KS2 ACTIVITIES at ECTON

Notes to guide EHFSA Tutors

Introduction

These notes are intended to guide the voluntary tutors leading KS2 activities at the G.A.Cox Centre at Ecton Hill. They are included on the KS2 webpage so that teachers who are considering bringing a party of pupils can assess the day's activities and the likely outcomes for the school's curriculum. They should be read in conjunction with the Worksheets and with the Table, "Ecton Hill– KS2 activities related to the National Curriculum, 2012". Some of the notes on the Table are rather cryptic, but they do show cross-curricular links.

Visiting teachers are always welcome to elaborate on the information provided by the Ecton Tutors as the day progresses.

*Note: the educational background to many of these activities, or similar ones, is given on the website, www.earthlearningidea.com **(ELI)**, which contains well over 120 Earth science activities, which schools are welcome to use freely.*

Preparation at school

In preparation for the visit, teachers could be asked to get the pupils to investigate copper before they come: e.g.

What is it? (A metal): What does it look like? (Samples from home or school): What is it used for? (Wiring, because it is a good conductor of electricity: making brass for locks etc): Where does it come from? (Countries e.g. Chile). How do they get it? (Mining out of the ground)

Copper metal does occur naturally, but it is mostly found as an ore, where the copper is combined with other things, like sulphur.

Activities led by EHFSA Tutors at Ecton

A) Introduction

Introduction to whole party before dividing up into groups.

Welcome to Centre – toilets, drinks, general behaviour.

Show examples of copper and lead items, including wiring. Revise pupils' knowledge of these (see above).

Demonstrate some of the minerals from the Gratnell trays or shelves, e.g., chalcopyrite and malachite (copper ores) and galena (lead ore).

We are going to visit an old mine, where copper was mined for several centuries, although it is shut now. We can go inside an old Level (tunnel), called Salts Level, to see how the miners dug out the copper ore. The miners had to dig through lots of limestone rock, which wasn't worth anything, to get at the rich copper ore.

We can sometimes find fossils in the limestone, which show that it was formed under the sea millions of years ago. It came from near here, so Ecton must have been under the sea then.

Demonstrate a large specimen of fossiliferous limestone, using the diagrams in the large folio to show how some of the fossils might have lived.

The mine is now at 240 metres above sea level, so we shan't drown! A lot of the limestone layers were folded, and we shall be going inside these folds. From time to time there must have been earthquakes, long before there were any people on Earth, and we shall find evidence for these ancient earthquakes.

B) Tutor Demonstrations (for the whole party)

1) How was limestone made? Part 1

Have a closer look at the large specimen of fossiliferous limestone, & diagrams to show how some of the fossils might have lived.

How was limestone formed?

We can imitate the first stage, using sand to show how loose sediment builds up on the sea bed.

Take a measuring cylinder ¾ full of water and add a spoonful of washed yellow sand. Let it settle and then ask the children what will happen if you add a spoonful of red sand, followed by white sand. (Flat-looking layers of sand, one on top of the other. If the sands are of different grain size, one can ask whether the next spoonful will settle more or less quickly).

Imagine that the model shows the Pacific Ocean – vast!

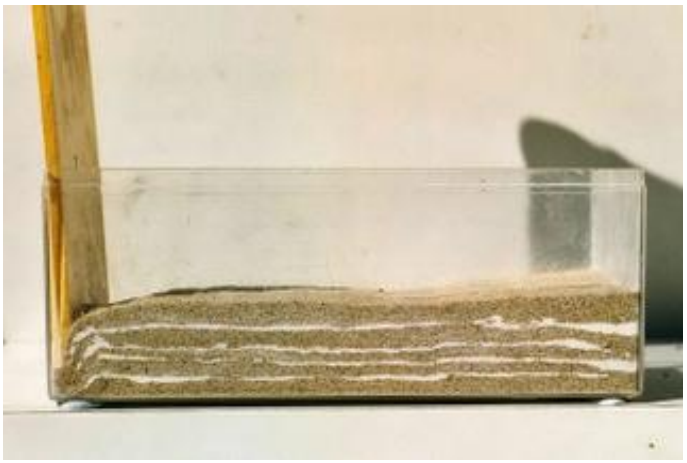
The layers would go on forever. We call each layer of sand a bed. Think of your own bed – it is flat and is long enough for you to lie out straight. (See ELI - Laying down the principles).

