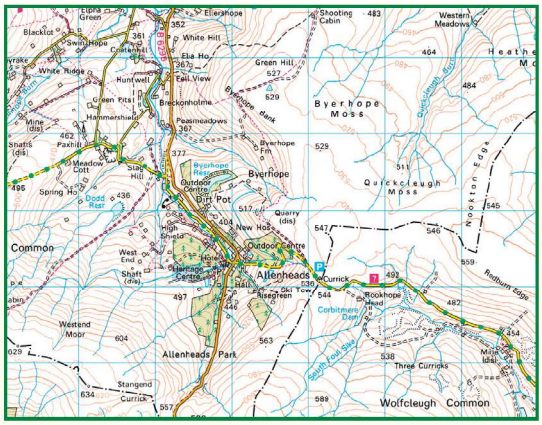
Allenheads, Northumberland

Contrasting locality: Lead mining

INTRODUCTION

The fieldwork element of this day involves looking at lead mining in the Rookhope valley and at Allenheads. The day also provides the opportunity to look at some of the rocks and minerals of the area.

All the resources required for pupils to carry out a day of fieldwork are included, as well as all the resources required for the introductory and follow-up activities. The table below summarises the activities.



Allenheads, Northumberland

Contrasting locality: Lead Mining

SUMMARY OF ACTIVITIES

Activity name	Details of activity
Introductory Activity 1	Detective map work
Introductory Activity 2	Life as a lead miner
Fieldwork Outline	Evidence of lead mining at Rookhope and Allenheads An introduction to the rocks and minerals of the area
Follow-up activity 1	Permeable and impermeable
Follow-up activity 2	Make a water wheel
Follow-up activity 3	Dressed for the occasion!
Follow-up activity 4	Design an advertising leaflet for Allenheads, a lead mining village

DETECTIVE MAP WORK

It is suggested that this map work should be done before the visit and then comparisons can be made during the visit. Some introduction to O.S. maps will be needed to get the most from this work. This could be done using the map extract used here but it would be more exciting for the children to prepare with a different map and then present this as a challenge!

Key idea – 'Detective Work'

- Look at the map and discuss together
- Collect as many clues from the map as possible about what the area is like
- Encourage the children to imagine what the place they are going to visit is like?
- In small groups describe what they would expect to find on their visit. Make a note of this description
- Compare their description with what they actually see when they get there

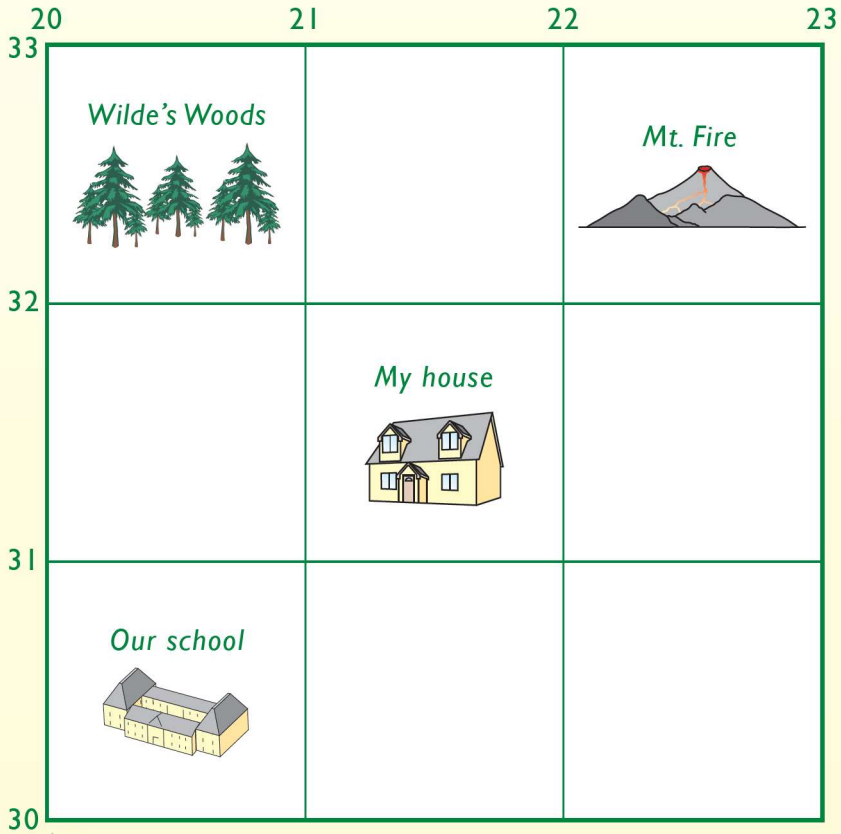
Introduction to map work

Before starting the map work the children will need to know a little about contours, scale, direction, map symbols and grid references. Below is a reminder about grid references.

- O.S. maps have a grid system.
- Each vertical and horizontal line has a number.
- To place 'My house' using a 4-figure grid reference take the numbers from the bottom left hand corner of the square with 'My house' in it, giving the vertical line number first and then the horizontal line number. In this example it is 2131. The most common way to remember which figure comes first is by the saying "Along the corridor and up the stairs".
- 6-figure grid references pinpoint features within the squares. This requires the map reader to imagine the grid square is divided in tenths along the horizontal and vertical scale. So 'My house' becomes 215315.

Allenheads, Northumberland

Introductory Activity 1 - Teacher Resource Sheet



Allenheads, Northumberland

Introductory Activity 1 - Pupil Resource Sheet 1

DETECTIVE MAP WORK

Use the O.S. map extract and the symbols for this site and in small groups complete the following:

1. As a group discuss and attempt the following and be prepared to feed back to the class.

- Point to north on your map.
- Trace the River East Allen with your finger. Can you work out in which direction it is flowing? Use the contours and spot heights to help you.
- The River East Allen starts in grid square 8546 near Dirt Pot. What are the names of the 2 streams that join here to form the river? Can you find another stream that joins the River East Allen?
- All of these names are used on the map for flowing water – river, syke, burn. Use the map to try and work out the difference between them.
- Put the river terms – syke, burn, river, in order from biggest to smallest.
- Find the names of 6 different sykes and 2 burns.
- What do you think a syke might look like? Describe it.

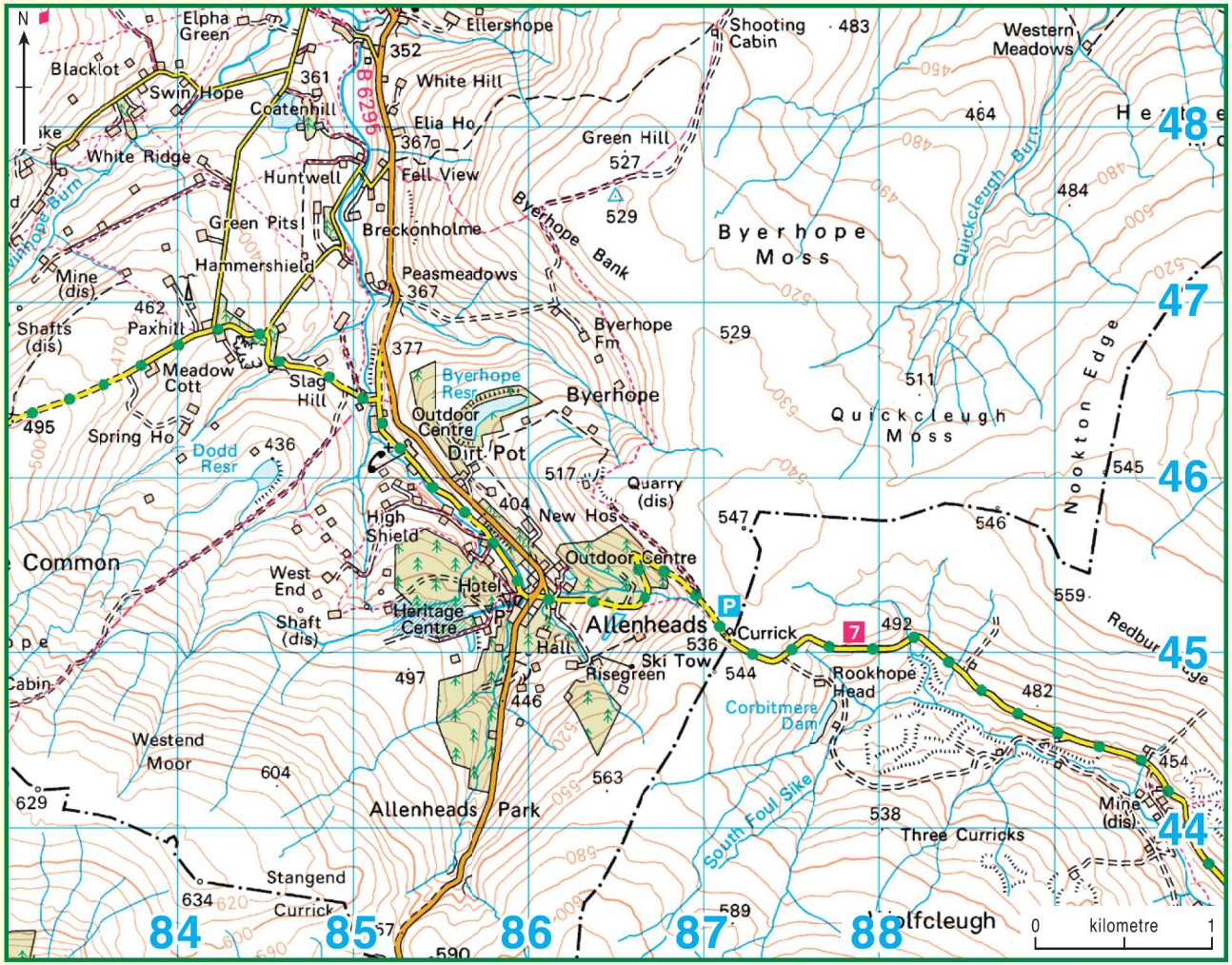
2. Allenheads map detective work

- Allenheads has had an industrial past as well as being a hill farming area. Use the map to guess what industries might have been here. What industry might still be here? What evidence do you have for your answers?
- Why do you think the B6295 road and the River East Allen are so close together?
- Look at these grid squares – 8747, 8746, 8846. Try to imagine what the landscape looks like here. What might be growing there? Is it high or low land? Is it sheltered or exposed? Is it flat or steep? Is it dry or boggy? Would it be a good place to pitch your tent to stay the night?

