

Geography: Key Stage 2 Years 5 and 6

Teachers Professional Development Programme

Enquiry 3: Why are mountains so important?



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Connecting the curriculum through enquiry based learning

Key Question: Why are mountains so important?

Learning objectives

During the enquiry pupils will have opportunities through the application and analysis of a wide range of geographical skills and resources to:

- **Recognise, identify** and **explain** what geographers define as mountains and **understand** how this can lead to disagreements;
- **Identify, locate** and **describe** the location of the largest ranges of mountains in the world and the countries that they cover;
- **Explain** how the movement of plates of the Earth's crust can form ranges of fold mountains;
- **Reflect** upon, **evaluate** evidence and reach a **conclusion** and **judgement** regarding the success or failure of expedition of Mallory and Irvine to climb Mount Everest in 1924;
- Demonstrate that they **understand** how fossils form and can **explain** why Edmund Hillary and Tenzing Norgay discovered fossils of sea animals on the summit of Mount Everest in 1953;
- **Identify, describe, compare and contrast** and **explain** the differences between the Cambrian Mountains of Wales and the Himalaya Mountains;
- **Measure, record, compare and contrast**

Purpose of the enquiry

This enquiry introduces pupils to the physical and human importance of a biome that covers one-fifth of the world's land surface. The study of mountains enables pupils to comprehend key concepts of physical geography such as plate tectonics and the formation of different rock types, as well as erosion and geological deep time. The interaction of people with mountains at a range of scales and locations illustrates the central paradigm of the discipline of geography – its focus on understanding the patterns and processes involved in the interrelationship of humans with the environments that surround them.

The enquiry begins with introducing the concept of 'mountain' through an investigation of three discrete examples. It then moves on to focus on the location and formation of the world's most significant ranges of fold mountains – and in particular why they are referred to as 'fold' mountains. The legend of Mallory and Irvine and the mystery that still surrounds whether they reached the summit of Mount Everest in 1924, together with the achievements of Edmund Hillary and Tenzing Norgay in 1953, is a stimulating route into investigating why fossils of 400-million-year-old sea animals are regularly found on the summit of the world's tallest mountain.

From a global scale, pupils then turn their attention to the location and distribution of mountains in the United Kingdom and how they are different from the much younger fold mountains they have studied previously. Time is then spent investigating why the mountains of the north and west of the United Kingdom have a much wetter and colder climate than southern and eastern areas and how this presents real challenges to people such as hill farmers (the most important type of farming in the UK by area) who attempt to make a living from the land. Pupils are then able to apply a wide range of geographical skills including map and satellite interpretation to understanding other ways in which mountainous areas are important to human economic activity including tourism and the exploitation of natural resources, such as water and the generation of hydroelectric power.

Finally pupils are able to revisit and apply their understanding of sustainable development and sustainability through evaluating the potential costs and benefits of schemes such as constructing new hydroelectric power plants which, although not having a carbon footprint, do inevitably come with social and environmental costs.

Context

This investigation follows the established pattern of introducing and connecting pupils with key concepts through discrete and easily accessible examples – in this case three case studies of specific mountains, one of which is actually on the planet Mars! Similarly pupils are encouraged and supported to further engage with the concepts of mountains and mountain ranges through real people – in this case the mountaineers Mallory and Irvine of 1924 and Hillary and Tenzing in 1953. Through their amazing stories pupils are introduced to the presence of fossils of sea creatures on the tops of the tallest mountains in the world and the processes of plate tectonics and erosion.

From this global context pupils move firstly to the national scale of the physical and climatic characteristics of mountains within the United Kingdom and then to the regional context of the Cambrian Mountains of Wales. Here the importance of mountains to human activity is explored through the operation of a hill farm, tourism and the exploitation of water resources both for human consumption and energy generation.

National Curriculum coverage Geography

Pupils should be taught to:

Locational knowledge

- Locate the world's countries, using maps to focus on Europe (including the location of Russia) and North and South America, concentrating on their environmental regions, key physical and human characteristics, countries and major cities.
- Name and locate counties and cities of the United Kingdom, geographical regions and their identifying human and physical characteristics, key topographical features (including hills,, mountains, coasts and rivers), and land-use patterns and understand how some of these aspects have changed over time.

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climate data for Derek's farm with where they live and begin to offer **reasons** for their **observations**;

- **Explain** and reach a **conclusion** as to why the mountains of the north and west of the United Kingdom are generally wetter and cooler than places in the south and east;
- **Identify, locate, describe** and **explain** the tourist attractions of the Cambrian Mountains by **interpreting** and **making judgements** from evidence presented on Ordnance Survey maps;
- **Evaluate** a range of evidence to make a **judgement** as to why reservoirs were constructed by the City of Birmingham in the mountains of central Wales over one hundred years ago;
- **Understand** that even 'green' and 'renewable' energy schemes will have environmental costs, **evaluate** both sides of an argument and make a **judgement** about the most appropriate way forward;
- **Understand** why Scotland is an attractive winter sports centre.

