

## Not misunderstanding the rock cycle Addressing common misconceptions about the rock cycle

A survey of science textbooks in the UK found a wide range of misunderstandings about the rock cycle. These included (Q = quotation from a textbook; R = response):

Q. '... the rock cycle provides a continuous supply of new rock.'

R. *The supply of rock is not continuous. New igneous and metamorphic rocks are mostly formed during mountain-building episodes – only three major ones have affected Britain in the last 500 million years.*

Q. 'All the time rocks are being pushed upwards'

R. *In most parts of the Earth rocks are not currently being uplifted and there are also major areas of subsidence*

Q. 'Rocks are being recycled all the time'

R. *The sedimentary part of the rock cycle is reasonably continuous. However, most igneous and metamorphic rocks are formed during mountain building episodes that only happen in differing places at different times and are not continuous in the same place.*

Q. 'The rock cycle has been making and changing rocks since the Earth was formed. Humans have made even more changes to the Earth'.

R. *Humans have not made even more changes than the rock cycle (even though humans move about twice as much sediment per year as all the world's rivers at the moment!).*

Q. 'The rock cycle: Rocks can be broken down by weathering and erosion. They can then be transported and deposited somewhere else. When they build up as sediments they become squashed together to form new rock. Make a poster or patterned note of the rock cycle'

R. *This is only the sedimentary part of the rock cycle; the whole rock cycle contains igneous and metamorphic processes. Most sediments need cementing as well as 'squashing' to become new rock.*

Q. 'The rock cycle is the movement of rock from the Earth's mantle to the surface and back again.'

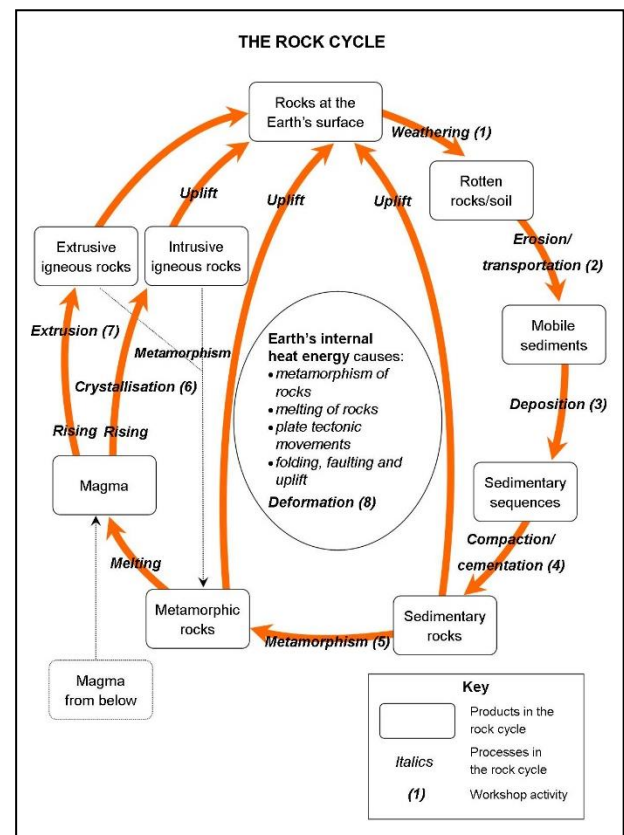
R. *No – most rock is not returned to the mantle the crust is being added to irreversibly.*

Q. 'The rock cycle takes place over hundreds of thousands of years.'

R. *Some parts of this rock cycle are quick, some happen over hundreds of thousands of years and some take millions of years.*

Meanwhile, research into student understanding of the rock cycle has shown that, 'students did not grasp the purpose of instruction about the rock cycle. Instead their responses indicate they perceive the rock cycle as the cause of rock formation, rather than a model representing relationships between rock categories and their formation. For example, when asked how a rock formed, one student responded, "It went through the rock cycle" much as laundry goes through a wash cycle – something that is done to a rock to change it.' from Ford, D. J. (2005). The challenges of observing geologically: third graders' descriptions of rock and mineral properties. *Science Education*, 89, 276-295, p375.

This sorting exercise has been designed to challenge these misconceptions.



