PROJECT BOOKLET
FOR YOUNG PEOPLE

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BACKGROUND INFO:

PLASTIC PIRATES – GO EUROPE!

Plastic Pirates - Go Europe! is a European citizen science action in which school classes and youth groups collect plastic samples at streams and rivers and document their results. The collected data is then analysed by scientists. In this way, young European citizens make an important contribution to research on the state of European rivers and the degree and possible origins of plastic waste pollution. The action aims to strengthen scientific cooperation in Europe, to promote citizen science engagement and society's participation in the European Research Area, and to raise awareness for a conscious and considerate approach to the environment. The campaign was first developed as Plastic Pirates in Germany in 2016 by the Kiel Science Factory and partners with funding from the German Federal Ministry of Education and Research (BMBF) for the Science Year 2016*17 - Seas and Oceans and has been continued since 2018 as part of the research focus "Plastics in the Environment". During the German EU Presidency in 2020, the campaign was extended to the countries of the Trio Presidency and implemented as a joint action of the Ministries of Education, Science and Research of Germany, Portugal and Slovenia in the period from 2020 to 2021. Since January 2022, the action has been extended to other EU Member States with the support of the EU Commission.

More information on the Plastic Pirates can be found at **plastic-pirates.eu/en**.

THE PROJECT BOOKLET PLASTIC PIRATES – GO EUROPE!

This **project booklet** aims to give young people aged between 10 and 16 hands-on experience of the issues related to seas and the ocean, particularly the problem of plastic waste in seas and flowing waterways. The key questions for the Plastic Pirates are as follows: **How bad is plastic waste pollution in flowing waterways and seas in Europe? What kinds of plastic are particularly common in the environment and what impact does this have on our seas and our ocean?**

This project booklet helps young people find their feet during the excursion and serves as a scientific guide to data collection.

The tone of the booklet is aimed at the young people themselves. It has been designed in such a way that they can complete the various steps of the project independently. Help them in your role as an educator.

The project booklet is suitable for use in a group of between six and 30 young people, whether a school class, a work group or a club. Including preparation and follow-up work, the project takes about three days, or six to eight teaching hours, to complete – plus approx. two hours for sampling. As different amounts of time can be allocated to the individual stages, the project booklet is also well suited to integration within a project week.

WHAT TEACHERS AND GROUP LEADERS NEED TO KNOW

A torn plastic bag on the riverbank or a yoghurt cup floating in the water are symptoms of serious interference with the highly complex system of seas, the ocean and flowing waterways. The **Plastic Pirates – Go Europe!** project focuses on this plastic waste problem and our future handling of it, but aims to familiarise the young people with the general topic of the ocean and water cycles in the process. They will learn what it means to work scientifically – and try their hand at it. Citizen science projects give people interested in science an opportunity to play a hands-on role in the research process. The **Plastic Pirates – Go Europe! campaign is one such example,** contributing to research into the spread of both macroplastic and microplastic in and around European rivers.

This booklet provides a step-by-step guide to conducting the project (including preparation and follow-up work).

The research data collected by many groups throughout Europe will, during the course of the project, be used to create a scientifically sound, digital online map. In a second step, this data will be evaluated by the research partners and then published. The Plastic Pirates team will keep you up to date about the scientific analyses:

plastic-pirates.eu/en/socialwall

The teaching materials and worksheets for the Plastic Pirates – Go Europe! youth campaign

Alongside this project booklet, teachers and group leaders at clubs/associations can also access supporting teaching materials and worksheets on the topic of seas and the ocean. These materials are suitable for educational work in both curricular and extracurricular settings. They contain exercises for young people, are structured in a modular way and can be ordered free of charge at **plastic-pirates.eu/en/material/order**.

FOR YOUNG PEOPLE

This booklet puts you in control. You decide which river you want to investigate for plastic waste. You take the samples. You measure, collect and enter the data gathered into our map at **plastic-pirates.eu/en/results/map**. In other words, you don't just 'play' at being scientists – you are a scientist!

This booklet will tell you exactly how it works and what you need to know. It will guide you through the project over the next few pages. Each step is an important building block for scientific study and ensures that your data are reliable and usable when you have finished.

You will use a range of methods to understand the pollution by waste in and around the river and to record your findings. The booklet contains specific instructions for each method. Split into groups. Different groups will tackle different aspects of the study.

THE BEAUTY OF THE OCEAN

Seawater makes up nearly two-thirds of the earth's surface, which is why earth is a blue planet when seen from space. The seas and the ocean are the largest connected habitat on our planet. They are important and precious – and more than half of the world's population live in coastal areas.

The ocean gives us pleasure in the form of swimming and surfing, days at the beach and cruises. It is our food source, we use it as a shipping route and we search for new natural sources on the seabed. People who do not live on the coast are also connected to the ocean via rivers.

At the same time, the seas and the ocean are also under threat, for example due to pollution caused by plastic waste. By taking part in the **Plastic Pirates – Go Europe!** project, you can help protect the world's seas and the creatures that live there. With the studies that you will carry out on rivers, you will help scientists to find out where the plastic waste is entering the seas and the ocean and where the waste comes from.

On the following pages, you will find out about aquatic ecosystems and their inhabitants.

Terms such as Atlantic Ocean and Pacific Ocean are still used and are not wrong, but marine researchers talk about a global ocean that connects the various sea and ocean basins with the marginal seas. For this reason, the plural term 'oceans' is avoided.

The deep sea

Even today, the deep sea largely remains a mystery.

Scientists know more about the surface of the moon than they do about large sections of the underwater regions of the world. That's because planets and moons can be charted using telescopes and satellites. Back down on earth, however, the ocean itself blocks our view of the seabed. In order to penetrate the depths of the ocean and transmit data and photos from the seabed, it is necessary to send various measuring instruments and robots on complex missions. Frequently, scientists discover new species in the deep sea or are able to photograph creatures that no one has ever seen before.

Large swathes of the seabed are made up of wide plains covered in sediment. Only very few creatures live here, as they are reliant on food that trickles down from above. When a whale dies and its corpse sinks to the bottom of the sea, it provides an abundance of food for all kinds of deep-sea dwellers. Although nearly no humans have seen the deep sea with their own eyes, our plastic waste has made its way into the deepest parts of the ocean (the Mariana Trench).

Why don't polar bears eat penguins?

The polar regions

The Arctic and Antarctic are amongst the coldest, windiest, darkest and stormiest regions on the planet.

The Arctic is an enormous area that makes up about five per cent of the earth and four per cent of the world's seas and ocean. It is a large water basin that is partially covered in ice in winter and summer and surrounded by continents.

The Antarctic, on the other hand, is a giant land mass, Antarctica, 98 per cent of which is covered by a layer of ice that is more than four kilometres thick in places. The lowest temperature ever recorded was –89.2° Celsius and was measured at the Vostok Station in the Antarctic. This is the world's pole of cold. However, because of climate change, the highest temperature to date of 20.7° Celsius was recorded in the Antarctic in February 2020.

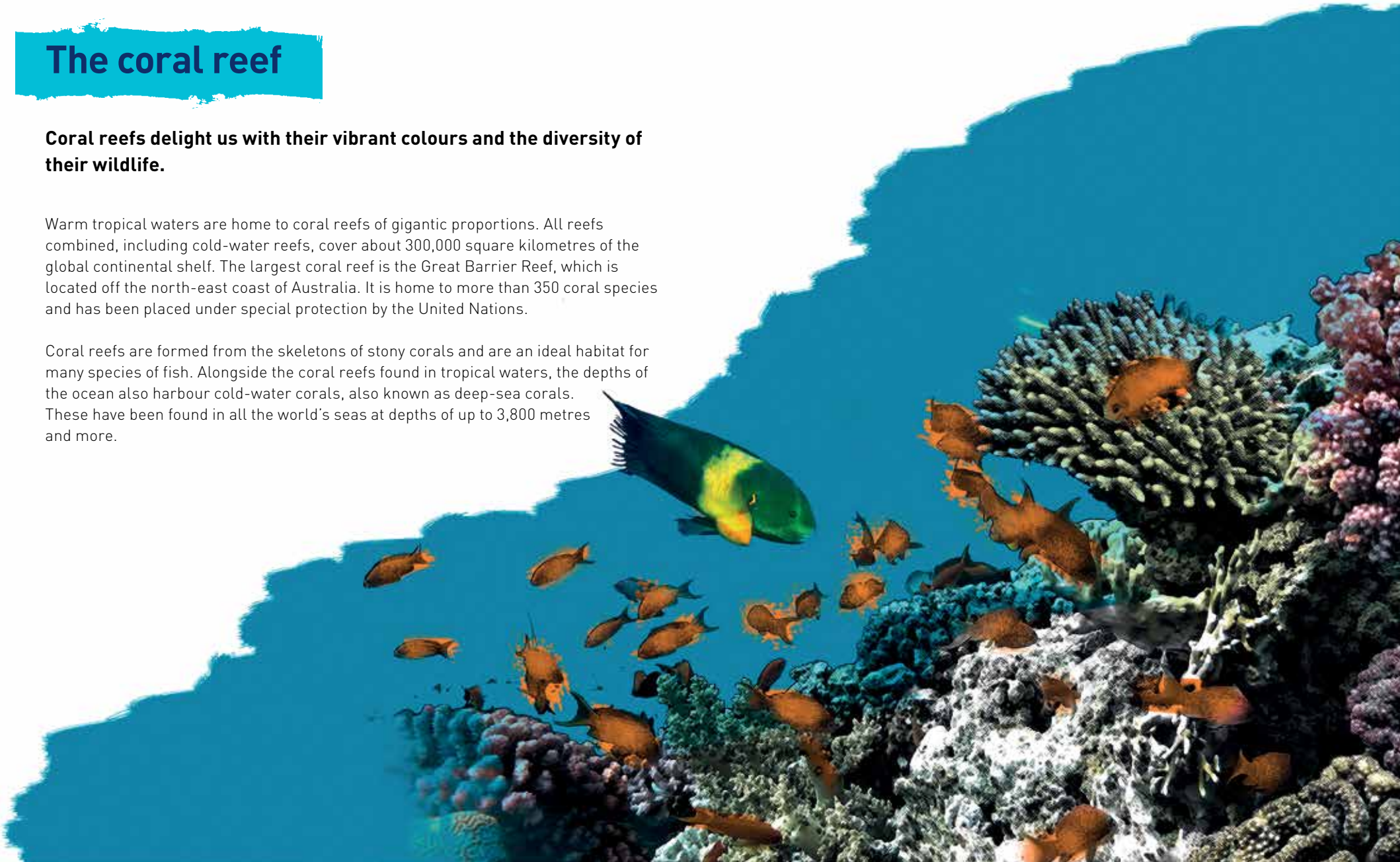
During the short polar summer, the sun doesn't set and its strong rays, combined with the large quantities of nutrients found in the cold waters, give rise to huge plankton blooms (i.e. massive numbers of plant and animal plankton). As a result, many species migrate to the polar regions to reproduce or feed, such as the large fin whales and humpback whales. The Antarctic, which in winter is twice as large as the United States due to the formation of sea ice, is also home to krill, a small shrimp-like creature that emits light. It is found in large swarms and is regarded as one of the most adapted animals on earth. Krill are eaten by penguins, seals and whales.

