

Geography: Key Stage 2 Years 5 and 6
Teachers Professional Development Programme
Enquiry 2: What is a river?



Author: David Weatherly

Connecting the curriculum through enquiry based learning

Key Question: What is a river?

Learning objectives

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

- **Identify** and **describe** how physical features of rivers change from source to mouth;
- Offer **reasons** to **explain** why the course of a river changes as it flows from higher to lower ground;
- Use OS maps, aerial photographs and GIS to **recognise, describe, compare and contrast** and **explain** how physical features change along the course of a river;
- Use a range of fieldwork techniques to **measure, record and present** and **explain** changes along a section of a local river and to **reach a conclusion** as to whether it constitutes a healthy habitat for living things;
- **Identify** and **describe** the features of river estuaries and **explain** why they are such important ecosystems for wildlife;
- **Describe** the components of the hydrological or water cycle and **explain** the important role that rivers play;
- **Recognise, describe** and **explain** the reasons why the Isle of Dogs developed to become part of the busiest river port in the world and **evaluate** the

Purpose of the enquiry

The objective of this investigation is to enable pupils to understand the features and processes of a common and very significant feature of physical geography with which they will be familiar. Rivers are commonplace in a wide range of environments and pupils will therefore, already know something about them. For example, from regular news reports and perhaps even direct experience of river floods in their own community. Many settlements in the United Kingdom, no matter what size, will have rivers flowing through or close to them.

The enquiry begins by establishing the key concept that rivers change over their course from source to mouth and develop distinctive physical features as they do so by altering the environment through erosion and deposition. Pupils are supported to apply a wide range of geographical skills that draw upon map work, satellite imagery and GIS resources to consolidate their understanding. Time is also devoted to exploring rivers, in particular their estuaries as important ecosystems and habitats for a wide range of living things. They are then introduced to examples of the many ways in which humans interact with rivers and exploit them economically as a resource, especially as ports for trade. Pupils are also given an opportunity to reflect upon how rivers can invoke emotional and artistic responses in people such as composers and painters who seek to evoke and portray the sounds and images of rivers for others to appreciate.

Context

The enquiry begins with the pupils being introduced to and understanding the features of a typical river channel as it progresses along its course from source to mouth. Having established these general characteristics, the pupils are encouraged and supported to study a local river to ascertain how and why it changes and to what degree it fits the typical model they looked at originally. This provides an opportunity to develop a range of fieldwork skills in the locality of the school and also to apply mapwork and graphical techniques to aid understanding. From this local context the pupils are then introduced to rivers at other scales, firstly within the United Kingdom and then in Europe. Throughout the investigation there is an emphasis on pupils' understanding of physical processes and also how rivers impact the landscape. They also look at the way in which humans interact with rivers for a range of purposes, such as trade 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.

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 and fieldwork

- 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.

Key Question: What is a river?

evidence and **make a judgement** about the causes of its sudden decline and closure;

- **Interpret** a range of geographical evidence to reach a **conclusion** as to why Bangladesh is at such a risk of serious annual river flooding;
- **Reflect** upon and **evaluate** the techniques used by classical composers to portray the different stages and features of the course of a river and create and record a personal musical piece to evoke the features of a waterfall;
- **Understand** climatically what the *Little Ice Age* refers to and how occasional severe winters impacted upon the River Thames and the people of London;
- **Explain** why China built the Three Gorges Dam along the Chang Jiang (Yangtze River) and describe and **evaluate** some of its geographical impacts.

- Use fieldwork to observe, measure, record and present the human and physical features in the local area using a range of methods, including sketch maps, plans and graphs, and digital technologies.

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 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.

Key Subject Vocabulary

River; Source; Mouth; Course; Channel; Meander; Stream; Waterfall; Bank; Flood plain; River island; Undercutting; Slip-off slope; Tidal, Marina, River cliff; Pebbles; Beach; Waves; Spit; Coast; Estuary; Erosion; Farms, Village; Town; Settlement; Fields, Hedgerow; Tropical rainforest; Atacama Desert; Wood; Rapids; Ox-bow lake; Mill; Hamlet; Railway; Transport;

Key Question: What is a river?

Bridge; Sewage works;
Leisure; Recreation;
Hypothesis; Validity; Load;
Energy; Transportation;
Habitat; Invertebrates;
Molluscs; Crustaceans;
Amphibians; Birds,
Mammal; Reptile;
Vertebrates; Algae;
Eutrophication; Pollution;
Indicator species; Biotic
Index; Valley; Agriculture;
Sea level; Flood; Bridge;
Mud flat; Brackish; Coast;
Diatom; Omnivore;
Herbivore; Carnivore;
Prey; Confluence;
Annotate; Wildlife; Spit;
Scale; Ecosystem;
Migration; Food chain;
Photosynthesis; Algae,
Bacteria; Hydrological
(water) cycle;
Precipitation; Runoff;
Aquifer; Evaporation;
Borough; River Thames;
Isle of Dogs; Henry VIII;
Marsh; Creek; Flood; Port;
Trade; Dock; Economic
activity; British Empire;
Container; Monsoon;
Refugee; Contaminated;
Famine; Aid; Pattern;
Relief; Romantic era;
Symphony; Movement;
Orchestra; Waterfall; Little
Ice Age; Climate.

Science

Evolution and inheritance

Pupils should be taught to:

- Identify how animals and plants are adapted to suit their environment in different ways and that adaptation may lead to evolution.

Art and design

Pupils should be taught:

- To create sketch books to record their observations and use them to review and revisit ideas.
- To improve their mastery of art and design techniques, including drawing, painting and sculpture with a range of materials (e.g. pencil, charcoal, paint, clay).
- About great artists, architects and designers in history.

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.

Music

Pupils should be taught to:

- Play and perform in solo and ensemble contexts, using their voices and playing musical instruments with increasing accuracy, fluency, control and expression.
- Improvise and compose music for a range of purposes using the inter-related dimensions of music.
- Appreciate and understand a wide range of high-quality live and recorded music drawn from different traditions and from great composers and musicians.
- Develop an understanding of the history of music.

NOTES

Ancillary Question 1: How does the course of the River Axe change from source to mouth?

Without any introduction to the activity divide the pupils into pairs and give each pair a randomly mixed set of the 18 photographs of the course of the River Axe from source to mouth in **Resource 1**. Explain that almost every river in the world flows from the land to the sea – from its source where it begins in higher ground, such as hills and mountains, to its mouth in lower ground along the coast. Explain that the 18 photographs are of the course or route of a river from source to mouth. The pupils have to rearrange them into the correct order – source to mouth. Allow the pupils plenty of physical space and time to complete this activity such as allowing them to use the floor of the classroom or outside corridors. Listen out particularly for the development of subject vocabulary as the pupils discuss the order into which they are going to place the photographs e.g. *stream, mud bank, waterfall, rapids, estuary, sea, erosion*.

At the end of the activity encourage feedback and discussion during which the pupils can justify and explain their decisions. How similar are the orders the images that the pupils have chosen? For example, has each pair selected the same first and last photograph?

Create a display of the photographs in the correct order: D; I; A; P; L; G; C; N; J; E; R; H; Q; F; O; M; B and K. As a short plenary to this exercise go through the PowerPoint presentation in **Resource 2**, which has the photographs arranged in the correct order. Discuss with the pupils the key ways in which the course and channel of the river change as it progresses from source to mouth. Develop thinking by asking the pupils to speculate and reason as to why the changes they have observed occur?

Now give each pair of pupils a cut up and mixed set of the subject vocabulary cards in **Resource 3**. The activity is to partner up each card with an appropriate photograph (there are more cards than photographs and some words and phrases could apply to more than one photograph). Tell the pupils to look carefully at and discuss the geographical features they can see in each image. Then they place each card on the photograph to which they think it applies. Again listen carefully to the pupils as they discuss and justify their choices. Some vocabulary may need explaining so respond to questions as they arise. Take feedback from the pupils and ensure that everyone understands the vocabulary and are confident in identifying each of the named features in the relevant photographs.

