The Crust and Plates

How does the crust move?
What pushes the plates along?

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As early as the 1600's scientists noted that the shapes of continents on opposite sides of the Atlantic Ocean (South America and Africa) seemed to fit together like pieces of a jigsaw puzzle.
In the following centuries scientists began to speculate that the Earth's landmasses had once been joined in a 'supercontinent' and some force had split them apart.

In 1912 Alfred Wegener, a German scientist, proposed the theory of continental drift which said that the continents were slowly drifting around the Earth. He used evidence of matching rock types, geological structures and fossils to show that continents had once formed a giant continent he called Pangaea. Wegener's theory was not widely accepted at the time because he could not provide a mechanism to explain how Pangaea split up to form the continents we know today.

By the 1960's there was evidence from new areas of scientific research, such as under sea exploration and the magnetism of rocks, to support Wegener's theories and explain possible mechanisms for the movement of continents.
Within less than a decade a new theory called plate tectonics was widely accepted. It combined Wegener's continental drift theory with evidence from many new areas of Earth science that explained the mechanisms causing continents to move.
Plate tectonic theory states that the Earth's outer shell, the lithosphere (including the crust and upper mantle), is broken up into a number of large rigid plates that slowly move about the planet.

These plates are continually being formed and destroyed.
Plates are separating at mid ocean ridges where new plate material (magma) is welling up from the mantle and pushing the plates apart. The other edge of the plate is pushed into or alongside a neighbouring plate or plates. When two plates collide a number of things can happen depending on which plate is heavier and the angle of collision.
The heaviest plates are those made mainly of sea floor. Although the crust under the seafloor is thinner it is heavier than continental plate material because of the type of rock (basalt) that is formed at mid ocean ridges.
Many plates are a mixture of oceanic and continental crust and some carry parts of more than one continent.
When a heavy plate is pushed against a lighter plate, the heavy plate will be forced beneath the lighter plate and the lighter plate will ride over the top. This is called subduction.
Over time the heavier plate will be forced deeper and deeper down into the mantle where it may partially melt and later rise to produce volcanoes along the edge of the subduction zone. This is the process creating the Taupo Volcanic Zone, Taranaki and the Kermadec Arc volcanoes.

The reason why plates move is a good example of the Nature of Science strand of the curriculum in action.
There is scientific debate over whether plate movement is caused by 'ridge push' or 'slab pull'. It is possible that the new plate material formed at a mid ocean ridge pushes the plate along but it is also possible that the opposite edge drags the plate along behind it as it is subducted. The movement of the mantle (convection) could be the cause of, or caused by either of these mechanisms.
Both are stories that fit the current state of scientific knowledge and they will change over time.
Whatever the mechanism plate movement averages 3-4 cm per year or 3-4m per century, Very slow!

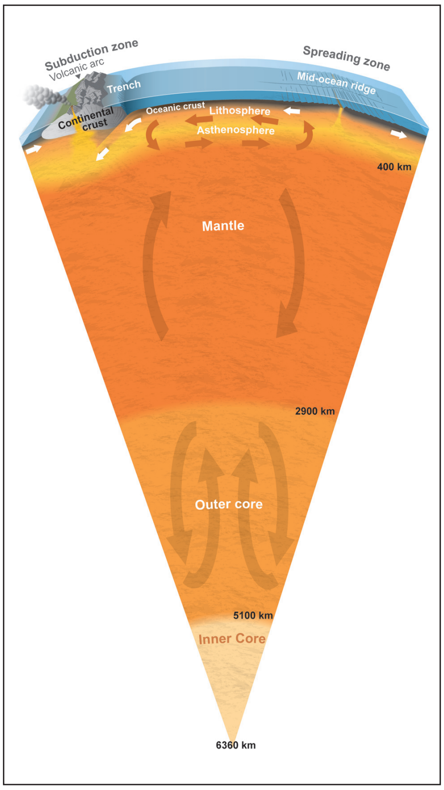
For a more detailed explanation of convection see:
http://www.msnucleus.org/membership/html/k-6/pt/plate/2/ptpt2_1a.html

Curriculum Links

Planet Earth and Beyond

Physical World

Science Concept	NOS
PE-Earth Systems L3/4 –develop an understanding of what makes up our planet **PW-Physics Concepts L1/2**-explore physical phenomena such as movement, forces and heat.	**Understanding about Science** **Investigating in Science**



GNS Science

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FAQs and links for further inquiry 3 & 4

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How many plates are there?

Most scientists agree that there are between 8 and 15 plates. Some large plates have areas within them that behave like a separate plate. They are often called 'micro' plates. This makes it difficult to give a definite number.

What plate is New Zealand on?

New Zealand lies across the boundary of two plates.

Some parts are on the western edge of the Pacific Plate and some parts are on the eastern edge of the Australian Plate.

The Australian Plate is called a continental plate because a lot of it is covered by land.

The Pacific Plate is mostly seafloor so it is called an oceanic plate.

Oceanic plates are heavier than continental plates even though the crust they are made of is thinner. Oceanic crust is mainly basalt, a dark, dense rock formed by the magma upwelling at ocean ridges where plates grow.

How does being across 2 plates affect New Zealand?

The two plates are crashing together. You could say New Zealand is a geological car crash!

The force of the collision causes our earthquakes and volcanoes.

Plate boundaries (edges) are not straight lines so this means the collision between the same two plates can have different results at different places. This is why some areas of the collision zone in NZ have volcanoes and some areas have mountain building and earthquakes.

Which plate are you on?

All of the North Island is on the Australian Plate and so is everything to the west of the Alpine Fault in the South Island, including Nelson and Westland.

The rest of the South Island, Stewart Island and the Chatham Islands are all on the Pacific Plate.

The collision zone (plate boundary) can easily be seen on the map running from north of East Cape around the east of the North Island, curving below Cook Strait, down the mountainous spine of the South Island and out to sea south of Milford Sound.

Which plate is Australia on?

All of Australia is on the Australian Plate. There are no plate boundaries running through Australia. Because there are no plate collisions happening in Australia they have fewer volcanoes and earthquakes.

If the plates are continually moving what did the world look like before and what will it look like in the future?

For animations see:

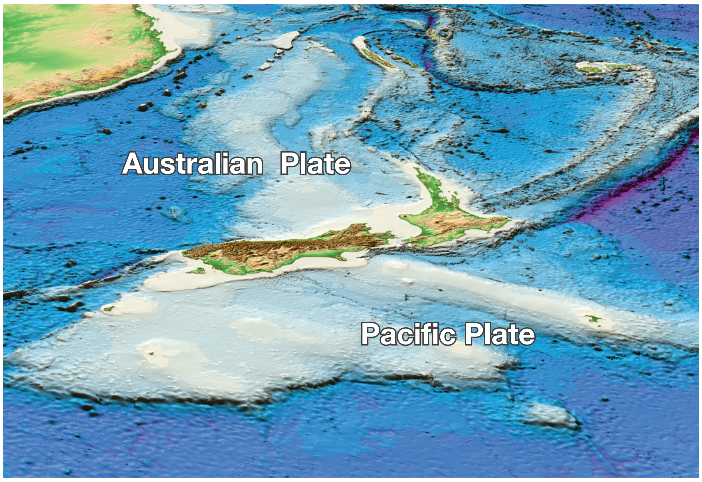
http://www.tki.org.nz/r/wick_ed/science/crusty.php

http://www.gns.cri.nz/research/tectonics/images/v2Low_res2.html

What will New Zealand look like in the future?

For an animation of NZ's future shape see

http://www.gns.cri.nz/store/download/plates.html



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