Drinkable Rivers
EUROPE

YOUR NAME

. . . . . .

SUPPORTED BY

WATERLAB
WWW.ONDERZOEKWATER.NL

WAGENINGEN
UNIVERSITY & RESEARCH

FALL 2019

CONTENT

Welcome to the Drinkable Rivers team! From now on, your research and results will be part of monitoring river water quality in Europe. Water is of incredible importance in our daily lives. We drink it, clean with it, swim in it and cook with it, all life is dependent on it. Water is life, we are water and should be thankful.

At the same time, we influence the water and surrounding land with our actions and habits. A couple of decades ago, most rivers were drinkable. In recent years, drinking water straight from a river is almost unthinkable. With Drinkable Rivers, we aim to engage more people to care for their rivers and the surrounding land.

This research is about monitoring water quality in rivers. As a member of our team, you collaborate with Drinkable Rivers, the TU Delft, Wageningen University and mainly other hubs that support our cause. Together, we will gain a broad insight in the health of European rivers.

INTRODUCTION

Your participation contributes to the health of European rivers and the environments that surround them. Keeping an eye on water quality is of vital importance to assess the health of our rivers and whether they may need extra care. Therefore, we combined a set of measurements that in time will give all of us an indication about the quality of the river.

You will measure chemical water quality like hardness, nitrate- and phosphate-content and the amount of dissolved minerals. In addition, you will look at the clarity of the water and investigate the surrounding land.

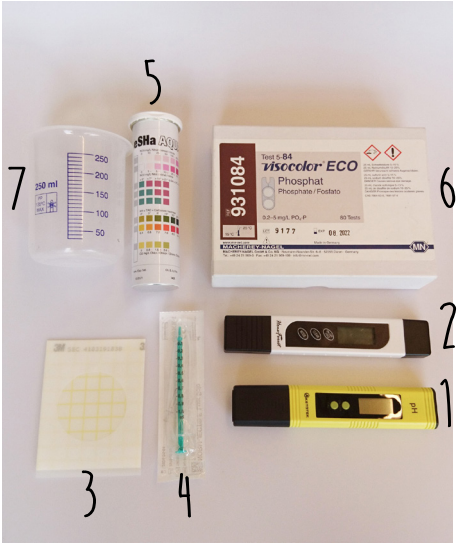
Thank you for joining our research team! In this manual, you will find all the instructions for the measurements and which materials you need. For more info about the project, have a look at *www.drinkablerivers.org*.

REQUIRED MATERIALS FOR ONE COMPLETE SET OF MEASUREMENTS

- This manual
- pH sensor (1)
- EC/temperature sensor (2)
- 1 E. coli patch (3)
- 1 ml pipet (4)
- 1 measuring strip + colour chart (5)
- 1 Visocolor ECO phosphate testkit (6)
- Secchi disk (not in picture)
- Clear container (7)
- Pen/pencil
-

3 apps:

- Eye on Water app on your phone/tablet
- Weather app AccuWeather
- Survey123 app for data submission



Eye on Water

AccuWeather

Survey123

READY TO GO?

You will now measure and observe many factors and circumstances that influence the water quality. For this, you will use your senses and observation skills, a Secchi-disk, a measuring strip, bacterial-patch, multiple digital sensors and two apps.

Before you get started

Before you start, read the instructions to all the measurements, so you know what to do and to reduce the chance of errors. Also, before you go to the measuring location, check whether you have all the materials you need. This includes the apps on your phone or tablet. **It is highly recommended to do the measurements in a group of at least 2 or 3 people, so you can divide tasks and help each other.**

Step 1 - Thank the River

We will start with expressing our gratitude to the river. Before using the water, we will thank it. Being thankful shows we value water. Water give us life, we are water and perhaps you might have never thanked water before. We do thank our parents, our teachers, our friends, why not also thanking water?

Also, if you have a song to share, this might be a good time. If you wish to share a story or an anecdote: what has your experience been with this river? Have you ever swam here? Have you fished or canoed in it? Have you eaten a picknick along the river?