Have we made a rock yet? No!

We'll find out later how we turn the loose grains into a rock.

2) Mountain building

When forces are applied to solid materials they may bend or break. This has happened to the beds of limestone and other rocks at Ecton.



Demonstrate what types of folds and faults can be produced by compression as follows:

Place the board vertically inside one end of the box.

Build up several thin layers of flour and sand (Can be prepared in advance). Spread the flour along the front of the box only. Do not fill it for more than half the height of the box.

Very carefully, push the vertical board across the box, so that it begins to compress the layers. When you notice the layers beginning to bend, stop pushing the board and ensure that the children have seen the folding. They could be asked to sketch what they can see.

Continue pushing the layers with the board until the sand is about to overflow the box. Ask the children to see if they can spot a thrust fault, where one layer slides

over the rest. We shall see folds and a thrust fault later in the mine in Salts Level. (See ELI - The Himalayas in 30 seconds!)

You can find out what happens when beds are stretched (put under tension), by making layers of sand and flour at one end of the box and then pulling away the board, to produce a normal fault (also seen in Salts Level). *(See ELI – A valley in 30 seconds! Photo)*

3) Brickquake (Tutor demonstration, with pupil help)

When rocks break at a fault, an earthquake is produced. This would have been true for the faults in the mine – except that they happened millions of years ago, before there were any people to feel them.

Demonstrate how stresses build up in rocks until failure takes place and one mass of rocks slides over another.

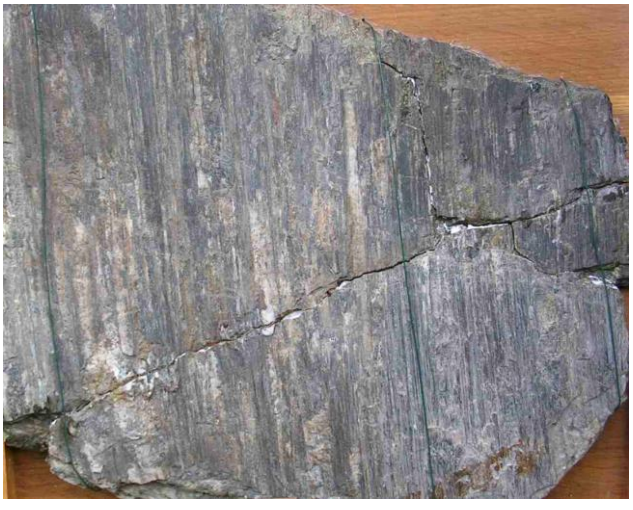
Place three or four bricks as shown, and attach an elastic rope to one of them. Ask a pupil to pull gently but steadily on the elastic rope (eye protection) and ask the class when they think the bricks will move. Repeat this a few times, using different pupils – it is difficult to predict when the bricks will move. Earthquake prediction is equally difficult.

Point out that there is tremendous friction between the bricks and that one might scratch the other when they move. This can be seen if a flagstone is used instead of the lowest brick.

For Y6 we can introduce a measurement of the force required, using a Newton meter.

Show the specimen of slickensides from the Centre and explain that these 'scratches' were made when a fault moved one lot of rocks against another. We shall see these in the mine too.

(See ELI - Earthquake prediction – when will the earthquake strike?)



Group Work

Divide party into three groups, for:

C) Pupil Practical Activities

D) Salt's Level Visit

E) Hill Walk

(With a group of 24 pupils or less, it may be better to divide into two groups for Practical Activities and Salt's Level and then do the Hill Walk all together).

C) Pupil Practical Activities

See Pupil Worksheets.

1) WS1 - How was Limestone made? Part 2

Introduction:

Limestone was laid down as loose bits on the sea bed in the same way as the beds of sand, but where did the limestone bits come from?

2) WS2 - Shell Smash

(See ELI – Rock, rattle and roll, imitating the effects of a rough sea on the shells).