Key Subject Vocabulary

Mountain; Rock;
Landscape; Volcano;
Crust; Mantle; Magma;
Lava; River; Ocean;
Hot spot; Summit; Sea level; Island; Planet;

Place knowledge

- Understand geographical similarities and differences through the study of human and physical geography of a region of the United Kingdom, a region in a European country and a region within North or South America.

Human and physical geography

Describe and understand key aspects of:

- Physical geography, including: climate zones, biomes and vegetation belts, rivers, mountains, volcanoes and earthquakes, and the water cycle.
- Human geography, including: types of settlement and land use, economic activity including trade links, and the distribution of natural resources including energy, food, minerals and water.

Geographical skills

- Use maps, atlases, globes and digital/computer mapping to locate countries and describe features studied.
- Use the eight points of a compass, four and six-figure grid references, symbols and key (including the use of Ordnance Survey maps) to build their knowledge of the United Kingdom and the wider world.

Connections to the subject content of other curriculum areas

Language and literacy

Teachers should develop pupils' spoken language, reading, writing and vocabulary as integral aspects of the teaching of every subject. English is both a subject in its own right and the medium for teaching; for pupils, understanding the language provides access to the whole curriculum. Fluency in the English language is an essential foundation for success in all subjects.

Spoken language

Pupils should be taught to speak clearly and convey ideas confidently using Standard English. They should learn to justify ideas with reasons; ask questions to check understanding; develop vocabulary and build knowledge; negotiate; evaluate and build on the ideas of others; and select the appropriate register for effective communication. They should be taught to give well-structured descriptions and explanations and develop their understanding through speculating, hypothesising and exploring ideas. This will enable them to clarify their thinking as well as organise their ideas for writing.

Reading and writing

Teachers should develop pupils' reading and writing in all subjects to support their acquisition of knowledge. Pupils should be taught to read fluently, understand extended prose (both fiction and non-fiction) and be encouraged to read for pleasure. Schools should do everything to promote wider reading. They should provide library facilities and set ambitious expectations for reading at home.

Pupils should develop the stamina and skills to write at length, with accurate spelling and punctuation. They should be taught the correct use of grammar. They should build on what they have been taught to expand the range of their writing and the variety of the grammar they use. The writing they do should include narratives, explanations, descriptions, comparisons, summaries and evaluations: such writing supports them in rehearsing, understanding and consolidating what they have heard or read.

Vocabulary development

Pupils' acquisition and command of vocabulary are key to their learning and progress across the whole curriculum. Teachers should therefore develop vocabulary actively, building systematically on pupils' current knowledge. They should increase pupils' store of words in general; simultaneously, they should also make links between known and new vocabulary and discuss the shades of meaning in similar words. In this way, pupils expand the vocabulary choices that are available to them when they write. In addition, it is vital for pupils' comprehension that they understand the meanings of words they meet in their reading across all subjects, and older pupils should be taught the meaning of instruction verbs that they may

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Solar System; Universe;
Tectonic plate; Scale;
Mountain range; Himalaya;
Andes; Rockies; Alps;
Atlas; Urals; Relief;
Political; Country; Strata;
Continent; Ocean; fold
mountains; Crinoids;
Compression; Oxygen;
Atmosphere; Blizzard;
Glacier; Ridge; Summit;
Col; Fossil; Sea; Animal;
Rock; Ocean; Marine;
Geology; Silt; Geologist;
Temperature;
Sedimentary; Igneous;
Metamorphic; Sediment;
Limestone; Tethys;
Distribution; Pattern; Key;
Direction; Peak; Erosion;
Glacier; Settlement;
Landscape; Woodland;
Marsh; Valley; Fodder;
Environment; Pasture;
Minerals; Growing season;
Silage; Slurry; Fertiliser;
Diversify; Business;
Tourists; Economic
activity; Profit; Climate
graph; Precipitation;
Climate station; Growing
season; Range of
temperature; Frost;
Co-ordinates; Ordnance
Survey; Eastings;
Northings; Grid square;
Grid reference; Disease;
Epidemic; Cholera;
Contamination; Health;
Hygiene; Medicine; Water;
Victoria; Slum; Urban;
Reservoir; Elevation;
Impermeable; Gravity;
Contour; Spot height;
Hydroelectric; Turbine;
Generator; Pylons;
Transmission; Cost and
benefit; Green; Planning;
Government; Resort;
Sustainable development;
Sustainability.

meet in examination questions. It is particularly important to induct pupils into the language that defines each subject in its own right, such as accurate mathematical and scientific language.

Numeracy and Mathematics

Teachers should use every relevant subject to develop pupils' mathematical fluency. Confidence in numeracy and other mathematical skills is a precondition of success across the national curriculum.

Teachers should develop pupils' numeracy and mathematical reasoning in all subjects so that they understand and appreciate the importance of mathematics. Pupils should be taught to apply arithmetic fluently to problems, understand and use measures, make estimates and sense check their work.

Pupils should apply their geometric and algebraic understanding, and relate their understanding of probability to the notions of risk and uncertainty. They should also understand the cycle of collecting, presenting and analysing data. They should be taught to apply their mathematics to both routine and non-routine problems, including breaking down more complex problems into a series of simpler steps.

Science

Earth and space

Pupils should be taught to:

- Describe the movement of the Earth, and other planets, relative to the Sun in the solar system.