STEP 2 - GENERAL DATA

First, write down the following data:

Name: _____ Country: _____

English/international name of your river:

_____

QR code to dataform

Date and time of your measurements

Date (dd/mm/yy): _____ Time (hh:mm): _____

GPS-location

You can find the GPS-location of your measuring location via, for example, the address bar in Google Maps (see figure below). The GPS-location is indicated by latitude ; longitude. For example, the GPS location of Science Centre Delft (the WaterLab home base) is 52.0070444 ; 4.3672613,17.

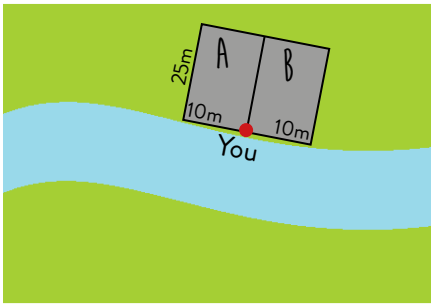
Latitude: _____ Longitude: _____

STEP 3- SURROUNDINGS

After thanking the rivers and adding the basic data, we continue with looking at the surroundings. What do you see? Many environmental factors influence the water. Some of these factors are natural, others are man-made. Focus on the factors named below and fill in your findings.

Materials

-AccuWeather app on your phone/tablet
-Camera on your phone/tablet



What do you see?

Observe the lands surrouding the bank you are standing on from 10m to your left, till 10m to your right. Look about 25m inland (see grey area in diagram). Which types of landuse do you see in panel A and B? (you can choose multiple options):

	A	B
-Agriculture/farming (crops)	☐	☐
-Meadow with fence with animals	☐	☐
-Meadow with fence without animals	☐	☐
-Nature	☐	☐
-Wild animals	☐	☐
-City/village	☐	☐
-Industry (factory, logging, etc.)	☐	☐
-Waste/rubbish (plastic, cans, etc.)	☐	☐
-Incoming streams or distributaries	☐	☐
-Other (describe below)	☐	☐

Air temperature

Asses the air temperature at your location using the AccuWeather app. In this way we ensure that everyone uses the same app and thus the same weather-model. Make sure the app is focussed on the location of your measurement!

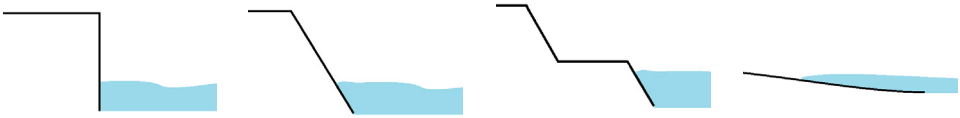
Outside air temp.:_____°C

_____

_____

River bank - Shape

Circle one of the four shapes of the transition from bank to river:



Straight | Angle | Cascading | Gradual

River bank - Soiltype

Circle one of the four soil types at your location on the rivers edge:

Gravel/rocks

Sand

Clay

Concrete/paved

Describe to the surroundings to us. What stands out to you? What did you observe that you could not report above?

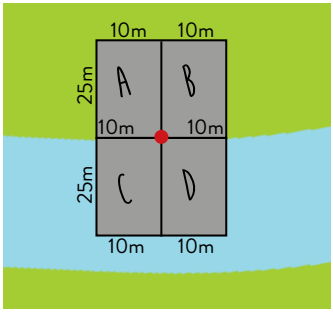
_____

_____

_____

_____

_____



Attach four photos of the surroundings

After you have done the above observations, please take four photos of your surroundings (one for section A, B, C and D) and save them on your phone/tablet. **Please upload them later in the online dataform!**

STEP 4 - SMELL AND COLOUR

How the water smells and looks, can already give you an indication of a river's health. Muddy, stinky water is probably not as healthy as clear water that smells more neutral. Use your senses and describe your findings.

