

Citizen Science: Testing the Water

Schools Activity Pack

Teachers Notes

Thank you for deciding to take part in Testing the Water. This is a national citizen science survey which aims to raise awareness of the critical importance of clean, unpolluted water for freshwater wildlife.

Freshwater wildlife needs clean unpolluted water to survive. Sadly, it only takes a little pollution to damage habitats like streams and ponds, and to harm the most sensitive plants and animals that call these places home. Most freshwater plants and animals evolved over millions of years in a world where the natural level of nutrients in ponds, lakes, streams and rivers was very low. When we add more nutrients we cause profound changes to the freshwater environment and the wildlife can't cope.

Although government agencies monitor pollution in our larger rivers, streams and lakes, we know nothing about nutrient pollution in 99% of our ponds, streams, ditches and other freshwater habitats, where so much of our fantastic freshwater wildlife lives. Until recently, the only way to find out about nutrient levels has been to do expensive laboratory tests. But in the last few years simple reliable kits have become available. With these kits, we can all 'see' nutrient pollution: quickly, easily and inexpensively for the first time.

This gives us a wonderful new opportunity, to discover more about water quality in all freshwater habitat types across England and Wales. The survey uses 'quick kits' to assess the level of nitrate and phosphate pollution; two nutrients which can pose a major risk to wildlife if they are above natural levels.

AIMS OF THE CLEAN WATER FOR WILDLIFE SURVEY

- To assess the level of nutrient pollution in all types of freshwater habitats; big and small, running and standing waters.
- To find freshwater habitats free from nutrient pollution, where freshwater wildlife can thrive.

EQUIPMENT PROVIDED

When sign up to Testing the Water, we will provide:

- Nutrient test kits (1 kit per 2 students + 5 spares).
Each 'kit' is made up of one nitrate test tube and one phosphate test tube.
- Student packs (1 per pair for the homework activity, and 1 per pair for the classroom activity).
- Recording form (1 per 2 students + 5 spares).

Please note, you will also need clean pots/containers to collect the water samples (1 per 2 students + spares) and latex gloves (for water collection and class activity).



Testing the Water teacher's notes to be used in conjunction with the 'Student Pack', and the 'Schools Activity Pack'

Overview

The survey is designed to include a homework activity (c.15 minute prep session) and a lesson activity (c.50 minute session). The survey protocol is flexible and you can choose to develop your own plan.

1. HOMEWORK ACTIVITY

Students are expected to work in pairs or small groups on this homework activity. The aim of the homework will be to:

- (i) Collect a water sample following the safety advice.
- (ii) Record the type of habitat they've sampled.
- (iii) Identify where they have collected the sample.

EQUIPMENT FOR HOMEWORK ACTIVITY

Each pair or group will need a Student Pack, one sampling pot and one pair of gloves (one pair for the person collecting the sample).

WHAT YOU NEED TO DO

The Student Pack contains all the information students will need – however you may want to do some prep with them to help them understand what is expected for this activity.

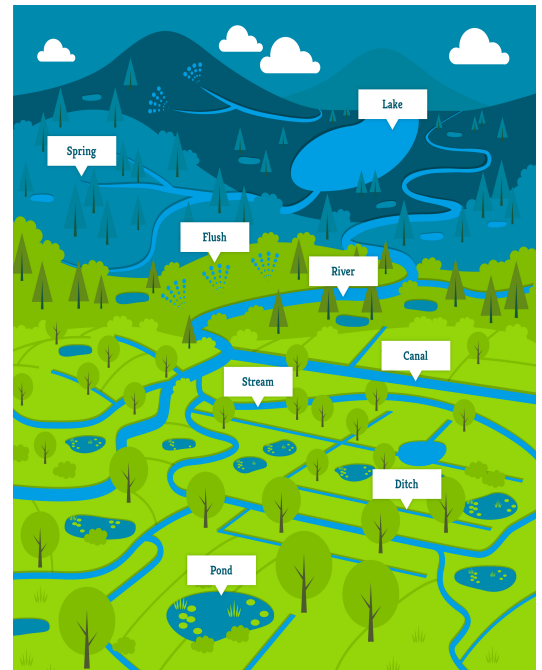
Explain the aims of the activity:

- To assess the level of nutrient pollution in all types of freshwater habitats; big and small, running and standing waters.
Do they know what nutrients are, and can they identify sources of nutrient pollution?
- To find freshwater habitats free from nutrient pollution, where freshwater wildlife can thrive.
Can they think of some places locally that might be free from nutrient pollution or some sites that they think might be particularly bad?

