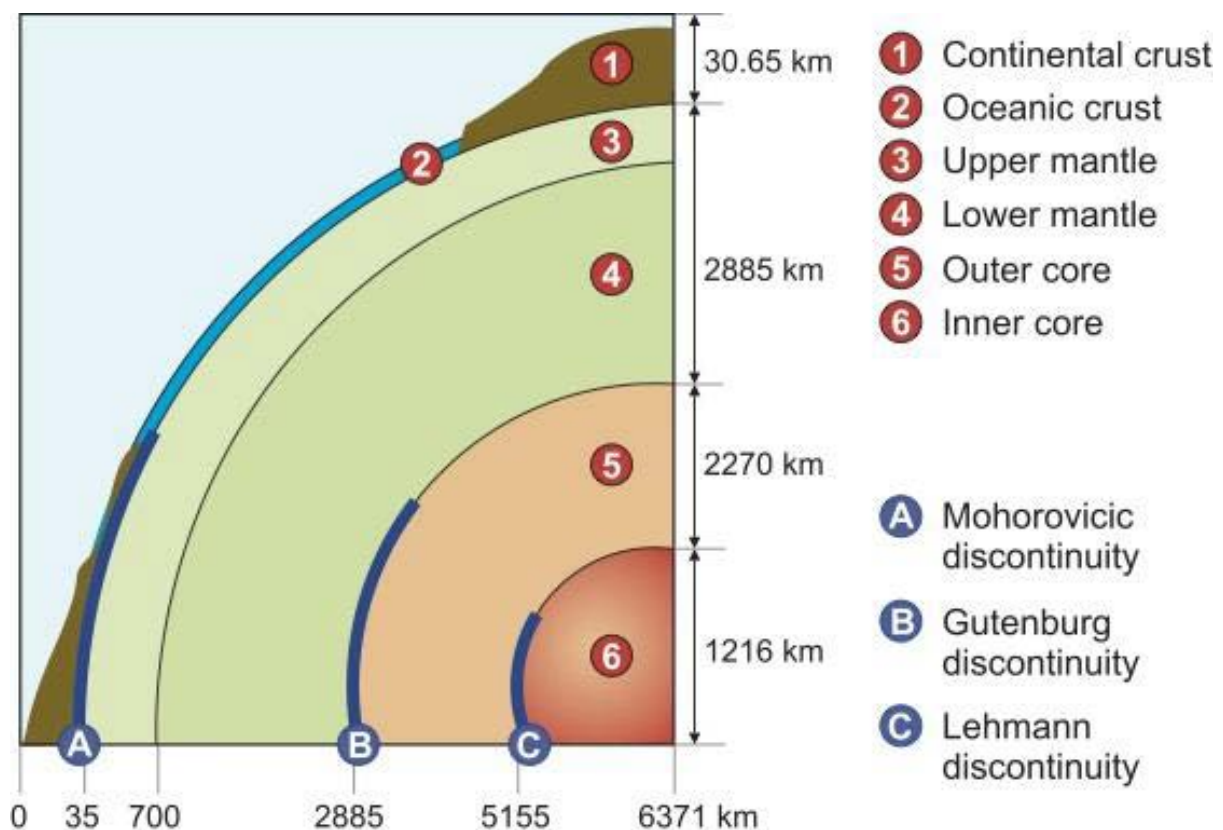
Geological Changes - Teacher Background

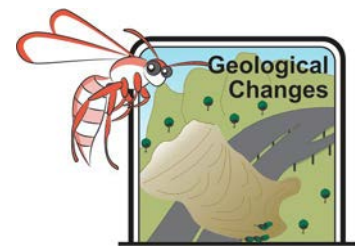


Although the Science understandings for Year 6 Earth Science activities relate to changes **at the surface** of our planet, a general understanding of what happens within the planet and its structure will help explain the forces at work. Teachers wishing more information may wish to view The Year 9 Plate Tectonics package on the WASP website www.wasp.edu.au

Planetary differentiation.

When our planet first coalesced from a cloud of cosmic dust about 4.5 billion years ago, it was very much hotter inside than it is today. It still had heat from all the little pieces of exploded super nova in the planetary disc smashing together under the force of gravity as well as heat from the natural radioactive decay of its minerals. The minerals forming rocks could melt and flow, albeit slowly, within the body of our planet. Heat driven convection currents moved materials in the same way they move the vegetables in vegetable soup when you heat it. The process that resulted in different rocks settling out to create different layers was density separation. The heaviest (or more correctly densest) minerals, those with lots of iron and nickel sank down towards the centre of the Earth to form a core of iron and nickel rich rocks. The lighter silica rich (quartz rich) ones moved slowly upwards to form the rocks of the outer crust. The very light materials rose to form our hydrosphere (rivers, lakes, water table and oceans) and our atmosphere.





