

Teacher - 'What's the difference between weathering and erosion?' Addressing common misconceptions about weathering and erosion

How can you address misconceptions about weathering and erosion like those below – which were found in a recent survey of science education textbooks?

Quote Sedimentary rocks are formed from the rock fragments that are made when a rock is weathered.

Quote The rocks are weathered – they are worn away where they stand

Quote Physical weathering. In a gale, grit and sand grains carried in the wind rub and scratch the surface of the rock as they blow against it.

Quote In cold weather the water freezes and expands. The forces generated by the ice cause pieces of rock to snap off.

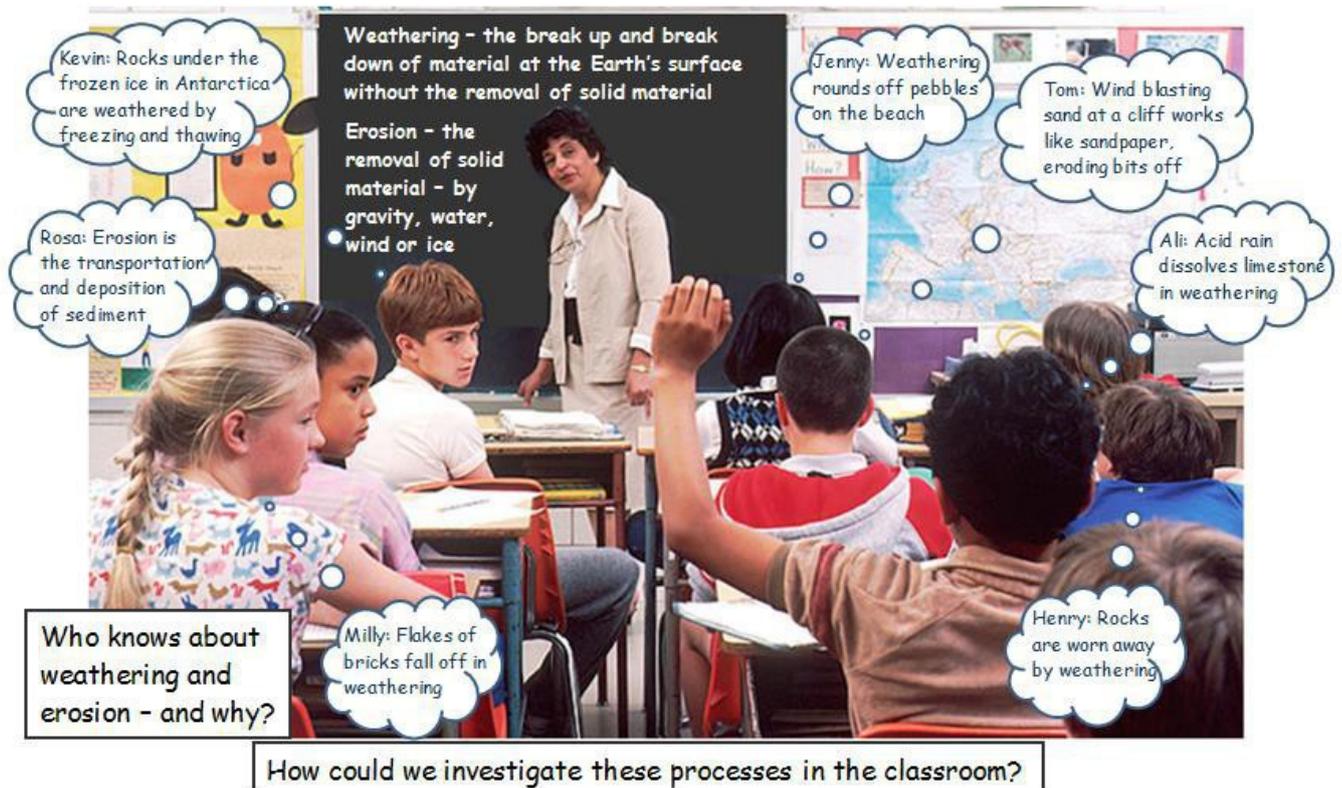
Quote Erosion. Any process that wears away rocks is called erosion. Rainwater is slightly acidic ... Some rocks are easily dissolved, eg. limestone.

Quote A diagram with the label 'weather breaks bits off the hills'

Try using a 'contrasting ideas' approach by showing your students the picture below and asking:

1. Who knows about weathering, and why?
2. How could we investigate these processes in the classroom?

If they find this difficult – ask them to note the definitions of weathering and erosion given on the blackboard in the picture.



This image was released by the National Cancer Institute, an agency part of the National Institutes of Health, with the ID 2200 (image). This work has been released into the public domain by its author, Michael Anderson (Photographer). This applies worldwide.

The back up

Title: 'Teacher - What's the difference between weathering and erosion?'