Pupils work in small groups, each with a plastic pot, an empty tray, some shells and a pebble. Arrange to synchronise the shaking for 15 seconds, so all the noisy work happens at the same time! You may wish to allow another 15 seconds of shaking. Point out that some shells would not be recognisable at all, i.e. the fossil record is incomplete. Refer back to the large specimen of crinoidal limestone used in the introduction to Ecton.

3) WS3 - Home-Made Rocks (See ELI - Make your own rock)

Introduction:

When we made layers of sand, did we make a rock? (No)

What do we need to do to turn the layers of sediment into rock?

Squeeze it.

Ask a pupil to try squeezing some sand to turn it to stone (impossible: we also need to stick the bits together with something).

We're going to make limestone. First we need to grind down the shell fragments which we made in the shakers, imitating the grinding down which is done by rays and other animals in the sea. Issue groups with a large weight and a small weight.

Ask them to put the large weight in a plastic tray first, to contain their crushed shells.

Stop the group when they have all done the crushing.

Now, make your own "limestone" as follows:

(Demonstrate one example, adding Plaster of Paris and taking care to add very little water, and then let them have a go in small groups.) You may wish to collect in their partially crushed shells and issue some shelly sand instead, to make it easier to produce a good "limestone" pellet.).

Mineral separation

(Run as a pupil circus of jigging, buddling and gold panning, after an initial quick demonstration of what to do at each site, outdoors)

Initial Tutor demonstration, using the Density Kit from the jigging/buddling locker

Look at the grey lump of minerals from a mine under the ground.

The grey mineral contains lead. (It is called galena i.e. lead ore).

There are other minerals with it.

How could you separate the minerals? (Pupils' answers will vary from dissolving in acid to melting).

Pass round similar sized samples of galena, barite, fluorite and calcite for pupils to 'heft' to discover that they are of different mass. If the group can understand it, the idea of density could be introduced.

Explain that the mixed minerals from the mine are first crushed and then separated. Demonstrate briefly at each activity; then let the pupils do them as a circus.

Pupil activities on mineral separation– see Pupil Worksheets

4) WS4 - Jigging

(Small group of pupils) See ELI 'Jigging - using density to separate different materials'.

Ensure that pupils add the mineral 'charge' to the Perspex tube over a tray to avoid spillage The tube should only be about a quarter full. This works best if the bucket is really full of water and the tube is jigged up and down as deeply immersed as possible. Please ensure that they tip the 'charge' out again into a tray for re-use.

5) WS5 - Buddling

(Small group of pupils) (See ELI – 'Riches in the river'). The model buddle is a piece of gutter with baffles glued across it.

Set it up outside on a railway sleeper, using a wood block to obtain at a slight angle. Place a partly-filled bucket of water at the bottom to catch the water. Pour a film pot's worth of crushed galena and sand onto the top of the buddle and gently flush with water from another bucket, using a beaker. Please ensure that, when they have finished, they wash the minerals carefully into the bottom bucket. Get the minerals back later, so DO NOT throw the water away!

6) WS6 - Panning

Is there gold in them tha' hills? (Small group of pupils.)

Pupils scoop up a handful of sand (with 'gold' in it) into the pan, with water and swish it gently round above the tub, to wash the sand back into the tub.

Please ensure that all the 'gold' goes back into the tub when they have finished!

D) Salt's Level Visit

Take with you: Pupil Worksheet (WS6) + items on Resources list.

Usual format for mine tour, i.e. escort group to the point where all can stand up straight and can get their eyes adjusted.

Limestone walls, some crinoid fossils, i.e. deposited under the sea.

Flowstone – acid demonstration.

Mining techniques, with shot holes. Get kids to pick up two stones and click them together rhythmically, at about 1 second intervals to show hammering rate for the two men.

Move to the slickensides at 43m and explain their significance. Stretch a rope diagonally across the Level between the two sets of slickensides and get half the kids standing on one side of the rope and half on the other, opposite each other in the middle of the Level. Explain that an earthquake would have happened when the fault moved, and might have lasted for 5 seconds. Earthquakes make a lot of noise! I'm going to say: "Go!" and count to five seconds, while pupils move in opposite directions, to imitate the movement of the rocks, making as much noise as they can at the same time! (Whistle to stop).