3. Grid references

As a group complete the grid below:.

Grid reference	What is there?
	Byerhope Reservoir
8245	
	A hotel in Allenheads
8843	
8344	Name the long-distance footpath:_____



O.S. Map of Allenheads

Ordnance Survey Map Symbols

Pupil Resource Sheet

ROADS AND PATHS

M1 or A6 (M) — Motorway

A35 — Dual carriageway

A30 — Main road

B3074 — Secondary road

Narrow road with passing places

Road under construction

Road generally more than 4m wide

Road generally less than 4m wide

Other road, drive or track, fenced and unfenced

Path

RAILWAYS

Multiple track

Single track

PUBLIC RIGHTS OF WAY

Footpath

Bridleway

BOUNDARIES

National

County (England)

Civil Parish (CP)

National Park boundary

SELECTED TOURIST AND LEISURE INFORMATION

P — Parking

Information centre

PC — Public convenience

Telephone

Campsite / caravan site

Golf course or links

Public house

Walks

Viewpoint

Picnic site

Country park

GENERAL FEATURES

\+ — Place of worship

Building

Bus or coach station

Triangulation pillar

Windmill

BP/BS — Boundary post / stone

CH — Clubhouse

FB — Footbridge

Mon — Monument

PO — Post Office

Pol Sta — Police station

Sch — School

TH — Town hall

LIFE AS A LEAD MINER

Purpose and aims of the visit:

The main aims of the fieldwork are:

- To use Allenheads as a contrasting locality for study
- To look at Allenheads as a lead mining village
- To look at the rocks and minerals in Allenheads

Background Information:

As village and towns grow they develop specific functions. The function or functions of a village or town relate to its main activities, for example a market town or a mining town. A town's function can change over time.

Allenheads originally grew as a result of lead mining. Lead mining has long since gone and the village is now trying to attract visitors. It is its former function as a lead mining village that will form the basis of this visit.

Allenheads is 400 metres above sea level and is reputedly the highest village in England. The reason for a village being sited at such a height was its mineral wealth. In the Nineteenth Century it was the single most important lead mining area in Britain.

Allenheads, Northumberland

Introductory Activity 2 - Teacher Resource Sheet

INTRODUCING THE FIELDWORK

a. Using Pupil Resource Sheet 2, introduce the idea that villages and towns have a function. Complete activity 1 on Pupil Resource Sheet 2.

b. As a class read the poem on Pupil Resource Sheet 2 and describe what a lead miner's life was like. Complete activity 2 on Pupil Resource Sheet 2.

Allenheads, Northumberland

Introductory Activity 2 - Pupil Resource Sheet 2

LIFE AS A LEAD MINER

1. As villages and towns grow they develop functions. The functions of a town relate to its main activities, for example a market town or a mining town. Functions change over time – Allenheads main activity was once lead mining but now it is trying to attract visitors.

   What is the function of the town or village where you live?

2a) The poem below describes a day in the life of a lead miner. Read the poem and think about what the life of a lead miner would have been like

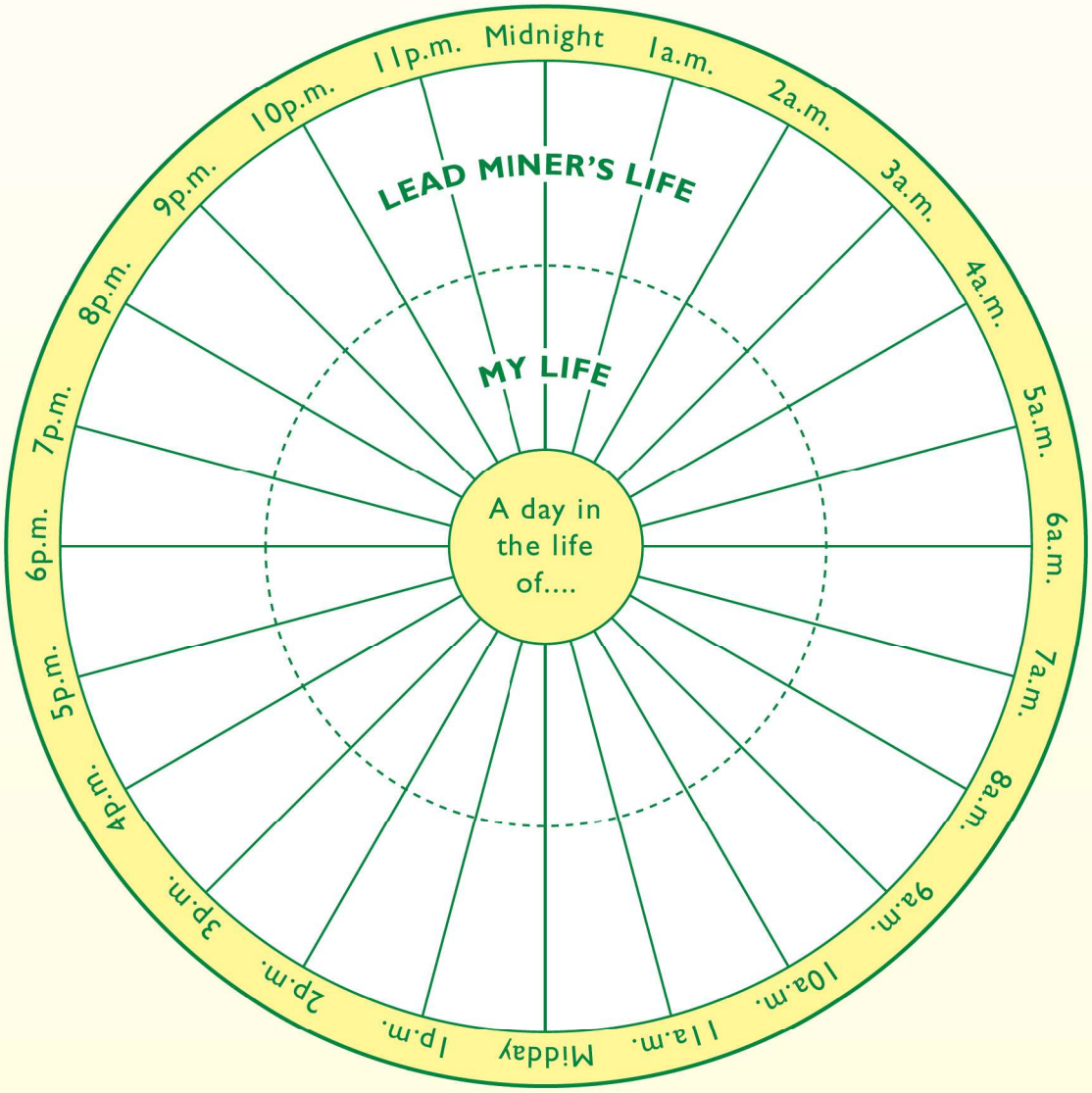
TWENTY-FOUR HOURS

00.00 Sleeping
01.00 Snoring
02.00 Twisting
03.00 Turning
04.00 Dreaming
05.00 Waking
06.00 Breakfasting
07.00 Walking
08.00 Pushing
09.00 Searching
10.00 Hammering
11.00 Drilling
12.00 Blasting
13.00 Shovelling
14.00 Eating
15.00 Loading
16.00 Sighing
17.00 Aching
18.00 Trudging
19.00 Cooking
20.00 Talking
21.00 Writing
22.00 Praying
23.00 Coughing
24.00 Sleeping

By Christopher Collin
(From '*Here I may sweat and dig for lead. Teesdale mining traditions in the words of local people*').

2b) A day in the life of...

Use the poem to record the activities in the day of a lead miner on the chart below. Over the next 24 hours record your own activities and add them to the chart so you can compare your life with the life of a lead miner. You can add extra categories to the key.



☐ In bed ☐ Talking ☐ _____

☐ Eating ☐ Writing ☐ _____

☐ Walking ☐ Praying ☐ _____

ORGANISATIONAL DETAILS

Aim of field work

To look at Allenheads as a contrasting locality with a focus on lead mining.

Target Group

Key stage 2 science , geography and rocks and soils. Some aspects may be suitable for Key stage 1.

Location

The fieldwork day takes you through Rookhope village (NY 937428) and along the road (suitable for coaches) to Allenheads (NY860453) stopping at Groverake Mine (NY 896442) on route. In Allenheads the remainder of the day is to be spent investigating the mining and geology of this once extremely important village in the North Pennines.

