

© UKRIGS Education Project: Earth Science On-Site

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In-school learning in preparation for field visit to Barrow Hill.**List of the concepts needed**

KS3 knowledge and understanding of geological processes should form the basis of the preparatory lesson(s) in school within the 1 to 2 weeks prior to the field visit.

KS3 geological processes**Time: 80 minutes**

In broad terms KS3 'geological processes' is the study of the 'Rock Cycle'.

Learning objectives for KS3

1. be able to describe and explain ways in which rocks are weathered
2. be able to observe and describe the key features of a rock specimen, including colour, texture and mineral content
3. be able to classify specimens of common rock types, using observed features, as igneous, sedimentary or metamorphic, and name such common rock types
4. be able to describe and explain how sedimentary rocks may be formed by processes including the erosion, transport and deposition of rock fragments
5. be able to make reasonable suggestions as to how a common sedimentary rock type they have described was formed, and how long the process took.

1. Weathering (10 minutes)

As the basis of a brief question and answer session, use photographs of rocks that have suffered weathering. Suggested images:

- boulder(s) showing onion-skin weathering
- boulder(s) split in half – e.g. Devil's Marbles
- jagged, broken rocks on mountain ridges, preferably with patches of snow still visible.

An internet search yields many possible images for classroom use. Examples:

<http://www.geos.ed.ac.uk/undergraduate/field/holyrood/spheroids.html>

http://academic.brooklyn.cuny.edu/geology/leveson/core/topics/weathering/picturegallery/display/newjerseygarrret_mt_1.html

<http://www.au.au.com/cameras/images/devils-marbles.jpg>

http://www.thewalkzone.co.uk/Lake_District/walk_36/180203h.jpg

Some internet images provide useful background discussion about the weathering mechanisms involved. Tasks in small groups: show the pupils the photographs and give them one minute to come up with suggested causes of the weathering depicted in each image. There is probably no single 'correct' answer in any of these situations because weathering is rarely one process operating on its own. Weathering is usually caused by a combination of physical and chemical weathering processes. It is the pupils' suggestions and subsequent discussion generated that are important. If pupils do not suggest chemical weathering, the teacher may need to pump-prime the discussion by asking them whether chemical changes might be possible in any of these examples.

2. The rock cycle (35 minutes)

This session is based on the rock cycle. A simplified pictorial version of the rock cycle should be used in the session and this diagram can be downloaded from:

<http://www.washington.edu/uwired/outreach/teched/projects/web/rockteam/WebSite/rockcycle.htm>

Activity 1: provide a set of six common rock types (sandstone, shale, conglomerate, granite, dolerite/basalt with crystals just visible, slate or schist or gneiss). Tasks in small groups:

- agree key features of each specimen (colour, texture, etc), and how the grains are held together (which allows them to identify whether they are sedimentary, or igneous or metamorphic).
- provide a set of name labels; groups have to decide quickly which label belongs to each specimen, and be able to justify (for able groups, provide more name labels than specimens!)
- plenary agreement on correct labelling and why the name label is appropriate.

Activity 2: teacher shows quick demonstrations of:

(1) sedimentation jar filled with water then 3 charges of different sediment (the last one being muddy to show slow fall of sediment)

(2) a volcano in a laboratory. This demonstration of a volcano uses wax and sand. See http://www.earthscienceeducation.com/workshops/rock_cycle/volcano.htm for details of the volcano demonstration.

NOTE: The Barrow Hill quarries worked an igneous rock which formed below the “Dudley Volcano” about 300 million years ago. The volcano itself is not longer visible as it is eroded away. However, in order to visualise the relationships in the field, pupils should be prepared by becoming familiar with the surface and sub-surface “anatomy” of a volcano. Suitable resources for this preparation include video footage of eruptions, block diagrams of volcanic features at the surface and underground, as well as the “volcano in the lab” demonstration from the key stage 3 ESEU workshop referred to above.

(3) effects of pressure on rocks. This simulation of the distortion of fossils by metamorphism uses modelling clay and cockleshells. Details are available at:

<http://www.earthscienceeducation.com/workshops/rockcycle/metamorphism.htm>

Task for small groups using the rock cycle diagram:

- decide what part of the rock cycle each demonstration is modelling
- decide at which point in the rock cycle each specimen would have been formed
- agree on the rough timescale needed for each rock type to have been formed, including the difference, for sedimentary rocks, between time for deposition and time for a deposit of loose sediment to be turned into a hard rock, and also how that may happen.

