

A guide to citizen science river water sampling and water quality testing in the field

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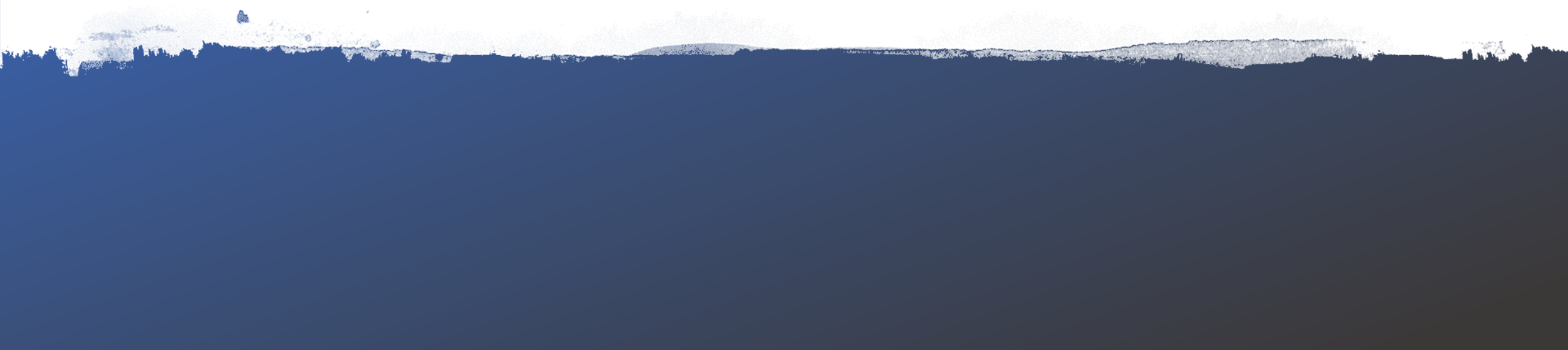


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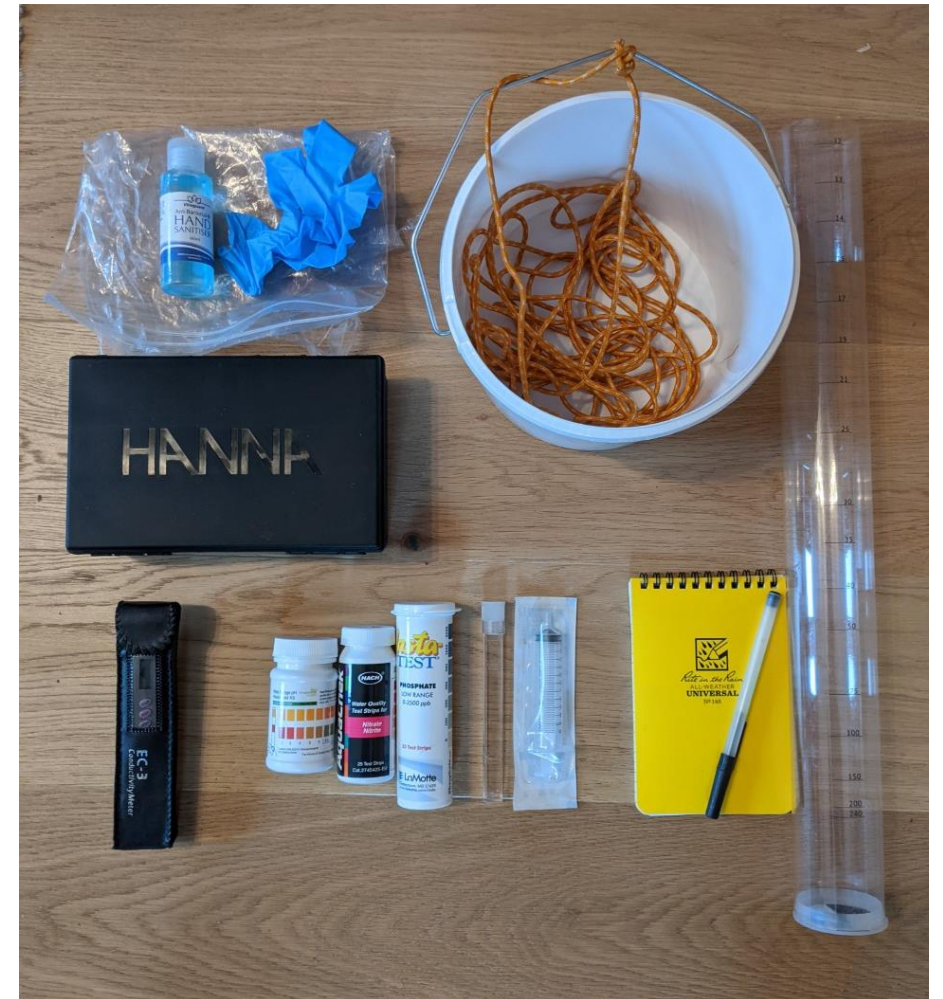
Getting out in the field



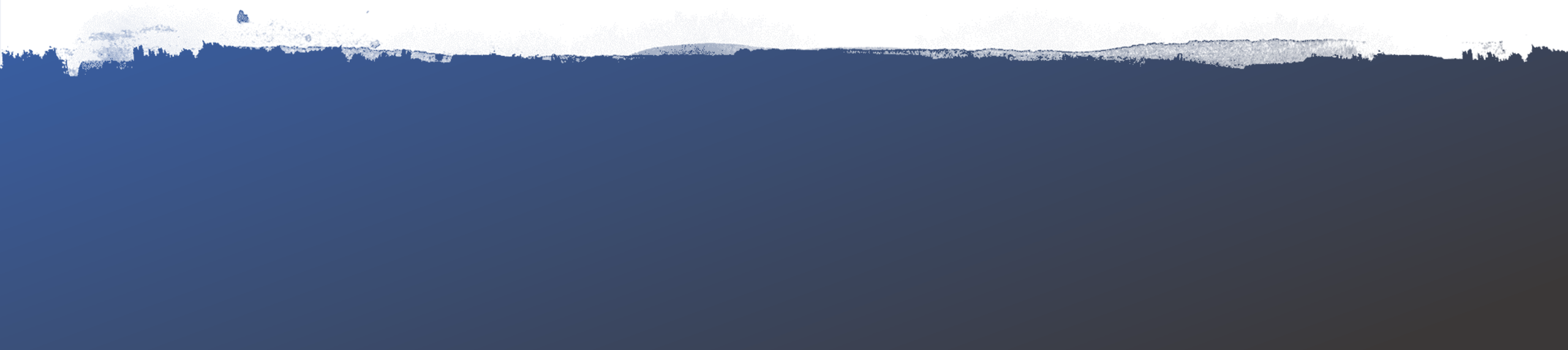
Things to take to the field

- Sampling container (with cord attached, if required)
- Hand sanitiser and/ or waterproof gloves
- Waste bag
- Phone for recording data on Epicollect/ emergency contact
- Paper form/ notepad and pen (in case your phone fails)
- EC and temperature meter
- Test strips (e.g., phosphate, nitrate, ammonia, pH) and accompanying test tubes (if required for relevant test)
- Syringe and filters (for transferring and filtering sample if required)
- Secchi tube
- Any other monitoring equipment you plan to use (e.g., a Hanna phosphate checker)

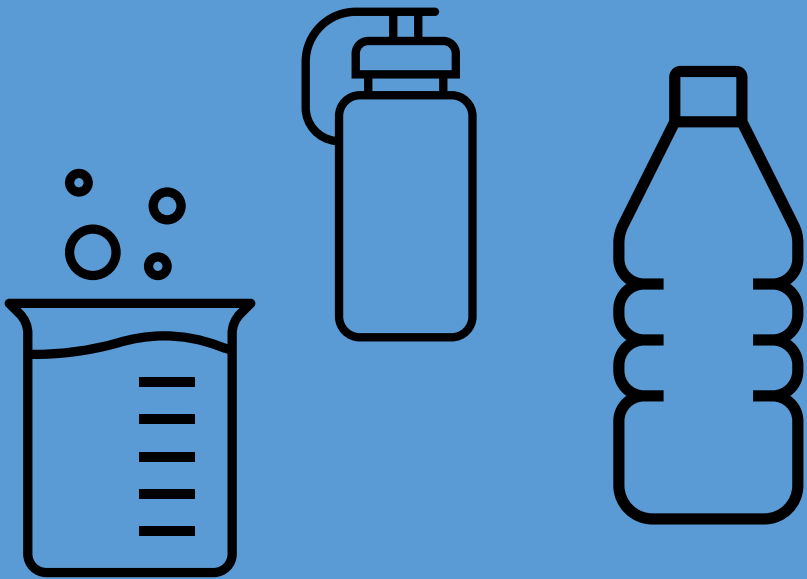
→ Video link: <https://bit.ly/3ovijOy>



Collecting a water sample



Choosing a sampling container



- Make your own, reuse a container you already have, or buy one for a few pounds
- The type of sampling container you choose will depend on where and how you plan to collect a sample (bridge, riverbank, or in-stream)
- Ideally sampling containers should:
 - be made from reusable plastic
 - be wide-necked or open topped
 - hold at least 1L of water
 - be easy to handle and transport

Low-cost sampling container ideas

- **Small bucket** – with cord attached are very versatile
- **Nalgene wide neck bottle** – with cord attached around the neck, if required
- **Clean milk carton** – cut into a sampling container, and attached to cord or a stick, if required
- **Large measuring jug**



Cord can be very useful for collecting hard-to-reach samples

Collecting a water sample – general approach

1. **Identify a safe place to collect your sample**, where water is free flowing - this could be from *a riverbank* or *a bridge*, or from *within the river channel**
2. **Perform a ‘triple rinse’ of your sampling container**, by filling your container and then emptying it down-stream, three times
3. Lower your sampling container into the water and aim to **collect your sample** for testing from just below the surface of the water
4. **Transport your sample to a suitable site nearby** to carry out water quality tests

* *only if approved by your volunteer coordinator*



Water sampling – general hints and tips



Good practice

- Collect your sample upstream of where you are standing
- Discard water downstream of where you are collecting it from
- Triple rinse your sampling container before collecting a sample for analysis
- Rinse your other monitoring equipment (syringes, test tubes etc.) in river water before carrying out tests



Warnings

- Take care not to disturb riverbed or bank side sediment – with either your body or your sampling container - as you collect your sample
- Avoid taking your sample from stagnant or very slow-moving areas within the river

Sampling from the riverbank

- Collect a sample from a location where:
 - You can access the water safely and easily
 - The water is free flowing, not stagnant or slow-moving
 - The water is deep enough for your sampling container
 - Rinse your container and discard water downstream of where you are collecting your sample
- Video link: <https://bit.ly/3wgZ8uv>

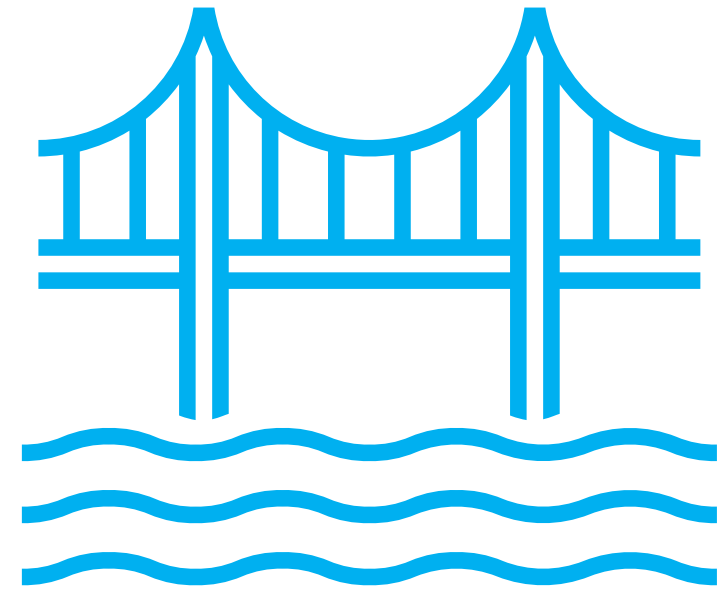


Take care not to disturb bankside or riverbed sediment as you collect your sample



Sampling from a bridge

- Choose a location on the bridge where you can safely and easily access the middle of the river channel with your sampling container (attached to cord) – here water will be deepest and fastest flowing
- Collect your sample from the upstream side of the bridge
- Discard any rinse water on the downstream side of the bridge (if safe to do so)



Take care not to disturb any material attached to the bridge, or the riverbed sediment, as you lower your container to collect a sample

Sampling from within the river channel

*Only use this approach if agreed with your group coordinators and it is safe to do so

- Collect the sample upstream of where you are standing in the river channel
- Discard any rinse water downstream of where you are standing



Take care not to disturb sediment as you enter the river



Performing water quality tests in the field



What are we measuring?