Materials

-Your senses
-Clear container/bottle
-A flat white surface is helpful

Assessing smell

1. Use the container to take a water sample from the river at elbow depth (about 30cm deep).
2. Close your eyes and smell the water in the container. What do you smell? Take your time to really smell and choose one or multiple of the following descriptions:

-No odour	☐	-Sulfuric (rotten egg)	☐
-Slightly earth/soil like	☐	-Slightly chemical	☐
-Earth/soil like	☐	-Chemical	☐
-Stale/musty	☐	-Oil	☐
-Algae (rotten smell)	☐	-Other (describe)	☐

_____

Assessing colour

1. Use the same water sample to assess colour as you used for the smell.
2. Look at the water from above, it helps if you hava white surface under the bottom of the container. How would you describe the colour? Choose one:

-No colour (clear)	☐	-Green	☐
-Light yellow	☐	-Green/yellow	☐
-Yellow	☐	-Grey	☐
-Yellow/green	☐	-Brown	☐
-Light green	☐	-Black	☐
		-Other (describe)	☐

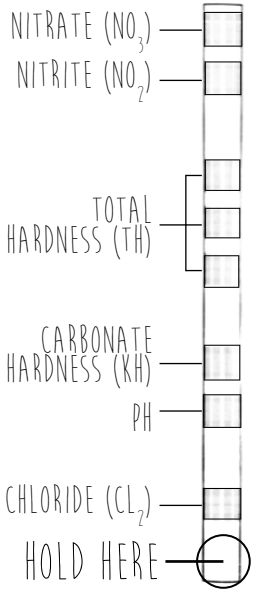
_____

STEP 5 - MEASURING STRIP

Now the water quality measurements begin! You will use a measuring strip to asses the presence of chloride (Cl_2), acidity level (pH), carbonate hardness (KH), total hardness (TH), nitrate-level (NO_3) and nitrite-level (NO_2).

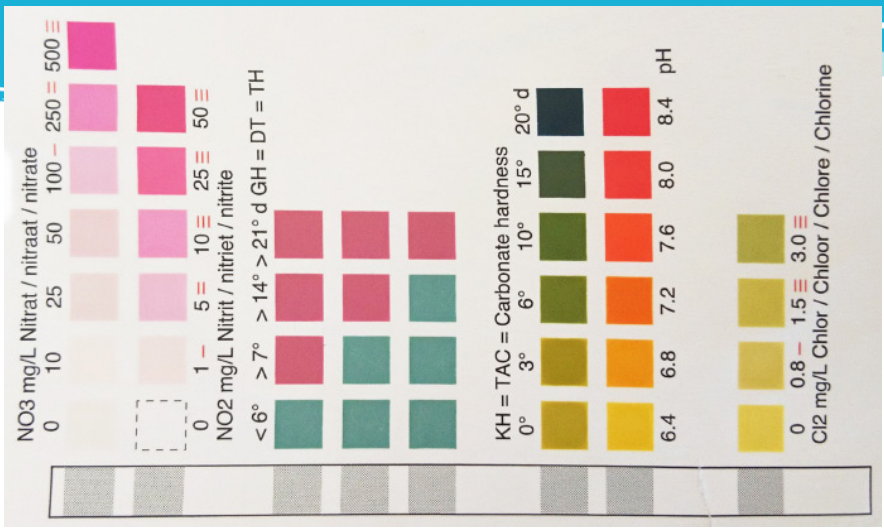
Materials

-Clear container/bottle. It is also fine if you can reach the water directly. Then you don't need a container.
-Measuring strip
-Colour chart on the bottle or as pictured on the next page. *(Beware of change in colour when printed! Please only print in true colours, otherwise the measurement is invalid!)*



Using the measuring strip

1. Look at the strip carefully and compare with the picture to the right. Determine for yourself which square measures which parameter.
2. Use the water sample from the previous measurement. Submerge the entire strip (all squares) for 3 seconds (count slowly).
3. Take the strip out of the water and shake it lightly to remove excess water.
4. Place the strip on a flat, preferably white, surface. **Compare the chloride (Cl_2) measurement immediately with the colour chart. Then *wait 60 seconds* for the other parameters.**
5. Write down the results on the next page. Make sure you write the result of the right square next to the right parameter. If your result is a colour between two adjacent squares, than please write 'between square 1 and square 2' . For example, pH 6,4-6,8.