The coral reef

Coral reefs delight us with their vibrant colours and the diversity of their wildlife.

Warm tropical waters are home to coral reefs of gigantic proportions. All reefs combined, including cold-water reefs, cover about 300,000 square kilometres of the global continental shelf. The largest coral reef is the Great Barrier Reef, which is located off the north-east coast of Australia. It is home to more than 350 coral species and has been placed under special protection by the United Nations.

Coral reefs are formed from the skeletons of stony corals and are an ideal habitat for many species of fish. Alongside the coral reefs found in tropical waters, the depths of the ocean also harbour cold-water corals, also known as deep-sea corals. These have been found in all the world's seas at depths of up to 3,800 metres and more.



EUROPE'S RIVERS –

WHERE THE SEA STARTS

Rivers connect all of Europe – from small streams through to major rivers. One of Europe's longest rivers is the Danube, which flows through a total of ten countries. The Danube stretches 2,850 kilometres from its source to the mouth of the river, where it flows into the Black Sea.

Many animal species that live alongside and in European rivers struggle with similar problems: one example of a typical European species found near rivers is the kingfisher. This little brightly coloured bird eats small fish or water larvae. Although the European population of the kingfisher is stable, the species is experiencing habitat loss due to the straightening of river paths, for example.

A typical freshwater fish found in European rivers is the brown trout, which occurs in clear and cold water from Portugal to the Volga. It is one of the few members of the salmon-like fish family. Brown trout are often severely threatened by environmental and water pollution. In Europe, the otter is found in many waters, but this species is also threatened by habitat changes, resource exploitation, hunting and water pollution and will disappear from many waters if no protection measures are introduced. In some regions where protection measures and reintroduction projects are in place, the otter population is even increasing again.

With regard to the pollution of rivers with litter, research has already shown that large amounts of litter are carried from rivers into the seas and oceans. Here they become a danger to marine life. Where exactly most of the litter ends up the rivers, who is behind it and what effects the litter has on the living creatures in the rivers still raises many questions. This is what you will research in the coming weeks and how you will contribute to a solution of the pollution problem!

DRAW YOUR RIVER HERE!

Your local river

Now it's over to you. Over the next few hours and days, your local river will become your classroom. But before you start doing field work and taking samples from your river, take a look at the river network as a whole.

Exercises

1. Locate your sampling site using Google Earth or an atlas and plot it on the map.

2. Sketch the course of the river in the white box. Note the source and the mouth of the river.

3. Name a maximum of five cities or towns that are passed by the river on its way to the estuary.

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4. Evaluate the state of your river.

- Give examples that indicate a rather heavy use or a near-natural river.
- Research whether there have been restoration measures in the past that have given the river back its natural appearance (such as the reintroduction of animal and plant species).
- Assess whether your river can be classified as rather polluted or clean.

5. Research one particularly fast-flowing and one particularly slow-flowing river within the EU and draw both on the map.
Jot down which factors influence the different flow velocities of rivers.

RIVER POLLUTION

A BIG PROBLEM FOR RIVERS AND THE OCEAN TOO

Sadly, we humans don't always look after our rivers and seas properly, leading to many different types of pollution.

The use of too much **fertiliser** in agriculture and therefore excess fertiliser in water run-off

Noise pollution, from ship turbines and offshore industry

Pollution caused by **organic pollutants** and **harmful substances** such as pesticides

Household and industrial **waste**

Pollution caused by **oil** from shipping and the petroleum industry

Some of the waste that we humans produce is transported into seas and the ocean via rivers. This means that the amount of waste in the ocean increases each year. Long-lasting plastic waste that degrades very slowly is a particularly serious threat to marine wildlife and the entire ecosystem.

But how does the waste enter the sea in the first place and how long does it take for plastic bags or fishing lines to degrade? And, of course, how does the issue affect us and how can we help to improve the situation?
Become a researcher and study the plastic waste found in rivers and seas!

Macroplastic

Macroplastic refers to all pieces of plastic that are larger than five millimetres. These include fishing nets, lids of water bottles, cigarette lighters and flip-flops.

Floating macroplastic is dangerous for marine wildlife. On the one hand, it can easily be mistaken for food and swallowed. As it cannot be digested, the animals starve to death as their stomachs are full of plastic. On the other hand, animals such as turtles, seals and whales can become entangled in torn-off nets, known as 'ghost nets', no longer being able to swim. They end up dying in these fishing nets or from other pieces of plastic waste.

Microplastic

Microplastic is smaller than five millimetres. Scientists now split small plastic particles into different categories based on size – for example larger microplastic (one to five millimetres), smaller microplastic (one micrometre to one millimetre) and nanoplastic (smaller than one micrometre), which is even smaller than bacteria. Microplastic is formed, for example, when larger plastic particles in the ocean are broken down into ever smaller parts by the sun's rays, the salt content in the water and the movement of waves.

Many microplastic particles are caused by car tyres wearing down on the roads. These particles then make it to the ocean via sewers and rivers. Microplastic generated by the fragmentation of larger objects is called 'secondary microplastic'. Small plastic pellets produced by industrial companies for the manufacture of larger plastic objects or as additives for other products also make their way into the environment, for example in transport accidents.

This microplastic is referred to as 'primary microplastic'. Like macroplastic, microplastic can also be confused with food by animals, resulting in it entering their bodies and thus becoming part of the food web. To date, only little research has been conducted into how dangerous microplastic can be for animals and humans. Although microplastic is much smaller than macroplastic, it can also pose a significant risk to marine wildlife.

Due to chemical properties, harmful organic substances can attach themselves to these tiny particles. If they are then mistaken for prey and eaten by plankton-eaters or other animals, they enter the food chain.

INFO

In this project, you will be investigating microplastic particles that are larger than one millimetre.

WORKING LIKE SCIENTISTS

When you think of scientists, you might have an image in your mind of old men in white coats with crazy hair. The reality is very different.

Researchers don't just work in laboratories all day. For some, their laboratory is even outdoors: at the beach, at a lake, in the forest or at a dune. Scientists also attend specialist conferences, supervise students, produce charts and communicate with colleagues – all as much a part of their day-to-day tasks as performing experiments and gathering data. It's a highly exciting and diverse profession. See for yourself ...

Now that you have learned so much about our ocean and our rivers and have gained important knowledge about the problem of waste, it's time to research the issue more closely. It's time for a scientific study.

You should be clear about three things:

- This is a scientific study in which you are gathering important research data on waste. These data will be published afterwards.
- The study will be carried out by many young people in various countries in Europe, so it is important that everyone sticks to exactly the same method.
- In this project, you are the researchers!

In the next few hours, you should therefore work through the FIVE STEPS of any scientific experiment:

STEP 1: Formulate a research question.
STEP 2: Make hypotheses (before starting their experiments, scientists make predictions about what they expect the results to be; these predictions are then checked).
STEP 3: Plan the research method.
STEP 4: Carry out the experiment and gather data.
STEP 5: Evaluate and compare your results.

On the hunt for waste

It is now time to plan the sampling procedure. We want to gain an insight into the waste by and in the river and record it using a variety of methods. Split into groups – with each group concentrating on one aspect of the issue of waste.

Look at the illustration on the next page and read through the research questions for each group (page 16 onwards). Split into groups, with each group selecting an aspect of the study that they will examine in more detail.

