Geo-activity Trails

ORGANISATIONAL DETAILS

Aims

To explore the factors influencing the landscape of the area around Low Force and Holwick.

Target Group

Key Stages 2 and 3

Location

Low Force, Upper Teesdale

Practical Details

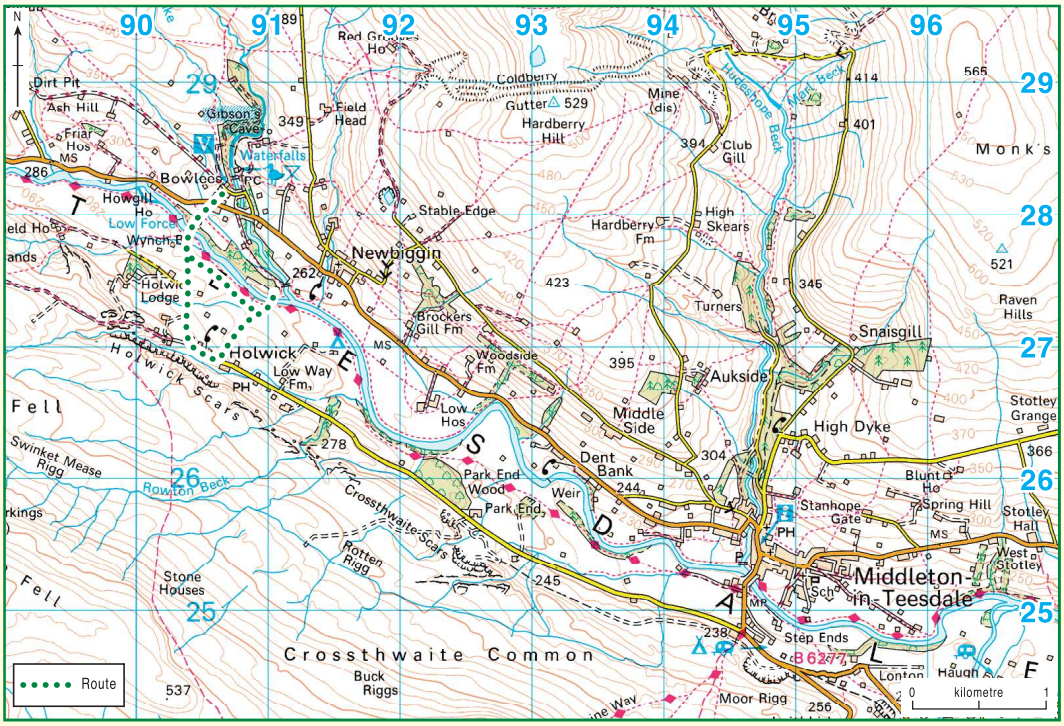
- Parking is free at the car park at Bowlees (GR: NY908281). Coaches can park on the main road opposite the footpath for Low Force (GR: NY 905281).
- Useful map – O.S. 1:25000 Explorer OL31, North Pennines Teesdale and Weardale.
- An additional leaflet, to be used in conjunction with these resources includes the Holwick Scar and Low Force Geological Trail produced by the North Pennines AONB Partnership.

Safety Issues:

- Sensible footwear, warm clothing and waterproofs are advised, as even in summer the weather in Upper Teesdale can be harsh.
- Refer to Hazard Identification Sheet.
- Duration 2 - 2.5 hours with a stop for lunch.

Holwick Scar & Low Force Geo-activity trail

Teacher Resource Sheet



HAZARDS IDENTIFICATION SHEET

The following notes will help teachers conduct their own risk assessments. This is not a risk assessment and teachers should follow guidelines from the Department of Children, Schools and Families.

Hazard Identified	Risk and to whom	Control measures
Vehicles in the car park	Caution needed when getting off the coach as the parking area is small and other vehicles may be passing. All students and staff.	Supervise students getting off the coach or minibus and gather in a safe place.
Parking on the roadside	The road next to the coach parking area has fast traffic. All students and staff.	Supervise students getting off the coach or minibus and group them away from the road.
Fast traffic on the road	The road between Bowlees and Low Force has fast traffic passing. All students and staff.	Supervise students along the road.
Extreme weather conditions	Weather conditions can be very harsh even in the summer. All students and staff.	Ensure students have warm waterproof clothing and suitable footwear. Recommend a sun hat and water for trips in the summer.
Unfenced water	The River Tees is not fenced. All students and staff.	Warn students about the water.
Uneven paths	Paths are uneven and may be slippery in wet weather. Students may slip and fall. All students and staff.	Warn about conditions.
Slippery surfaces	The track and path can be slippery in wet conditions Care is needed. All students and staff.	Warn about conditions.
Wynch Bridge	The Wynch Bridge should only have one person crossing at a time. All students and staff.	Supervise students across the bridge.
Steep drop	The viewing area for Low Force on the south side of the river is by a very steep drop into the river and although there is fencing it is not very secure. All students and staff.	Warn about conditions. Supervise and control students in the viewing area.
Slippery rocks	The rocks at Scoberry Bridge can be very slippery especially when wet. All students and staff.	Warn about conditions and supervise when looking for fossils.