Practical Details

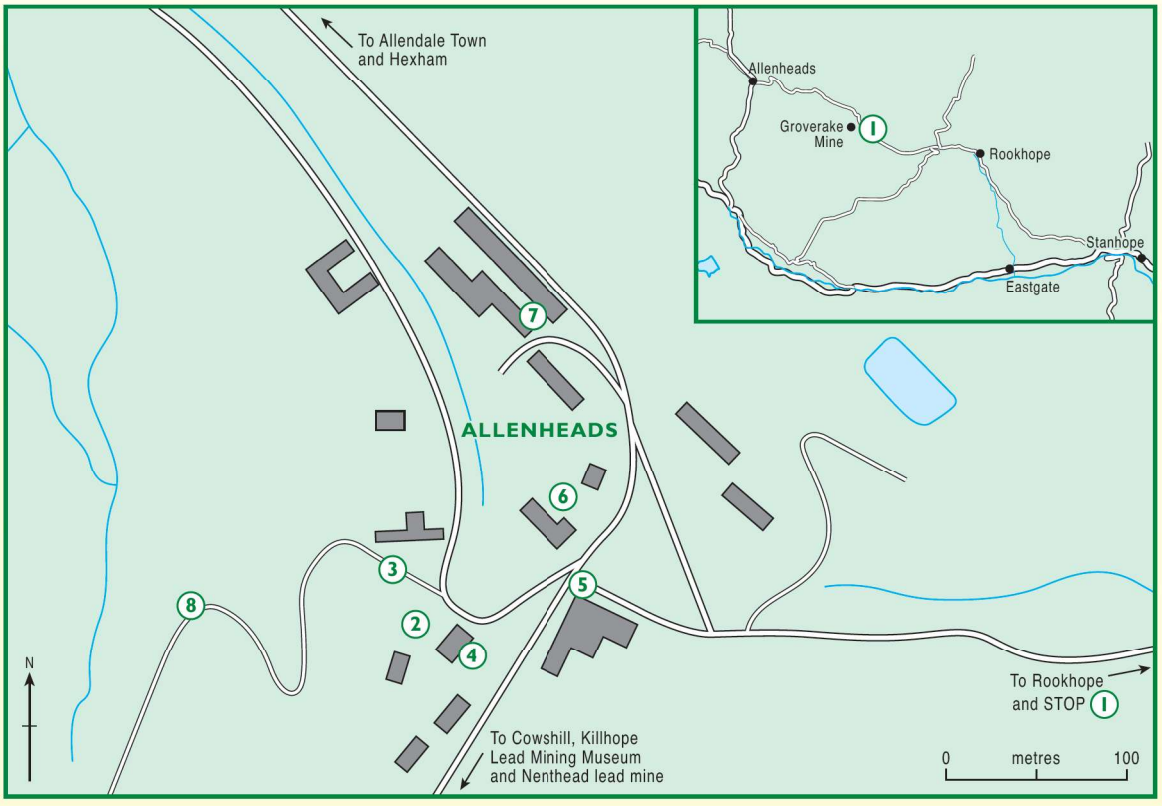
- Parking – At Groverake Mine suitable parking is available in an informal lay-by or at the old gated mine entrance for a coach or minibus. In Allenheads there is a large car park. Do not park in the village centre by the pub.
- Toilet facilities – Public toilets are available in the centre of Allenheads
- Useful maps – Ordnance Survey Explorer OL31 North Pennines, Teesdale and Weardale and OL 43 Hadrian's Wall, Haltwhistle and Hexham.

Safety Issues:

- Old mine workings can be extremely dangerous and you should keep to marked paths and away from all mine shafts.
- The roads are fairly quiet in Allenheads but pupils should be supervised on and off the coach and crossing the roads.
- Refer to the Hazard Identification Sheet.

Allenheads, Northumberland

Fieldwork Outline - 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
Getting on and off the coach or minibus	Caution needed when getting off the coach or minibus in the car park. All students and staff.	Supervise students getting off the coach or minibus and gather in a safe place.
Weather	Rookhope to Allenheads is an extremely exposed road and it is not advised to travel along the road in Winter. All students and staff.	Check weather forecast and make sure driving conditions are suitable. Wear suitable clothing and footwear for the weather conditions.
Old mine workings – Groverake Mine	Under **NO** circumstances is any one to walk down to the Groverake mine. Old disused mine workings can be extremely dangerous. All students and staff.	Warn about conditions.
Old mine workings - Allenheads	All of the old mine workings in Allenheads have been made safe but no students should play near an air shaft or if access granted at the main mine entrance no students should try to enter or play near any old machinery. All students and staff.	Supervise students at all times.
Uneven paths	Paths are uneven and may be slippery in wet weather. Students may slip and fall. All students and staff.	Warn about conditions

UNDERTAKING THE FIELDWORK

1. Minerals and mining

Everywhere you look in the North Pennines you see a mining legacy, which dates from a time when mining dominated the landscape and the lives of local people. For many hundreds of years much of the North Pennines, especially Weardale and Allendale, were important centres of lead and fluorite mining.

The earliest mining was almost certainly opencast diggings based on local knowledge where some minerals may have been found and then worked along a vein. Eventually it was necessary to sink shafts into a vein or along side, in order to gain access to deeper deposits. The extraction and processing has left its mark on the landscape. In places the mine buildings still survive, but often the spoil heaps are all that is left. Most importantly the minerals extracted were at the heart of many of the communities, and, though the industry was in decline from the beginning of the Twentieth Century, the last mine only closed in 1999.

The lead ore (galena, PbS) and other principal minerals were extracted from the rocks from what miners called veins and flats. **Veins** are sheet-like mineral occurrences that occupy more or less vertical cracks, fissures or faults in the rocks. Most veins are a few millimetres to tens of metres in width and typically consist of crude bands of minerals more or less parallel

Galena, lead sulphide (PbS), is a dense, silver-grey metallic mineral. This is the main ore that was worked in much of the North Pennines. It was sometimes associated with silver (sample in Rock Box)

with the sides of the vein. A range of minerals made up the veins, some such as fluorite (CaF_2), were initially classified as 'gangue' or unwanted products, but later formed an important commodity in the economic prosperity and longevity of many mines. **Flats** are roughly

Weardale Flourite with its green colour (sample in Rock Box)

Classic purple coloured flourite crystals from Fraser's Hush-Groverake Mine Complex, Rookhope. It forms perfect cubic crystals that are often found interlocking with others. Much of the flourite was crushed but several specimans can be found in museums.

horizontal occurrences of minerals that can extend for many metres away from a near vertical vein. Flats only occur in limestone, where large-scale mineral replacement has taken place. It was recognised early on in the geological development of the mines that flats were important locations for rich accumulations of lead and iron ores. Two of the regions largest and most productive lead mines, Allenheads, Allendale and Boltsburn, Weardale, mined the ore from flats and the associated veins are

called the Red and Boltsburn veins respectively.

During the later years of mining in Weardale and Allendale, fluorite became the most sought after mineral, with lead only being extracted as a by-product. The last mine to close in Weardale was Fraser's Hush-Groverake Mine Complex, Rookhope, which mined fluorite until its closure in 1999.

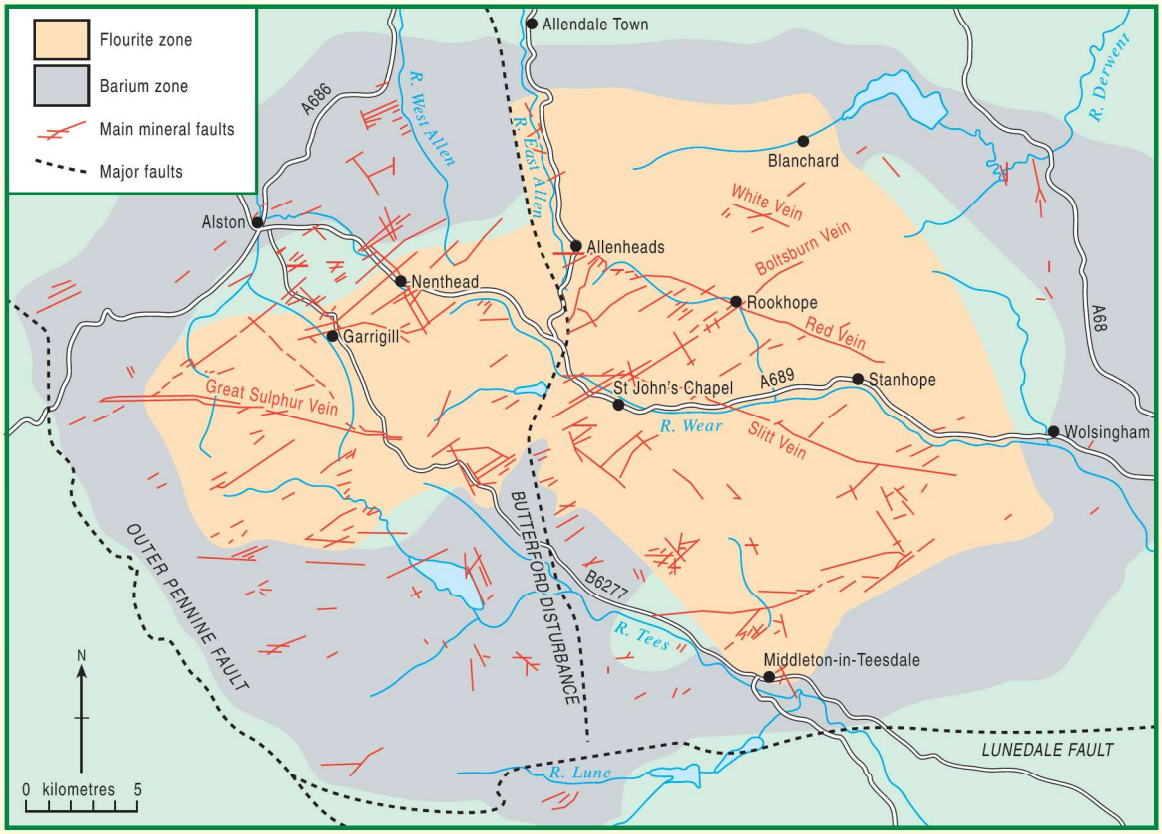
Use of mined ores

Galena (lead sulphide PbS): This metal is very soft and easily workable. It has been widely used for water pipes by plumbers and by builders for roofing (commonly seen on churches). A less obvious use for lead is as a chemical additive in paints, petrol and batteries.