Results

-Nitrate (NO3) _____ mg/L

-Nitrite (NO2) _____ mg/L

-Total hardness (TH) _____ °d

-Carbonate hardness (KH) _____ °d

-pH _____

-Chloride (Cl2) _____ mg/L

STEP 6 - E. COLI PRESENCE

With this measurement, you will make an estimate of the number of E. coli bacteria that are present in the water. This is very relevant, for E. coli can make you sick if you ingest (too much) water. **Attention: this measurement needs to incubate (grow) for 72 hours (3 days)! Take the petrifilm back home with you and wait with supplying all your results online until you have the E. coli results!**

Materials

-1 Petrifilm for E. coli

-Small pipet (1 ml) in sterile packaging

-Clear container/bottle. It is also fine if you can reach the water directly. Then you don't need a container.

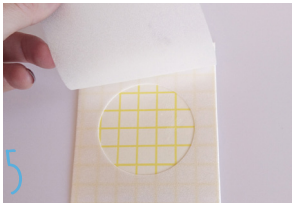
Making an E. coli sample

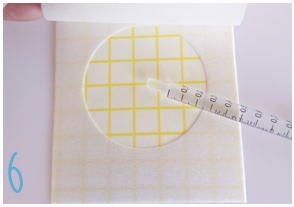
Take note: as we are measuring bacteria content, make sure that your hands nor anything else touches the surface of the circel, due to contamination!

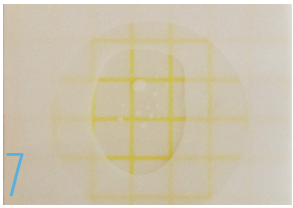
1. Take a new water sample with the white container.
2. Take the pipet out of its packaging. Don't touch the tip or drop it on the ground!
3. Fill the pipet with water from the container until the 1 ml mark.
4. Place the petrifilm on a flat, level surface.
5. Lift the top (see-through) film.
6. Hold the pipet straight above the middle of the circle (with grids) and slowly empty the pipette in the middle. A small circle of water will form around the centre.
7. Roll the top film down onto the sample, so that the water is covered by the topfilm.
8. With your finger, distribute the water on the circle in the following way: slowly press in outward circles on the top film, until the water has spread to the entire edge of the circle.
9. Leave the petrifilm undisturbed for at least one minute to allow the gel to form. Do NOT lift the topfilm for any reason or at any moment from now on.
10. Now move on to the other measurements in this manual.

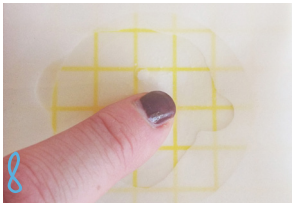
Once you're finished with all the measurements, carefully take the petrifilm home with you and let it incubate at room temperature for 72 hours (three full days).

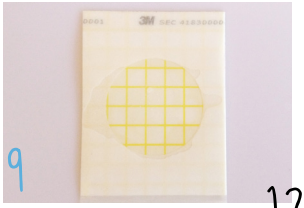
After three days, take a picture (with the date included) and submit it to the dataform. *If you want to, you can do your own count, using the guide on the next page.*









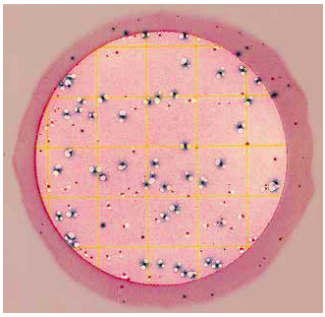


Counting E. coli colonies

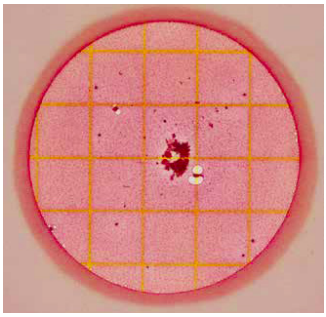
1. The result of this measurement is the number of colonies that have formed on the petrifilm. Look at the petrifilm from above (leave the topfilm down).
2. Look at the pictures below, for tips about how to count the colonies.
3. Count the blue and red colonies that are WITHIN the circle. Colonies on the edges or outside the circle should not be counted. Look at the other tips below!