BACKGROUND INFORMATION

The table below provides background information for the Geo-activity Trail. The first activity provides a brief introduction to the area. The second activity leads you along the trail to Holwick and then back to Bowlees. The information provided links to stopping points along the route. This information should be used in conjunction with the Student Activity Sheet. After introducing the information at each point, the students decide which information sticker refers to the point and which picture sticker. They then need to decide if the information suggests that the geology, the work of ice sheets or people, have influenced the landscape at that point and attach the appropriate stickers under the correct category. The walk can be summarised using the information at the end.

It may be useful to use the 'Rock Box' to introduce limestone (Sample 7), sandstone (sample 11), shale (sample 13) and dolerite (sample 5) before the visit.

Route stopping point	Number on geological trail	Background information
Activity 1 Point 1 - The field	X	This is a circular walk from Bowlees to Holwick and back. It introduces the main factors that have influenced the landscape of Upper Teesdale. Look around you to get a view across Upper Teesdale. The hills are flat topped and the valley sides are in a series of steps. The rocks that form Upper Teesdale were formed in the Carboniferous Period of the earth's history, about 350 to 300 million years ago. The North Pennines was located close to the equator during the Carboniferous Period and as sea levels rose and fell, different rock types were formed. When sea levels were high, there was a shallow tropical sea and over time limestone was formed. As sea levels fell, rivers deposited mud and sand in the sea. The mud formed shale and the sand, sandstone. Limestone and sandstone are more resistant to erosion and form the steps we see in the landscape today. Shales are easily worn away and so form the gentler slopes. Limestone, sandstone and shale are sedimentary rocks. Sedimentary rocks are formed by the accumulation of materials such as mud or sand or the calcareous shells of sea animals. Activity 1 – from the edge of the field flat topped-hills can be seen and steps in the landscape. In the immediate foreground there is an area of coniferous trees. Beyond these is an area of higher land that is formed of dolerite or Whinstone. Explain this landscape and complete the activity on the sheet.
Activity 2 Point 2 - The north side of the Wynch Bridge	4	A bridge was originally built here so that lead miners from Holwick could cross the River Tees to work in mines on the north side of Teesdale.
Point 3 - The south side of the Wynch Bridge	4	The waterfall you are looking at is Low Force and it is flowing over a rock called dolerite or Whinstone. Dolerite is an igneous rock. Igneous rocks are formed from molten magma from inside the earth, which has cooled and solidified. The dolerite here was formed from molten magma from being injected into the surrounding rocks – the limestone and sandstone. You will see dolerite again later.
Point 4 - Whetstone	6	From the Wynch Bridge follow the river downstream and after a few metres you will see a rocky area with a large mass of rock. The rocks here are in layers or beds and were sandstones and shales. When the dolerite was injected a slab of sandstone and shale broke off and fell into the hot liquid rock and was heated and changed. The sandstone was hardened and the shale was changed into hornfels, or whetstone as the lead miners called it. As these rocks have been changed by heat they are called metamorphic rocks.
Point 5 - Mineral workings	7	Continue downstream towards Scoberry Bridge. On the right hand side you will see piles of rocks and tunnel entrances. Miners have tunnelled into the hillside here searching for lead ore. However the mineral veins here have very little lead in them. They do contain zinc but not in large enough quantities to work them.

