

New Forest Wilder for Water

Clean Water for Wildlife Activity

Teachers Notes

Background

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.

The New Forest has been identified as an Important Freshwater Landscape, and home to some of the UK's rarest freshwater species. It is a mixture of semi-natural habitats including heathland, woodlands, mires and wetlands which have been traditionally grazed for 1000s of years without the kind of agricultural intensification and urbanization which has affected much of the rest of lowland England.

However, it isn't completely safe from water pollution. Sadly, people can inadvertently cause pollution and damage to important habitats and species because they don't realise where nutrient pollution comes from, or the impact it can have on our New Forest wildlife. 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 and why locations like the New Forest need to be protected from water pollution. 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.



In the New Forest, habitats which are rainwater fed and free from nutrient pollution, plus traditional land management and grazing animals, support some of the UK's rarest freshwater species.

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Clean Water for Wildlife

AIMS OF THE CLEAN WATER FOR WILDLIFE ACTIVITY

- To assess the level of nutrient pollution in different types of freshwater
- To understand what we can do to keep New Forest freshwaters free from nutrient pollution.

EQUIPMENT (c.5 CHILDREN PER GROUP)

- Nutrient test kits (one for each sample). Each 'kit' includes one nitrate test and one phosphate test (the foil packs contain 5 kits).
- One sample tray (any container can work, but we recommend a takeaway size tray because it is easier for children if their whole hand can go into the water).
- Timers (a stopwatch, watch or phone timer).
- A student sheet (which includes the colour chart to compare against the test kits).
- Pens and paper to record predictions and results (clipboards if outside).
- 4-5 labeled water samples (tap water/rainwater/New Forest freshwater + plus a local water sample if one is available).



Clean Water test kits is use to test a stream in the New Forest near a heavily used footpath

Health and Safety Guidance Note

Both the nitrate and phosphate kits contain a small amount of reagent powder which reacts with the water sample to produce a colour change. 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 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.

For your information the main reagents in the PackTest kits are as follows: nitrate kits contain zinc and naphthylethylenediamine; phosphate kits contain enzyme and 4-aminoantipyrine.

Make sure everyone washes their hands after the activity to protect from any bacteria or reagent that might be in the water. **Risk assessment with regards to the space and general activity are the responsibility of the activity organiser.**

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THE ACTIVITY

This lesson activity (c.50 minute session) is flexible and you can choose to develop your own plan. The activity can be done indoors or outside. You can run the session with 1 group or multiple groups.

WHAT YOU NEED TO DO BEFORE THE SESSION

You are going to prep 4-5 samples to mimic different types of freshwater pollution and habitats with no pollution:

- **RAINWATER:** This is rainwater which you can collect from a water butt or from a bucket left outside during a downpour – rainwater is free from nutrient pollution
- **NEW FOREST FRESHWATER:** You will also use rainwater to represent a New Forest pond or stream. These habitats are only filled from rainwater and are therefore also free from nutrient pollution.
- **TAP WATER:** Tap water is safe for us to drink but after treatment, it still contains levels of nitrates and sometimes phosphates that are higher than the levels found in rainwater.
- **MIXED SAMPLE:** Add some tap water to your rainwater sample. This is equivalent to a pond or stream that has been polluted by nutrients. It also demonstrates how adding a small amount of tap water (dishwater or any wastewater) into the environment can add pollution to New Forest freshwaters.
- **LOCAL SAMPLE:** Student can also collect water samples from a local pond or river and predict whether it will be closer to rain water or polluted water – the accompanying sheets should help them to interpret their results.

AT THE START OF THE SESSION

(1) Explain the aims of the activity:

- To assess the level of nutrient pollution in different types of freshwater and discuss what impact this might have on freshwater wildlife – the most wildlife rich freshwaters have undetectable levels of nitrates and phosphates (using these kits).
- Introduce the idea that water quality can be different, even if the water looks the same. We will be testing waters from different places to see if it would be good or bad for wildlife based on the levels of nutrients it contains and not on how it looks (teaching content later in this document).
- Understand why some freshwaters are impacted by nutrient pollution and where that nutrient pollution comes from (see student sheet)
- Think about why the New Forest is free from nutrient pollution and discover what we can do to keep New Forest freshwaters free from nutrient pollution (see the New Forest Water Code)

(2) Get the class into groups (the water testing activity is best done in groups of five). Students can work out how to organise themselves to complete the task, or if they need further guidance we would suggest identifying testers (2 people), a timer (1 person) and recorders (2 people).

At this point you could also discuss the ideas of a fair test.

(3) Ask them to collect their equipment. We suggest that the phosphate and nitrate tests are collected by different members of the group so that they do not get confused and that the water is collected last to minimise the risk of spilling.

GET THE STUDENTS TO MAKE PREDICTIONS

Get the groups to make predictions on the level of nutrient pollution (none, some or high) they expect from the different types of water and write the prediction down on the whiteboard or piece of paper. Discuss a couple of the predictions with the whole class.

HOW STUDENTS WILL TEST THEIR SAMPLE

Instructions for how to use the nutrient testing kits are given below and can also be watch on our demonstration video on our website.