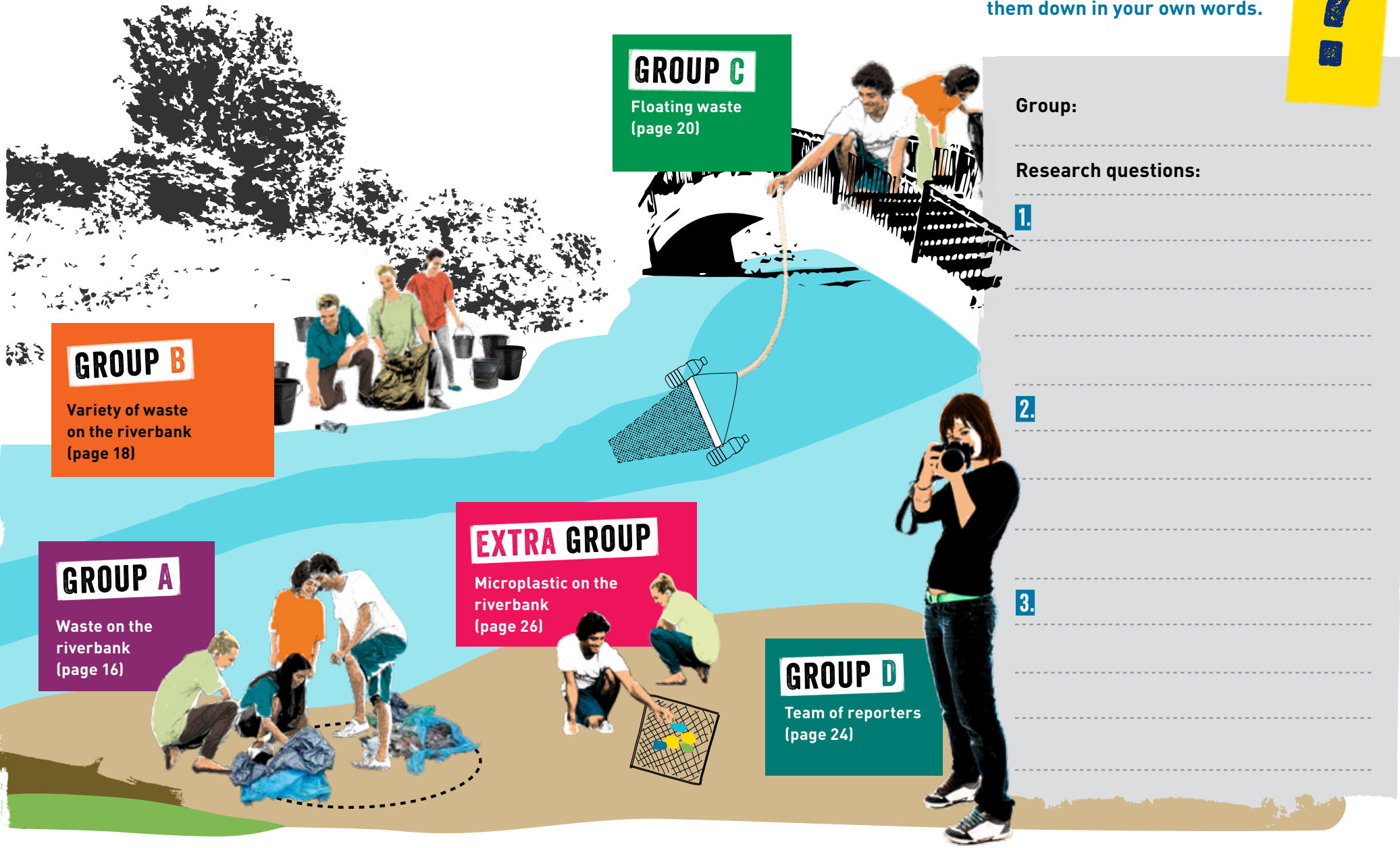
River sampling – let's go!

Samples are taken from European rivers using a particular scientific method.

As it is not possible to take samples of all rivers from source to mouth, we will use random sampling. This will give us a large body of data about the prevalence of plastic by and in European rivers.

The same method will be used at all sampling sites, enabling us to compare the data at a later stage. This is only possible, of course, if everyone sticks to the predefined method.

AN OVERVIEW OF RESEARCH METHODS



GROUP A

Waste on the riverbank
(page 16)

GROUP B

Variety of waste on the riverbank
(page 18)

GROUP C

Floating waste
(page 20)

EXTRA GROUP

Microplastic on the riverbank
(page 26)

GROUP D

Team of reporters
(page 24)

Read through the research questions for your group and write them down in your own words.

Group:

Research questions:

1.

2.

3.

PREPARING TO TAKE SAMPLES

To enable you to compare your results online with other groups at a later stage, it is important that all groups in all locations apply the same method.

Now read your sampling method carefully on the worksheet and fill in the boxes. Start assigning the first tasks to members of your group.

MY GROUP

I would like to do the following job:

Name	Job

Write down the most important aspects of your method in bullet point form:

The sample site

Look for a suitable spot at which to take your samples. When you have decided, think about the following questions:

- How long and wide is the river? Does its appearance change over its course?
- What does the riverbank look like? Think about soil composition, elevations and hollows, and vegetation. Does the riverbank look the same everywhere or are there big differences?
- How is the area close to the riverbank used by humans? How is the river used?

You will soon realise that every river and every riverbank are different. First of all, you will need to find a suitable spot by your chosen river where you can look for different types of waste. Please remember that safety always comes first when doing field work.

- Use Google Earth, for example, for remote exploration of your river and find a suitable site together with the other members of your group. Think about what specifically your group needs (e.g. access to the river, vantage point, plenty of space, particular ground). Please consider the available riverbanks, which could vary for certain rivers due to tides, for example.

Materials list

Look out for both yourselves as well as the environment: adhere to rules in protected areas and respect the breeding periods of birds.

Make sure that the river edge has a sufficiently large, freely accessible area, no dangerous bank and a wind-protected area where you can examine the rubbish more closely. The plastic pirates have already studied large rivers, such as

the Danube, but also very small rivers and streams. For group C it is also important that the river flows at least somewhat, so that the water can pass through the microplastic net.

Take a screenshot of your sampling site on Google Earth, print it out and stick it into the box. Describe the characteristics of your sampling site (meadow, fields, streets, cities, etc.).

Requirements for our group's sampling site:

NOTES

Find out the coordinates of your chosen site in decimal degrees and enter them here:

Latitude .

Longitude .

Example: Brussels/Senne: 50.89853, 4.40344

The pilot phase

A scientific study also includes a pilot phase. This is a trial run of the sampling procedure that helps you prepare for any problems that may occur during the actual sampling. Don't forget that your data forms part of a real scientific study.

Search for your material together and run through your sampling procedure. To do this, look for a large open space (e.g. school playground, empty car park), draw your section of the river in chalk and see where you could take your samples.

Were there any problems? How did you deal with them? What problems do you expect to encounter when taking samples from the river and how might you solve them?

Do you have problems or questions?
Feel free to get in touch with us:
plastic-pirates.eu/en/contact

Problem	Solution

Exploring the riverbank!

If possible (and allowed), explore the surroundings of your chosen site before taking samples. Take photos so that you can show the other groups what it looks like there. Imagine how you will apply your method at the site, taking into account the materials required and the various tasks that need to be completed. Can you identify any further obstacles? Complete the list above.

GROUP A

WASTE ON THE RIVERBANK

RECOMMENDED GROUP SIZE OF FOUR TO SIX

RESEARCH QUESTIONS

1. How much waste can be found on the riverbank?
2. What material is the waste made of? Does it float or sink?
3. How likely is it that the waste found on the riverbank will enter the river? Where on the riverbank is the waste found?

METHOD

1. To sample, you need a bit of space on the riverbank. Look for an easily accessible spot measuring approximately 50 metres along the river and 20 metres from the river.

2. Identify three different riverbank zones:
ZONE A: Foreshore. This zone is in regular (daily) contact with the river and roughly five metres wide. Here, you can often see the most recent high-water mark.
ZONE B: Backshore. This zone is in irregular contact with the river and encompasses the next ten metres of the riverbank.
ZONE C: Riverbank crown. This zone is not in contact with the river and starts about 15 metres from the river.

3. Now mark out your first transect. This is an artificial line that runs from the edge of the foreshore to the riverbank crown, so through all three zones. It is important that you place your transect at random – and not because you see somewhere with a lot or very little waste.

4. Now determine a sampling point in each of the three riverbank zones (A, B, C): at your sampling point, place a stick in the ground and tie a piece of string measuring 1.5 metres in length around the bottom. Run the string along the ground to trace out a circle. Use small stones to mark the circle. Now trace out the second and third circles in zones B and C. The distance between the circles should always be more or less the same. Use the illustration overleaf to help you.

5. Now search for waste in the first circle and place it on a white cloth next to the circle. Only collect waste – no natural objects such as wood or plant remnants. Only collect waste that is at least as large as a cigarette butt (two to three centimetres) and that is actually located within the circle, even if other waste is very close by.

6. On a sheet of paper, write down the transect number, the sampling point (e.g. '1A' means transect 1, foreshore sampling point) and the name of your school or club/organisation. Place this sheet of paper next to your cloth and take a photo of the sheet of paper and the waste spread out on the cloth (see photo on page 17). Make sure that the individual pieces of waste are easily visible, that they do not overlap and that there are no other objects on the piece of cloth. Check whether the waste with the sheet of paper can be identified.

Take a photo of each sampling point, even if no waste was found (photo of the sheet of paper with an empty cloth). Otherwise, your results cannot be included in the scientific study.

AIMS OF SAMPLING

- Identify the different riverbank zones (using the method described)
- Determine sampling points where you can look for waste on the riverbank
- Sort the waste by material

REQUIRED MATERIALS

- A straight stick, approx. 50 cm long
- Piece of string, 1.5 m long
- Pebbles or similar objects to mark out a circle
- Camera or smartphone
- Paper and a thick felt-tip pen
- A white cloth
- Tape measure
- 9 bags (for gathering the waste if this is to be counted later at the school/in the group's room)
- Work gloves

7. Count out the items of waste and sort them by the various materials. Enter your data in the results table on page 28.

8. Repeat the procedure in the two remaining circles and then mark out a second and third transect. This repetition is important to generate reliable data. Please ensure that your circles are roughly level with those of the first transect. Provided there is enough available space, the distance between the transects should be at least 20 metres.

