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Recommended preparation prior to field work:
At an early stage, a preparatory visit is essential, not only to familiarise yourself with the Earth science aspects but also the wildlife potential of the area.

It is assumed that, prior to this visit, schools will have already undertaken class-based activities related to rocks and possibly soils. The following packs, published by ESTA, were written to support the QCA Guidance, Unit 3D **Rocks & Soils**. These, and the additional activities listed, will give teachers and pupils a useful vocabulary and introduce Earth science concepts in a practical way. Many can then be put into context by investigating the ancient world largely hidden in the rocks beneath our feet. "**Working with Rocks**" provides useful background on the rock cycle and explains the terms igneous, sedimentary and metamorphic rocks. In both packs porosity and permeability are clearly defined. The UK Geology Wall Map, published by the Ordnance Survey would be useful additional reference material. Teachers may wish to introduce soils as part of the field visit, collecting samples for later investigation.

'**Working with Rocks'** includes the following activities:

1. Sequencing – story of a marble gravestone (literacy).
2. Sorting rocks – using different criteria, incl texture, colour.
3. Rock identification – using key terms as clues, introducing names of common rocks.
4. Testing rocks – testing for porosity, permeability and "hardness". Making wells.
5. Weathering – how to weather your own rock by freeze/thaw.
6. Use of rocks – devising a town trail & showing the use of building materials.

'Working with Soil' includes the following activities:

Science/Geography:
1. Looking at soil - see, feel, smell, content & properties.
2. Separating soils - by sieving dry.
3. Separating soils - by settling in water.
4. Porosity - water held in pore spaces.
5. Permeability - rate of water draining through.
6. Soil erosion - with or without vegetation cover?

There are also four Literacy and five Numeracy activities based on a storybook about a family of worms! Work on maps includes scale and compass points.

Additional activities:

1. To model layering in sedimentary rocks by settling in water – a demonstration.

Collect samples of different coloured sand, silt, and a few broken shells. Mix each sample with water in a beaker. Half fill a transparent tank or plastic jar with water. Ask the children to predict what will happen when material is tipped in. Carefully pour one beaker at a time into the larger container. Observe the settling of the sediment. Do not disturb. Pour in another beaker and observe. Repeat, using shells and the remaining samples. Note that clay in any of the samples will remain in suspension, make the water cloudy and take ages to settle. The sediment will be layered. Ask the children which is the oldest layer (the one on the bottom). Which is the youngest layer? (the one at the top).

Geologists call this 'the law of superposition' and it helps them to work out the order of a sequence of events as shown by the rocks.

2. Fossils.

It is unlikely that fossils will be seen on the visit, but children are interested in them and they are a significant part of interpreting Earth science. The definition of a fossil is:

> **"A fossil is the remains or trace of an animal or plant which lived in the distant past and is now found preserved in rocks. A body fossil is the altered remains of an animal or plant itself, eg shell, bone, leaf. A trace fossil is the trace left behind by an animal, eg footprint, burrow".**

Your local museum may have specimens to loan to schools. There are also many reference books available for children.

See also: Teaching Primary Earth Science **Issues 1 – Fossils**; and **22 – Putting Fossils into the National Curriculum.** Making plaster casts of fossils is one activity children enjoy.

3. To model geological time.

There are several ways of demonstrating the immensity of geological time.
The Earth was formed about 4,600 million years ago. Use a paper roll or string to make a time line. At a scale of 1cm to 1 million years it will be 46 metres long. To fit your classroom, you may need to reduce the scale in the oldest part. The names and dates of the geological periods of the last 570 million years, with significant events, are illustrated in column form on the UK Geology Wall Map, published by the Ordnance Survey. The advantage of a column is that the older are below the younger!

Other comparisons involve using a 24 hour clock or a calendar year.
See also: Teaching Primary Earth Science, **Issue 43 – Geological Time**.

