MARCHING WITH THE NEXT GENERATION TOWARDS A PLASTIC WASTE-FREE FUTURE IN SRI LANKA

STUDENT ACTIVITY BOOK

Norad

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IGES Institute for Global Environmental Strategies

HELP-O

MINISTRY OF ENVIRONMENT, SRI LANKA

Marching With The Next Generation Towards A Plastic Waste Free Future In Sri Lanka

Student Activity Book

Ministry of Environment, Sri Lanka
2024

Marching with the Next Generation Towards a Plastic Waste Free Future in Sri Lanka: Student Activity Book

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This book was prepared by the following team.

Authors

Institute for Global Environmental Strategies (IGES), Japan
Dr. Amila Abeynayaka, Ms. Miwa Tatsuno, Mr. Matthew Hengsbaugh, Ms. Thejani Yashodhara, Dr. Premakumara Jagath Dickella Gamaralalage, and Ms. Miki Inoue

Coordination

Environment pollution Control and Chemical Management Division (EPC&CM), Ministry of Environment, Sri Lanka
Mr. S.M. Werahera, Director, Ms. Jeewanthi Ranasinghe, Assistant Director, Ms. I. J. K. Palugaswewa, Assistant Director, Mr. D. Upul Premalal, Research Assistant, Mr. Sanjaya Chamara, Development Officer, Ms. Navoma Karunarathne, Research Assistant, Ms. Saranga Jayasundara, Program Assistant, Ms. Deepika Chandrasekara, Development Officer and Ms. W. A. R. Oshadi, Development Officer

Human and Environment Link Progressive Organization (HELP-O), Sri Lanka
Dr. Chathura Welivitiya, Mr. Lahiru Maduranga, Ms. Hansi Sadu Tharaka, Mr. Supun Suranjith, Ms. Chandi Devaki, Ms. Janani Madanayaka, Ms. Shehara Kalubadanage

Secretariat of the Basel, Rotterdam and Stockholm Conventions, Geneva, Switzerland

Advisors

Mr. K.R. Uduwawala, Secretary, Ministry of Environment and Ms. R.H.M.P. Abeykoon, Additional Secretary (Environment Policy & Planning), Ministry of Environment, Sri Lanka

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Special Committee members

Dr. Ashoke De Silva, Director, Department of Science, National Institute of Education

Dr. (Mrs) S. M. L. P. Subasinghe, Senior Lecturer, Department of Technology Education, National Institute of Education

Mrs. E. A. C. N. Perera, Senior Lecturer, Department of Technology Education, National Institute of Education

Ms. Nishamani Weerasinghe, Assistant Lecturer, Department of Science, National Institute of Education

Ms. Sitara Mediwake, Assistant Lecturer, Department of Science, National Institute of Education

Mr. Vipula Kulathunga, Former Director of Science Branch, Ministry of Education

Ms. K. A. R. De silva, Assistant Director of Education, Ministry of Education, Higher Education and Vocational Education

Ms. Y. M. P. K. Yapa, Deputy Commissioner of Education Publication, Education Publication Department, Ministry of Education, Higher Education and Vocational Education

Mr. U. L. Uwais, Deputy Commissioner of Education Publication, Education Publication Department, Ministry of Education, Higher Education and Vocational Education

Mr. I. A. M. Afsan, Deputy Commissioner of Education Publication, Education Publication Department, Ministry of Education, Higher Education and Vocational Education

Ms. G. M. A. D. N. Muhandiram, Assistant Commissioner of Education Publication, Education Publication Department, Ministry of Education, Higher Education and Vocational Education

Ms. C. D. Rathnaweera, Assistant Commissioner of Education Publication, Education Publication Department, Ministry of Education, Higher Education and Vocational Education

Mr. L. G. N. Dharmasiri, Assistant Director, Solid Waste Management Unit, Central Environmental Authority

Dr. V. T. S. K. Siriwardhana, Director, Environment Health, Occupational Health and Food Safety, Ministry of Health

Dr. Inoka Suraweera, Consultant Community Physicians, Environment and Occupational Health, Ministry of Health

Ms. Nadeeka Amarasinghe, Assistant Director, Sustainable Development Authority

Other Resource Contributors

Mr. Bandula Sarath, Former Director of Science Branch, Ministry of Education

Mr. K. D. Bandula Kumara, Director of Science Branch, Ministry of Education, Higher Education and Vocational Education

Ms. Sarojini Jayasekara, Former Director, Solid Waste Management Unit, Central Environmental Authority

Mr. Neel Ashoka, Science Field Centre Manager, Galle Educational Zone

Language Edition

Mr. Pradeep Indunil Piyarathna, Deputy Commissioner of Education Publication, Education Publication Department, Ministry of Education, Higher Education and Vocational Education

Message from the Secretary of the Ministry of Environment

Plastics have undeniably revolutionized our world, permeating every aspect of modern life with their versatility and convenience. However, managing our reliance on plastics is not just a matter of environmental stewardship; it is imperative for building a sustainable future. The importance of managing plastics cannot be overstated and it is a fundamental step towards achieving a more sustainable and resilient world for generations to come.

