TEACHING PRIMARY EARTH SCIENCE

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CLIMATE THROUGH TIME – 3

Deserts; Tropical Swamps, Rivers and Seas

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Introduction to this Issue: This third issue is linked to the two ovals on the *Climate through Time* poster about very diverse environments: deserts and tropical swamps, rivers and seas (focusing on tropical swamps). Sandy deserts are usually found in dry, arid climates and can be associated with salt and gypsum deposits; tropical swamps, rivers and shallow seas can be rich in plant remains and fossils, both marine and freshwater. Ideas here include ways to show how these environments were formed and to link them to present day environments and findings.

Sand Transport in Deserts

A key characteristic of a typical desert is the vast amount of sand which forms a variety of rippled surfaces and mounds, or sand dunes. The sand forming these often immense structures tends to be very well sorted, which means that the grain sizes of the sand can be very uniform. Sand is constantly being moved around in the desert environment. This transportation and resulting sorting of the sands is done by the wind. To see how the wind is capable of sorting, or grading, the sand particles you can do the following simple activity.

<u>Equipment</u>:

- 2 clean, dry ice-cube trays
- A piece of stiff card large enough to cover one tray
- A tub containing a mixture of fine and coarse sand (dry)
- Hairdryer
- Safety goggles
- Plastic table cover (preferable but not essential)

<u>Method</u>:

- Place both ice-cube trays end to end on a table, turn one upside-down
- Place the card on the upturned tray
- Pour a small heap of sand onto the card (approximately 3-4 tablespoons)
- Hold the hairdryer a short distance behind the sand heap to blow the sand over and into the empty ice cube tray (test the dryer holding distance and blowing speed needed to blow the sand over the tray)

<u>Results</u>: The sand that has landed in the ice-cube tray will be sorted according to weight and size. The heavier grains will have landed closest to the initial heap of sand and the lighter ones will have travelled further landing, in the last cube compartments, a gradual decrease of grain size should be visible between the two ends of the tray. The strength of the wind (hairdryer speed) will determine how far the grains travel. The sorted grain sizes should be apparent visibly but also evident by touch.

Alternatively, blow the sand across a length of card with an even coating of glue on its upper side. The blown sand should stick where it lands, forming a graded sand-sheet. Mark the card with equal divisions before adding glue for more informative results and tactile display item.

Shifting Slopes of Sand

The evidence of ancient deserts is found in preserved sand dunes. You have seen how sand is blown around and sorted in the first experiment, but now we investigate why it forms dunes of varying shapes. The following two experiments build dunes using different sediments of varied sized grains. Grains in a dune are held in place by friction. Dunes will keep their shape provided that the friction is stronger than gravity. These two experiments measure the angle of dunes and test for the highest angle at which the dune can be stable.

Experiment 1

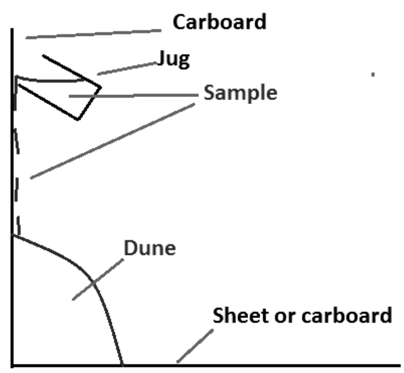
You will need the following: –

- Equal quantities (by volume) of different sized grains (e.g. sand, soil, gravel, beads)
- A thick cardboard of about 60cm square – to mark the shape of the dune on.
- A sheet or second piece of cardboard about 60cm square (to stand the experiment on and to aid the clearing away of each sample used).
- A jug to hold the grain material in.
- A different coloured felt tip pen or pencil for each of the grain sized samples you are using. These are for marking the shape of the dunes when they are formed.
- A protractor to measure the angle of the dunes.
- A note book and pen or pencil to keep notes on each of the dunes' angle and size.

Method:

1. Place the sheet onto the area of the experiment (a desk or on the floor).
2. Put the cardboard upright on the sheet (it must be vertical and at right angles to the sheet. It could be put against a wall or secured to table legs to hold it in place.)
3. Select one of the samples and put it into the jug (any amount but use the same volume for each sample).
4. Pour the contents of the jug against the upright card and allow it to form a pile on the sheet and against the upright.
5. When all the grains have been emptied out of the jug mark the shape of the dune with one of the coloured pens.
6. Place the protractor on the card with its base at the base of the card and measure the angle of the slope of the dune.
7. Make a note of the sample, angle and coloured marker.
8. Remove the sample pile from the card. Keep it all together as it will be needed for the next experiment.
9. Repeat 1 – 8 with each sample and then compare the results.

Shapes of Dunes



side view

Results:
The different profiles will show how different materials are held together by differing forces of friction against gravity.

This shows how different grain sizes can form different slope angles and why some sands will slide when others stay in place.