Living things and their habitats

Pupils should be taught to:

- Describe how living things are classified into broad groups according to common observable characteristics and based on similarities and differences, including micro-organisms, plants and animals.

Evolution and inheritance

Pupils should be taught to:

- Recognise that living things have changed over time and that fossils provide information about living things that inhabited the Earth millions of years ago.
- Identify how animals and plants are adapted to suit their environment in different ways and that adaptation may lead to evolution.

History

A local History study

- A study over time tracing how several aspects of national history are reflected in the locality (this can go beyond 1066).

Computing

Pupils should be taught to:

- Understand computer networks including the internet; how they can provide multiple services, such as the World Wide Web; and the opportunities they offer for communication and collaboration.
- Use search technologies effectively, appreciate how results are selected and ranked, and be discerning in evaluating digital content.
- Use technology safely, respectfully and responsibly; recognise acceptable/unacceptable behaviour; identify a range of ways to report concerns about content and contact.

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Ancillary Question 1: Why are the three mountains of Olympus, Mauna Kea and Everest so famous?

Write the names of the three mountains on the board for the pupils to read. Take some time to discuss what the pupils understand a 'mountain' to be. Most geographers agree that a mountain is a large mass of earth or rock taller than 304.8 m (1000 ft) that rises up above the surrounding land. So why are these three mountains particularly famous?

Show the pupils the photograph of Mount Everest in **Resource 1**. This will be the mountain that they almost certainly will know something about. Why is it famous? Because it's the highest mountain on the planet.

Now look at the mountain of Mauna Kea in **Resource 2**. What kind of mountain is this? A mountain that is also a volcano. Why might this volcanic mountain be so famous? Perhaps because it is the tallest volcano in the world.

And then there is Mount Olympus in **Resource 3**. How does this mountain compare with the other two? Mount Everest is famous because it has always been defined as the highest mountain on Earth. But strictly speaking this is not true – it is the highest mountain on Earth that is entirely above sea level from base to summit – 8848 m (29 029 ft) above sea level. Mauna Kea on the Island of Hawaii in the Pacific Ocean – see location maps in **Resource 4** – is the highest mountain in the world from base to summit (10 203 m or 33 474 ft) although only 4205 m (13 796 ft) is above sea level. Mount Olympus is, in fact, on the planet Mars (**Resource 3** is an artist's representation of what it could look like based on images from satellites and telescopes – see **Resource 5**) and is the highest mountain that geographers know of anywhere in our Solar System. See also the film at www.youtube.com/watch?v=ySFpJ-clnzU and the comparative diagram of the three mountains in **Resource 6**.

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Ancillary Question 2: How were the world's greatest mountain ranges formed?

Explain to the pupils that about one-fifth (20 per cent) of the surface of Earth is covered by mountain ranges. A *mountain range* is a large area where many mountains can be found close together. Among the greatest are the Himalaya, Andes, Rockies, Alps, Urals and Atlas. Using the world map of relief in **Resource 7** and also the map of countries in **Resource 8**, support the pupils to identify the continent within which each of these mountain ranges is located, together with examples of the countries covered. These mountain ranges appear very similar, as the images in **Resource 9** indicate. So much so that it would be almost impossible even for an expert geographer to identify which mountain range is which.

Explain to the pupils that all of the major mountain ranges in the world – which include all those that they have been looking at – are called *fold mountains* after the way in which they were formed. Encourage speculation as to what this might mean – what does the word *fold* mean in everyday usage e.g. to fold up, fold away.

Now tell the pupils that you are going to show them a short film made by a GCSE geography student to help explain to Key Stage 2 pupils how fold mountains were created. The film is at www.youtube.com/watch?v=EorDD_BXaN4

What do the pupils think happened? To extend this further, watch the two short films about the formation of the Himalaya range of mountains at www.youtube.com/watch?v=PDrMH7RwupQ and www.youtube.com/watch?v=HuSHOQ6gv5Y

Revisit with the pupils the Years 3 and 4 enquiry about earthquakes and what they learned then about the Earth's crust (**Resource 10**) being divided up into huge slabs or sections called plates that fit together like parts of a huge jigsaw. Along the edges of these plates, where one meets another, earthquakes and volcanoes occur. There is also a connection between the edges of the plates and fold mountain ranges. For example, which two plates meet right underneath the Himalaya mountain range? The Eurasian and Indian Ocean plates. When two plates move towards each other, as represented in the three films the pupils have watched, all of the layers of rock that lie in between them become crumpled or 'folded' up into the air to form mountain ranges. Today these layers or *strata* can be easily seen in all of the fold mountains of the world – **Resource 11**.

As a summative piece for this line of enquiry, the pupils could work in pairs to create and film their own narrated animation of how fold mountains are formed using layers of different coloured modelling clay to simulate the rock strata in between the plates. Place small bricks, large books or even hands at each end of the modelling clay to represent the plates. Then slowly move them together, to simulate compression. This pushes up the modelling clay until the bricks meet each other in the middle. This will leave the layers of modelling clay raised up to form the 'mountains'. The pupils also need to write and narrate a commentary using specialised subject vocabulary to describe and explain what is occurring.