Extend this exercise by telling the pupils that one of the features named on a card is an 'odd one out'. Can they identify which one it is and suggest why it should be considered as this? The answer is *marina* as it is the only geographical feature on the cards that is human or man-made as opposed to all the others, which can be considered natural or semi-natural geographical features.

Now encourage the pupils to return to the photographs and this time make a list of any other features they can see that are created by people (and therefore human geographical features) and not natural or semi-natural features e.g. *farms, boats, houses, village, town*. Develop and progress the discussion here by asking the pupils about features of the landscape that appear natural, such as fields and hedgerows – are these really natural in the same way as, perhaps, the tropical rainforest of Amazonia or the Atacama Desert, which they investigated in Years 3 and 4? They should instead be considered more appropriately as semi-natural features as humans have created and maintain them – mostly by cutting down the forests that grew over most of the United Kingdom a long time ago.

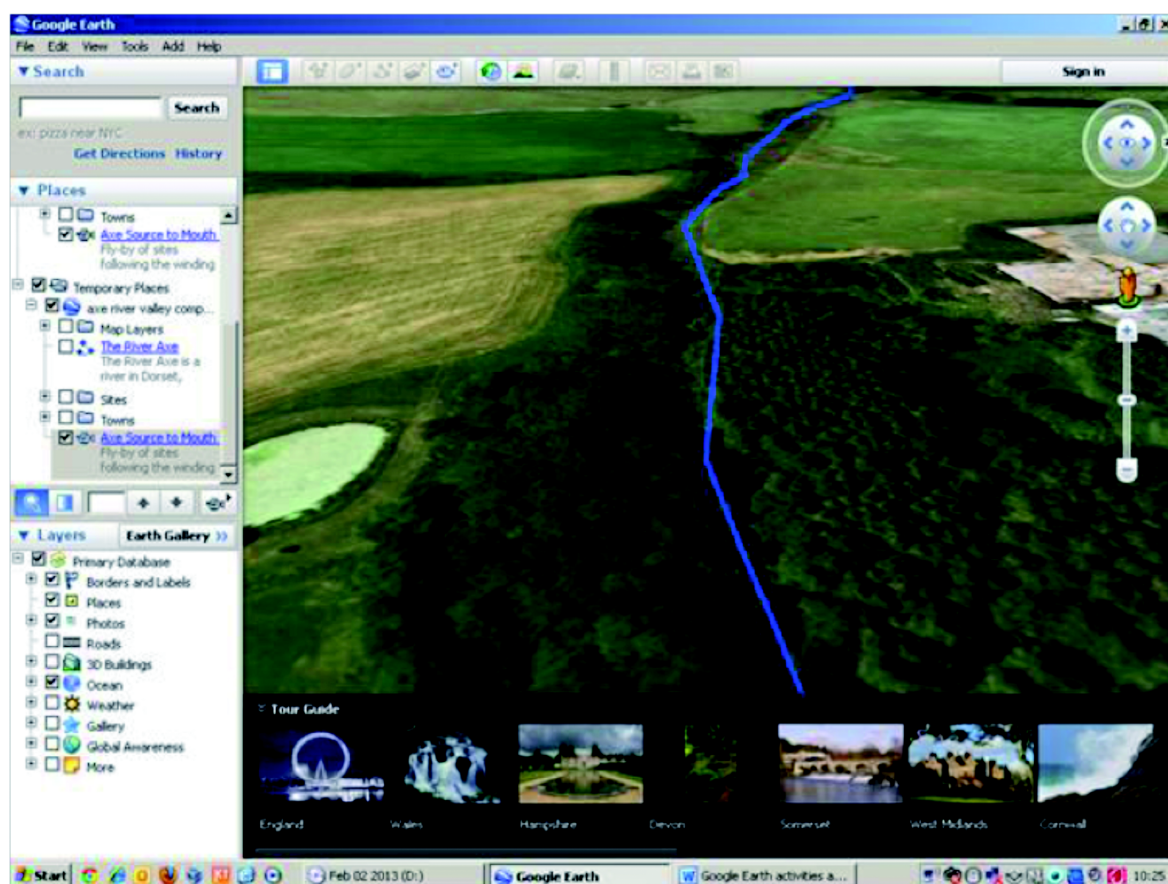
At the end of the activity add a set of vocabulary cards alongside the sequence of photographs in the wall display.

Resource 4 is a KML file. To open this file *Google Earth* needs to have been downloaded and the computer connected to the internet. Open the KML file and close the *Navigating in Google Earth* panel of information if it pops up. On the left-hand tool bar scroll down to *Temporary Places* and tick the box for the *Axe Source to Mouth Tour*. Now click on the camera icon to the right of this box. This will initiate the fly-through of the river which, at

Key Question: What is a river?

NOTES

normal speed, takes 11 minutes and 47 seconds. Clicking the blue/black icon of three rectangles on the far left of the top tool bar will enable a full screen view.



Encourage the pupils to watch the course of the river change from source to mouth. To begin with some of the pupils may find identifying the river on screen a challenge because at this point it is no more than a stream flowing through dense woodland. Fairly quickly, however, they will see the river appear and then become gradually wider and faster flowing with white water (indicating rapids) clearly identifiable. The River Axe will then begin to meander in its middle course and large loops will be identifiable as it flows across a wide and flat flood plain. Towards the sea, tributaries (smaller streams and rivers that flow into larger rivers) join the River Axe. As it approaches its mouth, the river becomes noticeably wider with sand and mud banks appearing along its edges as this section of the river is tidal. At its mouth the river flows into the English Channel having dropped 192 m in height and travelled for 45 km.

Distribute copies of the Ordnance Survey map extracts in [Resource 5](#). Allocate each pair of pupils one of the following grid squares: 4704; 4604; 4305; 4006; 3805; 3605; 3303; 3201; 2998; 2897; 2796; 2695; 2592; 2590; 2589. Now give each pupil a plain A4 piece of paper. Support them to draw a 15 cm square in the centre of their paper. Next they need to make an exact copy of their allocated grid square (including colours) and then label all of the geographical features associated with the river e.g. *River Axe*, *Meander*, *Steep Slope* (shown by contours very close together), *Gentle Slope* (contours wide apart), *Ox Bow Lake* (cut off meander loop), *Estuary*, etc.

When completed encourage the pupils to present their grid square diagram to the rest of the group, describing what it tells them about the river at that point.

Finally support the pupils to agree the order that the grid squares should go in from the source of the River Axe to its mouth. Then add them to the wall display. This is an important activity as it challenges the pupils to apply their understanding of how rivers change from source to mouth (gained from sequencing the photographs) using Ordnance Survey map graphics.

Key Question: What is a river?

NOTES

Next print the set of 10 aerial photographs taken along the course of the River Axe (**Resource 6**) and shuffle them well. Give them to the pupils to work with in pairs. Explain that the first task is to see if they can sort them into the correct order 1–10, with 1 being the image closest to the source and 10 closest to the mouth. As before allow plenty of time and space for this activity and encourage discussion and the use of subject vocabulary. Take feedback from each pair in turn. Is there a commonality of views? Are there any of the aerial photographs that are more difficult to place than others? At the end of the discussion give the pupils the correct order 1–10 (as in **Resource 6**). Consolidate understanding here of how the river changes from source to mouth in terms of its channel and course.