Geological Changes - Teacher Background

Although most of the original heat from formation has since been radiated out into space radioactive decay still provides enough heat to warm the rocks of our planet from within. In some places, such as the asthenosphere, a band of sticky melted rock which lies between the crust and mantle, hot molten magma still rises to flow out onto the surface whilst in other places cold surface materials are drawn back down towards the mantle to be recycled within it. Movement within the Earth is powered by heat causing molten rock to rise and gravity, which causes it to drop.

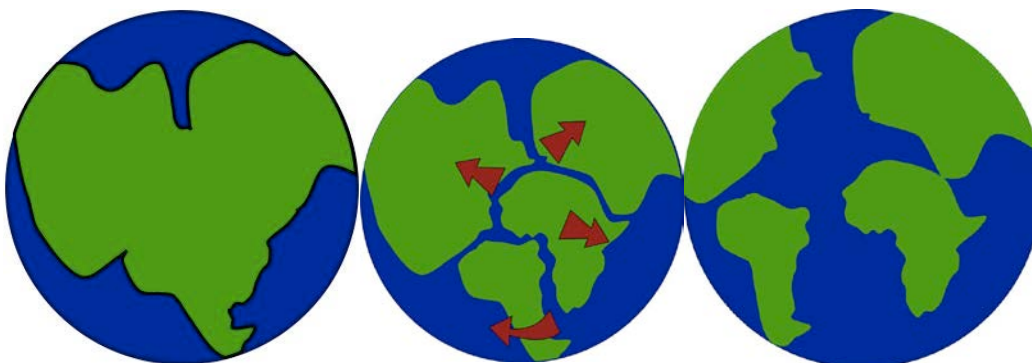
Our knowledge of the underlying layers of the Earth can only rarely depend on direct scientific observation and measurement as rocks from the mantle or below do not usually appear at the surface. What happens beneath must be inferred by other means. Early scientists such as Newton realised that the Earth did not have uniform density, as its planetary gravitational “pull” was too great for the observable size of the planet and the density of those rocks at the surface. Some of the ancient rocks in the Yilgarn and Pilbara are from the time when the Earth was more fluid and their mineralogy can give us indications of temperature, pressure and source at depth. The nickel bearing rocks of Kambalda and Kalgoorlie are from a time when nickel from the core flowed like lava onto the surface of the planet. More recent volcanoes bring up specimens from the melted crust.

For students at this stage, the Earth can be roughly classified into four layers:

1. **The crust** a thin, less dense, layer of solid silica rich material.
2. **The mantle** a denser sticky, slow moving layer of silica rich stony material.
3. **The outer core** mostly molten iron and nickel and is very dense.
4. **The inner core** mostly solid iron and nickel.

The diagram on the previous page provides more detail for more advanced students.

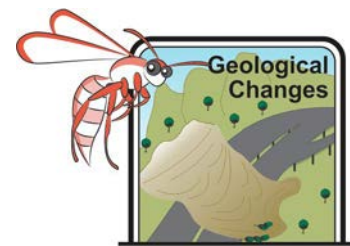
The crust is very thin and broken into tectonic plates or slabs that “float” above denser material below in the mantle. Plates can include both present continents (dry land) and sea floor. These plates have moved together to create supercontinents and pulled apart over millions of years of Earth’s history. Less dense continental crust overlies denser oceanic crust.