Discuss where they could sample:

- Aim to cover a range of different freshwater habitat types (e.g. ponds, lakes, river, streams or ditches) – for more information on these habitats look at Sheet 4 in the Student Pack.
- Some students will have a garden pond they can sample (these can be good sites for clean water).
- Others can collect rainwater, i.e. from a water butt (rain water is usually very low in nutrients).
- If students don't have access to a freshwater habitat, they could test their tap water (in lowland Britain tap water is usually surprisingly high in nitrates and phosphates – safe for us to drink, but too high for many sensitive freshwater plant and animals).
- As the teacher, you may want to collect some water samples yourself to ensure there is a variety of habitats to test.

Discuss how to collect a water sample safely:



There are many different types of freshwater habitats. Big or small, they can all be important for wildlife

Suggested topics for homework discussion

- Aims of the survey
- What sort of freshwater habitats they could sample?
- Health and safety
- How should they record their location?
- Filling in their sample pot label.

- Students **MUST** ask an adult to help them collect the water sample, even from a garden pond (you can explain that even professional freshwater biologists always work in pairs to reduce the risks).
- They should never collect a water sample from sites with deep water or places where the banks are steep or uneven. There are lots of locations where they can collect a water sample safely.
- They must wear the gloves provided when collecting their samples and must wash their hands once they've finished.
- If you need more information on health and safety, please see the full risk assessment online: freshwaterhabitats.org.uk/projects/thameswaterforwildlife.

Describe how to record their location:

- If they collect the sample at home or in a garden they can use their postcode to record the location.
- If they record from a park or other landmark you can search online to get a postcode or address.
- If they want to record their location in more detail they could draw a map of their location as part of their homework, or they could find the location on a map and record the grid reference.

Explain how to fill in the sample pot label:

- Working in pairs they should write both their names on the sample pot
- They should record the date the sample was taken.
- Ask them to tick what type of freshwater habitat they sampled, if it isn't listed there is an 'other' box and a space to write an alternative habitat.
- They should write down the name of the waterbody (if known), or they can make up their own name.
- And finally, they should record the location where they collected the sample (or bring in a map).



Students can sample from many locations safely if they follow the safety guidelines



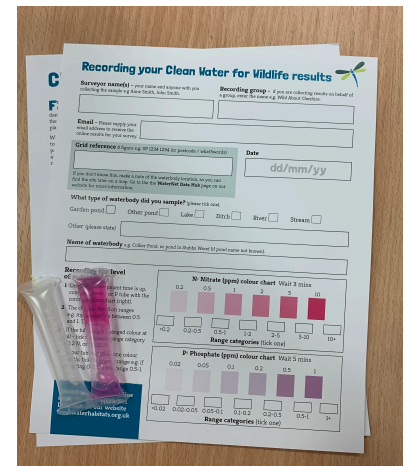
2. CLASSROOM ACTIVITY

Students are expected to work in pairs or small groups on this classroom activity. The aim of the activity will be to:

- (i) Test their water sample for two widespread nutrients (nitrate and phosphate).
- (ii) Discuss their results.
- (iii) Submit their results to the national survey.

EQUIPMENT FOR CLASSROOM ACTIVITY

Each pair or group will need a Student Pack, one 'nitrate test tube', one 'phosphate test tube', a 'recording form' (this contains the colour chart to compare their kit colour change) and two pairs of gloves (one pair per student). They will also need a watch or clock to time the colour development.



Use the colour charts on the recording form to determine the levels of nitrates and phosphate in your sample

WHAT YOU NEED TO DO

The Student Pack contains all the information students will need for the classroom activity – but we have provided some suggestions about how you could structure the activity.

Explain the aims of the activity:

They should be able to answer these questions based on the previous homework prep discussions:

- To assess the level of nutrient pollution in all types of freshwater habitats; big and small, running and standing waters.
Did they identify any sources of nutrient pollution when they were collecting their sample?
- To find freshwater habitats free from nutrient pollution, where freshwater wildlife can thrive.
Do they think their sample will be polluted or clean?

Discuss how to use the kits safely:

The kits are **low risk** because the reagent is contained within the tube. It is unlikely to come into contact with the user if sensible precautions are taken and the instructions given in the Testing the Water survey leaflet are followed.