Returning to the OS map extracts in **Resource 5**, give the pupils the following list of four figure grid references: 2796; 3805; 4305; 3100; 4106; 2589; 2592; 4604; 2897; 3404. The pupils now need to match up the correct grid square with each of the aerial photographs 1–10. The correct sequence is:

Aerial photograph number	Grid Square
1	4604
2	4305
3	4106
4	3805
5	3404
6	3100
7	2897
8	2796
9	2592
10	2589

Allow plenty of time for feedback and discussion. Support the pupils to describe and explain their choices using the correct vocabulary for the features identified. As a final activity in this key question, divide the pupils into groups of four and allocate one set of 10 aerial photographs to each group. Using the correct grid reference on the map and the photograph, support them to identify as many *human* land uses, features and activities as they can as shown on each photograph e.g. *roads, golf courses, farms, railways, housing estates, factories* etc. Challenge them to be as precise as possible, i.e. the correct number designation of roads, actual names of farms, villages, boat yards etc. Make a summative list of all the human geographical uses and activities during feedback from each group.

Play the river fly-through *Axe Source to Mouth Tour* on *Google Earth* again, this time in conjunction with the OS map extracts. Now ask the pupils to identify as many *human* land uses and activities as they can. Use the video control tool bar in the bottom left hand corner of the screen to pause and restart the fly-through and to increase its speed if appropriate. These particular points along the fly-through are useful places to pause the film to identify some important features:

- 01.03: Bakers Mill at 468045
- 01.16: Village of Mosterton at 457055
- 01.20: Hockey pitch at 454053
- 01.26: Hay bales in black polythene covers with tractor and trailer at 437055
- 02.01: Tennis court at Manor Farm at 431059
- 02.10: Hamlet of Court and village of Seaborough at 425059
- 02.34: Village of Clapton at 415065
- 02.45: Railway appears for the first time at 409064

Key Question: What is a river?

NOTES

- 03.47: Railway bridge over the River Axe at 373058
- 03.51: Winsham Bridge carrying the B3162 over the River Axe at 379059
- 04.13: Village of Ammerham at 366057
- 04.33: Village of Bridge and Forde Abbey at 360054
- 05.08: Road bridge over the River Axe at Chard Junction at 341048
- 05.13: Sewage works and water treatment plant at 341048
- 05.56: Railway bridge of the River Axe at 329028
- 06.04: Road bridge over the River Axe at the village of Broom at 325025
- 07.13: Road bridge carrying the A358 over the River Axe at Weycroft at 308000
- 07.18: Railway bridge over the River Axe at Weycroft at 306999
- 07.49: Road bridge over the River Axe at Axminster at 294988
- 08.03: Road bridge carrying the B3261 over the River Axe at 290982
- 08.23: Road bridge carrying the A35 over the River Axe at 287979
- 09.46: River weir at Whitford showing canoes/kayaks and parked cars at 262953
- 10.46: Road bridge carrying A3052 over River Axe at Colyford at 259928 – this is also the furthest inland extent of high and low tides indicated by the black border lines to the river on the OS map
- 11.38: Road bridge over River Axe estuary and marina/harbour at Seaton at 254900

Key Question: What is a river?

NOTES

Ancillary Question 2: How does the course of my local river change from source to mouth?

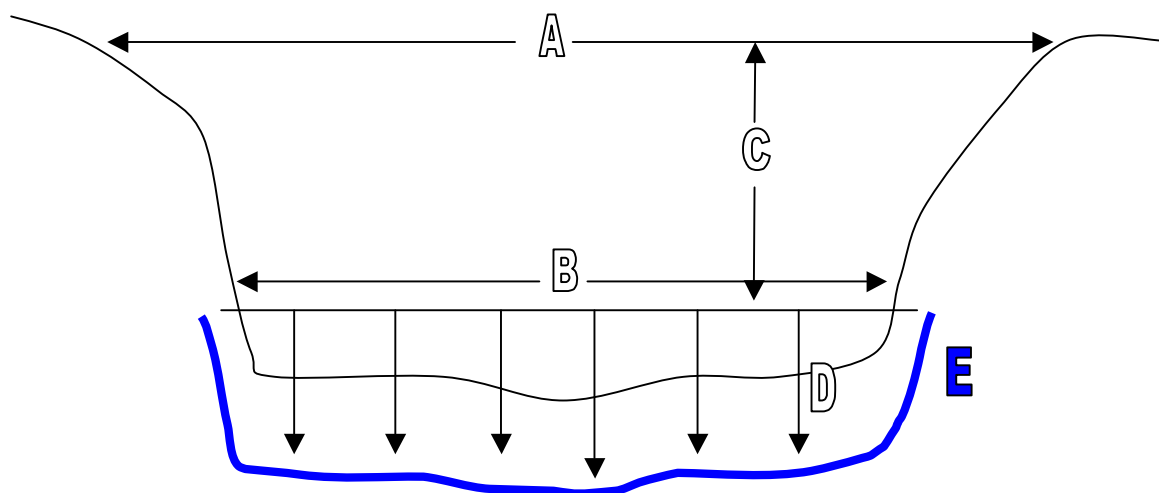
Several elements of the investigation of the River Axe in Ancillary Question 1 are easily replicable to a stream or river in the local area of any school. Photographs can be taken by a teacher of a nearby stream at various points along its course from source to mouth for the pupils to sequence and to describe and offer reasons for the changes observed – in exactly the same way as for the River Axe.

Similarly *Google Earth* satellite images of key points along the course of the stream can be easily 'screen grabbed', saved and then printed or projected for the pupils to observe. After having dragged the slider to zoom in and out to arrive at the level of detail required, any *Google Earth* image can be saved by clicking on the second icon from the right along the top toolbar.

Thirdly, 1:50 000 *Landranger* OS map extracts can be purchased of the area through which the course of the stream flows, either in hard copy from *Ordnance Survey* www.ordnancesurvey.co.uk/shop/maps.html or downloaded, saved and printed from *Digimap for Schools* <http://digimapforschools.edina.ac.uk/> (if your school is a subscriber).

With these three resources – ground level photographs of the stream along its course, *Google Earth* satellite images at various points along the stream and a 1:50 000 OS *Landranger* map – the pupils can be supported to replicate the activities that they carried out when investigating the River Axe in Ancillary Question 1.

If it is possible for the pupils to safely access a large stream or small river locally over a distance of approximately 250 m along its bank (such as the one shown in **Resource 7**), they can then carry out a hypothesis-based fieldwork investigation involving the collecting, recording, presentation and interpretation of data. A hypothesis is merely an idea or theory for the pupils to investigate to evaluate whether it is true (proved) or not (disproved). So the pupils could be set the hypothesis that: *There is no change in the course of River X between locations Y and Z*. The pupils could then work in groups at intervals of, say 10 m, along the stream between the two points X and Y. Each group will need a tape measure, a metre ruler, a cork and a stop watch. At each interval along the stream the pupils can collect data for five things or variables as shown in the diagram below:



- Distance A: from the top of the left bank to the top of the right bank;
- Distance B: across the top of the water surface;
- Distance C: the distance from the water surface to an imaginary line joining the tops of the banks;
- Distance D: the depth approximately every 20 cm across the stream (then calculate the average);
- Speed E: the speed or velocity of flow of the water. Measure a distance of 5 m along the stream bank at each location (approximately 2.5 m above and 2.5 m below the

Key Question: What is a river?