Route stopping point	Number on geological trail	Background information
Point 6 - Limestone and fossils	8	Continue downstream to Scoberry Bridge. Cross the bridge and just on the right there is a bare area of rock next to the river. This rock is limestone and was formed from the skeletons of sea creatures that accumulated as a limey mud on the sea floor. If you look closely at the rocks here you will see white fossils preserved in the rocks. There are fossil shells of an extinct brachiopod called Gigantoproductus, which is similar to a modern day cockle. There are also fossil crinoids here. These long cylindrical fossils are the stems of the crinoids which are related to modern sea urchins and star fish.
Point 7 - Drystone walls	X	Go back across Scoberry Bridge and cross the stile in the wall in front of you. Follow the footpath to the farm buildings. At the farm buildings you will see drystone walls bordering the field to your right. The walls have been made of rounded boulders that the farmer has cleared from the field. These stones are called 'clearance stones'. The boulders are rounded as they have been moved by ice sheets during the last ice age. As the boulders were moved by the ice sheet they were knocked against each other, knocking off their corners and producing their smooth shape.
Point 8 - Striated boulders	X	Continue to follow the footpath through the field towards Holwick. The footpath is marked in places with large rounded boulders. These boulders, like the ones in the walls, were rounded as they were moved along by an ice sheet during the last ice age. If you look very closely at them you will see they are covered in scratches or grooves on their surface. These scratches or striations were caused as the boulders were ground together as they were dragged along in the ice sheet.
Point 9 - Holwick Scar	1	On reaching the road in Holwick, turn right along the road and follow it to the junction for Holwick Lodge. There is a Teesdale Time Trail panel at this point. At the information panel there is a good view of Holwick Scar. Holwick Scar is made of dolerite or Whinstone like the rocks at Low Force. The dolerite forms a horizontal band or sill of rock as it was formed by molten magma being injected into the surrounding rocks. The rocks look as though they are made of columns. This is because vertical cracks formed as the molten magma cooled and contracted
Point 10 - Drumlins	2	Take the track that goes to Holwick Lodge. After about 100m there is a gateway that provides a good view down the dale. Look over the gate and down the dale. The hills in front of you are smooth and look as if they have been moulded into long oval or egg-shaped mounds. An ice sheet covered this area during the last glaciation and material called 'till', (a mixture of sand, gravel, boulders and clay), was left covering the landscape. The ice sheet moulded this till into the elongated hills in front of you, called drumlins. The drumlins have a steeper slope at the upstream end than at the downstream end and their long axis is parallel to the direction of flow of the ice sheet. Drumlins therefore help us to know in what direction the ice sheet moved. Here the ice sheet was moving down the valley. Continue along the track to the cattle grid and then leave the track to take the footpath across the fields to the Wynch Bridge and then back to Bowlees.

There is more information about the geology of the area at the Bowlees Visitor Centre.

Holwick Scar & Low Force Geo-activity trail

Student Activity Sheet

Activity 1

Where am I?

This area is Upper Teesdale. The hills around you are flat topped and the valley sides are in a series of steps.

Draw a sketch and add the following labels:

Prominent ridge of dolerite or whinstone

Step in the landscape of more resistant sandstone or limestone

Slope of less resistant shale

Coniferous trees in the foreground

Activity 2

The landscape around you has been influenced by its geology (the rocks), the work of ice sheets that once covered the area and by people. At each stopping point you will be given information. You have to decide which pieces of information and picture stickers the information refers to. Then place your stickers in the correct box below to show if the information suggests that the landscape has been influenced by geology, the work of ice sheets or by people.

The landscape of Upper Teesdale has been influenced by:

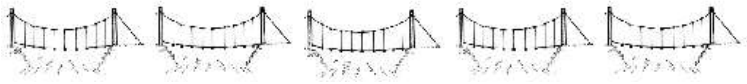
Geology

The work of ice sheets

People

O.S. map of Holwick and Middleton-in-Teesdale



Written label	Picture label
The Wynch Bridge was built for lead miners to cross the River Tees so they could work in the mines on the north side.	
The waterfall at Low Force flows over igneous rocks of dolerite or Whinstone.	
The sandstone and shale rocks here have been changed as they were heated by the injection of the dolerite.	
The tunnels in the hillside were made by miners looking for lead ore.	
Fossils of sea animals can be seen in the limestone. There are shells of brachiopods and stems of crinoids.	
The drystone walls of the farm are made of rounded boulders left by an ice sheet.	
The boulders along the footpath have been scratched as they were moved by the ice sheet.	
Holwick Scar is made of dolerite. The dolerite or Whinstone was formed by molten magma being injected into the rocks.	
These smooth oval hills are drumlins and are formed by an ice sheet moulding glacial debris.	

This sheet needs to be printed onto sticky labels (Avery Labels No. L7651)



Teesdale, County Durham

Signposting of Places of Interest and Information in Upper Teesdale

1. Bowlees Visitor Centre – Bowlees Visitor Centre is the start of a trail, which takes you to Gibson's Cave and facilities adjacent to the centre include disabled access, toilets and a picnic area. Bowlees Visitor Centre has an exhibition area and local information. There is also a shop and a café providing light refreshments.