Make sure that the pieces of waste are easily visible and that they do not overlap.

EXAMPLE PHOTO

A transect is an imaginary line that connects two or more sampling points.

Sampling points where data are collected are determined along this line.

TRANSECTS

RESULTS LOG

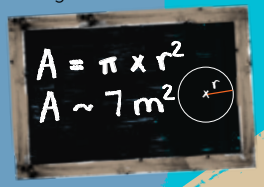
Complete the table on page 28!

TIP

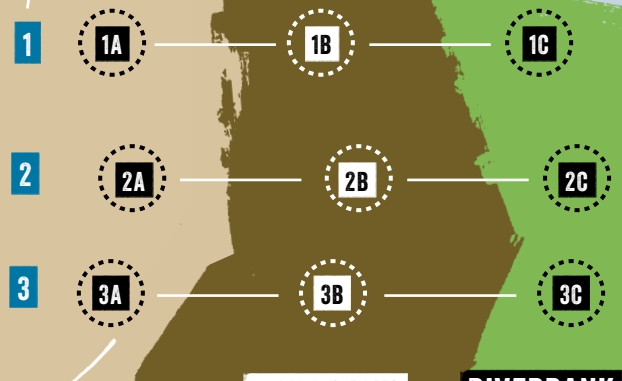
If you find a particularly large amount of waste, you can pack it into bags after the last circle and count it at school or in your group's room. Please ensure that each bag is labelled with the number of the transect and sampling point (e.g. '1A') to avoid mixing up waste from different sampling points.

CALCULATING THE AREA OF THE CIRCLE

In order to work out how much waste there is in one square metre of your riverbank, we first of all need to know the **area of the circle** (A). Use the following formula:



π: Pi = approx. 3.14
r: Radius of the circle (= 1.5 m)



RIVERBANK ZONE A
Foreshore

RIVERBANK ZONE B
Backshore

RIVERBANK ZONE C
Riverbank crown

GROUP B

VARIETY OF WASTE ON THE RIVERBANK

RECOMMENDED GROUP SIZE OF SIX TO EIGHT

RESEARCH QUESTIONS

1. Which category of waste is most represented?
2. Which single-use plastic items were found most often? What is the ratio of single-use plastic waste to other waste?
3. Which (political) measures would lead to less plastic waste on the riverbank?

AIMS OF SAMPLING

- Set up the waste-sorting station
- Categorise the pieces of waste along the riverbank
- Calculate the proportion of single-use plastic

METHOD

1. First, find a place to set up a 'waste-sorting station'. It should be at least 50 metres away from Group A and not be exposed to wind. This is where you will sort, count and document the waste you find. Split yourselves up: at least two participants are responsible for sorting and documentation. More people are needed if a lot of waste is found. The sorters should familiarise themselves with the waste categories (page 28) and set up the station: write the categories on a piece of adhesive tape and stick it to the canvas. Position buckets for the pieces of waste which could easily fly away (plastic packaging and plastic bags) in order to prevent waste already accounted for from mixing with the other waste (page 19). If you should find a lot of waste that doesn't fit into a category, you can supplement the categories with one of your own (see 'Results', page 28).
2. The other participants take buckets and look for waste. **Be careful not to search in the area of Group A (they need an area of approx. 50 metres on the riverbank)!** In the process, do not venture more than 20 metres from the river. Before getting started, mark this 20-metre point and then walk next to each other along the river. Doing so will allow you to maintain approximately the same distance from one another.
3. Collect all of the waste you find. **Be careful if you encounter sharp objects and hygiene items – always use work gloves to pick up these items!** Sandy or dirty pieces of waste should be thoroughly shaken out. Once your bucket is full, take it to the sorting station, where the sorting experts will help you separate the waste into the proper categories. Make your way back to the sorting station after an hour at the latest, or as soon as you are unable to find any more waste.
4. Now measure how much of the riverbank you covered. Use the measuring tape or the string to do so. If you walked quite a distance, you can also measure 50 or 100 metres of string and then simply use the string to measure the distance. Make a note of this value in the data table on page 28.

INFO

Collect and document all waste (not only single-use plastic) in order to generate reliable data about all of the waste.

REQUIRED MATERIALS

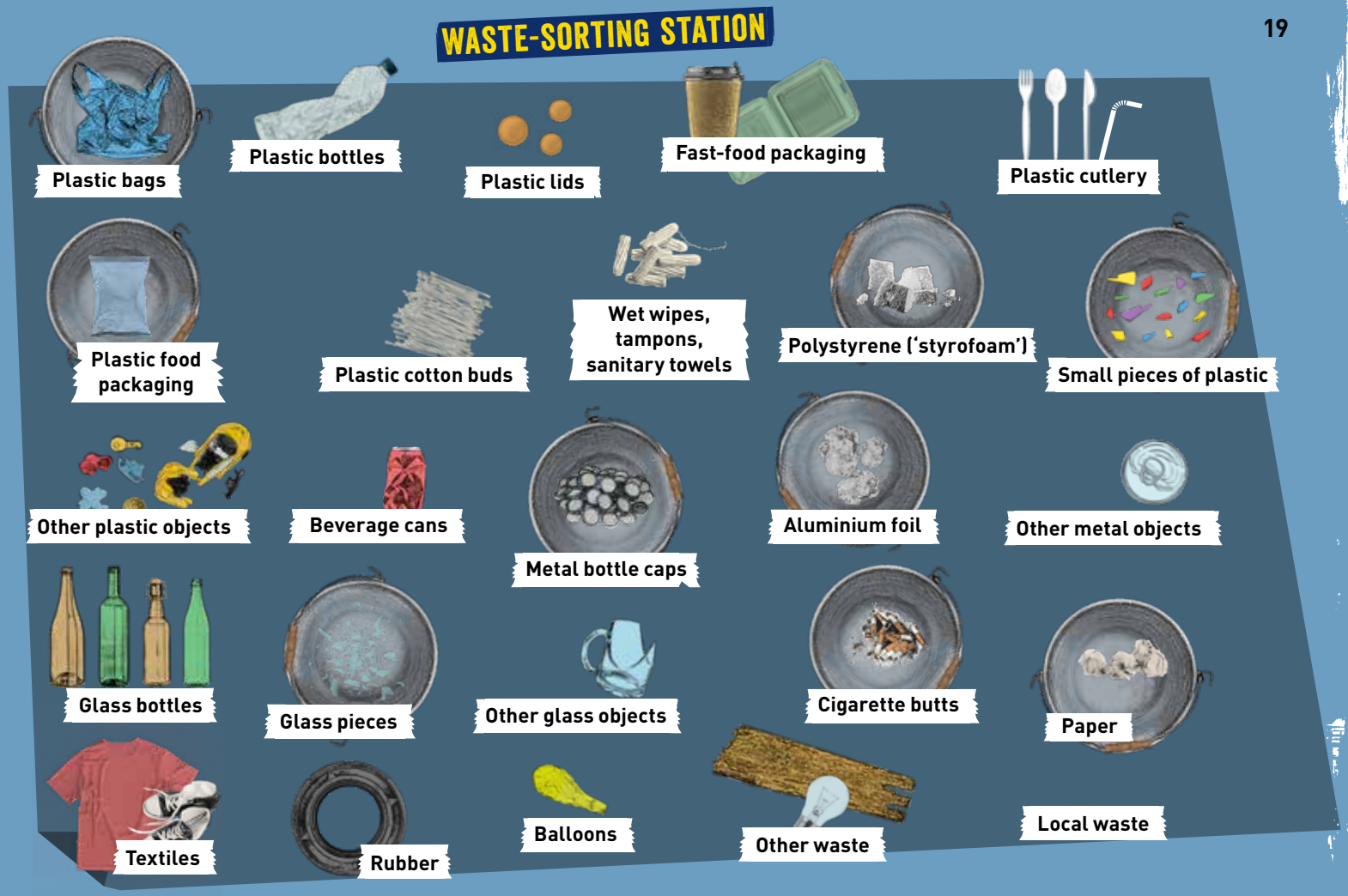
- Buckets, bags or other containers for collecting and sorting the waste (the more the better)
- Canvas, approx. 5 m by 2 m
- Fabric adhesive tape and thick felt-tip pen
- String, at least 10 m long, the longer the better (for measuring the area)
- Tape measure
- Camera or smartphone
- Waste bags for removing the waste
- Work gloves
- Scale, ideally a luggage scale

5. Count up the first pile of waste (see image below) and write down the result in the data table. If no waste was found in a particular category, enter a zero in the table. Now spread the waste out so that nothing overlaps. Take a photo of the waste together with the category name and then check the quality of the photo. Take several photos if too much waste in one particular category is found.

6. Follow this procedure for all of the waste categories.

7. Now weigh the plastic waste you found. Then weigh all of the waste together, including plastic waste, and enter the results in the table (page 28). You can use a waste bag for weighing purposes. Once finished, dispose of the waste properly.

8. Calculate the total number of all types of waste and what percentage each category represents. Use the formula below to calculate the proportion of single-use plastic. Record your results on page 28 and discuss which measures would be effective to reduce the waste in each category (e.g. prohibition of single-use plastic).



% single-use plastic =

$$\frac{\text{Total number of single-use plastic}}{\text{Total number of waste items (including single-use plastic)}} \times 100$$

HOW ARE PIECES OF WASTE COUNTED?