Subtitle: Addressing common misconceptions about weathering and erosion

Topic: Using a 'contrasting ideas' approach to address weathering/erosion misconceptions

Age range of pupils: 8-18 years

Time needed to complete activity: 15 minutes

Pupil learning outcomes: Pupils can:

- describe the processes of weathering and erosion;
- distinguish between examples of weathering and erosion;
- discuss how the processes can be simulated in the classroom.

Context:

Textbook surveys have shown that misconceptions between weathering and erosion are common, when the scientific consensus is clear:

- Weathering is the break up and break down (physical break up and chemical breakdown) of rocks at the Earth's surface without the removal of solid material (although material can be removed in solution)
- Erosion is the removal of solid material, by gravity, water, wind or ice (as the start of transportation).

Some responses to the statements in the picture are given in the table below:

Pupil	Statement	Correct/incorrect + comment	Possible practical activity in the classroom
Ali	Acid rain dissolves limestone in weathering	Correct: the acid rain removes the limestone by dissolving it and carrying the solute away in solution – so this is weathering.	Add vinegar, limescale remover or other acid to a cleanly-broken piece of limestone to show the reaction. In the reaction a soluble substance is produced which is then dissolved.
Henry	Rocks are worn away by weathering.	Incorrect: rocks are worn away by erosion, by gravity, wind, water or ice although they may have previously been weakened by weathering.	Putting rock samples into a plastic container and shaking – to demonstrate <u>erosion</u>
Rosa	Erosion is the transportation and deposition of sediment.	Incorrect: erosion is the initial removal of sediment – which may then be transported and deposited; it can be the start of transportation.	Adding water to a sand-filled gutter – after the sediment is eroded at the top, it is transported along the gutter and deposited in the pool at the bottom – through three distinct processes.
Milly	Flakes of bricks fall off in weathering.	Incorrect: the removal of solid material is erosion, in this case, by gravity; the flakes may have been previously weakened by weathering though.	Look for flakes of brick beneath old brick school walls – these, having been weakened by weathering, have been removed by <u>erosion</u> through gravity.
Tom	Wind blasting sand against a cliff works like sandpaper, eroding bits off.	Correct: when solid material is removed by wind – this is erosion (even though it is being done by the weather in this case).	Sand blasting can be demonstrated by a powerful electric fan directed at a pile of dry sand – but it can be very messy and anybody in the way should wear safety glasses.
Jenny	Weathering rounds off pebbles on the beach.	Incorrect: beach pebbles are rounded by erosion, not weathering – the pebbles are thrown against one another in storms, abrading one another – a process called attrition.	Putting rock samples into a plastic container and shaking – to demonstrate <u>erosion</u> .
Kevin	Rocks under the frozen ice sheets in Antarctica are weathered by freezing and thawing.	Incorrect: the physical break up of rock by ice requires many cycles of freezing and thawing; rocks beneath the Antarctic ice sheets remain frozen.	Put a similar selection of fragments of different rocks (including some permeable ones) into two different plastic boxes (eg lunch boxes) and add enough water to cover the fragments. Leave one on the table as a control. Put the other into a freezer or the freezing compartment of a fridge until it is frozen and then take it out and allow it to thaw. Examine it after this first cycle (not much will have happened). Repeat this for several cycles until the permeable rocks break up through the 9% expansion of water as it becomes ice. Then the contrast with the control is clear.

When the textbook errors below were found, corrections were written using a similar number of words and a similar level of language and these were sent to the publishers of the textbooks in question. The corrections written for the quotes above are given below.

- Quote Sedimentary rocks are formed from the rock fragments that are made when a rock is weathered.
- Correction* *Rock fragments that form sedimentary rocks have been formed by erosion. [Note: The unusual sedimentary rock laterite is formed by the weathering of rock fragments under sub-tropical conditions.]*
- Quote The rocks are weathered – they are worn away where they stand.
- Correction* *Wearing away of rocks is erosion.*
- Quote Physical weathering. In a gale, grit and sand grains carried in the wind rub and scratch the surface of the rock as they blow against it.
- Correction* *Erosion. In a gale, grit and sand grains carried in the wind rub and scratch the surface of the rock as they blow against it.*
- Quote In cold weather the water freezes and expands. The forces generated by the ice cause pieces of rock to snap off.
- Correction* *When it is cold the water freezes and expands, when it is warmer, it melts again. The freezing and thawing weakens the rock until it snaps off. [Note. Rocks are not broken by one freezing episode].*
- Quote Erosion. Any process that wears away rocks is called erosion. Rainwater is slightly acidic ... Some rocks are easily dissolved, eg. limestone.
- Correction* *The dissolution of limestone is weathering, not erosion.*

- Quote Diagram with the label 'weather breaks bits off the hills'
- Correction* *Bits are broken off, not by the weather but in erosion by water, wind, ice or gravity - weather only loosens the material during weathering.*

Following up the activity:

Pupils could check their own textbooks for misconceptions like these.