Experiment 2. This demonstrates how different materials are held together by differing forces of friction against gravity and will show you the maximum angle at which the particular samples can form a dune.

You will need the following:-
- The same samples you used for the first experiment
- Clear jar or beaker with a lid or cling film to hold the sample in.
- Protractor
- Note book and pen

Method:
1. Half fill the jar with one of the samples
2. Seal the top to retain the sample inside
3. Place the jar on its side on a table so that the material is lying along the side
4. Slowly roll the jar to one side only until the sample material begins to slide.
5. Hold the jar still in that position
6. Measure the angle with the protractor
7. Note the sample and the angle.
8. Repeat 1 -7 with each sample and compare the results.

This shows how different grain sizes can form different slope angles and why some sands will slide when others stay in place.

Tropical Swamps and the Formation of Coal
When plants are growing they draw in carbon dioxide from the air and release oxygen. The plants retain some of the carbon which allows humans to use the free oxygen they release. When plants die they slowly release the carbon back into the atmosphere as they decay via aerobic (with oxygen) decomposition. However if the dead plants are covered so that oxygen cannot get to them or they accumulate in stagnant swamp areas (where the oxygen has already been used up), they will retain the carbon. When trees died in the ancient lush tropical swamps they soon became water saturated and were very quickly buried by slimy mud and further layers of foliage sealing them off from oxygen and resulting in anaerobic decomposition. The carbon they contained was therefore locked away for millions of years. These partially decayed plants became deeply buried by other sediments and over time were eventually converted to coal.

As coal was found to be a very useful fuel we have been mining it to burn. If coal was left on the surface then it would release its carbon very slowly, at a rate that nature can absorb without it causing too many problems. However we do not leave it either underground where it would not release any carbon or on the surface where it releases it slowly, we burn it. This releases the carbon very quickly which then combines with oxygen forming carbon dioxide, this is released into the atmosphere where it is involved in trapping heat and in increasing the Earth’s atmospheric temperature. Because it is released very quickly and it is added to other rapidly released carbon dioxide, from oil, the total amount of carbon dioxide in the atmosphere is increasing resulting in what we now call climate change.

Maps and global movement
Having investigated tropical swamps and how coal is formed, due to compression and time children could look at where these swamps were at the time they were formed and how they came to be where they are now. Looking at the globes (left side of the poster) showing the position of Britain and Ireland they will find them just north of the equator during the Carboniferous, a time when there was a plentiful supply of tree ferns and similar plants, as shown by fossil evidence. Looking carefully you can see that our area was partly land and partly shallow seas. Later, during the Cretaceous we had moved further north, but were still in a fairly warm environment, again conducive to swamp formation and thus coal formation. Children could use the globes and the main map to link up the areas, as the letters (C, K) indicate, when each of the swamp areas was laid down. (More ideas overleaf).

Using the main map of the UK and Ireland and the oval colour code - which is light green - we can see that there are many areas that are this colour.

- Firstly the children need to identify when the area was laid down using the codes above (C and K).
- Children can find areas near where they live or alternatively chose an area to investigate.
- Can they see a pattern across the map and where they are within this pattern?
- Think about the ages of the rocks, Carboniferous are much older than Cretaceous, does the map show this? If not what might have happened?
- Older children can use the web to investigate what fossils they might find in the coal and whether these are the same in rocks of different ages.
- They could follow this up by investigating whether there are currently coal mines in the area they chose, or were there in the past; thus cross curricular topics could be devised linking Geography, Science and History based on coal formation, mining and links to settlements, which leads to the next section.

Coal Mines and their History

We have seen how coal was formed millions of years ago and now we will look briefly at the mining industry's history and investigate the position of the coal fields.

Coal is located at different depths within the rocks so in some areas it was necessary sink very deep mines to reach the coal. This caused a number of problems:

- It was very dangerous and hard manual work. The men were lowered down deep mines in a metal cage; they worked underground all day; the only light was from the lights they carried.
- There was a lot of waste material dug out before the coal was reached. This waste was heaped up on land at the side of the mines covering farming land and resulting in a very large pile. This blotted out the landscape but when the coal industry was a major employer and source of energy this was accepted. Many such spoil heaps from the disused mines are now being landscaped and some have even been changed into nature reserves, leaving very little evidence of what were once very large industrial sites.
- The coal industry was a very large employer. There are a number of towns and villages built just to accommodate the miners and their families.

To investigate this history there are two useful sites on the internet

1. www.cmhrc.co.uk This site has maps of all the coal mines in the British Isles. In addition to pictures of some of the old mines and personal accounts of what it was like to work underground.
2. www.ncm.org.uk This is the site of the National Mining Museum. It gives some details of the working lives of the miners and some insight to the mining communities, **(If you can visit this museum it will include a trip underground into a now disused mine)**

The *Climate through Time* poster can be downloaded in low or high resolution formats from: www.bgs.ac.uk/education/climate_change/climate_through_time.html

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