Result

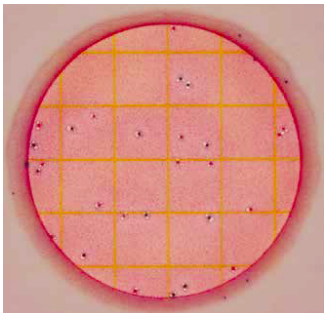
Total number of red + blue colonies: _____



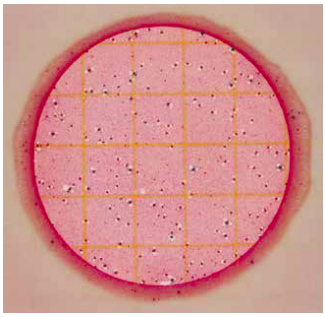
Blue colonies with gas = 49
Total colony count = 87 (red + blue colonies).



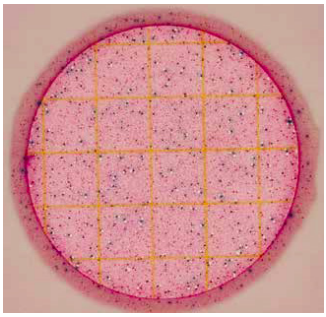
Total colony count = 3 (red colonies with gas). Other particles are irregularly shaped and are not associated with gas bubble and are thus not bacteria.



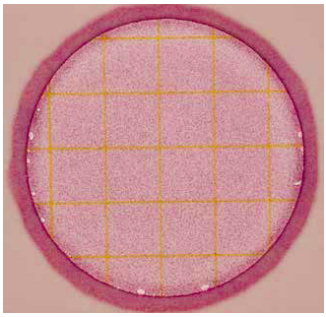
Blue colonies = 13. Total colony count = 28 (red and blue colonies. Do not count colonies that appear on the foam barrier.



Estimated blue colonies = 17.
Estimated total colony count = 150.



TNTC = colonies that are Too Numerous To Count have many small colonies that make it very hard to count them.



Another example of TNTC. The colonies are so small and numerous you can barely see them.

STEP 7- PHOSPHATE

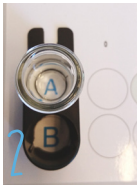
Phosphate, together with nitrate, is one of the most important pollutants for natural waters. Phosphate levels in water are often too high, due to run-off from agricultural fields and sewers. Phosphate functions as a nutrient for aquatic plants, but too much can put a natural system out of balance.

Materials

-1 Visocolor ECO phosphate testkit, containing:
- -1 syringe (do NOT throw away after)
- -2 testtubes
- -Slide comparator
- -Colour chart
- -2 reagents: PO_4-1 and PO_4-2

Measuring phosphate-levels

1. Fill both tubes with 5 ml of sample water. Use the syringe to measure 5 ml and check if the water reaches the line by holding the tube at eye level**. DO NOT throw the water back in the river** at the end of the measurements. Put it down the drain.
2. Place the comparator on the start position on the colour chart. Put 1 testtube in A-position in the comparator.
3. Take the other testtube (B), add 6 drops of **PO_4-1**. Screw the cap on the tube and shake for 10 seconds.
4. Open testtube B and add 6 drops of **PO_4-2**. Again, close the tube and shake for 10 seconds.
5. **Keep the tube closed** and wait for 10 minutes.
6. Open the tube and place it in the B-position in the comparator.
7. Now slide the comparator from left to right across the colour chart, step by step. Look at the tubes from above and compare the colours of A & B. As soon as the comparator is on a step that makes the colour of A & B appear similar, read the number on top of that row.



