Creating & Destroying Plates

What happens when plates move?

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Discuss

What do you know about the two types of plates?
Some plates are mainly ocean (made of seafloor) and some plates are mainly continental (have landmasses on them) Oceanic plates are thinner and heavier. Continental plates are thicker and lighter so they 'float' higher in the mantle. Both types of plate are relatively solid (rigid), they are made of different sorts of rock and they can move around slowly on the surface of the Earth.

Activity

In pairs or groups make

- 2 blocks of blue plasticine and 2 blocks of green playdough each about 5cmx5cm.
- The blue blocks (oceanic plates) should be about 1cm high and the green (continental plate) about 2cm high.

What type of plate does the blue plasticine represent and why?
Oceanic plate- thinner, heavier.

What type of plate does the green playdough represent and why?
Continental plate-thicker, lighter.

- Hold a continental plate (green) in each hand and push them firmly towards each other. **What happens?**
  - Both plates should crumple at the edge and create 'mountains' where they are forced into one another. Because they are the same weight and thickness one does not sink below the other. This action is what has created the world's tallest mountain range-the Himalayas.
- Make a large thin layer of red playdough to represent the mantle and put two oceanic plates (blue) on top of this so that they touch each other along one edge. 'Erupt' some mantle material by mounding up the underlying red layer at the join line. This will force the two oceanic plates to separate. Continue creating upwelling magma with the red playdough so that the blue plates move further and further apart.
  - This represents divergence of the plates caused by creation of new plate material from magma in the mantle. This is often called sea floor spreading and creates long lines of ocean ridges. This is a volcanic process but the lava produced usually oozes out rather than erupting explosively.
- Hold a continental plate in your left hand and an oceanic plate in your right hand so that the top of the blue plate is just touching the bottom of the green plate. With one hand on the outside edge of each plate push the plates slowly together.

What happens to the 'underneath' plate?
It gets forced below the green continental plate. This is subduction

What happens on the top surface in the area where the plates meet?
The plates gets crumpled by the pressure.

What is the force that stops the plates sliding easily past each other?
Friction

If the plates were solid and couldn't be bent like plasticine how would that alter the movement?
It would be jerkier instead of smooth and the plates might crack.

If there was a hot layer below the plates what would happen to the plate that is being pushed down?
It might get hot and 'melt'. Friction would be reduced and the layers could slide more easily.

- Lay two continental plates side by side. Push them toward each other while sliding them in opposite directions at the same time.

What happens to the edges?
They crumple and get pushed up a little. This is a transform fault like the Alpine Fault.

Learning Intentions

- Make representations of oceanic and continental plates and use them to show divergence and convergence at plate boundaries.

Success Criteria

Students can

- Explain what the plasticine represents and how some properties are similar to the plates
- Use accurate vocabulary (converge and diverge) to explain what plates can do
- Use the materials to model divergence and convergence

Resources

- Blue plasticine
- Green playdough
- Red playdough
- or bread, butter & jam -see explanation on Teacher's Notes page

Vocabulary

Converge, diverge, boundary, edge, collision, crumple, continental, oceanic, weight, sea floor spreading, landmass

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The greatest lengths of plate boundaries are found in the world's oceans. Most of the creation and destruction of the Earth's crust takes place in the middle of, or around the edges of oceans. The areas where plates interact are marked by earthquakes, volcanoes or both.

Plates can converge (come together), diverge (move apart) or move alongside each other. Divergence creates and convergence destroys the crust of the Earth.

Most divergence happens when oceanic plates are forced apart by new magma which rises from the mantle and hardens into new sea floor. This creates underwater lines of mountains, often called mid ocean ridges. Diverging plate boundaries produce earthquakes and volcanoes but they are not usually as large or violent as the earthquakes and volcanoes caused when plates converge (collide).

