Laying out the rock cycle: product and process
Sorting out the rock cycle products – and then adding the processes

Give each small group of pupils a page-sized diagram of the rock cycle, like the one on page 4 and a selection of the products of the rock cycle, similar to those listed below. Then ask them to place these things in the best places on the rock cycle diagram (a photograph of the 'best places' is shown below – but it is a good idea not to show this to the pupils, at least, until the end of the activity).

Rock cycle diagram with the 'products' laid out in the best places. (*Chris King*).

The rock cycle products that might be included are:

- a photograph of 'Rocks at the Earth's surface', like the one opposite;
- a small bag of soil to represent 'Rotten rocks and soil';
- a small bag of sand - as 'Mobile sediments';
- a photograph of layers of coloured sand in a measuring cylinder (opposite), representing a 'Sedimentary sequence';
- a selection of small specimens of:
  - sedimentary rocks, such as: conglomerate, sandstone, limestone, mudstone;
  - metamorphic rocks, like: slate, schist, gneiss, metaquartzite and marble;
  - igneous rocks, e.g. granite, gabbro and basalt;

  (these rocks are shown on the rock reference sheet on page 8).

Rocks at the Earth's surface. (*Peter Kennett*).

A measuring cylinder 'sedimentary sequence'. (*Peter Kennett*).

After they have attempted this for a few minutes, give them the best answers and check that the rock cycle products have been laid out in the best places on their diagrams. The rock flash cards on page 5 may help in naming the rocks.

Then explain that these are the things <u>produced</u> by the rock cycle processes – they are the products of the rock cycle. They are shown in the rectangular boxes on the rock cycle diagram. Explain that each product results from a rock cycle process – the processes are shown in italics on the diagram.

Finally, lay out a classroom/lab-sized 'rock cycle' in an approximate circle around the room, using the cards on page 6. Add the products (rocks, photos, etc.) in the correct places. Finally, add the process cards on page 7, noting for the pupils the usual time-spans of these processes (see reference photo in the 'Context' section below).

The back up

Title: Laying out the rock cycle: product and process.

Subtitle: Sorting out the rock cycle products – and then adding the processes.

Topic: Pupils are asked to place a series of rock cycle products in the correct places on a diagram of the rock cycle, then to consider how all these are linked by rock cycle processes.

Age range of pupils: 10 – 18 years

Time needed to complete activity: 20 minutes

Pupil learning outcomes: Pupils can:

- place examples of rock cycle products (rocks, sediments, photographs) in the correct position on a rock cycle diagram;
- describe these as products of the rock cycle, and name the products;
- explain how the products are formed by rock cycle processes, and name the processes;
- describe the time spans over which each rock cycle process operates.

Context:
The 'room-sized' rock cycle, when laid out looks like this:

The 'room-sized' rock cycle laid out. (Chris King).

This activity is intended either as an introduction to the rock cycle or to consolidate rock cycle learning at the end of the topic. Many pupils find it difficult to understand the rock cycle because it is an abstract concept. The activity is intended to reduce the abstraction of the concept.

The only rock cycle product not included as a physical or photographic example is magma. This is because magma is the name given to molten rock underground – when magma is extruded at the surface, it is no longer called magma, but is called lava instead. So, it is impossible ever to see magma.

The 'process' cards have time spans added because many pupils think that the rock cycle is a steady process and so the processes must act steadily. That this is not so is clear from the cards, as is the fact that, whilst sedimentary processes act everywhere on the surface of the planet, metamorphic activity only occurs during the mountain-building processes of plate margins; most igneous processes are also confined to plate margins.

Before giving the rock names and showing the flash cards, it is often best to describe the rocks, as in the table below, to show that you don't need to know rock names to be able to 'do' Earth science.

Pebbles stuck together	conglomerate
Sand stuck together	sandstone
Lime sand stuck together (reacts with dilute acid)	limestone
Mud stuck together	mudstone, shale or clay
Low-grade metamorphic rock	slate
Medium-grade metamorphic rock	schist
High-grade metamorphic rock	gneiss
Metamorphosed sand	metaquartzite
Metamorphosed lime sand (reacts with dilute acid)	marble
Pale-coloured, coarse-grained, silica-rich igneous rock	granite
Dark-coloured, coarse-grained, iron/magnesium-rich igneous rock	gabbro
Dark-coloured, fine-grained, iron/magnesium-rich igneous rock (Same composition as above)	basalt

Following up the activity:
Most of the rock cycle processes can be modelled or investigated using the Earthlearningideas shown in the table below.

