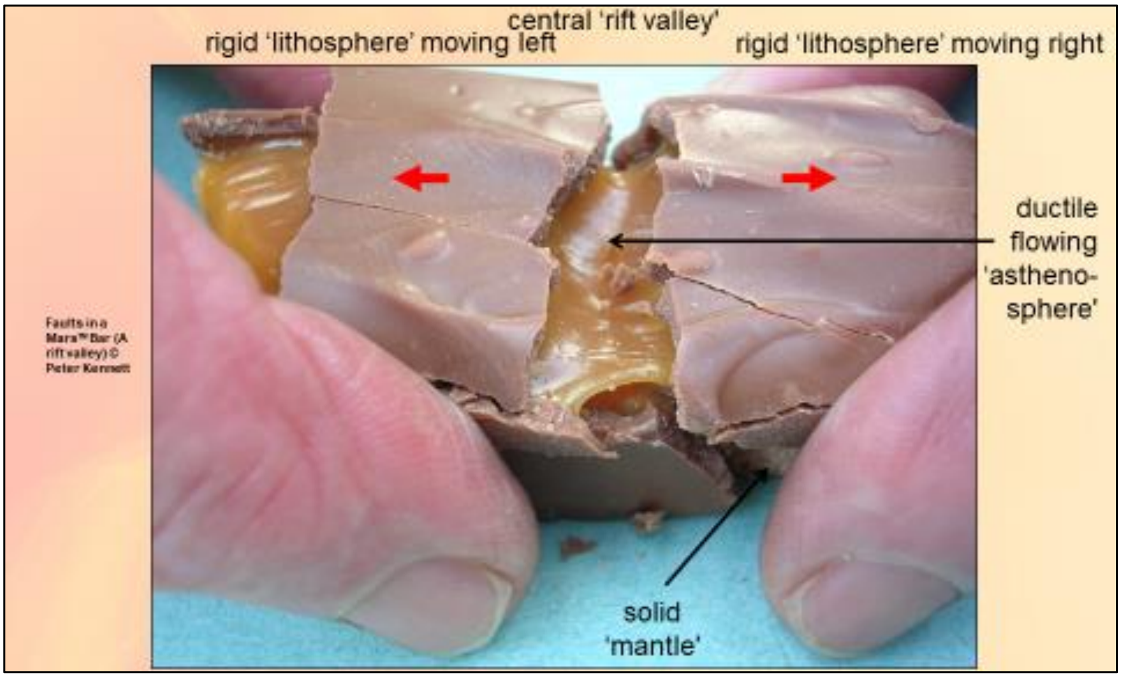
Faults in a Mars™ Bar

Pulling apart a Mars™ Bar to model a divergent plate margin

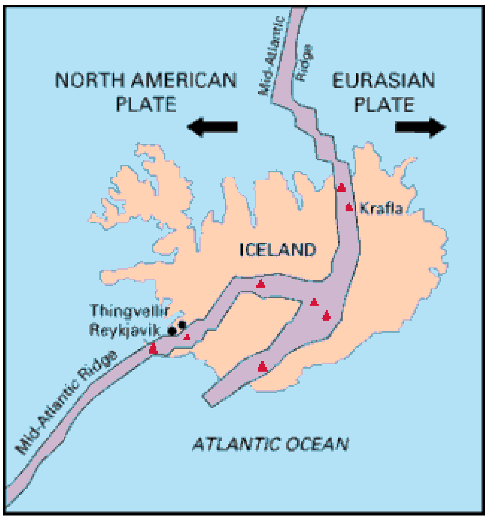
Pull apart a Mars™ Bar to demonstrate some of the features at a sea floor spreading centre. Ensure that the Mars™ Bar is at room temperature and not too cold. Explain that the features at sea-floor spreading centres relate to the pulling apart of the lithosphere as two plates move away from each other.

Gently pull the Mars™ Bar until it begins to crack in the middle. The brittle outer layer of chocolate shows cracking (i.e. brittle failure), at right angles to the direction of pulling. This is equivalent to the brittle lithosphere cracking under tension and producing a rift valley down the middle of an oceanic ridge. Any cracks which are parallel to the direction of pulling are in the same direction as the transform faults which cut across oceanic ridges (although true transform faults are formed by a more complex process).

The gooey caramel beneath the chocolate can be seen to have flowed and thinned under tension. This is equivalent to the 'weak' layer, or asthenosphere, beneath the lithosphere.
The solid nougat beneath the caramel layer represents the solid mantle beneath the asthenosphere.



The results of pulling apart a Mars™ Bar in the direction of the red arrows
(Diagram reproduced courtesy of the Earth Science Education Unit).



Iceland, Mid-Atlantic Ridge © USGS

Gap between the North American and Eurasian plates in Iceland © Chris73

The back up

Title: Faults in a Mars™ Bar

Subtitle: Pulling apart a Mars™ Bar to model a divergent plate margin

Topic: A demonstration of the forces involved in the creation of a rift valley at a divergent margin, using a Mars™ Bar

Age range of pupils: 12 – 16 years

Time needed to complete activity: 5 minutes

Pupil learning outcomes: Pupils can:
- describe the response to tension in a Mars™ Bar as it is pulled apart;
- relate the features seen in this analogy to the processes active at oceanic constructive margins

Context: The activity models the processes which are taking place at oceanic ridges and continental rift valleys, and enables pupils to see that tensional forces can produce "rift valleys". It is appropriate in both geography and science lessons.

Following up the activity:
- Use Potty Putty™ to show the nature of the mantle, permitting elastic, plastic and brittle deformation, depending on the circumstances.
- Use the Earthlearningidea activity *A valley in 30 seconds - pulling rocks apart: investigating faulting in an empty box,* to study the behaviour of materials under tensional forces.
- Try cooling another Mars™ Bar first before pulling it apart, to investigate the influence of temperature on the plasticity of the components.

Underlying principles:
- Forces produce deformation of the rocks that they are acting upon.
- Rock is weak in tension and horizontal tensional forces cause the rock to fracture. This leaves sections of rock upon which gravity can act vertically so they slide downwards along clearly defined planes.
- The fault which results is called a **normal fault** and the fault plane lies at a high angle, at times even vertical.
- A second normal fault often develops, with the rocks in between being faulted down, to form a rift valley.
- Tensional forces are typical of divergent (constructive) plate margins, e.g. at the Mid-Atlantic Ridge where it appears above sea level in Iceland (see map and photos).

Thinking skill development:
- A pattern is established of fractures being produced by tension.
- There is a direct bridging link with faulted structures, such as rift valleys.

Resource list: One Mars™ Bar (any size!).

Useful links:
https://www.geolsoc.org.uk/Plate-Tectonics

The US Geological Survey has published a useful downloadable book about plate tectonics on its website, called '*This dynamic Earth: the story of plate tectonics'* available at:
http://pubs.usgs.gov/gip/dynamic/dynamic.html
See Earthlearningideas:
Bouncing, bending, breaking - Modelling the properties of the Earth's mantle with Potty Putty™ from a toy shop;
Model a spreading ocean floor offset by transform faults - A model of the transform fault 'steps' in oceanic ridges and their magnetic stripes, if the discussion arises among older students.

Source: Earth Science Education Unit, Keele University