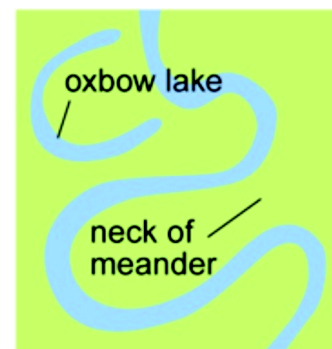
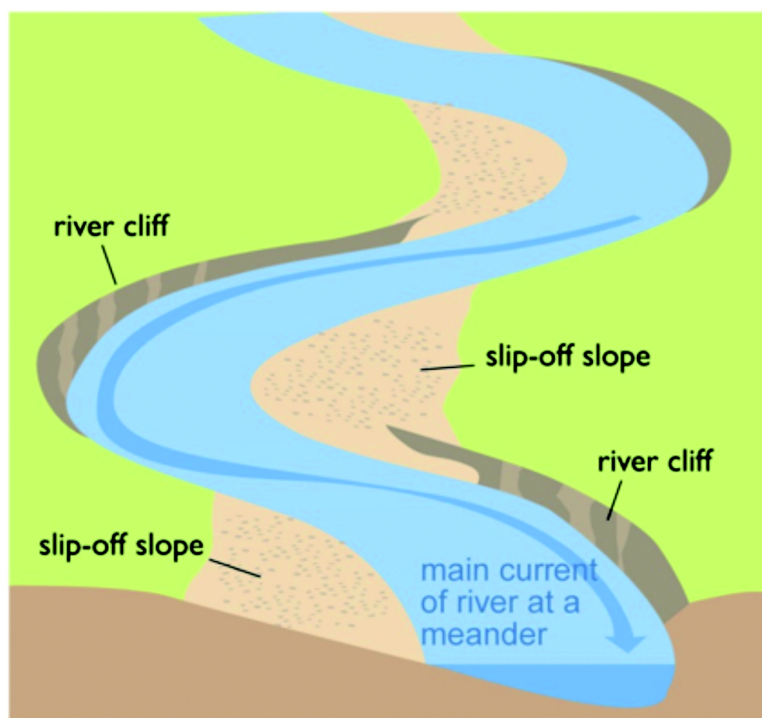
NOTES

measuring point). Now time how long it takes a cork to travel this distance. Do this five times and then calculate an average speed from the five measurements.

The pupils can now enter their data into an Excel spreadsheet and use a range of graphical techniques to present and display their results. They could then write up their investigation in a short report with the following sections:

- *Objective of the investigation* (what they set out to prove or disprove linked to the hypothesis);
- *Location* (where the investigation took place including maps and photographs);
- *Methods of data collection* (the techniques used to capture the information required);
- *Recording* (how they created their Excel spreadsheet);
- *Presentation* (graphs and charts of results);
- *Interpretation* (what the results suggest);
- *Conclusion* (summary and judgements as to whether the hypothesis has been proved or disproved);
- *Evaluation* (a consideration of how the investigation could have been improved and how valid and trustworthy the results are).

If it is possible for the pupils to work at a meander along a large stream or small river (such as the one shown in the images in [Resource 8](#)), they could test the hypothesis that: *The depth of a river channel does not change when it meanders.* A curve or bend in the course of a river is called a *meander*. Meanders are the most easily recognisable feature of a river.



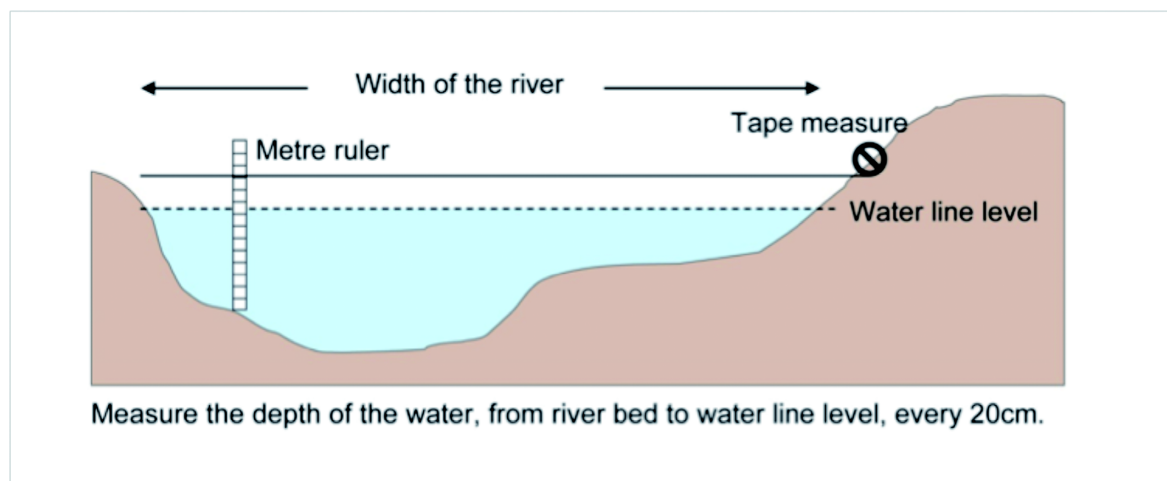
The speed at which water flows through a river meander will vary at different points on the bend – the outside, middle and inside sections. Water flowing around the outside of the meander will flow the fastest as it has the furthest distance to travel, so should have the most energy for erosion. The water depth will therefore be deepest at this point. The slow flowing, low energy water on the inside of the meander will deposit its load of heavier gravel and stones, creating the shallowest points on the cross-section. During fieldwork, pupils can collect data from across both a meander and a straighter section of the stream. By comparing cross-sections of their results for both locations the pupils can ascertain whether there is a noticeable difference in the depths of the river channels.

The method is as follows:

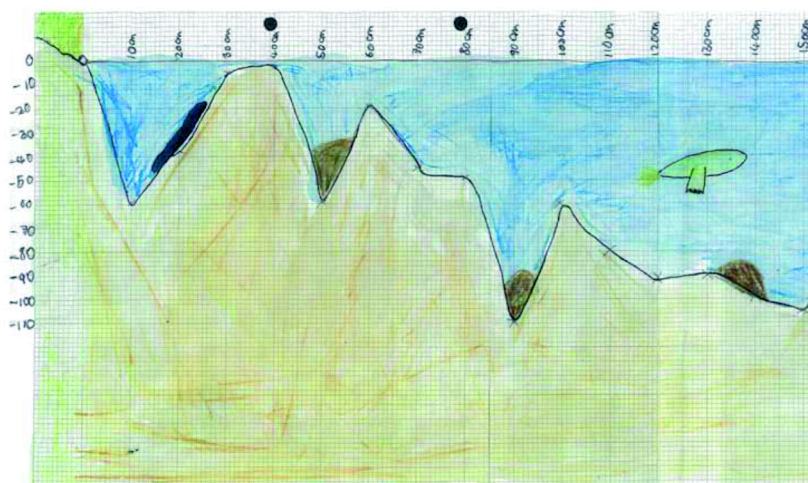
Key Question: What is a river?

NOTES

- Two pupils record the width of the stream channel from the water's edge on either side, by using a tape measure held straight just above the water. Once they have measured the stream's width they should remain in place with the tape measure held tight.
- At 20 cm intervals across the stream, two other pupils should measure and record the depth in centimetres, using a metre stick with centimetre markings.
- Repeat the method as outlined above, on a straight section of the same stream.



On separate sheets of squared graph paper plot the two cross-sections to scale. Plot each 20 cm interval along a horizontal axis (stream width). On the vertical axis plot the stream depth using a negative scale as shown in the example below. Join the dots to create the stream profiles. There will almost certainly be a clearly noticeable difference between the profile of the meander and straight stream sections. It is expected that the meander cross-section will show the greatest variety in stream depth measurements. The example of a cross-section below shows the progression of stream depth from the shallowest point on the inside of the meander to the deepest section on the meander's outside edge.



Stafford Brook meander plotted profile by pupils from Hatch Beauchamp Primary School, Somerset

Pupils can connect their geographical study of a large stream or small river with a variety of science investigations e.g. testing the hypothesis: *River X provides a healthy habitat for invertebrates*. Invertebrates are defined by one characteristic: they do not possess a backbone – 97 per cent of all animals are invertebrates. In a stream habitat, insects such as dragonfly larvae and water boatmen are part of this group, along with molluscs such as pond snails, crustaceans (e.g. freshwater shrimps) and also aquatic worms and leeches. Amphibians, birds, mammals and reptiles all have backbones and are therefore vertebrates.

For the purposes of this investigation a healthy stream or river habitat is assumed to be one with low levels of water pollution. Pollution levels in a stream directly affects the levels

Key Question: What is a river?