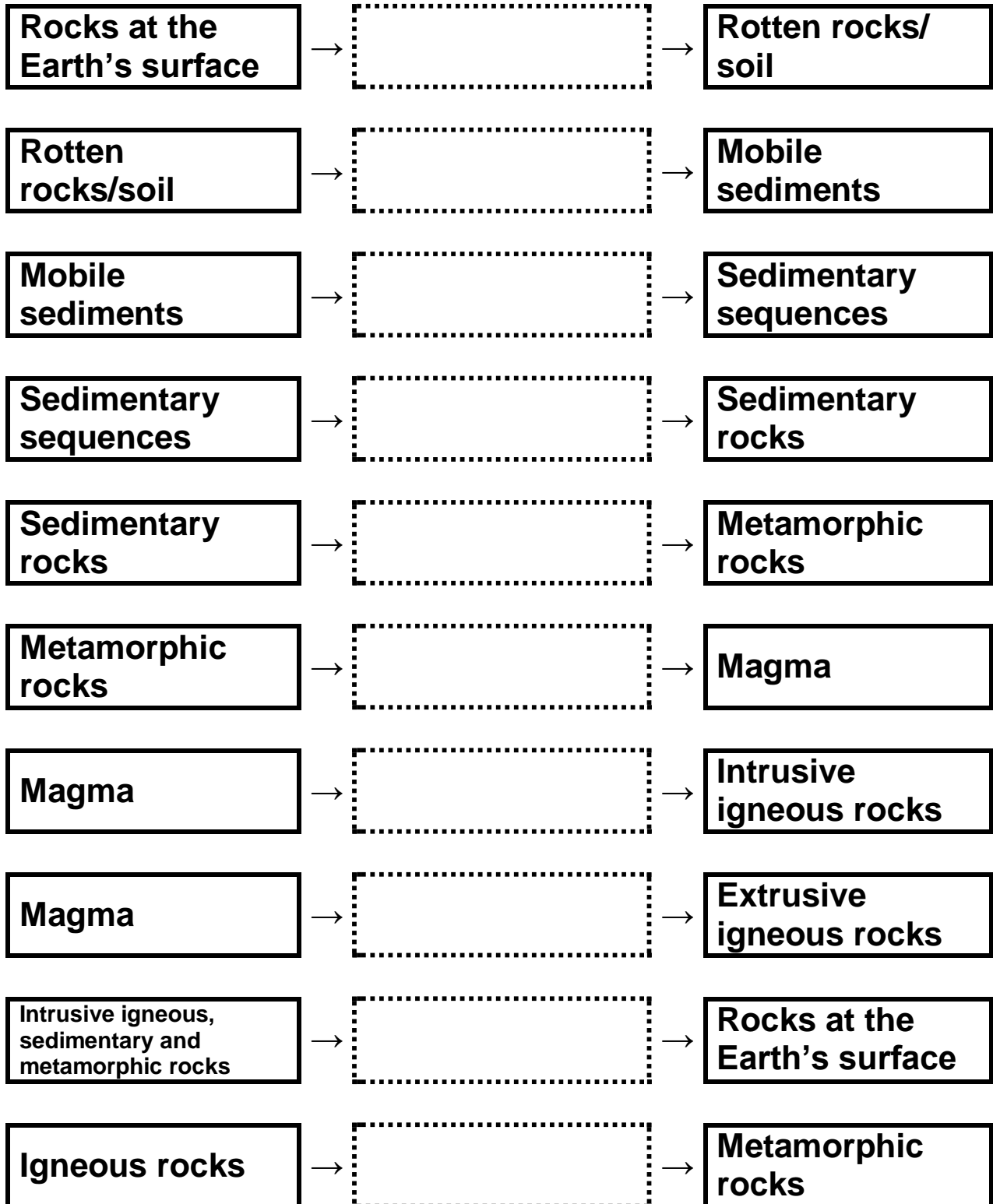
*Used with permission from the Earth Science Education Unit (ESEU).*

## The rock cycle

Cut out the process cards then:

1. Put them in the right places on the 'Sorting out the processes' sheet and check you have the best answers – then remove them
2. Put them in the best places on the 'Sorting out the rates' sheet, check, then remove them
3. Put them in the best places on the 'Sorting out the areas' sheets

### 1. Sorting out the processes (put the 'process cards' in the right places)



## 2. Sorting out the rates (put the 'process cards' in the right places)

**Geologically fast**

**Geologically slow**

**Geologically fast or slow**

[Dotted box for sorting]