Fluorite (Calcium fluoride, CaF_2): The word fluorite derives from the Latin word 'fluere' meaning 'to flow because of the minerals use as flux in iron and aluminium smelting. Some of the last operators of mines in Weardale and Allendale were British Steel. It was originally referred to as fluorspar by miners and this is still its commercial name today. Fluorite is also used as a source of fluorine for hydrofluoric acid and fluorinated water. The element fluorine also gets its name from fluorite, fluorine's only common mineral. Other uses of fluorite include an uncommon use as a gemstone (low hardness and good cleavage reduce its desirability as a gemstone), ornamental carvings (in which it is sometimes misleadingly called Green Quartz) and special optical uses.

Galena, lead sulphide (PbS), is a dense, grey metallic mineral. This is the main ore that was worked in much of the North Pennines (sample in Rock Box).

Weardale green fluorite (sample in Rock box) Classic purple coloured fluorite crystals from Fraser's Hush-Groverake Mine Complex, Rookhope. It forms perfect cubic crystals that are often found interlocking with others. Much of the fluorite was crushed but many spectacular specimens can be found in museums.



Map showing the distribution of mineral veins and mineral zones in the North Pennines. This is a simplified map, but still shows hundreds of mineral veins found by the miners

Allenheads, Northumberland

Fieldwork - Pupil Resource Sheet

What do you need: a pencil, a hand lens and a clipboard

Where do you go: follow the map and answer the following questions

STOP 1: Groverake Mine

You are now looking towards Groverake Mine in the Rookhope valley, Weardale. This is an area famous for its long history of mining different minerals. Groverake Mine has a long history of mining with many of the buildings you can see dating back to the 19th Century. For hundreds of years lead mining was the most important industry in Weardale, but Groverake Mine achieved far more prosperity as a florospar (fluorite) mine and only closed in 1999.

Fact: Over 700, 000 tonnes of fluorspar was mined at Groverake Mine, or 35, 000 large lorry loads!

The steel framework you can see is called the HEADGEAR and is a very important part of most mines. What was it used for?

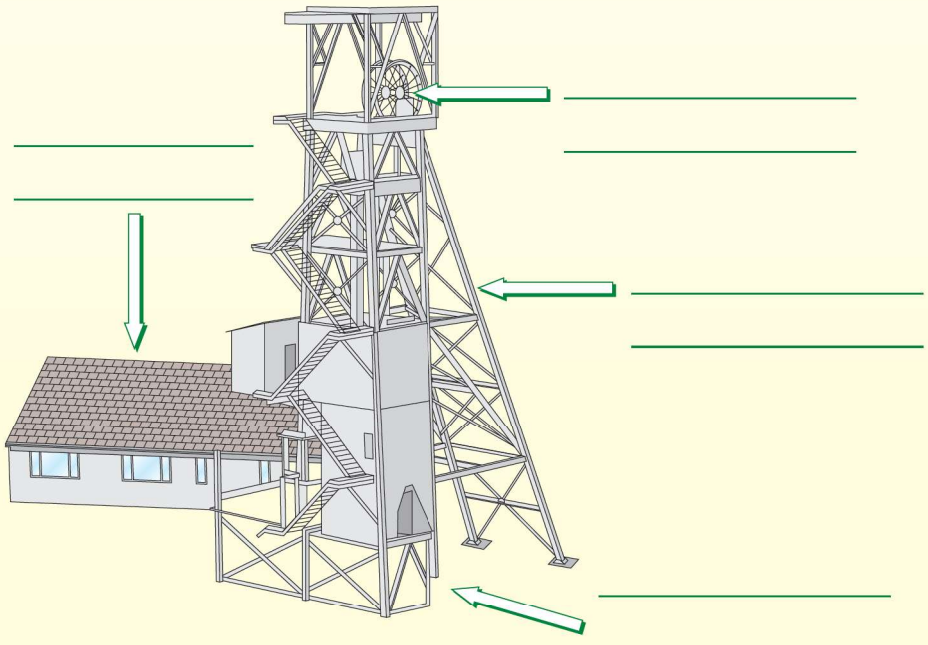
_____

_____

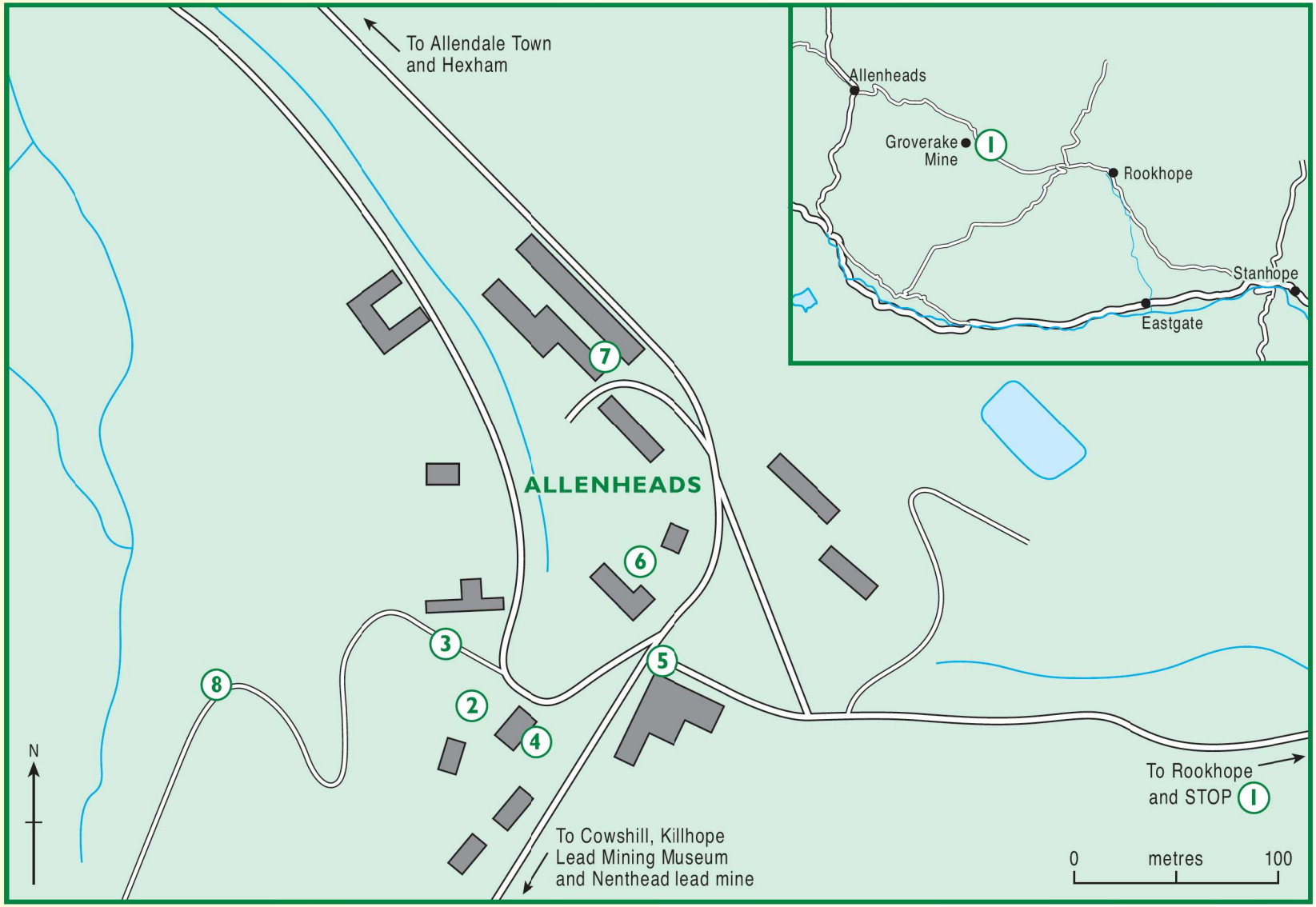
_____

The head gear is used as a pulley system for taking men down into the mine usually in metal cages or for bringing minerals back to the surface.

Fill in the missing labels using the names in the box for the different parts of the mining headgear.



