BRS-NORAD PROJECT MARINE LITTER AND MICROPLASTICS: PROMOTING THE ENVIRONMENTALLY SOUND MANAGEMENT OF PLASTIC WASTES AND ACHIEVING THE PREVENTION AND MINIMIZATION OF THE GENERATION OF PLASTIC WASTES







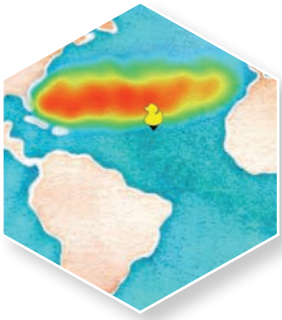

PLASTIC IS FOREVER

TEACHER RESOURCE BOOK

BASEL / ROTTERDAM / STOCKHOLM
CONVENTIONS

The book has been developed by the BRS Secretariat in the framework of the project "Marine Litter and Microplastics: Promoting the Environmentally Sound Management of Plastic Wastes and Achieving the Prevention and Minimization of Generation of Plastic Wastes". The project is funded by the Norwegian agency for development cooperation (Norad).

This document is produced with the financial assistance of the Norwegian Ministry of Foreign Affairs. The views expressed herein can in no way be taken to reflect the official opinion of the Norwegian Ministry of Foreign Affairs.



INTRODUCTION

WHAT IS PLASTIC?

Plastic is usually a synthetic material, either a polymer or combination of polymers of high molecular mass modified or compounded with additives such as fillers, plasticizers, stabilizers, lubricants, pigments. According to the ISO 472 "plastic is a material which contains as an essential ingredient a high polymer and which, at some stage in its processing into finished products, can be shaped by flow" (ISO, 2013). A polymer is a chain of several thousand repeating molecular units or several different types of monomers which are either natural or synthetic organic compounds (Villanueva et al., 2014).

HISTORY OF PLASTIC

In the 1950s, plastics began to come into wide use and within a few years production rose at a high rate. The amount of plastic produced has grown constantly since then, increasing from 2 million tons in 1950, to 407 million tons in 2018 (UNEP, 2020c). Currently, consumers are exposed to a variety of plastic products. Plastics are lightweight, with varying degrees of strength, they can be both thermal and electrical insulators, they can be molded in various ways, and they offer a large range of characteristics and colors, which are achieved through chemical additives. Plastics are most commonly used for packaging and food containers, such as LDPE (e.g. bags, containers, food packaging film), containers made from HDPE (e.g. milk bottles,

shampoo bottles, ice cream tubs), and PET bottles for water and other drinks, as well as building and construction, transportation, electrical and electronic equipment, agriculture, healthcare, sport, energy generation.

However, plastics can also pose challenges related to impacts on human health and the environment. Larger pieces of plastics accumulate, for example, on beaches or sink to the ocean floor. These can cause harm directly to marine animals, for example by entanglement in debris. Many species of birds ingest smaller pieces of plastics. Other plastic waste is carried on ocean currents and can accumulate in ocean gyres. Under the influence of sunshine and saltwater, larger pieces can break into microplastics. Microplastics are now widely distributed through the oceans, and they can be vectors for pollutants and pathogens.

The value chain of plastic remains linear with less than 20% of plastics re-entering the value chain and huge amounts of plastics ending up landfills/dumpsites or in terrestrial and marine environments each year. (Geyer et al., 2017).

Management of plastic waste has been a constant challenge. By 2015, it was estimated that 79% of all plastic wastes generated worldwide had been landfilled or dumped, a further 12% incinerated and only 9% recycled (Geyer et al., 2017). Median waste collection coverage is still around 50% in developing countries and in some countries, the collection rate is even lower. Landfilling or open dumpsites pose problems, such as the leaching of plastics additives and whole plastics particles from landfill sites into the wider environment. The controlled incineration of plastic waste can also have environmental and climate impacts due to CO2 and POPs emissions, toxic pollution and unintentionally produced formation and release of POPs. In addition, the open burning of plastic waste releases toxic gases such as dioxins, furans, mercury and polychlorinated biphenyls into the atmosphere.

Moreover, the leakage of plastic into the environment can occur from a variety of land-based and ocean-based sources in the form of macro-plastics and microplastics (small plastic particulates below 5 mm in size). The sources are uncontrolled dumping of municipal waste, littering, wastewater, storm run-off and sewer, wear from tyres and road makings, and synthetic fibers.

In 2019, the Conference of the Parties to the Basel Convention adopted two important decisions to address plastic waste. These steps have strengthened the Basel Convention as the only global legally binding instrument to specifically address plastic waste. The decisions include a set of actions for preventing and minimizing the generation of plastic waste, improving its environmentally sound management and controlling its transboundary movement; reducing the risk from hazardous constituents in plastic waste; and public awareness, education and information exchange.

USING THE HANDBOOK

Teachers and educators can help turn the tide on plastic pollution

To solve the plastic crisis, it is necessary that different types of stakeholders work together, from scientists that study the problem, policy makers that introduce laws, changes in citizen behavior, industry that work in a different way.

Worldwide citizen science activities have been of major importance for raising awareness about plastic pollution.

Young people have increasingly become aware of planetary problems (for example the climate action movement) and they can contribute to solve the plastic crisis, by adopting and promoting different behaviors that can lead to significant changes in society.

The role of educators is particularly important to spread knowledge and understanding of plastic crisis from a scientific and a civic point of view.

HOW TO USE THE TEACHER RESOURCE BOOK

This education toolkit proposes different types of education activities organized in eight sections. The Teacher Resource Book goes along with the Student Workbook, where responses from students can be collected and evaluated.

Sections 1 – 5

> Educational activities to be carried out in class through laboratories, games, investigations lead by the students on different topics related to plastic: Plastic waste and microplastics (section 1); Exploring plastics (section 2); Human and environmental health (section 3); Policies to reduce plastic waste (section 4); and Solutions to plastic pollution (section 5). These activities can be included in the school curricula as stand-alone classes, or through a longer-term project on marine litter. The teacher can carry them out alone in their class.

Section 6

> Awareness raising activities include ideas on how to organize an awareness raising festival on the impacts of human activities on the marine environment, including activities dedicated to raise awareness about marine litter, and guidance on how to develop Citizen Science activities. These activities require external collaboration from the school and all or part of these activities are carried out outside the school.

Section 7

> Perception survey to assess the impact of the education and awareness raising activities on students' perception and self-assessed behavior about plastic waste. The same survey shall be conducted before and after the educational/awareness raising activities. The survey can be applied both to educational activities in class (when you have planned to conduct a few of the educational activities from sections 1-5) and/or to measure the impact of the awareness raising festival and Citizen Science projects (section 6).

Section 8

> Additional resources for the educator, to be used in class of for the educators to expand their knowledge about plastic pollution.

This educational toolkit has been developed by collating existing educational activities, by adapting scientific research studies, and through development of new educational activities. Attributions for each activity are available in the references.

Section 1:
PLASTIC WASTE AND MICROPLASTICS

Activity 1:

What do you see?

YOU WILL NEED:

- Flipchart paper/sticky note pad

STUDENTS WORKBOOK
What do you see?
page 6

INSTRUCTIONS

STEP 1 – in small groups

> Use the **What do you see?** photographs to introduce the context of global waste and to enable students to start identifying some problems and questions which the photographs raise for them.

> We suggest organizing the class into small groups and giving each group two photographs, one of plastic waste on beaches or in the natural environment and one of animals impacted by plastic debris (these pictures should be chosen carefully for younger students).

> Ask the students to spend a few minutes looking at the photographs and to think about the following:

— What do you see?

— What does it make you think about?

— Are there any problems that you can identify?

— What questions do the photographs raise for you?

You may wish to ask the students to record their responses on flip chart paper or sticky notes.

STEP 2 – the whole class

> Ask for feedback on their responses and develop a list of the problems that they identified and any questions that the photographs raised for them.

> Now ask the students to look at the list of problems and to develop ideas for solutions to the problems.

> Enable students to feedback on some of their ideas.

STEP 3 - the whole class

> Share with the students that they'll be learning more about plastics, plastic waste and their impacts, but also solutions about it, both through laws and regulation and through individual action.

AGE:
11-18/ adults

Activity 1.1:

Microplastics on the seashore

Biology | Chemistry | Ecology

In this activity students investigate microplastic pollutants in a sample of sand from a local seashore, lakeside or riverbank.

YOU WILL NEED:

- A sample of sand polluted with plastic and other waste
  NB: Nearly every sandy beach worldwide contains microplastics, along with plastic fragments of different sizes.
- Magnifying lenses
- A computer to show a video

INSTRUCTIONS

> Ask the students to observe the sand samples with the naked eye and with the magnifying lens. Can they see any plastic particles?

> Discuss where the students think the plastic particles come from.

> Watch some videos about plastics in the environment.

> Discuss with the students the hazards of microplastics and the importance of preventing marine pollution by separately collecting, re-using and recycling plastic objects.

Videos of plastic in the environment

To learn more about plastics in the oceanic environment:

- "How microplastics affect your health" by UNEP
  https://www.youtube.com/watch?v=aiEBEGKQp_I (1:57 min)
- "Plastic Pollution: How Humans are Turning the World into Plastic" by Kurzgesagt – in a nutshell and UNEP Clean Seas campaign
  https://www.youtube.com/watch?v=RS7IzU2VJIQ (9:01 min)

STUDENTS WORKBOOK

Microplastics on the seashore
page 8

Activity 1.2:

Counting and categorizing microplastics

Biology | Chemistry | Ecology | Citizen Science

In this activity students will count and categorize microplastic pollutants in a sample of sand from a local seashore, lakeside or riverbank based on size, morphology, color. This activity builds up on activity 1.1 (Microplastics on the seashore).

STUDENTS WORKBOOK

Counting and categorizing microplastics
page 9

YOU WILL NEED:

- A sample of sand polluted with plastic and other waste.
  NB: Nearly every sandy beach worldwide contains microplastics, along with plastic fragments of different sizes.
- Magnifying lenses
- Rulers
- Tweezers

INSTRUCTIONS

> Ask the students to observe the sand samples with the naked eye and with the magnifying lens. Can they see any plastic particles?

> Tell the students that plastic debris once arrived in the marine environment goes through a process of degradation, and from large plastic waste objects smaller plastic particles are created. For this, scientists categorize plastic debris according to size. Scientists also categorize plastic debris according to morphology. Finally, the categorization in base of the color is interesting because it gives information about the additives that are added to plastic products as colorants.

> **Size:** Tell them to remove the plastic particles from the sand and categorize them according to the size in macroplastics (plastic pieces > 2.5 cm), mesoplastics (plastic particles between 5 mm to 2.5 cm) and microplastics (plastic particles ≤5 mm) as suggested by UNEP (Chesire et al. 2009).

> **Morphology:** Then ask the students to categorize the plastic pieces into 5 morphological descriptors: 5 morphological descriptors (fragments; films; lines; styrofoam; pellets) as suggested by GESAMP (Tahir et al. 2019)

> **Color:** 8 color classes (black/grey; blue/green; brow/tan; white/cream; yellow; orange/pink/red; transparent; multicolor) as suggested in EMODnet (Galgani et al. 2017).

References for the scientific methods used:

> Cheshire et al. 2009; Galgani et al. 2017; Tahir et al. 2019

Activity 1.3:

Microbeads from cosmetics

Biology | Chemistry | Ecology

Microbeads are tiny plastic beads used in cosmetics and personal care products (e.g. exfoliating and hand-washing creams, toothpastes). In this activity, students will learn to isolate and examine microbeads from such products and consider their impact on the environment.

STUDENTS WORKBOOK

Microbeads from cosmetics
page 12

YOU WILL NEED:

- Some cosmetics and personal care products that contain microbeads and others that do not contain them. Check the composition: if polyethylene is listed, the product contains microbeads.
- Clear acetate sheets
- Magnifying glasses or a microscope
- Transparent reusable plastic cups
- Tap water
- Dishwashing detergent
- Salt
- Spoon

INSTRUCTIONS

> Using the materials above, ask the students to read the composition of the products, choose one product with polyethylene and examine with magnifying lens by spreading the product on an acetate sheet

> Now ask them to prepare 3 different solutions:

— 1- Tap water

— 2- Water plus detergent (1/2 spoonful per cup)

— 3- Water plus salt (1 spoonful per cup).

> Then tell them to put the product into the three different liquids to test if the microbeads float, using the transparent cups.

> Based on the students' results, predict whether in the natural environment, microbeads will float or sink in freshwater (e.g. in a lake) and in saltwater (e.g. in the sea).

> Discuss the need to avoid products containing microbeads; discuss how one can raise awareness among family and friends.

Introductory video on microbeads

- "The story of microbeads" by the Story of Stuff – **https://www.youtube.com/watch?v=uAiIGd_JqZc** (2.11 min)

Additional resources:

> Lusher AL, McHugh M, Thompson RC (2013). Occurrence of microplastics in the gastrointestinal tract of pelagic and demersal fish from the English Channel. Marine Pollution Bulletin 67(1): 94-99. **https://www.sciencedirect.com/science/article/abs/pii/S0025326X12005668?via%3Dihub**

> Arthur et al. (eds.). (2009). Proceedings of the International Research Workshop on the Occurrence, Effects, and Fate of Microplastic Marine Debris. National Oceanic and Atmospheric Administration Technical Memorandum. NOS-OR&R-30 **https://repository.library.noaa.gov/view/noaa/2509/noaa_2509_DS1.pdf**

> Thompson RC et al (2004). Lost at sea: where is all the plastic? **https://www.science.org/doi/10.1126/science.1094559**

Activity 1.4:

How many microbeads are we dumping at sea

Biology | Chemistry | Ecology

This is an extension of the activity "Microbeads from cosmetics". In this activity students will make a rough estimate of how many microbeads are being dumped each year by people in their town. They will also investigate and debate the environmental issues involved.

YOU WILL NEED:

- The same material as for "Microbeads from cosmetics"
- Measuring spoons with a volume of 5 ml (like those used for cough syrups, etc.)
- Coffee filters

STUDENTS WORKBOOK

How many microbeads are we dumping at sea?
page 14

INSTRUCTIONS

> Ask the students to:

1. Measure 5 ml of a product containing microbeads and dissolve it in a cup half-filled with tap water plus 5 ml of dishwashing detergent.
2. Stir the mixture for one minute, then filter the mixture with a coffee filter.
3. Transfer the microbeads from the filter paper to an acetate sheet. Now count the microbeads.
4. Using this result and the volume of the product's original container, calculate how many microbeads are contained in a whole tube or bottle.
5. Estimate how many containers of this product are used by a person in one year, and how many people in their town are likely to use this product.
6. Multiply these numbers together to calculate how many microbeads their town is dumping into the sewage system (and then into the sea) per year from this one product.
7. Finally, ask the students to research information about the problem of microbeads in the environment, and on current debates and actions limiting or banning their use in products.
8. Based on the students' results, predict whether in the natural environment, microbeads will float or sink in freshwater (e.g. in a lake) and in saltwater (e.g. in the sea).

Section 2:
EXPLORING PLASTICS

Activity 2.1:

Identifying plastics

Chemistry

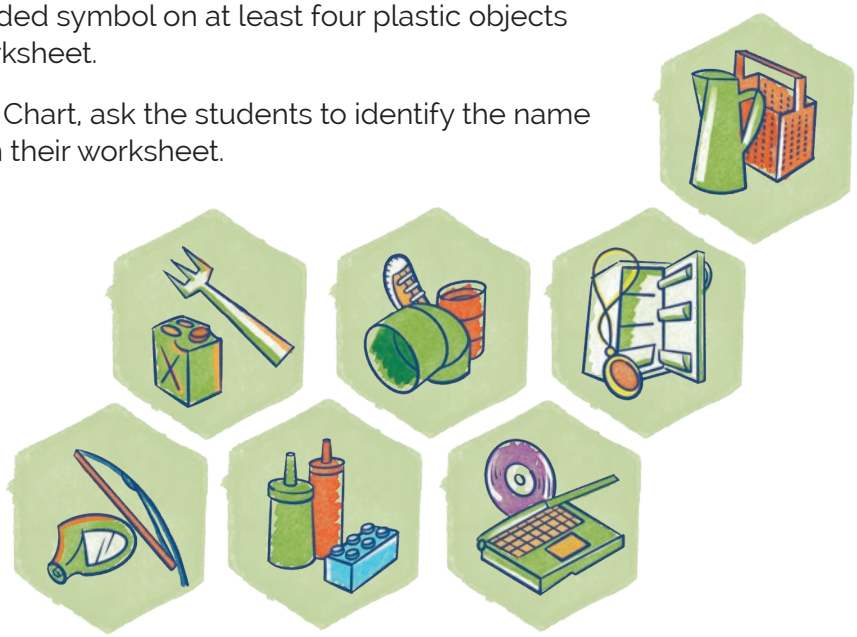
In this activity students will sort and investigate the properties of different types of plastics.