4. Modelling igneous rocks.

This can best be done as part of "Changing materials" – liquids to solids by cooling. Children are likely to have some first-hand knowledge from home, school, holidays, with additional input from TV , including news. Examples include water to ice where children can see the crystals. Chocolate, toffee & sugar-based sweets show solidification on cooling & may show crystallisation. Industrial melting in furnaces and subsequent cooling happens in iron & steel making, glass making.
Magma [molten rock] comes from volcanoes as flows of lava, often full of gas bubbles. It cools rapidly on land or under water as a glass or pumice (glass froth). Such rapid cooling results in microscopic crystals. Magma cooling slowly at depth beneath mountain chains produces rocks with larger crystals eg granite and gabbro.
Magma cooling nearer the surface in fractures form dykes of rock with small-medium crystals, eg dolerite. Crystallisation from a watery solution by evaporation is slightly different.
Useful illustrations include active volcanoes, ancient lava flows (Giant's Causeway etc), granite tors on Dartmoor etc. See also **Working With Rocks**.

5. Modelling the Pressure effects of Metamorphism.

The pressures suffered by rocks during metamorphism in plane collisions is immense. The minerals in the rocks accommodate the pressure by re-aligning themselves at right angles to the pressure. This is how muddy rocks become slate, and the new direction of splitting is called cleavage (see Figure 1).

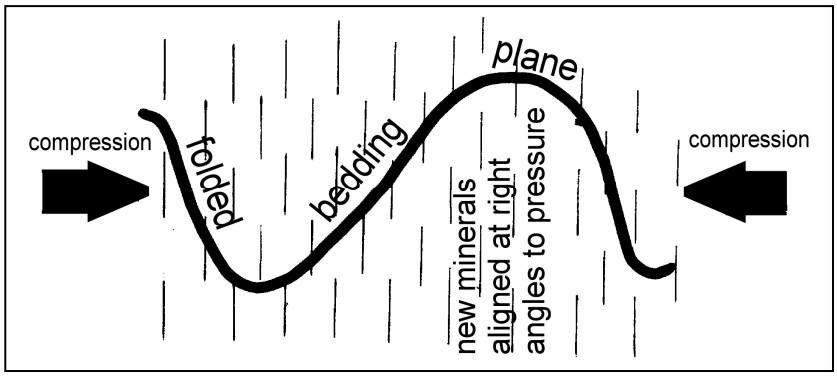

Figure 1. Diagram of Cleavage and Bedding Planes.

To demonstrate this you need a flat surface, two pieces of wood, or books, about 40 matchsticks [beheaded] or short lengths of drinking straw. For a large group this demonstration could be done on an Overhead Projector screen. Lay the books about 10cm apart. Scatter the sticks/straws randomly between them. This represents the unsquashed clay minerals as found in mudstone etc. Ask the children to predict what will happen when the books are pushed towards each other. Gently push the books together (as in plate collision), and observe how the straws/sticks behave (see Figures 2a and 2b).

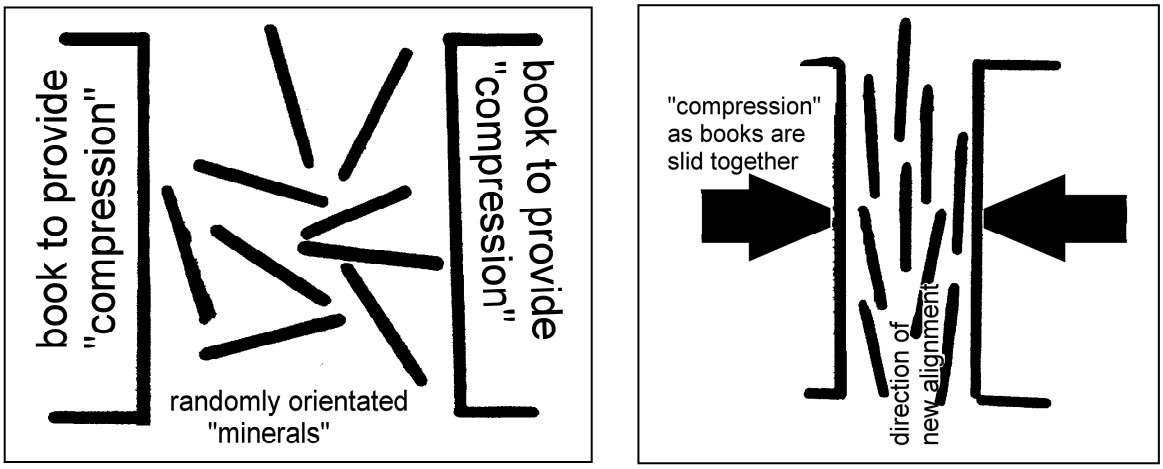

Figure 2a. and 2b. Demonstration showing cleavage formation.

