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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. Use information available from the Dartmoor National Park website and the publication "**Exploring a Dartmoor Valley – The Meldon Beneath our Feet**".

There are toilets [including disabled] at Meldon Reservoir Car Park and at Meldon Station when the café is open.

The teacher will need to decide whether to include the experience of a train ride from Okehampton Station to Meldon station on the preserved Dartmoor Railway [See **MAQ3 locaccess** for contact details]. The teaching trail can then start from Meldon Station. If using minibuses, however, park at Meldon Reservoir Car Park. Here, the trail is written to start from the car park, but parties starting at Meldon Station would begin at site "F" and complete the cycle from there. There is **no parking** at Meldon Station.

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, including 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 and showing the use of building materials.

'***Working with Soil'*** includes the following activities:
Science/Geography:
1. Looking at soil - see, feel, smell, content and 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).

A similar model could be the daily disposal of rubbish over a week. If collection is made early on Monday morning the rest of Monday's rubbish will go into the bin and reach the bottom. Tuesday's rubbish will be next, on top of Monday's, followed by Wednesday's ……..etc, with Sunday's rubbish on top - the last in the bin and youngest!

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.
"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 older are below 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 - see the crystals.

Wax and fat can be melted.
Chocolate, toffee and sugar-based sweets show solidification on cooling and may show crystallisation. Some are solidified froth or bubbles, like pumice!
Industrial melting in furnaces and subsequent cooling – iron and steel making, glass making.
A model volcano can be made by utilising a mixture of baking powder, liquid detergent and red food colouring in the neck of a model volcano and adding vinegar. The eruption produces a red carbon dioxide froth, which trickles down the model!
In bakeries soft materials like cream and jam are injected into dough under pressure, as in doughnuts and profiteroles. Cream eggs are made in the same way.
Compare the result with magma!

Magma [molten rock] cooling slowly at depth beneath mountain chains produces rocks with larger crystals eg granite.
Magma cooling nearer the surface forms rock with small-medium crystals, eg dolerite.
Magma reaching the surface at 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.
Useful illustrations include active volcanoes [Hawaii, Tenerife etc], ancient lava flows [Giant's Causeway etc], granite tors on Dartmoor etc. See also Working With Rocks.
Crystallisation from a watery solution by evaporation is rather different.

5. Modelling metamorphism – baking clay
Hot molten magma loses heat to the surrounding rocks as it cools and crystallises. This baking of rocks is known as metamorphism. When clay-rich rocks are baked they re-crystallise and harden. This has happened at Meldon when the Dartmoor Granite and Meldon microgranite [aplite] baked the mudstones at the end of Carboniferous times. Limestone recrystallises to form marble during metamorphism.
If the school has a pottery kiln, this could be a useful time to link with Art.
A sample of clay can be tested before firing, and the children asked to predict the outcome of firing. Fired clay is shrunk, hard, has little water and is only slightly porous. If glazed in a second firing it is no longer porous. Link to the use of bricks and tiles in buildings.
In the BBC "Come Outside" series Auntie Mabel and Pip visit a brickworks.

For Teacher Reference
The following issues of Teaching Primary Earth Science provide useful background information for a visit to Meldon Valley:
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.
Samples of Meldon rocks should be included in your collection. See follow-up suggestions.

Meldon KS2: Suggested Follow-up work
Much material could go into a folder on the Meldon Valley, being the first part of a wider study, adding later sections on soils, vegetation, wildlife, conservation, recreation and quarrying. Exploring a Dartmoor Valley – The Meldon Beneath our Feet is useful background. Also, check the Dartmoor National Park website.

1. Completion of all worksheets [from the Teaching Trail notes]
- ***Map of sites in the Meldon Valley.**
- ***Rock Reference Sheets. 2 versions - use as appropriate.**
- ***Site A(i to iv) worksheets [4 versions] - Identifying stone blocks in walls.**
- ***Site B worksheet - At Meldon Dam Viewpoint.**
- ***Site C worksheet - Meldon Pool, Spoil tip & Lime kiln.**
- ***Site D worksheet - Boulder field.**
- ***Site E(i & ii) worksheet - Meldon Aplite Quarry.**
- ***Site F worksheet - Meldon Station and Viaduct.**
- ***Site G worksheet - Meldon Viaduct Viewpoint.**
- ***Site H worksheet - Railway Bridge - Weathering.**
- ***Site J (i & ii) worksheet - Railway cutting.**

The Summary Worksheet may be used instead of the previous worksheets if this is thought appropriate.

