

Student's document

POLLUTION INCIDENT: Measuring pollutant concentrations in river water

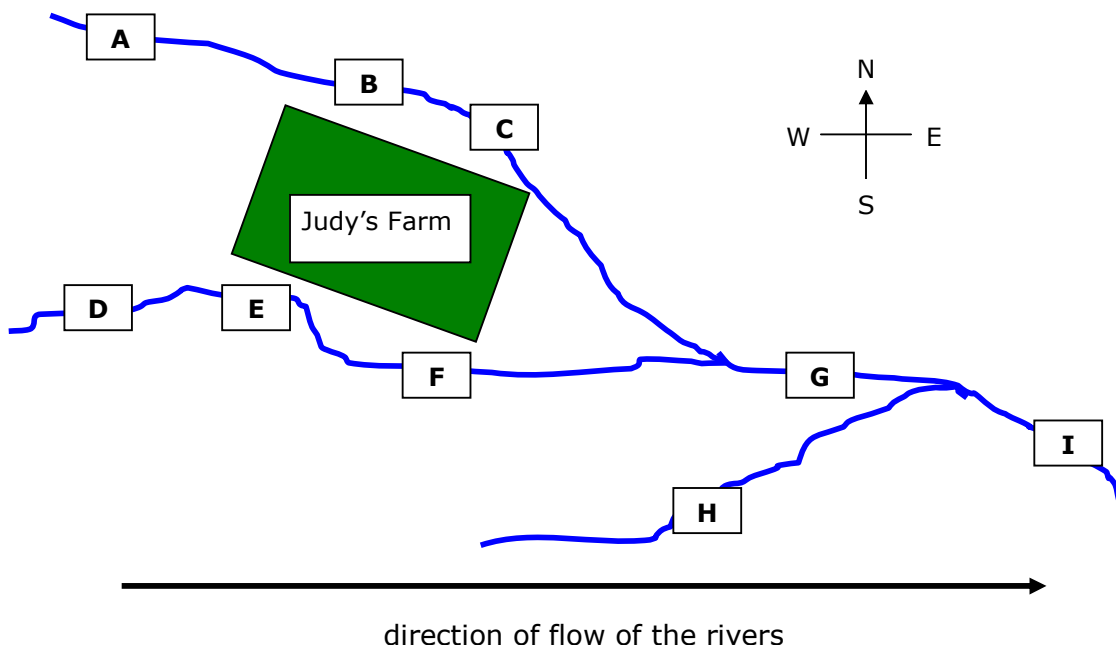
6 am in the morning. It's been raining heavily all night. The river is high, but the clouds are clearing. In the calmer water above the weir and glistening in the early morning sun, fish are floating on the surface of the water, dead. It's another pollution incident and another job for environmental scientists, like those who work for the UK Environment Agency. As a member of the team, you would want to act with speed and efficiency to resolve the problem. Symptoms of pollution are not always so obvious. However, the sooner you can identify the pollutant and its source, the sooner action can be taken to prevent further environmental damage.

Your brief

You are a member of a team of environmental scientists that monitors and responds to water pollution incidents. Your work is vital to keeping your country's environment safe and clean. You also play an essential role in helping your government uphold the legal requirements of the EU Water Framework Directive.

A possible water pollution incident has been reported. It seems likely that it is caused by fertilisers (natural or man-made) from a farm being washed into the river. Quick and easy to use test kits are taken to the site to check the quality of the water. To minimise damage to the environment, your team needs to work quickly and without error to resolve the problem.

This sketch map was prepared by the chief field officer. It shows the sites from which water samples are to be collected.



The land slopes gently down from the north-west to the south-east. Upstream of sampling points A and D both rivers are 'white water' rivers. In other words, they run rapidly through rocks and boulders where they bubble and froth.

In this simulation, you will be provided with samples that represent the water obtained from various parts of the river (A to I). You need to gather evidence of the pollution. The pollutants and their source must be identified and action to control the situation recommended. You may also need to supply valid evidence to support a prosecution if the law has been broken.

Your investigation

Work as a team. Your teacher will decide who is in your team. You will need to read **Your investigation** so that you can decide what tasks need to be done and who is to do them. Your teacher will act as your manager or supervisor to whom you report your findings and from whom you may ask for technical advice.

Planning

This activity is about time and workload management. Your teacher will tell you what lesson and laboratory time you will have to work on this assignment. The team will be given access to commercial test kits. There are various makes. Not all use tests identical to one another. You will need to find out what is available for you to use.

You have 3 hours of laboratory time available and a further 1½ hours outside the laboratory. No more time is available. There are many samples to test. Your team needs to collect sufficient reliable data to have confidence in your analytical results and be able to draw valid conclusions about the pollutants and their source. Your recommendations for action depend on these valid conclusions.

Remember reliable data are:

- repeatable (the same person gets the same results when the analysis is repeated)

and

- reproducible (two or more people get the same results using the same method).