Steel Frame	Winding Wheel	Mine Shaft	Mining Offices


To Allendale Town
and Hexham
ALLENHEADS
7
6
5
3
2
4
8
N
To Rookhope
and STOP I
To Cowshill, Killhope
Lead Mining Museum
and Nenthead lead mine
0
metres
100
Allenheads
Groverake
Mine
I
Rookhope
Stanhope
Eastgate

Draw your own picture of the headgear in this box. Add your own labels and you can even draw part of the mine shaft undrground with men going down the mine in their mine cages.

We shall now drive along the road to the old mining village of ALLENHEADS.

The last 1km of the road follows a valley that was dug out by the miners in the search for lead and other important minerals.

Welcome to Allenheads!

Beneath the village of Allenheads lies the single biggest lead mine in the North Pennines. Everything you see in Allenheads forms part of the history of lead mining and during the 1800's Allenheads was the headquarters of W.B.Lead one of the most successful and long lasting lead mining companies. Lets now learn more about Lead Mining...

STOP 2: Allenheads Heritage Centre

The use of water!

During the 1800's a very large number of boys and men worked in lead mining industry centred on Allenheads. Muscle power alone was not sufficient and the mining industry required huge amounts of power from other sources for the crushing equipment and smelting of the iron ore. At this time throughout most of Britain coal was used to provide steam power for the Industrial Revolution. However, in the North Pennines things were very different and water was used to drive large water wheels and hydraulic engines.

Why was water used instead of coal to power a lot of the mining equipment?

The Armstrong Hydraulic Engine

A Newcastle investor and engineer, W.G. Armstong, developed the hydraulic engine. The hydraulic engine uses water under pressure to push a large piston back and forth in a cylinder. The principle is exactly the same as that of large steam engines, only using water rather than steam.

What is the difference between water and steam?

The Armstong Hydraulic Engine was installed to work the Allenheads mine sawmill operating large saws to cut wood. A sawmill is where wood from trees is cut into useful sizes. The wood you find in DIY shops comes from sawmills.

Why did Allenheads need a sawmill for the mining or lead and fluorospar?

Fact: On the hillsides around Allenheads are small reservoirs of water that were once used to power the Hydraulic engines. The reservoirs once had a combined capacity of nearly 282 million litres of water, or 124 Olympic size swimming pools full of water!

STOP 3: Mining Trucks

These red mining trucks are called 'TUBS' and were used by the miners in Allenheads to move the lead and fluorspar ores from deep under ground to the surface.

Label the photograph of the tubs using the words in the box to help you.

Wheel	Tub	Rail	Coupling

The use of electric motors to move the tubs from underground full of lead ore and rocks was a much later addition in the mid-1900's.

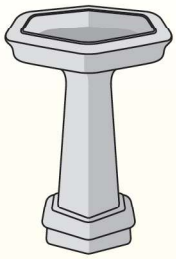
What do you think the miners used before electric motors to move these heavy tubs to the surface?

STOP 4: Old Iron Well

Rocks are all around us and are very useful and control many natural processes

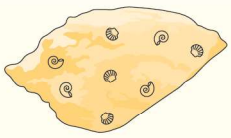
Some rocks are **IMPERMEABLE**
they don't allow water to soak through.

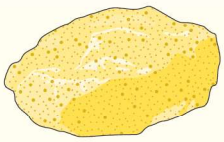
It is mostly **Hard** rocks that are impermeable.



Some rocks are **PERMEABLE**
they let water soak through.

It is most **softer** rocks that are permeable
The rocks that create the surrounding hills around Allenheads are made of limestone, sandstone and mudstones (also called shale). These rocks are about 320 million years old.





Based on your observations, the Iron well exists because the surrounding rocks are (circle the correct answer):

PERMEABLE **IMPERMEABLE**

Why do you think this?

_____

_____

_____

What was the water from the Iron Well once recommended for?

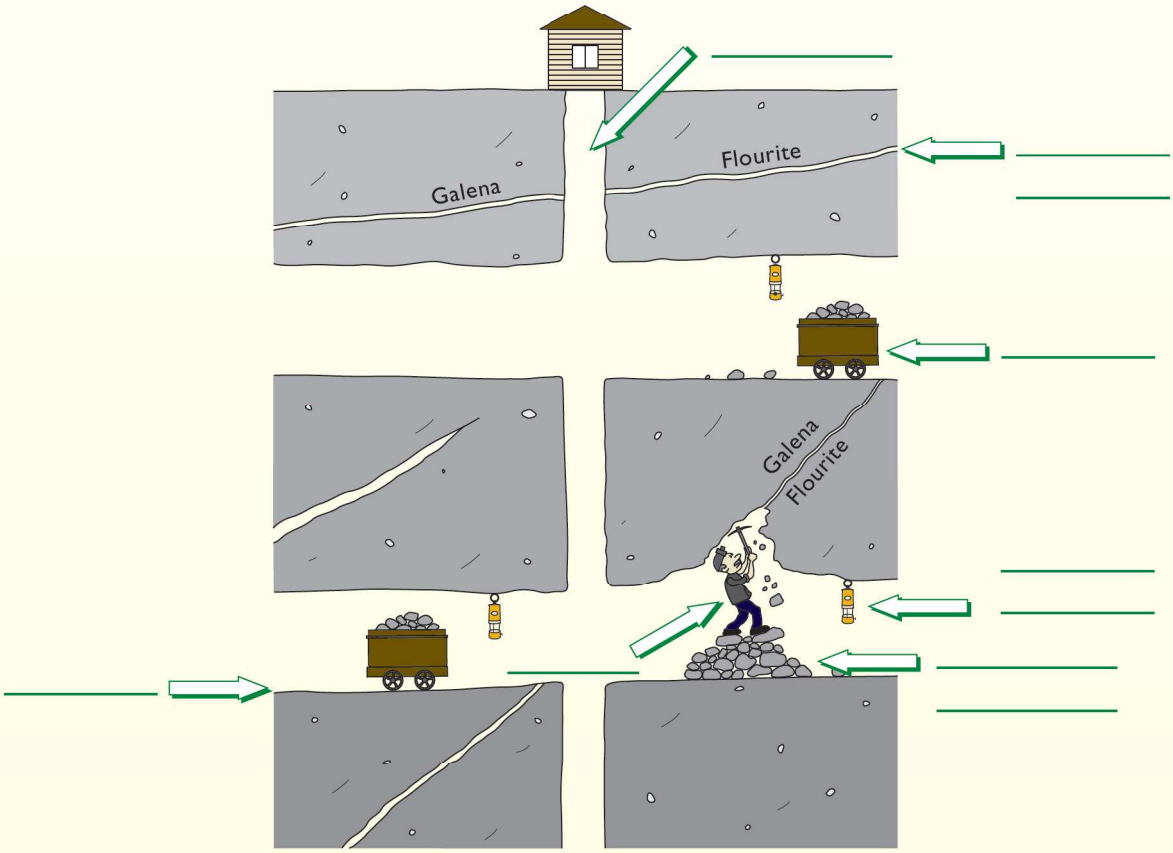
_____

_____

STOP 5: The Gin Hill Shaft

The Gin Hill Shaft is about 70 m deep and provided access for miners to a number of different levels. The miners would have climbed down a series of ladders to reach the veins and seams in each level that they were working. The ponies had a separate entrance into the mine down a gentle slope and were used to bring the tubs full of lead out of the mine.

Label the sketch of the mine using the words in the box to help you.



Tub	Shaft	Miner	Miners lamp
Mineral vein		Level	Miners platform

The Gin Hill mine shaft was abandoned later in the history of the mine and is now only an **air shaft** with the main mine entrance about 100 metres away at **Stop 6**.

Why is it important to have air shafts in mines?

Did You Know: The Gin Hill mine shaft is nearly as deep as 17 double decker buses placed on top of each other!

STOP 6: Old Mine buildings

The history of lead mining is everywhere in Allenheads and the once owners of the lead mines, W.B Lead, even built houses, schools and churches for their workers. As the mine at Allenheads was the largest in the North Pennines it was important for the lead mine owners to provide all of the necessary facilities for its workers.

The mine buildings that you can see at stop 6 are related to the later processing of the minerals when they reached the surface. Make sure you look at the photograph below and identify each of the buildings and what is was used for.

1. Crushing and sorting: Cushing and sorting of the rocks brought to the surface in the tubs was an essential part of the mining operation. The lead ore and fluorite were often found scattered through veins or occurred in patches. A mixture of lead ore, fluorite and worthless rock (limestone, shale and sandstone) was brought to the surface and this had to be separated and sorted. This allowed only the important ores and minerals to be transported away from the mine.

2. Engine house: This is where the engine is positioned to drive the machinery for crushing, sorting and later in the mines history hauling the tubs to the surface from deep underground.

3. Entrance to mine: A later entrance was constructed into the mine for ease of access when attention was turned from looking for Lead to mining Flourite. Flourite is a very important mineral in steel making, making of glass and in the petrochemical industry such as on Teesside today.

STOP 7: Mine workers cottages and workshop

What look likes miners cottages in the photograph above are really a mixture of workshops on the ground floor and miners shared sleeping rooms on the first floor.

Many miners lived in cottages provided by the mine owners. Many of the terraced cottages in Allenheads have large front gardens. The lead mine owners encouraged gardening as a suitable hobby for the miners and this tradition is still carried on today in many North Pennine villages.

STOP 8 Rocks and Minerals near the Old Forge:

Senses for rock investigation

Famous Five

What are our five senses? Write them here.

1. _____

2. _____

3. _____

4. _____

5. _____

Which sense?