The rock cycle lesson can be reinforced by sticking the 'room-sized rock cycle' cards around the walls of the lab at the end of the lesson – so that the pupils walk into the 'rock cycle' whenever they enter the room.

Underlying principles:

- Examples of all rock cycle products (except magma) can be found at the Earth's surface and can be given as specimens or photos to pupils.
- Different rock cycle processes produce different products, all of which contain evidence of how they were formed.

Thinking skill development:
Understanding the rock cycle requires abstract thinking skills. This activity allows pupils to use the construction thinking skill to construct their rock cycles, with debates involving cognitive conflict and metacognition.

Resource list:
- rock cycle diagram
- photographs of 'Rocks at the Earth's surface' and of layers of coloured sand in a measuring cylinder, representing a 'Sedimentary sequence'
- small bag of soil
- small bag of sand
- selection of small specimens of:
  - sedimentary rocks, such as: conglomerate, sandstone, limestone, mudstone;
  - metamorphic rocks, such as slate, schist, gneiss, metaquartzite and marble;
  - igneous rocks, such as granite, gabbro and basalt (see reference sheet on page 8)
- rock name flash cards
- rock cycle 'product' and 'process' cards for a room-sized rock cycle to be laid out

Useful links:
See the Earth Science Education Unit virtual rock kit for photographs of common rock cycle rocks in hand specimen, close-up, at outcrop and in use at:
http://www.earthscienceeducation.com/virtual_rock_kit/DOUBLE%20CLICK%20TO%20START.html

The Geological Society of London has produced a useful animation of the rock cycle with a range of associated activities for pupils and teachers including rock photographs and descriptions at:
http://www.geolsoc.org.uk/ks3/gsl/education/resources/rockcycle.html

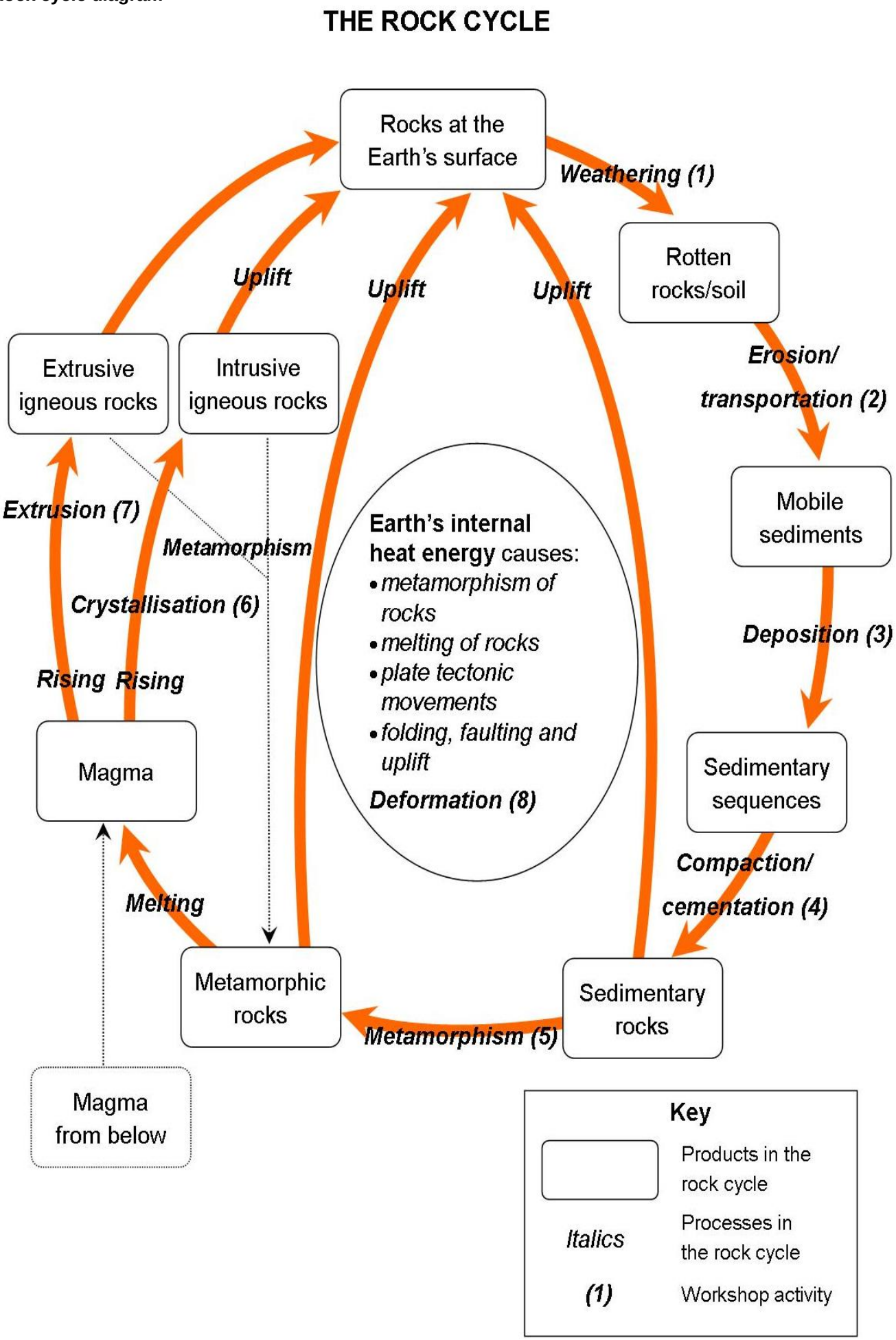
There are more than twenty Earthlearningideas investigating rock cycle processes, as listed in the table below.