Electrical conductivity

Temperature

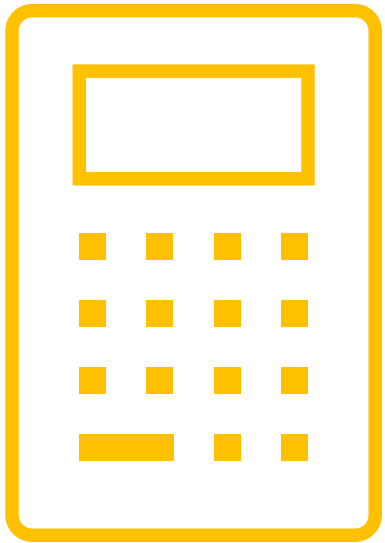
Phosphate

Nitrate

Turbidity

In-field water quality tests - an overview

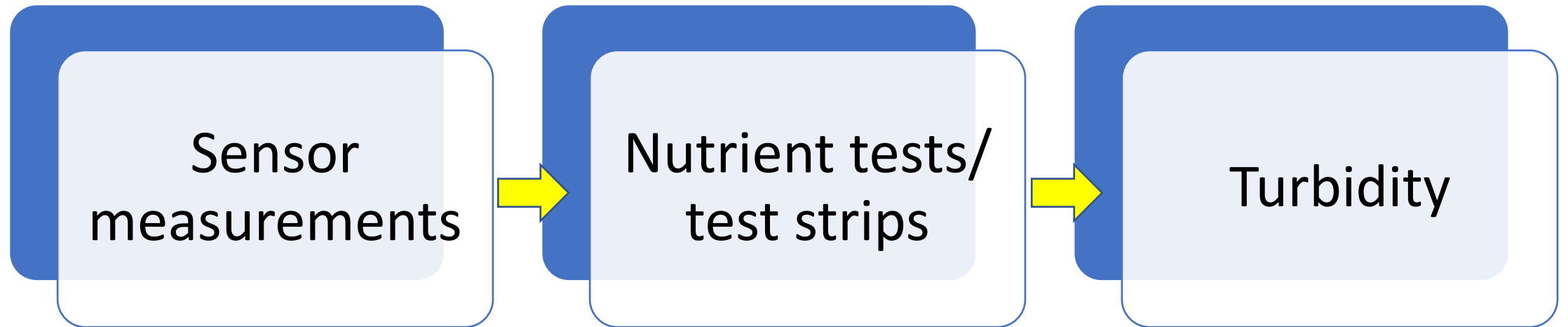
Parameter	Units	Monitoring	Equipment options and examples
Electrical conductivity	μS/cm (microsiemens per cm)	All groups	EC and temperature meter
Temperature	°c (degrees centigrade)	All groups	EC and temperature meter
Phosphate	ppm (mg/l) / ppb (μg/l)	All groups	Phosphate test strips Phosphate checker Phosphate handheld meter
Nitrate	ppm (mg/l) / ppb (μg/l)	All groups	Nitrate test strips Nitrate handheld meter
Turbidity	NTU (Nephelometric Turbidity Units)	All groups	Secchi tube
Ammonia	ppm (mg/l) / ppb (μg/l)	Optional	Ammonia test strips Ammonia checker Ammonia handheld meter
pH	pH	Optional	pH test strips pH meter
Dissolved oxygen	ppm (mg/l) / ppb (μg/l)	Optional	DO test kit DO meter




Unit conversions – quick reference

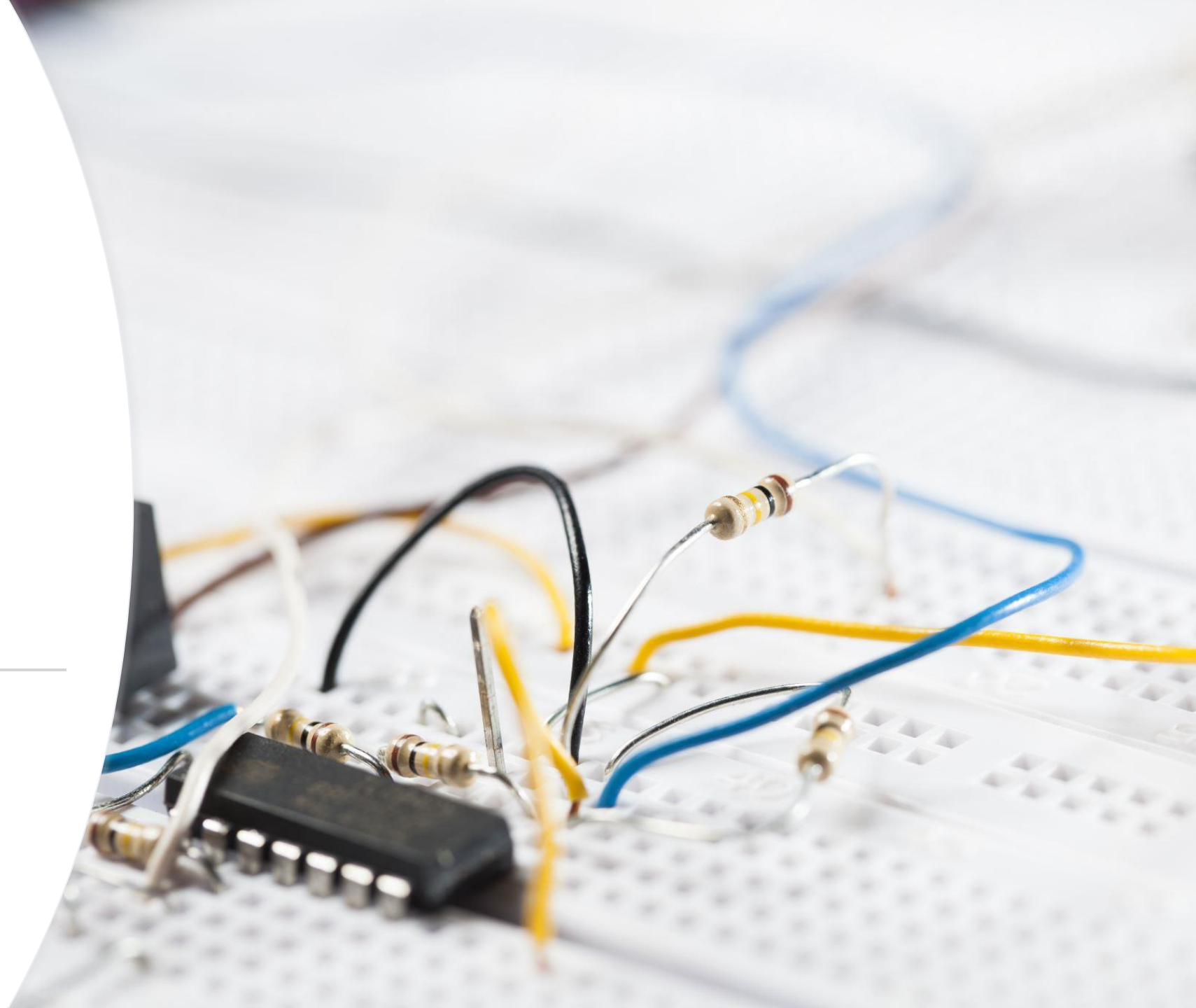
- 1 ppm (part per million) =
1 mg/l (milligram per litre)
- 1 ppb (part per billion) =
1 μ g/l (microgram per litre)
- 1 ppm = 1000 ppb
- 1 mg/l = 1000 μ g/l

Order of testing in the field...





Temperature and Electrical Conductivity



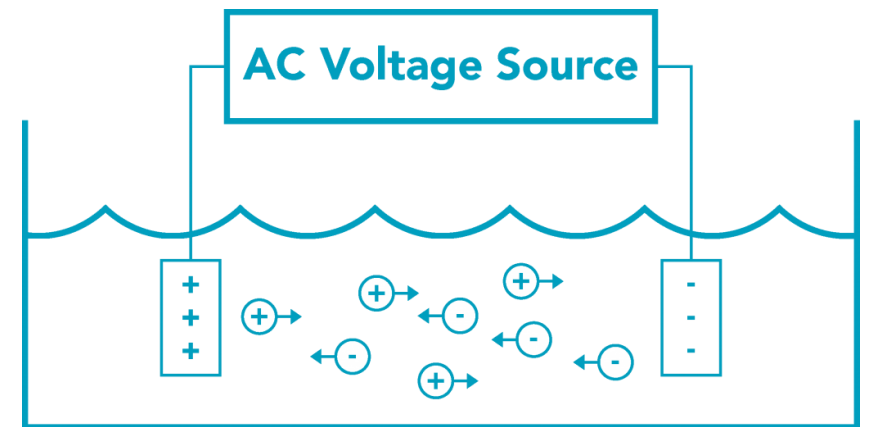
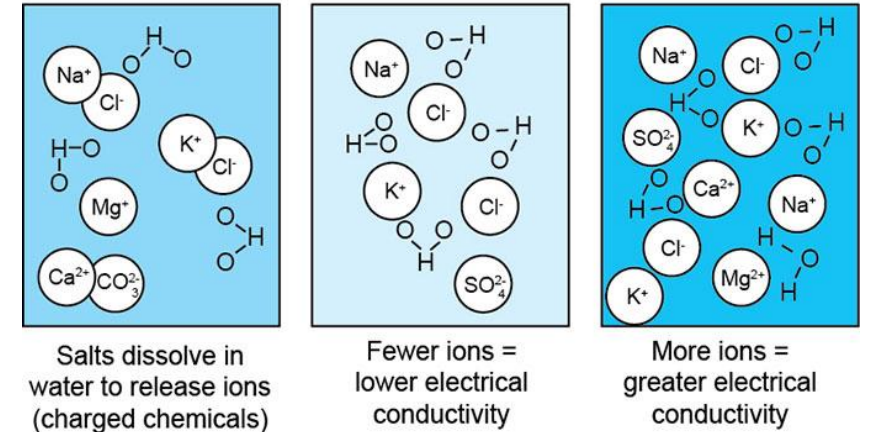


Why measure temperature?