The centre also provides information on the Teesdale Time Trail.

Further details can be obtained from Bowlees Visitor Centre on 01833 622292.

2. Teesdale Time Trail – The Teesdale Time Trail will help you to discover the unfolding story of Teesdale and beyond through information points and four geological trails. Pick up a Teesdale Time Trail leaflet from Bowlees Visitor centre or from a Tourist Information Centre or follow a geological trail from Cow Green, Holwick, Tynehead or Knock.

3. Moor House – Upper Teesdale National Nature Reserve – The reserve comprises an almost complete range of upland habitats typical of the North Pennines. Natural England runs a spring and summer activities programme on the reserve. The events programme is available from tourist information centres or by phoning the reserve base (see below). Green Guide volunteers can be booked to lead groups around parts of the National Nature Reserve, subject to their availability. A minimum of 2 weeks notice is required. A self-guided nature trail leaflet for Cow Green and Widdybank Fell areas is also available.

Further details can be found in the section on 'Other educational opportunities on the North Pennines', or Natural England can be contacted at the reserve base on 01833 622374.

4. Tourist Information Centres – These are located in Middleton-in-Teesdale (01833 641001) and Barnard Castle (01833 690909 or 696356).

5. YHA Langdon Beck - YHA Langdon Beck is one of the leading green tourism centres in the country. The first UK winner of the prestigious EU Eco Label Award for tourism accommodation, YHA Langdon Beck provides an ideal base for environmental education in the North Pennines. A host of features, including wind turbines and solar panels, rainwater harvesting and composting provide great on-site examples of practical ways to live more sustainably. There are also extensive educational activities for groups, and bespoke packages can be designed on request. For non-educational visitors, informal activities and tours are available on request.



ORGANISATIONAL DETAILS

Aim

To explore the factors influencing the landscape of Moor House - Upper Teesdale National Nature Reserve.

Target Group

Key Stages 2 & 3

Location

Cow Green, Upper Teesdale.

Practical Details

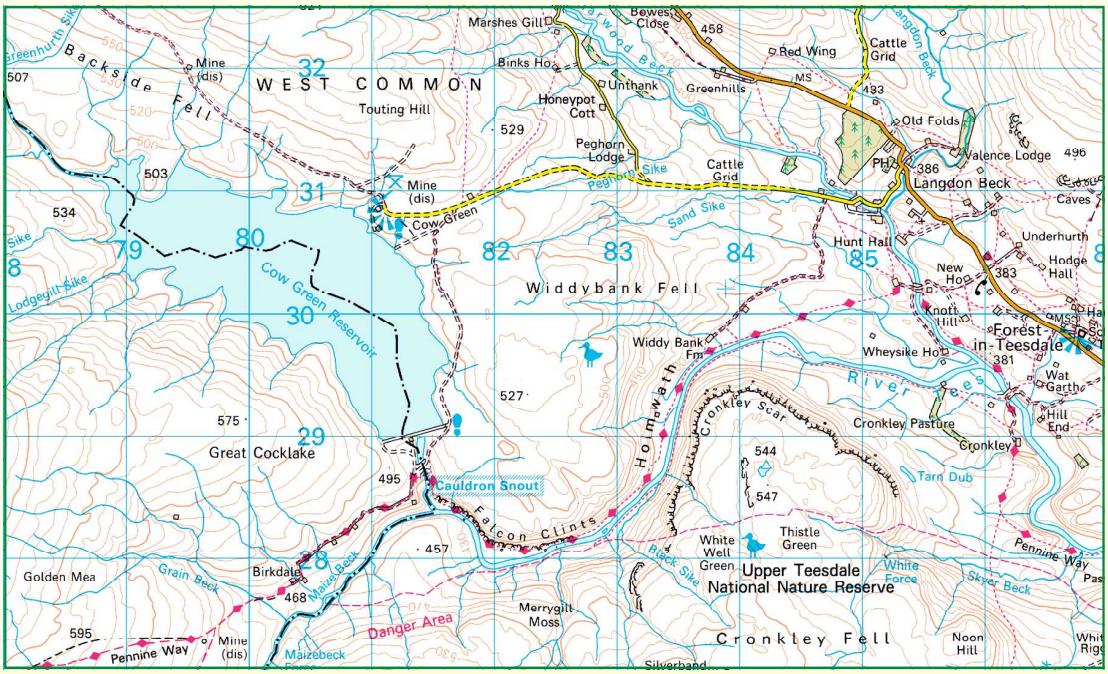
- Parking is free at the car park at Wheelhead Sike.
- Coaches are required to ask permission in advance from Raby Estates. Contact Jeremy Greensides – 01833 640209
- Useful map – O.S. 1:25000 Explorer OL31, North Pennines Teesdale and Weardale.
- Additional leaflets include Moor House – Upper Teesdale National Nature Reserve and Nature Trail produced by English Nature and Cow Green Geological Trail produced by the North Pennines AONB Partnership.
- Follow the route map stopping at the points indicated. The stopping points are shown by a rock with a red flag.