YOU WILL NEED:

- One refuse bag with clean plastic waste items per group of students
- Tanks/bowls of water
- Scissors
- Torches

INSTRUCTIONS

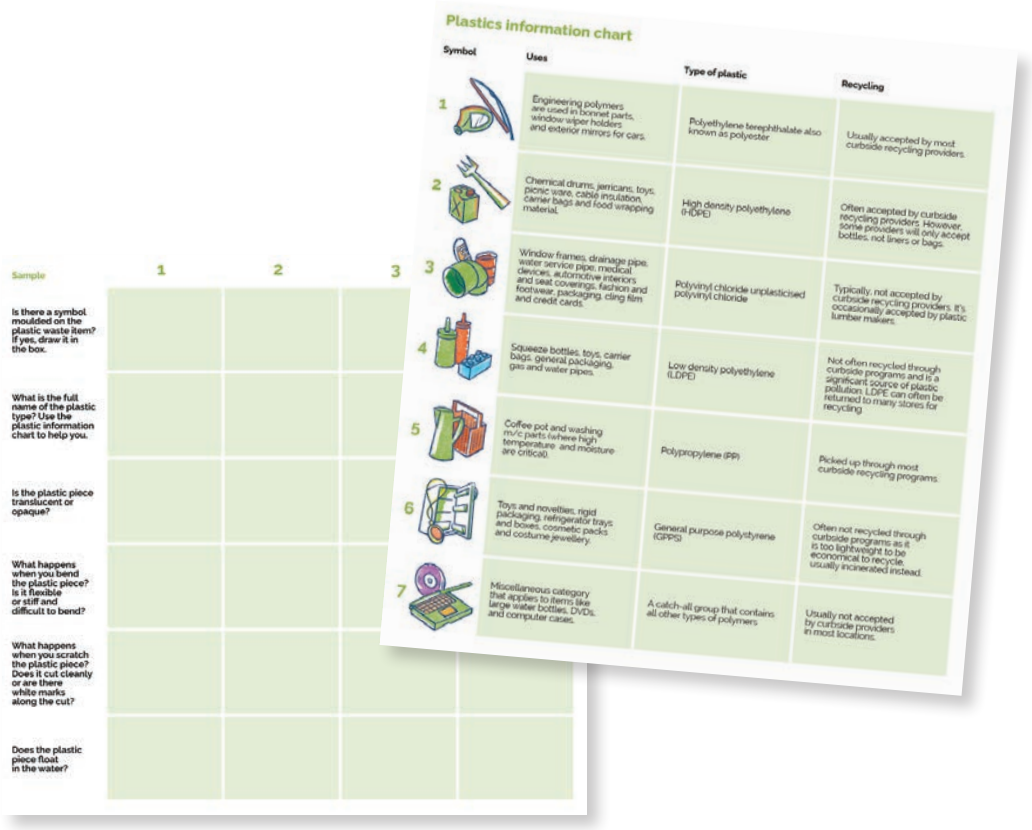
1. Organize the class so that the students are working in small groups. Give each group a bag of different clean plastics waste items.
2. Ask the group to sort the plastics into a way that they think is most likely to generate the most income from a plastic scrap dealer.
3. After a few minutes ask students to provide feedback on their reasons for sorting the plastics the way they have.
4. Ask students to spot the molded symbol on at least four plastic objects and record them on their worksheet.
5. Using the Plastic Information Chart, ask the students to identify the name of the plastic and record it on their worksheet.



STUDENTS WORKBOOK

Identifying plastics
page 19

6. Ask students to cut samples (approximately 5 cm2) from the four plastic objects for testing. Students may need to be shown how cut the plastics safely.
7. Discuss with your students the various tests they are to carry out and check their understanding of the scientific vocabulary e.g. transparent/translucent/opaque/flexible/stiff/hard, etc.
8. For the scratch test you may want to show them how to use the end of a pair scissors safely.
9. Ask students to work through the comparative tests and record their observations on the table.
10. Discuss their findings.
11. You may want to introduce how in real-life whether sorting plastic by hand or mechanically, plastics tend to be sorted by the polymer they are made from to maximize potential for reuse or recycling.



Sample	1	2	3
Is there a symbol moulded on the plastic waste item? If yes, draw it in the box.			
What is the full name of the plastic type? Use the plastic information chart to help you.			
Is the plastic piece translucent or opaque?			
What happens when you bend the plastic piece? Is it flexible or stiff and difficult to bend?			
What happens when you scratch the plastic piece? Does it cut cleanly or are there white marks along the cut?			
Does the plastic piece float in the water?			

Plastics information chart

Symbol	Uses	Type of plastic	Recycling
1	Engineering polymers are used in bonnet parts, window wiper holders and exterior mirrors for cars.	Polyethylene terephthalate also known as polyester	Usually accepted by most curbside recycling providers.
2	Chemical drums, jerricans, toys, picnic ware, cable insulation, carrier bags and food wrapping material.	High density polyethylene (HDPE)	Often accepted by curbside recycling providers. However, some providers will only accept bottles, not liners or bags.
3	Window frames, drainage pipe, water service pipe, medical devices, automotive interiors and seat coverings, fashion and footwear, packaging, cling film and credit cards.	Polyvinyl chloride unplasticised polyvinyl chloride	Typically, not accepted by curbside recycling providers. It's occasionally accepted by plastic lumber makers.
4	Squeeze bottles, toys, carrier bags, general packaging, gas and water pipes.	Low density polyethylene (LDPE)	Not often recycled through curbside programs and is a significant source of plastic pollution. LDPE can often be returned to many stores for recycling.
5	Coffee pot and washing machine parts (where high temperature and moisture are critical).	Polypropylene (PP)	Picked up through most curbside recycling programs.
6	Toys and novelties, rigid packaging, refrigerator trays and boxes, cosmetic packs and costume jewellery.	General purpose polystyrene (GPPS)	Often not recycled through curbside programs as it is too lightweight to be economical to recycle, usually incinerated instead.
7	Miscellaneous category that applies to items like large water bottles, DVDs and computer cases.	A catch-all group that contains all other types of polymers	Usually not accepted by curbside providers in most locations.

Activity 2.2:

How long does it take for plastics to degrade?

Chemistry | Ecology

STUDENTS WORKBOOK

Waste timeline
page 21

In this activity students will gain awareness that different types of materials take different times to decompose and therefore have varying impacts on the environment.

YOU WILL NEED:

- Students to cut out the set of cards, e.g. teabag, plastic bottles
- Scissors

INSTRUCTIONS

> Divide the class in pairs or small groups.
Each group should have a set of cards cut out from the workbook.

> Introduce the activity by asking students what they think happens to various items on their cards once people have finished with them. Suggest to the students that if the items were thrown away in a 'normal' bin (rather than recycled or composted) the mixture of items would end up in a landfill site or rubbish tip.

> Check students understanding of the term 'decompose' then ask them to place their cards from fastest to slowest material to decompose on the table in front of them.

> Discuss the students' timelines. Ask them why some materials decompose before the others.

> Ask students for their ideas of the approximate timings that it takes for the items to decompose, then reveal the answers.

> Conclude the lesson with a plenary session where you ask the students if they think it's a problem that some things, particularly plastics and electrical goods, take years to decompose.

> What might the solutions be?

ITEM	TIME TO DECOMPOSE
 Teabag	**4 weeks**
 Banana peel	**6 weeks**
 Apple core	**2 months**
 Woolen sock	**1 year**
 Plastic bag	**20 years**
 Magazines	**50 years**
 Plastic bottle	**450 years**
 Mobile phone	**1,000 years**

Additional resources:

> UNEP (2015). Biodegradable Plastics and Marine Litter. Misconceptions, concerns and impacts on marine environments. United Nations Environment Programme (UNEP), Nairobi. **https://wedocs.unep.org/handle/20.500.11822/7468s**

Activity 2.3:

Composting investigation

Chemistry | Ecology

In this experiment students will study the degradation time of different types of items and will observe changes through time. They will learn which material take the longest to decompose.

Allow students to bury a selection of materials in a marked area of soil. dig them up every fortnight and observe the changes. Which materials take the longest to decompose?

YOU WILL NEED:

A selection of materials to be buried in the soil.
We suggest you work with 3 of the following types of items:

A. Plastic bags (one of the following):
   - Traditional polyethylene plastic bags (HDPE)
   - Compostable plastic bags

B. Journal paper or paper packaging

C. Skin of a fruit (apple/banana/local fruit)

For each of the items, get 3 replicates of the same item.
They will be used in the physical toughness comparison, as controls, and in the composting experiment.

STUDENTS WORKBOOK

Composting investigation
page 23

INSTRUCTIONS

Physical toughness and predictions:

> Have the students compare the physical toughness – the ability to experience deformation before breaking, of one of each item A, B, and C.

> Based on the observations of the toughness of the three items, have the students formulate a hypothesis about the relative resistances of the items to degradation in the environment.

> Controls: store one of each items A, B, and C away from sunlight and soil.

Composting experiment:

> Have the students bury the remaining 3 items in a marked area of soil in the school garden. If access to a garden is not available, then prepare a box of soil to be kept in the class. In this case make sure the soil keeps humid by watering it regularly.

> Each week, have the students dig the three items and observe changes in their physical appearance. Do they show signs of degradation? Take pictures. Have the students record the observations in their Students Workbook.

> Have the students compare the physical appearance of the buried items with the control samples. Based on the extent of decomposition observed, extrapolate your findings to come up with predictions for the time it would take for the three types of items to completely decompose. Have the students compare their extrapolations with the initial hypothesis. Revise it if necessary and propose additional experiments to test it.

Activity 2.4:

Know your plastics

Chemistry

In this activity students learn to distinguish the 6 different types of plastic with a unique resin identification code on the base of their different density.

YOU WILL NEED:

- 3 Graduated cylinders per group;
- Glass rods;
- Pasteur pipettes;
- Solution of ethanol and water (6 parts of alcohol, 4 parts of water) density about 0.90 g/mL (The 96% ethyl alcohol has a density of about 0.80 g/mL, pure water has density 1 g/mL);
- Saturated solution of NaCl (the common kitchen salt), density about 1.2 g/mL;
- 6 types of plastic (PET, PVC, PS, PP, HDPE, LDPE)

STUDENTS WORKBOOK

Know your plastics
page 25

INSTRUCTIONS

> Divide students in groups of 4 or 5 persons.

> The identification of the different kinds of plastic allows separate collection and therefore the possibility of recycling the plastic types that can be recycled. Polymer recycling is part of the policy of saving energy and protecting the environment.

> It is not easy to recognize the various types of plastic, even if the beverage containers are usually made of PET, bags are made in LDPE and pipes in PVC.

Which plastic floats and which plastic sinks?

- The goal of this activity is to build a density scale of the six polymers that have a unique resin identification code. The activity is based on the application of Archimedes Principle: "in the presence of a gravitational field, a body immersed in a fluid receives a thrust from the bottom upwards equal to the weight of the displaced fluid volume".
- The result of the principle of Archimedes is that if we immerse a body in a fluid, the body sinks if its density is higher than that of the fluid, it floats if its density is lower, it is in indifferent equilibrium, that is, it does not sink and does not float, if its density is identical to that of the fluid.
- In a 100 mL graduated cylinder, 70 mL of pure water are added and six pieces of plastic are introduced; three float (HDPE, LDPE and PP) and three sink (PET, PVC, PS).
- Recover and dry the three samples that float in water and insert them into a 100 mL graduated cylinder containing 70 mL of ethanol/water solution. LDPE and HDPE sink, while the PP floats. By adding still pure water (half a milliliter at a time) the density of the solution is increased, until the LDPE floats. The HDPE remains on the bottom.
- Recover and dry the three samples that sink into water, and insert them into another 100 mL graduated cylinder containing 70 mL of saturated NaCl solution.
- The PS floats, the other two sink. The two remaining polymers (PVC and PET) are subjected to the flame test (because their density, due to the addition of additives and plasticizers, is very similar).

Additional resources:

- The teacher can explain that: plastic waste can be recycled effectively only if they are composed of a single type of plastic resin; mix of plastic resins cannot be easily recycled; food contamination alters the quality of the material prevents it to be recycled.
- The teacher can explain that some resin types release toxic chemicals when they are heated.

Activity 2.5:

Making bioplastics

In this activity students learn how to make bioplastic.

YOU WILL NEED:

INGREDIENTS

- 1.5 tablespoons corn starch
- 1 teaspoon vinegar
- 1 teaspoon glycerine
- 5 tablespoons of water
- food colouring (optional)

EQUIPMENT

- 1 saucepan
- 1 wooden spoon
- 1 round edged knife
- A selection of pastry cutters or moulds to shape the plastic
- Non-stick baking sheets or greaseproof paper

INSTRUCTIONS

> Introduce the activity by reminding the students that until now you have looked at plastics made from oil.

> If you have sourced any items made from bio plastics, you might want the students to handle them to see if they can spot any differences between bio and oil-based plastics.

STUDENTS WORKBOOK

Making bioplastics
page 28

> Now introduce the practical investigation of making bio plastic. You may choose to demonstrate the practical or allow the students to follow the instructions on the workbook.

> If students are making the plastics themselves, raise the necessary safety issues related to heating and handling hot materials.

> There are a number of different methods and ingredients for making bio plastic. You may wish to encourage your students to experiment with a range of methods, for example through research on the internet.

Activity 2.6:

Investigate bioplastics

In this activity students research the impacts of oil-based and bioplastics on the environment.

STUDENTS WORKBOOK

Investigate bioplastics
page 29

YOU WILL NEED:

- Internet connection

INSTRUCTIONS

1. Divide the students in groups and ask them to use the internet to research into oil-based plastics versus bioplastics. Suggest them to use the Graphic Organizer to structure their research and record their findings. If you have already done the previous activities, where different types of plastic polymers were investigated, you might tell students to choose one of the oil-based polymers for the comparison with bioplastics.

   For younger students, before they get started, you may wish to check students understanding of key terms such as renewable/non-renewable, decompose, etc. and discuss search terms before they use the internet.

2. Following their research, ask the students to do a Positive, Minus, Interesting (PMI) analysis of the two plastic types and then take a class vote on which material they feel, on balance, is best for the environment.
   1. Ask the students "Why is it important to think about all sides of an issue or idea?"
   2. Ask the students to identify Plus-Minus-Interesting aspects about bioplastics. By defining these aspects, students will have a clear-cut understanding about the issue. PMI: Plus = Advantages/Minus = Disadvantages/Interesting = out of the ordinary
   3. Record on the black board the answers given by the different groups.

3. Ask the students to provide a definition of bioplastics.

4. After the students have developed a definition of bioplastics, show the image on page 26 or draw it on the blackboard.

EXTENSION IDEA

Enable students to do further research to compare bio plastics with recycled plastic using the Graphic organizer and the Positive, Minus, Interesting (PMI) table.