Activity 3: How did sediment become hard rock? This can be modelled for sandstone, as shown on the JESEI website at:

<http://www.chemsoc.org/networks/learnnet/jesei/sedimen/index.htm>

3. Sedimentary processes (35 minutes)

Activity 4: pupils place cubes of sugar in a closed container and shake for 30 seconds and then observe changes to the shape and size of the cubes. Repeat activity at 30 second intervals, weighing & measuring the cubes at each stage. Tasks in small groups:

- decide what is the cause of the changes they have observed
- decide what part of the rock cycle is modelled in the experiment
- agree what will affect the degree of rounding and size reduction of rock fragments in the rock cycle.

Activity 5: provide three piles of sediment (one of gravel, one of soil and one of sand) and watering cans for pupils to use to pour water over the sediments to see how far the water spreads the sediment. Tasks for pupils work in small groups:

- agree what needs to be done to ensure the test will be a fair test
- pour 2 litres of water slowly over each pile of sediment
- observe what happens and measure how far the water spreads each pile
- agree which type of material was spread further
- predict what would happen if they poured 4 litres of water over each pile of sediment.

Activity 6: teacher shows demonstrations of river erosion, transport and deposition using a child’s slide extension or a very long tray covered with a sand and gravel (pea-sized) mixture.

Tasks for pupils in small groups:

- decide how the different types of sediment are moved along the river bed in this model
- agree where erosion takes place and what evidence shows that erosion has occurred here
- agree where deposition occurs and why deposition occurred at this place
- decide what different results they could expect to see if (a) the slope of the tray is increased and (b) a greater volume of water is poured into the tray.

Activity 7: teacher shows a demonstration of the formation of ripple marks using a fish tank (approximately 100cms long, 50cms deep and 50cms wide) and two wooden cylinders 3cm diameter and slightly longer than the width of the tank

Put clean, well sorted sand of fine to medium grain size into the tank, sufficient to line the floor of the tank to a depth of several cm. Place the tank on the wooden rollers, and fill the tank with water to a depth of 15-20cm. Gently and rhythmically rock the tank back-and-forth in an oscillatory motion until ripples form on the sediment surface. (This does not take long, but there is the potential for disaster if the tank is rocked too vigorously!)

Details of **Activities 5 and 6** (and of related practical activities) are available at:

<http://www.kented.org.uk/ngfl/subjects/geography/rivers/Teacher%20Plans/whatiserosionanddeposition.htm>

PREPARATORY HOME WORK

Prior to the **On-Site** visit to the Barrow Hill Site a suitable preparation is to raise pupils' awareness of the use of stone in the built environment. Set a homework exercise to list as many different uses of stone that they can see in suitable places. This might be on their way home from school, around school buildings, a local park, shopping centre or monument etc. Stress this is an exercise in observation, and a competition to see who can find the most examples.

Some of the less obvious examples pupils might find are: **clay** used to make bricks and tiles; **silica sand** used to make glass; **road metalling** stone gravel bonded with bituminous material to surface roads; **limestone**, and other minerals used to make concrete and cement.

FOLLOW-UP WORK

1) The data collected at St Mark's churchyard could be used to follow up the ESO-S visit by graphing and presenting the combined data for all of the groups, and discussing the degree to which the different hypotheses on weathering of headstones can be supported. Discussion of the nature of more objective and more subjective methods of data collection on the results could be included, along with the effect of having a larger data set.

2) Alternatively, after the **On-Site** visit, as a homework exercise, pupils are asked to describe in detail two different uses of stone as part of a survey of building stone in the local area.

The term "building" may need to be very loose. Suitable sites could include a local church, gravestones (helpfully dated), school buildings, local walls, high street shop fronts, kerbstones, cobblestones, local monuments, bridges, and the pupil's own home. In some areas concrete, cement and bricks could be designated as "man-made" stone for the purpose of this exercise.

Teachers (or pupils) should identify two sites to work on (perhaps taken from the preparatory homework exercise above). Remind pupils about situations where permission is required, and appropriate behaviour is expected. Also, draw attention to thoughts about safety, especially if kerbstones, or a cobbled road is chosen.

Pupils should record:

- the location or address of the building / construction;
- a sketch of the relevant part of the site, labelling the rock being surveyed, and the use to which it has been put;
- a description of at least two different rocks (perhaps on two buildings) and the use to which they have been put. For each describe the rock, identify it as igneous, metamorphic, or sedimentary, and give the properties that make it suitable for their purpose;
- finally record the evidence for the effects of weathering on the chosen rock, identifying the kind of weathering responsible, giving the reasons for their conclusion.

A suitable copy of homework record sheet for the follow-up exercise can be found on the following page.