- If the reagent powder does come into contact with the user before the water sample is taken, or after dilution, the following first aid measures apply:
Eye contact: Immediately rinse eyes with water for at least 15–20 minutes. Seek medical attention.
If swallowed: Do not induce vomiting. Give one or two large glasses of water to dilute and seek medical attention.
Dust breathed in: Move to fresh air. You may need to seek medical attention if symptoms such as wheezing, coughing, shortness of breath, or burning in the mouth, throat, or chest occur.
Skin contact: Flush the skin with water. No further attention should be required. If redness or irritation does develop, seek medical attention.
- If you need more information on health and safety, please see the full risk assessment online: freshwaterhabitats.org.uk/bfer-lps-citizen-science-testing-the-water/

Suggested topics at the start of the classroom activity

- Where do nutrients come from and what's their effect on wildlife?
- What result do they expect from different freshwater habitats (e.g. high, medium or low nutrients)?
- How to fill in the recording form and use the kits.

Ask the student to fill in the recording form:

- Ask the students to copy the site information from their sampling pot labels onto their recording forms. Please ask the students not to fill in their email addresses. None of the email addresses from the recording forms will be collated into our systems to respect the student's privacy.
- **COLLECT THE RECORDING FORMS FOR THE STUDENTS AT THE END OF THE SESSION AND SEND THEM TO FRESHWATER HABITATS TRUST (details below).**

Demonstrate how students will test their water sample:

Instructions for the nutrient testing kits are available on the recording form and through our 'How to' video. You can watch the video here: <http://bit.ly/2ggmQ6w>.

- Put on your safety gloves.
- Pull out the pin and discard.
- Squeeze out the air with the pin hole pointing towards the sky.
- Still squeezing, turn the tube upside down and insert below the water.
- Release your hold on the tube whilst it is underwater, it will start to fill up automatically.
- A good squeeze will automatically fill the tube to about half way (it's a good tip to leave the bottom of the tube under the water until the level stops rising – people often lift the tube out too soon to see how much it has filled up!).

Phosphate test

- Ask the students to do the phosphate test first. The phosphate tube is labelled **PO₄ at the base**.
- Set the timer and wait for the colour to develop - this will take **5 minutes**.
- At the end of the five minutes ask them to compare their tube against the phosphate colour chart and tick the appropriate box. NB. If their tube sits exactly on a colour band, they should tick the box above.

Nitrate test

- Ask the students to do the nitrate test next. The nitrate tube is labelled **NO₃ at the base**.
- Set the timer and wait for the colour to develop - this will take **3 minutes**.
- At the end of the three minutes ask them to compare their tube against the nitrate colour chart and tick the appropriate box. NB. If their tube sits exactly on a colour band, they should tick the box above.

DISCUSSING THEIR RESULTS

The Student Pack contains lots of information to help them understand their results. You can structure the discussion and any further homework activity to suit your needs, but here are a few suggestions.

Do they have an unpolluted 'clean water' site?

- Once students have recorded their testing the water for wildlife results on the recording form they can find out whether they have a clean or polluted site by studying the diagram on Sheet 5 of the Student Pack.
- **Phosphate** – If their result is less than 0.05mg/l they can conclude that the site has no evidence of phosphate pollution. Levels of phosphate above 0.1mg/l indicate that the wildlife at their site is probably being significantly affected by pollution.
- **Nitrate** – If their result is less than 0.5mg/l they can conclude that their site has no evidence of nitrate pollution. Sites with levels of nitrate above 1mg/l are significantly affected by nitrate pollution.
- **A 'clean water' site** – with no evidence of nutrient pollution, will have phosphate levels less than 0.05mg/l **and** nitrate levels less than 0.5mg/l. If either nutrient is above these background levels; the site is showing some evidence of nutrient pollution.

What is clean water?

- Clean Water has a chemistry or biology which would be normal for a given area in the absence of human disturbance. This is commonly referred to as the reference condition; minimally impaired water quality or natural background levels.
- Nutrients will be present, but in the absence of pollution they will be at very low levels, almost undetectable using the quick kits. It only takes a little nutrient pollution to damage a freshwater habitat and when clean water is lost we risk losing the variety and richness of life found in these habitats.

What is nutrient pollution?

- This is the process where too many nutrients, mainly phosphate and nitrate, drain into freshwater habitats – ponds, lakes, rivers, streams, ditches, canals and even your garden pond.

What is the effect of nutrient pollution on wildlife?