In general, the waste is counted as it is found. Waste items that are only loosely connected or that are found inside other containers are counted individually. For example, a plastic bag that contains other waste must be emptied and each piece must be recorded separately (be careful and wear gloves). Pieces of waste which are firmly connected (e.g. a glass bottle with the lid screwed on) or tightly wrapped objects (e.g. fishing nets) are counted as one piece of waste. The larger object determines the waste category.

RESULTS LOG

Complete the table on page 28!

Plastic bag with straw and disposable coffee cup = category 'plastic bag' 1×, category 'plastic cutlery and plates' 1×, category 'takeaway packaging' 1×

Glass bottle with a screwed-on metal lid = category 'glass bottle' 1×

GROUP C

FLOATING WASTE

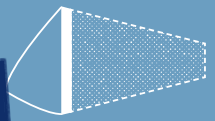
RECOMMENDED GROUP SIZE OF FOUR TO SIX

Your group will examine two different types of waste: larger floating waste and microplastic.

RESEARCH QUESTIONS

1. How many large items of waste float along the river towards the sea? Is the majority of what you see floating natural (e.g. leaves and branches) or rather floating waste?
2. How large are the floating items of waste and what materials are they made of?
3. How much microplastic is floating in the river towards the sea?

A NET FOR SAMPLING MICROPLASTIC



If you wish to take part in sampling of microplastics, you will need a special net, which you can borrow free of charge from our website plastic-pirates.eu/en/material/sampling-net. Remember to send your net back once you have taken your samples – also free of charge, of course.

AIMS OF SAMPLING

- Sample with the net
- Observe floating waste
- Count and classify large floating waste and larger microplastic

METHOD

CASTING THE SAMPLING NET

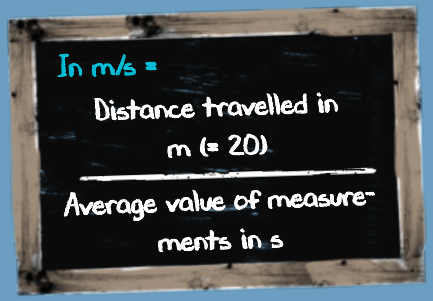
1. Find a suitable spot for casting your sampling net. This could be a jetty, a small bridge or an accessible spot on the riverbank.
2. Cast your net, with the opening facing the opposite direction to the river's current. Stabilise the net so that the river water can flow through the opening. Note down the current time. The net should be in the river for 60 minutes. You can tie the net to a bridge railing or a bollard. Once the net is attached, please take a photo of it floating in the river. This information will be helpful later to interpret the data.

REQUIRED MATERIALS

- Sampling net
- String/rope (to cast the net)
- Stopwatch/smartphone
- Tape measure or string, 20 m long
- Three sticks of similar size (may be found at the sampling site)

MEASURING THE FLOW SPEED

3. Now measure the flow speed of the river right next to the location where the net has been cast: to do so, use the measuring tape to measure off 20 metres on the riverbank along as straight a stretch as possible. Mark a starting point at zero metres and a finishing point at 20 metres.
4. Now lay or toss one of the sticks at the level of the starting point and the approximate location of the net and start the stopwatch. Stop the stopwatch as soon as the stick passes the finishing point. Record the time in seconds in the results table on page 29.
5. Repeat the measurement with the two remaining sticks and complete the table.
   Calculate the average and use the following formula to calculate the flow speed of your river.



OBSERVATION OF FLOATING WASTE

6. Now start observing floating items. Look for a vantage point from which you can observe the floating waste. If possible, stay close to your net so that you can monitor it. Now estimate the entire width of the river and the width which you can overlook. Objects in the water (buoys, rocks) can be helpful in doing so. On a bridge, you can also determine the GPS coordinates and use those to determine the width of the river. Enter both values on page 29.

7. Now keep a lookout for floating waste. As soon as you see an object, try to take a photo of it. Make the other members of your group aware of it and, together, attempt to identify the object and to find out what material it is made out of. **Waste that is stuck and not drifting is not counted.** Make a note of your observations in the list on page 29. Keep a watch for floating waste for at least 30 minutes.

8. As soon as the period has elapsed, write down the time in the results table. Retrieve the net after 60 minutes and make a note of the end time when you do this.

9. Seal the net so that it doesn't come open again. Take it to your school or group room to dry. The next page continues with the analysis of the microplastic.

WIDTH OF THE RIVER

Use Google Earth, for example, to measure the width of the river at the point from which you made your observations. Enter the value in the results table on page 29.

CALCULATION OF MICROPLASTICS PER 1,000 LITRES OF RIVER WATER

You will need the following data to calculate the number of microplastic fragments per cubic metre of river water:

- Flow speed in m/s.
- Area of the net opening; measure the internal opening of your sampling net in metres!
  Side a = ... m, side b = ... m
  Don't forget that not all of the net is submerged in the water. Normally, about 9 to 11 cm of the net is submerged. Therefore, use a value of 0.09 m for b. Calculate the surface area of the opening in m^2: **a × b = ... m^2**.
- Length of time for which the net was cast, in seconds.

Enter your values in the following formula:

$$\text{Number of microplastics per 1,000 litres} = \frac{\text{Number of microplastic fragments in the net}}{\text{Flow speed of the river in m/s} \times \text{Area of the net opening in } m^2 \times \text{Length of time (in seconds) for which the net was cast}}$$

ANALYSIS OF THE MICROPLASTIC

WHITE PELLETS

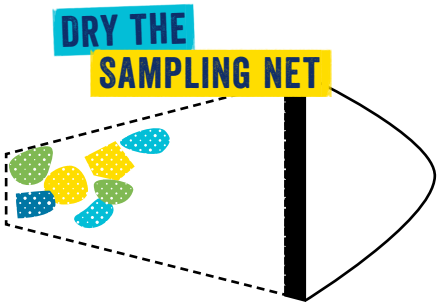
MICROPLASTIC FILAMENTS OF VARIOUS COLOURS

SMALL STONES

MICROPLASTIC FRAGMENTS OF VARIOUS COLOURS

INFO! IDENTIFYING MICROPLASTIC

It isn't always easy to tell small plastic fragments apart from stones, shards of glass and mussel shells. Take a look at and compare the photos. What are the differences between the four groups? Pay special attention to the differences between white pellets, white fragments and pebbles.



RESULTS LOG

Complete the table on page 29!

As soon as the net (and its contents) are dry, open it and empty the entire contents onto a tray. Ensure that you have really removed all materials; otherwise, small pieces could remain in the net.

Look for microplastic using a dissecting microscope or a magnifying glass and sort the plastic pieces into fragments and pellets. Make a note of the results in the table on page 29. Please see the opposite page for details on how to recognise microplastic.

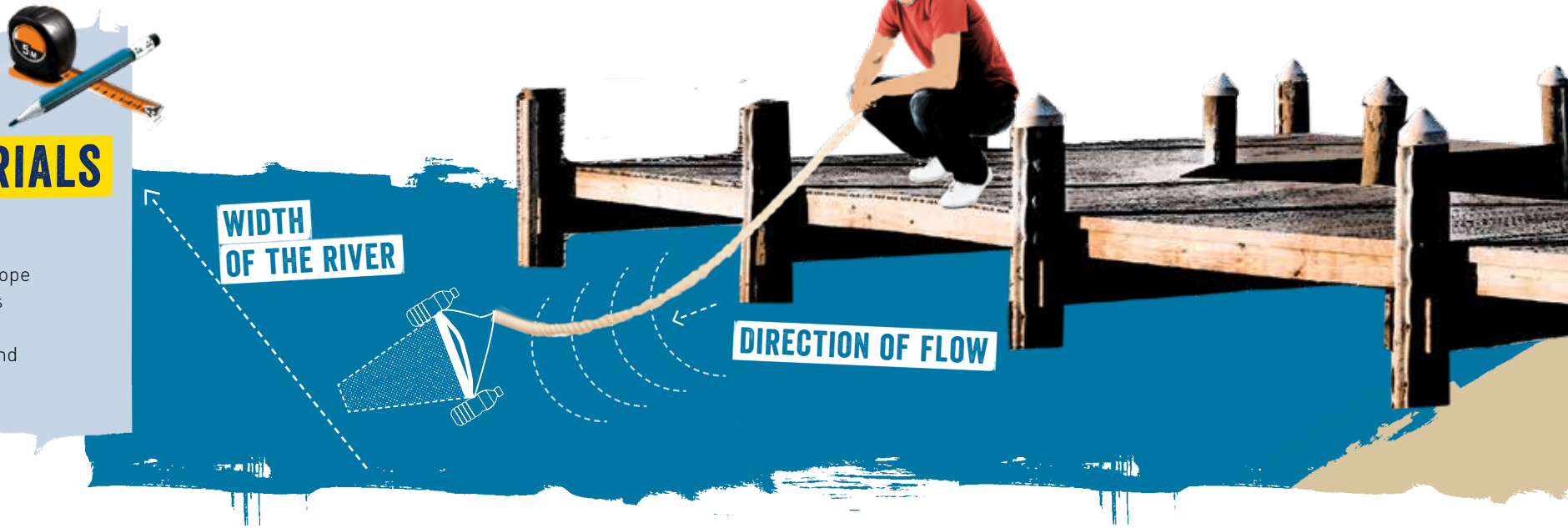
Then pack the entire contents of the net (microplastic and other objects) into a tightly sealable bag and label this bag with the name of your school or organisation and your group name.

Your teacher/group leader will return this bag to us along with your net so that your results can be confirmed.

Note: Please send the sample even if you did not find any microplastic.