Move to the crosscut at 110m. Find the silvery galena (lead ore) in the Shack Vein and the green malachite (copper ore) in the Ida Alley Cross Course. Why do the veins run in straight lines? How much the group can take in will depend on their age etc. but the answer is that the veins follow faults, which made a space for fluids to flow up within the limestone and to leave behind the minerals. With side lighting and the eye of faith, oblique slickensides are visible on the obvious fault plane on the right hand side. (Worked 1859-1868).

Move to the Deep Ecton Shaft. Get a few of the taller pupils, or their teachers to peer over the safety barrier to see the water down below. Usual story about the shaft, ropes, kibbles etc. What would happen if you fell down the shaft? How long would you take to hit the water below? I calculate that it would take about 3 seconds. ($s = ut + 1/2at^2$, where s = 40m). When I say: "GO!" all shout: "Wheeee" for 3s and then shout SPLASH when I get to 3!

If you fell down the shaft from the very top to the bottom of the mine when it was working, you would have fallen about 400m. How long would this take? 10 times as long = 30s perhaps? No – only 9 seconds (gravitational acceleration, in simple terms!). When I say: "GO!", shout: "Wheeee", but this time you estimate the 9 seconds on your own and we'll see who is closest. A little girl did fall into another shaft at Ecton over 100 years ago and was killed, so you must take great care, and NEVER ever throw things down shafts.

Move to the pipe vein – usual look around, dead tractor; worked out pipe vein; climbing shaft; malachite: flowstone stained by copper and zinc minerals; narrow level to ladderway cut before black powder, therefore very narrow; late 19 Century working – dirty walls because of compressed air drills etc.

Light a candle a few metres into the later (1884) workings. Usual discussion of light available to miners in the olden days. Blow out candle, if children are happy about this. Can you see your hand in front of your face? etc. Never explore old mines or caves without someone who knows what they are doing.

Reverse the route and come out. Get kids to leave cap lamps on the helmets if there is another group to follow.

E) Hill Walk

Walk up zig-zag path to Dutchman Mine, then to Engine House, then up the slope to the stile in order to see the "Fishpond". Return via the Powder Hut.

Themes: (See National Curriculum excerpt for ideas)

Usual, but try to include comment on the relief – hills and valleys; permeable v impermeable rock; river erosion (Manifold); flooding even today – remember 2004!

Estimate heights and distances.

Dutchman Mine – early use of explosives; water supply, untreated because it's naturally filtered through rock.

Engine house, pipe vein, nearby climbing and hauling shafts – history; working conditions; visualise busy landscape when in its heyday – packhorses, lots of people etc.

Display photo of the huge copper mine at Bingham Canyon, Utah, U.S.A. – the world's biggest man-made hole! It is 4,000m (2½ miles) across and 1,200m (3/4 mile) deep. Butterton Church spire is 3,200m (2 miles) away, so it would be more than that. We climb 100m from the road to the Engine House, so Bingham Pit is 12 times as deep.

Would such a mine be acceptable today in the Peak District?

It may be possible to get children to enact the former horse whim below the semicircular wall, and then to change to the chuffing steam engine – we haven't tried this yet!

Plants and animals – mountain pansies; orchids; blackcaps; buzzards; rabbits etc.

Farming. Environmental concerns. Powder hut (1884 according to L. Porter)

F) Finale (for whole party before they leave for home)

1) Copper in Malachite (Tutor demonstration)

How do we know that there is copper in the green malachite mineral? (Tutor demonstration)

Grind up some malachite. Dissolve it in dilute sulphuric acid. Add an iron nail and do something else for a while. Take out the nail later and show that it is coated in copper (colour change).

2) Black Powder (Tutor demonstration)

If this is done at all, have the charcoal, saltpetre and sulphur already weighed out, so that all that remains is to mix it carefully, take it outside and light it.

Relate the cloud of smoke to the reason why the miners blasted at teatime and left it to settle before shovelling the next day.

3) Banger (Tutor demonstration)

Outside! What happens when black powder is confined in a tube? Imagine what would happen when much more black powder was confined in 30 holes drilled into the rock.