Activity 2.6: **INVESTIGATE BIOPLASTICS**

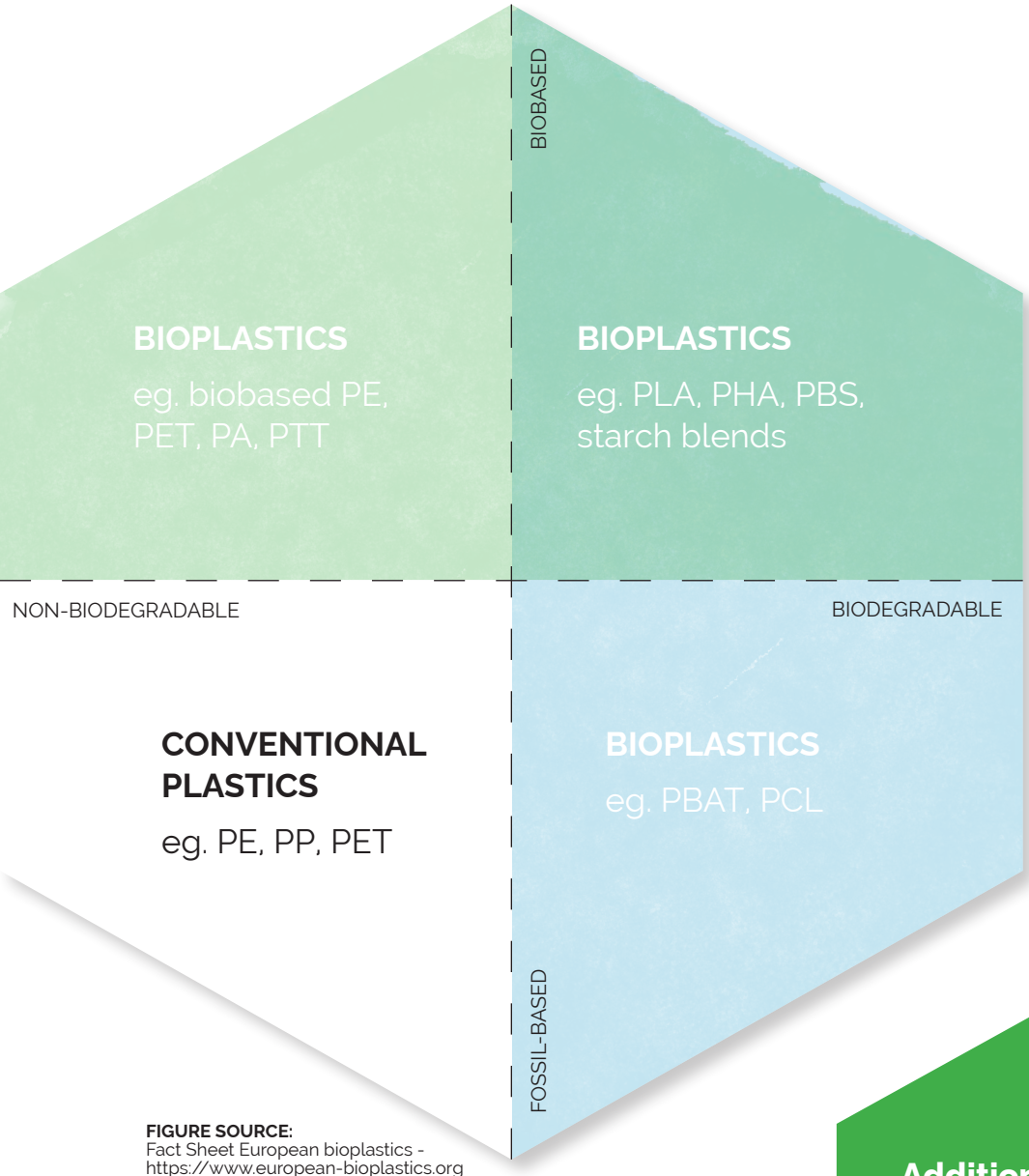


FIGURE SOURCE:
Fact Sheet European bioplastics - https://www.european-bioplastics.org

USEFUL SITES

- Bioplastics and biodegradable plastics **https://www.explainthatstuff.com/bioplastics.html**
- Plastics **https://www.explainthatstuff.com/plastics.html**

Additional resources:

- What are bioplastics? **https://www.european-bioplastics.org/bioplastics/**
- UNEP (2015). Biodegradable Plastics and Marine Litter. Misconceptions, concerns and impacts on marine environments. United Nations Environment Programme (UNEP), Nairobi. **https://wedocs.unep.org/handle/20.500.11822/7468**

Section 3:
HUMAN AND ENVIRONMENTAL HEALTH

Activity 3.1:

How do microplastics get in our food?

In this drama activity young children act out the story of how microplastics find their way into our food.

YOU WILL NEED:

- Three adults (preferably) – one to tell the story and ask the questions, the other two to act as a young girl *[GIVE HER A LOCAL NAME]* and a young boy *[GIVE HIM A LOCAL NAME]*.
- 20–25 young students, which will be divided in three groups before the start of the story. Each student will know to which group they belong:
  - a large group of small fish;
  - a smaller group of medium-sized fish;
  - and one big tuna.
- A classroom with:
  - a couple of desks to represent the girl and boy house;
  - a chair for the fishing location near the seashore;
  - some other desks and chairs for the young girl and boy's dining room.
- The material for the activities should be as much as possible used material that is being reused. Some easy-to-make items:
  - a 'big tuna fish' outfit made from cardboard;
  - a similar cardboard cut into medium size pieces (for the larger fishes) and into small size pieces (for the small fishes), all in a fish shape (one piece per pupil);
  - a rod and a rope with a rounded hook to 'fish' the tuna;
  - 20–25 plastic balls made by taping together the bases of small (e.g. 0.5 l) plastic bottles collected at school/home.

  Some easy-to-find objects:
  - Disposable plastic items collected in the plastic waste produced at school/home and cleaned (bottles, cups, trays and other containers, especially from food packaging);
  - 10–13 hula-hoops (one per medium-sized fish);
  - 27 plastic plates (one per student, plus the young girl and young boy played by the two adults);
  - Two pieces of cheap blue fabric, each about 1.5 m x 2.5 m.

INSTRUCTIONS

STEP 1: In the young girl and the young boy's house

> The young girl and the young boy live in a small house near the sea. They go fishing every day to find food to eat.

Ask your students:

— Where will they go?

— What will they need to go fishing?

> When they get home, they do their housework. One day they have a big tidy-up: they collect lots of old objects they don't want and dump them into the sea. The rubbish contains many plastic items. *(Throw the plastic items onto a piece of blue fabric.)*

Ask your students:

— Was the young girl and the young boy's behavior acceptable?

— What do you think will happen to the plastic objects?

— Will they disappear?

> The sun, wind and waves break up the plastic objects into smaller and smaller pieces called microplastics. *(Move the blue fabric to look like sea waves.)* But microplastics don't rot away. They stay in the sea for years and years because they are not biodegradable.

Ask your students:

— Do you know what biodegradable means? *(Explain the meaning of the word.)*

STEP 2: Fish in the sea

(Remove the first piece of blue fabric with plastic objects and lay the other piece of fabric on the floor with the plastic balls on it.)

> The sea is calm and the young girl and the young boy are fishing. In the water, some small fish are playing and swimming after each other. When they see some food, they eat it. *(Every pupil takes a plastic ball.)* Then they go to sleep. *(The students lie on the floor.)*

> Some medium-sized fish come along. They are hungry too, so when they see the sleeping small fish, they eat them. *(Each medium fish puts a hula-hoop around two small fish and takes their plastic balls.)* Then they go to sleep too. *(The medium fish lie down on the floor.)*

> Suddenly, a big tuna fish passes by, spots the sleeping fishes – and eats them! *(The 'big tuna' pupil takes all the balls from the other students and swims away.)*

> Then the big tuna fish sees something else that looks tasty, but it doesn't notice the hook – until too late! The young girl and the young boy feel a pull on the fishing rod; they pull with all their strength... and catch an enormous tuna fish!

STEP 3: Back at home

(All the students are now in the 'dining room'.)

> The young girl and the young boy take the big tuna fish home, happy with such a big catch. They decide to invite some children to share it with them. *(Everyone gets a plate with a piece of cardboard tuna and a plastic ball.)* They start eating, then they notice something strange....

Ask your students:

— What's on your plate, as well as the fish?

Then explain:

— The balls are the remains of the plastic objects the young girl and the young boy dumped in the sea.

DISCUSSION

> Have a discussion with the students about how to avoid microplastics polluting the sea. Ask some of the questions below:

— Do you like fish? What is your favorite fish meal?

— What happened to the plastic objects that the young girl and the young boy threw away – how did they turn into the balls that the fish ate?

— Do you think we should not eat fish – even though it is so tasty and good for us?

— How should we dispose of plastic objects in a better way? *(Show the students a bin for collecting plastic waste separately. Explain that many plastics can be recycled.)*

> Explain that microplastics can also end up in air and soil. It can be in the water we drink and other food we eat (not only in fish).

> Highlight that it is also not ok to throw plastic waste on the ground.

Additional resources:

> Lusher AL, McHugh M, Thompson RC (2013). Occurrence of microplastics in the gastrointestinal tract of pelagic and demersal fish from the English Channel. Marine Pollution Bulletin 67(1): 94-99. **https://www.sciencedirect.com/science/article/abs/pii/S0025326X12005668**

> Thompson RC et al (2004). Lost at sea: where is all the plastic? **https://www.science.org/doi/10.1126/science.1094559**

AGE:
12-18

Activity 3.2:

How microplastics affect your health

Chemistry | Ecology | Medicine

In this activity students will watch a short video about the impacts of microplastics on the environment and on human health.

STUDENTS WORKBOOK

How microplastics affect your health
page 32

Practical tips to avoid exposure to plasticizers
page 34

YOU WILL NEED:

- Video "How microplastics affect your health" by UNEP (www.youtube.com/watch?v=aiEBEGKQp_I) (1:57 min)

INSTRUCTIONS

> Show the video "How microplastics affect your health" and then have the students answer the questions. You can show the video a second or a third time if they were not able to answer at the questions after the first time.

> Then discuss together their answers.

> Look at the questions and answers:

Q1. What are microplastics?
A. Pieces smaller than 5 mm

Q2. How do they originate?
A. Some of them are used in cosmetics or toothpaste, but most derive from floating waste that is constantly exposed to UV radiation and crumbles in to smaller and smaller pieces. Additional information:

Q3. How many plastic particles float in the ocean?
A. 51 trillions

Q4. What are the two types of chemicals added to plastics that scientists think have impacts on health?
A. BPA makes plastic bottles transparent, but there is evidence it interferes with our hormonal system. DEHP makes plastic more flexible, but may cause cancer.

Q5. Why would it be bad if microplastics were toxic?
A. Because they travel up the food chain.

Q6. Make an example of a food chain with microplastic in it.
A. The food chain in the video: 1) microplastics > zooplankton > small fish > predatory fish> humans; 2) microplastics > oysters > humans; 3) microplastics > crabs > humans.

Activity 3.2: **HOW MICROPLASTICS AFFECT YOUR HEALTH**

Q7. In which food items have microplastics been found?
A. Honey, sea salt, beer, tap water. They have been found also in the household dust.

Q8. What types of additives have been found in human bodies?
A. Phthalates and BPA

Q9. Where have these additives been found and in what quantities?
A. Phthalates are found in the bodies of 8 out of 10 babies and nearly all adults; BPA are found in the urines of 93% of people

Q10. Do we have to panic?
A. No. There is little science and it is inclusive, but a lot of stuff happened that we did not plan for, and we have lost control of plastic.

> After the students have answered individually the first 10 questions, ask a student to come at the blackboard and all together discuss the answer they have given.

Q11. What can be done?
This question is not answered in the video.

> Discuss with students some practical tips to avoid exposure to plasticizers.

1	Limit the use of single-use plastics (silverware, glasses, dishes, food containers)
2	Limit, when possible, the use of PVC products and preferring alternatives
3	Limit the time playing with plastic toys, including electronic games
4	Limit the use of take-away food if prepared and served in plastic containers
5	Do not use microwave for food in plastic containers
6	Do not eat hot food in plastic dishes and with plastic silverware, but prefer alternative materials
7	Limit the consumption of water from plastic bottles
8	Limit the use of plastic wrap and only use safe to contact one
9	Make physical activity, if possible outdoor in green spaces

DISCUSSION

Phthalates, or phthalate esters, are esters of phthalic acid. They are mainly used as plasticizers, i.e., substances added to plastics to increase their flexibility, transparency, durability, and longevity.

> **How People Are Exposed to Phthalates:** People are exposed to phthalates by eating and drinking foods that have been in contact with containers and products containing phthalates. To a lesser extent exposure can occur from breathing in air that contains phthalate vapors or dust contaminated with phthalate particles. Young children may have a greater risk of being exposed to phthalate particles in dust than adults because of their hand-to-mouth behaviors. Once phthalates enter a person's body, they are converted into breakdown products (metabolites) that pass out quickly in urine.

> **Determinants of exposure (from the LIFE project Life Persuaded):** Data on lifestyle and food consumption habits as determinant of exposure were collected through a dedicated questionnaire and food diary. From the analysis of the questionnaire, it was possible to establish which behaviors are significantly associated with a higher risk of exposure for mothers and children or in some cases only for one of the two groups.

> **Children:** Higher levels of phthalates are associated with:
  i) use of disposable plastic (plates, glasses, etc.);
  ii) use of plastic containers in microwave;
  iii) playing many hours a day with plastic toys including electronic toys, especially for children 4-6 years old. The use of disposable plastic (plates, glasses, etc.) is also associated with higher levels of BPA.

> **Mothers:** Higher levels of phthalates are associated with:
  i) use of disposable plastic (plates, glasses, etc.);
  ii) use of plastic containers in microwaves;
  iii) consumption of water from plastic bottles;
  iv) frequent consumption of takeaway food. Frequent consumption of precooked foods and the use of food films is associated with increased exposure to BPA.

> Physical or recreational activity is a protective factor for both children and mothers as lower levels of phthalates have been measured in people who practice. It is therefore evident that lifestyle and eating habits can affect exposure, so changing some attitudes can limit it. From the conclusions of the association study between exposure-lifestyle-determining, some practical tips for the population have been elaborated in order to limit the exposure to phthalates and BPA (see Student workbook sheet Practical tips to avoid exposure to plasticizers).

Additional resources:

> CIEL et al. (2019). Plastic & Health: The Hidden Costs of a Plastic Planet – available at **www.ciel.org/plasticandhealth**

> Phthalates factsheet - **www.cdc.gov/biomonitoring/Phthalates_FactSheet.html**

Activity 3.3:

Microplastics and environmental health

In this activity students will learn about the impacts of microplastics on the environment and on human health.

STUDENTS WORKBOOK

Microplastics and environmental health
page 35

YOU WILL NEED:

- Internet connection
- Video projector

INSTRUCTIONS

1. Organize the students in small teams and tell them to read the questions/answers table.
2. Show the video "The state of knowledge on microplastics and their impact on environmental health" by Kara Lavender Law at the US National Academies of Sciences, Engineering, Medicine

   Tell the students to take notes during the video in order to answer the questions. **https://www.youtube.com/watch?v=0YPHcSTcKWg** (28.59 min) until minute 25:12.
3. Leave 5 to 10 minutes for the teams to compare their answers and pool them together, before colleting the answer from each group. You can either provide the answer to the whole class together, or grade them and bring the results in the next days.

EXTENSION IDEAS

Picking up from topics that were discussed in the presentation by Dr. Kara Lavander Law, ask students to make a research project on the following subjects:

- Why is more correct to speak about plastics instead of plastic?
- What are nano-plastics and what are their possible impacts on health?
- Conduct research on fibers and tire wear and assess their importance in global microplastic quantities.
- Research the internet for the definition of "Proprietary formulation" for plastic materials and discuss how this can impact the management of plastic waste derived from these materials.

- Compare the number of marine species impacted by entanglement with the number of marine species impacted by plastic debris by ingestion. Look at Grid-Arendal Vital Rates graphics (**https://www.grida.no/publications/60**)
- Make research about additional impacts of plastics on human health. Read the CIEL report Plastic and Health (**https://www.ciel.org/plasticandhealth/**) and the Open Access study about microplastics found in human placenta (**https://www.sciencedirect.com/science/article/pii/S0160412020322297**). What are the possible concerns for human health?

Questions/answers table

	QUESTION		ANSWERS
I. PLASTICS PRODUCTION AND FATE OF PLASTIC WASTE (Up to min 2:29)			
1	**When is the nominal start of plastic production?**		1950
2	**How does plastic production relate to the production of steel, cement, and aluminum?**		Plastic production has outpaced these productions
3	**How much plastic has been produced since the conventional start of commercial production?**		8.3 billion metric tons
4	**How does the curve of plastic waste generation relate to the curve of plastic production?**		It is almost identical, it is slightly offset
5	**How much of all plastics produced have become waste?**		70% of total plastics produced have become waste
6	**What is the fate of plastic waste?**	6.1 **Recycled**	9%
		6.2 **Incinerated**	12%
		6.3 **In landfills or the natural environment**	The rest
7	**Considering the plastics still in use and the plastics in landfill and the natural environment, how much plastics are still in existence on the planet?**		90%
II. PLASTICS DETECTION IN THE NATURAL ENVIRONMENT (From min 2:29 to 6:39)			
1	**When was the first seabird found with plastic debris in his gut?**		In 1966
2	**What was the plastic production level at that time?**		Plastic production was 5% of current levels
3	**When was plastic debris first found floating in the ocean and in which ocean?**		In early 1970 small bits of plastics were found floating in the North Pacific Ocean
4	**What was the plastic production level at that time?**		Plastic production was about 10% of current levels
5	**When was plastic debris floating in the floating in the North Atlantic Ocean first recorded?**		In the mid-1970s
6	**When was the term "garbage patch" first used? To refer to plastic pollution in which ocean?**		In 2003 in the Pacific Ocean
7	**What was in the bellies of albatross chicks photographed at Midway atoll?**		Cigarette lighter and bottle caps
8	**How does the garbage patch look like?**		There is no floating island, but there is clearly contamination. You can see some objects that do not belong to the sea. You can see some plastic objects.