Safety Issues:

- Sensible footwear, warm clothing and waterproofs are advised, as even in summer the weather in Upper Teesdale can be harsh.
- Extra care needs to be taken at Cauldron Snout as the waterfall is not fenced and the rocks are slippery.
- Refer to Hazard Identification Sheet.
- Duration 2 .5 – 3 hours with a stop for lunch. A further 30 minutres should be included if the volcano exercise is done in the car park at the end.

Cow Green Geo-activity trail

Teacher Resource Sheet 1



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Vehicles in the car park	Caution needed when getting off the coach as the parking area is small and other vehicles may be passing. All students and staff.	Supervise students getting off the coach or minibus and gather in a safe place.
Extreme weather conditions	Weather conditions can be very harsh even in the summer. All students and staff.	Ensure students have warm waterproof clothing and suitable footwear. Recommend a sun hat and water for trips in the summer.
Unfenced water	The River Tees is not fenced. All students and staff.	Warn students about the water.
Uneven paths	Paths are uneven and may be slippery in wet weather. Students may slip and fall. All students and staff.	Warn about conditions.
Slippery surfaces	The track and path can be slippery in wet conditions Care is needed. All students and staff.	Warn about conditions.
Cauldron Snout waterfall	The waterfall is unfenced and the drop is very sudden. Therocks in the river are very slippery. All students and staff.	Supervise students near the waterfall and warn about the conditions.

BACKGROUND INFORMATION

The table below provides background information for the Geo-activity Trail. The first activity provides a brief introduction to the area and the National Nature Reserve. The second activity leads you along the trail to Cauldron Snout. Each stopping point is marked with a rock with a red flag. The information provided links to these points. This information should be used in conjunction with the Student Activity Sheet. After introducing the information at each point the pupils decide which information sticker/s refers to the point and which picture sticker/s. They then need to decide if the information suggests that the geology, the work of ice sheets or people, have influenced the landscape at that point and attach the appropriate stickers under the correct category. The walk can be summarised using the information at the end.

Route stopping point	Number on nature trail	Number on geological trail	Background information
Activity 1 Point 1 - Information panels	1	1	This walk is in the Moor House – Upper Teesdale National Nature Reserve and is around the headwaters of the River Tees. This area is typical of the North Pennines and is a National Nature Reserve for its rare plants, wildlife, geology and landscapes. The hills to the west are the highest in the North Pennines. The sketch map on the Student Activity Sheet names the hills you can see. Use the O.S. map extract to put the heights on. The car park is at 600m a.s.l. Compare this to the height of your school. The hills have a bulky form and are flat topped. This is due to their horizontal layers of sandstone, limestone and shale, from which they are made. The geology map shows the rocks types on this walk from the car park to Cauldron Snout.
Activity 2 Point 1 - Information panels	1	1	About 20 000 years ago this area was covered in ice when the ice age was at its peak. The ice would have been over 100m thick and would have covered the top of Cross Fell. The hollow that Cow Green reservoir now fills would have been slightly deepened and rounded by the ice.
Point 2 - Limestone exposure	1	1	The flat area of grey rock is limestone. This is a sedimentary rock formed of layers of limey mud deposited on the floor of a tropical sea, during the Carboniferous Period 330 million years ago. The North Pennines was close to the equator during the Carboniferous Period. Look carefully for fossils – pieces of coral and shell in the rock.
Point 3 - Glacial deposits at Slapestone Sike	X	X	The ice sheets that covered this area dropped or deposited a mixture of clay, sand, cobbles and boulders of varying sizes. These glacial deposits cover the area and in places stop water draining freely. Where this has happened a peat soil has formed on top since the last ice age. Peat is made of undecayed plant material. Coarse moorland vegetation grows in these wet areas.
Point 4 - Rod's Vein	6	3	Rod's Vein is a mineral vein of barytes – a naturally occurring barium sulphate mineral. A mineral vein is a vertical band of minerals that fills cracks in the surrounding rocks. Barytes was mined here until 1952 and it was used in the paint and chemical industries. The entrance to the mine is now below the water in the reservoir. Shafts were also made to get into the mine and you can see a capped shaft here. Barytes is a white, dense mineral (it feels heavy) and hence its name 'heavy spar'.
Point 5 - Arctic vegetation plot	9	X	Many different types of arctic and alpine plants grow in this area. These plants are known as the 'Teesdale Assemblage'. They have survived here since the last ice age because of the rock type, which is sugar limestone. The arctic plants include spring gentian, mountain everlasting, alpine bistort and false sedge. Grazing by sheep prevents coarse grasses dominating the vegetation and crowding out the rare arctic and alpine plants.