- Water temperature controls the rate of many chemical, physical and biological processes in a river
- Water temperature determines whether a river habitat is suitable for different aquatic species to survive
- Warm water can hold less dissolved oxygen than cold water
- Water temperature is measured in degrees centigrade ($^{\circ}\text{C}$)

Why measure electrical conductivity?


- **Electrical conductivity (EC), measured in $\mu\text{S}/\text{cm}$, gives us an indication the total amount of dissolved solids (TDS) in the water**
- Water containing dissolved salts (ions) conducts electricity
- EC naturally varies between different freshwater bodies (due to differences in geology) and can range from $<100 \mu\text{S}/\text{cm}$ to $>1000 \mu\text{S}/\text{cm}$ in rivers
- EC also varies as a result of changes in water temperature and stream discharge
- Understanding the natural range (baseline conditions) in EC can help us to understand when readings are unusually high, which may indicate a contamination event has occurred



Credit: Senosorex



For more
information...



For more information about why water temperature is an important water quality parameter to measure:

Fondriest - <https://bit.ly/3bI6lf7>

USGS - <https://on.doi.gov/3f5GoYU>

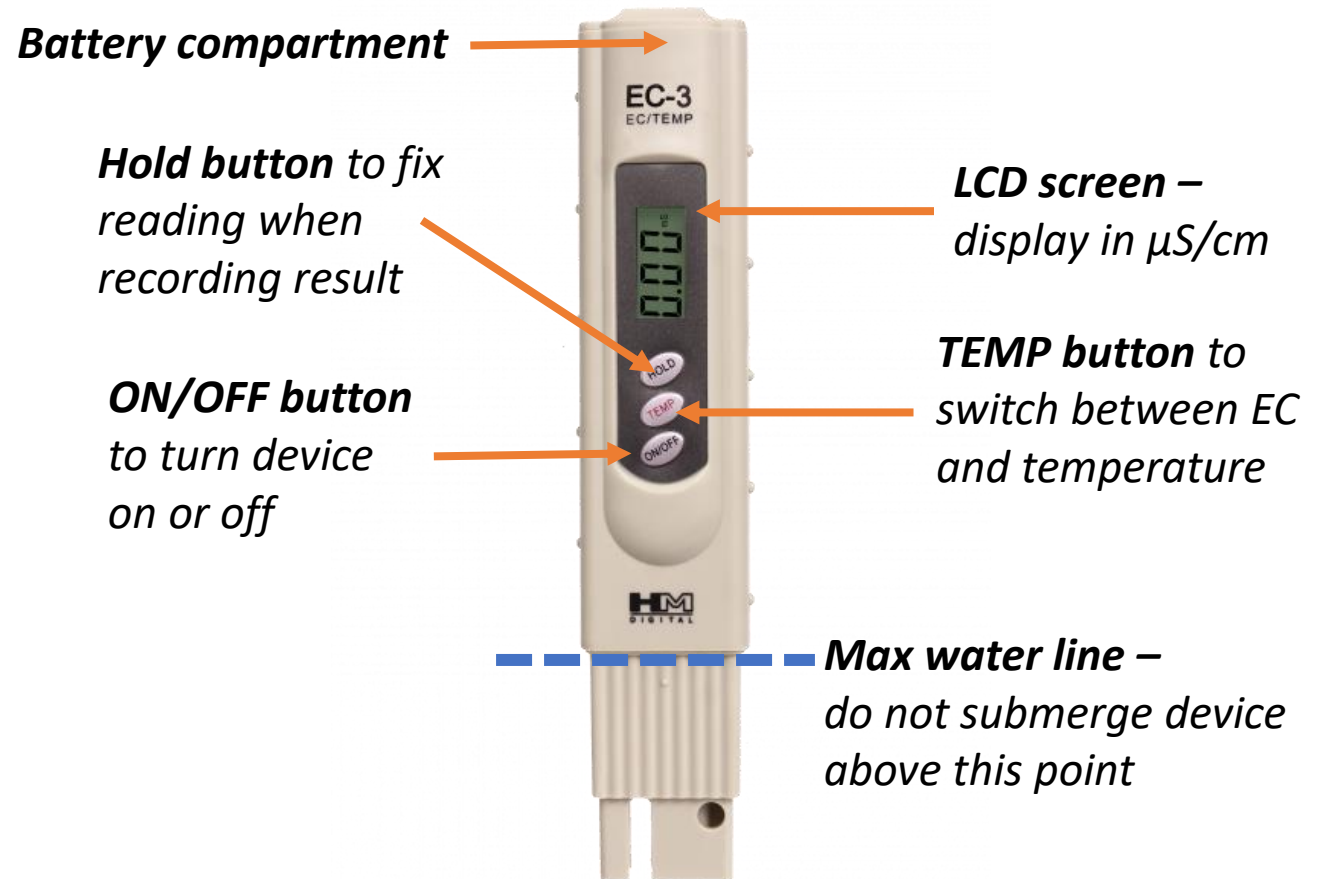
For more information about why electrical conductivity is an important water quality parameter to measure:

Fondriest - <https://bit.ly/2QE3Nrg>

USGS - <https://on.doi.gov/2Rq7Nw1>

What do you need to measure EC and temp?

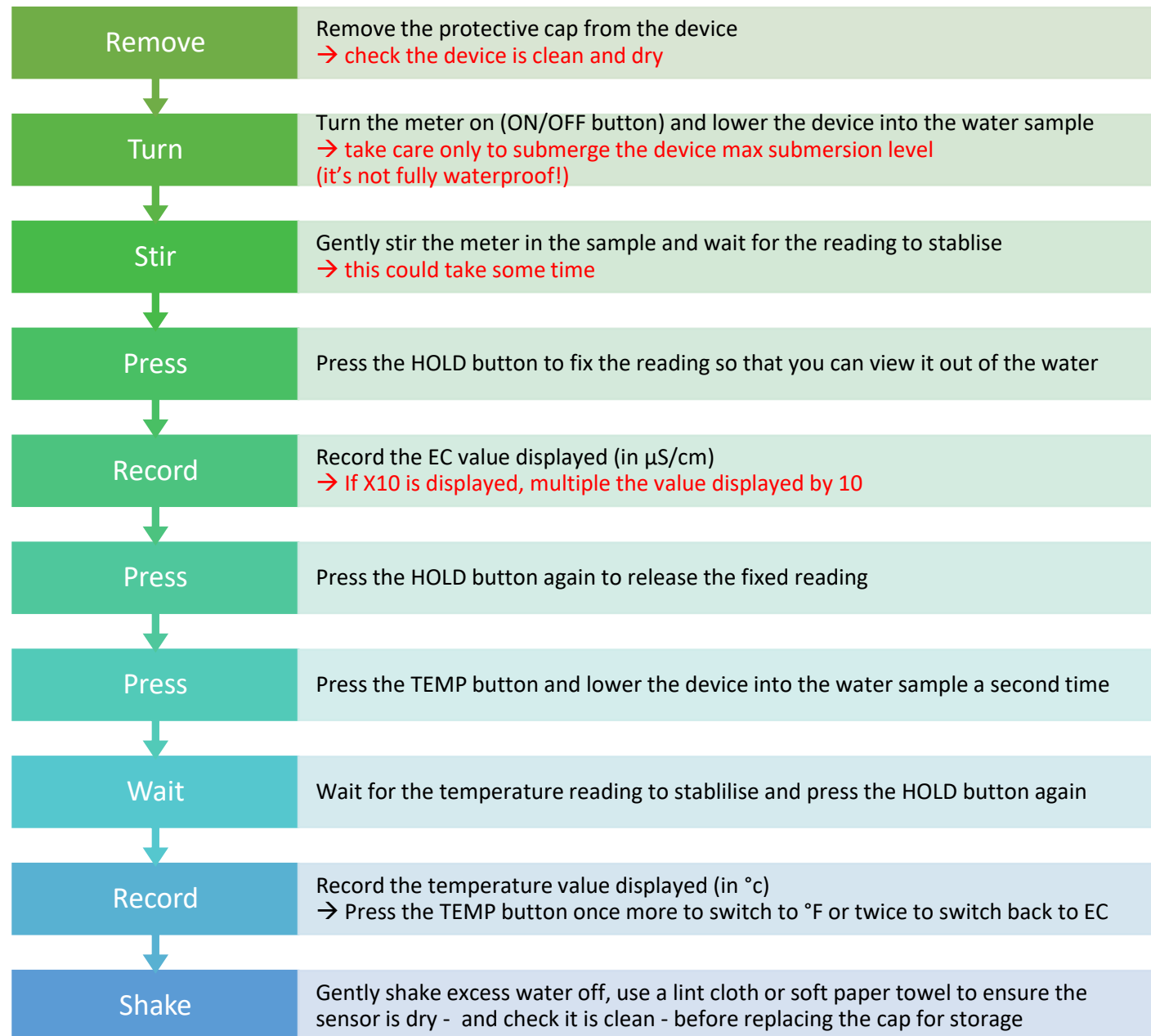
- A combined EC and temperature handheld meter – for example, the HM Digital EC-3
- Your water sample either in a sample container or flowing river water at your sampling site (within arms reach)
- Take care not to submerge the meter too deep!