Label this picture with the correct senses that you think a geologist would use to investigate the rocks on the gravel path. Use the words in the box to help you.

_____

_____

_____

Feeling	Tasting	Smelling	Seeing

Now you know which senses are most important to use to be a geologist!

Be a geologist!

Geologist's use their senses to recognise different rocks and minerals. Pick up some of the rocks or minerals from the path.

TOUCH

Feel and explore the textures of the rocks and minerals in the path with your fingers. Then write the words you can think of to describe them here...

SEE

What are the most interesting rocks and minerals you can see in the path? Draw them here...

SMELL

Write words to describe the smells you discover of the minerals and rocks...

Fact: All of the rocks and minerals in the path are older than the Dinosaurs and many are about 320 million years old.

The rocks and minerals

Now you are a geologist use your senses to find the following different minerals and rocks. Make sure you tick the boxes ✓ once you find the mineral or rock. Draw two examples of the rocks or minerals in the box below.

Frosterley marble with fossils of coral ☐

Flourite (Purple and green coloured crystals) ☐

Quartz ☐

Galena ☐

Limestone ☐

An experiment!

Fizzing rocks!

Steps

6) Empty one bottle of malt vinegar (same as you have on your fish and chips) or one bottle of white wine vinegar into a plastic bowl.
7) Put one of the rocks or minerals that you have collected into the middle of the bowl filled with vinegar. Can you see anything happening to the rock or mineral.
8) Leave the rock or mineral in the bowl for a minute and if nothing happens remove and replace with a different rock or mineral.
9) Continue with step 3 until you have placed all of the rocks or mineral in the bowl for a minute each.
10) Fill out the table below with your observations and tick the box for those rocks or minerals that fizzed!

Rock or mineral name	Observation - What happened?	Did it Fizz? (tick the box for yes) ✓

At your school, on your way home and at home look for other rocks and minerals that may be found for building or in pathways, or for gravestones, or fireplaces and tell your teacher or friends about what you have discovered.

Allenheads, Northumberland

Fieldwork - Teacher Resource Sheet

What do you need: a pencil, a hand lens and a clipboard

Where do you go: follow the map and answer the following questions

STOP 1: Groverake Mine

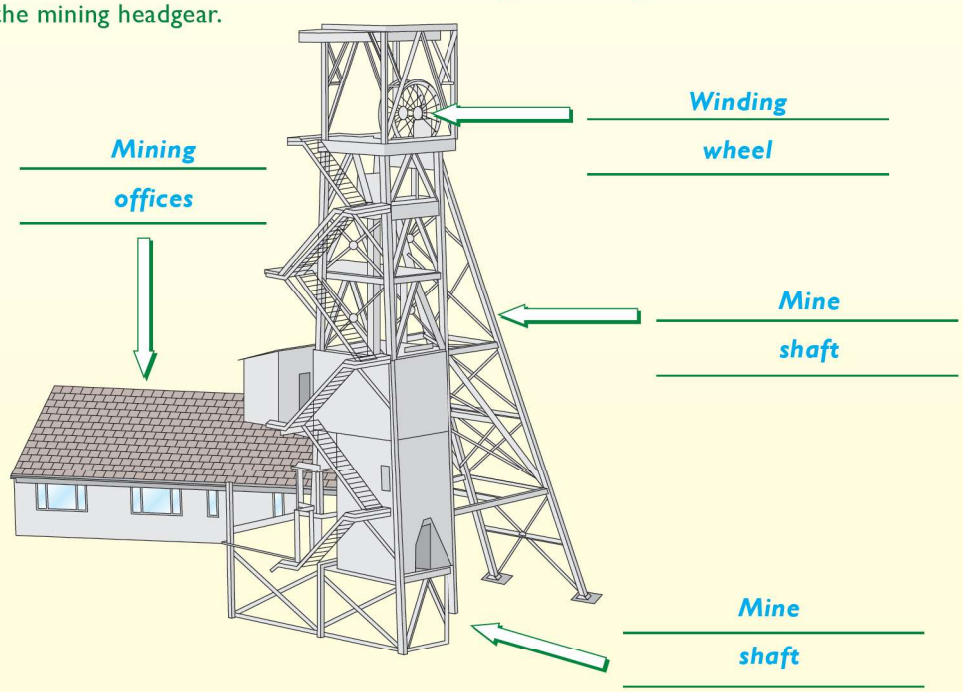
You are now looking towards Groverake Mine in the Rookhope valley, Weardale. This is an area famous for its long history of mining different minerals. Groverake Mine has a long history of mining with many of the buildings you can see dating back to the 19th Century. For hundreds of years lead mining was the most important industry in Weardale, but Groverake Mine achieved far more prosperity as a florospar (fluorite) mine and only closed in 1999.

Fact: Over 700, 000 tonnes of fluorspar was mined at Groverake Mine, or 35, 000 large lorry fulls!

The steel framework you can see is called the HEADGEAR and is a very important part of most mines. What was it used for?

The head gear is used as a pulley system for taking men down into the mine (usually in metal cages) or for bringing minerals back to the surface.

The head gear is used as a pulley system for taking men down into the mine usually in metal cages or for bringing minerals back to the surface. Fill in the missing labels using the names in the box for the different parts of the mining headgear.



Steel Frame	Winding Wheel	Mine Shaft	Mining Offices

Draw your own picture of the headgear in this box. Add your own labels and you can even draw part of the mine shaft undrground with men going down the mine in their mine cages.

We shall now drive along the road to the old mining village of ALLENHEADS.

The last 1km of the road follows a valley that was dug out by the miners in the search for lead and other important minerals.

Welcome to Allenheads!

Beneath the village of Allenheads lies the single biggest lead mine in the North Pennines. Everything you see in Allenheads forms part of the history of lead mining and during the 1800's Allenheads was the headquarters of W.B.Lead one of the most successful and long lasting lead mining companies. Lets now learn more about Lead Mining...

STOP 2: Allenheads Heritage Centre

The use of water!

During the 1800's a very large number of boys and men worked in lead mining industry centred on Allenheads. Muscle power alone was not sufficient and the mining industry required huge amounts of power from other sources for the crushing equipment and smelting of the iron ore. At this time throughout most of Britain coal was used to provide steam power for the Industrial Revolution. However, in the North Pennines things were very different and water was used to drive large water wheels and hydraulic engines.

Why was water used instead of coal to power a lot of the mining equipment?

It was too difficult to transport coal up into North Pennines to the remote villages where the lead mining was being undertaken.

The Armstrong Hydraulic Engine

A Newcastle investor and engineer, W.G. Armstong, developed the hydraulic engine. The hydraulic engine uses water under pressure to push a large piston back and forth in a cylinder. The principle is exactly the same as that of large steam engines, only using water rather than steam.

What is the difference between water and steam?

They are both the same except steam is water at boiling point.

The Armstong Hydraulic Engine was installed to work the Allenheads mine sawmill operating large saws to cut wood. A sawmill is where wood from trees is cut into useful sizes. The wood you find in DIY shops comes from sawmills.

Why did Allenheads need a sawmill for the mining or lead and fluorospar?

Most mines were linked to saw mills for making of props to hold up the roofs of the underground tunnels and make it secure to work underground.

Fact: On the hillsides around Allenheads are small reservoirs of water that were once used to power the Hydraulic engines. The reservoirs once had a combined capacity of nearly 282 million litres of water, or 124 Olympic size swimming pools full of water!

STOP 3: Mining Trucks

These red mining trucks are called 'TUBS' and were used by the miners in Allenheads to move the lead and fluorspar ores from deep under ground to the surface.

Label the photograph of the tubs using the words in the box to help you.

Wheel	Tub	Rail	Coupling

The use of electric motors to move the tubs from underground full of lead ore and rocks was a much later addition in the mid-1900's.

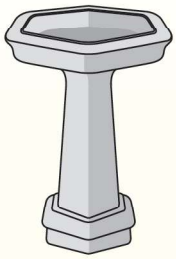
What do you think the miners used before electric motors to move these heavy tubs to the surface?

Most miners in the North Pennines used ponies to move the tubs from underground on gentle ramps up to the surface. It has only been in the recent history of mining that electric motors have been used to operate the tubs and conveyor belts.

STOP 4: Old Iron Well

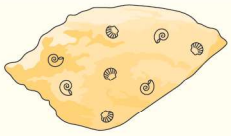
Rocks are all around us and are very useful and control many natural processes

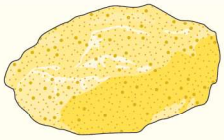
Some rocks are **IMPERMEABLE**
they don't allow water to soak through.



It is mostly **Hard** rocks that are impermeable.

Some rocks are **PERMEABLE**
they let water soak through.





It is most **softer** rocks that are permeable
The rocks that create the surrounding hills around Allenheads are made of limestone,

sandstone and mudstones (also called shale).
These rocks are about 320 million years old.

Based on your observations, the Iron well exists because the surrounding rocks are (circle the correct answer):

PERMEABLE **IMPERMEABLE**

Why do you think this?

As the water is iron coloured this comes from the rocks in the surrounding hillsides. The water drains through the rocks where the iron is removed in solution and then is precipitated at this spring. For this process to happen the rocks must be permeable.

What was the water from the Iron Well once recommended for?