Activity 3.3: MICROPLASTICS AND ENVIRONMENTAL HEALTH

	QUESTION	ANSWERS
III. MICROPLASTICS: DEFINITION, CHARACTERISTICS AND DISTRIBUTION AT SEA (From min 13:05 to 17:20)		
1	**Which instrument is used to collect microplastics in the surface ocean?**	A plankton net
2	**What is the scientific consensus definition of microplastics?**	Small bits of plastics
3	**What are some common shapes of microplastics?**	Resin pellets, fragments, line, film, microbeads
4	**How are the majority of plastic particles produced?**	By fragmentation of larger objects
5	**Is it possible to tell the origin of plastic particles collected with a plankton net?**	No, it is impossible to tell their origin either by geographic origin, type of object except fishing line.
6	**What are the categories of plastics that are produced from wear?**	Textile fibers and tire wear particles
7	**How many types of synthetic polymers are made of microplastics?**	Hundreds of types of synthetic polymers
8	**What is the Resin Identification Code (RIC) of a milk jug and what synthetic polymer is it?**	A milk jug has a number 2 RIC, corresponding to high density polyethylene
9	**What is the Resin Identification Code (RIC) of a detergent bottle and what synthetic polymer is it?**	A detergent bottle has a number 2 RIC, corresponding to high density polyethylene
10	**Are they chemically the same? Why so?**	No, they are not chemically the same. They differ because of the chemical additives that have been added to the polymers
11	**Why are additives used in plastic products?**	To give the plastic product its properties and usefulness like flexibility or color, resistance to microbial colonization
12	**How do microplastics evolve in the environment?**	They will become smaller, the shape will change, the chemical composition will change as they are exposed to UV radiation and fragmenting
13	**Why is the scientific community so interested in microplastics?**	Because they are abundant and widespread
14	**Where have microplastics be found in the marine environment?**	Beaches, water column, deep-sea sediments, Arctic Sea ice
15	**In which other environments have they been found?**	In freshwater environments: lakes, rivers and streams; in terrestrial environments: agricultural and other soil. They have been found in the air, snow, drinking water, tap water, wastewater, storm water.
16	**Where is the highest concentration of microplastics in the North Atlantic Ocean?**	Along the East coast of the United States, next to Florida, entering the Atlantic Ocean
17	**What are the ocean mechanisms that explain this pattern of concentration?**	Winds blow at the surface of the ocean and the Earth is turning, this forms gyre systems, that are basin scale systems that determine a convergence zone at 30 degrees north that brings plastic and other floating debris together and slows them down in kind of an oceanographic dead end
18	**What are the patterns of concentration in the North Pacific Ocean?**	The patterns are the same: high concentration between 20 and 40 degrees north. In addition, low values at the tropics
19	**What are the garbage patches?**	They are accumulations of microplastics because of ocean circulation

Activity 3.3: **MICROPLASTICS AND ENVIRONMENTAL HEALTH**

QUESTION	ANSWERS
IV. IMPACTS OF MICROPLASTICS ON MARINE ORGANISMS AND THE ENVIRONMENT (From min 17:20 to 20:42)	
1 **What is the major concern with microplastics?**	They are small enough that they can be ingested
2 **What organisms can be impacted by microplastics?**	Zooplankton, other invertebrates, fish, marine mammals
3 **How many species of marine organisms have been impacted?**	More than 220 species
4 **What are the possible impacts?**	Internal damage, false sense of satiation and starving, inflammation, transfer across the cell membranes
5 **What is the complication associated with the potential impacts of microplastics?**	A complex array of chemicals is associated with plastics, including by-products from manufacture, chemicals added during manufacture, chemicals adsorbed from the environment. Many of these chemicals are known to be potentially harmful to organisms. There is concern that if an animal is eating these plastics the chemicals will transfer to the animal tissue and cause harm
6 **Do laboratory experiments show evidence of impacts from microplastics to organisms that ingested them?**	A complex array of chemicals is associated with plastics, including by-products from manufacture, chemicals added during manufacture, chemicals adsorbed from the environment. Many of these chemicals are known to be potentially harmful to organisms. There is concern that if an animal is eating these plastics the chemicals will transfer to the animal tissue and cause harm
7 **Do studies conducted in nature show evidence of impacts from microplastics to organisms that ingested them?**	There is no conclusive evidence. 47% of the studies that studied microplastics impacts in the field showed evidence of effects, while 53% did not show evidence of effects
V. MICROPLASTICS AND HUMAN HEALTH (From min 20:42 to 25:15)	
1 **Is there evidence that the things we eat and drink are contaminated by microplastics?**	Yes
2 **List some examples**	Seafood, bottled water, beer, tap water, tea, honey, salt, sugar
3 **What did a study on human stools from 8 individuals from different geographies and diets show?**	That microplastics were present in all the samples of human stools
4 **What program has been promoted by the World Health Organization?**	A study on drinking water
5 **Is there evidence that humans are retaining microplastics after ingestion and that are they causing harm (according to the presentation)?**	There is no conclusive evidence
6 **What is the wide consensus about plastics?**	That we know enough to act to try to work towards solutions to prevent plastics from entering the environment and prevent exposures

Activity 3.4:

Toxic cocktails

In this activity students will search on the internet to learn what are the chemicals associated with plastic marine debris, which represent a potential toxic cocktail for marine organism that ingest them.

YOU WILL NEED:

- Wi-Fi connection for the class

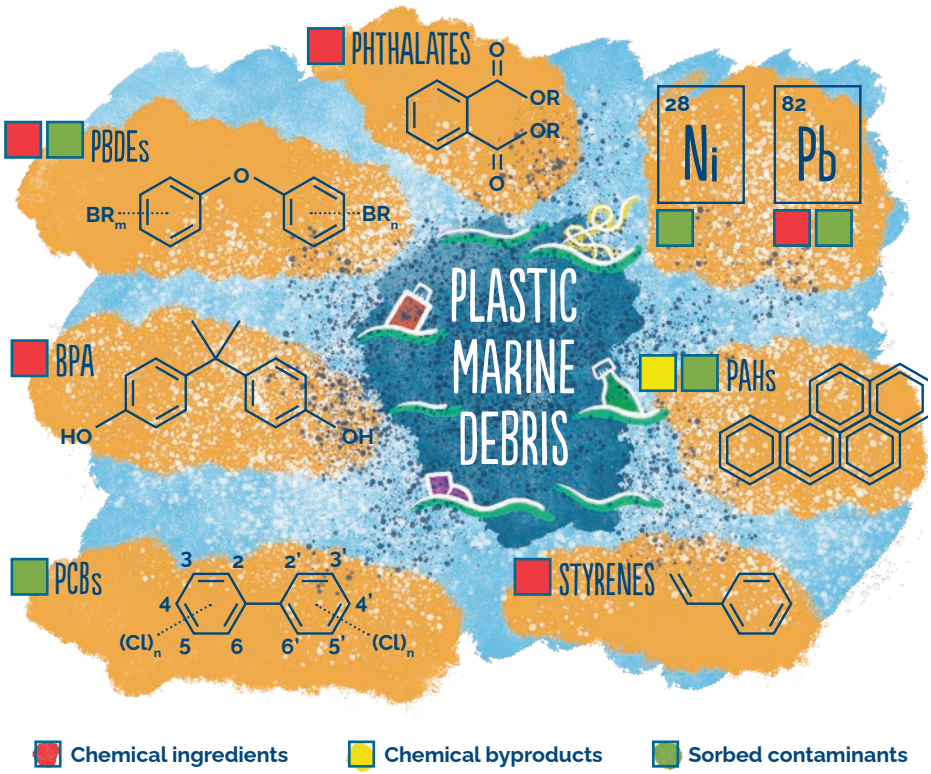
INSTRUCTIONS

> Introduce the exercise by telling the students that a range of chemicals are associated with plastic marine debris. Among which chemical by-products of polymer synthesis, additives added on purposes (chemical ingredients of the plastic type), and legacy environmental contaminants that are absorbed at the surface.

> Tell the students to make an internet search to identify the different chemicals illustrated in the figure Cocktail of Contaminants and put the right color in the white squares.

> You can expand the activity by asking students to search for information to fill the table "Contaminants ID" (page 40 of the workbook).

STUDENTS WORKBOOK
Toxic cocktails
page 39



Section 4:
POLICIES TO REDUCE PLASTIC POLLUTION

Activity 4.1:

The Basel Convention and plastic waste

In this activity students will learn about the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal, including the functioning of the 'Prior Informed Consent' procedure, classification of the types of waste and the recent Plastic Waste Amendments.

OBJECTIVES

The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal was adopted in 1989 and entered into force in 1992 with the aim to:

1. Minimize the generation of hazardous wastes in terms of quantity and degree of hazard;
2. Control transboundary movements of hazardous wastes and other wastes;
3. Promote the environmentally sound management (ESM) of hazardous wastes and other wastes.

SOME KEY DEFINITIONS

Transboundary movement (TBM): any movement of hazardous wastes or other wastes from an area under the national jurisdiction of one State to or through an area under the national jurisdiction of another State or to or through an area not under the national jurisdiction of any State, provided at least two States are involved in the movement.

Environmentally sound management (ESM): taking all practicable steps to ensure that hazardous wastes or other wastes are managed in a manner which will protect human health and the environment against the adverse effects which may result from such wastes.

- **Number of Parties:** 191 (as of July 2023)
- **Objective:** To protect human health and the environment against the adverse effects resulting from the generation, management, transboundary movements, and disposal of hazardous and other wastes
- **Relevance today:** At least 8.5 million tons of hazardous waste moving from country to country each year. Moreover, many countries complain that they are receiving shipments which they never agreed to and which they are unable to deal with properly.

Hazardous wastes and other wastes cover by the scope of the Convention are subject to the Prior Informed Consent (PIC) Procedure. The PIC procedure contains 4 stages:

1. **Notification by the exporting country:** The Exporting State send an export notification to the custom authority of the import and/or transit countries.

2. **Consent and issuance of a movement document:** The export can only take place if the exporting State has received the written consent of the import State and the import State has confirmed the existence of a contract between the exporter and the disposer specifying ESM of the exported wastes. The custom authority of the exporting country can then proceed with the issuance of the movement document which must accompany the wastes at all times from the departure to the arrival.
3. **Transboundary movement**
4. **Confirmation of disposal:** The generator and exporting country receive confirmation that the wastes have been disposed of by the disposer as planned and in an environmentally sound manner.

Type of waste:

1. **Hazardous Wastes (Annex VIII)**

   (a) Wastes that belong to any category contained in Annex I, unless they do not possess any of the characteristics contained in Annex III.

   (b) Wastes that are not covered under (a) but are defined as, or are considered to be, hazardous wastes by the domestic legislation of the Party of export, import or transit.

2. **Other Wastes (Annex II)**

   — Waste requiring special consideration

3. **Wastes excluded from the Scope of the Convention:**

   — Wastes which, as a result of being radioactive, are subject to other international control systems, including international instruments, applying specifically to radioactive materials, are excluded from the scope of this Convention.

   — Wastes which derive from the normal operations of a ship, the discharge of which is covered by another international instrument.

Waste type 1 and 2 are part of the Scope of the Convention and subject to the PIC Procedure.

In May 2019, the COP amended Annexes II, VIII and IX to the Basel Convention to change the scope of plastic waste covered by the Convention:

- Certain types of plastic waste, namely those that are difficult to recycle (listed in Annex II) or are hazardous (listed in Annex VIII), will only be allowed to be exported if the importing country grants a PIC. This PIC has to secure that the waste will be managed in an environmentally sound manner in the importing country.
- Non-hazardous, clean and sorted plastic waste destined for recycling in an environmentally sound manner can be traded without applying the PIC procedure.
- The amendments as such do not imply a ban on the import, transit or export of plastic waste.

Activity 4.1: **THE BASEL CONVENTION AND PLASTIC WASTE**

Further actions to address plastic waste under the Basel Convention following the new Plastic Waste Amendments:

1. **Minimization/prevention of plastic waste:** The COP emphasized the need to adopt a life-cycle approach, called upon Parties to make further efforts at the domestic level, and encouraged Parties to set time-bound targets.
2. **Reducing the risk from hazardous constituents:** Plastic waste may contain hazardous substances. The COP strongly encouraged Parties and others to make effort to create new technology and processes to reduce the use of hazardous constituents in the production of plastics.
3. **Review of Annexes I and III to the Basel Convention:** The COP requested the expert working group on the review of annexes to consider whether any additional constituents or characteristics in relation to plastic waste should be added to Annex I or III to the Convention.
4. **Technical guidelines:** The COP decided to update 'The Technical Guidelines for the Identification and ESM of Plastic Waste and for their Disposal' and decided to establish a small intersessional working group to undertake this work. UNEP/CHW.16/6/Add.3/Rev.1: **https://www.brsmeas.org/2023COPs/Meetingsdocuments/tabid/9373/language/en-US/Default.aspx**
5. **Partnership on Plastic Waste:** The COP decided to establish the working group of the Partnership on Plastic Waste and adopted the Term of Reference and workplan for 2020-2021. Its goal is to improve and promote the ESM of plastic waste at the global, regional and national levels and prevent and minimize their generation so as to reduce significantly and in the long-term eliminate the discharge of plastic waste and microplastics into the environment, in particular the marine environment.
6. **Public awareness:** The COP invited Parties and others to enhance public awareness, education, and information exchange

List of Annexes:

ANNEX I: wastes to be controlled under the Basel Convention

ANNEX II: wastes for special consideration (see entry Y48 for plastic waste)

ANNEX III: hazardous characteristics of wastes (H1 to H13)

ANNEX IV: lists the disposal operations; it includes two sections, namely section A entitled "Operations which do not lead to the possibility or resource recovery, recycling, reclamation, direct re-use or alternative uses" and section B entitled "Operations which may do not lead to the possibility or resource recovery, recycling, reclamation, direct re-use or alternative uses"

ANNEX V: section A entitled "Information to be provided on export notification" and section B "information to be provided on the movement document"

ANNEX VI: Arbitration

ANNEX VII: The ban amendment (Parties and other States which are members of OECD, EC, Liechtenstein)

ANNEX VIII: Hazardous waste (see entry A3210 for plastic waste)

ANNEX IX: Non-hazardous waste (see entry B3011 for plastic waste

YOU WILL NEED:

- **Overview of the Basel Convention**
- **Text of the Basel Convention**
- **Overview of the Basel Convention and plastic waste**
- **Story Map of Plastic waste and the Basel Convention**
- **Addressing plastic pollution under the Basel Convention**
- **FAQ on Plastic Waste Amendments**
- **Guidance materials for ESM of plastic waste**
- **Online course: Plastic Waste and Basel Convention**

STUDENTS WORKBOOK

The Basel Convention and plastic waste
page 42

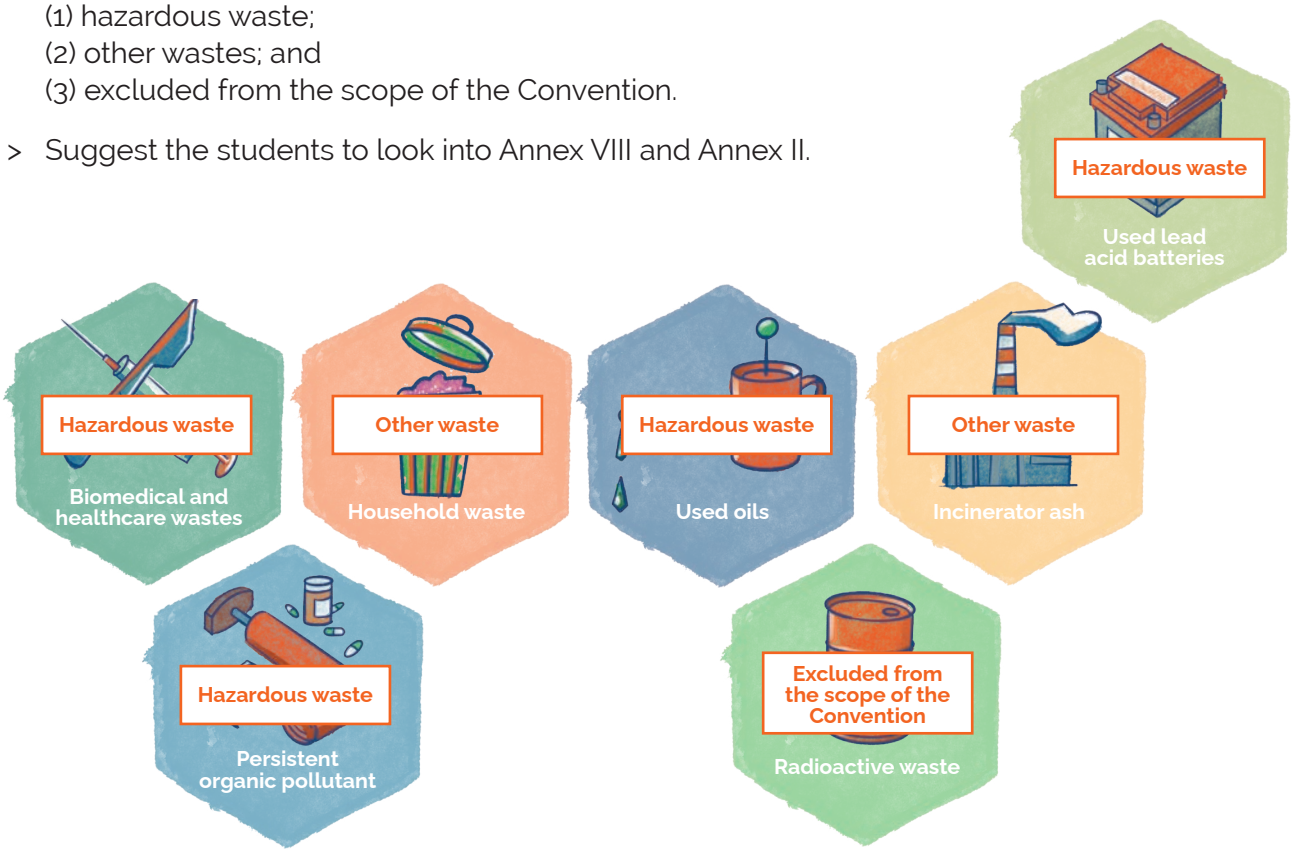
INSTRUCTIONS

The students will work in groups and will make a quiz competition in the shortest amount of time.