REQUIRED MATERIALS

- Tray
- Dissecting microscope or magnifying glass
- Sealable bag (to send off the sample)



GROUP D

TEAM OF REPORTERS

RECOMMENDED GROUP SIZE OF FOUR TO SIX

RESEARCH QUESTION

1. How successful was sampling?
2. What are the possible sources of waste near the river? Where does the waste come from? Who might be responsible?
3. How could we possibly handle the waste problem?

METHOD

1. Search for possible sources of waste in the surrounding area and take photographic evidence. Consider the following sources of waste: overflowing bins by the river, overflowing bins near the river, bulk waste, scrapyards, diverted waste water, gratings, fishing equipment, very light plastic objects (which could be transported by wind). Could a larger one-time event be responsible for the waste (e.g. a storm or a festival)?
2. As a group, discuss whether there have been any severe weather conditions in recent weeks. If yes, mark the corresponding data fields on page 29.
3. Collect the data from groups A, B, C and the extra group and enter all values in the tables on pages 28 and 29. Do this very carefully, because this step is very important so that your collected data can be included in the scientific evaluation.
4. Talk to the other groups and interview them. What methods have they used and what did they aim to research? Were there any major problems? What was their motivation like when taking samples? Complete the results table on page 29.
5. Ask the other groups what waste they have found so far and think about where it might have come from. Take photographic evidence.
6. Now take a photo of all participants (using a self-timer if available) and write the name of your school/organisation and the river on the photo. With your consent, this photo and your group name will be shown for all to see on the interactive map at: **plasticpirates.eu/en/results/map**!
7. Don't forget to make a note of the date of today's sampling on results page 29. Also note down the coordinates (in decimal degrees) of your group C sampling location there (you can use Google Maps for this, for example, and ask your teacher for help if necessary).

AIMS OF SAMPLING

- Document the sampling with photos or a short video
- Seek out and identify sources of waste and estimate the effects of the weather
- Secure data and photographic evidence

REQUIRED MATERIALS

- Camera or smartphone
- A notepad and pen

INFO

Did you see any animals or plants that were affected by the waste? Feel free to send us photos!

ARTICLE ABOUT THE SAMPLING PROCESS

Take a look at your photos and write a short article about your sampling procedure for your school website. It may include the following:

- The jobs done by each group
- How much waste was found by each group, and what kind
- Whether any microplastic was found
- The suspected source of the waste
- How you liked the work and the project
- How river waste can harm plants, animals and humans
- What we can all do to avoid waste in rivers and seas

Publish a few of your photos or a short video.

What kind of waste is left behind and by whom? Take a look at the table and think about further evidence that may shed some light on the source of the waste.

Source of waste	Evidence
Residents	**Overflowing bins, household waste**
Riverside visitors	**'Party waste' (barbecue equipment, empty beer bottles)**
Fly tippers	**Junk**
Industry	**Microplastic pellets**
Agriculture	**Larger plastic films for covering fields, plastic coverings for greenhouses**
Shipping	**Items that are used on board ships: canisters, waterproof clothing**
Fishing	**Nets, fishing lines, salt packs, polystyrene/styro-foam boxes, other fishing equipment**
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EXTRA GROUP

MICROPLASTIC ON THE RIVERBANK

OPTIONAL, IF THERE IS A SANDY BEACH

RESEARCH QUESTIONS

1. How much microplastic can be found on sandy sections of the riverbank (river beaches)?
2. Compare the microplastic you found on the riverbank with the plastic shown on page 22 and categorise it.
3. Does the microplastic look similar to the food of a bird species common in the area?

METHOD

1. Identify the high-water mark (the point at which wet and dry sand meet). If you cannot find this line, take samples within the first metre of the riverbank.
2. Lay out a 20-metre-long piece of string along this line and mark out three points parallel to the river – at the start, middle and end of the length of string.
3. Measure out a 50 centimetre by 50 centimetre square at each of these points and mark it out in the sand.
4. Go to the first square. Remove all larger natural objects (e.g. stones, algae, plants, wood). Use a spade to dig about two centimetres into the sand within (!) the square and deposit it on a tray.
5. Filter the sand on the tray with the sampling sieve. Place everything left behind in the sieve onto another tray. If the sand is damp, do not filter it on the beach, but pour it into a bag. Label the bag with the sampling point number (1, 2, 3), close it securely and take it with you back to your school/group room. Here, leave your sand to dry in appropriately labelled trays and filter it once it is dry. Place everything left behind in the sieve onto another tray.
6. Take a close look at the contents of the tray. Sort microplastic into one corner, count the plastic fragments and pellets and complete the results table on page 29. Page 22 (Group C) describes how you can recognise microplastic.
7. As soon as you have counted all the microplastic pieces and entered them into the table on page 29, label a bag (name of your school/organisation, sampling point number (1, 2, 3)). Pour the entire contents of the tray into the bag, including sand (not only the larger microplastic). Seal the bag.
8. Repeat the procedure with the second and third samples. Note: Please do not mix the samples; instead, pour them into separate labelled bags.

AIMS OF SAMPLING

- Determine the high-water mark and trace a transect along the sandy beach
- Separate microplastic and sand by filtering
- Identify and classify microplastic

REQUIRED MATERIALS

- Sampling sieve, mesh width: 1 mm; find instructions at **plastic-pirates.eu/en/material/download**
- Piece of string, 20 m long
- Small spade or tub to dig out the sand
- Three sealable bags to hold the samples
- Trays

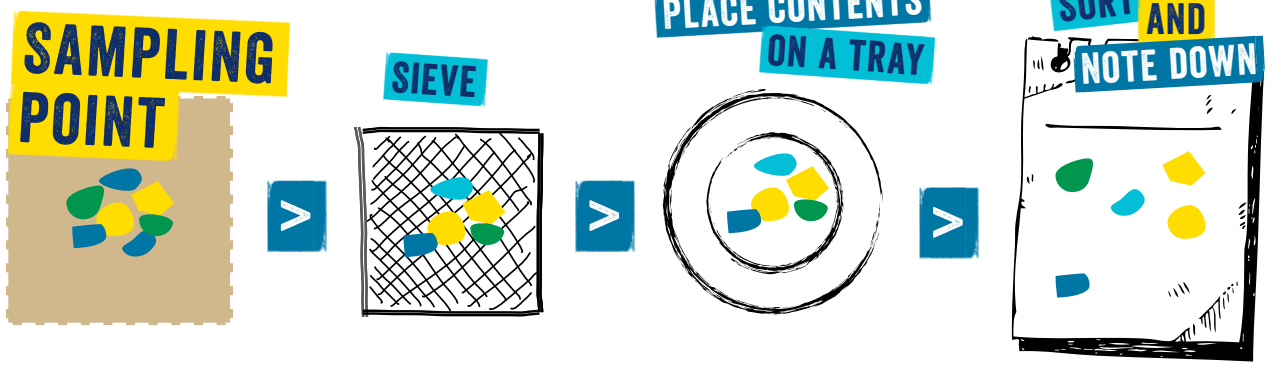
CALCULATING THE SAMPLING AREA

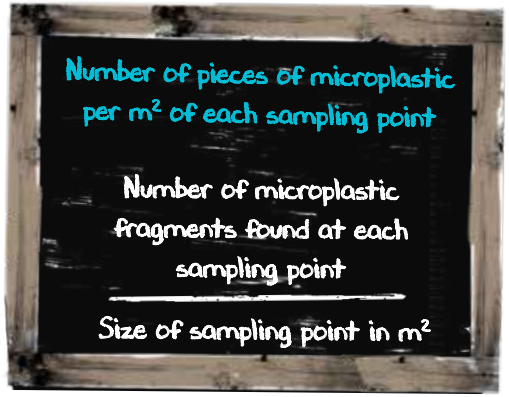
- Work out the size of your sampling squares in m^2: **side a in m × side b in m = … m^2**
- Calculate the number of pieces of larger microplastic for 1 m^2 of each sampling point: number of larger microplastic fragments / area of the sampling point in m^2
- Calculate the average of the three sampling points to determine how much larger microplastic per m^2 of river beach you found

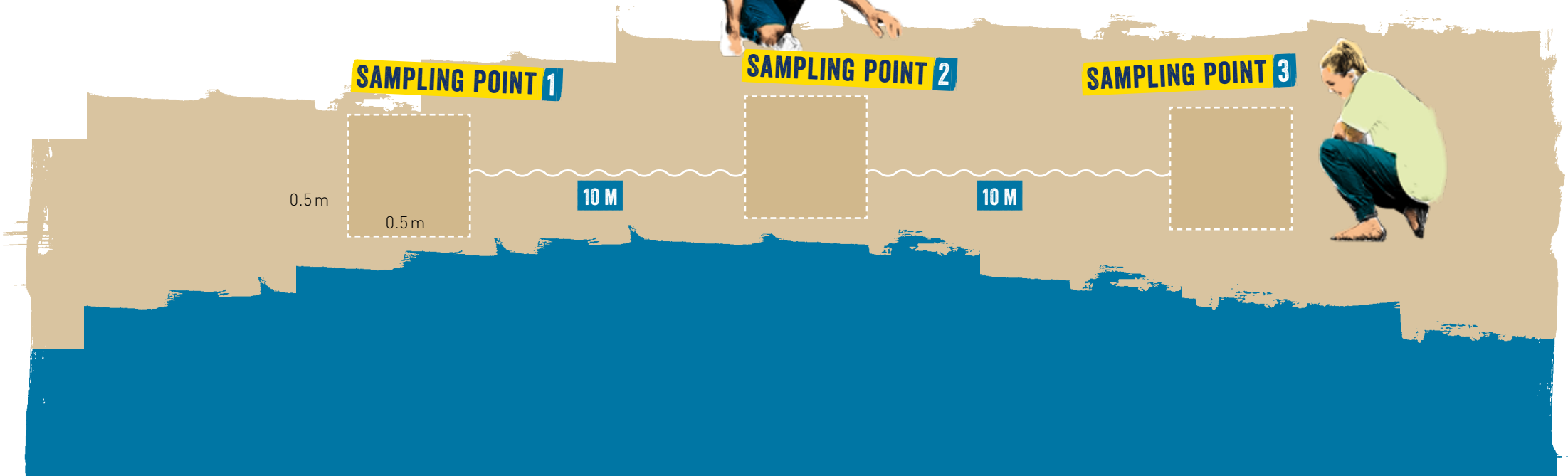
A SIEVE
FOR SAMPLING MICROPLASTIC AT THE RIVER BEACH

If you wish to take part in sampling of microplastic, you will need a sampling sieve, which you can construct yourselves.