Source: Devised by Chris King of the Earthlearningidea Team. Thanks to the Earth Science Education Unit for permission to use the photographs and diagrams.

Earthlearningideas that can be used to model or investigate rock cycle processes.

Rock cycle process		Earthlearningideas modelling or investigating that process	
Weathering	Physical weathering	*Cracking apart* *Ice power*	*Weathering – rocks breaking up and breaking down*
	Chemical weathering	*Weathering limestone with my own breath*	
Erosion and transportation		*Rock, rattle and roll* *Mighty river in a small gutter* *Changing coastlines*	*Dust bowl* *Grinding and gouging*
Deposition		*Mighty river in a small gutter*	*Dust bowl*
Compaction/cementation		*Make your own rock*	
Metamorphism		*Metamorphism – that's Greek for 'change in shape' isnt it?*	*Squeezed out of shape*
Crystallisation		*Why do igneous rocks have different crystal sizes*	*The unfair 'build your own crystal' race*
Extrusion		*Volcano in the lab* *See how they run*	*Blow up your own volcano* *Bubble-mania*
Deformation		*The Himalayas in 30s* *Margarine mountain-building*	*Banana benders*
The whole rock cycle		*Rock cycle through the window* *Rock cycle in wax* *Sand on a sill*	*James Hutton or Mr Rock Cycle* *Rockery 2*
Weathering/erosion misconception		*Teacher – 'What's the difference between weathering and erosion?'*	