NOTES

of dissolved oxygen, i.e. polluted water contains lower levels of dissolved oxygen which, in turn, impacts upon the number and variety of invertebrates present. The main sources of stream and river pollution include:

- *Organic matter: sewage, food waste, farm effluent and fertilisers*

This is the most common source of freshwater pollution. Bacteria and other micro-organisms feed on organic matter and large populations quickly develop, using up much of the oxygen dissolved in the water. Fertilisers and farm waste draining into a river will increase the concentration of nitrates and phosphates in the water. Algae use these chemicals to grow and multiply rapidly. This will turn the water green. This massive growth of algae, called *eutrophication*, leads to pollution. When the algae die, they are broken down by the action of the bacteria, which quickly multiply, using up considerable amounts of dissolved oxygen in the water. As a result there is much less oxygen for other animals living in the river habitat.

- *Industrial and chemical waste*

Chemical waste pollutants such as cyanide, zinc, lead, copper and mercury from factories and industrial processes, are sometimes accidentally discharged into rivers. If these discharges are in high concentrations, river animals will be killed immediately. Pollutants in lower levels can enter the food chain and accumulate until they reach toxic levels, eventually killing predators at the top of the food chain such as fish, birds and mammals.

- *Oil pollution*

If oil enters a stream or river then the oil will spread out to create a thin film over the entire water surface, which prevents oxygen entering the habitat.

- *Water temperature – water warmed by industrial processes.*

Industry often uses river water for cooling factory machinery. Sometimes large quantities of warm water can be discharged back into a river, raising the water temperature and lowering the amount of dissolved oxygen (warm water has less capacity for storing dissolved oxygen).

Certain species of freshwater invertebrates cannot survive in water with low levels of dissolved oxygen, so their presence or absence indicates the extent to which a river is polluted. These species are called *indicator species*.

This investigation uses a simple method of stream dipping called *kick sampling* to discover which invertebrates are living in the stream or small river. Scientific keys are then used to identify invertebrate species by closely observing their characteristics. Invertebrates will each be given a *sensitivity score*. This indicates how sensitive they are to levels of pollution (dissolved oxygen) in the water (a '10' means they are very sensitive whereas a '1' means they are not affected by pollution levels and can live in any environment).

Sensitivity scores are combined to calculate a *Biotic Index*, which can help ecologists reach conclusions about the health of a river habitat. The recording of the species found, their sensitivity scores and the calculation of the Biotic Index is carried out using

Resources 9 and 10.

The pupils can be divided up into groups of three or four and each group will require the following equipment:

- A pond dipping net;
- A large white tray;
- An 'interesting finds' tray – a smaller white tray split into sections (similar to a cutlery drawer tray);
- A large tea strainer or smaller net for closer inspection of invertebrates found;
- A magnifying glass;
- A freshwater invertebrate identification key, which can be downloaded for free from the *Open Air Laboratory* (OPAL) network at

Key Question: What is a river?

NOTES

www.opalexplornature.org/sites/default/files/7/file/water-survey-field-guide-2014.pdf

- Invertebrate recording sheet (**Resource 9**);
- Water pollution and Biotic Index score sheet (**Resource 10**);
- Clipboard;
- Pencil;
- Calculator;

Working in supervised groups the pupils can now collect examples of invertebrate species present in the stream or small river using a simple technique called *Kick Sampling and Stone Washing* – see the Field Studies Council demonstration and guidance at www.youtube.com/watch?v=yoFK4hCu42c

Following sampling the invertebrates can be identified from the key and recorded on a copy of **Resource 9**. The Biotic Index can be calculated simply by following the instructions in **Resource 10**. The Biotic Index score will then give the pupils an indication of the health of the stream using the following as a guide:

Poor 1.0–2.0
Fair 2.1–2.5
Good 2.6–3.5
Excellent 3.6 +

NOTES

Ancillary Question 3: Why are river estuaries such important places for wildlife?

Distribute copies of the relief map of the United Kingdom in **Resource 11**. Ask the pupils to find the following rivers: *Thames, Ouse, Dee, Mersey, Severn, Clyde, Forth, Test and Exe*. For each river find the source and the mouth. Which of these rivers do the pupils estimate to be the longest?

Now ask the pupils to look at what happens to all of these rivers as they enter the sea. In all cases, as the river approaches the sea it becomes much wider with large areas of mud banks on both sides. These mud banks are covered and uncovered each day by the tide – see the photographs in **Resource 12**.

The River Severn (see map in **Resource 13**) is the longest river in the United Kingdom – just a few kilometres longer than the River Thames. It flows into one of the country's largest estuaries situated between Bristol and Cardiff, before entering the Bristol Channel.

At this point the film at www.youtube.com/watch?v=yyMJDZOM7XI can be shown to the pupils as a way of consolidating much of what they have already learned about the course and channels of rivers and also to develop their understanding of estuaries.

Now show the short film of the Exe Estuary at www.youtube.com/watch?v=PGYxMcndC6o. Discuss with the pupils what the main features of the Exe estuary are. What are the most significant things they see in the film? What are the natural and human geographical features they can see? Was the film made at high or low tide and how can the pupils tell? Make a particular point of emphasising the mud banks that re-exposed at low tide.

Next encourage the pupils to look at the aerial photograph of the Exe Estuary in **Resource 14** and orientate it with the Ordnance Survey map extract of the Exe estuary in **Resource 15**. Tell them that the photograph was taken at grid reference 959899 with the camera pointing in a SE direction.

Print off a copy of **Resource 14** for each pupil and have them stick it onto the middle of an A3 piece of plain paper. This will give them room to annotate around the outside of the aerial photograph with the following labels pointing to the correct location on the photograph with an arrow:

- M5 motorway;
- Starcross;
- Countess Wear area of Exeter;
- Dawlish Warren;
- Exeter canal;
- Exmouth;
- Turf;
- Confluence of River Clyst with Exe estuary (the point where the River Clyst flows into the Exe estuary);
- Powderham Castle and Deer Park;
- Topsham;
- An area of exposed mud;
- An area of exposed sand;

Before moving on, ask the pupils whether they think the aerial photograph of the estuary was taken at high or low tide? How do we know? There are large areas of uncovered sand and mud banks. Summarise for the pupils that an *estuary* occurs when a river slows and widens to flow into the sea, such as with the River Exe. Here incoming salt water from the sea mixes with outgoing freshwater from the river. This creates *brackish* water (somewhat salty but not as much as pure sea water), which is really important for wildlife.

Now the pupils can work in pairs to undertake the Exe Estuary mapwork challenge. The photographs in **Resources 16–22** were all taken from The Point in Exmouth at 993807 but with the camera pointing in different directions. Can the pupils use the aerial photograph and the OS map together to answer the following questions from the clues provided?

Key Question: What is a river?

NOTES

- The photograph in **Resource 16** was taken looking WSW. What is the name of the settlement in the photograph and how many different activities can you see taking place on the estuary?
- The photograph in **Resource 17** shows the First Great Western train from Penzance to London Paddington entering Starcross. In which direction was the camera pointing when this photograph was taken?
- **Resource 18** shows the same train passing through Starcross railway station. How is the railway station represented on the map (which symbol is used)?
- In **Resource 19** is a building called Courtlands. The photograph was taken from The Point looking NNE. What is the six-figure grid reference on the map for Courtlands?
- The photograph in **Resource 20** was taken looking north to the cliffs at Lymptone. How are these cliffs shown on the map (which symbol is used)?
- Powderham Castle is shown in **Resource 21** looking NW from The Point. How is the deer park that surrounds the castle shown on the map?
- **Resource 22** is a photograph of Mamhead House looking W from The Point. Find it on the map. What kind of trees surrounds the house?
- The photograph in **Resource 23** was taken in Lymptone looking towards Powderham Castle. In which direction was the camera pointing?
- The photographs in **Resources 24** and **25** were both taken in Exton.
Resource 24 was taken in a WNW direction and shows Exminster. How is the electricity pylon and cable shown on the map? How do we know that the area beside the river is a nature reserve?
Resource 25 was taken looking NW towards Countess Wear. What is the name and number of the road that the bridge in the photograph carries over the estuary?
- The photographs in **Resources 26** and **27** were both taken from Turf at 964861.
Resource 26 shows Exton railway station. In which direction was the camera pointing when the photograph was taken? **Resource 27** is looking in ESE direction and shows a training centre. What kind of training centre is this?
- The photographs in **Resources 28–31** were all taken from Starcross car park at 977822. **Resource 28** was taken looking SE towards Exmouth Sailing Club. What is the purpose of the large concrete tower? **Resource 29** shows The Point in Exmouth. In which direction was the camera pointing when the photograph was taken? **Resource 30** is a photograph of the church with a tower in Exmouth. How is this church shown on the map? **Resource 31** was taken in a SSE direction and shows two people at the end of Dawlish Warren Spit. Use the scale on the map to work out how far the people are away from the car park in Starcross.