HM Digital EC-3 Meter

How to use the HM Digital EC-3 meter

→ Video link: <https://bit.ly/3wlf63>



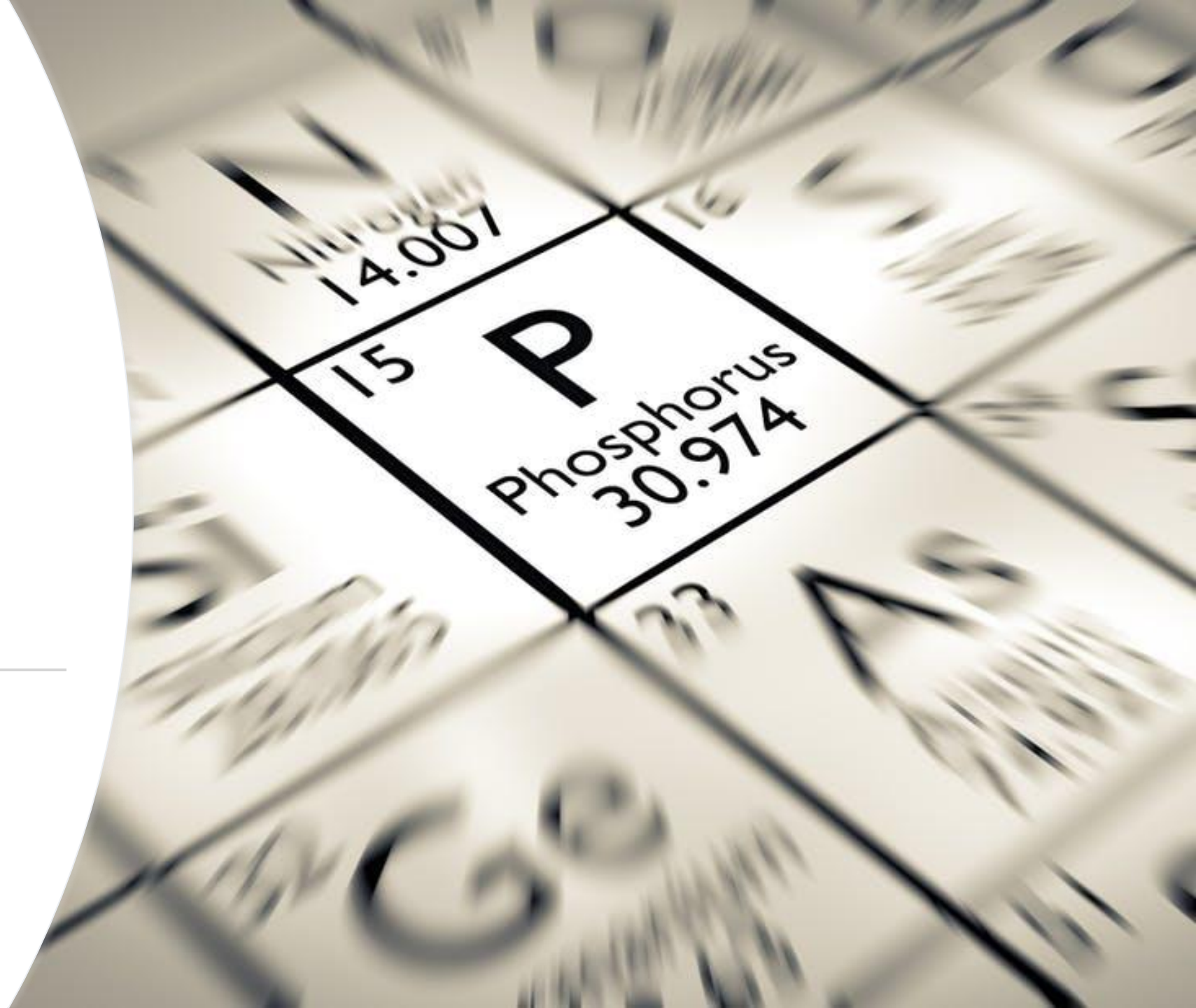
Looking after the HM Digital EC-3

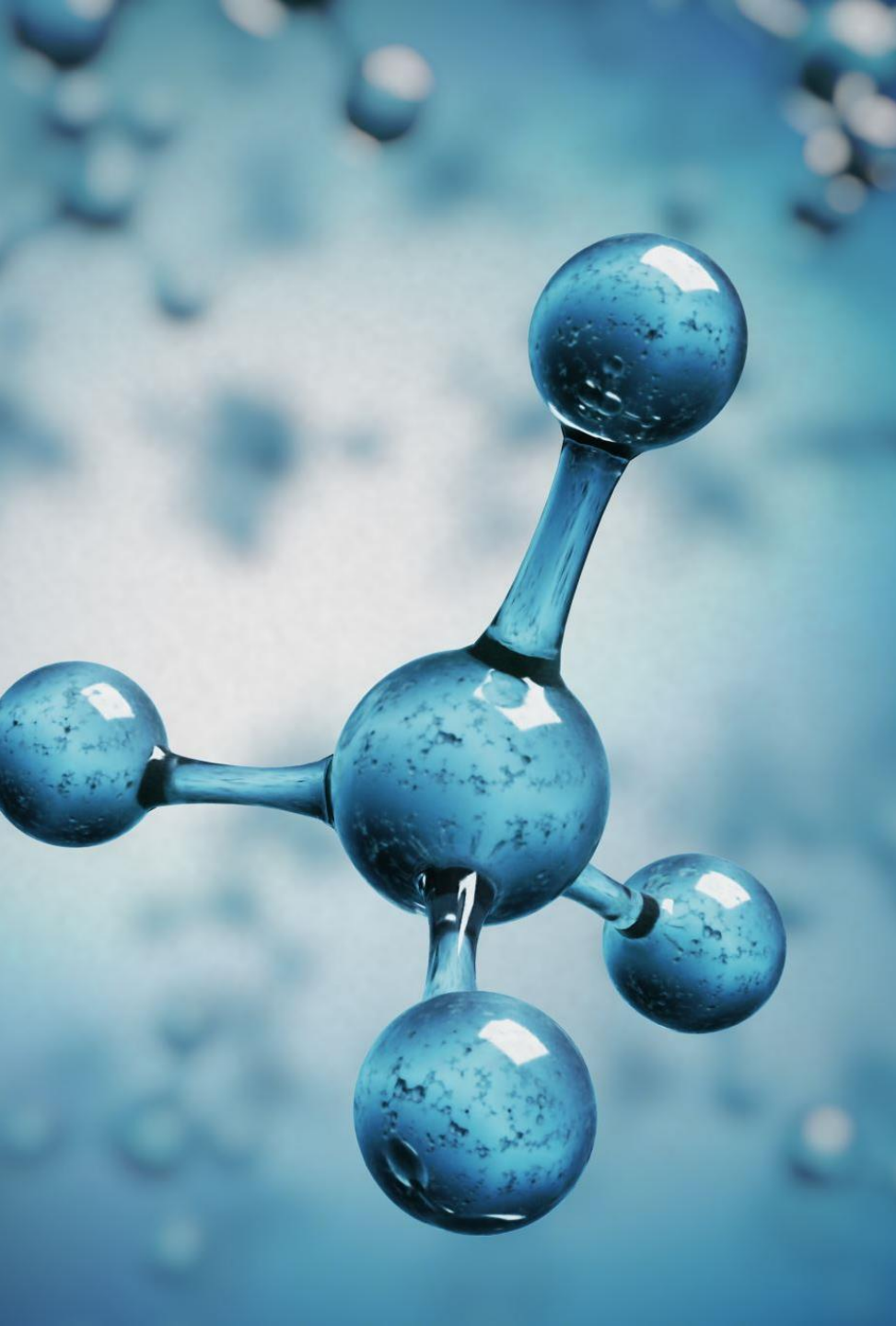
The HM Digital EC-3 is robust (and comes with a 3-year warranty) but needs to be looked after to continue to perform well...

- Make sure the device is clean and dry every time you put it away after testing
- Store somewhere cool and dry place between trips to the field
- You may need to change the batteries (model 375A) in your device at some point – follow the instructions provided by the manufacture
- The device is factory calibrated, but after a while may benefit from recalibration – your group coordinators will advise if this is necessary
- More information about the HM Digital EC-3 meter can be found online (<http://hmdigital.com/product/ec-3/>) and in the manufacture's instructions provided with the meter



Phosphate






Why measure phosphate?

- Phosphate (PO_4^{3-}), also referred to as orthophosphate, is the bioavailable form of phosphorus, found dissolved in water
- Phosphate found in rivers comes from a variety of sources, including agricultural run-off and wastewater discharges
- Phosphate is an essential nutrient, but high concentrations in rivers can cause serious damage to aquatic ecosystems
- Its concentration is commonly measured in ppm (mg/l) or ppb ($\mu\text{g/l}$)



For more
information...



For more information about why phosphate is an important water quality parameter to measure:

USGS -

<https://on.doi.gov/33YAGIB>

Fondriest -

<https://www.fondriest.com/pdf/Phosphorus.pdf>

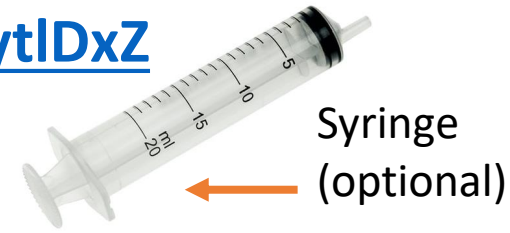
What do you need to measure phosphate?

- A suitable method for determining the concentration of phosphate in your water sample, for example:
 - phosphate test strip kit, with colour change chart (e.g. La Motte Insta-test phosphate test strips – 0-2.5ppm)
 - phosphate hand-held colorimeter kit, with reagents (e.g. Hanna Phosphate Checker, Hach DR300 Pocket Colourimeter (Phosphate)- 0-2.5ppm)
- Your water sample in a sampling container, and potentially a syringe (depending on guidance given by your group coordinators)



How to use La Motte Insta-test phosphate test strips

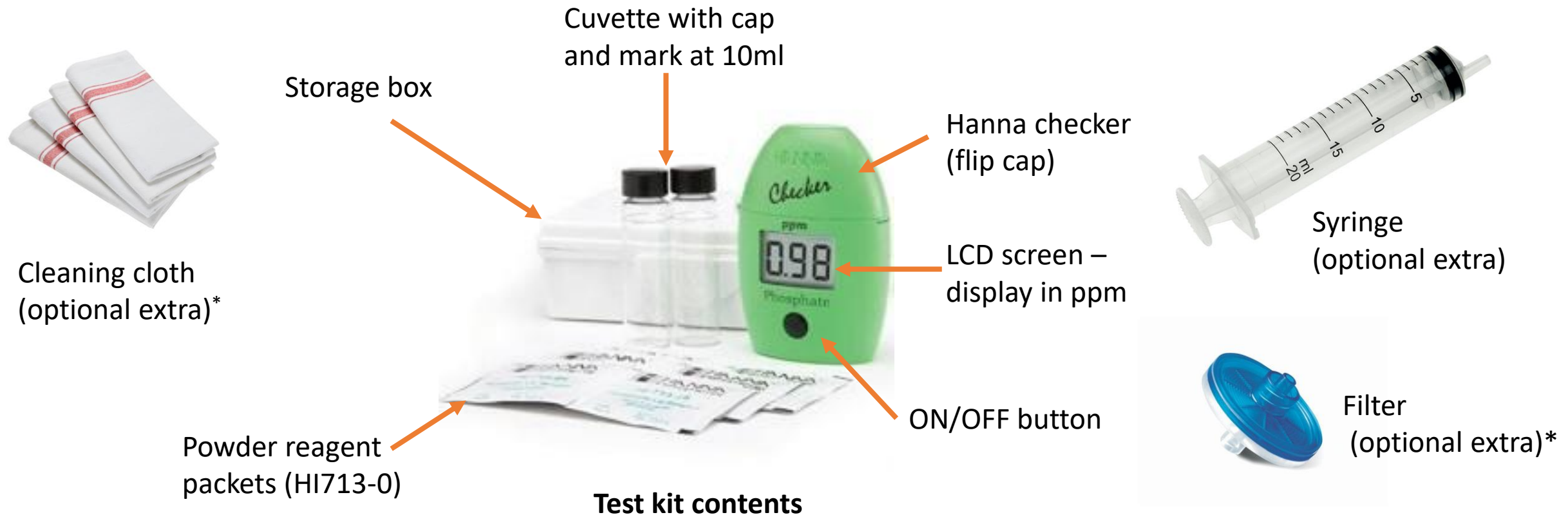
→ Video link: <https://bit.ly/3ytIDxZ>



Rinse	Rinse the test tube provided (and syringe, if using) with river water
Fill	Fill the test tube with your sample water (to the 10ml mark) either directly or using a clean syringe
Remove	Carefully remove a test strip from the bottle, and immediately replace the bottle cap
Bend	Gently bend the test strip in half with the pads facing inwards and secure the strip inside the cap of the test tube
Replace	Securely replace the test tube cap, then gently and slowly invert the test tube completely five times
Remove	Remove the test tube cap (including the attached test strip)
Place	Place the bottom of test tube on white squares below the colour chart on the test strip bottle and look down through sample to compare the colour of your reacted sample to the chart
Select	Select the colour and associated concentration that best matches your reacted sample and record this value