WRITE THE RESULT DOWN: _____ MG/L

STEP 8 - SENSORS

With the sensors, we will get a more accurate measurement of the pH, which we will compare to the results of the strip. In that way we can assess whether strips are as accurate as sensors, or not. Furthermore, you will use sensors to measure the water temperature and the Electric Conductivity (EC) of the water. The EC sensor measures how much minerals are dissolved in the water, which tells us how salt or fresh the water is. It also gives an indication of the amount of pollutants.

Materials

-pH sensor (yellow)

-EC sensor with build-in temperature sensor (white)

-Container/bottle. It is also fine if you can hold the sensor directly in the river and read the display while the sensor is still in the water.

Measuring pH, EC and temperature

1. Take a new sample with the container or measure the river directly.
2. Take the cap off the sensors.
3. Hold the sensors in the water sample and move them back and forth. In this way, you clean both sensors before you take the measurements.
4. Discard the water sample and take a new one. Do not dry the sensors in between.
5. Turn on the sensors with the on/off buttons.
6. Place the pH sensor in the container (about 3-4 cm/ 1-1,5 inches deep) and wait for 20 seconds. Then read the display and write down the result.
7. Place the EC sensor in the water (same depth as in 6) and press 'mode' until you see µS/cm. Wait 20 seconds and write down the result.
8. Press 'mode' until you see degree Celsius and write down the temperature.
9. Turn the sensors off, dry them carefully and place the caps back on.

Results

pH: _____ EC: _____ Temperature: _____

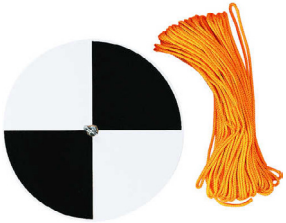
STEP 9 - CLARITY

This final measurement focusses on the clarity of the water: how far can you look into the water? In other words: how much sunlights reaches the bottom? This gives an indication about the amount of plantgrowth (for example, algae) and pollution (for instance, residue from mud or sand). You will measure this in two ways: with a Secchi disk and with the 'Eye on Water' app. These two types of measurements complement each other.

Materials

-Secchi disk on the cap of the **filled** white bottle
-'Eye on Water' app on your phone/tablet

Using the Secchi disk



1. Make sure the water and bottom of the river are not (extra) disturbed before the measurements. So make sure nobody has been swimming or walking in the water, has been poking around with a stick etc. **Ideally, you do the measurement 1 arm length from the riverbank.**
2. The rope of the Secchi-cap has knots at every 5 cm that aid you in estimating how deep the Secchi-cap is submerged (and thus how far you can see into the water).
3. Can you see all the way to the bottom of the river? If yes, lower the bottle with the Secchi-cap all the way to the bottom and count the knots to assess how far you can see.
4. If not, start slowly lowering the Secchi disk in the water, until you can not see it anymore. Then, lift it to the point that you can just about see the distinction between black and white. Count the knots and write down how far the Secchi disk is submerged.

Low turbidity/high clarity

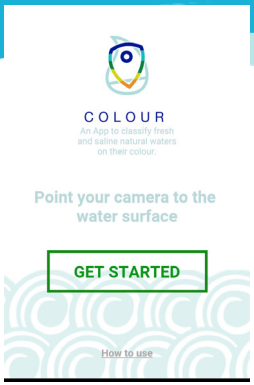
High turbidity/low clarity

Result

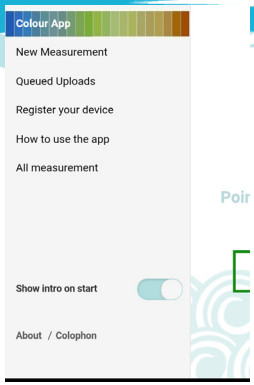
Depth of Secchi disk:_____ cm

Eye on Water app

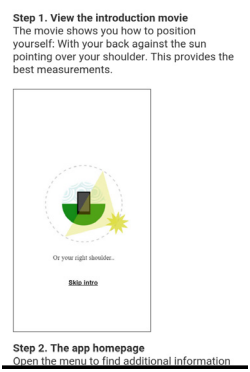
1. Download the Eye on Water Colour app.
2. Open the app. Automatically, a tutorial will play. If you want to see the tutorial again, you can find it online, at the menu on the left.
3. Start a new measurement and follow the steps of the app.
4. Submit your measurement, it will automatically be added to our data map, which can be found here: xxxxxxxxx.
5. Since the Eye on Water measurement is automatically added, you do not need to fill it in at the dataform once you finish all the measurements. **Please make sure that your submission to the Eye on Water app and the dataform have the same GPS location, so that we can combine the data later.**