Estuaries are one of the richest ecosystems to be found anywhere in the world. They are incredibly important for wildlife especially wading birds that feed on the invertebrates living in the mud banks that are exposed at low tide. **Resource 32** has the images of eight of the most important wading birds to be found on the Exe Estuary. Can the pupils name the birds by using the RSPB online bird guide at www.rspb.org.uk/wildlife/birdguide/

In addition they can research key facts about the birds in the UK such as: what each species eats, when a species of bird is likely to be seen on an estuary in the UK, how many of these birds nest and are resident throughout the year and which species migrate to the UK in the winter from somewhere else?

Finally, in this enquiry an opportunity can be taken to illustrate and explain a *food chain* that exists in and on the mudflats of River Exe Estuary using **Resource 33**. This shows four components of a mud flat food chain.

Firstly in the shallow water above and in the mud are countless billions of *Diatoms*. A diatom is a minute microscopic plant that obtains its energy through photosynthesis using energy directly from the sun. Most diatoms are about 20–200 microns in size (a micron is 0.1 mm). This means that you could fit about 10 million in a coffee mug.

Preying on the diatoms is the *Ragworm*. This worm inhabits a vertically orientated burrow and can reach huge densities in the upper reaches of estuaries where conditions are

Key Question: What is a river?

NOTES

unsuitable for other species. It is an omnivore and is able to feed in a variety of ways. It can filter diatoms by spinning a mucus 'web' inside its burrow, which catches particulate food such as phytoplankton from water drawn in from outside. The web is then ingested along with any catches.

Ragworm forms an important part of the diet of many estuarine birds such as the *Greenshank*, which probes for them with its long beak.

In turn, unsuspecting wading birds such as greenshanks on the mud flats can find themselves the food of birds of prey such as the *Peregrine Falcon*, the fastest of all falcons, which hunts unseen high above the mudflats before folding its wings back and swooping down at speeds of up to 100 km per hour.

NOTES

Ancillary Question 4: Why are rivers such an important part of the water cycle?

In scientific and purely practical and functional terms, a river is a physical mechanism for returning excess precipitation from the land to the sea, where it originated. Within the *hydrological* or *water cycle*, water in a river is collected mostly from precipitation that has run off the land surface and not been evaporated or absorbed and stored in underlying *aquifers* (underground layers of rock or soil that store water). It is of course a vitally important process, without which most of the land surface of the world would be permanently under water. A simple experiment known as *Water cycle in a bag* can introduce the key concepts and processes of the water cycle to pupils in a practical way.

Take a large bowl and fill it with several centimetres of water. Place a small yoghurt pot in the centre of the bowl of water, making sure not to get any water inside it. Cover the large bowl with cling film and fasten down securely to the side of the bowl. Put a weight on top of the cling film, over the centre of the small pot to push the cling film down into it slightly. Place the experiment on a warm sunny window sill for a few days. The pupils will find that the heat of the sun evaporates the water, the water vapour rises, condenses on the cool plastic then falls into the small container. This is a microcosm of what happens in the real water cycle.

The *Met Office* www.metoffice.gov.uk has a variety of resources for introducing and developing investigations of the hydrological or water cycle beginning with the animation at www.youtube.com/watch?v=SvA11luweNk

Then allow the pupils time to fill in the spaces on a copy of the diagram at www.metlink.org/wp-content/uploads/2015/02/metofficeeducation_ks3_watercycle_wrkst.pdf

The correct answers are at www.metlink.org/wp-content/uploads/2015/02/metofficeeducation_ks3_watercycle_wrkst_answers.pdf

One aspect of the water cycle in particular always engages pupils of primary age. This is the fact that all of the water that has ever existed on earth is still present on earth today! Droplets of water as old as the earth itself go round and round the water cycle as part of a never-ending cycle. Encourage the pupils to think about the fact that a droplet of rain falling on them today might have fallen on thousands of different people and things during its 'life'.

Challenge the pupils to think about the last raindrop to fall on them and to tell its life story to date by including a variety of things, places and people it may have dropped on since the formation of the earth 5 billion years ago. The pupils can be as creative as they wish here – perhaps telling the story of the raindrop through a rap, poem, improvised drama or a cartoon strip.

NOTES

Ancillary Question 5: How has the *Isle of Dogs* changed since the reign of Henry VIII?

Show the pupils the image in **Resource 34**. What feature of a river does it show? It shows a meander. Now ask the pupils where they think that the most famous river meander in the world is – it is on a river seen by millions of people on television several times a week. As a clue tell the pupils that the people in **Resource 35** know it very well. They are all actors and actresses who have played characters in the long-running BBC television soap opera series *EastEnders* – Jessie Wallace plays Kat Moon, Steve McFadden plays Phil Mitchell, Nitin Ganatra plays Masood Ahmed and June Brown plays Dot Branning.

So what is the link to the most famous river meander that millions of people see every week on television? If the pupils have not guessed it by now, show them the satellite image in **Resource 36** and the opening sequences of the programme since its beginning at www.youtube.com/watch?v=cS9Q-ohLrPA and www.youtube.com/watch?v=OuRUTa690JQ

Albert Square, the fictional setting of *EastEnders* in the equally fictitious London Borough of Walford, is located in the East End of London. The meander on the River Thames seen in the opening sequence of every programme encloses an area known as the *Isle of Dogs*. So why is this area within the meander known as the Isle of Dogs? One theory is connected to the man in **Resource 37**. Who is this man and how is the name of the area linked to what is seen happening in **Resource 38**?

King Henry VIII was reputed to have kennelled his hunting dogs in derelict farm buildings on the 'island' within the meander and the first historic record of the use of the name occurs in his letters and papers of 1520 where there is a record of the purchase, for a ship, of 'a hose for the *Mary George*, in dock at the Isle of Dogs' for 10d (4p). In 1520 the area inside the huge meander would have looked very similar to the images in **Resource 39** – mud flats, marshes, creeks – and was frequently flooded by the River Thames. Encourage the pupils to identify and describe as many natural geographical features as they can from these images. Key subject vocabulary include *marsh, mud flats, creek, river, flood*. What adjectives would the pupils use to describe these places? Perhaps *remote, frightening, lonely, windswept*.

One of the most famous descriptions of this kind of marshland tidal environment was written by Charles Dickens in the opening passage of his book *Great Expectations*. This is how the main character in the book, Pip, describes how he feels about the marshland environment of North Kent, a few miles downstream from the Isle of Dogs, in which he lives:

'Ours was the marsh country, down by the river, within, as the river wound, twenty miles to the sea. My first most vivid and broad impression of the identity of things seems to me to have been gained on a memorable raw afternoon towards evening. At such a time I found out for certain, that the bleak place overgrown with nettles was the churchyard and that the dark, flat wilderness beyond the churchyard, intersected with dykes and mounds and gates, with scattered cattle feeding on it, was the marshes; and that the low leaden line beyond, was the river, and that the distant savage lair from which the wind was rushing was the sea; and that the small bundle of shivers growing afraid of it all and beginning to cry, was Pip.'