You will find instructions on the website plastic-pirates.eu/en/material/download.







RESULTS
HOW POLLUTED IS OUR RIVER?

Once you have entered your results, ask the other groups to complete the tables. You will then have an insight into your river and the types of waste present there.

GROUP A

WASTE ON THE RIVERBANK

	Transect 1			Transect 2			Transect 3			
	Sampling point A	Sampling point B	Sampling point C	Sampling point A	Sampling point B	Sampling point C	Sampling point A	Sampling point B	Sampling point C	Total waste types
Paper										
Cigarette butts										
Plastic										
Metal										
Glass										
Food leftovers										
Other waste										
Total of each station										
Per m²										*

* To calculate the total amount of waste per m², divide the total amount of waste by the total area of all stations you have examined. If you have done all 9 stations, then you have to divide the sum of the waste parts of all stations by the total area (63m²).

Average waste per m² in each riverside zone:

foreshore	backshore	riverbank crown
(Sum of the waste parts of station A) / (Investigated area of station A)	(Sum of the waste parts of station B) / (Investigated area of station B)	(Sum of the waste parts of station C) / (Investigated area of station C)

GROUP B

VARIETY OF WASTE ON THE RIVERBANK

PLEASE NOTE

If you find a lot of waste which cannot be put into a category, but which is important for your sampling location or for current events, describe it and count it in the field labelled 'Local waste'. This could be, for example, salt packs for fishing, stacks of old newspapers, batteries or face masks and disposable gloves that have accumulated due to the coronavirus pandemic.

	Number
Plastic	
Plastic bags	
Plastic bottles for drinks	
Plastic lids of drink bottles	
Takeaway and fast-food packaging, including disposable coffee cups and their lids	
Plastic cutlery and plastic plates (also plastic coffee stirrers and plastic straws)	
Plastic packaging for sweets, biscuits, crisps, etc.	
Cotton buds with plastic sticks ('Q-tips')	
Wet wipes, tampons and sanitary towels	
Polystyrene ('styrofoam')	
Total number of single-use plastic	
Small pieces of plastic less than 2.5 cm	
Other unidentifiable plastic objects	
Metal	
Metal beverage cans	
Bottle caps	
Aluminium foil	
Other unidentifiable metal objects	
Glass	
Glass bottles for drinks	
Glass pieces	
Other unidentifiable glass objects	
Other waste	
Cigarette butts	
Paper	
Textiles (clothing, shoes, textile remnants)	
Rubber (car tyres, rubber bands)	
Balloons	
Other unidentifiable waste	
Local waste:	
Total number (including single-use plastic)	

Share of single-use plastic in the total number of all waste items found: ____ %

Length and width of riverbank searched: L ____ m W ____ m

Weight of total plastic waste: ____ kg

Weigth of all waste including plastic: ____ kg

GROUP C

FLOATING WASTE

Flow speed m/s

Run	Distance in metres	Time in seconds
1st stick		
2nd stick		
3rd stick		

Microplastic

Start time : End time : Time in minutes

	Pellets	Fragments	Total
Number of fragments caught			
Number per 1,000 l of water			

Floating items

Start time : End time : Time in minutes

List of floating waste (item and material, e.g. 'bottle (plastic), bag (paper), string (other)')

Total number of floating waste

River width:

Observed width for the quantification of floating items:

EXTRA GROUP

MICROPLASTIC ON THE RIVERBANK

Microplastic	Sampling point 1	2	3	Total
Pellets				
Fragments				
Total of each station				
Per m²				

GROUP D

TEAM OF REPORTERS

Sources of waste	Yes	Possibly	No	Evidence
Residents				
Riverside visitors				
Fly tippers				
Industry				
Agriculture				
Shipping				
Fishing				

Sampling point coordinates

Latitude: .

Longitude: .

Sampling date: . .

Weather over the last seven days	Yes	No
Heavy rain, flooding		
Storm, strong winds		
Heat, dryness		

Problems during sampling	No problems	Some problems	Lots of problems	The biggest problems
Group A				
Group B				
Group C				
Extra group				

UPLOAD YOUR DATA

Once you have evaluated your findings, you should upload the key data, as well as your photos, to the following website:

plastic-pirates.eu/de/results/data-upload

Think about a name for your group, which you will use when uploading your results so that other project groups can compare their findings with yours.

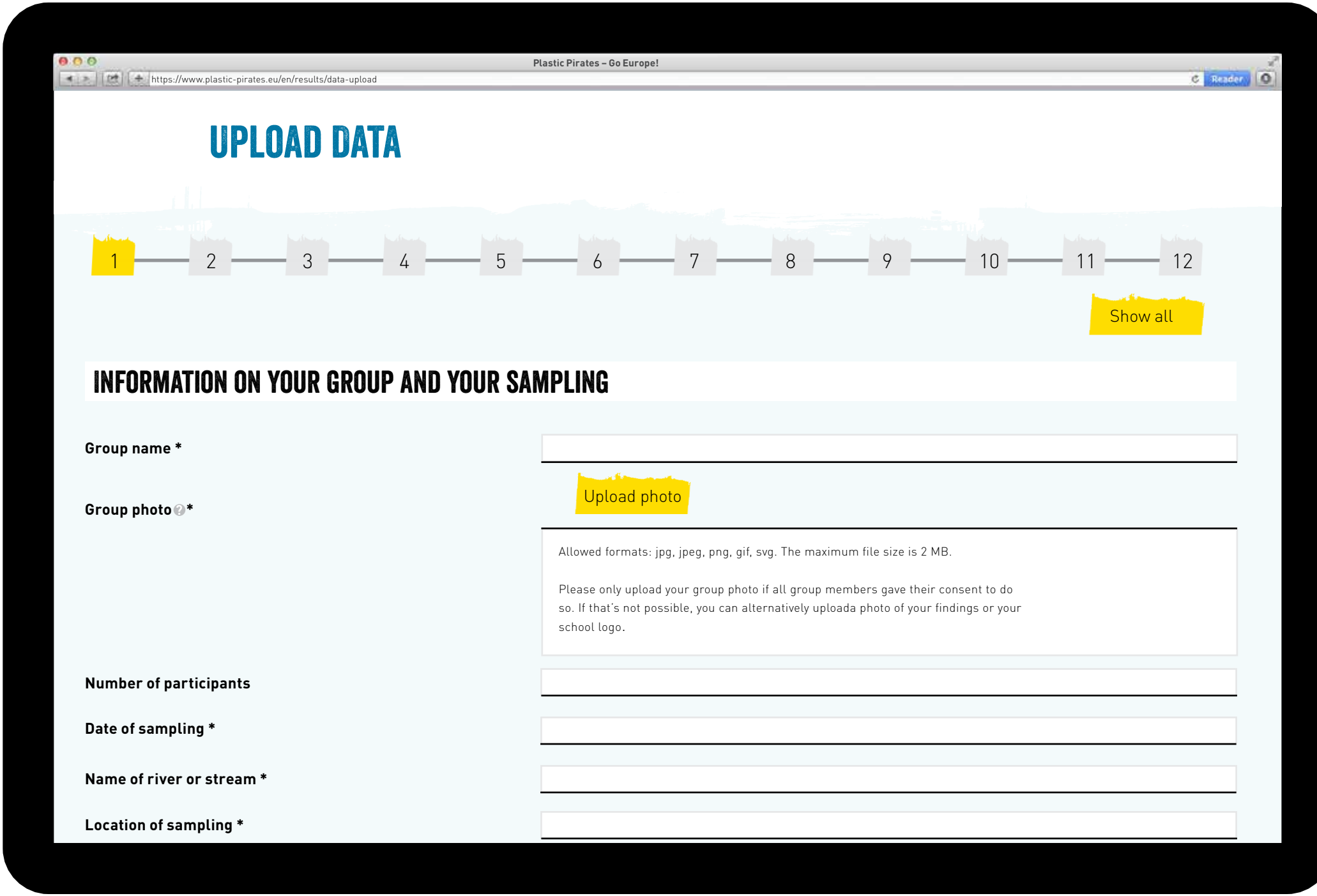
To do so, go to the website and fill in the fields. The reporter team, group D, will take on this task together with the teacher. For the scientific evaluation and interpretation, the scientists will also need your original data.

Please therefore also upload a scan or photo of the completed results pages (28 and 29). Enter your data two weeks after the end of the campaign period at the latest.

Your data are online – what happens now?