See support for this activity at

<http://science-mattersblog.blogspot.com/2011/03/plate-tectonics-look-inside-folds-and.html>
www.minimegeology.com/blog/2014/05/12/rock-layer-folding-experiment/
<http://jazinators.blogspot.com/2010/05/teaching-folds-using-play-doh.html>

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Ancillary Question 3: Why is the legend of Mallory and Irvine the greatest unsolved mystery of mountaineering?

Show the pupils the photographs of George Mallory (**Resource 12**) and Andrew Irvine (**Resource 13**) and the film at www.youtube.com/watch?v=kls7JzoJpmw

Then read them the following passage recorded in the diary of Noel Odell on 8 June 1924:

At 12:50 there was a sudden clearing of the atmosphere, and the entire summit ridge and final peak of Everest were unveiled. My eyes became fixed on one tiny black spot silhouetted on a small snow-crest beneath a rock-step in the ridge; the black spot moved. Another black spot became apparent and moved up the snow to join the other on the crest. The first then approached the great rock-step and shortly emerged at the top; the second did likewise. Then the whole fascinating vision vanished, enveloped in cloud once more.

What do the pupils think is the great unsolved mystery?

George Mallory and Andrew Irvine were two British mountaineers who, in 1924 with basic equipment and very little supplementary oxygen by modern standards, attempted to climb to the summit of Everest. At 12:50 pm on 8 June 1924, they were seen for the last time by Noel Odell. They were never seen again until the body of Mallory was discovered in 1999. Irvine has never been found.

The great mystery is, did either of them reach the summit? When they were last seen they were within striking distance of the summit. The search continues to find the body of Irvine, which many believe remains high on the north ridge together with the camera that he was carrying. Did Noel Odell see them pushing for the summit or descending after already reaching it earlier in the day? But then a fierce snow storm descended across the mountain and they were never seen again.

On 24 June 1924 the deaths of Mallory and Irvine were reported widely in British newspapers of the time led by *'the following message from His Majesty the King – the King is greatly distressed to bear the sad news of the death of Mr Mallory and Mr Irvine*

Encourage the pupils to think about how modern-day newspapers would have reported the event – say in the style of a tabloid newspaper – if the loss of Mallory and Irvine had occurred today rather than nearly 100 years ago. Would there be a message from the Queen and the Prime Minister for example? The pupils can design and produce the front page of a modern newspaper and, using the conventions of journalism, tell the story of Mallory and Irvine (see **Resource 14** for conventions).

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Ancillary Question 4: Why did Edmund Hillary and Tenzing Norgay find fossils of sea animals on the summit of Everest?

On the 29 May 1953 two mountaineers (Edmund Hillary of New Zealand and Tenzing Norgay of Nepal **Resource 15**) climbed to the summit of Everest. When they returned they brought down rocks containing fossils of sea animals called *crinoids*, which means 'like a lily flower' (**Resource 16**). We know exactly what this 400 million year old fossil looked like because many species of crinoids are alive today in warm shallow seas and oceans all around the world – see examples in **Resource 17**. They have a very simple structure and most are free swimming with a 'holdfast' to attach them when required to rocks or the bottom of the sea (**Resource 18**). Ask the pupils what they understand a fossil to be. Encourage discussion. What are the fossils they most commonly see? Perhaps those of giant dinosaurs?

Fossils are the remains of animals and plants that lived long ago. To be classified as a fossil the remains must be over 10 000 years old and are either *body fossils* or *trace fossils*. Body fossils are the remains of animals or plants such as bones, shells and leaves. Sometimes this includes whole animals such as woolly mammoths that have been frozen in ice or insects caught in the sap of trees, which fossilises to form *amber*. Trace fossils, on the other hand, record only the activity of animals such as footprints, track ways or coprolites (fossilised poo!).

The short video at www.youtube.com/watch?v=3rkGu0BlitKM is an animation of how fossils are formed. Play the film a number of times and emphasise particularly the process by which bone fossils of animals are made. If desired, investigation of rocks and fossils can be extended at this point through supporting the pupils to visit the Jurassic Coast World Heritage Site online learning and teaching materials at <http://jurassiccoast.org/learning-zone/> – see in particular Key Question 3: *Rock detectives!* and Key Question 6: *What can we find out from fossils?*

After Hillary and Tenzing returned from the summit of Everest with their crinoid fossils, the big question for geographers and geologists was: what were the remains of ancient sea animals, which used to live in warm, shallow seas, doing nearly 9000 m up in the air on top of the highest mountain on earth in freezing cold temperatures? Revisit the films at www.youtube.com/watch?v=PDrMH7RwupQ and www.youtube.com/watch?v=HuSHOQ6gv5Y and also the modelling clay animated films that explain how fold mountains came into being.

Now give out copies of **Resource 19** to each of the pupils. This resource shows the Tethys Sea, which once lay in between the Indian and Eurasian tectonic plates between 50 and 400 million years ago. Within its warm, shallow waters swam billions of crinoids (Part 1). As crinoids died they floated to the sea bed where they were covered with silt and sediment and slowly compressed into fossils within layers of limestone rock (Part 2).