You should end up with the straws aligned more-or-less in the same direction (see Figure 2b). This represents the mineral alignment found in slate and how they tend to split easily in one plane.
Ask the children what will happen when the pressure is removed.
They stay in the same alignment, don't rebound, these rocks are not elastic. With straws you can go further and actually crush them flat. What would happen if you used a vice?
With sandy rocks, the quartz grains tend to be rounded and hard. They do not compress much and tend not to develop cleavage. Perhaps try to demonstrate this using hard balls.

For Teacher Reference
The following issues of Teaching Primary Earth Science provide useful background information for a visit to Mosedale:

1 - Fossils	2 - Introducing Rocks	3 - Soil
5 - Using Rocks	9 - Minerals	10 - Out and About 1
12 - Out and About 2	20 - Out and About 3	24 - Out and About 4
25 - Out and About 5	37 - Organising Field Trips	

Cut and varnished samples of the common rocks found in the Mosedale area would be useful for detailed identification.

Mosedale KS2 Suggested Follow-up Work.
Much material could go into a folder on the Mosedale Valley, being the first part of a wider study, adding later sections on soils, vegetation, wildlife, conservation, recreation and quarrying.

1. Completion of all worksheets:
- *Site A pupil worksheet 1 Mungrisdale Village Hall looking at building stones.
- *Site B pupil worksheet 3 Mungrisdale lime kiln.
- *Site C pupil worksheet 3 Drystone walls at St. Mungo's House.
- *Site D pupil worksheet 4 School House Quarry and dykes.
- *Site E pupil worksheet 5 Naming rocks at Mosedale Quarry (gabbro).
- *Site F pupil worksheet 6 Investigating scree at Stone Ends Quarry.
- *Site G pupil worksheet 7 Studying pebbles at Long Hill Quarry.

2. Classroom display of all aspects of the field visit, including maps, diagrams and photographs. Samples of rocks could be displayed, showing a broken, fresh face, suitably labelled. Sample may be cut (by an adult with a DIY tile cutter) and varnished to bring out the detail, possibly showing layering and fossils within the sedimentary rocks. Recognisable fossils may be identified using reference books and making plaster casts of fossils is an enjoyable activity (see preparation notes).

3. Demonstrate layering in sedimentary rocks as described in preparation, including fine and coarse sand, broken shells etc. Put results into the display, with samples of both limestones (as in 2) and other sedimentary rocks you may have to hand. Include photographs from Mosedale and elsewhere (including postcards).

4. The display could include the UK Geology Wall Map with mosedale marked on it. Rock samples children collect from further afield could be added to the display, with labels and markers linking the sample to the location on the map.

5. Research into quarrying in Mosedale and elsewhere. Aspects to focus on include: size, depth, benching, blasting, dumper trucks, crushers, road and significant use of rail transport, environmental impact, reclamation, jobs etc.
Collect some data on tonnages and usage (see website below) and relate to other quarrying local to the visiting school.
Visit the Quarry Products Association website to view the "Virtual Quarry"
www.qpa.org or www.virtualquarry.co.uk

6. Research into uses of limestone - in the local area and further afield. Incorporate into classroom display. Where does all the limestone go to? (See **PEST 38 - Limestone – The world's most useful rock**).
Early use of limestone was as a building stone in churches and houses, as well as for walls and bridges; used to neutralise acid soils and as a flux in iron furnaces, partly powered by water. More recently limestones have been burnt with shale or clay to make cement; and the harder Carboniferous limestone has been used as aggregate for roadstone, sometimes being coating with bitumen, and also as railway ballast. It has been used in making iron and steel, and glass; as a filler in paint, plastics and rubber; neutralises acid soils and power station gasses; even used in animal feeds and in flour and toothpaste!

Take photographs of any examples of these rocks being used and include them in a classroom display.