Supercontinent Pangaea

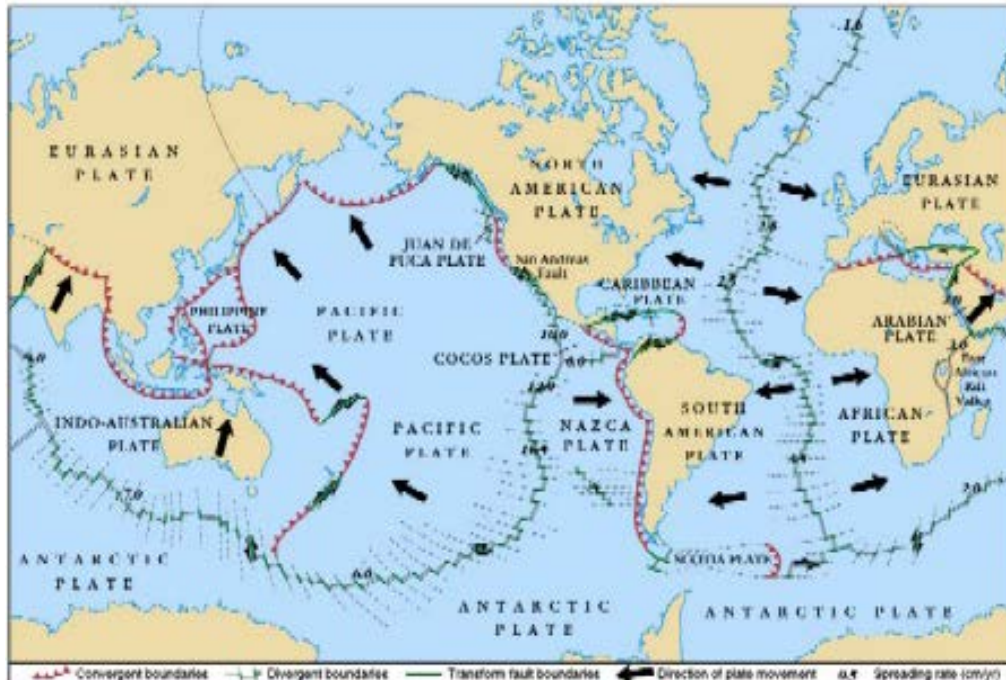
Modern continents

The movement of these tectonic plates is the source of earthquake and volcanic activity and creates mountain ranges and ocean deeps. The word “tectonic” comes from the Latin



Geological Changes - Teacher Background

meaning building. They are the moving plates that build mountain ranges and create ocean basins.

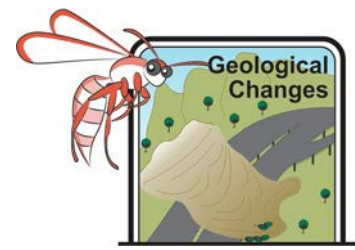


Tectonic Plates pulling apart

When molten magma rises towards the surface it pushes tectonic plates apart. The crust thins and sags creating basins and oceans. Since magma is sourced from the crust/mantle interface it is dense, dark and flows freely. Basalts are good examples of such free flowing lava. The Atlantic Ocean began to form when the Americas pulled apart from Europe and Africa. Basalts flowed out from volcanoes on the ocean bottom and still do. The band of volcanic islands running down the centre of the Atlantic Ocean is evidence of this. Free flowing lava means that little stress will be built up as rocks push past each other and there are fewer earthquakes of relatively small magnitude. The lava flows out layer upon layer to form a flat dome called a "shield" volcano. They are called shield volcanoes because they resemble a round warrior's shield laid on the ground. The Hawaiian Islands are good examples of this type of volcano. Most volcanoes on Earth are undersea and of this type.

Tectonic plates pushing together.

When tectonic plates push together the denser slab is pulled downwards towards the mantle. It also pulls more crust downward after it. Rock is forced past rock creating frequent earthquakes of devastating magnitude. The overlying slab may crumple and form mountains such as the Andes whilst increasing heat and pressure forces the underlying slab to melt. Melted continental crust creates wet, sticky explosive magma and results in high conical volcanoes. The volcanic Pacific Ring of Fire is the result of the Pacific tectonic plate pushing under the Eurasian tectonic plate (see map). High conical volcanoes such as Mt Fujiyama are created and the area is subject to frequent earthquake activity.



Geological Changes - Teacher Background

Heat driven convection currents push plates over the mantle and cold dense gravity pulls them down again to be remelted and recycled.

Stress within plates

Because the geographic continent of Australia lies well within the margins of the greater Indo-Australian Plate we do not suffer from major volcanism or earthquakes that occur at plate margins. However we do suffer earthquakes from intra-plate stress.

The Australian Plate is presently moving northwards towards South China at roughly the same speed as your fingernails grow. In about 250 million years it will have crashed into Borneo pushing up even more mountains as it ploughs north. Variation of rock types within the Australian plate and friction with plates along its margins means that movement is not uniform across the plate. Internal stresses build up and this is released as earthquakes.

These are usually smaller and less devastating than those at plate margins.

Western Australia has many such earthquakes daily. Swarms of minor earthquakes move through our Mid-west. Along major fault lines where brittle rocks have moved against each other for millions of years, stress may build up until it is released as an earthquake. There is a major fault which runs north to south near our western coast (the Darling Fault) and faults near Kalgoorlie move frequently.

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