Birmingham River Champion's water chemistry guidance

Overview

Water chemistry monitoring is an important way of assessing river quality and the 'cocktail' of pollutants that can harm their ecological health. Citizen science data on water chemistry play a vital role in detecting pollution by tracking changes over time, helping protect aquatic life. In the Birmingham River Champions, we provide equipment to measure different water quality elements. Below we summarise these different parameters and the sampling procedures.

We suggest all water quality samples are taken in **slightly deeper, slower waters** (making sure you are not entering above welly height) – this could be immediately upstream or downstream of the riffle where you collect **Urban Riverfly** samples. You can collect your water sample using a **container** like a jug, glass jar or even the turbidity tube (see below), from which all of the necessary testing can be performed. Ensure that the container is **swilled** out with river water twice before testing. Water should be collected just below the **surface (10-30 cm deep)** - avoid sampling only surface water and disturbing the underlying sediment where possible.

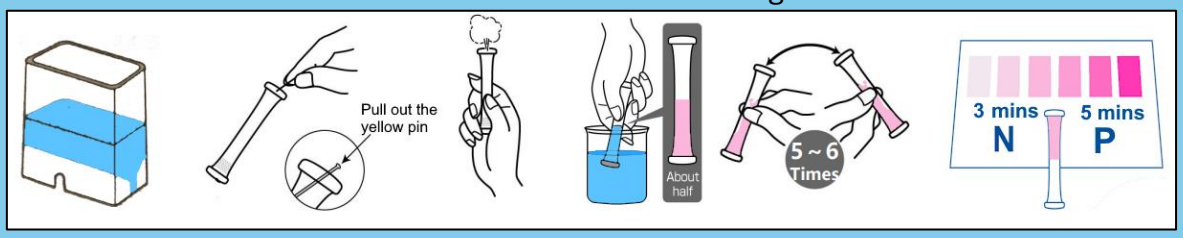
Nitrate and phosphate

Nitrates (NO3-) and phosphates ($PO4^{3}$-) are key nutrients essential for plant growth, but at high concentrations can produce **harmful algal blooms** that can **reduce dissolved oxygen levels** ('eutrophication'). High nitrate and/or phosphate levels can stem from **agricultural, sewage** or **industrial pollution**. In the UK, a common guideline for ecologically impacted surface waters is **1.0** mg NO3-N/L (above **10** mg NO3-N/L are where preventative measures need to be taken). Phosphate is often naturally rare in freshwater environments, and government guidance recommends that rivers should not exceed annual mean phosphate concentrations of **0.1** mg PO4-P/L (above **1** mg PO4-P/L evidences severely compromised water quality conditions).

Nitrate and phosphate levels are being assessed *via* sampling kits provided by Freshwater Watch, and your data will contribute to this global initiative alongside Birmingham River Champions. Fill the sampled river water up to the **1.5ml line** on the measuring cup (incorrect water volumes provide inaccurate results). The nutrient-testing tubes contain a chemical reagent which **changes colour** relative to the **concentration** of dissolved nitrate or phosphate in the sample water. Once the reagent is mixed with the water sample, the colour development in the tubes is **time-sensitive**. Therefore, concentration ranges (according to colour development) should be recorded at **exactly 3 minutes** (for **nitrate**) and **5 minutes** (for **phosphate**). The steps for collecting nitrate and phosphate measurements are as follows:

- Fill the measuring cup with the river water sample to the 1.5ml line.
- Remove the small yellow pin from the top of the testing tube to open the hole.
- Squeeze the sides of the tube to expel about half of the air volume.
- Whilst squeezing, insert the tube into the sample cup until it touches the bottom.
- Release the tube and allow the tube to suck up all of the sample water (the tube will be about half full).

- Place a finger over the pin hole and shake lightly until all of the powder is immersed in the water (its okay if the powder may doesn't fully dissolve).
- Place the tube on a flat surface for the required time (nitrate = 3 minutes, phosphate = 5 minutes). Keep the tube in the palm of your hand on cold days (less than 10 °C).
- Place the tube between colours on the corresponding colour chart and observe the best match. Observations should be made out of direct sunlight.



The solution in the test tube should be disposed of **away** from the river and squeezed out in a **sink** – it can then be recycled. Please note that reactive powder is safely contained in durable tubes, but should be stored away from non-trained individuals as it can be harmful (see the **risk assessment** for further details).