Route stopping point	Number on nature trail	Number on geological trail	Background information
Point 6 - Sugar limestone	10	4	This rock is a limestone but it is very white and crumbly – hence its name. The limestone has been changed by heat and so it is a metamorphic rock. Encourage the children to think about where the heat to change the rock has come from, as you continue on the walk. The explanation for the heat will be explained at Cauldron Snout.
Point 7 - Limestone exposure	13	6	A dam has been built across the valley of the River Tees to hold back the water in the reservoir. The dam on this side of the valley is built of concrete as it could be tied into the hard rock found here, which is dolerite or Whinstone. On the far side of the valley there is no hard rock to build on as this side is covered in glacial deposits and so the dam is an earth bank. The glacial deposits are blocking the river valley that existed before the last ice age and so after the ice sheet melted the river could not use the same channel and instead has cut its way through the dolerite or Whinstone at Cauldron Snout.
Point 8 - Cauldron Snout	14	7	Cauldron Snout is the waterfall. The river here flows over the hard dolerite rock or Whinstone. The Whin Sill was formed by hot molten rock from deep within the earth being injected into the layers of limestone and sandstone. The Whinstone is an igneous rock. It was the heat from the injection of the Whin Sill that changed the limestone we saw earlier to sugar limestone. A simple exercise here to help to explain the intrusion of the Whin Sill is to have a large plastic beaker that is tightly packed with 3 – 4 layers of different coloured plasticene. Make a hole in the bottom of the cup and up through the layers of plasticene about the width of a pencil. Insert a tube of toothpaste in the bottom of the cup and squeeze the toothpaste so that goes between the layers of plasticene and out of the top, if you want to illustrate a volcano. Use all the information gathered to summarise the factors that have influenced the landscape of the Moor House – Upper Teesdale National Nature Reserve.

The return journey to the car park can be made by crossing the River Tees on the bridge below the dam and then walking up the side of the dam and across the dam to rejoin the nature trail. Once at the car park the volcano activity on the Student Information Sheet could be done or this could be used later in school.

Cow Green Geo-activity trail

Student Activity Sheet 1

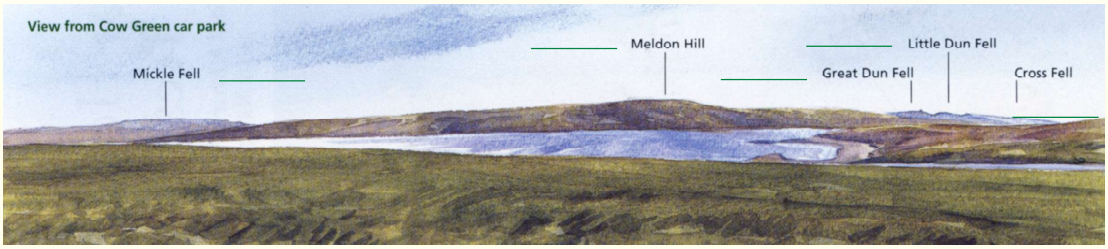
Activity 1

Where am I?

The Moor House – Upper Teesdale National Nature Reserve is around the headwaters of the River Tees and is an area typical of the North Pennines.

View to the west across Cow Green Reservoir

Using your O.S. map extract add the heights to the hills marked on the picture.