[Dotted box for sorting]

[Dotted box for sorting]

[Dotted box for sorting]

[Dotted box for sorting]

[Dotted box for sorting]

[Dotted box for sorting]

[Dotted box for sorting]

[Dotted box for sorting]

[Dotted box for sorting]

[Dotted box for sorting]

[Dotted box for sorting]

[Dotted box for sorting]

[Dotted box for sorting]

[Dotted box for sorting]

### 3. Sorting out the areas (put the 'process cards' in the right places)

**Going on in all parts of the Earth all the time**

**Going on in some parts of the Earth only, eg at tectonic plate margins**

**‘Process cards’** (cut these out)

<b>Weathering</b>	<b>Erosion/ transportation</b>	<b>Deposition</b>
<b>Compaction/ cementation</b>	<b>Metamorphism</b>	<b>Metamorphism</b>
<b>Melting</b>	<b>Rising and intrusion</b>	<b>Rising and extrusion</b>
<b>Uplift</b>		

**Some answers**

**The rock cycle:**

**1. Sorting out the processes**

Rocks at the Earth’s surface	→	Weathering	→	Rotten rocks/ soil
Rotten rocks/soil	→	Erosion/ transportation	→	Mobile sediments
Mobile sediments	→	Deposition	→	Sedimentary sequences
Sedimentary sequences	→	Compaction/ cementation	→	Sedimentary rocks
Sedimentary rocks	→	Metamorphism	→	Metamorphic rocks
Metamorphic rocks	→	Melting	→	Magma
Magma	→	Rising and intrusion	→	Intrusive igneous rocks
Magma	→	Rising and extrusion	→	Extrusive igneous rocks
Intrusive igneous, sedimentary and metamorphic rocks	→	Uplift	→	Rocks at the Earth’s surface
Igneous rocks	→	Metamorphism	→	Metamorphic rocks

**2. Sorting out the rates**

<b>Geologically fast</b>
Weathering
Erosion/ transportation
Deposition
Rising and extrusion

<b>Geologically slow</b>
Compaction/ cementation
Metamorphism
Melting

<b>Geologically fast or slow</b>
Rising and intrusion
Uplift

**3. Sorting out the areas**

<b>Going on in all parts of the Earth all the time</b>
Weathering
Erosion/ transportation
Deposition
Compaction/ cementation

<b>Going on in some parts of the Earth only, e.g. at tectonic plate margins</b>
Metamorphism
Melting
Rising and intrusion
Rising and extrusion
Uplift

## The back up

**Title:** Not misunderstanding the rock cycle.

**Subtitle:** Addressing common misconceptions about the rock cycle.

**Topic:** A sorting exercise directly focussed on common rock cycle misconceptions.

**Age range of pupils:** 11 years upwards

**Time needed to complete activity:** 15 minutes

**Pupil learning outcomes:** Pupils can:

- describe the main rock cycle processes;
- explain which processes are geologically fast and which are geologically slow;

