

The heat is on Modelling the movement of heat from the Earth's core outwards

This activity needs a large open space either outdoors or in a large hall. Explain to the pupils that they will be modelling the **transfer of heat** from the core outwards and the eruption of lava at oceanic ridges.

Note: The activity is aiming to get away from the widely-held concept that convection in the mantle drives plate motion like a conveyor belt. Plate movement is largely gravity driven. The mantle (solid) convection cells transfer heat from the deep Earth to the Earth's surface.

Divide the pupils into two groups. Explain that some of them will represent the plates of the Earth, some the mantle and others the core. Explain that something blue will be used to represent cold conditions and something red to represent hot. Blue and red balls are used here but blue and red paper, cardboard, sashes, etc. could be used instead.

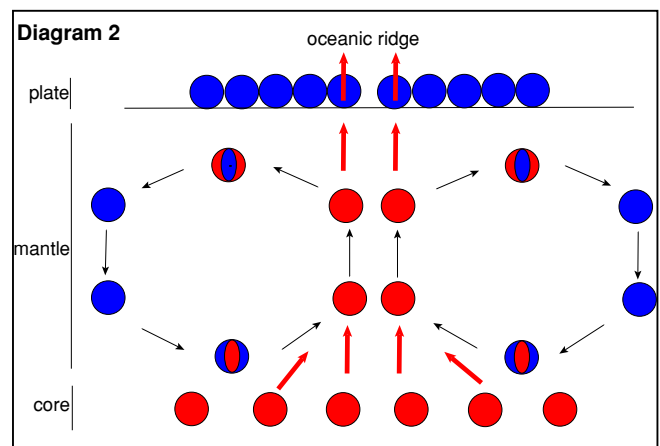
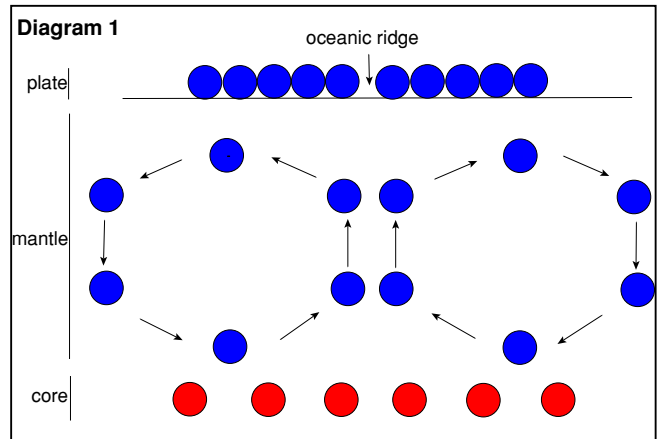
For each of the two groups give:-

- blue balls to the pupils representing the plates;
- blue balls to the pupils representing the mantle;
- red balls to the pupils representing the core. These pupils should have a large box of red balls with them to give to the circulating mantle-heat pupils.

Ask the pupils to do the following:-

- arrange themselves as shown in Diagram 1 opposite;
- the mantle pupils should start to move slowly round in circles. Pupils on the left move anticlockwise and pupils on the right move clockwise;
- the core pupils pass red balls to the innermost mantle pupils, as shown in Diagram 2 opposite;
- the mantle pupils display their red balls when they are in the middle but as they move around at the top, near the plates, they give their red balls to the plate pupils and display their blue balls as the mantle starts to cool. As they move round towards the core, they begin to heat up again and receive a red ball from a core pupil;
- meanwhile, the red balls are passed to the innermost plate pupils who wave them over their heads to simulate heat escaping in erupting lava. The balls are then put down as more are passed to them.

Explain to the pupils that the mantle material near the core becomes hot and therefore less dense than the surrounding material and so rises. As this hot material reaches the plate and loses heat at the oceanic ridge, it cools, becomes more dense and so sinks back down towards the core. There is a constant conveyor belt of heat from the core to the surface.