Elsewhere on the Earth's surface plates move together, creating converging plate boundaries. When two plates move together a number of things can happen

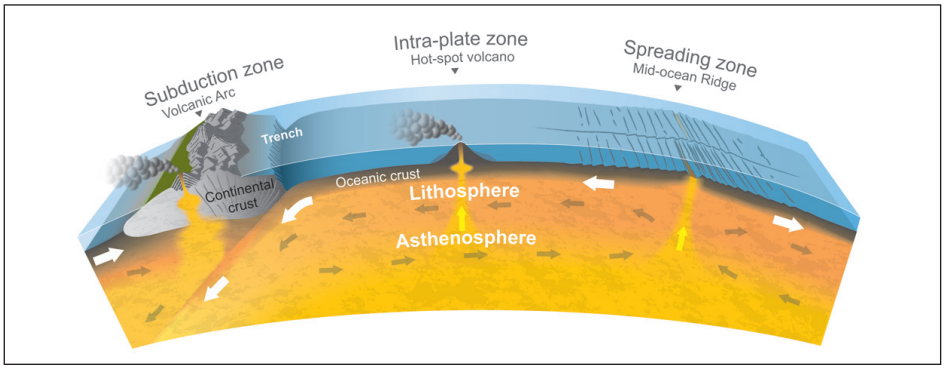
- Two continental plates meeting head on will crash together, causing earthquakes and creating mountains (eg Himalayas)
- A heavy (oceanic) plate will sink below a lighter (continental) plate causing earthquakes and volcanoes (eg NZ's North Island) This is called subduction.
- Plates which are moving in opposite directions will rub against each other sideways causing earthquakes and in NZ's case some mountain building (The Alpine Fault)

The movement of the plates is like a huge, very slow conveyor belt. New crust is created at oceanic ridges, carried along by convection currents in the mantle and destroyed when the plate reaches a collision zone with the edge of another plate.

Using plasticine to represent the continental and oceanic plates has some limitations. Students are representing something rigid by using something relatively plastic. Keep reinforcing that the 'real plates' are not as plastic as the plasticine and will crack rather than bend once the pressure gets too great.

Keep the plasticine as 'unmixed' as possible so it can be used again in Lesson 6.

Types of plate boundary diagram



GNS Science

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**

Alternative Modelling Material

Plasticine and playdough can be expensive if you want each student to make their own model.

A cheaper alternative is bread. Use a thick slice (toast bread) to represent the continental plate and a thin slice (sandwich bread) for the oceanic plate.

Remove the crusts.

Use jam to replace the red playdough for the diverging plate model.

For the subduction model 'butter the oceanic plate' The butter or margarine makes it possible to slide one slice under the other and represents the sea floor sediments which are carried down with the oceanic plate. 'But' the top of the oceanic slice against the bottom of the continental slice and push gently. As well as 'subduction of the sandwich bread' you should also get some buckling and folding in the overriding 'continental toast bread' just as happens to the real plates.

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Are there any places above the sea where the plates diverge?

When two continental plates move apart from each other a rift valley is created as the crust becomes stretched and thinned. This is happening in the 200km wide Rift Valley in East Africa. Shallow earthquakes and volcanoes are common in this region.

The Mid Atlantic Ridge is created by diverging, oceanic, plate boundaries beneath the sea. However this event 'comes ashore' in Iceland. This area of the ridge has many active volcanoes including Surtsey which erupted and created a new island in 1963.

Why are some big volcanoes such as Hawaii not on plate boundaries?

Some volcanoes occur over hot spots in the Earth's mantle rather than at plate boundaries.

The Hawaiian Islands and the Auckland Volcanic Field are examples of hot spot volcanoes. **More in Lesson 7**

For visuals on convection and the 3 types of plate boundary see:

http://www.youtube.com/watch?v=ifke1GsjNN0&feature=related

For an entertaining kids version of plate movement see:

http://www.youtube.com/watch?v=gEm_ea5pvgs&feature=related

For a lesson series with excellent animations of plate tectonics and interactive activities which would extend able students see:

http://www.montereyinstitute.org/noaa/

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