Start screen



Menu



Tutorial

New measurement

STEP 10 - DATA SUBMISSION

Thank you very much! Now the most important step: Submit your data to us, using the online dataform.
You have written down your data and your E. coli have grown for three days. Did you do the bonus question on page 20? Now you need to submit the data to us. The dataform can be found www.drinkablerivers.org, or by scanning the QR-code to the right. Please submit your data via the form, so that we can collect all the results in one place.

Pay attention when submitting and make sure that you fill out the right data in the right place. Mistakes are easily made, and lead to unusable data. That would be a pity after all your hard work! Read the instruction of the data form carefully before you start filling out your findings.

You need the Survey123 app and a QRscan-app on your phone to use the QR code.

STEP 11 - RETURN THE MATERIALS

-Throw the used measuring strip in the waste bin. Throw away the phosphate samples in the drain. DO NOT throw them back in the river.
-Use the page with materials to count whether your kit is complete before leaving the measurement location.
-Return the research kit and all its tools to the hub that you borrowed it from.
-The only things you should throw away are the measuring strip, the used (and submitted!) E. coli petrifilm and the accompanying pipet.
-If, unfortunately, anything is broken or got lost, please report it to the hub. Don't leave an unpleasant surprise for the next researcher!

FOLLOW UP

The data you submit is collected in an online database. We will download the data on the 25th of October, 2019. The data will then be used by students of the University College Roosevelt and other enthusiastic student or researchers to analyse your findings and get insight in the health of the rivers.

Meanwhile, the data you submit is immediately visible on our online data-map, which can be found at www.drinkablerivers.org and www.onderzoekwater.nl. Here you can see your own data and compare with others.

Share your experience with us, your friends and family. If you write on social media, add **#drinkablerivers, #drinkableriversdata, #citizenscience, #monitorwater** and **#WaterLabSC**, or tag us at **@DrinkableRiver**. Invite others to join as well!

UPDATES? YES PLEASE!

Of course it's fun and interesting to follow the developments of our research. General information about the project can always be found at www.drinkablerivers.org. Whenever there are important updates, we will place them on our Facebookpages (@DrinkableRiver and @WaterLabSC) and websites, or email directly to the hubs, so that they can inform you, our local participants.

If you have urgent questions about the research, please contact your hub first. If they can't answer your question or are unavailable, please email data@drinkablerivers.org.

Drinkable Rivers

CONTACT

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BONUS QUESTION!

DOES YOUR RIVER TAKE IT SLOW?

Rivers flow at different speeds, some are very fast (especially after rainfall) and others flow more slowly. Test the flow of your river.

You need:
-A stopwatch, phone or watch
-A lightweight stick, leaf, or easy to see (non polluting!), floating object.

1. Get your stopwatch or phone ready.
2. Mark your startposition (draw an X in the ground).
3. Throw the stick or leaf into the river, as far from the riverbank as possible.
4. Follow the stick or object for 30 seconds, then stop walking. Mark the spot where you are now.
5. Measure the distance between the start- and endpoint by counting your steps. One large step is about 1 meter.
6. Write down how far your object has travelled in 30 seconds:

_____ METER

SUBMIT YOUR MEASUREMENT WITH YOUR DATAFORM. THEN ALSO ADD A SELFIE FOR OUR WALL OF RESEARCHERS!

THANK YOU FOR JOINING US

MANY THANKS FROM
LI AN, MARIT, SANDRA
(LEFT TO RIGHT)

AND RENATA
(WHO UNFORTUNATELY DIDN'T MAKE IT TO OUR SELFIE)

Drinkable Rivers

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