Contents of the Hanna Phosphate Low Range Handheld Colorimeter (HI-713)

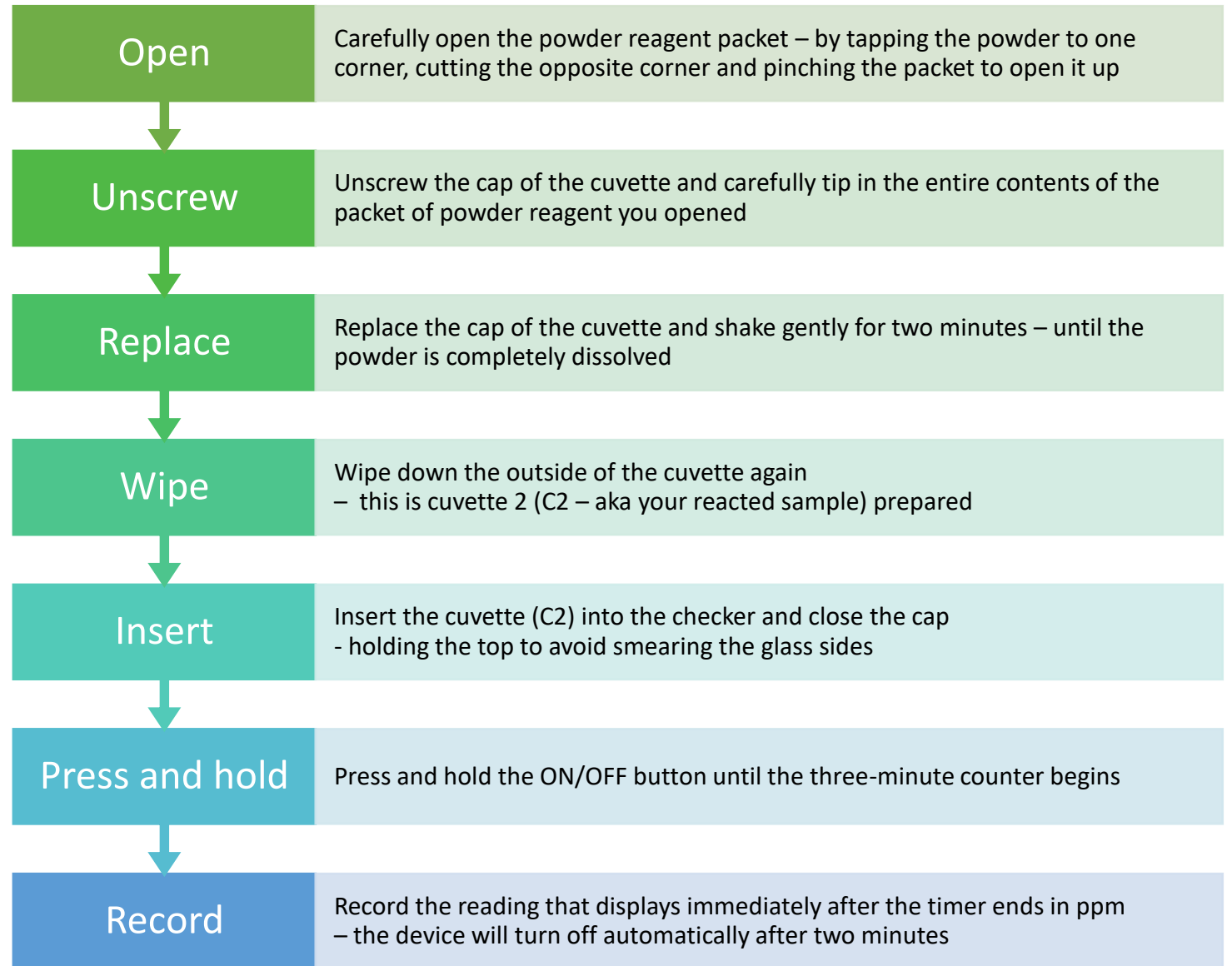


* Not included in kit provided by Hanna

How to use the Hanna Phosphate Low Range Colorimeter (HI-713) – Part 1



How to use the Hanna Phosphate Low Range Colorimeter (HI-713) – Part 2



Top tips for using the Hanna Phosphate Checker

→ Video link:

<https://bit.ly/3v7wZG4>



If the sample contains lots of debris, or is very turbid, filter it before analysis



If you notice bubbles in the cuvette, gently swirl or tap it to remove them



Always make sure the cuvette is clean and dry before placing into the checker: wipe off fingerprints with a cloth

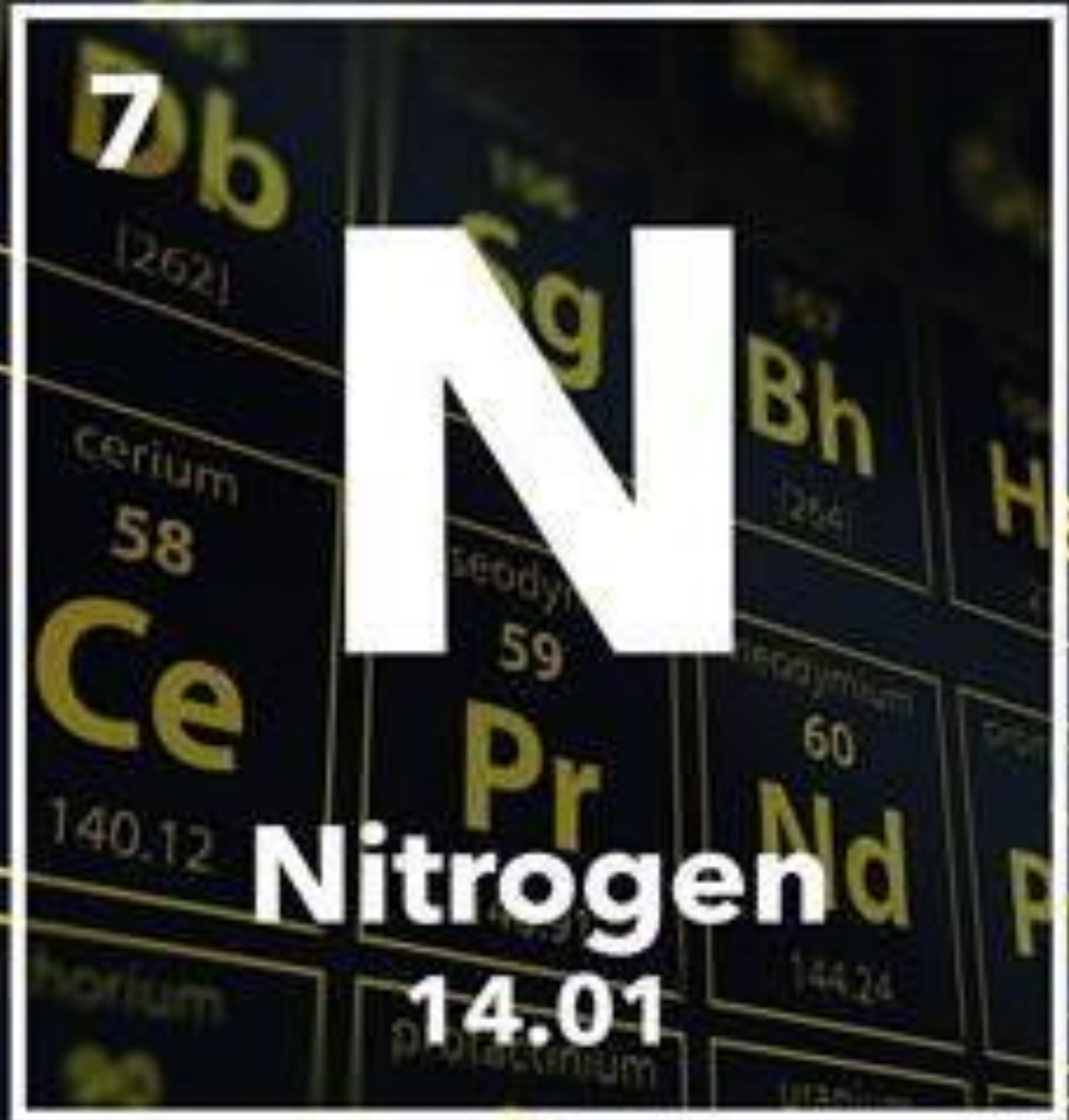


If any error codes appear, such as low battery (“bAt”), check the instruction booklet provided for guidance on what to do



In cold weather, the powder reagent may take slightly longer to dissolve, so use a separate cuvette for the blank and reacted samples (C1 and C2) to avoid time-out

Nitrate

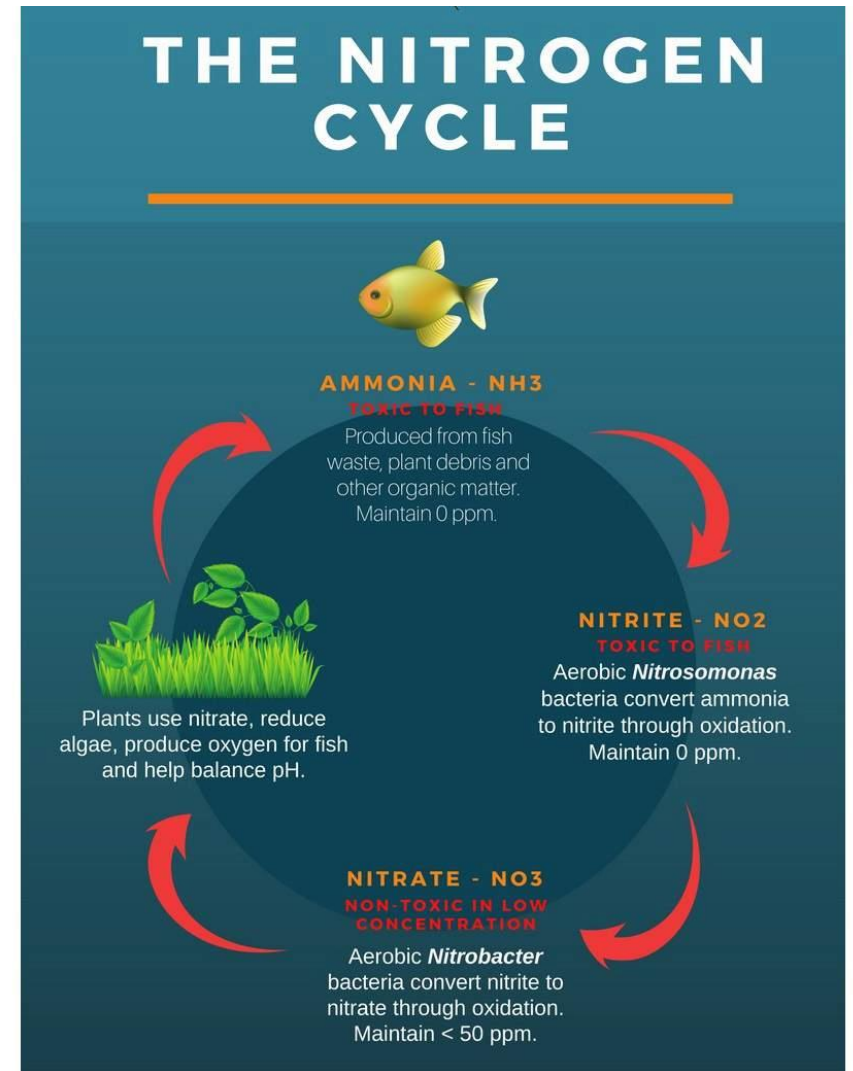


A periodic table of elements is shown in the background, with a white box highlighting the element Nitrogen. The element's symbol 'N' is prominently displayed in large white letters. Below it, the word 'Nitrogen' and its atomic weight '14.01' are written in white. The background elements are in a dark blue color with yellow text.