Your level of confidence will also depend on the measurement precision allowed by the test kits.

Plan the team's work carefully before starting the analyses. Decide who is going to do what. Check the plans with your teacher before you proceed to carrying out your investigations. Some things to think about:

- How long will each test take?
- How many times should each test be carried out on a sample?
- Who should carry out the tests?
- What is the best way to share the workload and maximise the team's chances of getting reliable data in the time available?

Practical activity

Your teacher will tell you when your laboratory time and materials are available. Collect the apparatus and materials you need and set out your working area.

Remember that a risk assessment must have been carried out for each activity before you start work.

Datasheets

As you can see, there are nine sampling sites (A-I). Each member of your team will be given three further **datasheets**:

- *Analyst's recording sheet*
- *Summary analysis sheet*
- *Classification of river quality.*

Collect these before starting work.

Expert panel

If available, get some further background information from the *Scientists at work* DVD ROM (available from www.4science.org.uk). Watch the short video showing scientists from the UK Environment Agency at work, investigating a water pollution incident. They have equipment to be able to carry out preliminary tests in the field.

Tips for finding information

Each test kit has instructions on how to use it. Read these carefully before starting. Your teacher may give you other suggestions or instructions.

You might find it interesting to visit these websites:

- UK Environment Agency <http://www.environment-agency.gov.uk/> (follow the 'Water quality' link in the left-hand menu)
- European Environment Agency <http://www.eea.europa.eu/>

There are various commercial test kits. Here are just four examples:

<http://www.lagunaponds.com/lagunaengeu/testkits/testkits.php?link=110>

<http://www.palintest.com/>

<http://www.kittiwake.com/Default.aspx/ProductSection/90/ProductSubSection/106/ProductSubSubSection/293>

<http://www.wagtech.co.uk/ShowCat.php?catid=1>

You may want to find out how the various tests work.

Procedures

Your teacher will advise you which test kits are available to you. Each test kit comes with instructions for its use. You will be testing water from various sampling sites on the river. You will be checking on: pH, dissolved oxygen and the concentration of ammonia, nitrite, nitrate and phosphate in the water.

Your findings

- Do you consider your results to be reliable (repeatable and reproducible)?
- Do you consider your conclusions to be valid (reliable data have been correctly interpreted)?
- What evidence do you have to support your decisions? Discuss this with your team.

Write your results on the *Analyst's recording sheet* and summarise the team's results on *Summary analysis sheet*. Include these with your report.

Write a brief report for your manager (i.e. your teacher). It should:

- summarise your key findings
- indicate your level of confidence in your results
- recommend what further action should be taken (this could include further testing).

Student self assessment

In 50-100 words say:

- what scientific skills and knowledge you used and how effectively you used them.
- how you worked as a team and give examples of how you supported others in your group or were supported by them.
- what the advantage is of working in a team.
- how the group managed its time and workload.

Student datasheet: Classification of river quality

The tables below are based on the classification system for rivers used by the UK Environment Agency.

Chemical grade	A	B	C	D	E	F
Description	Very good	Good	Fairly good	Fair	Poor	Bad
Oxygen / mg dm^{-3}	7.3	6.4	5.5	4.6	1.8	<1.8
Ammonia / mg dm^{-3}	0.3	0.7	1.6	3	10.9	>10.9

Phosphate grade	1	2	3	4	5	6
Description	Very low	low	moderate	high	Very high	Excessively high
Phosphate / mg dm^{-3}	<0.06	0.06 to 0.17	0.18 to 0.30	0.31 to 0.60	0.61 to 3.0	>3.0

Nitrate grade	1	2	3	4	5	6
Description	Very low	low	moderate	high	Very high	Excessively high
Nitrate / mg dm^{-3}	<5	6 to 10	11 to 20	21 to 30	31 to 40	>40

Information in the following two tables are from Laguna Test kits

Nitrite level			
Description	Safe	Lethal to fish long term	Toxic to fish
Nitrite / mg dm^{-3}	0	0.3	>0.3

pH level			
Description	Too acidic for most fish and plants	Safe	Reduced plant growth and increased algae growth
pH	<6	6.6 to 7.2	>7.4

- Note:
- ammonia and nitrite are toxic to fish
 - high pH levels can indicate high levels of ammonia
 - dissolved oxygen is essential to fish
 - nitrite is formed when bacteria oxidise ammonia.

Student datasheet: Analyst's recording sheet

Add data from your measurements. Record repeated measurements side by side in neighbouring columns.

Name:			Date:			
	Measurements					
Sampling location	pH	oxygen	ammonia	nitrate	nitrite	phosphate
A						
B						
C						
D						
E						
F						
G						
H						
I						

Student datasheet: Summary analysis sheet

Record results from all team members. Record mean values in a different colour in the shaded boxes.

Team members:								Date:					
	Measurements												
	pH	oxygen	ammonia	nitrate	nitrite	phosphate	Conclusions						
A													
B													
C													
D													
E													
F													
G													
H													
I													