Demonstration of the movement of heat from the core (front) through the mantle to the oceanic ridge (back)
Pupils from Hagley Catholic High School, Worcestershire, UK
(Abigail Brown)

The back up

Title: The heat is on.

Subtitle: Modelling the movement of heat from the Earth's core outwards.

Topic: This activity can be used to consolidate knowledge about the structure of the Earth and the heat flow within it in science or geography lessons.

Age range of pupils: 8 - 14 years.

Time needed to complete activity: 30 minutes.

Pupil learning outcomes: Pupils can:

- visualise that the Earth has structural layers, core, mantle, plates;
- appreciate that heat is transferred from the core outwards;
- realise that when this heat reaches the surface, often at oceanic ridges or hot spots, it emerges in lava, as in the volcanoes of Iceland;
- realise that the Earth is very slowly cooling.

Context:

This activity models the way in which heat is transferred from the cooling Earth's core to the Earth's surface. However, pupils will need to be reminded that the convection of heat does not mean that the Earth's mantle is liquid. Earthquake evidence shows that the Earth's mantle is solid, so that the heat is being transferred outwards through the mantle while the mantle remains solid.

Following up the activity:

Pupils could use a search engine to investigate oceanic ridges or try the Earthlearningideas 'Magnetic stripes' or 'Model a spreading ridge offset by transform faults'.

To find out more about the core of the Earth, the pupils could try the Earthlearningidea 'A core activity'.

Underlying principles:

- Heat is transferred from the core of the Earth outwards.
- Heat moves through the mantle and escapes all over the Earth's surface but at a higher rate at oceanic ridges and hot spots.
- Movement caused by plate tectonics was probably faster in the early Earth, when the core was hotter, and is gradually slowing down. Eventually, it will stop, as it seems to have done on Mars.

Thinking skill development:

A pattern emerges as the red balls (heat) are transferred from the core outwards and as the pupils in the mantle move around. Discussion of what they are modelling involves metacognition. Cognitive conflict is caused by many pupils imagining convection cells in the mantle which move the plates as though they were on a conveyor belt. It is heat that is transferred by convection in the solid mantle. Conflict is also caused by acting out the model of the spherical Earth on a flat surface in a limited space. Applying the model to what is happening in the Earth is a bridging skill.

Resource list:

- a supply of red and blue balls, coloured paper/cardboard, sashes or something to represent cold (blue) and hot (red). More red things will be needed than blue.
- a large box or tub to keep the red things.

Useful links:

Earthlearningideas:-

http://www.earthlearningidea.com/PDF/81_Magnetic_stripes.pdf

http://www.earthlearningidea.com/PDF/84_Transform_faults.pdf

http://www.earthlearningidea.com/PDF/147_Core.pdf

http://www.earthlearningidea.com/PDF/78_Bouncing_bouncing_breaking.pdf

Source:

Developed by Elizabeth Devon from an Idea by Dr. Ian Kille, Northumbrian Earth

<http://www.northumbrianearth.co.uk/>

Grateful thanks for his expertise to Dr. Ian Stimpson, Keele University, Staffordshire and to the other members of the ELI Team.

© **Earthlearningidea team.** The Earthlearningidea team seeks to produce a teaching idea regularly, at minimal cost, with minimal resources, for teacher educators and teachers of Earth science through school-level geography or science, with an online discussion around every idea in order to develop a global support network. 'Earthlearningidea' has little funding and is produced largely by voluntary effort.

Copyright is waived for original material contained in this activity if it is required for use within the laboratory or classroom. Copyright material contained herein from other publishers rests with them. Any organisation wishing to use this material should contact the Earthlearningidea team.

Every effort has been made to locate and contact copyright holders of materials included in this activity in order to obtain their permission. Please contact us if, however, you believe your copyright is being infringed: we welcome any information that will help us to update our records. If you have any difficulty with the readability of these documents, please contact the Earthlearningidea team for further help.