7 Db [262]					
cerium 58 Ce 140.12	praseodymium 59 Pr 140.91	neodymium 60 Nd 144.24			

Why measure nitrate?

- Nitrate (NO_3^-) is the oxidized form of nitrogen found dissolved in water
- Nitrate in water comes from a variety of sources, including agricultural run-off and wastewater discharges
- Nitrate is an essential nutrient, but high concentrations in rivers can cause serious damage to aquatic ecosystems
- Its concentration is commonly measured in ppm (mg/l) or ppb ($\mu\text{g/l}$)




Simplified nitrogen cycle in water

Credit: Aqueon



For more
information...



For more information about why nitrate is an
important water quality parameter to measure:

USGS - <https://on.doi.gov/342PGPo>

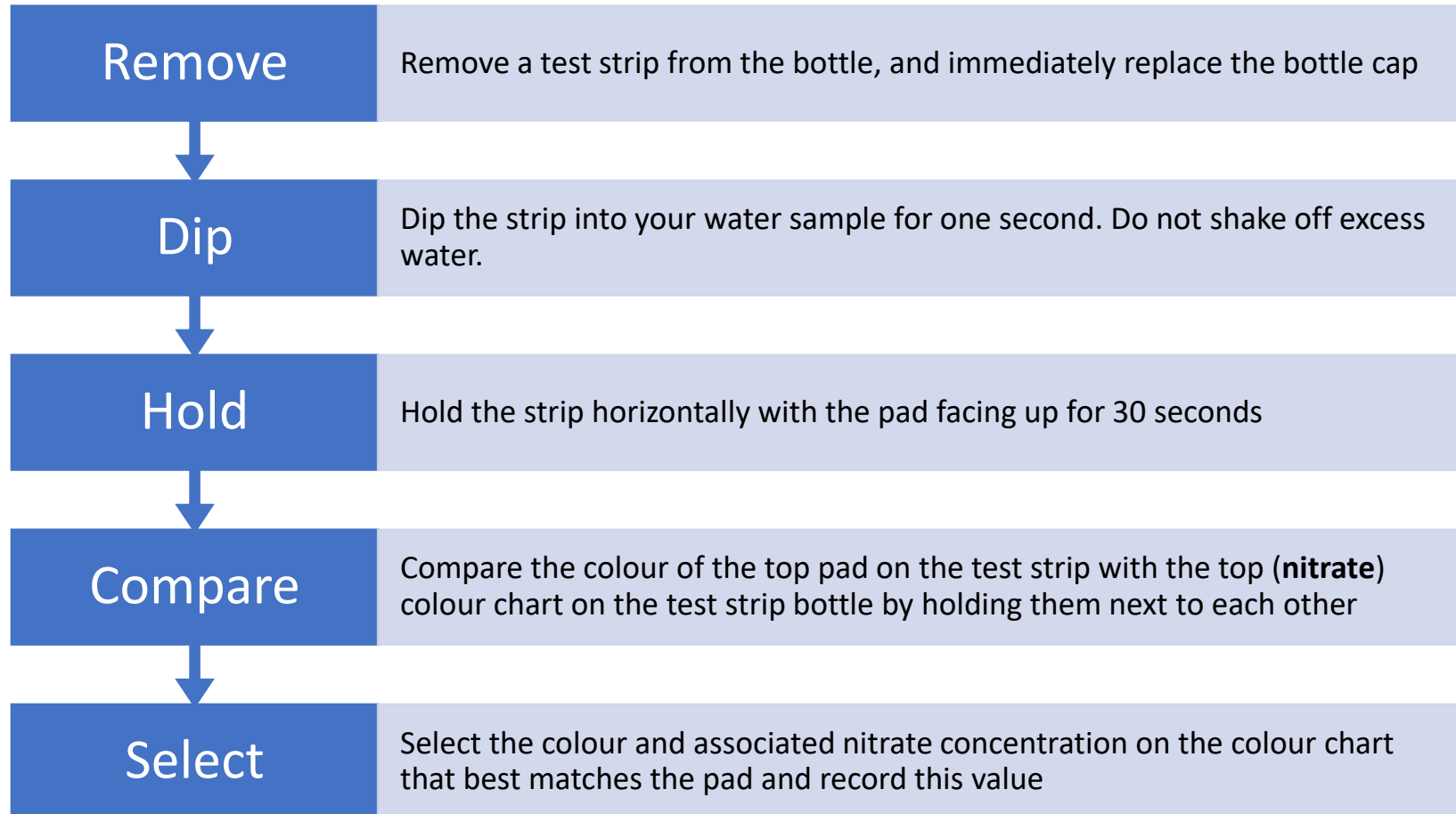
EA - <https://bit.ly/3bJMD2O>

What do you need to measure nitrate?

- A suitable method for determining the concentration of nitrate in your water sample, for example:
 - (i) nitrate test strip kit, and colour change chart (e.g. Hach nitrate water quality test strips – 0- 50ppm)
 - (ii) nitrate hand-held colorimeter kit, with reagents (e.g. Hach DR300 Pocket Colorimeter (Nitrate) – 0.4- 30ppm)
- Your water sample in a sampling container, and potentially a syringe (depending on guidance given by your group coordinators)



How to use Hach water quality test strips for Nitrate



→ **Video link:**
<https://bit.ly/3yvbCAr>

Turbidity






Why measure turbidity?

- Turbidity is a measure of relative water clarity
- Turbidity gives an indication of the amount of suspended solids (SS) and coloured dissolved matter in the water
- Turbidity can increase in a river due to natural processes (such as increased erosion due to rainfall) or human inputs
- High turbidity can affect chemical, biological and physical properties of a stream
- Turbidity is measured in Nephelometric Turbidity Units (NTU)



For more
information...



For more information about why turbidity is an important water quality parameter to measure:

Fondriest - <https://bit.ly/3yuDrJ9>

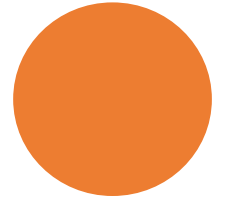
USGS - <https://on.doi.gov/3yAgpRt>

What do you need to measure turbidity?

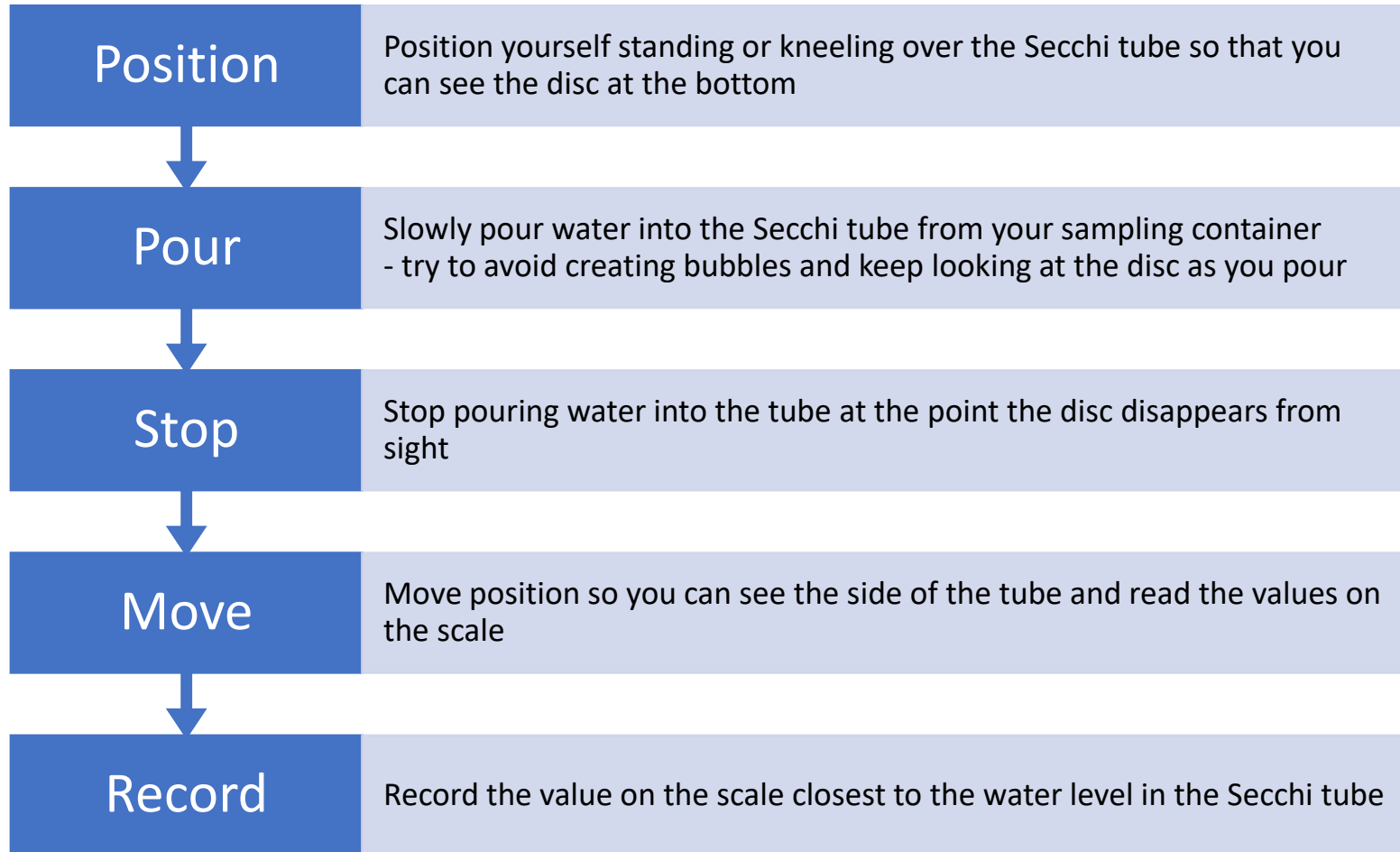
- A secchi tube (or the equipment and instructions to make your own*)
- Your water sample in a sampling container (ideally one which is easy to pour from)

* This will be provided by your group coordinators

→ Video link: <https://bit.ly/3fxiiFz>



How to use a Secchi tube



- If the disc is no longer visible before you reach the first mark, record the reading as >240 NTU
- If the disc is still visible when you reach the final mark, record the reading as <12 NTU

