Geological postcards 2 – sandstone and limestone
Picture postcard puzzles

You may have studied the common rock types, sandstone and limestone. You will know that they have much in common because both:
- are sedimentary rocks;
- were first laid down as layers of loose grains and were later compacted and cemented to form rocks;
- may contain fossils;
- may be quite soft and crumbly, but may also be well cemented and resistant.

The main differences are that:
- limestones are mainly composed of calcium carbonate and sandstones are mainly composed of silica (or silicon dioxide);
- the calcium carbonate mineral in limestones is usually calcite, and the silica mineral in sandstones is quartz;
- well-cemented limestones and most sandstones are usually cracked. In limestones, water dissolves the rock as it trickles down through the cracks and so it widens them. Most limestones are therefore permeable, but hard sandstones are impermeable;
- the most common 'cracks' in both limestones and sandstones are the parallel sets of cracks called joints – joint sets in limestones and sandstones are usually vertical;
- underground streams often occur within limestones, but not sandstones;
- when limestones are weathered, a thin alkaline soil is usually left above, whereas weathering of sandstones results in acid soils and peat often forms on them.

Limestone with shelly fossils *(Photo: Peter Kennett)*

Coarse sandstone *(Photo: Peter Kennett)*

Because of the differences, the landscape that develops on sandstone bedrock may be quite different from that formed on limestone.

Study each postcard (see page 3). One shows landscapes that have developed on hard sandstones and the other on well-cemented limestones. Try to decide which is which and explain the reasons for your decision.

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The back up:

Title: Geological postcards 2 – sandstone and limestone

Subtitle: Picture postcard puzzles

Topic: Using 'postcards' of landscape features as clues to the nature of the underlying rocks.

Age range of pupils: 14 -16 years

Time needed to complete activity: 10 minutes

Pupil learning outcomes: Pupils can:
- relate a list of properties of two different rock types to photographs of these rocks;
- understand the relationship between the physical and chemical properties of rocks and the characteristic landscapes which have developed on each of them;

- explain that the exploitation of useful resources depends on the nature of the rocks;
- be stimulated to try to understand landscapes in their local area or when they are on holiday elsewhere.

Context: This activity can be used as a revision exercise in the properties of different rock types. It can also help to bridge the divide between science and geography in schools. The real locations of the photographs are:

LIMESTONE:-
The Green Bridge of Wales, © Manfred Heyde
Permission is granted to use this document under the terms of the GNU Free Documentation License http://en.wikipedia.org/wiki/en:GNU_Free_Documentation_License Version 1.2)
Limestone pavement with 'clints (ridges) and grykes' (furrows), near Austwick, North Yorkshire (PK):
Stalactite formation, Ingleborough Cave, Clapham, North Yorkshire (PK):
Tunstead Quarry, near Buxton, Peak District.
Image taken from the Geograph project. © Peter McDermott. This work is licensed under the Creative Commons Attribution-Share Alike 2.0 Generic License.

SANDSTONE:-
Carbonifeous sandstones in a quarry above Crowden, Peak District (PK):
Sea stack in Old Red Sandstone, Old Man of Hoy, Orkney (PK):
Moorland developed on Carboniferous age sandstones and shales, Burbage Edge, Peak District (PK):
Cross-bedded sandstones of Old Red Sandstone age, Eday Island, Orkney (PK)

Following up the activity:
The landscape of the area around the school can be related to the underlying geology, using the local geological map, rock samples and photographs. Pupils could be taken on a local field excursion to examine landscapes and geology at first hand.

Underlying principles:
- Well-cemented (hard) sandstones and limestones both usually form upland country inland and headlands at the coast.
- Well-cemented sandstones are largely impermeable, so there are many surface water features such as rivers, streams and lakes. Boggy ground with peat, reeds and coarse grass is common.
- Well-cemented limestones are permeable because of their well-developed joint sets, so there is very little surface water and valleys that may have formed in earlier times are now largely 'dry'.
- Rainwater becomes acid by trickling through plants and soil. As it passes through limestone it reacts with the calcium carbonate and carries it away as dissolved calcium hydrogen carbonate.
- Stalactites (hanging down) and stalagmites (growing up) may form in spaces below ground where the above reaction is reversed.
- Underground streams and caverns are common within well cemented limestone country.
- Limestone is a source of calcium carbonate. This is needed by the chemical industry, for lime-making and in the manufacture of cement powder.
- Many sandstones are 'freestones', i.e. they can readily be cut into blocks for use in the building industry.