Game I:

> Sort the following waste in their respective category:
(1) hazardous waste;
(2) other wastes; and
(3) excluded from the scope of the Convention.

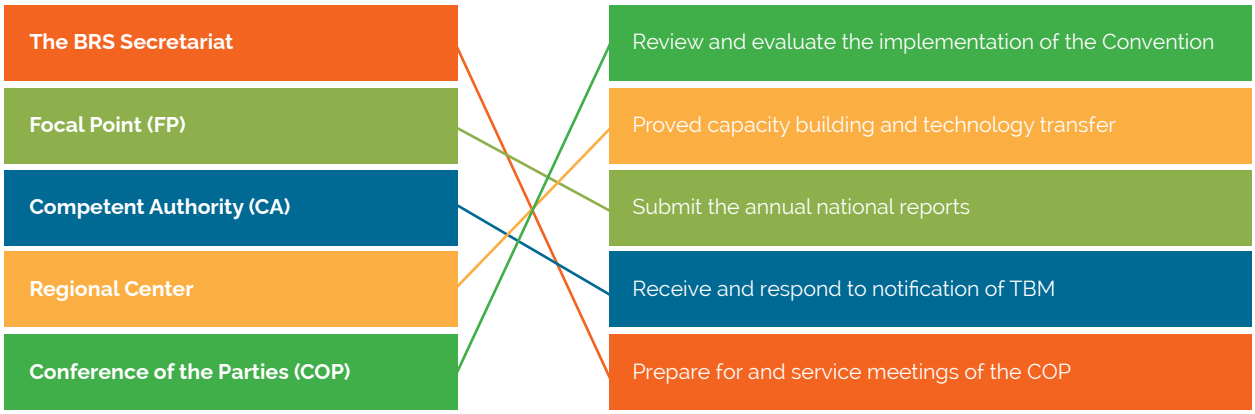
> Suggest the students to look into Annex VIII and Annex II.



Activity 4.1: **THE BASEL CONVENTION AND PLASTIC WASTE**

Game II:

> Link the key player to its role (one choice possible)



Game III:

> Following the flowchart below, decide if the waste be exported for each case studies and fill the last column of the table.

	1 Export of biomedical waste	2 Export of used oils	3 Export of PET bottles
Are one the three conditions prior to the export fulfilled?	YES	YES	YES
Is the import country a Party?	YES	NO	YES
Is the waste allowed to be imported by the import country?	YES	YES	YES
Has the export party received a writing Consent from the import party?	YES	YES	YES
Are the export waste accompanied by a movement document?	NO	YES	YES
Can the waste be exported?	NO	NO	YES

Game IV:

> With the help of Annex II, VIII and IX, indicate three types of plastic waste which are exempt from the PIC procedure:

1. **Polyethylene (PE)**
2. **Acrylic polymers**
3. **Polyethylene terephthalate (PET) - Provided it is destined for recycling in an environmentally sound manner and almost free from contamination and other types of wastes**

> The winning group will have responded faster and made no errors. A penalty will be included for errors in classifying the objects.

> When each group has finished their batches of waste, there will be restitution at the black board to discuss the results and potential errors made.

SOME KEY DEFINITIONS

Polyethylene (PE): the most commonly produced plastic. It is a polymer, primarily used for packaging.

Acrylic polymers: any of a group of polymers prepared from acrylate monomers. These plastics are noted for their transparency, resistance to breakage, and elasticity. Acrylate polymer is commonly used in cosmetics as an adhesive.

Polyethylene terephthalate (PET): the most common thermoplastic polymer resin of the polyester family used in fibres for clothing and containers for liquids and foods.

Activity 4.2:

Bans to microbeads, plastic bags, and single-use plastic products

In this activity students learn in which countries there are bans on the use of microbeads, single-use plastic bags and single-use plastic products.

STUDENTS WORKBOOK

Bans to microbeads, plastic bags, and single-use plastic products
page 46

YOU WILL NEED:

- Internet connection to show website "The World Counts".

INSTRUCTIONS

STEP 1

> Introduce the activity showing the website "The World Counts" (**https://www.theworldcounts.com/challenges/waste/plastic-bags-used-per-year**) to show the number of plastic bags produced worldwide daily, weekly, monthly or yearly. Have the students record in the Student Workbook the number of plastic bags produced at the beginning of the class.

STEP 2

> The human footprint on Earth has been increasing rapidly since the beginning of the 20th century, doubling every 20 years. In 2020 the mass of plastic objects was 8 Giga tons, i.e. the double of the mass of all terrestrial and marine animals, estimated at 4 Giga tons.

> Governments have realized that actions are needed to reduce the impacts of plastic objects, such as microbeads that impact marine life. Give some information about governments taking action to reduce microbeads, plastic bags, foamed plastics and other single-use plastics.

> Plastic bag bans, if properly planned and enforced, can effectively counter one of the causes of plastic overuse. Governments around the world are increasingly awake to the scale of plastic pollution. More than 60 countries have introduced bans and levies to curb single-use plastic waste. Plastic bags and, to a certain extent, foamed plastic products like Styrofoam have been the main focus of government action so far. The EU has also included bans on other single-use plastic items.

STEP 3

> Tell the students to look at the map on "What Countries are Doing to Combat Litter" **https://www.grida.no/resources/6919** and respond to questions 1-4.

> Divide the class in groups of 4 or 5 students to respond to questions 5-8. Ask them if they think bans should be applied in their country; tell them to think together how microbeads, single-use plastic bags, foamed plastics, and other single-use plastic items could be avoided.

STEP 4

> Come back to the website "The World Counts" and have the students write in the Student Workbook the number of plastic bags produced so far. Ask them to make the algebraic subtraction.

TIPS FOR THE TEACHER

> You can also prepare the questions 1 – 4 in Kahoot (**www.kahoot.com**) and make a competition for the students. Who answer fastest win.

Additional resources:

> Elhacham, E., Ben-Uri, L., Grozovski, J. et al. Global human-made mass exceeds all living biomass. Nature 588, 442–444 (2020). **https://www.nature.com/articles/s41586-020-3010-5**

> UNEP (2018). SINGLE-USE PLASTICS: A Road-map for Sustainability **https://www.unep.org/resources/report/single-use-plastics-road-map-sustainability**

Section 5:
SOLUTIONS TO PLASTIC POLLUTION

AGE:
8-14

Activity 5.1:

Lifecycle of a plastic drink bottle

In this activity students understand the environmental impact of a plastic drink bottle at different stages of its lifecycle. The activity can also be extended to enable students to identify opportunities within the product lifecycle for designers, engineers and scientists to reduce environmental impact.

YOU WILL NEED:

- A plastic drink bottle
- Internet connection to show the video "What really happens to the plastic you throw away" (04:06 min)

STUDENTS WORKBOOK

Lifecycle of a plastic drink bottle
page 51

INSTRUCTIONS

> Start this activity by showing the plastic bottle and asking how many bottles the students use in an average day or week and whether they reuse them.

> Play the TED-Ed video "What really happens to the plastic you throw away" to show how most plastic bottles are made and processed to check whether they have their story line correct.

> Ask each group to cut out the set of lifecycle cards from the student workbook. Allow a few minutes for the students to arrange the cards in a way that tells the story of the drink bottle from beginning to end. Ask for feedback on their story line.

> Introduce the concept of Lifecycle Analysis (LCA) and the stages that many companies use to calculate the environmental impact of their products.

> Give each group a copy of an LCA sheet (min. A4 format, A3 or poster better) and ask them in groups to discuss the questions and write their answers on the sheet.

> Once the students have completed their questions, you can introduce the idea that LCA can be used to identify where in the lifecycle they think the bottle has the biggest impact on the environment.

> Ask the students for their ideas of ways to reduce the environmental impact. They might include, using different materials, thinner plastic, encouraging more people to recycle bottles, etc.

Activity 5.2:

Everyday comparison debate

In this activity students will explore the impact of everyday objects and see the relationship between their choices and the impact on the environment. Debate helps develop an argument and encourages good conversation around complex issues.

STUDENTS WORKBOOK

Everyday comparison debate
page 55

YOU WILL NEED:

- Internet access
- Scrap paper to write on
- Pen or pencil

INSTRUCTIONS

STEP 1. Lifecycle Assessment

> Create two teams and decide on two everyday objects to compare. Some examples are:
  - — Pen vs. pencil
  - — Cotton bag vs. paper bag vs. plastic bag
  - — Plastic packaging for food vs. bee wraps
  - — Plastic bottle vs. reusable bottle
  - — Plastic container for yogurt vs. glass container
  - — Styrofoam food container vs. steel lunch box

  It is advantageous to choose everyday objects for this activity as it will help shift the perspective on the choices that can make in daily life.

> Give the students 20 minutes to research the different kinds of environmental impact of the everyday products chosen. Use valid sources such as respected newspaper articles and scientific studies (Google Scholar is a great resource for scientific studies) to uncover the case for the product.

> To make sure they cover all aspects of a product lifecycle, tell them to consider these different aspects:

1. Raw materials and extraction. Which raw materials are used to make the product?
2. Production (including Design/Manufacturing): How is the raw material used in the product made?
3. Packaging: How is the product packaged?

4. Transportation/distribution: How is the product transported from the factory to the place where it is sold?
5. Use: How is it used? For how long?
6. End of life: What happens after the product has been used? Can it be sent to recycling? Are there recycling plans for the product in your area? If it cannot be recycled, how can it be disposed off properly?

STEP 2. Tell the students to develop a Plus, Minus, Interesting (PMI) analysis of the product

> The Plus, Minus, Interesting (PMI) analysis can be applied to products, actions, idea, etc. In the PLUS section all the positive aspects of a product action, idea etc. should be listed. This can include: advantages, benefits, strengths, positives, good things. In the MINUS section, all the negative aspects should be listed, including: disadvantages, deficiencies, weaknesses, minuses, negatives. Finally, in the INTERESTING, anything that seems interesting and that needs future investigation should be listed. For example: implications and possible outcomes, attention-grabbing, out of ordinary, appealing.

> Here, the PMI analysis it will be applied to everyday objects. Tell the students to consider the PLUS, MINUS, INTERESTING characteristics of the product they are working with throughout its lifecycle.

STEP 3. Scoring the pairs of products

> Let each team illustrate to the other team the Lifecycle Analysis (LCA) and the Plus, Minus, Interesting (PMI) analysis of their product. Revise all analyses with inputs from the other team.

> After the discussion, proceed to score each product with the whole class to make a decision about whether it is good or not to continue producing and using it. Each idea in the Plus-Minus-Interesting category will be given a scoring that will range from +5 to -5. The scoring is subjective in nature and during the scoring assessment there can be further discussion with the class. After the scoring each idea listed in the table for the three categories Plus-Minus-Interesting, figures are tallied to decide if an object should be used or not. Give a time limit of 3-5 minutes for the discussion of each step.

> Compare the score of the two pairs of products.

DISCUSSION

- What are all the different ways a product can impact the planet?
- What different perspectives should we take into account when we create products?

If time permits, each team can come up with a way in which this product could be redesigned to be part of the circular economy.

Activity 5.3:

The 4Rs: Rethink, Reduce, Reuse, Recycle

In this activity students explore the opportunities for rethinking, reducing, reusing and recycling plastics to reduce their negative impacts on the environment and people.

NOTE: Depending on your curriculum focus or areas of students' interest, the lifecycle analysis and 4Rs activities can be continued and extended in a variety of ways. Here they target plastics drinks bottles, but they can be done with other single-use plastic products, such as water sachets, food containers, etc.

STUDENTS WORKBOOK

The 4Rs: Rethink, Reduce, Reuse, Recycle
page 58

INSTRUCTIONS

STEP 1

> Firstly, recap on the students' learning from the LCA of a plastic bottle activity (Activity 5.1). Introduce the idea of the 4Rs = Rethink, Reduce, Reuse, Recycle as a way to help students identify opportunities to reduce the environmental impact of a plastic bottle (or alternative product).

STEP 2

> Use the **4Rs definition sheet** to enable the students to work in pairs to sort out a definition for each 'R'. Make sure they are clear about the difference between reuse and recycle.

STEP 3

> Redesign...using the 4Rs. Suggest to the students to think as designers and/or consumers and identify opportunities to reduce the environmental impact of the plastic bottle (or an alternate plastic product, such as a plastic bag). The students may find it easier to look at opportunities for improvement throughout the product's lifecycle (from sourcing materials to final disposal).

> You may want to suggest that different groups look at one or two of the Rs. The students can annotate their ideas on the workbook or use the poster.

> If any prompting is needed, these might be useful questions:

- **RETHINK:** Do we need to use plastic bottles at all? What could we use instead? Can we use other raw materials to make plastic?
- **REDUCE:** Can we use thinner plastics to make the bottles?
- **REUSE:** Is it safe to reuse a plastic bottle? What could we do to encourage people to reuse a bottle?
- **RECYCLE:** Can we encourage people to sort more plastic bottles and send dispose them correctly so that they can be recycled? Can a bottle be designed in a way to make recycling easier which would improve the efficacy of recycling?

Activity 5.4:

Is recycling worth it?

In this activity students will learn about the efficacy of recycling plastic drink bottles.

YOU WILL NEED:

- Set of cards on environmental impact of recycling plastic drink bottles — 1 per small group
- Plastic recycling: True or False? sheet — 1 per small group

INSTRUCTIONS

STEP 1

> During the 4Rs activity, the students are likely to have suggested that recycling is an option for reducing the environmental impact of plastics. This activity enables the students to explore whether recycling plastic makes any real difference to the environment.

> Ask the students to cut out the cards from their workbook. Now ask them to place them on the appropriate parts of their LCA sheet. They will need to think how and where recycling plastics reduces environmental impact in the product lifecycle.

STEP 2

> Review their findings.

> You might want to back up the information on the cards with the **Plastic recycling: True or False?** card activity that should help to consolidate their learning about plastic recycling. **NB. All the statements on the cards are true!**

STUDENTS WORKBOOK

Is recycling worth it?
page 59

EXTENSION IDEAS

You might want to extend the use of the LCA activity to look at the impact on people affected by the production, use and disposal of the water bottle/plastic products. You can either ask the students to use a different color pen to highlight where on the LCA sheet people are involved and whether the impact is positive or negative or use one of our product evaluation activities that focus on impacts on people.

HOMEWORK IDEAS

You might want to set a homework activity that enables students to research in more detail the work of designers, scientists and engineers who are developing more sustainable solutions to oil based plastics.

Activity 5.5:

Reduce your plastic footprint

A project over several weeks

In this activity students learn how much plastic waste they produce each day/week/year.

YOU WILL NEED:

Internet access to use the plastic footprint calculator developed by the Basel Action Network (**https://www.ban.org/plastic-waste-transparency-project-1**). The calculator takes into account plastic use from several categories:

STUDENTS WORKBOOK

Reduce your plastic footprint
page 61

Food and kitchen needs

- PET bottles
- Plastic bags
- Food wrappers
- Yogurt containers

Bathroom and laundry

- Cotton swabs
- Detergent, cleaning products bottles
- Shampoo, shower gel, cosmetic bottles
- Refill packets
- Toothbrushes
- Toothpastes

Disposable containers and packaging

- Take away plastic box
- Take away plastic cup
- Straws
- Disposable cutlery
- Plastic plates

Other

- Toys
- Furniture

INSTRUCTIONS

According to the age of the students, they can do their individual calculation, or you can make an average calculation for the whole class, all together.

STEP 1:

> Calculate the plastic footprint in a day/week/year. Calculate the plastic footprint during a whole life.

STEP 2:

> Compare the daily/weekly and yearly footprint of the students.

STEP 3:

> Calculate average yearly footprint for all the students at schools/for all citizens in the city and the country.