Discuss with the children the adjectives that Dickens used to describe the marsh – *raw, bleak, wilderness, leaden, savage* etc. How does his description compare with the pupils' impressions?

Tell the pupils that in the nearly 500 years since its first mention in the papers of Henry VIII, the Isle of Dogs has changed greatly. Divide the pupils into groups of four and explain that you are now going to give them a selection of resources showing the Isle of Dogs at different dates. The objective for them is to identify and describe the changes that have taken place over the years and also to try to explain why they happened.

Key Question: What is a river?

NOTES

There is plenty of evidence to be seen in the range of maps and images that they have to work from.

A selection of **Resources 40–71** can now be scrutinised by the pupils in their groups. The resources are in chronological order:

Resource	Date
40	1747
41	1784
42	1797
43	1799
44	1802
45	1810
46	1813
47	1840
48	1849
49	1854
50	1858
51	1880
52	1907
53	1920
54	1933
55	1945
56	1945
57	2015
58	2015
59	2015
60	2015
61	2015
62	2015
63	2015
64	2015
65	2015
66	2015
67	2015
68	2015
69	2015
70	2015
71	2015

The key thing for the pupils to observe from all of the resources is the gradual transformation of the Isle of Dogs from a barren and, in many ways, hostile environment to become part of the busiest port in the world. By 1802 the northern 'neck' of the meander has been dug through to create a large *dock* – the West India Dock. What is a 'dock' and

Key Question: What is a river?

NOTES

what would have gone on there in the 1840s? What kind of ships? Would there have been machines to do the work? A dock is somewhere where ships tie up to load up goods that are exported to other countries or to unload goods that they have brought in from overseas. What would the ships have looked like? Would they have been sailing or steam boats or both? Tens of thousands of dock workers would have had to unload and reload the ships by hand, often very quickly within 2–3 days. As long as a ship was in port it was not earning any money for the owner. The dock workers were therefore pushed very hard. Working conditions were poor and pay very low. All of the dock workers would have been *casual*, which means they were taken on and paid by the day and did not have a contract for full time work. There were many more men wanting work than jobs to go around, so pay could be very low. This is a description by Colonel G.R. Birt about the conditions of dock workers at Millwall Docks in 1889:

‘The poor fellows are miserably clad, scarcely with a boot on their foot, in a most miserable state ... These are men who come to work in our docks who come on without having a bit of food in their stomachs, perhaps since the previous day; they have worked for an hour and have earned 5d; their hunger will not allow them to continue: they take the 5d in order that they may get food, perhaps the first food they have had for twenty-four hours.’

By 1868 the East India Dock and the Millwall Dock on the Isle of Dogs had been built and, with 16 000 ship movements each day, the port of London had become the busiest port in the world. By the 1950s the *British Empire* was made up of 35 countries around the world. Goods that couldn't be produce at home were imported from these countries of the British Empire into London. Amongst the food and products that were imported were tea, sugar, spices, rubber, coffee, cacao, cotton, tobacco, jute, bananas, oranges, beef, mutton, lamb, cheese and butter.

The modern Isle of Dogs is now a very different place. Both the East and West India Docks closed during the 1970s and Millwall Dock closed in 1980. In present-day images the outlines of the docks can still be seen but there are no ships. What do the pupils feel the Isle of Dogs is like today? What do they think has replaced the docks based on what they can see? What sort of jobs do people do now?

Today the Isle of Dogs and particularly the *Canary Wharf* area is an important financial and commercial area with over 6000 jobs in insurance, banking, legal services and the information sector (e.g. newspapers and television media). So what killed the docks in such a short time? In 1955 the docks were at their busiest and wealthiest and yet, 15 years later, all but one was closed down never to reopen. The clue is in **Resource 72**. What kind of ship is this? It's a container ship. Why did this kill the docks at the Isle of Dogs?

Between 1960 and 1970 the shipping industry moved from carrying goods in cargo ships, such as those that used the docks at the Isle of Dogs, to loading goods into huge containers of standard size. This meant that much larger ships could be used to transport the cargo in containers around the world helping to lower shipping costs. Ships became much larger, too large to travel up the River Thames to the centre of London and the Isle of Dogs docks. The deep water port of Tilbury, just 25 km downstream along the River Thames, took the majority of trade from the Isle of Dogs – see **Resources 73** and **74**.

Between 1960 and 1980 all of London's docks were closed leaving around 21 sq km of derelict land and tens of thousands of unemployed former dock workers in the East End.

Key Question: What is a river?

NOTES

Ancillary Question 6: Why is river flooding such a problem in Bangladesh?

Show the pupils the two news reports at www.youtube.com/watch?v=b3wIJJrUDf8 and www.youtube.com/watch?v=R3ax_v1Bnjc and explain that the country referred to is Bangladesh – see the maps in **Resource 75** and the infographic in **Resource 76**.

Explain that almost every year the people of Bangladesh suffer from very serious flooding as rivers burst their banks and flow over the land, towns and cities – as they can see in the images in **Resource 77**. Ask the pupils to consider what they feel the greatest problems the people affected by the flooding will face – what will they eat? Where will they find shelter and, most importantly, from where will they get fresh water to survive?

So why does Bangladesh suffer from serious river flooding almost every year? Explain to the pupils that the first reason can be seen in the satellite image and map in **Resource 78** – what is it? Three mighty rivers – the Ganges from the northwest, the Brahmaputra from the north and the Meghna from the northeast meet in the middle of Bangladesh before flowing out into the Bay of Bengal. The second reason is that the relief of the country is very low and flat with nowhere in Bangladesh higher than 39 metres. The pupils are going to work out for themselves the third reason for the annual floods from a histogram they are now going to draw using the data below, to show average monthly rainfall in the city of Sylhet in Bangladesh.

Month	Rainfall in mm
January	10
February	25
March	90
April	310
May	600
June	1200
July	900
August	800
September	500
October	250
November	30
December	5

What do the pupils notice about the pattern of rainfall in Bangladesh from their completed histogram? What happens during the period May–August? This is the main reason for river floods. How much rain falls during these four months? 3500 mm. By comparison Cardiff, the wettest city in the UK, receives just 1150 mm in the entire year and Dalness, the wettest place in the whole of the UK, receives a total of 3300 mm. So Bangladesh has more rainfall in just four months than the wettest place in Britain gets in a year! This is because every summer a strong wind called the *monsoon* blows in over Bangladesh from the southwest. Because this wind has blown for thousands of kilometres over the Indian Ocean before reaching Bangladesh, it is wet with lots of moisture, which falls as rain as soon as it reaches land. See the film at www.youtube.com/watch?v=R3ax_v1Bnjc

As a summative piece to this exercise, the pupils could write a short explanatory text explaining the three reasons why Bangladesh suffers from serious river floods in most years.

NOTES

Ancillary Question 7: How did Bedřich Smetana use music to describe the course of his beloved national river?

Explain to the pupils that in 1874 Bedřich Smetana (**Resource 79**) composed one of the most famous pieces of music written about a river. Smetana was working during the Romantic era of classical music and the river about which he composed this piece is called the Vltava (pronounced the val'tava), which is the longest river in the present-day Czech Republic. Check the map of European countries **Resource 80** for the location of the Czech Republic and map of Central Europe (**Resource 81**) for course of River Vltava.

It was first performed in 1875. In the second movement of a six-movement suite entitled *Ma Vlast* (My Country), Smetana wanted to evoke and portray the sounds and images of the River Vltava along its 430 km course as it drops 1016 m in height to flow through the capital city of Prague before joining the River Elbe.

Before playing the movement, divide the pupils into pairs and challenge them to sort the photographs of the River Vltava in **Resource 82** into the correct order from source to mouth (the confluence with the River Elbe).