Now, on separate paper, the pupils can draw Parts 3, 4 and 5 of this sequence and write the following text alongside their diagrams:

- Part 3: The Indian Plate and Eurasian Plate move towards each other. As the Tethys Sea narrows the layers of limestone rock containing crinoid fossils begin to buckle up into the air;
- Part 4: About 25 million years ago the Indian and Eurasian Plates meet below what is now the huge Himalaya fold mountain range, nearly 8 km high and containing Mount Everest with crinoid fossils at the summit;
- Part 5: In 1953 Hillary and Tenzing become the first people to reach the summit of Everest where they find rocks containing crinoid fossils.

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Ancillary Question 5: How are the Cambrian Mountains different from the Himalaya Mountains?

Project the satellite image of the United Kingdom in **Resource 20** and give out copies of the relief map of the United Kingdom in **Resource 21**. Take time here to discuss with the pupils what they notice about the distribution of higher ground and mountains across the country – particularly those areas shown to be higher than 500 m. Which of the four nations of the United Kingdom has the largest area of high ground and mountains, and which has the least?

In terms of compass direction, which areas of the United Kingdom have the greatest proportion of high ground and mountains? The north and west. Which areas have the smallest proportion of high ground and mountains? The south and east. Which is the highest mountain in England, Wales, Scotland and Northern Ireland? What are the main mountain ranges in Scotland, Wales, England and Northern Ireland called?

Draw the pupil's attention to the area of the Cambrian Mountains in Wales using the map in **Resource 21** and also the larger-scale map of Wales in **Resource 22**. Now distribute copies of the photographs of the Cambrian Mountains in **Resource 23**. How do the mountains here compare with the pictures of the fold mountains of the Himalaya, Andes, Rockies, Atlas, Alps and Ural ranges that the pupils studied earlier in the enquiry in **Resource 9**? The mountain ranges of Britain are all very much lower, less rugged and more rounded than the fold mountains studied earlier. This is mainly because they are a great deal older. Most of the rocks, for example, that make up the Cambrian Mountains of Wales are around 400 million years old compared with the much younger age of the rocks of the Himalayas, which are around 55 million years old. So, rather like comparing a 10 year old with an 80 year old! Because the mountains of Britain are much older than the Himalaya, Andes, Rockies etc. the forces of erosion such as the rain, wind and ice have had eight times as long to wear them down and round them off!

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Ancillary Question 6: Why is the climate such a challenge for Derek?

Introduce the pupils to Derek Jenkins (**Resource 24**). He has a farm in the Cambrian Mountains in Wales. Divide the pupils into small groups and provide each group with a set of the photographs of his farm in **Resource 25**. Working together and just using evidence in the photographs, encourage the pupils to make notes in response to the four questions in **Resource 26**. Encourage feedback and discussion regarding their responses to the questions and summarise all of the possibilities on the board.

Give out copies of the text in **Resource 27**. Here Derek talks about his farm, how he earns a living and the different kinds of problems and challenges he faces. Read through the passage with the pupils and then tell them to use different colour pens or pencils to:

- Underline in red all of the ways in which Derek earns a living – what he produces or provides to sell to others for a profit (this is the definition of an *economic activity*);
- Underline in green any problems he faces that can be considered *natural* or *environmental*;
- Underline in blue any problems he faces that are to do with *economic* factors such as prices he receives for what he produces at market;
- Underline in yellow things that Derek does in an attempt to overcome the natural problems created by the mountain environment.

For further background reading on the economic crisis facing hill farmers in Wales and elsewhere across the country see www.bbc.com/news/uk-wales-33804496 and www.assembly.wales/research%20documents/rn14%20-%20022%20welsh%20beef%20prices/rn14-022.pdf

The Met Office provides weather averages for the period 1981–2010 for 300 locations across the United Kingdom at www.metoffice.gov.uk/public/weather/climate/. The pupils can click on the weather station shown by a red dot closest to their own locality and then select the 'Averages table' from the top tool bar. This will generate a table of data such as that shown for Bedford below. Using the data for temperatures, the pupils can create one average temperature for each month (add the maximum and minimum temperatures together and divide by two). Now the pupils can use this average temperature for each month and the average rainfall figure to draw their own climate graph for their chosen locality, such as the one for Plymouth in **Resource 28**.

Month	Max. temp (°C)	Min. temp (°C)	Days of air frost (days)	Sunshine (hours)	Rainfall (mm)	Days of rainfall ≥ 1 mm (days)	Monthly mean wind speed at 10m (knots)
Jan	6.9	1.2	11.0	63.6	49.0	10.5	10.7
Feb	7.2	0.8	11.5	83.1	36.7	8.8	10.3
Mar	10.3	2.6	6.4	106.8	40.8	9.7	10.3
Apr	12.9	4.0	3.0	168.2	47.3	9.2	9.1
May	16.3	6.8	0.3	201.4	48.3	9.0	8.4
Jun	19.3	9.8	0.0	183.4	51.4	8.7	7.7
Jul	22.1	12.0	0.0	197.6	49.2	8.7	7.6
Aug	21.9	12.0	0.0	187.2	54.5	8.3	7.9
Sep	18.7	10.1	0.0	138.5	54.9	8.6	8.4
Oct	14.4	7.1	0.9	109.3	62.5	9.9	9.1
Nov	9.9	3.8	5.2	66.0	53.4	10.2	9.2
Dec	7.0	1.5	10.7	54.3	49.7	10.1	9.6
Annual	13.9	6.0	49.1	1559.2	597.6	111.7	

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Next the pupils can draw a comparative climate graph to the one of their own locality using the data for Derek's farm in **Resource 29** and the climate graph template in **Resource 30**.