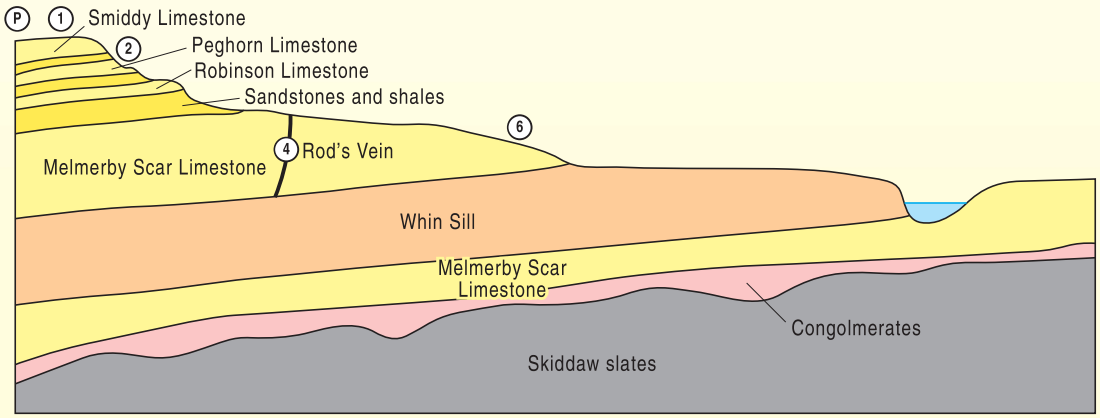
What height above sea level (a.s.l.) is your school at? _____ m a.s.l.

The car park at Cow Green is 600m a.s.l. How much higher are you than at school? _____m.

How much higher again is the highest hill on your sketch map (Cross Fell)? _____ m.

The rocks on the walk

The hills that you can see to the west are flat-topped. This is due to the horizontal layers of limestone, shale and sandstone of which they are made. The geology cross-section below shows the rock types you will walk over on this trail.



Activity 2

Look for the red flags on the marker stones as they are stopping points for information.

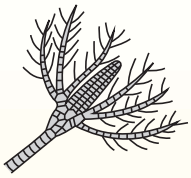
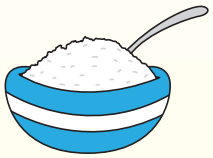
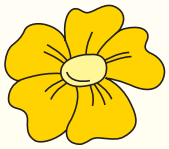
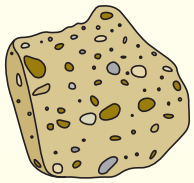
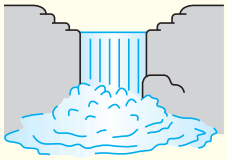
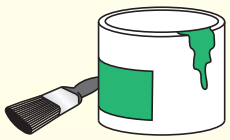
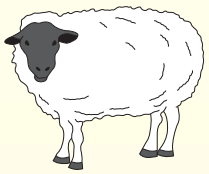
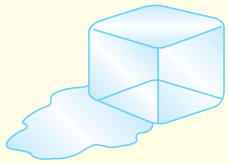
The landscape around you has been influenced by its geology (the rocks), the work of ice sheets that once covered the area and by people. At each stopping point you will be given information. You have to decide which pieces of information and picture stickers the information refers to. Then place your stickers in the correct box below to show if the information suggests that the landscape has been influenced by geology, the work of ice sheets or by people.

The landscape of Moor House - Upper Teesdale National Nature Reserve has been influenced by:

Geology

The work of ice sheets

People

Rod's Vein - A barytes mine until the 1950's. Barytes is used in paint and in the chemical industry.	The hollow that the reservoir fills has been enlarged and rounded by an ice sheet that covered this area 20,000 years ago.		
Sugar limestone - This is a limestone that has been changed by heat. It is a **metamorphic rock**. It looks like sugar.	Rare arctic and alpine plants are found here. They are called the 'Teesdale Assemblage' and have survived on the sugar limestone.		
Limestone with fossils - This is a **sedimentary rock**.	Glacial material left by the ice sheet can be seen under the peat. It is a mixture of clay, pebbles and boulders.		
The waterfall at Cauldron Snout falls over dolerite rock or Whinstone. This is an **igneous rock**.	Sheep graze this area and stop coarse grasses crowding out the rare plants.		
The dam on the far side is made of earth as it is built on material deposited by the ice sheet. This glacial material blocks the old channel of the Tees.			