Water quality testing – general hints and tips

- Know the general range you expect to get at your site
→ Check with your group coordinator or use water sense:
e.g. pH is generally around 7
- If you get any readings that look particularly unusual, consider repeating the test

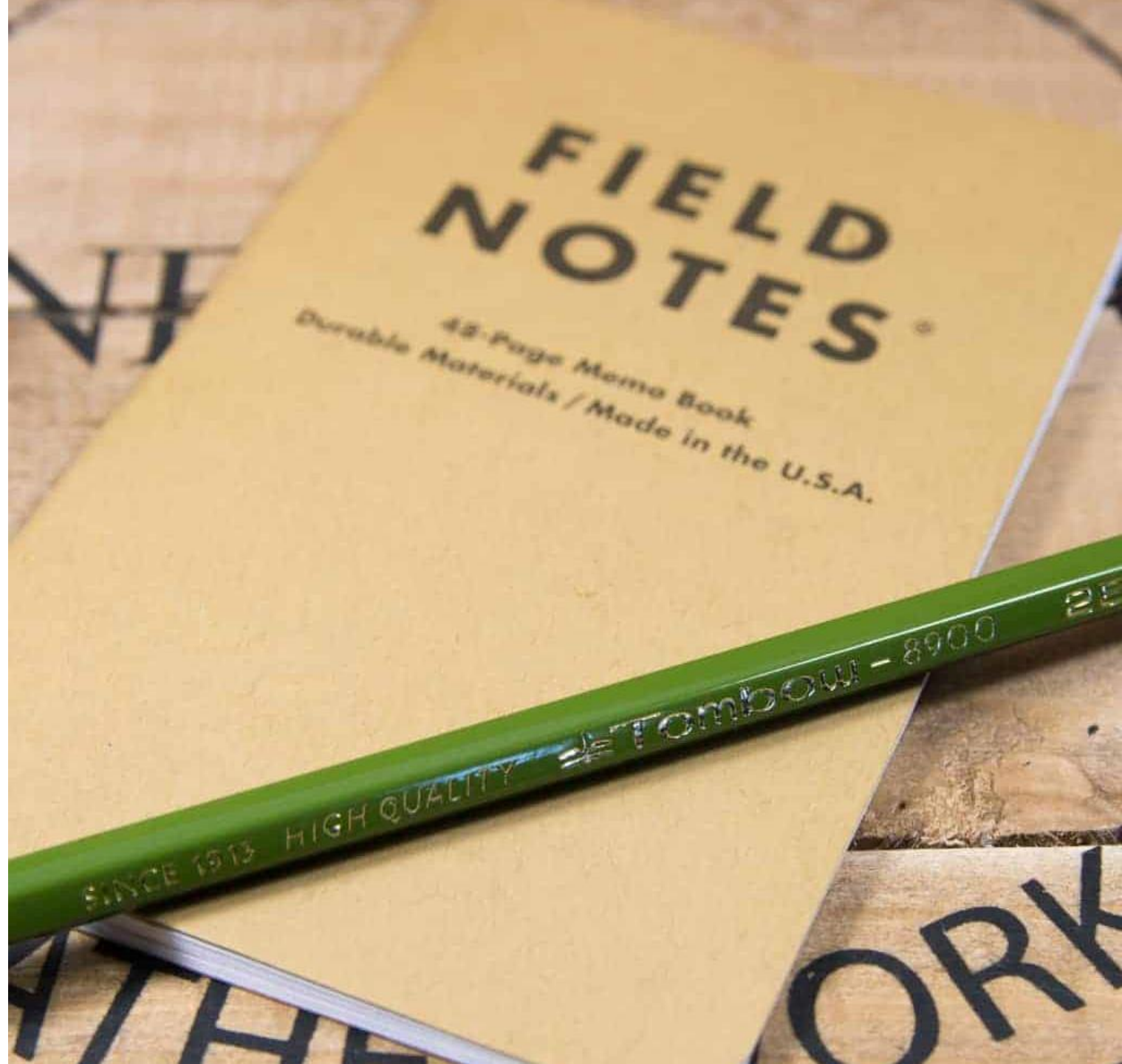


Recording data and other
observations in the field



Recording field surveys

- Your group will have a standard form for you to complete every time you carry out a survey in the field
- You should be able to record your data directly onto the epicollect app on your phone, or via a printed form provided by your group coordinator
- In case your phone doesn't work, or you misplace the form, it's a good idea to take a notepad and pen into the field



Things you'll need to record...

These questions are essential

General details

- Surveyor name
- Location
- Site reference
- Date
- Time

Water quality data

- Methods of data collection
- Results from field tests

Quick reference sheets on how to identify algal blooms and what other signs of pollution to look out for in the field will be provided

These questions are very useful

Site characteristics

- Rainfall in the last 24hrs
- Flow conditions
- Relative water level

Signs of pollution

- Presence of algal bloom
- Size of algal bloom
- Any other signs of pollution

The survey questions provided on your epicollect or paper form will guide you quickly and easily through these sections so you can record everything you need to in the field, as you go...



Download the
app



Access your
groups project



Add an entry



Upload your
entry



How to use epicollect

1. Downloading the Epicollect app



→ Search for and download the FREE **Epicollect5 Data Collection** app from the Google Play or Apple store

- Epicollect is available on Apple and Android phones
- You will need a google account to create an account on Epicollect and use the app



Epicollect5 Data Collection

Oxford University, CGPS Productivity

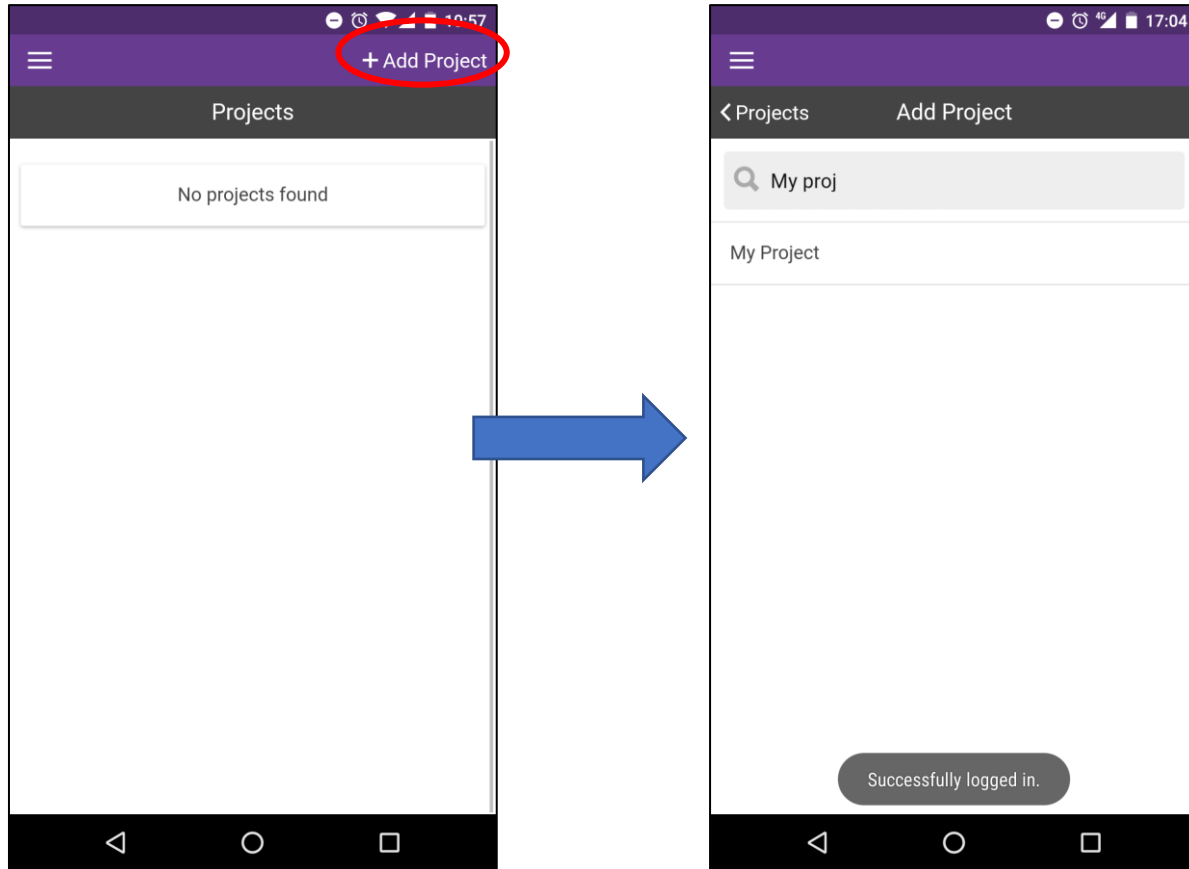
★★★★★ 363 

E Everyone

 This app is available for all of your devices

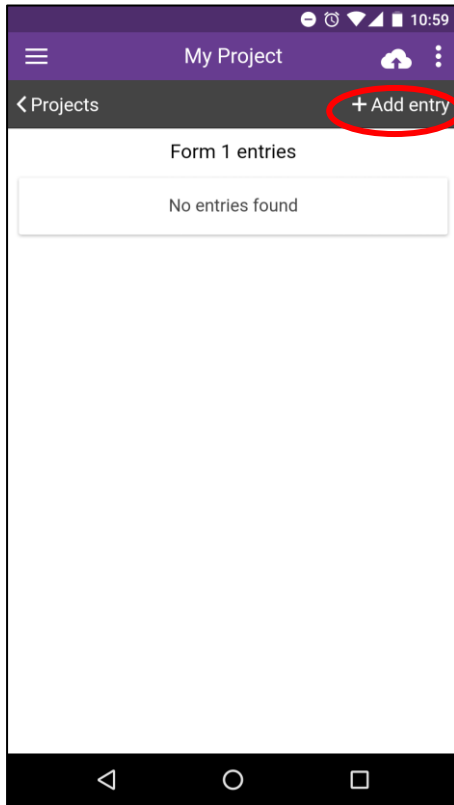
Installed

2. Accessing your group's Epicollect project

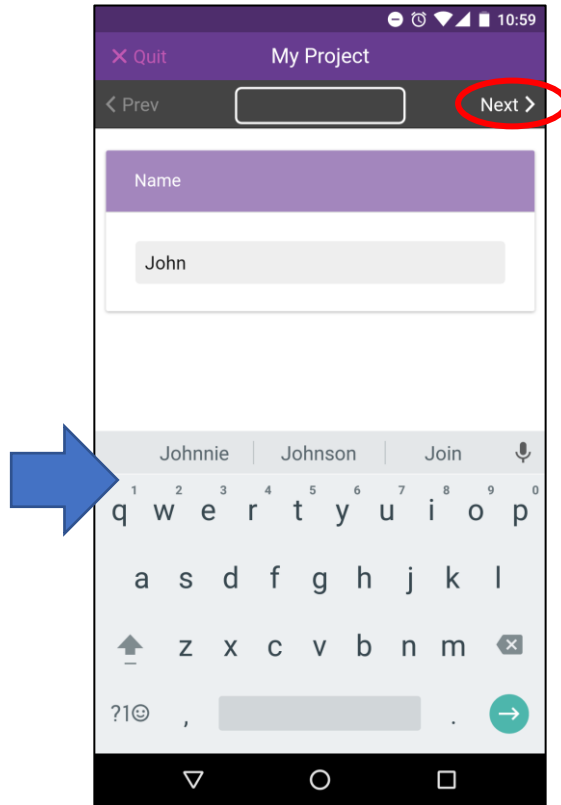


- Open the Epicollect app on your mobile device and sign into your account
- Click on the “+ **Add Project**” button in the top right-hand corner
- Start typing the project name in the search bar to find your group's project and click on it once it appears to add it to your projects list