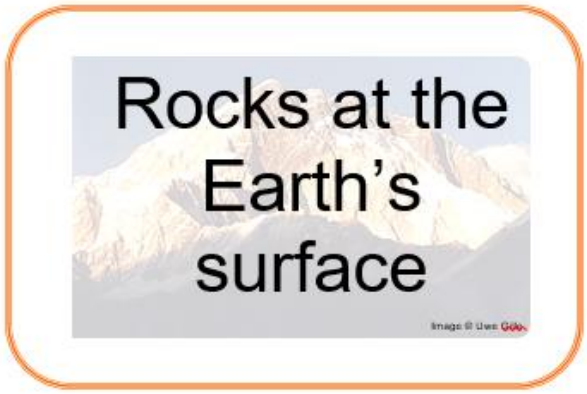
Rock cycle diagram

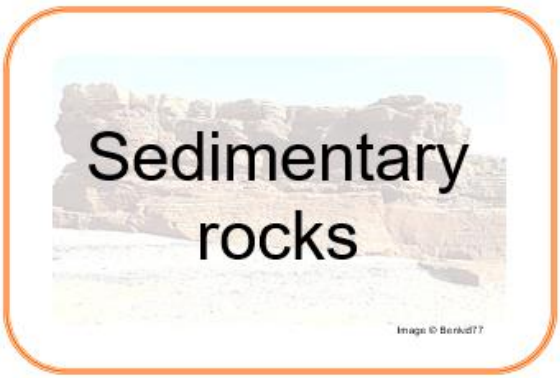


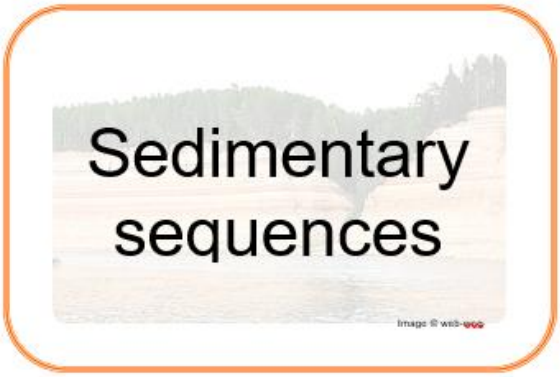
Rock name flash cards

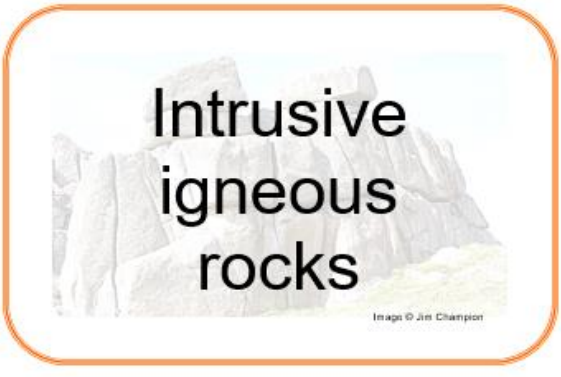
gabbro (intrusive igneous rock)	**limestone** (sedimentary rock)
granite (intrusive igneous rock)	**mudstone** (sedimentary rock)
slate (metamorphic rock)	**conglomerate** (sedimentary rock)
sandstone (sedimentary rock)	**schist** (metamorphic rock)
marble (metamorphic rock)	**gneiss** (metamorphic rock)
shale (sedimentary rock)	**metaquartzite** (metamorphic rock)
basalt (extrusive igneous rock)	**clay** (sedimentary rock)

Rock product cards









Rock process cards

Weathering
Tens to hundreds of years

Erosion/ transportation
Seconds to tens of years

Deposition
Seconds to thousands of years

Rising
Days (extrusion) to millions of years (intrusion)

Crystallisation
(under Earth's surface) Thousands to millions of years

Extrusion
Seconds to weeks

Compaction/ cementation
Hundreds to millions of years

Metamorphism
Millions of years – during mountain-building episodes

Melting
Tens to millions of years

Uplift
Hundreds to millions of years

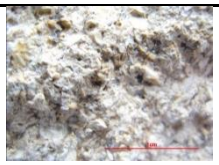
Deformation: folding, faulting and uplift
Seconds (faulting at active Earth zones) Seconds to millions of years (faulting, folding metamorphism during mountain-building episodes)

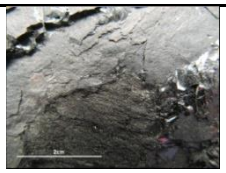
Rock reference sheet

Hand specimen	Close up
	
Conglomerate - pebble-sized grains cemented/ compressed together – a coarse-grained sedimentary rock.	

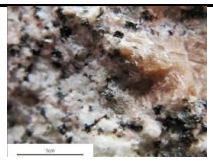
Hand specimen	Close up
	
Sandstone – sand-sized grains cemented/compressed together, often with layers (bedding) – a medium-grained sedimentary rock.	

	
Mudstone – mud-sized grains compressed together, often with fine layers (lamination) – a fine-grained sedimentary rock.	

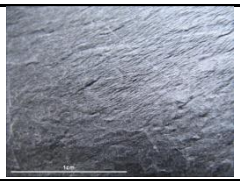
	
Limestone – lime grains cemented/compressed together; lime (calcium carbonate) reacts with dilute acid.	

	
Coal – plant material compressed together – a black sedimentary rock.	

	
Basalt – dark-coloured, fine-grained (too small to be seen) interlocking crystals (dark-coloured crystals are usually rich in iron/magnesium) – a fine-grained, dark-coloured, iron/magnesium-rich igneous rock, often with gas holes.	

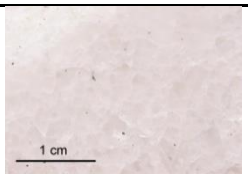
	
Granite – pale-coloured, coarse-grained (clearly visible) interlocking crystals (pale-coloured crystals are usually rich in silicon) – a coarse-grained, pale-coloured, silicon-rich igneous rock	

	
Peridotite – very dark-coloured, coarse-grained (clearly visible) interlocking crystals (dark-coloured crystals are usually rich in iron/magnesium) – a coarse-grained, very dark-coloured, very iron/magnesium-rich igneous rock	

	
Slate – mud-sized (too small to be seen) interlocking crystals parallel with each other; can break into sheets (cleavage) – a fine-grained, low-grade metamorphic rock	

	
Schist – clearly visible interlocking crystals parallel with each other – a medium-grade metamorphic rock	

	
Gneiss – clearly visible interlocking crystals in bands – a high-grade metamorphic rock	

	
Marble – clearly visible interlocking crystals – formed when limestone is metamorphosed; the calcium carbonate crystals react with dilute acid	