Finally they can complete the table in **Resource 31**, which enables them to compare and contrast the climate at Derek's farm with where they live. Once completed encourage discussion and reasoning. What are the most striking differences and/or similarities between the climates of the two locations? Derek's farm will most likely be wetter and colder with less sunshine, stronger winds, more likelihood of frost and a shorter growing season than where the pupils live. The important thing here is to encourage the pupils to begin to think of reasons to help explain why Derek's farm is so much wetter, colder with less sunshine, stronger winds and a shorter growing season than most other places in the United Kingdom – and how this presents a real challenge to him in terms of making a living.

Encourage the pupils to compare the map of relief in the United Kingdom (**Resource 21**) with the annual rainfall and winds map (**Resource 32**) and the two temperature maps (**Resource 33**). What do the pupils notice about the amount of rainfall, and also temperature, in both January and July in the Cambrian Mountains compared with the rest of the United Kingdom? The mountains of the north and west of the United Kingdom have higher rainfall and lower summer and winter temperatures than the lower lands of the south and east. Why are mountains in the United Kingdom colder and wetter than lower land? Temperature falls as the height of land increases – by 6 °C for every 1000 m.

Rainfall increases with height in the United Kingdom as the prevailing winds, which blow from the southwest (see rainfall map **Resource 32**), are moist because after blowing over the Atlantic Ocean, they are carrying a great deal of water vapour. When the air reaches the mountains of the north and west it is forced to rise. As the air rises, it cools and because cool air is not able to carry as much moisture as warm air, the water vapour condenses to form water droplets that fall as rain.

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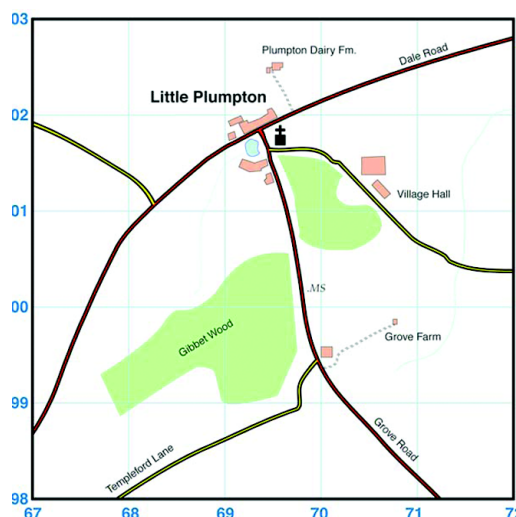
Ancillary Question 7: Why do tourists visit the Cambrian Mountains?

One very important way that Derek has been able to earn money to keep his farm profitable has been to offer bed and breakfast accommodation to paying guests – tourists and holiday makers. This is called *diversification*.

Now give out the OS 1:25 000 map extract of the area around the town of Machynlleth in **Resource 34**. Give pupils time to familiarise themselves with the map and ask them questions. What are the red lines? What do you think all of the green areas show? How is the river shown? Use this as an opportunity to remind pupils about grid lines and grid squares on an OS map and how to both read off and provide four and six-figure grid references. This is covered at www.youtube.com/watch?v=75QppfhijBk

Then practice some examples of both four and six-figure grid references using the fictional map below. For example, the church with a tower in the village of Little Plumpton is in grid square 6901. (This is a combination of the vertical line (easting) and the horizontal line (northing) that intersect at the bottom left hand corner of the square in which the church is located. Always read along the bottom first (the eastings) and then up the side (the northings). Combine to give the four-figure reference.

Its precise location as identified with an exact six-figure grid reference is 696 (69 and six-tenths towards easting 70) and 018 (01 and eight-tenths towards northing 02) – written as 696018.



https://en.wikipedia.org/wiki/Grid_reference#/media/File:Fictional_Map_1.jpg

Next, distribute the Tourist and Leisure Information Key for the Ordnance Survey map extract (**Resource 35**) and read through what each of the symbols means with pupils. How many can they see straightaway on the map? Draw attention to the map scale shown alongside the map key and explain that this is needed because maps are much smaller than the places they show. We therefore need a means of converting distances on a map back to the actual distance on the ground (the distance we would find if we went there). We do this by using the edge of a piece of paper to mark off the distance between two locations on a map and then laying it along the scale line with the left hand mark always positioned at 0 km. Take time to demonstrate the technique using examples on the map for both straight line and winding distances e.g. along a road or river– see www.youtube.com/watch?v=cf8ZI1TY5IU and www.youtube.com/watch?v=g8CUeXPTBW

Now divide the pupils into pairs and give each pair a copy of **Resource 36** to work through together and complete.