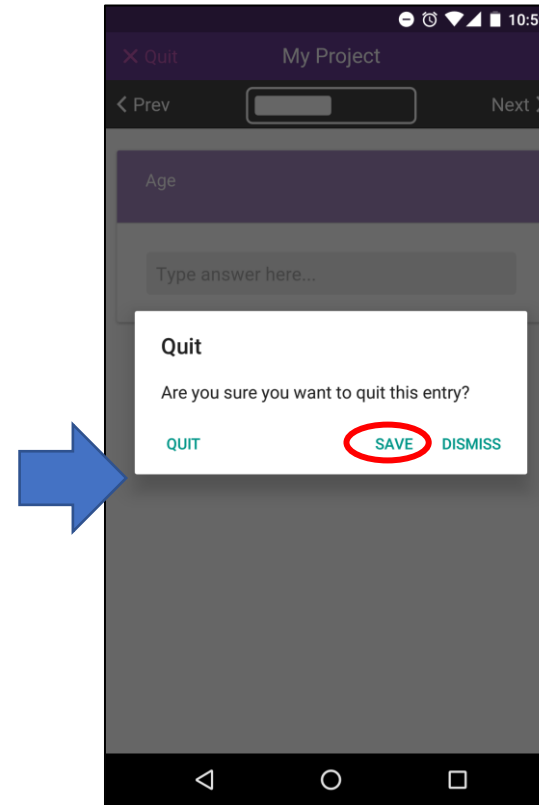
3. Entering data into the Epicollect app



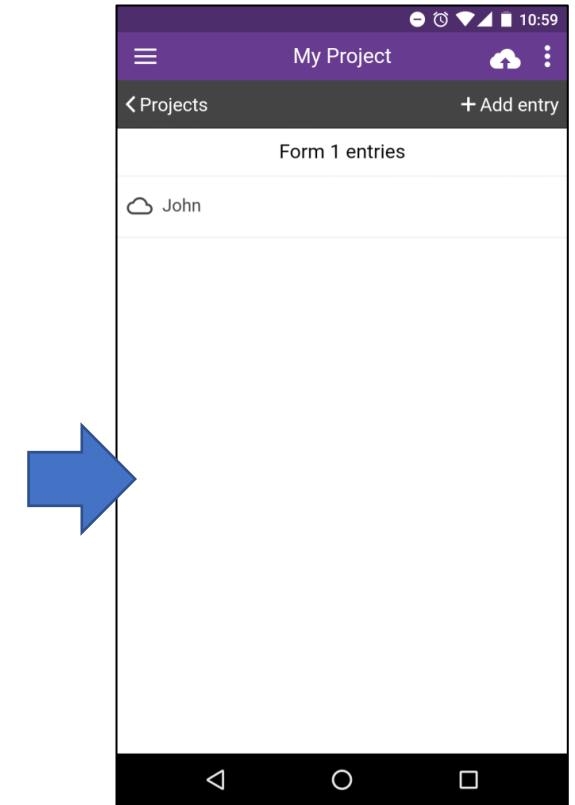
→ Select your group's project from the list and click **+Add entry**



→ Work through the questions on the form, clicking "**Next**" to move on, or "**Prev**" if you need to make any changes



→ If you need to quit before finishing, you'll be asked to "**SAVE**" the form for later, or "**DISMISS**" it, deleting the entry

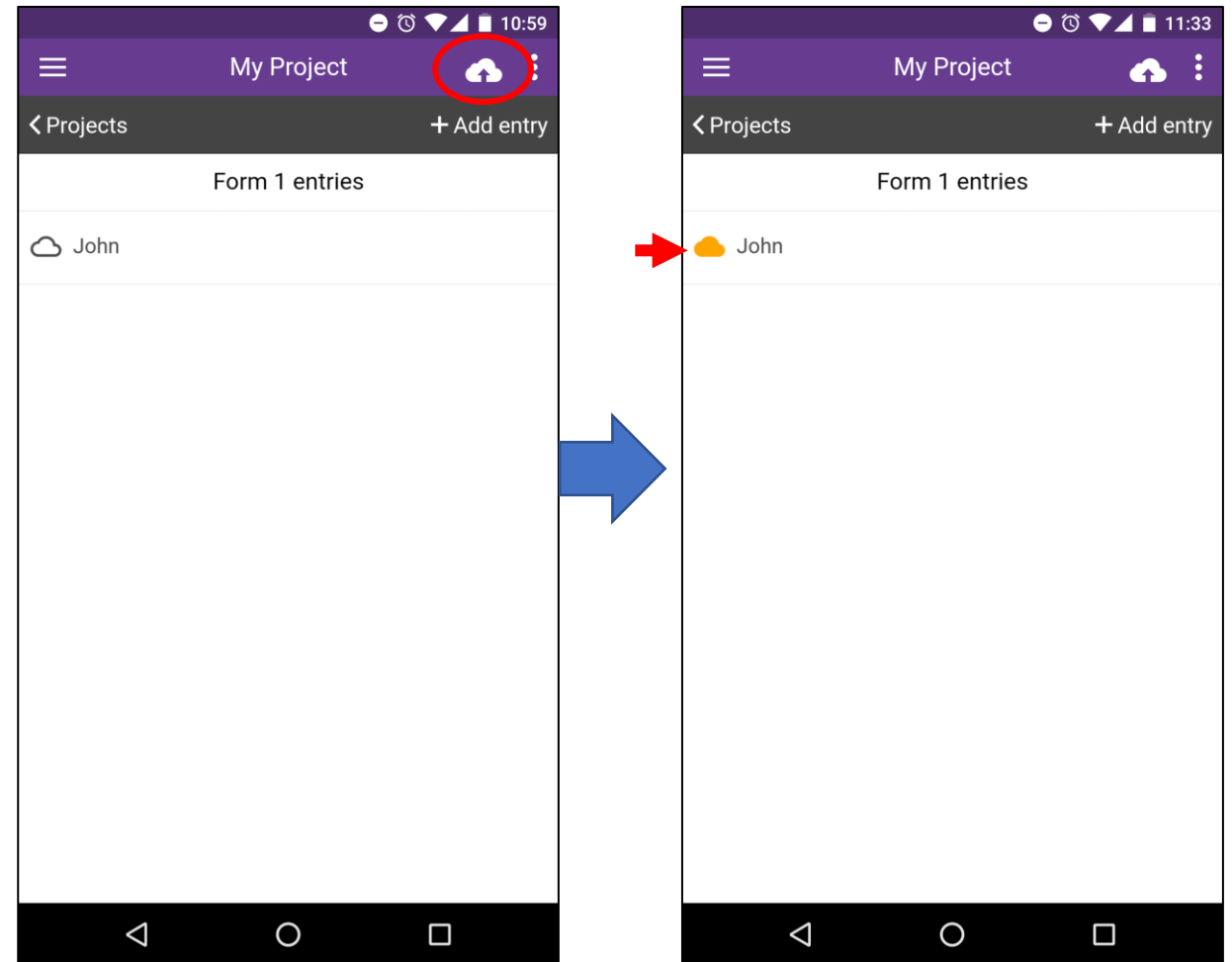


→ When you save your form entry, it will appear in a list of your entries for that project

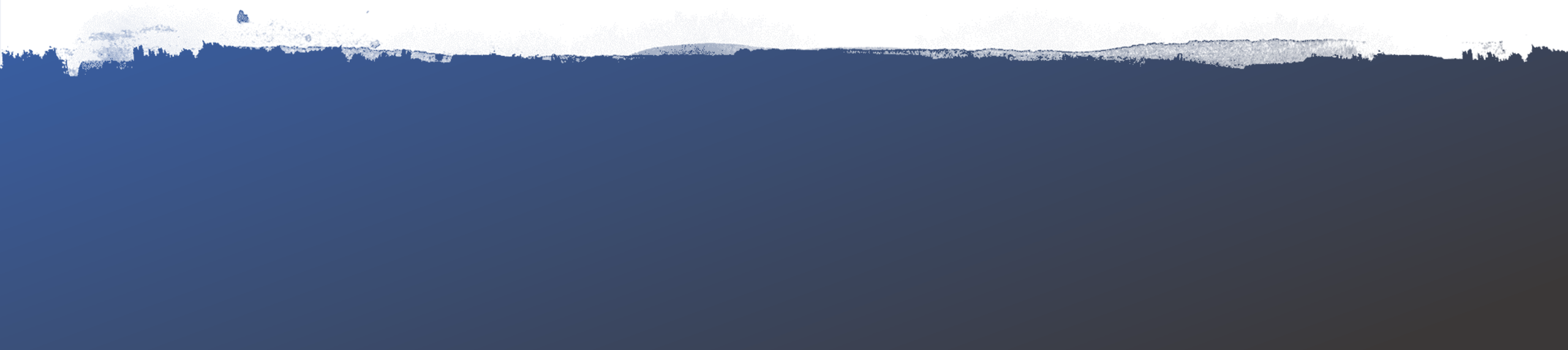
4. Uploading data from the epicollect app

→ Once you have saved and completed your survey and are satisfied with it, click the **upload** button

- You can edit an entry on your phone but only before it's been uploaded
- The web application is the online project database where all data entries are stored and can be viewed
- The cloud icon next to the form entry will change from white to colored once that entry has been successfully uploaded to the web application
- You can add entries when you're offline (in the field) and upload them later when you're online (at home)



Returning from the field



Safely disposing of samples and reagents

- Do not dispose of reagents or water samples mixed with reagents directly into the river or down a surface water drain – this could contaminate the river
- Lower concentration and toxicity reagents found in some of the test kits presented here, mixed with river water samples, can be disposed of in a “green space” away from the river, where the water will infiltrate, and any reagents will biodegrade safely
- Higher concentration and toxicity reagents found in some of the test kits presented should be disposed of down a wastewater sink or toilet when you return home, these will be treated at the sewage treatment works
- Water samples which have not been mixed with any reagents can be returned directly to the river or to a green space
- Take all other waste material, such as packaging, home with you and dispose in your household waste

Storing and maintaining monitoring equipment

After every sampling trip, check that your monitoring equipment is clean and dry before putting it away

You may need to rinse some of your equipment when you get home, for example your sampling devices, containers or sensors, particularly if the water you were sampling appeared to be contaminated

Store all your monitoring equipment in a cool, dry location, ready for your next field survey

Ensure that any electronic monitoring equipment is well maintained and regularly calibrated where required

Thank you for your
contribution to
safeguarding our
rivers!

CARDIFF
UNIVERSITY

PRIFYSGOL
CAERDYDD



Natural
Environment
Research Council