- Find out more about this on Sheet 2 of the Student Pack.
- Nutrients are used by plants to grow, they are a natural part of all ecosystems, but when excess amounts are added it acts like fertilizer, causing fast growing and pollutant tolerant species to smother slower growing and more delicate species, often our rarer species.
- As the plant community becomes less diverse this has a knock on effect on the freshwater animals present, reducing their diversity, and the habitat slowly becomes less rich in wildlife.
- Even a small amount of nutrient pollution can have a big impact. At the moderately polluted category over half the plants and animals that should be present could be lost.

Where does nutrient pollution come from?

- Find out more about this on Sheet 2 of the Student Pack.
- **Nitrate pollution:** The single largest source of nitrate pollution is from fertilizers. Fertilizers are commonly used to improve crop growth in agricultural farming and can also be added to gardens, parks and golf courses. Much of this fertilizer drains away via runoff into rivers, streams, ponds and other waterbodies – this is called diffuse pollution.
- The huge areas of land used for agriculture in this country means that there are now no rivers in lowland England and Wales which are not affected by this type of nutrient pollution.
- In lowland England you can often see evidence of nitrate pollution in tap water. Water companies ensure tap water is safe for human consumption, but the levels are not always low enough for wildlife to thrive.
- **Phosphate pollution:** The main sources of phosphate pollution are from detergents (soap) and sewage, from pipes which discharge into rivers and streams – this is called point source pollution.
- Other sources are from agriculture and high density livestock farming.
- Phosphate pollution is a particular problem in urban areas - more people means more soap, more sewerage and more potential for nutrients to drain directly into freshwater habitats.
- Pollutants on the roads can bypass treatment works and travel directly into rivers through road drains. In some older houses misconnected pipes can send detergents into the road drainage network instead of the sewage system.
- In times of high rainfall water levels can become too high for the sewers, and storm drains can take untreated sewerage straight into our rivers.

Suggested topics for class discussion based on their results

- Understanding clean water and nutrient pollution,
- Why were the clean water places unpolluted?
- Why were the polluted places polluted?
- Where could these nutrients be coming from?
- What could be done to reduce nutrient pollution?

WHAT DO THE CLASSES RESULTS SHOW?

Find out more about this on Sheet 6 of the Student Pack.

We got a clean water, unpolluted result, why?

- This will greatly depend on the types of freshwater habitat you sampled and the type of land use surrounding the habitat.
- Freshwater habitats that are within natural habitats, where few nutrients are added, such as nature reserves, woodland and heathland are likely to contain clean water.
- Streams and rivers can also hold clean water when they start in these areas, however as they travel through large areas of land they often soon become polluted.
- Garden ponds can also be good clean water habitats if they are only filled with rain water.

Our site was polluted, is that unusual?

- In modern landscapes it is not unusual to find freshwater habitats which are impacted by nutrient pollution.
- There are many potential sources of pollution. It is important to think about what is in the surrounding land. Are there agricultural fields? Is there runoff from roads?
- Some ponds can be located quite far away from sources of pollution, but because they are connected to small drains or streams, the pollution can still get there.
- If it is a garden or park pond, has tap water been used to fill it up?

WHAT ELSE COULD STUDENTS DO?

- We have included some case studies in the Student Pack (Sheet 7 and 8) to illustrate how students could present their results and describe their findings.
- The class could combine the results and produce a poster, to compare their results, with the results from one of our case studies – were they the same results or different, why?
- Students could consider 'what next?' – How can individuals and communities make a difference to protect the best clean water sites? We've produced a follow on pack with more information which is available from our website: freshwaterhabitats.org.uk/bfer-lps-citizen-science-testing-the-water.
- They could produce a leaflet which describes their results, and what they would do to make a difference to clean water for wildlife in their neighbourhood.

If students produce a report, poster or leaflet would we love to see them and we'll be posting

some of the best examples on the Testing the Water website

freshwaterhabitats.org.uk/bfer-lps-citizen-science-testing-the-water

Please send to Anne Carter acarter@freshwaterhabitats.org.uk

SEND US YOUR CLEAN WATER FOR WILDLIFE RESULTS

We hope you've enjoyed taking part in the Testing the water for Wildlife survey. Please contribute your results to the national survey by:

Submitting the results to Freshwater Habitats Trust via the online DATA PORTAL
at <http://bit.ly/BFERCleanWaterDataPortal>

HAVE YOU STILL GOT QUESTIONS?

There is more information on our website or you can contact Anne Carter, the Project Officer:

W: freshwaterhabitats.org.uk/bfer-lps-citizen-science-testing-the-water/

E: acarter@freshwaterhabitats.org.uk