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Ancillary Question 8: Why were the 'treasures of untold value' to be found in the Cambrian Mountains so precious to the people of Birmingham?

Give out the quotation by Thomas Barclay in **Resource 37**. Explain that the 'treasures of untold value' he was talking about were to be found in the mountains of Wales.

Divide the pupils into small groups and tell them that you are going to give them five pieces of evidence to help them work out what these riches were. They will have only one chance to answer as a group so it will be best not to rush into a response before they have seen all of the evidence and evaluated it.

The first piece of evidence is the quote in **Resource 37**. Give each group a few minutes to look again at the quote and the date (over 100 years ago) and to speculate about all the things that 'the riches' might be. Could there be things that were considered 'riches' in 1898 that we might not today? What things today have the greatest value? – e.g. gold. Are there other ways to interpret 'value' and 'riches'? – such as friendships, experiences (such as travelling) and health. Take feedback and write all the suggestions on the board.

Now give out the second piece of evidence in **Resource 38**. Explain that this shows the kind of living conditions in 1898 with which many of the 525 000 people of Birmingham had to cope. Give the groups a few minutes to reflect upon this new piece of evidence. How does it contribute to what they speculated about originally? Does it support their original intuition or send them off on a different direction altogether?

Next is **Resource 39**, which shows the poor of the slums of Birmingham queueing at a standing water pump in the street. What does this tell us about living conditions? There is no piped water supply to the overcrowded homes. Allow time for the pupils to reflect and be intuitive in their thinking – to speculate.

Resource 40 shows a cartoon representation from the time of a disease spreading death so quickly and aggressively that even armies can't hold it back. What could have been the disease? How might it have been spread?

Finally give out the fifth piece of evidence – **Resource 41**, photographs of one of many reservoirs (Claerwen) to be found in the Cambrian Mountains. What is a reservoir? What is its purpose? How are reservoirs created? Why are mountainous areas such as Wales a suitable place to create reservoirs? Explain that reservoirs are huge artificial lakes of water that are created by building dam walls across valleys through which rivers are flowing. The water builds up behind the dam wall to create a reservoir.

Now it is time to focus the thinking of all of the groups. If water represents the 'treasures of untold value' described by Thomas Barclay then why? What was its value? The answer lies in **Resource 42**. By 1898 it had been discovered that cholera was spread by the consumption of water and food contaminated with bacteria. This knowledge led the council of Birmingham to seek out sources of fresh water. They identified the mountains of Wales and the valleys of the River Elan and Claerwen in particular as the ideal location to construct reservoirs to collect the water, which could then be piped all the way to the city 118 km away. These valleys were considered ideal because they had:

- an average annual rainfall of 1830 mm;
- narrow valleys, which made the building of dams easier;
- impermeable bedrock, which prevented the water seeping away;
- an elevation 52 m higher than the city of Birmingham, enabling water to be transported by pipeline to Birmingham using gravity alone.

An Act of Parliament was passed in 1892 for the compulsory purchase of the total water catchment area of the Elan Valley (180 sq km) and in 1893 building work began. The 100 tenant farmers occupying the area were evicted and only landowners received compensation payments from the City of Birmingham. Today, submerged forever below the Claerwen Reservoir are 18 farms, 3 manor houses, a school and a church. The Elan Valley scheme was opened in 1904.

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Now distribute copies of the OS map extract of the Elan Valley and the Claerwen reservoir in **Resource 43**. Spend some time to allow the pupils to familiarise themselves with the map – the location of Claerwen reservoir, contour lines to show height in 10 m intervals (the closer together the steeper the land), spot heights (black height numbers beside black dot) to show exact height of some locations, woodland areas, streams etc.

Next divide the pupils into pairs to complete the exercises in **Resource 44**, which will require copies of the images in **Resources 45–48**.

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Ancillary Question 9: How else is the precious resource of water used in the Cambrian Mountains?

Project the photograph of the dam and reservoir in **Resource 49**. It is Nant-y-moch Reservoir in the Cambrian Mountains of Wales, which has been created by building a dam across the River Rheidol.

Distribute copies of the OS map extract in **Resource 50**. The photograph was taken in grid square 7586 showing the dam wall with the reservoir behind. Explain that this reservoir was not created to supply fresh drinking water but for another very important purpose. Can the pupils find any evidence on the map to suggest what this purpose might be?

Encourage them to trace the course of the river on the map south from the dam wall to the settlement of Devil's Bridge (Pontarfynach) and then westwards towards Aberffwd. Can they find any clues along the way? The most important clue is the power station in grid square 7079 and shown in the photograph in **Resource 51**. What kind of power station will it be?

Hydroelectric power is produced by the force of falling water. In mountainous areas such as mid-Wales, hydroelectric power stations have been built to provide electricity to homes, schools, farms and businesses. The annual energy production is about 85 GWh (gigawatt-hours) – enough to power 12 350 homes. An underground shaft takes water from the main reservoir to the Dinas Reservoir in grid square 7482 where further water is added. The underground shaft carrying the water continues to Bwa-drain at 715798. At this point the water drops vertically down a 250 m surge shaft to the power station where it spins the blades of a giant turbine such as the one in **Resource 52** (see water bottle for scale). The turbine is connected to a generator. As the generator spins it makes electricity, which is transmitted away from the power station along high tension cables suspended between pylons (**Resource 53**). After passing through the turbine, the water flows back into the river on the other side of the dam (**Resource 54**).