You've done your part – and it's now time for others to get to work. It all lies in the hands of the research partners, who will scientifically evaluate the data submitted by all project groups. As this is such a large-scale study, it will take a bit of time to make everything absolutely watertight in line with scientific standards. We will keep you up to date via social media about the scientific evaluation:
plastic-pirates.eu/en/socialwall

You can find results from previous counting periods here:
plastic-pirates.eu/en/results/analysis


Plastic Pirates – Go Europe!
https://www.plastic-pirates.eu/en/results/data-upload
Reader
UPLOAD DATA
1
2
3
4
5
6
7
8
9
10
11
12
Show all
INFORMATION ON YOUR GROUP AND YOUR SAMPLING
Group name *
Group photo *
Upload photo
Allowed formats: jpg, jpeg, png, gif, svg. The maximum file size is 2 MB.
Please only upload your group photo if all group members gave their consent to do so. If that's not possible, you can alternatively uploada photo of your findings or your school logo.
Number of participants
Date of sampling *
Name of river or stream *
Location of sampling *

COMPARISON OF WASTE IN RIVERS IN EUROPE

Now you can go to **plastic-pirates.eu/en/results/map** to compare your data with other project groups. Complete the table and answer the questions in the box.

COMPARISON OF RESULTS:

	Our results	Average in your country	Average in Europe
Flow speed of the river in m/s			
Items of waste per m² of riverbank			
Proportion of single-use plastic in per cent			
Total number of items of floating waste in 30 minutes			
Pieces of larger microplastic per 1,000 litres of river water			
Pieces of larger microplastic per m² of river beach			

What is your view of waste pollution at your river?

SCALE

1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐

No pollution ⟷ Severe pollution

Find answers to the following questions:

- Did other project groups find more or less waste than you?
- Is there anywhere in your country where a lot of waste was found? What is the situation in other countries?
- What might the reasons be?
- What material is the waste in European rivers principally made of?
- Are your samples different in any way?
- Where do you think the waste in the various countries comes from?
- Which rivers carry the most waste into the sea and why (e.g. size and length of the river, total amount/volume of water, proximity to cities and industrial sites)?
- Guess how the flow velocity of your river affects the litter load on the river bank. Take your research from the exercise on page 9 into consideration.

EVALUATION AND FOLLOW-UP WORK

Group

You have entered your results. Now it's time to answer your group's research questions.

Answer to research question 1:

Answer to research question 2:

Answer to research question 3:

HAVE ANY NEW RESEARCH QUESTIONS CROPPED UP?

WHAT MAKES ME THINK – AND INSPIRES ME TO ACT

QUESTIONS THAT TAKE YOU FURTHER

How has the campaign changed your view of the issue of plastic waste?

What did you find particularly surprising during the programme?

What do you regard as the greatest challenge?

Who would you like to tell about the project, and why?

What have you learned about yourself throughout the project?

How has your understanding of the term ‘science’ changed over the course of the project?

OVER TO YOU ...

After researching the waste pollution of your river, you should now think about how you can approach the problem of plastic waste in your environment. Form groups, choose a topic from the double-sided page and develop your own project on the subject. The questions should serve as inspiration for coming up with and implementing your ideas.

REDUCE

YOUR OWN ATTEMPT TO REDUCE YOUR PLASTIC WASTE

Think about how you, maybe even together with your friends or family, can avoid producing waste in your everyday lives.

- During which activities or on which days of the week in particular is a lot of waste produced?
- What material is the waste made of?
- What alternatives are there and how difficult would it be to use them in your everyday life?
- How much waste would that save?

PLASTIC-FREE

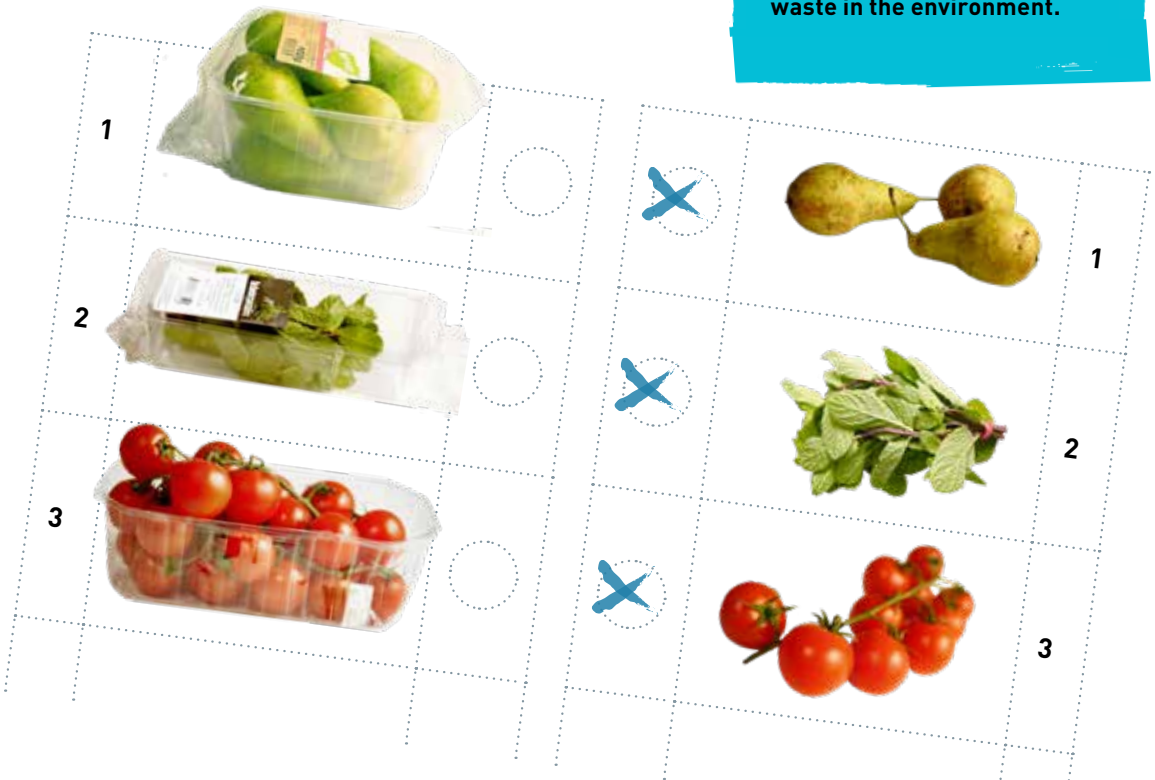
CASTING YOUR VOTE WHEN SHOPPING: THE CHOICE IS YOURS!

Each time we buy a product, we are casting a vote and letting the manufacturer or retailer know that we would like to buy more of that product. Find out how your shopping could involve less packaging.

- What is important to customers when shopping?
- Would they be prepared to pay more for items with less packaging?
- What are some of the hurdles to shopping at the farmer's market or in packaging-free shops?

INFO

Not all single-use plastics are bad! It is logical to make certain products out of plastic and to only use them once. Some of these include items in hospitals which are contaminated after use. These items are very helpful, but it must be ensured that they are disposed of properly and that they do not end up as waste in the environment.



UPCYCLING
AS GOOD AS NEW!

Upcycling means that waste products are given a new function and thus once again have value.

- Which waste is generated in your area that is not reused in other ways?
- How could the waste be transformed into a new product with new value?
- Who might need the product?
- Are there negative or positive side effects (e.g. on the environment)?

Have you carried out a project or otherwise been engaged the topic of plastic waste? Then feel free to share your pictures and videos with us on our Instagram channels.

@plasticpiratesgoeurope and @plasticpiratesgermany

under the hashtag #PlasticPiratesEU

For further questions you can also contact us by e-mail: info@plastic-pirates.eu

OUTREACH
RETHINKING AND CHANGING

You can only make changes if you make others aware of the problem.

- How could you raise awareness for an environmental topic of your choosing (e.g. writing an article, making a stop-motion film)?
- Which target group do you hope to reach and what is the message you want to get across?
- Who are the decision makers (e.g. from the worlds of politics, industry, trade) and how are measures implemented by them?

More information can also be found in the ‘Over to you’ chapter of the teaching materials and worksheets.

NOTES

NOTES

LIST OF MATERIALS

NEEDED TO PARTICIPATE IN THE ACTION

GROUP A

- [ ] Straight stick, about 50cm long
- [ ] Cord, 1.5m long
- [ ] Small stones or similar to mark a circle
- [ ] Camera or smartphone
- [ ] Paper and thick felt-tip pen to label the 9 stations 1A - 3C
- [ ] White cloth
- [ ] Measuring tape
- [ ] 9 bags to collect the litter, if you plan to count it later on
- [ ] Work gloves

GROUP B

- [ ] Buckets, bags or other containers for collecting and sorting the rubbish (the more the better)
- [ ] Tarpaulin, about 5x2m (an old tablecloth will also do, for example)
- [ ] Fabric tape and thick felt-tip pen
- [ ] String, at least 10m long, better longer (to measure the area)
- [ ] Measuring tape
- [ ] Camera or smartphone
- [ ] Bin liners to transport the litter
- [ ] Work gloves
- [ ] Scales (preferably a suitcase scale)

GROUP C

- [ ] Sampling net plus cable tie (you can order them here: plastic-pirates.eu/en/material/sampling-net)
- [ ] two empty 0.5l plastic bottles as floats for the net
- [ ] Cords/ropes (for spreading the net)
- [ ] Stopwatch/Smartphone
- [ ] Measuring tape or string, 20m long
- [ ] Three sticks of about the same size (can also be collected well on site)

GROUP D

- [ ] Camera or smartphone
- [ ] Paper and pen

EXTRAGROUP

- [ ] Sampling sieve, mesh size 1 mm (you can make that yourself, for instructions see: plastic-pirates.eu/en/material/download)
- [ ] Cord, 20m long
- [ ] Small shovel or cup for scooping the sand
- [ ] Three well-sealable bags for the samples
- [ ] Flat dishes

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