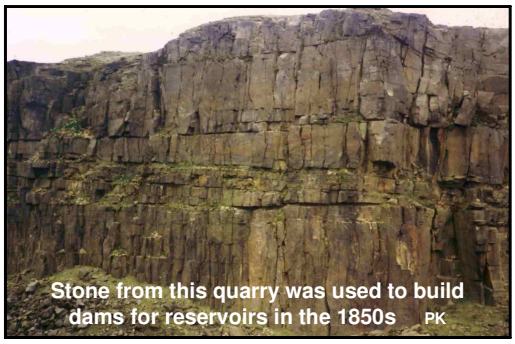
Thinking skill development: Pupils study the photographs to build up a cognitive pattern. Cognitive conflict may occur in matching the properties of the rocks to the postcards. If pupils follow up the activity by relating rock types to other landscapes, bridging skills are involved.

Resource list:
- class sets of 'postcards' and photographs of sandstone and limestone printed from these sheets;
- (optional) samples of sandstone and limestone to accompany the photographs.

Useful links:
The website of the British Geological Survey contains an extensive library of excellent photographs of landscapes and geological features, and geological map extracts, which may be freely used in the classroom situation. See http://www.bgs.ac.uk/opengeoscience/home.html
Teachers in countries other than the U.K. may prefer to use a search engine to find photographs of rocks and landscapes in their own country and under their own climatic conditions.

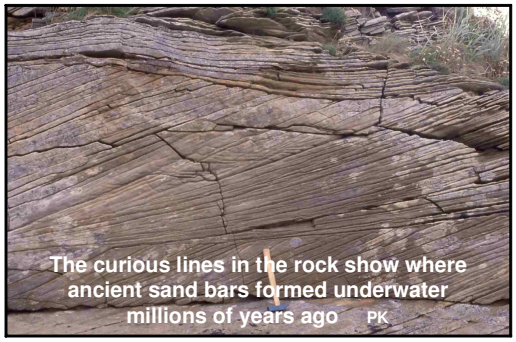
Source: Devised by Peter Kennett of the Earthlearningidea team.

Postcard 1

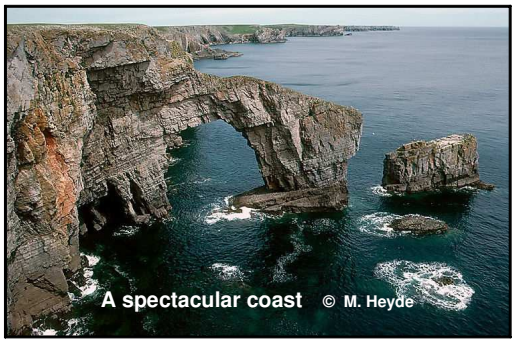

Stone from this quarry was used to build dams for reservoirs in the 1850s PK


Climbers enjoy the challenge of reaching the top of this sea stack, 137m above the sea PK

Misty moorland with vegetation of bracken, coarse grass and reeds PK

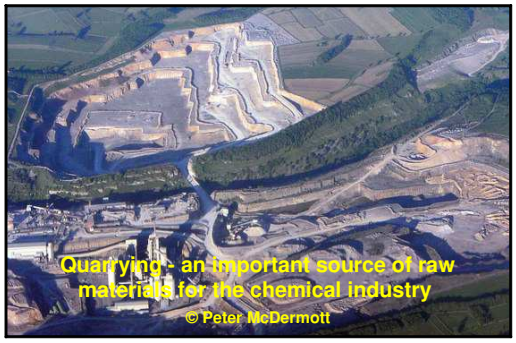

The curious lines in the rock show where ancient sand bars formed underwater millions of years ago PK

Postcard 2


A spectacular coast © M. Heyde


A natural 'pavement' with cracks enlarged by weathering PK


'Queen Victoria's bloomers' Some fascinating shapes are formed underground as water trickles through the rock PK


Quarrying - an important source of raw materials for the chemical industry
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