Complete this line of enquiry by asking the pupils to reflect a little about the advantages and disadvantages of renewable energy schemes such as this. The electricity produced is 'clean' and 'green' in the sense that it doesn't result in the production of harmful greenhouse gases, such as carbon dioxide, that contributes to global warming and climate change – which is good. But can the pupils think of any other potential harmful impacts on the environment? What do companies that produce hydroelectric power in places such as this have to do before they can start generating electricity? They have to flood a very large area, normally a deep valley, to create the reservoir and the huge head of water that is required. Looking at the map ask the pupils to estimate the area of Nant-y-moch Reservoir (each grid square is 1 sq km). Before flooding, it would have looked something like the valley in the photograph in **Resource 55**.

Explain to the pupils that an electricity generating company has applied for planning permission to build a dam and create a reservoir of similar size in a nearby valley in order to generate enough 'green' and renewable electricity to power 15 000 homes. The scheme will also create at least five full-time and three part-time jobs and at least 20 temporary jobs during the construction phase, which will take 3–5 years. In doing this it will also make a substantial contribution to meeting the government's greenhouse gas reduction target by 2020. **Resource 56** contains some background information about the valley that will be flooded, compiled by nature conservation organisations who do not want to see the scheme go ahead. How do the pupils feel about the benefits and costs of the project? Is it possible to balance one against the other?

As a summative piece, there is an opportunity for the pupils to draft a narrative considering both sides of the argument and then making a judgement based on their personal perspective – see conventions in **Resource 57**.

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Assessment

This enquiry presents several opportunities to evaluate at different stages how the pupils are progressing in geography through the mastery of key geographical skills and outcomes. It is not necessarily intended that all the following learning activities should be assessed. Rather the list can be used as a general guide for selecting perhaps one or two assessment opportunities relevant to individual pupils rather than on a whole group basis.

Ancillary Question	Learning Activity	Possible source of evidence of achievement
1	Recognise, identify and explain what geographers define as mountains and understand how this can lead to disagreements	Comparative diagram or model to scale of Mt Everest, Olympus and Mauna Kea
2	Identify, locate and describe the location of the largest ranges of mountains in the world and the countries that they cover	Annotated world map
2	Explain how the movement of plates of the Earth's crust can form ranges of fold mountains	Create and record animated film with accompanying narrative
3	Reflect upon, evaluate evidence and reach a conclusion and judgement regarding the success or failure of expedition of Mallory and Irvine to climb Mount Everest in 1924	Media recount newspaper report in modern genre
4	Demonstrate that they understand how fossils form and can explain why Edmund Hillary and Tenzing Norgay discovered fossils of sea animals on the summit of Mount Everest in 1953	Part 1–4 diagram of Indian and Eurasian plate movement to form Himalaya Mountains with accompanying text
5	Identify, describe, compare and contrast and explain the differences between the Cambrian Mountains of Wales and the Himalaya Mountains	Oral
6	Measure, record, compare and contrast climate data for Derek's farm with where they live and begin to offer reasons for their observations	Data recording Climate graphs Summary comparative data sheet Oral
6	Explain and reach a conclusion as to why the mountains of the north and west of the United Kingdom are generally wetter and cooler than places in the south and east	Map interpretation Piece of explanatory writing
7	Identify, locate, describe and explain the tourist attractions of the Cambrian Mountains by interpreting and making judgements from evidence presented on Ordnance Survey maps	Map interpretation exercises from 1:25 000 maps
8	Evaluate a range of evidence to make a judgement as to why reservoirs were constructed by the City of Birmingham in the mountains of central Wales over one hundred years ago	Photograph and map work interpretation exercises Short explanatory text
9	Understand that even 'green' and 'renewable' energy schemes will have environmental costs, evaluate both sides of an argument and make a judgement about the most appropriate way forward	Oral and discursive writing
Homework	Understand why Scotland is an attractive winter sports centre	Guide

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Homework possibilities

The pupils could be asked to investigate winter sports and how mountain ranges all over the world are visited by tourists each year who want to participate in a range of activities such as skiing and snowboarding. One approach could be to focus on Scotland and to produce a small guide called: *Where to ski in Scotland* including a map of the ski centres, mountain ranges, ideas of where to stay, the best slopes to visit and information about weather and climate and snow fall. This would extend their understanding of the variety of ways in which mountains are so important, despite the fact that they are the permanent home of only a tiny proportion of the world's population.

Key Question: Why are mountains so important?

Further reading



Collins *Big Cat* has books for every child in the classroom with a wide variety of genres, top authors, relevant topics and a range of engaging formats and illustrative styles. Listed below is a selection of from the Big Cat list to support the enquiry topics in Connected Geography for KS1. Find out more at Collins *Big Cat* – www.collins.co.uk

ISBN: 978-0-00-723106-5	<i>Hard times: Growing up in the Victorian Age</i>	Jillian Powell	
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