Turbidity

Turbidity measures how **clear** the water is. Cloudy or murky water (high turbidity) means there are **particles suspended** (e.g., detritus, algae, or pollutants). Turbidity can be caused by erosion, runoff (particularly during floods) or unnatural contaminants from industry, roads, sewage or agriculture. High turbidity levels can indicate poor water quality as it reduces light needed for plants and species that depend on this.

In Birmingham River Champions, turbidity is also measured *via* **Freshwater Watch** kits. For this, a 0.5 metre plastic tube with a **Secchi disc** at the bottom is used, which contains white and black segments for visibility purposes. Turbidity measurements are then based on the depth of water in the plastic tube after which you can no longer see the **separation** between the **disc's black** and **white triangles**. The tube has a 'Nephelometric Turbidity Units' (**NTU**) scale on the side that measures this. You can either add water gradually into the tube until the triangles can't be separated, or fill the tube in its entirety and empty iteratively and record the last measurement where this occurs.

Electrical conductivity and temperature

Electrical conductivity shows how easily **electricity** can pass through water, which depends on the amount of **dissolved salts** or **minerals** in the water. Low concentrations of salts **naturally** occur in rivers, but higher levels can occur due to **pollution** sources like road salt, wastewater, or industrial runoff. Electrical conductivity is most effective at detecting pollution sources during lower flow conditions when they are less diluted.

Water temperature is crucial for freshwater life, regulating behaviours (e.g., migratory patterns), biological processes (e.g., metabolic rates), and controlling dissolved oxygen levels. Temperature changes can occur below industrial or sewage discharges.

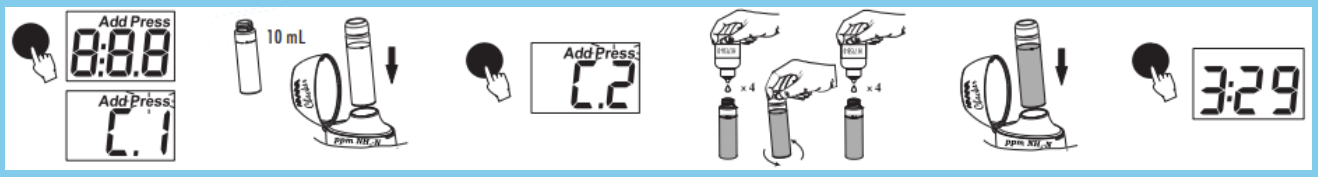
Electrical conductivity and water temperature can both be measured *via* the **HM Digital sensor**. For this, simply turn the sensor on where electrical conductivity should be the default measurement ('µs'), and then click the 'Temp' button to change to temperature. You can keep clicking this button to alternate between the different parameters.

Ammonia

Ammonia (NH_3) is a form of nitrogen that occurs naturally in rivers from sources like decaying plants and soil inputs. It is found in high concentrations in sewage and agricultural waste, and can reliably detect these pollutants that can be toxic to fish and other organisms. Guidelines for environmentally friendly ammonia levels differ between river types. For the Upper Tame catchment (i.e., the Tame, Cole, Rea, and Blythe rivers), your ammonia measurements should be **0.25 ppm or less 90% of the time**, while **multiple readings** above **0.58 ppm** suggest the water quality is seriously affected. It should be noted that your measurements reflect 'ammonia nitrogen', which is 1.214 times lower than 'total ammonia' used in statutory guidance (i.e., the two aforementioned values convert to 0.3 and 0.7 ppm or mg/L).

Ammonia concentrations are being assessed *via* a Hanna 'colorimeter'. This compares how much light passes through a solution containing reagents that react to ammonia levels versus your river water sample. For this, the following steps should be undertaken:

- Rinse your vials out with river water and fill both to the 10ml line.
- Press the black button to turn on, wait to see "C1", "Add" and "Press" blinking.
- Add your river water sample into the colorimeter, close the cap, press the black button again, wait until you see "C2", "Add" and "Press" blinking.
- In the other vial, add 4 drops of the **H1715A-0** reagent. Replace cap and swirl.
- Then add 4 drops of the **H1715B-0** reagent. Replace cap and swirl.
- Replace the first vial (containing river water) with the second (containing reagents) in the colorimeter shortly after mixing, close the cap, and press and **hold** the black button.
- Wait for the 3 and a half minute countdown when your reading will be displayed.



To **ensure accurate readings**, aim to collect the clearest water possible and wipe the vials down with a clean cloth prior to placing in the colorimeter. The solution should be disposed of **away** from the river and down a **sink**. Note that the **H1715B-0** reagent is **highly toxic**. It should be stored safely away from non-trained individuals and handled with caution (gloves worn). Please refer to the **risk assessment** for further details.

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