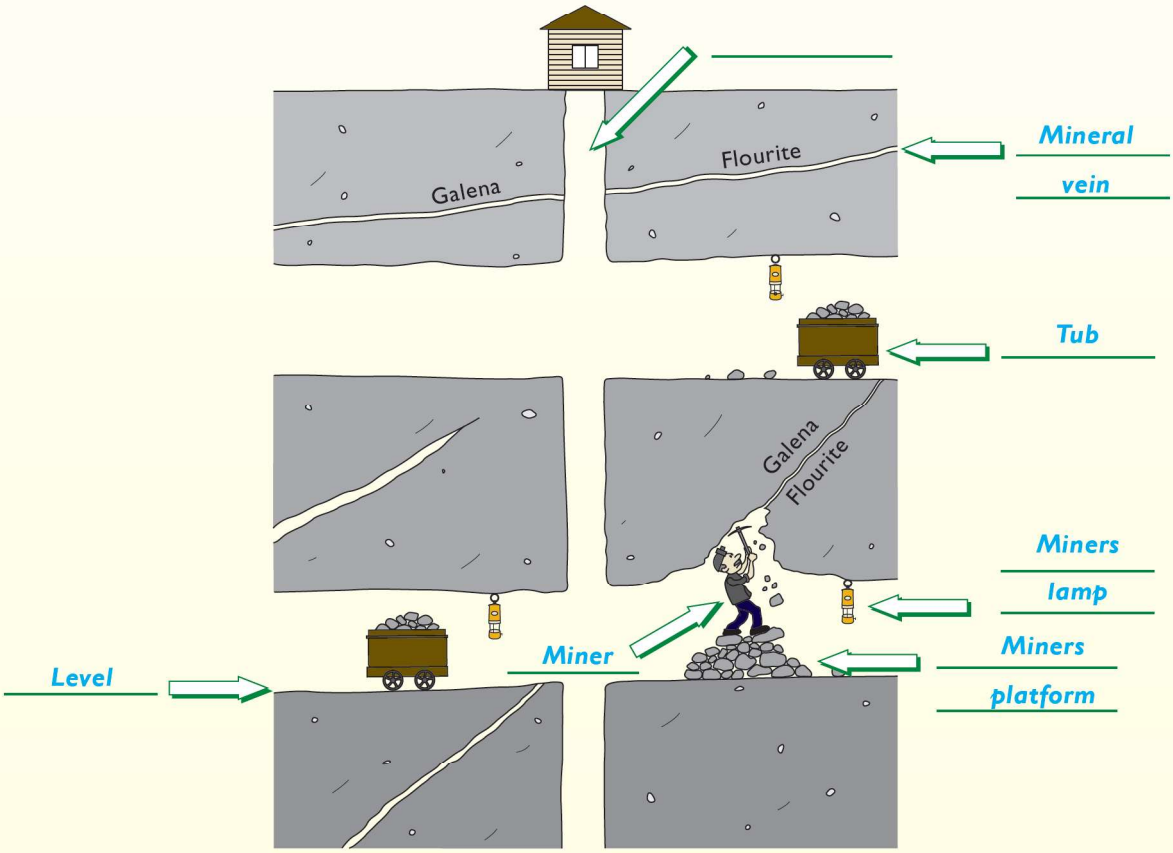
It was once advised for pregnant mothers to drink a glass of this water a day to help build strength.

Do not drink it today!

STOP 5: The Gin Hill Shaft

The Gin Hill Shaft is about 70 m deep and provided access for miners to a number of different levels. The miners would have climbed down a series of ladders to reach the veins and seams in each level that they were working. The ponies had a separate entrance into the mine down a gentle slope and were used to bring the tubs full of lead out of the mine.

Label the sketch of the mine using the words in the box to help you.



Tub	Shaft	Miner	Miners lamp
Mineral vein		Level	Miners platform

The Gin Hill mine shaft was abandoned later in the history of the mine and is now only an **air shaft** with the main mine entrance about 100 metres away at **Stop 6**.

Why is it important to have air shafts in mines?

To let fresh air into the mine and to stop the dangerous build up of toxic and poisonous gases.

Did You Know: The Gin Hill mine shaft is nearly as deep as 17 double decker buses placed on top of each other!

STOP 6: Old Mine buildings

The history of lead mining is everywhere in Allenheads and the once owners of the lead mines, W.B Lead, even built houses, schools and churches for their workers. As the mine at Allenheads was the largest in the North Pennines it was important for the lead mine owners to provide all of the necessary facilities for its workers.

The mine buildings that you can see at stop 6 are related to the later processing of the minerals when they reached the surface. Make sure you look at the photograph below and identify each of the buildings and what is was used for.

1. Crushing and sorting: Cushing and sorting of the rocks brought to the surface in the tubs was an essential part of the mining operation. The lead ore and fluorite were often found scattered through veins or occurred in patches. A mixture of lead ore, fluorite and worthless rock (limestone, shale and sandstone) was brought to the surface and this had to be separated and sorted. This allowed only the important ores and minerals to be transported away from the mine.

2. Engine house: This is where the engine is positioned to drive the machinery for crushing, sorting and later in the mines history hauling the tubs to the surface from deep underground.

3. Entrance to mine: A later entrance was constructed into the mine for ease of access when attention was turned from looking for Lead to mining Flourite. Flourite is a very important mineral in steel making, making of glass and in the petrochemical industry such as on Teesside today.

STOP 7: Mine workers cottages and workshop

What look likes miners cottages in the photograph above are really a mixture of workshops on the ground floor and miners shared sleeping rooms on the first floor.

Many miners lived in cottages provided by the mine owners. Many of the terraced cottages in Allenheads have large front gardens. The lead mine owners encouraged gardening as a suitable hobby for the miners and this tradition is still carried on today in many North Pennine villages.

STOP 8 Rocks and Minerals near the Old Forge:

Senses for rock investigation

Famous Five

What are our five senses? Write them here.

1. *Taste* _____

2. *Smell* _____

3. *Touch* _____

4. *Hearing* _____

5. *Seeing* _____

Which sense?

Label this picture with the correct senses that you think a geologist would use to investigate the rocks on the gravel path. Use the words in the box to help you.

_____

_____

_____

Feeling	Tasting	Smelling	Seeing

Now you know which senses are most important to use to be a geologist!

Be a geologist!

Geologist's use their senses to recognise different rocks and minerals. Pick up some of the rocks or minerals from the path.

TOUCH

Feel and explore the textures of the rocks and minerals in the path with your fingers. Then write the words you can think of to describe them here...

Rough, smooth, hard, soft, brittle.

SEE

What are the most interesting rocks and minerals you can see in the path? Draw them here...

Sparkles, bright, dull, grey, black, multi coloured, purple, green, white blobs, cubic, crystals, fossils...

SMELL

Write words to describe the smells you discover of the minerals and rocks...

Smelly, no smell, earthy smell.

Fact: All of the rocks and minerals in the path are older than the Dinosaurs and many are about 320 million years old.

The rocks and minerals

Now you are a geologist use your senses to find the following different minerals and rocks. Make sure you tick the boxes ✓ once you find the mineral or rock. Draw two examples of the rocks or minerals in the box below.

Frosterley marble with fossils of coral ☐

Flourite (Purple and green coloured crystals ☐

Quartz ☐

Galena ☐

Limestone ☐

An experiment!

Fizzing rocks!

Steps

6) Empty one bottle of malt vinegar (same as you have on your fish and chips) or one bottle of white wine vinegar into a plastic bowl.
7) Put one of the rocks or minerals that you have collected into the middle of the bowl filled with vinegar. Can you see anything happening to the rock or mineral.
8) Leave the rock or mineral in the bowl for a minute and if nothing happens remove and replace with a different rock or mineral.
9) Continue with step 3 until you have placed all of the rocks or mineral in the bowl for a minute each.
10) Fill out the table below with your observations and tick the box for those rocks or minerals that fizzed!

Rock or mineral name	Observation - What happened?	Did it Fizz? (tick the box for yes) ✓
Galena	*Only the Frosterley Marble and limestone should fizz with the vinegar. This is because they are made of calcium carbonate that reacts with acid (vinegar) and will fizz. You may need to buy a few*	*X*
	bottles of vinegar as after several rocks the reaction may not be quite so strong or visible. This is a very good technique to tell the difference between limestone and other rocks and minerals.	
	Add several drops of vinegar. *No reaction was visible.*	

At your school, on your way home and at home look for other rocks and minerals that may be found for building or in pathways, or for gravestones, or fireplaces and tell your teacher or friends about what you have discovered.

Allenheads, Northumberland

Follow-up Activity 1 - Pupil Resource Sheet 3

PERMEABLE OR IMPERMEABLE?

Rocks can be '**PERMEABLE**', which means they let water flow through them or they can be '**IMPERMEABLE**', which means they do not let water flow through them.

The amount of water that can flow through a rock depends on factors such as how many holes there are in the rock, how the holes are connected and whether the rock is made up of grains like sandstone or interlocking crystals like hard, igneous rocks.

Investigating permeability!

Using 3 rock samples from the Rock Box to find out which of the rocks is the most permeable using the 2 tests below:

1. **The bubble test** – Find sandstone (sample 11), limestone (sample 7) and dolerite (sample 5) from the Rock Box. Put the three samples into a container of water so that the water covers them. Watch for bubbles. Watch the 'bubbly' rocks carefully and see which rock most of the bubbles come from.

   In the table below rank the rocks according to the amount of bubbles they produce. Give the most 'bubbly' rock a rank of 1 and the least 'bubbly' rock a rank of 3.