This sheet needs to be printed onto sticky-backed paper (Avery Labels No. L7651)



Cow Green Geo-activity trail

Student Activity Sheet 2

MAKE YOUR OWN VOLCANO

You will need:

A jug	Vinegar
Baking soda	Red food colouring
Flour	Tray
Stirring rod	Sand
Funnel	Plastic bottle

Instructions

1. Empty the baking soda and 3-4 spoons of flour into the jug. Mix with the stirrer.

2. Place the funnel into the neck of the plastic bottle. Pour the mixture of baking soda and flour into the bottle.

3. Put wet sand on the tray.

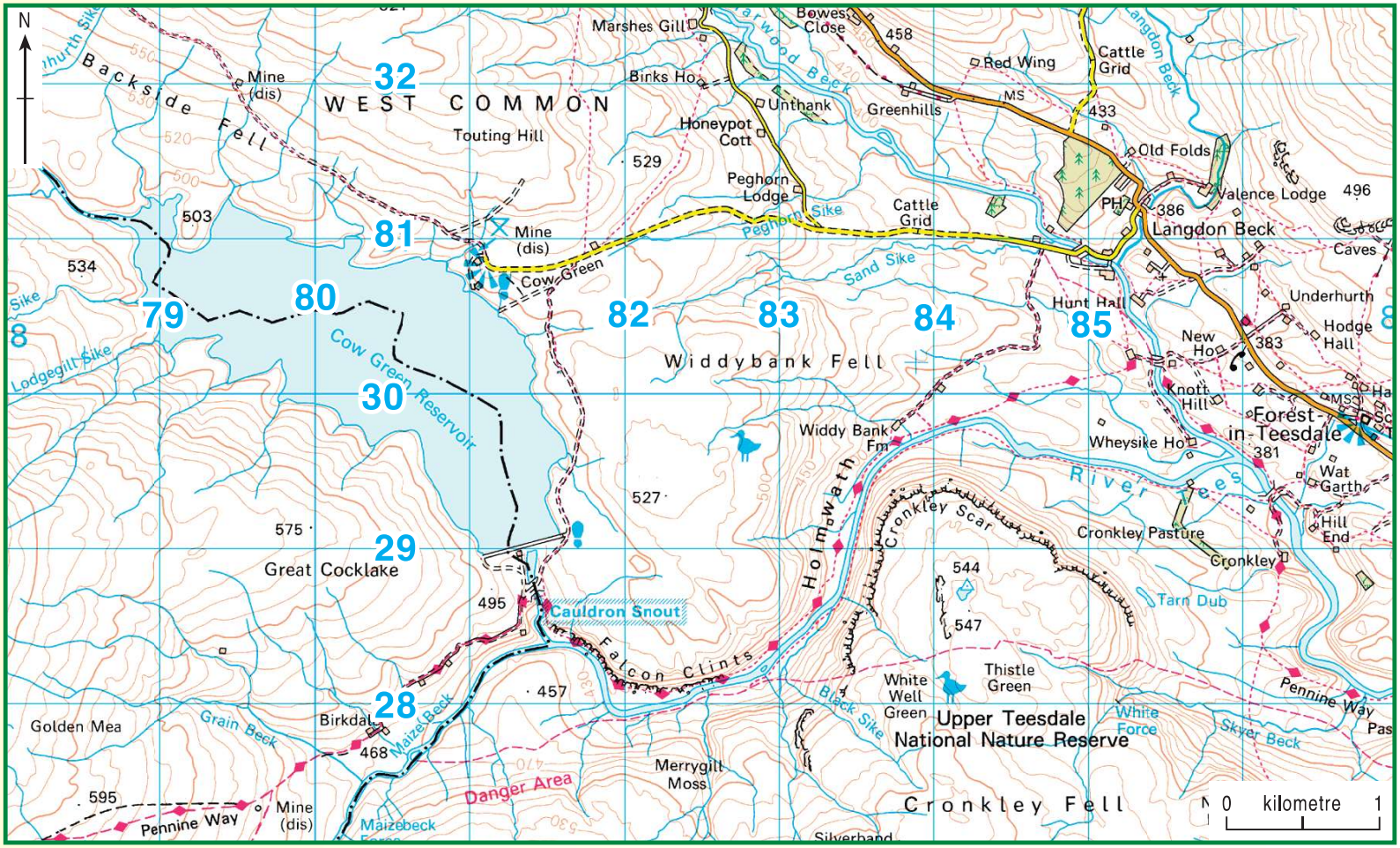
4. Stand the bottle with the baking soda and flour mix in the centre of the tray and pack the wet sand around it. Make the sand into a cone shape.

5. Pour the vinegar into the jug and add red food colouring to make it a rich red colour.

6. Place the funnel into the mouth of the plastic bottle and pour the vinegar into the bottle. Quickly remove the funnel from the bottle.

7. The sandy volcano you have made will begin to erupt. The vinegar and soda mix to give off carbon dioxide. This makes the flour turn frothy and forces it out of the bottle as red lava!





O.S. Map of Cow Green