Forty Minute Fieldwork: Water Pollution

Key topic areas	Equipment and resources required
• Environmental quality	Nitrate and/or Phosphate water testing strips
• Pollution	Water sample bottles
• Agriculture	Map of the field site
• Biodiversity and Ecosystems	Litter survey
• Health	Measuring cylinder
• Water cycle	

Context

None of the UK's natural water courses are considered clean according to a report from the UK Parliament in 2024. Many contain chemicals such as nitrates, phosphates and fluoride as well as heavy metals such as lead and mercury. Physical contaminants are also found in UK rivers such as oils and microplastics.

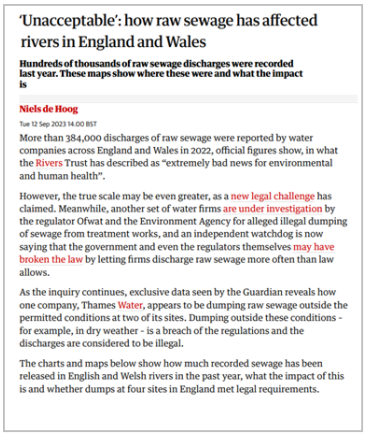
Run off from agricultural land can be a source of nitrate and phosphate contaminants as they are commonly found in fertilizers used to boost arable yields. Where these are applied to the land via spraying systems, their route into water courses can be very quick but levels of these contaminants will also increase after rain events where excess fertilizer washes into streams and rivers. Urban parks, land fill sites and industrial sites located close to rivers can also be sources of these chemicals in water courses, and sewage systems and urban drainage systems can direct microplastics and oils into water too.

Levels considered harmful to human health if drunk (ppm)	
Nitrate	10
Phosphate	40

High levels of nitrates and phosphates can have a damaging impact on humans, animals and the local environment. Excess contaminants in drinking water can be carcinogenic and lead to a wide range of serious health conditions affecting every organ in the body. Nitrates and phosphates can also cause eutrophication. This is where these chemicals cause excessive aquatic plant growth within ponds, lakes and rivers. These plants remove oxygen from the water through photosynthesis and change the chemical balance in the water needed for the survival of aquatic animal species.

Classroom set up

Introduce the topic of water pollution to students through a guided reading exercise. An historical newspaper or online article on blue baby syndrome or a more recent article on sewage dumping in UK rivers could be a good choice as they are likely to provoke a strong reaction in students. Students can highlight a number of contexts they find in the article (type of pollution; causes of pollution; impacts of pollution; possible management of pollution).



'Unacceptable': how raw sewage has affected rivers in England and Wales

Hundreds of thousands of raw sewage discharges were recorded last year. These maps show where these were and what the impact is

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More than 384,000 discharges of raw sewage were reported by water companies across England and Wales in 2022, official figures show, in what the Rivers Trust has described as "extremely bad news for environmental and human health".

However, the true scale may be even greater, as a new legal challenge has claimed. Meanwhile, another set of water firms are under investigation by the regulator Ofwat and the Environment Agency for alleged illegal dumping of sewage from treatment works, and an independent watchdog is now saying that the government and even the regulators themselves may have broken the law by letting firms discharge raw sewage more often than law allows.

As the inquiry continues, exclusive data seen by the Guardian reveals how one company, Thames Water, appears to be dumping raw sewage outside the permitted conditions at two of its sites. Dumping outside these conditions - for example, in dry weather - is a breach of the regulations and the discharges are considered to be illegal.

The charts and maps below show how much recorded sewage has been released in English and Welsh rivers in the past year, what the impact of this is and whether dumps at four sites in England met legal requirements.

A more in depth examination of the process of eutrophication can be taken using a diagram with the annotations omitted. Students collaborate with their peers to try and place descriptions of the different stages of the process in the right places in the diagram.

Using a map and/or satellite image of the field site, students can identify potential sources of water pollution. This may be agricultural land, industrial sites, water processing plants, or high density residential areas. From this mapping, students might like to predict to what extent their field site will have evidence of oil, nitrate and phosphates or plastic pollution.

In the field

What takes place in the field very much depends on the locational circumstances of the field site. Students at schools with access to a water course (a stream or a river) or pond can take water samples (no larger than 50ml) using lidded canisters or bottles. The water should be scooped from the surface or mid-depth, not from the bottom of the channel where mud and debris may end up in the sample. Students in schools without access to a water course or pond can take samples from deep puddles or ideally, with great care, from water flow as it enters drains.

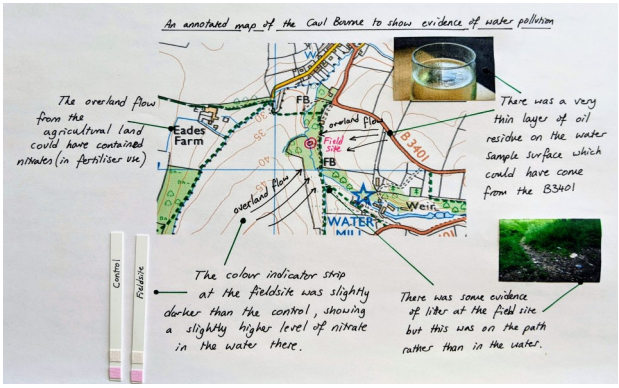
At the field site, students should also conduct a litter survey, noting the degree of plastic contamination there is the area of the water sampling. This can either be done through a formal litter survey on a paper recording sheet, or by taking a photograph of the survey site and using this as evidence when back in the classroom.

Nitrate and nitrite water testing strips

On return to school, students should use nitrate or phosphate water testing strips to measure for evidence of these chemicals in the water they have sampled. These strips use a colour change marker to indicate the amount of nitrate or phosphate, read via a key on the container of the specific brand used. Using tap water as a control measure, students can compare the levels of these chemicals in clean tap water with that found at the field site. The water sample can also be poured into a thin measuring cylinder and left for twenty four hours. After that time period, any oil residue in the water will have risen to the top and be visible. Students can note how much, if any, oil is in evidence at the field site water sample.

Suggested data presentation

As the data collected is that of multiple sources with no definitive nor empirical evidence, the data lends itself well to an annotated map of the field site, with photographs and the testing strips themselves forming part of the annotations. The map should clearly show the field site as well as the sites that were initially seen as potential sources of water pollution. This creative and informal approach allows students to experiment with different ways of presenting the information on the page.



Key questions for reflection and analysis

- How do nitrate / phosphate levels in the water at the field site compare to tap water?
- What reasons might there be for these levels (based on land use and topography)?
- If more samples had been taken, might the results have been any different? Why?
- Are the water testing strips a good way of reading chemical levels in the water sample? How could these be improved?
- Other than from road surfaces, how else might oils enter the water course?
- Did any aspect of the results surprise you? How and why?
- Other than nitrate and phosphate, what other chemical analysis could be done using test strips?
- What impact might time of year have on the type of contaminants one might find in a river?

Taking it further

Thinking about the management problems that can arise as a result of land use conflicts, students could work in teams (each representing a different land user) to strategise a management plan for their field site, with the aim of reducing water contamination. These plans can then be presented to their peers from opposing land user groups and a debate could be held to try to find a mutually beneficial solution.