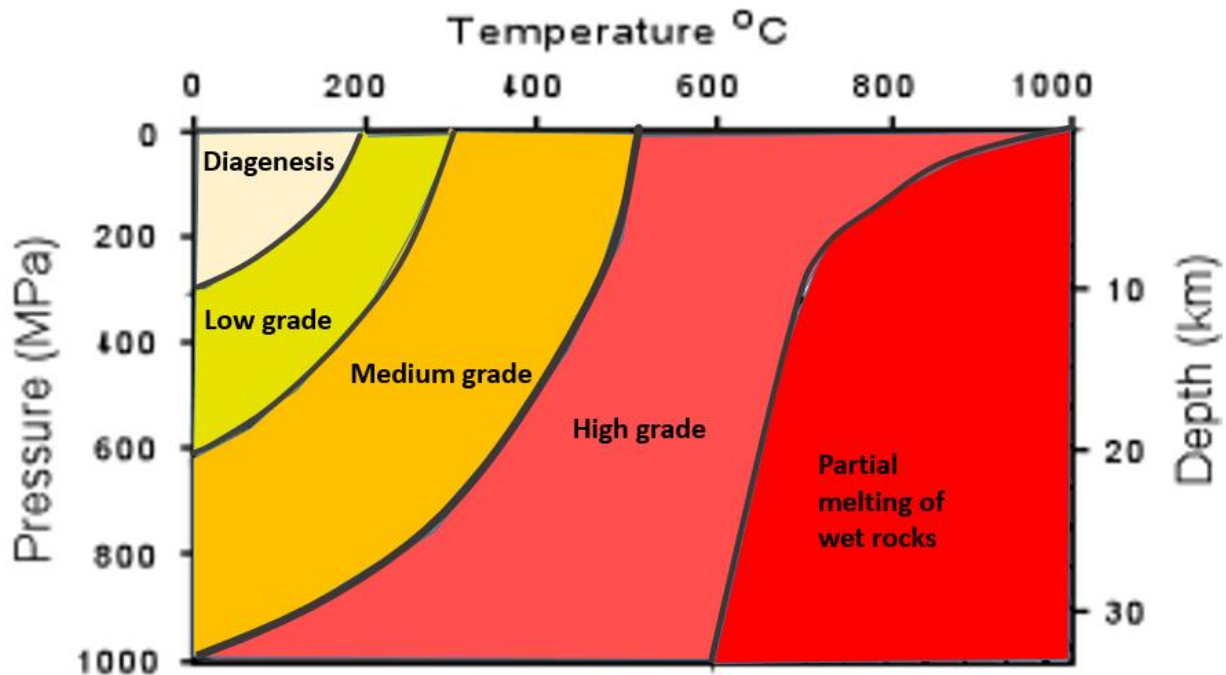
- explain which processes go on all the time, and which happen only in some parts of the Earth at certain times, such as at plate margins.

### Context:

This activity takes the educational approach known as constructivism. Through constructivism, student misconceptions are identified and directly targeted by teaching.

### Following up the activity:

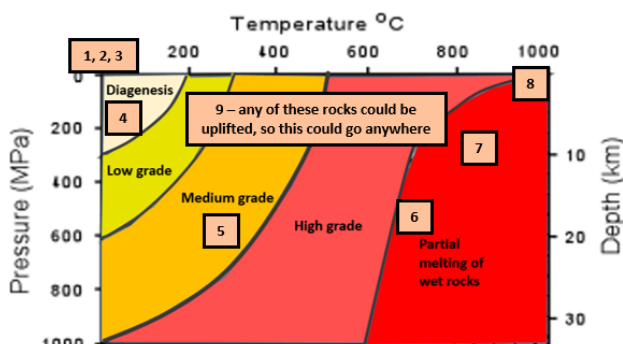
To further consolidate pupil understanding, ask them where the 'process cards' would fit on this diagram of internal Earth processes (MPa = megapascals; km = kilometres).



Note: Rocks containing water (i.e. 'wet rocks') melt at a lower temperature than dry rocks and wet rocks are the most common, which is why the wet rock melting curve is shown in this diagram. Rocks first melt partially before melting completely at higher temperatures.

Amended from diagram published by Tamtawan.p under the Creative Commons Attribution-Share Alike 3.0 Unported licence.

Likely answers – internal Earth processes diagram:



Key	
1	Weathering
2	Erosion/ transportation
3	Deposition
4	Compaction/ cementation
5	Metamorphism
6	Melting
7	Rising and intrusion
8	Rising and extrusion
9	Uplift

### Underlying principles:

- Rock cycle products are produced by rock cycle processes, as shown on the diagram on page 1.
- The rock cycle is not steady, some processes happen very quickly and others geologically slowly.
- Whilst the sedimentary rock cycle processes are acting in most land areas most of the time, internal processes are mainly confined to plate margins.

### Thinking skill development:

An understanding of the rock cycle requires high order abstract thinking skills, as shown in educational research by Kali, Orion and Eylon, as described in their paper: Kali, Y., Orion, N. & Eylon, B-S. (2003). The effect of knowledge integration activities on students' perceptions of the earth's crust as a cyclic system. *Journal of Research in Science Teaching*, 40, 6, 545–565.

**Resource list:**

- scissors to cut out 'process cards'

<http://www.geolsoc.org.uk/ks3/gsl/education/resources/rockcycle.html>

**Useful links:**

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:

There are more than twenty Earthlearningideas investigating rock cycle processes.

**Source:** Chris King of the Earthlearningidea Team.

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