2. Classroom display of all aspects of the field visit, including maps, diagrams and photographs. Samples of rock collected should be displayed, showing a broken, fresh face, suitably labelled. Any sample may be cut [by an adult with a DIY tile cutter] and varnished to bring out the detail, possibly showing layering within the sedimentary rocks, random crystal orientation in the igneous rocks and the original layering in hornfels, now a metamorphic rock. Examples include: mudstone, hornfels, muddy limestone, chert, dolerite, microgranite [aplite], granite.
The display should include the UK Geology Wall Map. Meldon is in the blue shading [Carboniferous] midway between Okehampton and the red shading of Dartmoor Granite. Note the extent of Permian and Triassic rocks up to the Scottish border, containing pebbles eroded from Devon. Rock samples children collect from locally or further afield could be added to the display, with labels and markers linking the sample to the location on the map.
Time Line display for different parts of the landscape. An important part of the visit is to help pupils to realise that today's landscape has features from different times in the past. The following table could be used to create a timeline for features in the Meldon Valley landscape. At a scale of 2mm = 1 year, a string 4 metres long could be strung across the classroom to equal a time interval of 2000 years, perhaps the length of time that agriculture has been practiced. The labels of the main features could be pegged up at the correct scaled distance from the end labelled "Today".

Flowers and blossom on trees: a few days or weeks.
The quarrying at Meldon: about 100 years, but still going on today.
The quarrying at Meldon Aplite Quarry: stopped 50 years ago.
The railway: built about 130 years ago.
The limekilns: active more than 150 years ago.
Farming was probably started a couple of thousands of years ago.

The following features would "off the scale" but provide scope for discussion.
The boulder field was formed about 10,000 years ago (i.e. 20m along the timeline!)
The rocks themselves were formed about 300 million years ago (this would require a timeline 600 km long!)

3a. Make a model of the valley, including quarries and other features seen - use plaster to cement sand to produce the landscape. Use light sand for the microgranite [aplite]. The viaduct will take some technological input!

b. Make a model of the microgranite [aplite] quarry. Half of model could show a working quarry with men and small machinery etc, with the other half as seen today [with "vegetation" purchased from toy/model shops].

4. Research into quarrying and uses of rocks and minerals - in the local area and further afield.
Early use was in buildings, bridges and dry-stone walls, as loose rocks of various types were abundant, left after the last ice age, 18,000 years ago. These include granite boulders from Dartmoor Tors. See notes in teaching trail.
Microgranite [aplite] has been used as an aggregate, as an abrasive and for making light green glass bottles.
The dark muddy limestone was used to make lime. See notes in teaching trail.
Hornfels from Meldon Quarry to the north is very hard and used as aggregates for roads and as railway ballast. You may have seen the display board on the trackside path, east of Meldon Station, giving details. The railway to Okehampton is still used to transport ballast over the rail network. The quarry was originally owned by British Rail, but was sold at privatisation and is now owned by Aggregate Industries. See below for modes of transport.
China clay [kaolin] is from chemically altered feldspar from granites around Lee Moor and St Austell.
Ball clay is much finer, as the clay was washed off Dartmoor into the Bovey Basin and to Dorset in Oligocene times. Two trains a week carry both types of clay to Stoke-on-Trent for use in the pottery industry. They are also used as "fillers" in plastics, paints, tyres and paper. Soak ordinary white paper in water and then squeeze!
Vein minerals. By the Red-a-ven Brook a copper mine operated in the C19, with several vertical shafts, horizontal adits and a water wheel. The main mineral was chalcopyrite, a copper-iron sulphide.

5. Research into the use of rail and road transport.
In 1871 the London and South Western Railway Company built a line from Exeter to Okehampton. It was extended as single track to Lydford in 1874, requiring the building of the Meldon Viaduct, 165 metres long, 46 metres above the West Okement River. The lattice girders are supported by interwoven piers. The first set are made of wrought iron and rivetted together. The second set are of mild welded steel, fitted in 1878 to support double track when the line was extended to Plymouth. The line was closed in 1965 with the Beeching axe, and Brunel's Great Western line between Exeter and Plymouth was preferred. The Meldon to Exeter line continued to be used for quarry traffic. There are great environmental benefits of using rail transport, especially the reduced need of lorries, with mud or dust thrown up and danger on narrow roads. Today the Okehampton to Meldon section is also used for passengers, as the preserved Dartmoor Railway.
Road transport is used for some movement of aggregates, where customers don't have rail access! This is especially for major works, like road construction. When the Meldon Dam was built the viaduct was topped with conrete slabs so that lorries could use it.
The A30 is now a dual carriageway from the M5, enabling easy access for visitors to the area and allowing long distance travellers a quicker journey.

Working with Soil
If not done prior to the visit, it would be appropriate for the Soil topic to follow the visit even if the school isn't following the QCA guidance, **Unit 3D – Rocks and Soils**. The notes on preparation for the visit give details of ESTA's **Working with Soil** pack. It is anticipated that soil samples will be collected during the visit from a selecton of localities.