   The amount of bubbles coming from the rock reflects the amount of space between the grains in the rock. The more space the more bubbles that are produced. If no bubbles come from the rock there are no air spaces and the rock is impermeable. Complete the table by deciding if each rock is permeable or impermeable and which is most permeable.

Rock Sample	Rank of how 'bubbly' the rock is	Is the rock permeable or impermeable?	Write in this column whether the rock is the most or least permeable or of intermediate pereability
Sandstone			
Limestone			
Dolerite			

2. **The thirsty rock test** – Use the same rocks as you did for the test above but make sure they are dry first. Complete the steps below:

- Measure and pour the same amount of water into three containers, making sure there will be enough water to cover the rocks.
- Make a note of how much water was poured into each container on the table below.
- Put 1 rock into each of the different containers.
- Leave each rock in the water for 30 minutes.
- Carefully remove the rocks from the containers – make sure you allow all excess water to drain back into the container.
- Calculate how much water each rock has soaked up. This can be done by pouring the excess water back into the measuring jug and subtracting this from the volume of water you a started with.
- Use your results to complete the table below.

Rock Sample	Sandstone	Limestone	Dolerite
Volume of water in container at start of investigation (ml)			
Volume of water in container at end of investigation (ml)			
Amount of water soaked up by each rock (ml)			
Is the rock permeable or impermeable?			
Write in this row whether the rock is the most or least permeable or not permeable			

Allenheads, Northumberland

Follow-up Activity 2 - Pupil Resource Sheet 4

MAKE A WATER WHEEL

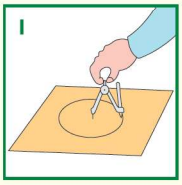
The lead mines were powered by water. Before the hydraulic engine machinery was operated by power produced by water wheels. These water wheels could be 'undershot' where the water turned the wheel by flowing under it or 'overshot' where the water turned the wheel by flowing over it. Have a go at making your own water wheel.

(Reproduced with kind permission of Nenthead Mines)

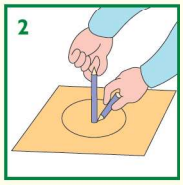
MAKE A WATER WHEEL

You will need: cardboard, scissors, sticky tape, a pair of compasses, a pencil, a ruler, a straw, a wire coat-hanger

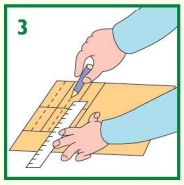
Ideally a water wheel should be made with a material like wood or plastic which will not go soggy and floppy in water. But as these need to be cut with hack saws or very sharp knives, it is much safer if models are made with cardboard, - though they will soon disintegrate when used in water.



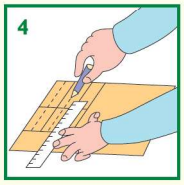
Draw a circle on a piece of cardboard by using a pair of compasses with a radius of about 4cm.



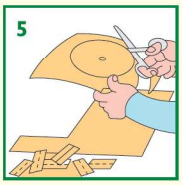
Put a pencil on the centre point made by the compasses and draw around this pencil.



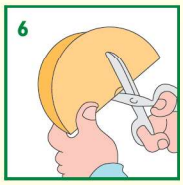
Draw six rectangles on some cardboard each, about 3cm by 4cm.



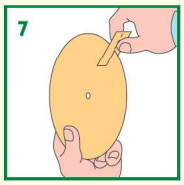
Draw a line up the middle of the rectangle and mark it 2cm from one end.



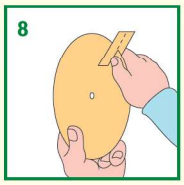
Cut out the circle and the rectangles.



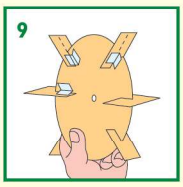
Cut out the centre hole of the circle so that the straw just fits through the hole.



Cut along the centre line of each rectangle as far as the mark. Slide the circle through the slit of a rectangle.

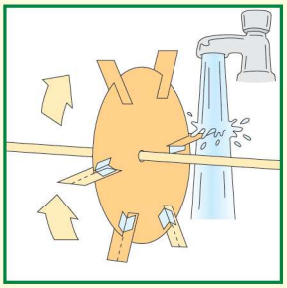


Secure in position with sticky tape.

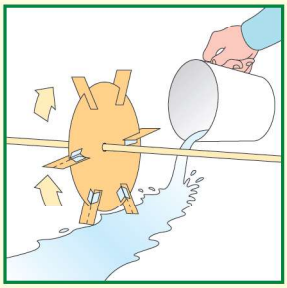


Repeat with the other five rectangles until you have a wheel with six blades.

10 Use sticky tape to secure the straw in the centre of the wheel. Use a piece of wire from the coat hanger and push this through the straw. Now hold it in a stream of flowing water. Try it with water falling from above and with water rushing underneath.



Water from above
Overshot



Water from below
Undershot





Allenheads, Northumberland

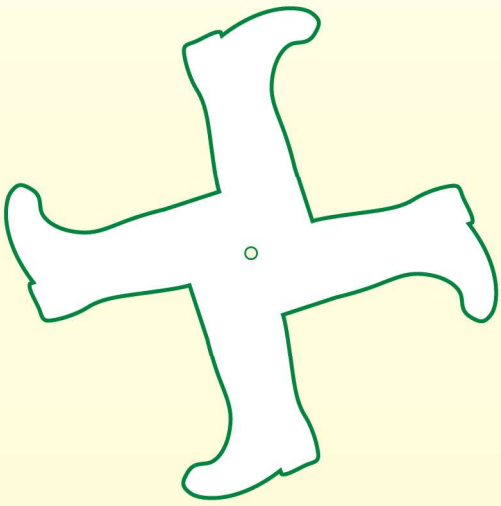
Follow-up Activity 3 - Pupil Resource Sheet 5

DRESSED FOR THE OCCASION!

1. Use the template and the instructions below to make a walking lead miner.

The Walking Lead Miner

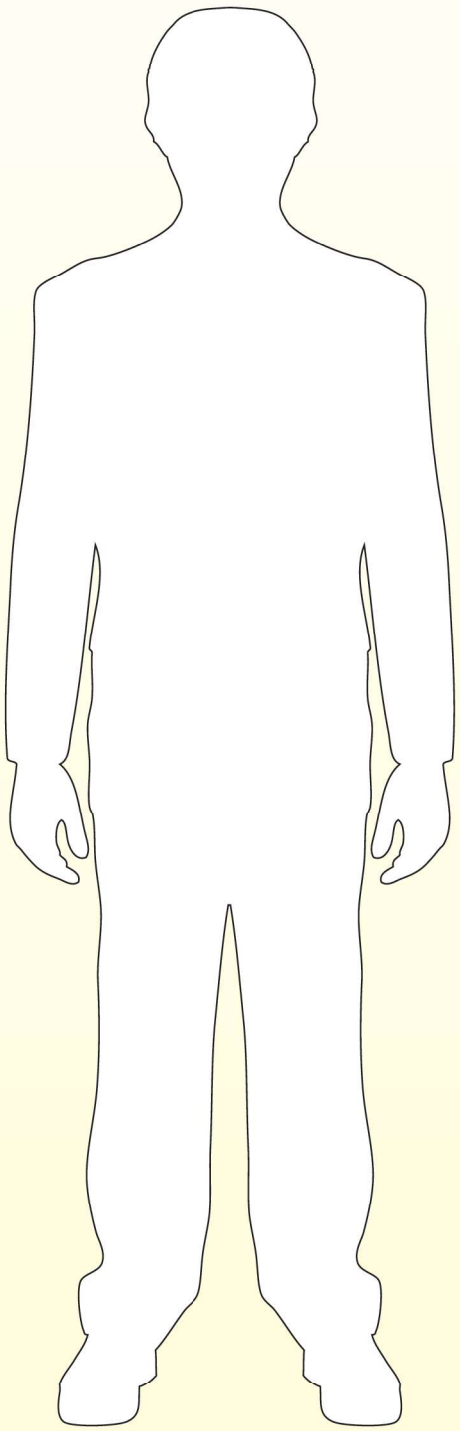
- Colour in your lead miner and his boots
- Cut out the lead miner and the boots
- Use a butterfly clip to attach the boots to the lead miner
- Now make him walk!







2. Draw and colour on the figure below to show how you think a person going down a lead mine today would be dressed!



Allenheads, Northumberland

Follow-up Activity 4

Design an advertising leaflet for Allenheads, the lead mining village.

This activity is based on designing an advertising leaflet or flier for Allenheads and provides good opportunities for literacy genres and oracy.

- Collect examples of tourist advertising leaflets and fliers from local Tourist Information Centres.
- In groups of 3-4 look at the example leaflets and fliers and list the essential kinds of information they contain. For example, maps, photographs, drawings, websites and other contact details, background information about the place, persuasive sections encouraging the tourist to visit, opening times, facilities etc.
- As a class feedback the essential details needed to produce a leaflet or flier and list the information on the board.
- Orally, with the whole class, consider the different styles of writing that are used, for example persuasive, factual, bulleted etc. Key to this is to:
  Remember the purpose
  Consider the audience
  Make it informative but also tempting to read, easy to read in small 'bites' and clear
- In groups decide on the sections and styles that your leaflet will contain. Divide up the sections so that individuals in the group write different sections.
- As a group design your leaflet or flier (use the examples to help you decide on the style).
- Each group presents their leaflet to the class explaining why they chose their design.