STEP 4:

> Discuss with the students of the possible ways to reduce their daily footprint. For each of the four categories of plastic waste (food and kitchen needs, bathroom and laundry, disposable containers and packaging, other) inspect which one could be eliminated next week from consumption.

> Tell the students to take note of everything they use in the following week.

STEP 5:

> After a week, re-do the calculation of the plastic footprint and compare with the other students who have reduced the most its plastic footprint.

EXTENSION IDEAS

You can have the students do the lifecycle assessment activity of the plastic products that they use the most.

Activity 5.6:

Packaging-free lunch

In this activity students look at their own use of packaging, especially single-use packaging, and see if they can reduce it.

YOU WILL NEED:

To prepare the class you have to retrieve information about plastic waste in your country. If recent data are available for your country, you can use them. Otherwise, look at the charts on Our World In Data/Plastics (**https://ourworldindata.org/plastic-pollution**) to extract those data. In particular:

- Plastic waste generation per person (**https://ourworldindata.org/grapher/plastic-waste-per-capita**)
- Total plastic waste by country (**https://ourworldindata.org/grapher/plastic-waste-generation-total**)
- Mismanaged plastic waste by country (**https://ourworldindata.org/grapher/inadequately-managed-plastic**)

INSTRUCTIONS

STEP 1. Engage

> Ask the students to recollect the benefits of packaging. Their answers could include:
  - Preventing accidental poisoning (e.g via the use of child-proof lids on medicines)
  - Preserving food
  - Transporting goods easily (e.g. less spoilage, breakage than glass)
  - Protecting sensitive products from heat and cold
  - Increasing food shelf life
  - Protecting fragile and expensive goods (e.g. computers, glassware)
  - Product recognition

STEP 2. Explore

> During one lunch time, ask the students in your class to place all lunch scraps and packaging waste in a bucket. Count all food scraps, recyclable packaging and non-recyclable packaging. Graph those results and store them.

STEP 3. Explain

Suggested Teachers Script:

> We have seen that packaging is very useful. It preserves food and stops it from being wasted, and it ensures that the contents of packages are delivered without being damaged. The problem is, a lot of packaging is used, a lot of it is plastic, and of this, a high proportion is being wasted.

> About how much do you weigh? (Thirty kilos? Forty Kilos?) In our country we produce about [XX] kilos of packaging per person per year, of which [XX] is mismanaged (e.g. double or triple your weight). Much of this is plastic. Packaging makes up XX% of the domestic and council waste stream, and about XX% of total waste. We recycle about XX% of our packaging.

> Many of the problems associated with plastic have arisen because single-use or disposable items have often replaced re-usable, refillable containers. In fact, much of the total amount of plastic used in [*country name*], around XX%, is used for manufacturing single-use disposable packaging, including plastic bottles / water sachets, cups, and bags.

Can you think of the problem with waste PLASTIC packaging?

> Problems could include:
  - it is a wasted resource and could potentially be recycled;
  - it is filling up landfills;
  - it can contribute to litter;
  - it lasts a very long time in the environment;
  - tiny pieces can get into the marine environment, and be ingested by plankton, then these get eaten by bigger fish;
  - animals and birds can ingest plastic, causing them to have their digestive systems blocked;
  - animals such as birds can get entangled in plastic packaging.

STEP 4. Elaborate

> Plan a Packaging-Free Lunch Day.

> First of all think about reusable dishes, silverware and glasses to use for eating that can substitute single-use plastic tools.

> Then brainstorm with students how to reduce food packaging with our school lunches.

> If you are working with young children, prior to that day list the ideas on packaging free lunches on the blackboard and, send a letter to parents, including some packaging-free food ideas.

> Examples of packaging free lunches could include:
  - bring lunch from home rather than buying it at the canteen;
  - re-using e.g. bread wrappers instead of getting a new lunch wrap every day;
  - bring yoghurt in re-usable containers rather than buying individually wrapped yoghurt pots;
  - buying chips (crisps) in large bags, not individually wrapped;
  - harvesting vegies from the school garden to give away at lunchtime e.g. carrots, snow peas;
  - making biscuits at home: have them instead of individually wrapped bars or biscuits;
  - bringing your own water bottle.

> Remind students leading up to the Packaging-Free Lunch Day.

> On the day of the Packaging-Free Lunch, ask the students in your class to place all lunch scraps and packaging waste in a bucket. Count all food scraps, recyclable packaging and non-recyclable packaging.

> Graph those results.

Step 5. Evaluate

> After the event, discuss the difference in lunch waste between the 'before' and 'after' the Packaging-Free Lunch Day. Discuss the use of fresh foods vs. packaged food in terms of packaging and energy consumption (and nutrition).

> Ask the students to make a statement about the exercise of making a rubbish free lunch. Would they commit to having another rubbish free day, maybe once a term?
Could they convince the whole school? What about changing every-day habits?
Should we include morning tea in the rubbish free lunch?

EXTENSION IDEAS

- For older students, you might suggest that they create a bee wrap to package their sandwiches.
- Promote the Packaging-Free Lunch to the whole school.

AGE:
11-18/ adults

Activity 5.7:

Change is in our hands

In this activity students will learn what are the main sources of marine pollution as well as their degradation time and will reflect on the major threats to the marine environment. They will be able to raise awareness on the dangers of pollution and understand that change is also in our hands. They will realize the importance of protecting the ocean and will be able to be actively involved in it, being able to make conscious decisions regarding the ocean.

YOU WILL NEED:

- Notebooks
- 1 type of marine litter for each group
  (e.g. plastic cup, water bottle, balloon, cotton swab, aluminum can, fishing net, glass bottle, straws, cigarettes, plastic dishes)

STUDENTS WORKBOOK

Change is in our hands
page 63

INSTRUCTIONS

The activity lasts about 90 minutes.

Suggested script:

Marine pollution is one of the main issues of our time. It can be defined as presence of solid waste and liquid pollutants in the waters of the seas and oceans, as a result of human activity. This type of pollution comes not only from waste dumped into the sea or spills from vessels, but also from other sources, such as domestic sewage, industrial discharges, and urban and industrial surface runoff.

The language and objectives used in this activity can be tailored to different age groups and competences, simplifying the concepts or including more detailed information.

STEP 1 (for the whole class)**:**

> Watch the video "Sources and Impacts of Marine Litter" (**https://www.youtube.com/watch?v=017bBeXhYz4&t=3s**) (3:50 min).

> Make a little debate about the video and what we can learn from it.

Activity 5.7: **CHANGE IS IN OUR HANDS**

STEP 2 (in groups)**:**

> Assign a type of marine litter to each group and ask the students to fill in the worksheet "Know, Think, Act!" on their workbook, planning an original campaign aimed to prevent or inform people about the specific type of marine litter they got.

STEP 3 (the whole class)**:**

> Each group presents its campaign to the class.

> Each group will vote for the best campaign.

STEP 4 (the whole class)**:**

> This is the big challenge: to implement the best campaign!

STEP 5: Evaluation

> The evaluation of the acquired knowledge can be done through the presentation of the campaigns developed by the students.

Additional resources:

- **Beat the microbead**
- **How big is the ocean?**
- **Associaçao Portuguesa do Lixo Marinho**
- **10 ideas for 21st century education**
- **Stopping Marine Litter Together**
- **Ocean pollution and marine debris**
- **Rise Above Plastics**
- **Sources and impacts of marine litter by Jane Lee**
- **The nurdles' quest for ocean domination - Kim Preshoff**
- **Plastic debris in the oceans**
- **Plankton eating plastic caught on camera for the first time**
- **KNOW FEEL ACT! to Stop Marine Litter**
- **Return To Offender Weekend call to action**

AGE:
14-18/ adults

Activity 5.8:

Video making to fight plastic pollution

STUDENTS WORKBOOK

Video making to fight plastic pollution
page 64

In this activity students will create short videos to raise awareness about plastic pollution and what they have learnt about possible solutions. This will foster their sense of citizenship and ownership and give students an active voice in the problem and thus empower them to act.

YOU WILL NEED:

- Smartphones

INSTRUCTIONS

> In this activity students will create a video (max. 2 min) on the issue of marine litter. Some key themes to be considered:
  - Why is marine litter a concern?
  - What can be done?
  - What has been done in our school/community to deal with it?

> Other ideas can include:
  - Results from the Packaging-Free Lunches, showing the comparison of plastic packaging used in normal days or about the plastic free lunch. The work is done in small groups.
  - A video on the campaign proposal(s) that were created in the activity "change is in our hands" (Activity 5.7).

> According to the age of the students, they will do the video on their own, or you will help them with filming. You might want to give instructions on how to prepare the speech that they will say in the video, such as for example writing down the text and measuring the time to read it before to shoot the video; or for example tell them to make the video with their smartphones in horizontal position.

> Once the videos are done, the class, and/or the school, will vote to select the best videos. There can also be some public voting on the best videos on YouTube.

Activity 5.8: **VIDEO MAKING TO FIGHT PLASTIC POLLUTION**

GET INSPIRATION

If needed, you can show these videos for students to get inspiration.

- Microplastic madness - the real-life story of New York City fifth graders who took action to stop plastic pollution **https://www.youtube.com/watch?v=s0jIH1fUqZU** (1.10 min)
- Microplastic madness – Youth comments from around the world talks about the film that has been screened in 45 countries and across the US, sparking global youth action! **https://www.youtube.com/watch?v=dAByVOIowo0&feature=youtu.be** (2:32 min)

Bye bye plastic bags

- This is how a pair of sisters got Bali to ban plastic bags by the World Economic Forum **https://www.youtube.com/watch?v=Sr_ZaKRx5Hg** (3:06) **http://www.byebyeplasticbags.org/**

AGE:
11-18/ adults

Activity 5.9:

Tweet it, bump it, haiku it, draw it!

In this activity, students use their creativity to express what they have learnt about plastic pollution and possible solutions through art. This activity can be made after the single activities or at the end of the school year.

INSTRUCTIONS

> Tell the students to get creative and create some art related to what they have learnt about plastic pollution and possible solution and share with others.

> The whole class can be working on the same art expression (Tweet, Bump, Haiku, Draw). In this case you could have more than one session, each one dedicated to one or two of the art expressions. Or you could have the students chose which art expression they prefer.

> **Tweet:** Setting a 140-character limit per tweet, the students have to synthesize and summarize the work into 1-3 tweets. #creative and #funny #hashtags are #encouraged

> **Bump:** The students use words and images to create a bumper sticker encapsulating what they have learnt.

> **Haiku:** Students have to summarize the work in haiku form, 17 total syllables in three lines, following the structure: 5 syllables, 7 syllables, 5 syllables.

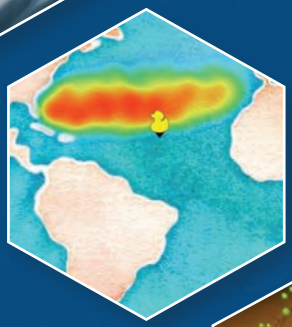
> **Draw:** Students use large paper and colored sharpies to draw an image that summarizes what they have learnt.

STUDENTS WORKBOOK

Tweet it, bump it, haiku it, draw it!
page 65

Section 6:
AWARENESS RAISING FESTIVAL AND CITIZEN SCIENCE PROJECTS



Activity 6.1:

The ocean festival

An awareness raising festival on the impacts on society on the marine environment will be developed. Children will participate in a series of interactive activities about marine litter organized in collaboration with experts from a local university, research institute, aquarium or museum. The goal of this activity is to raise awareness about marine litter and promote understanding about the causes, impacts and solutions to the problem.

DESCRIPTION OF THE FESTIVAL

Ideally, a large event (the festival) will be organized to raise awareness about the impact that society has on the marine environment. Activities at this event might include outdoor activities (sea kayaking, beach conservation), and discovery activity (tour of an aquarium, tour of protected marine area) to develop the feeling of connection with the natural marine environment.

In the framework of this event, four specific activities will be dedicated to raising awareness about marine litter. Ideally, local experts on marine litter will conduct the specific activities. Experts might come from universities, research institutes, NGOs. In these specific activities, multiple techniques will be used to increase awareness and engage children in the topic of marine litter, including posters and artwork, demonstrations, and mini-experiments. Children will take part in each activity (in no particular order) for approximately 8–10 min and in groups of six to eight. Their total duration of the intervention on marine litter will be 45-50 minutes.

Children will also participate in a perception survey (see Activity 7.1. Perception Survey) to assess their awareness and concern about marine litter, their understanding of the impacts and the causes and their self-reported litter reducing behavior, before and after participating in the specific activities about marine litter. Here below the summary:

1. Pre-activity perception survey (5 minutes)
2. Marine litter activities (not important the order followed – 45-50 minutes)
   a. Learn about macro-litter
   b. Observe microplastic litter and plankton through a microscope
   c. Mock shop with traffic light labeling for waste footprint
3. Outdoor activities (sea kayak, walking on a protected beach) and discovery activities (visit an aquarium, an exhibit) during the rest of the day of the festival
4. Post-activity perception survey (5 minutes, to be done at school 2 weeks after the event)

Objectives and methods of the festival, awareness raising activities on marine litter, and perception surveys are derived from the work of Hartley et al. (2015).

Activity 6.1: **THE OCEAN FESTIVAL**

Table: different activities and people in charge

WHAT	DESCRIPTION	PEOPLE IN CHARGE
Awareness raising event/ festival about the impacts that society has on the marine environment.	Ideally will include outdoor activities such as sea kayaking, beach conservation, and a tour of the aquarium/museum. These activities serve to elicit the emotional contact of children with nature.	Schools to find local partners for the outdoor activities. Local/national governments could also be in charge of this.
Interactive activities about marine litter	These activities serve to raise awareness about marine litter and promote understanding about the causes, impacts and solutions to the problem.	Experts on marine litter from universities, research institutes, NGOs, etc.
Perception survey	The survey aims at studying the perception and self-assessed behaviors of primary school children about marine litter and to verify the impacts of the interactive activities. The same sets of questions will be administered to children before the interactive activities about marine litter and at least two weeks after their participation in these activities.	Teachers

YOU WILL NEED:

- Macro-litter from a beach close to the event/festival location
- Plankton specimens
- Microscopes
- Maps and pictures
- Mock shop
- Additional ideas can be taken from the activities in the Teacher Resource Book.
- Additional material that local experts use in their Outreach and Education activities about marine litter.

INSTRUCTIONS

ACTIVITY 1: Learn about macro-litter

> Children will learn about macro-litter items that have recently been collected from a beach by the festival organizers. The macro-litter items will be cleaned, and any potentially dangerous items will be removed or handled only by the experts carrying out the activity.

> Children will observe the main items that comprise marine litter and perform a small experiment to sort different materials, including plastic, paper, wood, metal, cloth and glass and identify what their source may have been.

> Children will observe the proportion of plastic in the sample of marine litter and will be told that that plastic represents approximately 75% of the litter found worldwide.

> Children will be told that that marine litter (similar to items in front of them) can have negative consequences: that wildlife can mistake marine litter for food or get entangled in it; that dirty beaches and seawater might discourage tourists from visiting the area; that dirty or sharp objects are dangerous to humans; that marine litter damages fishing boats and the fish they are trying to catch; and that marine litter does not look very nice.

> Besides all the negative impacts of plastic, children will be told information about simple actions everyone can take to reduce the potential causes of marine litter, including recycling, picking up litter, waiting until they find a bin to dispose of litter and encouraging people around them to do the same. This information will be communicated visually and verbally.

TIP: Pictures of marine mammals, turtles, seabirds entangled in ghost fishing nets can be shown.

ACTIVITY 2: Observe microplastic litter and plankton through microscopes

> Children will examine microplastic litter and plankton through microscopes to understand that litter breaks down gradually over time and can become very small, and that plastic takes many years to do this.

> Children will be told that this microplastic can be ingested by small marine organisms and wildlife.

TIPS: The short video "Plankton eating plastic caught on camera for the first time" - **https://www.youtube.com/watch?v=mGzIz9Ld-sE&feature=emb_logo** (0.50 min) can be shown.

The visualization "Plastic adrift" (**http://plasticadrift.org/?lat=18.6&lng=-40.6&center=-1.1&startmon=jan&direction=fwd**) shows where a plastic waste item that is thrown in the ocean will end up in the future.

The visualization "Perpetual Ocean" by NASA (**https://svs.gsfc.nasa.gov/vis/a000000/a003800/a003827/**) shows surface floating currents and can be used to tell children that floating plastic waste are carried by ocean currents and accumulated in oceanic gyres.