- Pull out the pin and discard.
- With thumb and forefinger, squeeze out the air with the pin hole pointing towards the sky – children might need to use two hands or multiple fingers.
- 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 testers to do the phosphate test first and hand the test to the recorders.
The phosphate tube is labelled **PO₄ at the base**.
- Gentle shake the test kit, holding the tube where the pin was removed, for 10 seconds to mix the reagent with the water.
- Set the timer and wait **5 minutes** for the colour to develop.
- At the end of the five minutes ask them to compare their tube against the phosphate colour chart (in the student pack) and record the result.

Nitrate test

- Ask the testers to do the nitrate test next and hand the test to the recorders.
The nitrate tube is labelled **NO₃ at the base**.
- Gentle shake the test kit, holding the tube where the pin was removed, for 10 seconds to mix the reagent with the water.
- Set the timer and wait **3 minutes** for the colour to develop.
- At the end of the three minutes ask them to compare their tube against the nitrate colour chart (in the student pack) and record the result.

Using your clean water kits

You use one phosphate and one nitrate tube for each water sample (marked N for nitrate or P for phosphate on the tab at the base of the tube)

- 1 Pull out and discard the yellow pin leaving a small air hole



- 2 With the air hole pointing upwards, use your finger and thumb to squeeze out the air



- 3 Keeping the air squeezed out, turn the tube upside down and insert below the water

- 4 Gently release the pressure and suck up enough water to fill the tube just over half way

Still squeezing, turn tube upside down and insert below the water and squeeze out the air

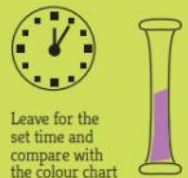
- 5 If you need to, turn the tube upright again, squeeze out a bit more air to suck up more water to just over half way

- 6 Gently shake the tube to mix the water and powder inside



- 7 Make a note of the time and wait for the colour reaction

- 8 Compare the tube with the colour chart immediately when the time is up, as the colour will continue to develop.



- 9 Record the results

DISCUSSING THE RESULTS

Record the different results in a table for the class on whiteboard or piece of paper- and decide which types of water are clean water with no pollution, or polluted by nutrients. You may want to collect the equipment as each shares their results to minimise distraction during the discussion. If without a whiteboard it is good to line up all of the different waters with the testing kits at the front, giving the children a chance to have a look at the other groups results. Use 'Hands up' exercise below to poll the class at different points in the discussion.

Hands up questions for the class:

- If your tests changed colour
- If your test did not change colour
- If you think your water would be a good for biodiversity
- If you think your water would not be good for biodiversity
- If you don't know

Hands up questions for the class:

- If you think your water would be a good for biodiversity
- If you think your water would not be good for biodiversity
- If you don't know

Hands up questions for the class:

- If you think adding tap water into the environment would be good for rare freshwater plants
- If you think adding tap water into the environment would be bad for rare freshwater plants
- If you don't know

Compare the results with the predictions made earlier and use the 'student sheet' to answer the following questions:

- Which samples were clean water samples? Why are clean water places unpolluted?
- Which samples were polluted? Why are polluted places polluted and where could those nutrients be coming from?
- Can we tell which freshwaters in the New Forest are free from pollution just by looking at them?
- Why places like the New Forest free from nutrient pollution?
- What we can do to keep New Forest freshwaters free from nutrient pollution (see the New Forest Water Code)?

The New Forest Water Code can be found on our Wilder for Water webpage, with more details about the messages under the visitor tap.

CONTENT FOR TEACHERS

What is clean water?

- Clean Water has a chemistry or biology which would be normal for an area in the absence of human disturbance. This is 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, both phosphate and nitrate, drain into freshwater habitats – ponds, lakes, rivers, streams, ditches, canals and even your garden pond. Natural levels are under 0.05 ppm of phosphate (PO₄) and under 0.5 ppm of nitrates (NO₃).

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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 large 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.
- If we add tap water to the environment, then we risk adding excess nutrients to clean water habitats.

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.
- 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. This is also why it is really important to only flush the three Ps down the toilet – Pee, Poo and Paper (toilet paper) – as otherwise a blockage could result in more storm overflows.
- If we, or our dogs, pee or poo in the countryside and don't clean it up – we are adding polluting nutrients.

What is the effect of nutrient pollution on wildlife?

- Find out more about this on the student sheet.
- 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.

What else could students do?

- See if the groups can come up with any ways to stop nutrients from entering the environment. Good suggestions could be: only flush the 3Ps, reduce fertiliser use on fields, don't pour tap water onto the ground or fill up ponds with it, making sure to go to the toilet before walks to stop wild wees, etc.
- The class could combine the results and produce a poster, to describe their results, and what they would do to make a difference to clean water for wildlife in special freshwater landscapes like the New Forest.
- **Take part in the Freshwater Species Discovery Quiz and enter the Wonderful Wetlands colouring competition.**

END OF ACTIVITY

Make sure everyone washes their hands after the water test activity.

- Pour all of the water down a drain including the water in the sample tubes.
- The plastic kits and pins can be recycled.
- The rest of the equipment can be collected in and reused.

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