Next play the Vltava movement in its entirety to the pupils (**Resource 83**) (just over 12 minutes 30 seconds in length). Reflect upon the music as they look at the images of the river they have just sequenced. What are the pupils' first impressions of how the composer is using the tempo of the music and different musical instruments to portray the various stages of the river? Can they immediately identify any particular features of the river described by the music? Now play the following sections of the movement:

- 00.00–03.48: How is the composer evoking the upper course of the river as it flows quickly from its source down the mountain side in fast flowing streams? Flutes joined by clarinets and pizzicato strings and harps.
- 05.22–08.05: Here the river is in its middle course, flowing more slowly and sedately and meandering gently from side to side. How has the tempo and the use of different instruments changed from the upper course? Full orchestra dominated by violins.
- 08.06–10.21: Here the river has reached the rapids. How do we know this from the composition and style of the music? Full orchestra and crashing cymbals.
- 10.22–end: The lower course of the river in its final stage as it approaches the point where it joins the River Elbe, which will take its waters on to the sea. What feelings does the music evoke in the listener? How is Smetana showing the pride and triumphal feelings he has about his country's national river?

As a summative piece to this enquiry the pupils could be encouraged and supported to work in small groups to create a piece of music lasting approximately a minute to describe a river feature. They could then rehearse it, record it and save to an audio file. For example, the pupils could be asked to compose something to convey the sounds and grandeur of waterfalls using the film at www.youtube.com/watch?v=IcL678AASFc as an initial stimulus.

NOTES

Ancillary Question 8: How do we know what happened to the River Thames during the *Little Ice Age*?

Explain to the pupils that from about 1400 to around 1850, the climate of Britain was very much colder than it is today, especially in winter. In fact it was so cold in winter between 1400 and 1850 that the River Thames in London froze over completely on 24 occasions, which lasted for weeks and even months in some years – with ice as thick as 28 cm. This time has become known as the *Little Ice Age*. Ask the pupils to consider how we know this given that there was no photography, films, television or radio news reports?

Well, we have what was written in newspapers, books and also people's diaries. Most importantly we have paintings of artists that recorded what they saw happening on the River Thames. Divide the pupils into small groups and give each group a set of the paintings in **Resource 84** giving them the dates of each painting.

The winter of 1683–4 was the coldest ever experienced in England. What do the artists show in their paintings? As soon as the River Thames froze over Londoners set up what became known as *Frost Fairs*, the first of which was in 1608. Perhaps the most famous was in 1814 when an elephant walked backwards and forwards across the frozen river. What can the pupils see happening at the fairs? Local people set up stalls and tents selling food and souvenirs, as well as presenting entertainment such as plays and comedy turns or offering sports of different kinds. Over 2000 watermen who normally ran water taxi services across the river converted their boats into sleds and pulled their customers across the ice.

Take time to discuss all of this with the pupils and then suggest they think about what would happen today if the River Thames froze over in the middle of London? Now encourage and support them to paint a picture in the style of any one of the examples they have looked at in **Resource 84**. They should depict what they think a modern-day frost fair might look like – would there be fast food, games, dancing, sports etc.? Would anything be different or is having fun in the snow pretty much the same as it was over 500 years ago?

Key Question: What is a river?

NOTES

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 of 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	Identify and describe how physical features of rivers change from source to mouth	Photograph sequencing
1	Offer reasons to explain why the course of a river changes as it flows from higher to lower ground	Oral
1	Use OS maps, aerial photographs and GIS to recognise, describe, compare and contrast and explain how physical features change along the course of a river	OS map interpretation Aerial photograph sequencing <i>Google Earth</i> fly through exercise Short piece of explanatory writing
2	Use a range of fieldwork techniques to measure, record and present and explain changes along a section of a local river and to reach a conclusion as to whether it constitutes a healthy habitat for living things	Data collection Excel spreadsheet Graphs and charts Written write up report of hypothesis testing
3	Identify and describe the features of river estuaries and explain why they are such important ecosystems for wildlife	OS Map exercise Bird profiles Food chain diagrams Oral
4	Describe the components of the hydrological or water cycle and explain the important role that rivers play	Experiment Completed flow diagram
5	Recognise, describe and explain the reasons why the Isle of Dogs developed to become part of the busiest river port in the world and evaluate the evidence and make a judgement about the causes of its sudden decline and closure	PowerPoint presentation Television news report Explanatory writing
6	Interpret a range of geographical evidence to reach a conclusion as to why Bangladesh is at such a risk of serious annual river flooding	Rainfall graph Annotated map with labels
7	Reflect upon and evaluate the techniques used by classical composers to portray the different stages and features of the course of a river and create and record a personal musical piece to evoke the features of a waterfall	Recorded musical piece Oral
8	Understand climatically what the <i>Little Ice Age</i> refers to and how occasional severe winters impacted upon the River Thames and the people of London	Analysis of paintings

Key Question: What is a river?

NOTES

Ancillary Question	Learning Activity	Possible source of evidence of achievement
Homework	Explain why China built the Three Gorges Dam along the Chang Jiang (Yangtze River) and describe and evaluate some of its geographical impacts	Geographical report PowerPoint presentation

Homework possibilities

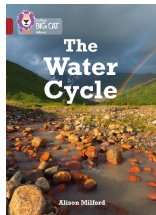


The pupils could develop their understanding of the human use of rivers by carrying out an investigation: *Why was the Three Gorges Dam built across the Chang Jiang (Yangtze River) in China?* They could write a geographical report or produce a PowerPoint presentation that includes brief background information on location (with maps) and construction but most importantly an explanation of its purpose in terms of generating hydroelectric power. They could also be asked to identify advantages and disadvantages of the scheme particularly in relation to the environment and benefits to local people and the country as a whole.

Key Question: What is a river?

Further reading

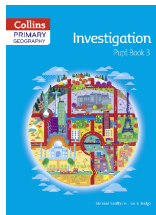




Collins *Big Cat* has books for every child in the classroom with a wide variety of genres, top authors, relevant topics and a range of engaging formats and illustrative styles. Listed below is a selection of from the Big Cat list to support the enquiry topics in Connected Geography for KS1. Find out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


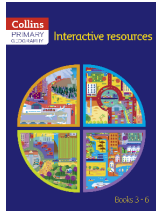
ISBN: 978-0-00-816388-4	<i>Water Cycle</i>	Alison Milford	
ISBN: 978-0-00-816389-1	<i>Food Chains</i>	Sally Morgan	
ISBN: 978-0-00-812777-0	<i>Spotlight on Brazil</i>	Charlotte Coleman-Smith	

PRIMARY GEOGRAPHY

Collins *Primary Geography* provides a progressive, skills based scheme for primary school pupils.

ISBN: 978-0-00-756359-3	<i>Primary Geography Pupil Book 3 Investigation</i>	Stephen Scoffham and Colin Bridge	
ISBN: 978-0-00-756360-9	<i>Primary Geography Pupil Book 4 Movement</i>	Stephen Scoffham and Colin Bridge	
ISBN: 978-0-00-756361-6	<i>Primary Geography Pupil Book 5 Change</i>	Stephen Scoffham and Colin Bridge	

Key Question: What is a river?

ISBN: 978-0-00-756362-3	<i>Primary Geography Pupil Book 6 Issues</i>	Stephen Scoffham and Colin Bridge	 The cover of the 'Primary Geography Pupil Book 6 Issues' is yellow. It features a central globe with various geographical icons like a mountain, a river, a city, and a forest. The text 'Collins PRIMARY GEOGRAPHY' is at the top left, 'Issues Pupil Book 6' is at the top right, and 'Stephen Scoffham and Colin Bridge' is at the bottom right.
ISBN: 978-0-00-756369-2	<i>Primary Geography Interactive resources 3-6</i>		 The cover of the 'Primary Geography Interactive resources 3-6' is dark blue. It features a central globe with various geographical icons. The text 'Collins PRIMARY GEOGRAPHY' is at the top left, 'Interactive resources' is at the top right, and 'Books 3-6' is at the bottom right.