Show the location of Midway Islands in the middle of the Pacific Ocean on a world map. Discuss with children how far these islands are from mainland and how many people live there. Then show Chris Jordan's pictures of albatross chicks with their bellies full of plastic waste items such as cigarette lighters and bottle caps. Pictures can be found here: **http://www.chrisjordan.com/gallery/midway/#CF000313%2018x24**

Activity 4: Mock shop with traffic light labeling for waste footprint

> Children are presented with a mock shop with products that followed a traffic-light labelling system to represent the environmental and waste footprint of the product. In the traffic light labelling system, the green dot signifies a product that used the minimum amount of material, or packaging that uses recycled material, or can be recycled. A red dot represents products that used more material than necessary, or packaging that does not use recycled content, or is difficult to recycle.

> Children first go through and elect items without realizing the significance of the red dots.

> They are then given a shopping list with the task to 'purchase' products using tokens and at the till received the 'eco-price' of their shop.

> Children are then required to alter their product choices to decrease the packaging footprint of their shop.

> This activity has the goal to convey information about simple things to look out for and actions everyone can take when they are shopping that will help reduce marine litter (e.g., buy products with less packaging or with packaging that uses recycled material or that can be easily recycled).

TIPS: some objects that could be put on sale include single-use plastic items used in everyday life (red dot) and their more sustainable counterpart in more durable/easier to recycle materials (green dot): plastic bottle vs. refillable bottle; water sachet vs. refillable water; plastic silverware vs. bamboo or metal silverware; rice or other food to be bought in small single-use packages vs. rice to be bought in bulk; shampoo sachets vs. shampoo bottle or solid shampoo; sandwich in plastic packaging vs. sandwich in bee wrap.

Final interactive session

> A final 10 min interactive question and answer round-up session to summarize the key messages from the activities, namely: Is there any evidence of marine litter and is it a problem? Where does it come from and where is it found? What can be done and how to take action?

FOLLOW-UP ACTIVITIES IN THE CLASS

- After two weeks from the event, teacher will administer the post-activity perception survey. After having done this, they can do some follow up activity on marine litter, such as the activity "Change is in our hands" that can be found in the Teacher Resource Book. It is important they do not carry out this specific activity on marine litter before the post-activity perception survey in order be able to evaluate the activities carried out during the awareness raising festival.

AGE:
11-15

Activity 6.2:

3-Day citizen science project to study macro and micro litter in the natural environment

In this activity students will collect data on quantity, typology, and distribution of beach marine litter through the application of a standard protocol and rigorous scientific criteria. This activity will raise awareness about marine litter and plastic pollution. It is proposed that this activity is carried out together with a perception study in order to assess its value in triggering changes in the perception and behavior of involved students.

BACKGROUND INFORMATION

Marine litter is defined as any anthropogenic persistent, manufactured or processed solid material discarded, disposed of or abandoned in the marine and coastal environment (Galgani et al. 2013). Citizen Science has been used to collect valuable data on marine litter. These data have been used, together data provided by professional scientists, to inform the EU Plastic Strategy. Benefits from the Citizen Science approach include not only enhanced monitoring skills, but also increase in overall Ocean Literacy and citizens' empowerment improving, at the same time, education in the environmental field.

A perception survey has the goal to (1) examine children's baseline marine litter understanding, attitudes, and self-reported behaviors, and (2) test the impact of an intervention to raise children's awareness, change their attitudes and increase self-reported litter-reducing (see activity 7.1).

YOU WILL NEED:

- Metal sieves (5 mm and possibly also 1 mm)
- Training session (1 day)

If you wish to carry out also the perception survey:

- Perception survey form (activity 7.1)

Activity 6.2: **3-DAYS CITIZEN SCIENCE PROJECT TO STUDY MACRO AND MICRO LITTER IN THE NATURAL ENVIRONMENT**

INSTRUCTIONS

The Citizen Science activity includes 3 steps and can be carried out in 3 or 4 days.

1. Training session (1 day)
2. Field work and sampling (1 or 2 days)
3. Categorization and counting of litter items (1 day)

Perception survey:

If you wish to carry out also the perception survey, the pre-activity perception survey shall be administered before the start of the Citizen Science activity and the post-activity perception survey shall be administered 2-3 weeks after the end of the activity. The post-activity perception study is the same as the pre-activity perception study. Changes in self-assessed knowledge and behavior of participant will be evaluated through statistical analysis. It is important to make sure that participants that responded to the pre-activity perception survey will respond also to the post-activity perception survey in order to have a balanced sample size for the statistical analyses.

1. Training session

> The training session will be carried out during day 1. Students will attend informative theoretical and practical training sessions about marine litter categories (size, material), sampling protocols, categorization methods.

> Real examples of marine litter items (macro and micro) can be recovered from a beach/survey site similar to the one where the monitoring will take place. In alternative, pictures of macro litter can be shown (for example, pictures from Annex CS4 – Photo Identification Guide) as well as of micro litter (Tahir et al. 2019).

1.1. Marine litter categories by size

Marine litter can be categorized according to size (Chesire et al. 2009):

— macroplastics (plastic pieces > 2.5 cm);

— mesoplastics (plastic particles between 5 mm to 2.5 cm);

— microplastics (plastic particles ≤ 5 mm).

1.2. Macro litter: Marine litter categories by material

Marine macro litter can be categorized according to nine material classes (Fleet et al. 2021):

1. artificial polymer materials;
2. rubber;
3. cloth/textile;
4. paper/cardboard;
5. processed/worked wood;
6. metal;
7. glass/ceramics;
8. chemicals;
9. organic waste.

1.3. Macro litter: Plastic marine litter by type of product

Plastic marine litter can be classified in 6 categories according to the type of product:

1. Food Packaging (FP)
2. Household Products (HP)
3. Personal Care (PC)
4. Smoking Materials (SM)
5. Fishing Gear (FG)
6. Packing Material (PM)

A particular focus will be given to single-use plastic items belonging to the Food Packaging category, by highlighting:

— Single-use beverage bottles;
— Bottle caps;
— Drinks cups;
— Lids;
— Take out food containers;
— Plastic trays;
— Plastic silverware;
— Pouches.

A particular focus will also be given to fishing gears, by highlighting ghost fishing nets in comparison to other fishing gears.

1.4 Macro litter: Plastic marine litter by type of material and material layers

Plastic litter can be identified by the Type of material, looking for the Resin Identification Code (RIC) a small number written in a triangle that tells the type of polymer of which a plastic object is made. See:

— Activity 2.1: Identifying plastics - plastics information chart.
— Annex: BA1 - Brand Audit Visual Guide

Plastic marine litter can also be categorized according to the material layers, i.e. if they are made of a single-layer of plastic or if they are made of multi-layers where plastic is used together with other materials. See Annex: BA1 - Brand Audit Visual Guide

1.5 Macro litter: Plastic marine litter by type of material and material layers

Plastic litter can be identified by the Type of material, looking for the Resin Identification Code (RIC) a small number written in a triangle that tells the type of polymer of which a plastic object is made. See:

1.6 Micro litter: morphology and color

Microlitter can be categorized according to morphology and color (see Activity 1.2: Counting and categorizing microplastics).

Morphological descriptors:

1. fragments;
2. films;
3. lines;
4. styrofoam;
5. pellets.

Activity 6.2: **3-DAYS CITIZEN SCIENCE PROJECT TO STUDY MACRO AND MICRO LITTER IN THE NATURAL ENVIRONMENT**

Color classes:

1. black/grey;
2. blue/green;
3. brow/tan;
4. white/cream;
5. yellow;
6. orange/pink/red;
7. transparent;
8. multicolor.

2. Field work and sampling

> Field work will take place in day 2 and day 3 (according if the activity lasts 3 or 4 days). All the macro and micro litter collected during the day(s) will be taken back to the class/lab for analysis the subsequent day.

2.1 Identification of study site and sampling unit

The criteria for the site selection for this activity are:

— Beach composed of sand and exposed to the open sea;

— Accessible to surveyors all year round;

— Accessible for ease of marine litter removal;

— Ideally not subject to other marine litter removal activities.

The study site will be documented and characterized in detail following Marine Litter Beach Documentation and Characterization Form of the OSPAR Marine Litter Beach Questionnaire (Annex CS3 - OSPAR Beach questionnaire). Discuss with children the distance of the selected beach from a big city, a river, if the beach is inside a natural park etc.

On the beach, select a sampling unit. A sampling unit is a section of a fixed length of beach covering the whole area between the water edge where possible and safe or from the strandline to the back of the beach. Ideally, the beach should be 100 m length (parallel to the shoreline) on lightly to moderately littered beaches and at least 50 m for heavily littered beaches (Galgani et al. 2013). If the beach you are working in is very polluted, choose 25 m transept.

Determine the exact location of the sampling unit using a GPS (the one in the smartphone might work) describing to the students that you need to do this to be able to find the same sampling unit later in time.

2.1 Monitoring protocol for macro-litter

In the sampling unit defined above, collect all the macro litter items from the sea line to the highest point reached by the high tide. Put them in plastic bags. Count the plastic bags. Take pictures.

2.2. Sampling protocol for microlitter

The protocol for monitoring microplastics is the one of the EU Marine Strategy (Galgani et al. 2013). In each selected transept of 100 m where the collection of macro-litter occurs, nine

random stations (minimum 5 random stations) will be sampled with a sieve (millimeter mesh) for microplastic (from 1 to 5 mm) survey.

According to the EU Marine Strategy methods (Galgani et al. 2013), the sediment will be sampled by collecting with a metal spoon or trowel the top 5 cm of sand from the area contained within a metal 50 cm x 50 cm quadrat and passing through a 1 mm metal sieve and then be stored in metal (e.g. foil) or glass containers (i.e. not stored in plastic containers). The volume of sediment examined will be recorded. Two sieves will be used (1 and 5 mm) to separate the debris form beach sediment. Preferably the sieves could be stacked together. Microliter will be preserved in foil or a glass jar (not plastic).

3. Categorization and counting of litter items

> On the last day (3rd or 4th day), the collected litter items are classified and counted, under the supervision of researchers using the protocols explained during the training session in day 1. Data from entered in the respective databases.

3.1 Macro litter items:

Macrolitter items will be categorized according to Type of Material, Type of Product, and single-use plastic product for Food Packaging products. Additional categories can be added if deemed necessary.

Example of table for macro litter categorization

Type of material	Type of product	Single-use plastic	Brand name	Total number of items
Artificial polymer materials	Food Packaging	Single-use beverage bottles		
Artificial polymer materials	Food Packaging	Bottle caps		
Artificial polymer materials	Food Packaging	Drink caps		
Artificial polymer materials	Food Packaging	Lids		
Artificial polymer materials	Food Packaging	Take-out food containers		
Artificial polymer materials	Food Packaging	Plastic trays		
Artificial polymer materials	Food Packaging	Plastic silverware		
Artificial polymer materials	Food Packaging	Pouches		
Artificial polymer materials	Food Packaging	Other		

Activity 6.2: **3-DAYS CITIZEN SCIENCE PROJECT TO STUDY MACRO AND MICRO LITTER IN THE NATURAL ENVIRONMENT**

Type of material	Type of product	Single-use plastic	Brand name	Total number of items
Artificial polymer materials	Household products			
Artificial polymer materials	Personal care			
Artificial polymer materials	Smoking materials			
Artificial polymer materials	Fishing gears – fishing nets			
Artificial polymer materials	Fishing gears – other fishing gear			
Artificial polymer materials	Packing material			
Rubber				
Cloth/textile				
Paper/Cardboard				
Processed/Worked wood				
Metal				
Glass /ceramics				
Chemicals				
Organic waste				

3.2 Categorization and counting microlitter items:

Students will observe microplastics with microscopes. Use tables in Activity 1.2: Counting and categorizing microplastics to categorize microplastic items according to size and color.

Example of table for microplastic categorization

	Fragments	Films	Lines	Styrofoam	Pellets
Black/Grey					
Blue/Green					
Brown/Tan					
White/Cream					
Yellow					
Orange/Pink/Red					
Transparent					

ADDITIONAL ACTIVITIES

After the Citizen Science activity, researchers/teachers and students/participants will discuss about the results of cataloguing and observation of the findings. Themes for discussion include:

- Problems that marine litter may cause to the environment (animals, plants, shoreline, human beings);
- Different ways in which the damage can be caused, depending on the macro- or micro- nature of the litter;
- Methods of transport of marine litter far from the pollution sources and the role of rivers; importance of up-stream waste management;
- Possible actions that can be taken also personally to reduce the dispersion of polluting materials at sea;
- Importance of scientific research in this field and the methodologies it uses;
- Importance of raising citizens' awareness of the problem.

ANNEXES

CS1 – Fleet., D., Vlachogianni, T. and Hanke, G., 2021. A Joint List of Litter Categories for Marine Macro Litter Monitoring. EUR 30348 EN, Publications Office of the European Union, Luxembourg, 2020, ISBN 978-92-76-21445-8, doi: 10.2760/127473, JRC121708

CS2 – Galgani, F., Hanke, G., Werner, S., Oosterbaan, L., Nilsson, P., Fleet, D., Kinsey, S., RC, T., Van Franeker, J., Vlachogianni, T., Scoullos, M., Mira Veiga, J., Palatinus, A., Matiddi, M., Maes, T., Korpinen, S., Budziak, A., Leslie, H., Gago, J., Liebezeit, G., (2013). Guidance on Monitoring of Marine Litter in European Seas. European Commission, Joint Research Centre (2013). MSFD Technical Subgroup on Marine Litter (TSG-ML). EUR 26113; doi: 10.2788/99475.

CS3 - OSPAR_BeachQuestionnaire

CS4 – Photo Identification Guide

Additional resources:

> EU Marine Strategy Protocol for monitoring micro-plastic: Galgani, F., Hanke, G., Werner, S., Oost- erbaan, L., Nilsson, P., Fleet, D., Kinsey, S., Thompson, R.C., van Franeker, Jan, Vlachogianni, T., Scoullos, M., Veiga, J.M., Palatinus, A., Matiddi, M., Maes, T., Kor- pinen, S., Budziak, A., Leslie, H., Gago, J., Liebezeit, G., TSG-ML, (2013). Guidance on Monitoring of Marine Litter in European Seas: Chapter 3: Beach Litter (Eu- ropean Commission, 2013) **https://op.europa.eu/en/publication-detail/-/publication/76da424f-8144-45c6-9c5b-78c6a5f69c5d/language-en**

Activity 6.3:

1-Day citizen science activity for beach litter monitoring

The goal of this activity is to collect data on quantity, typology, distribution of marine litter on beaches, through the application of an international scientific protocol, and to raise awareness about marine litter and plastic pollution.

YOU WILL NEED:

- OSPAR_BeachQuestionnaire (Annex CS3)
- Photo Identification Guide (Annex CS4)
- Field recording sheet
- Excel data submission form
- Smartphone or camera to take pictures
- Metric cord to measure the sampling unit
- Pencils and rubber

INSTRUCTIONS

This activity can be carried out by field teams of 4-8 dedicated people for each sampling unit. If you are working with a class of students, divide them into small groups.

The collection and categorization of litter items can be carried out once, or they can be carried out 4 times a year once in every season to assess seasonal changes in the amount and type of marine litter.

Students and volunteer citizen scientists will collect, categorize, and analyze the beach litter in order to gather information on the amount and type of marine litter. The litter items will be categorized according to nine material classes (artificial polymer materials; rubber; cloth/textile; paper/cardboard; processed/worked wood; metal; glass/ceramics; chemicals; organic waste) using the "Joint List of Litter Categories for Marine Macro Litter Monitoring" (https://mcc.jrc.ec.europa.eu/) developed in the framework of the EU Marine Framework Strategy Directive and with a particular focus on single-use plastic items and fishing gears. Such rigorous protocol will allow for systematic and scientific data collection and analysis that can be used to inform policy-making and awareness raising.

In the day of the collection and categorization, students will be briefed about the protocol and the organization of the work before starting the collection. The activity will start by familiarizing with the protocol and preparing the material needed to follow it (e.g. a Photo identification guide and Data Form). The data collected can be used for a report prepared by the students and can be used for awareness raising and advocacy with local policy makers.

STEP 1. Site selection and sampling unit recommendations

> The beach to choose as survey site will be documented and characterized in detail using the Marine Litter Beach Documentation and Characterization Form of the OSPAR Marine Litter Beach Questionnaire (OSPAR Commission, 2010 – Annex CS3 - OSPAR_BeachQuestionnaire). In accordance to the OSPAR protocol, the sampling site will be described recording the position in respect to the shore, the conformation of different kind of beaches, the proximity to rivers and harbors and the presence of aquaculture/fishing activities.

> The criteria for the site selection are:

— Beach composed of sand and exposed to the open sea;

— Accessible to surveyors all year round;

— Accessible for ease of marine litter removal;

— Ideally not subject to other marine litter removal activities.

