Aim:

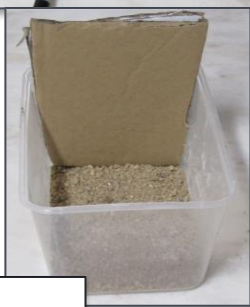
To investigate the features produced at convergent and divergent plate boundaries

Materials:

- Deep plastic takeaway or storage box
- Cardboard
- Scissors
- Marking Pen
- Dry sand (appx 500 g) – sand must be dry.
- Flour (appx 100g)

Method

A. Convergent boundary



1. Trace around the narrow end of the box twice on the cardboard.
2. Cut out the two pieces, leaving a few extra centimetres of height.
3. Place the cardboard pieces upright at one end of the box.
4. Create a thin layer of sand in the bottom of the box.
5. Alternate layers of flour and sand until there are five layers in total.
6. Slowly push the vertical cardboard pieces across the box, compressing the layers.
7. When you notice the layers beginning to bend, stop pushing and draw a scale diagram of the result.

8. Continue pushing the layers until the sand is nearly at the top of the box. Draw a scale diagram of the result.

B. Divergent boundary

9. Hold the cardboard pieces upright in the centre of the box.
10. Create a layer of sand in the bottom of the box on one side only.
11. Alternate layers of flour and sand until there are five layers in total. These layers should fill most of one side of the box.
12. Slowly pull the vertical cardboard pieces across the empty side of the box.
13. When you notice the layers beginning to deform, stop pulling and draw a scale diagram of the result.

14. Continue pulling the cardboard until it reaches the other side of the box. Draw a scale diagram of the result.

15. Add arrows to your diagrams to show the directions of the forces in each case.

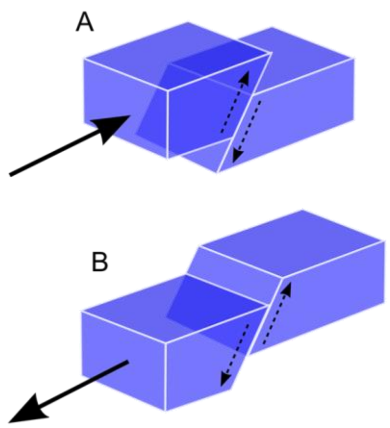
Analysis:

How did the convergent (pushing) forces affect the layers of your model? The layers fold and thicken when pushed together. There may be formation of reverse/thrust faults.

What changes occurred in the surface of the convergent model? Relate these to landforms. The surface mounds upward like a mountain or high plateau. Earlier pushing looks more like a mountain.

How did the divergent (pulling) forces affect the layers of your model? The layers near the moving board thin and extend downward.

What changes occurred in the surface of the divergent model? Relate these to landforms. The surface developed cracks running across the slope that exposed the underlying flour layers. A structure like a valley was formed as the sediments collapsed.



(A) Convergent forces create folds and reverse faults.
(B) Divergent forces create normal faults.

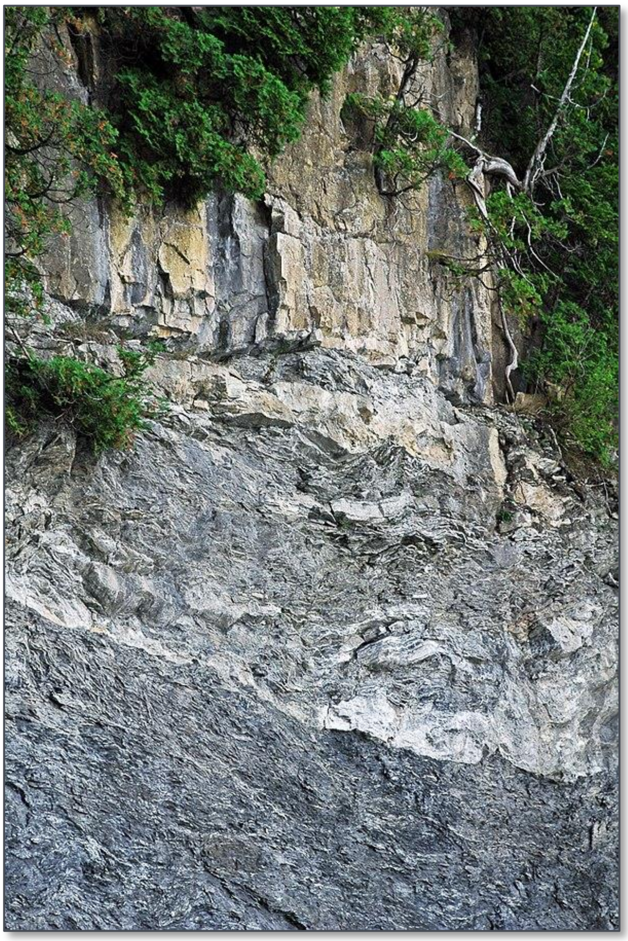
Use your knowledge of forces and faults to relate the geological features below to a type of plate boundary.

What type of fault? Reverse fault

How can you tell? The overhanging portion of the fault (hanging wall) has moved upward. This is caused by a pushing force.

What type of fault? Normal fault

How can you tell? The overhanging portion of the fault (hanging wall) has moved downward. This is caused by a pulling force.



What tectonic setting? This is at a convergent plate boundary

How can you tell? The lower rocks appear to be folded, much like the layers of sand and flour in the model of a convergent boundary.

Discussion points:

- *How do rock layers offer clues to the past?* Faults offer a window into the past forces that acted on a region. Surface features associated with faulting are eroded over time, but the displacement of layers remains visible at road cuttings, beaches or cliffs.
- *How has the choice of modelling materials affected the outcome of this model?* Sand and flour have very different grain sizes and properties to each other. Flour is 'slippery' compared to sand and layers may slide more easily. Neither substance fractures like rock.
- *Why do some rocks bend and some break?* The temperature, age and composition of rocks affects their material properties. For example, young limestones tend to deform, whilst older limestones will fracture. Heat makes rocks more plastic, so more likely to stretch or fold.

A video of these experiments being conducted can be found here.

References:

Fernandez JG (2011). Types of faults (image). Wikimedia Commons.
Rygel MC (2012). Normal fault (image). Wikimedia Commons.
St John J (2006). Champlain thrust fault (image). Wikimedia Commons.
St John J (2014). Reverse fault in gyprock (image). Wikimedia Commons.