Underlying principles:

- Weathering is the break up and break down (physical break up and chemical breakdown) of rocks at the Earth's surface without the removal of solid material (although material can be removed in solution).
- Erosion is the removal of solid material, by gravity, water, wind or ice (and is the start of transportation).

Thinking skill development:

Through using the 'contrasting ideas' approach, pupils have to think about their own mental construction of the terms 'weathering' and 'erosion' and test these against potentially wrong ideas through cognitive conflict.

Resource list:

- the picture, preferably reproduced at A4 size, as on page 4, and laminated

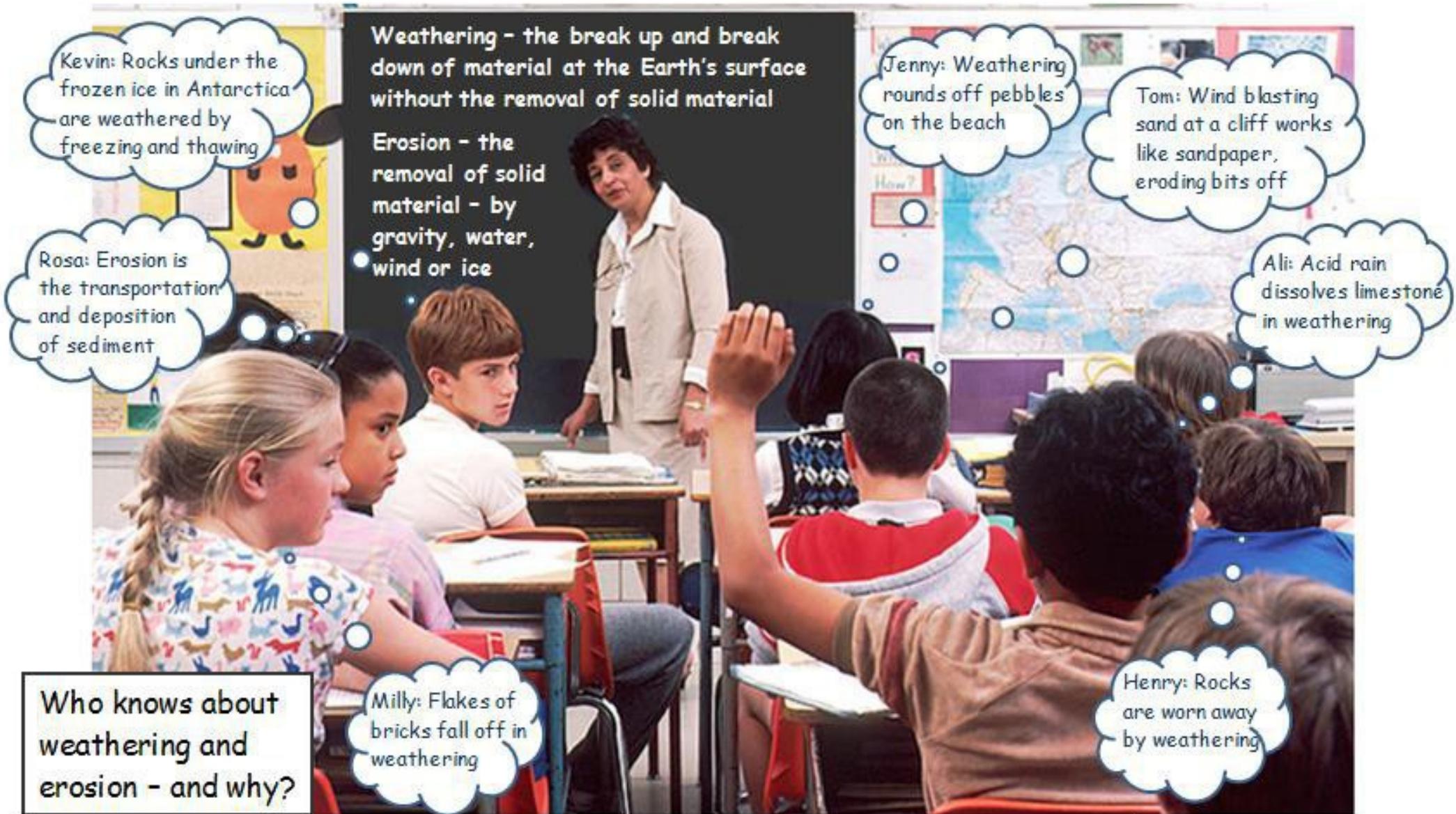
Useful links:

Pupils could search for other misconceptions about weathering and erosion on the internet by using the terms, 'weathering erosion misconception'.

Source: Devised by Chris King of the Earthlearningidea Team, based on the 'Concept Cartoon' idea developed by Brenda Keogh and Stuart Naylor, see: <http://www.conceptcartoons.com>

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Who knows about weathering and erosion - and why?

How could we investigate these processes in the classroom?