> The sampling unit is a section of a fixed length of beach covering the whole area between the water edge where possible and safe or from the strandline to the back of the beach. The Marine Strategy Framework Directive recommends that at least 2 sections on the same beach are identified for monitoring purposes on the same beach and recommends that each section is at least 100 m width (parallel to the shoreline) on lightly to moderately littered beaches and at least 50 m for heavily littered beaches (Galgani et al. 2013). For monitoring a site and carrying out the survey on two sampling units, the MSFD (Galgani et al. 2013) reports that 2 persons are needed for 6 hours each, for collection and categorization of litter recovered in two units (area defined with a linear transect of 50 m or 100 m parallel to the shoreline and a length extending from the water edge to the back of the beach) in one day. For this reason, the class will be divided in 2 groups, each on working on a sampling unit of 50 – 100 m according to the amount of litter on the selected beach (please use the same length of the sampling units for the 2 groups).

STEP 2. Collect debris in a systematic way

> The collection of the litter on the beach will be done in the morning by the two groups, following the MSFD protocol. All objects found in the sampling area will be collected and put in black plastic bags. The total number of collection bags will be counted and weighted and data recorded on a Field-recording sheet.

> During the collection, one student for each group will be in charge of taking pictures. Pictures include photos of the overall beach; photos of the individual monitoring site before, during and after the collection; photo of individual litter items; photo of the total amount of collection bags at the end of the collection, with and without the whole collection team. Pictures can be taken with camera or smartphones in horizontal position.

STEP 3. Sort, categorize, and count all litter items

> In the afternoon the collected debris items will be carried in a suitable space where the students will categorize the debris items according to the Joint list of litter items developed in the framework of the EU Marine Strategy Framework Directive. Each group will work on the samples they have collected under the supervision of teachers.

> Within the two groups, students can be divided in smaller groups, each one categorizing and counting different types of waste (first, divide the waste in the nine material categories; then subdivide again the waste according to the specific litter items. For plastic objects – i.e. objects falling in the artificial polymer materials, the highest level of detail available on the Joint List will be used). For each of the two groups, one student will be in charge of writing the data in the field notebook.

> Another student for each group will be in charge of taking pictures. Picture might include: the different piles of litter before and after the sorting and the team that is working at the sorting; the most abundant; the weirdest litter items.

> The two (or more) students that wrote the Field-recording sheet will copy the field data in a standard Excel data submission form that is designed according to the protocol. Subsequently, the data in Excel spread sheet can be used by the whole class to analyse the data.

STEP 4. Analyse the data, write a report, share what learned

> As a first approximation for a data analysis, the litter items collected in each category (plastic, paper, metal, glass, etc.) can be summed up to show the total amount of litter items for each category. Histograms and/or pie charts can be created in Excel. Also, if more than one sampling unit will be monitored as suggested here — or if the same site is monitored in successive times — data from each sampling unit/monitoring event can be compared.

> The data can be used to create a report and results can be shown on social media, using both graphics developed during data analysis and pictures. The report can be shown to school administration, to the press, to local policy makers.

ANNEXES

CS1 – Fleet., D., Vlachogianni, T. and Hanke, G., 2021. A Joint List of Litter Categories for Marine Macro Litter Monitoring. EUR 30348 EN, Publications Office of the European Union, Luxembourg, 2020, ISBN 978-92-76-21445-8, doi: 10.2760/127473, JRC121708

CS2 – Galgani, F., Hanke, G., Werner, S., Oosterbaan, L., Nilsson, P., Fleet, D., Kinsey, S., RC, T., Van Franeker, J., Vlachogianni, T., Scoullos, M., Mira Veiga, J., Palatinus, A., Matiddi, M., Maes, T., Korpinen, S., Budziak, A., Leslie, H., Gago, J., Liebezeit, G., (2013). Guidance on Monitoring of Marine Litter in European Seas. European Commission, Joint Research Centre (2013). MSFD Technical Subgroup on Marine Litter (TSG-ML). EUR 26113; doi: 10.2788/99475.

CS3 - OSPAR_BeachQuestionnaire

CS4 – Photo Identification Guide

Section 7:
PERCEPTION SURVEY

Activity 7.1:

Perception survey for 8-15 year old students

It is predicted that after participating in the educational activity about marine litter during the Ocean Festival and the Citizen Science activity (respectively activity 6.1 and 6.2), students would be significantly more concerned about marine litter, have a better understanding of the causes of plastic pollution and negative impacts, and report engaging in more actions to help tackle the problem.

STUDENTS WORKBOOK

Perception survey
page 67

YOU WILL NEED:

- Perception Survey

SURVEY DESCRIPTION

The goal of the survey is to (1) examine children's baseline marine litter understanding, attitudes, and self-reported behaviours, and (2) test the impact of an intervention to raise children's awareness, change their attitudes and increase self-reported litter-reducing.

The survey is made of 19 questions divided in 5 thematic areas: 1) Problem awareness and concern; 2) Perceived proportion of plastic and estimated degradation time; 3) Perceived impacts; 4) Perceived causes; 5) Self-reported litter-reducing behaviour.

1. Problem awareness and concern

Children's problem awareness and concern about marine litter will be measured by asking children "Do you think litter on the beach and in the sea is a problem?" and "Are you worried about the problems that litter on the beach and in the sea might cause?" Children will respond on a four-point scale, not at all, a little bit, quite a bit, and a lot.

2. Perceived proportion of plastic and estimated degradation time

Children's perceptions about the composition of marine litter, specifically, the proportion of marine litter that is plastic, will be measured by asking children "What percentage of litter on the beach and in the sea do you think is plastic?" Children will have pre-determined answers with four different percentage range and will have to select only one.

Children will also be asked "How long do you think it takes a plastic bottle to breakdown/decompose?" to assess their perceptions about the longevity of this common item. Children will have an open response box to provide their estimated degradation time (days, weeks, months, years).

3. Perceived impacts

Children's perceptions about the negative impacts that marine litter can be measured with five questions, 'Do you think litter on the beach and in the sea is bad for:

(a) Marine wildlife?

(b) Tourism?

(c) Human health?

(d) The fishing industry?

(e) The appearance of the coast?

Children will respond to each of these on a four-point scale, not at all, a little bit, quite a bit, and a lot.

4. Perceived causes

Children's perceptions about the possible different causes of marine litter were measured with four questions, "Why is there litter on the beach and in the sea?"

(a) Because people drop litter on the beach

(b) Because there are not enough bins

(c) Because businesses (cafes, restaurants, shops) and the fishing industry cause litter at the coast, and

(d) Because lots of things we buy have too much packaging that is difficult to recycle.

Children will respond to each of these on a four-point scale, not at all, a little bit, quite a bit, and a lot.

5. Self-reported litter-reducing behaviour

Children's self-reported litter–reducing behaviours will be measured with five questions, "Have you done the following things in the last week?:

(a) Disposed of litter properly?

(b) Picked up litter lying around?

(c) Recycled?

(d) Bought goods with less packaging?

(e) Encouraged family and friends to do any or all of the things above?

Children will respond to each of these on a four-point scale, not at all, a little bit, quite a bit, and a lot.

INSTRUCTIONS

> It is important to define who is the person in charge of administering and collecting the surveys. This can be the teachers, if the project of the awareness raising festival and of the perception survey is led by teachers. But it could also be schools' directors, educators from an NGO, or research scientists that are implicated in the awareness raising activities during the festival. In any case, teachers will be involved because their help is needed in administering the surveys to children and making sure they clearly understand the items and questions.

Activity 7.1: **PERCEPTION SURVEY FOR 8-15 YEAR OLD STUDENTS**

> The same set of questions will be administered before and after the students take part in the awareness raising activities.

> The goal of the survey is to evaluate the changes in the perception of marine litter and self-assessed behaviours about it by children. For this reason, the teacher/educator will make sure that all children that participate in the pre-activity survey will also participate in the post-activity survey. The teacher/educator will also make sure that all surveys are anonymous.

Pre-activity perception survey

> A perception survey will be given to the children before they participate in the awareness raising activity. This can be done at school a few days before the event or when children arrive at the festival location. The survey will be done under the supervision of the teacher that will make sure that the children understand the questions and will take 5 minutes to complete. Anonymity will be assured.

Participation in the awareness raising activities

> Children take part in the awareness raising activities as suggested in the description of the awareness raising festival. It is important that they are exposed to the four types of activities and that during the day there are also moments in which to make connections with the environment.

Post-activity perception survey

> The same perception survey will be given to the children at least two weeks after the participation in the activities.

> It is important to have good collaboration with teachers, so to assure that they will administer the test to the students.

> Collaboration with local researchers is possible.

Statistical analyses

> Statistical analyses of the perception survey can be carried out by teachers, local researchers from universities or research institutes.

> Non-parametric statistical methods will be used to analyse survey responses because the survey is predominantly composed of ordinal data (1–4 response scale). Wilcoxon's matched pairs signed ranks test (Z score) will be used to determine whether the intervention influenced children's problem awareness and concern about marine litter, perceived proportion of plastic and estimated degradation time, perceptions about the impacts and causes of marine litter, and self-reported behaviours. Additional indications on how to carry out the statistical analyses are available in Hartley et al. 2015.

REFERENCE:

Hartley B.L. et al. 2015 Marine litter education boosts children's understanding and self-reported actions. Marine Pollution Bulletin (90) 209-217. Available at: https://doi.org/10.1016/j.marpolbul.2014.10.049

Section 8:
ADDITIONAL RESOURCES

SCIENTIFIC VISUALIZATIONS

A list of scientific visualizations to help understanding surface ocean circulation and the movement of floating plastic debris. They also help visualizing how much plastic there will be in the ocean in the future if we continue with business as usual. These visualizations have been made by scientists using scientific data.

Perpetual Ocean by NASA
The Want to know where a plastic waste item that is thrown in the ocean will end up in the future?
https://www.nasa.gov/topics/earth/features/perpetual-ocean.html

Plastic adrift
Want to know where a plastic waste item that is thrown in the ocean will end up in the future?
http://plasticadrift.org/?lat=18.6&lng=-40.6&center=-1.1&startmon=jan&direction=fwd

Interactive Mapping application for marine microplastics
How much of the microplastics would end up in the ocean if we keep on increasing the plastic production as we are currently doing?
https://rshiny.lifewatch.be/ng-ocean-plastic-challenge/

Number of plastic bags produced daily, weekly, monthly, in a year
https://www.theworldcounts.com/challenges/planet-earth/waste/plastic-bags-used-per-year/story

VIDEOS ON PLASTIC POLLUTION

A series of videos on plastic pollution. Some of these videos have been integrated in the proposed educational activities. Others can be used to complement them or as assignments to be seen at home.

Plastic pollution in the ocean - what we know and what we don't know about
by Waves by thecamp - **https://www.youtube.com/watch?v=MKQjO0H4nI8&feature=emb_logo (2:41 min)**

The story of microbeads
by the Story of Stuff - **https://www.storyofstuff.org/movies/lets-ban-the-bead/** (2.11 min)

What is marine debris?
A cartoon crash course by PEW - **https://www.pewtrusts.org/en/research-and-analysis/video/2016/what-is-marine-debris-a-cartoon-crash-course** (1:54)

Charting the garbage patches of the sea
https://www.youtube.com/watch?v=M4UK9Yt6A-s (3.21 min)

World Animal Protection's Sea Change Campaign
https://www.youtube.com/watch?v=uVWdOt1vS4g (2.14 min)

Are Microplastics in Our Water Becoming a Macroproblem?
https://video.nationalgeographic.com/video/news/00000150-9641-dd5e-a751-bf4517e80000 (2.51 min)

Plankton eating plastic caught on camera for the first time
https://www.youtube.com/watch?v=mGzIz9Ld-sE&feature=emb_logo (0.50 min)

Turtles and plastic pollution
https://www.youtube.com/watch?v=JIklRSR0ov4 (1:19 min)

Plastic Ocean
by UN - **https://www.youtube.com/watch?v=ju_2NuK5O-E** (7:28 min)

Plastic Pollution: How Humans are Turning the World into Plastic
by Kurzgesagt – in a nutshell and UNEP Clean Seas campaign -
https://www.youtube.com/watch?v=RS7IzU2VJIQ (9:01 min)

How microplastics affect your health
by UNEP - **https://www.youtube.com/watch?v=aiEBEGKQp_I** (1:57 min)

PODCASTS ON PLASTIC POLLUTION

A series of podcasts on plastic pollution. They might be useful with high school students.

Plastisphere: A podcast on plastic pollution in the environment
https://anjakrieger.com/plastisphere/

The Plastic Tide: exploring plastic waste in our environment
https://www.npr.org/series/684530164/the-plastic-tide

Plastic pollution with Richard Thompson
https://www.bbc.co.uk/programmes/m000674n

BIBLIOGRAPHY

A series of reports about plastic waste and their impacts on environmental health and human health.

CIEL (2019a). **Plastic & Climate: the hidden costs of a plastic planet**
https://www.ciel.org/reports/plastic-health-the-hidden-costs-of-a-plastic-planet-may-2019/

CIEL (2019b). **Plastic & Health: the hidden costs of a plastic planet**
https://www.ciel.org/reports/plastic-health-the-hidden-costs-of-a-plastic-planet-february-2019/

GAIA (2018). **Discarded: Communities on the Frontlines of the Global Plastic Crisis**
https://zerowasteeurope.eu/2019/04/discarded-communities-on-the-frontlines-of-the-global-plastic-crisis/

UNEP (2015a). **Biodegradable Plastics and Marine Litter. Misconceptions, concerns and impacts on marine environments**. United Nations Environment Programme (UNEP), Nairobi -
https://wedocs.unep.org/handle/20.500.11822/7468

UNEP (2015b). **Plastic in Cosmetics**
https://wedocs.unep.org/handle/20.500.11822/9664

UNEP and Grid-Arendal (2016). **Marine Litter: Vital Graphics**
https://wedocs.unep.org/handle/20.500.11822/9798

World Health Organization (2019). **Microplastics in drinking water**
https://www.who.int/water_sanitation_health/publications/microplastics-in-drinking-water/en/

WWF (2020). **Stop Ghost Gear**
https://www.worldwildlife.org/publications/stop-ghost-gear-the-most-deadly-form-of-marine-plastic-debris

REFERENCES

The educational activities in Teachers Resource Book have been developed or have been inspired from existing educational material and scientific publications, of which they are, at different degrees, derivatives.

- Acaroglu L. The Circular Classroom. Module 1. Available at: **https://circularclassroom.com/** and of Sharma and Priyamvada (2017). STUDENTS(Plus-Minus-Interesting): A creative thinking strategy to foster critical thinking. International Journal of Academic Research and Development 2(6): 974-977
- EPA Tasmania (2018). Waste – A Teaching Manual Grade 4 Plastic **https://epa.tas.gov.au/Documents/Teaching%20Manual%20-%20Waste%20-%20Grade%204%20-%20Plastics.pdf**
- Hartley B.L. et al. (2015). Marine litter education boosts children's understanding and self-reported actions. Marine Pollution Bulletin (90) 209-217. Available at: **https://doi.org/10.1016/j.marpolbul.2014.10.049** Indications on how to carry out the statistical analyses are available in Hartley et al. 2015.
- Hartley B.L., Pahl S., Holland M., Alampei I., Veiga J.M., Thompson R.C. (2018) Turning the tide on trash: Empowering European educators and school students to tackle marine litter. Marine Policy 96: 227-234. **https://www.sciencedirect.com/science/article/abs/pii/S0308597X17305122**
- Locritani M., Merlino S., Abbate M., (2019). Assessing the citizen science approach as tool to increase awareness on the marine litter problem. Marine Pollution Bulletin 140 320-329. Available at: **https://doi.org/10.1016/j.marpolbul.2019.01.023**
- Owens (2017). Talking trash – **https://ctmarinedebris.wordpress.com/about/**
- Practical Action/Plastic Challenge – **https://practicalaction.org/plastic-challenge**
- Realdon G (2015). Microplastics: small but deadly. Science in School 34: 32–35. **https://www.scienceinschool.org/wp-content/uploads/2015/11/issue34_microplastics.pdf**
- F. Santoro et al. (eds). (2017). Ocean Literacy for All – A toolkit, IOC/UNESCO & UNESCO Venice Office, Paris (IOC Manuals and Guides, 80). available in Open Access under the Attribution-ShareAlike 3.0 IGO (CC-BY-SA 3.0 IGO) license (**http://creativecommons.org/licenses/by-sa/3.0/igo/**). Available at: **https://unesdoc.unesco.org/ark:/48223/pf0000260721**


1968/159/2014
14
Ref
MINT
Size
100X100X3-5CM

BASEL / ROTTERDAM / STOCKHOLM
CONVENTIONS

BASEL
CONVENTION

Norad

BRS-NORAD PROJECT MARINE LITTER AND MICROPLASTICS: PROMOTING THE ENVIRONMENTALLY SOUND MANAGEMENT OF PLASTIC WASTES AND ACHIEVING THE PREVENTION AND MINIMIZATION OF THE GENERATION OF PLASTIC WASTES