The Student Activity Book titled "Marching with the Next Generation Towards a Plastic Waste Free Future in Sri Lanka" is a companion to the same titled Teacher Resource Book prepared parallelly by the Ministry of Environment in collaboration with the Institute for Global Environmental Strategies (IGES) and the Ministry of Education under the "Marine Litter and Microplastics (Norad-1)" project. While the Teacher Resource Book serves as a guide for educators, the Student Activity Book is designed to empower the next generation of Sri Lankans to become responsible citizens and advocates for a plastic waste-free future. These books are not just educational resources; they are tools to inspire action. Intended for use at Science Field Study Centers, they provide students with the necessary materials to engage in extracurricular activities focused on plastic waste management. By actively involving students in these activities, we aim to instill in them a deep understanding of the impacts of plastic pollution and equip them with the skills and knowledge needed to address this pressing issue.

Moreover, guiding students in plastic management cultivates critical thinking and problem-solving skills within them as they explore innovative solutions to address this global challenge. Ultimately, by engaging students in plastic management, we not only protect our planet but also inspire a generation of conscious citizens committed to preserve the beauty and integrity of our natural world for generations to come.

I take this opportunity to express my gratitude to the Institute for Global Environmental Strategies (IGES), United Nations Environment Programme (UNEP), Ministry of Education and HELP-O for their technical and financial support, as well as all the staff of the Environment Pollution Control and Chemical Management Division of Ministry of Environment for their remarkable support in completing this task.

Together, we are paving the way for a brighter, plastic waste-free future in Sri Lanka.

K.R. Uduwawala
Secretary
Ministry of Environment

Message from the Secretary of the Ministry of Education, Higher Education and Vocational Education

It is with great pleasure that I convey a message regarding the Teacher Resource Book and the Student Activity Book on' Marching with the Next Generation towards a Plastic Waste-Free Future in Sri Lanka' under the NORAD project. It is a timely need to draw our special attention to the severe impact of microplastics on the environment.

Since environmental sustainability has received primary attention in the current world, it is essential to equip students with knowledge and practical solutions regarding it. The goal of creating an environmentally sensitive generation of citizens can be achieved by integrating co-curricular activities with formal education. In this way, the aspiration of creating a plastic waste-free Sri Lanka can be more successful.

The experiences gained from using these books, which have been prepared using the expertise of the resource persons and integrated with the curriculum, will undoubtedly help the future generation to become an environmentally friendly group. This will enable future generations to lead a sustainable lifestyle by reducing the use of plastic and creating positive change in their communities. This program is planned to be implemented at the national level by involving the Science Division of the Ministry of Education, Higher Education and Vocational Education and the Science Field Study Centers. By implementing these plans, it will be possible to build an eco-friendly and sustainable society

"The earth does not belong to man, man belongs to the earth."
(Red Indian Chief Seattle)

The sensitivity to the above idea expressed by Seattle is very important to create a green and sustainable environment. I hope that this effort will be helpful in empowering the children of our country for a green, sustainable Sri Lanka. I express my gratitude to all the parties who have committed to this cause.

Nalaka Kaluwewa
Secretary
Ministry of education, higher education and vocational education

Message from the Executive Secretary of the Secretariat of the Basel, Rotterdam and Stockholm Conventions

Global plastic production and consumption have grown exponentially since 1950s and are set to increase by 70% by 2040 if business continues as usual. Plastic production involves the use of chemical additives and other substances, many of which are of concern for human and environmental health, including a subset listed under the Stockholm Convention on Persistent Organic Pollutants (POPs). Consequently, plastic waste generation is forecasted to rise from an estimated 360 million metric tonnes per year in 2019 to 1,014 million metric tonnes per year by 2060 under a business-as-usual scenario. Currently, only 10% of generated plastic waste is recycled.

There is increasing clarity regarding the links between plastic and human and environmental health. Plastic pollution in all forms causes adverse effects in a wide array of organisms in marine, freshwater and terrestrial environments. Throughout its life cycle, plastic also contributes to climate change: In 2020, plastics generated 1.8 billion tonnes of CO_2 equivalent, 10% of which was released during waste management and treatment.

The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal, with its 191 Parties, forms an important part of the solution. In 2019, Parties to the Basel Convention adopted the Plastic Waste Amendments. By extension, the legally binding provisions of the Basel Convention, which apply controls on the global trade in hazardous and other waste, now apply to plastic waste. In addition to ensuring the trade in plastic waste is more transparent and better regulated, under the Basel Convention, governments must take steps not only to ensure the environmentally sound management of plastic waste, but also to tackle plastic waste at its source.

The Basel Convention is not the only instrument to tackle plastic pollution. The Stockholm Convention, with its 186 Parties, which requires Parties to prohibit, eliminate and restrict the production, use, import and export of a number of hazardous chemicals, plays a pivotal role in reducing hazardous additives we find in plastic, ensuring it is safer for use and easier to recycle. To top it off, all eyes are on the Intergovernmental Negotiating Committee on Plastic Pollution, which was mandated by the United Nations Environment Assembly to develop an international legally binding treaty on plastic pollution, including in the marine environment.

The plastic waste crisis is truly an issue of global concern requiring immediate action from policy makers, regulators, industry and civil society – including children and youth! In fact, children can play a critical role in addressing plastic waste. They can raise awareness, exert positive influence on their family and friends, hold us accountable and be ambassadors of change. It is my hope that this book can help harness the new generations' potential to fight plastic pollution.

Rolph Payet
Executive Secretary
Secretariat of the Basel, Rotterdam and Stockholm Conventions

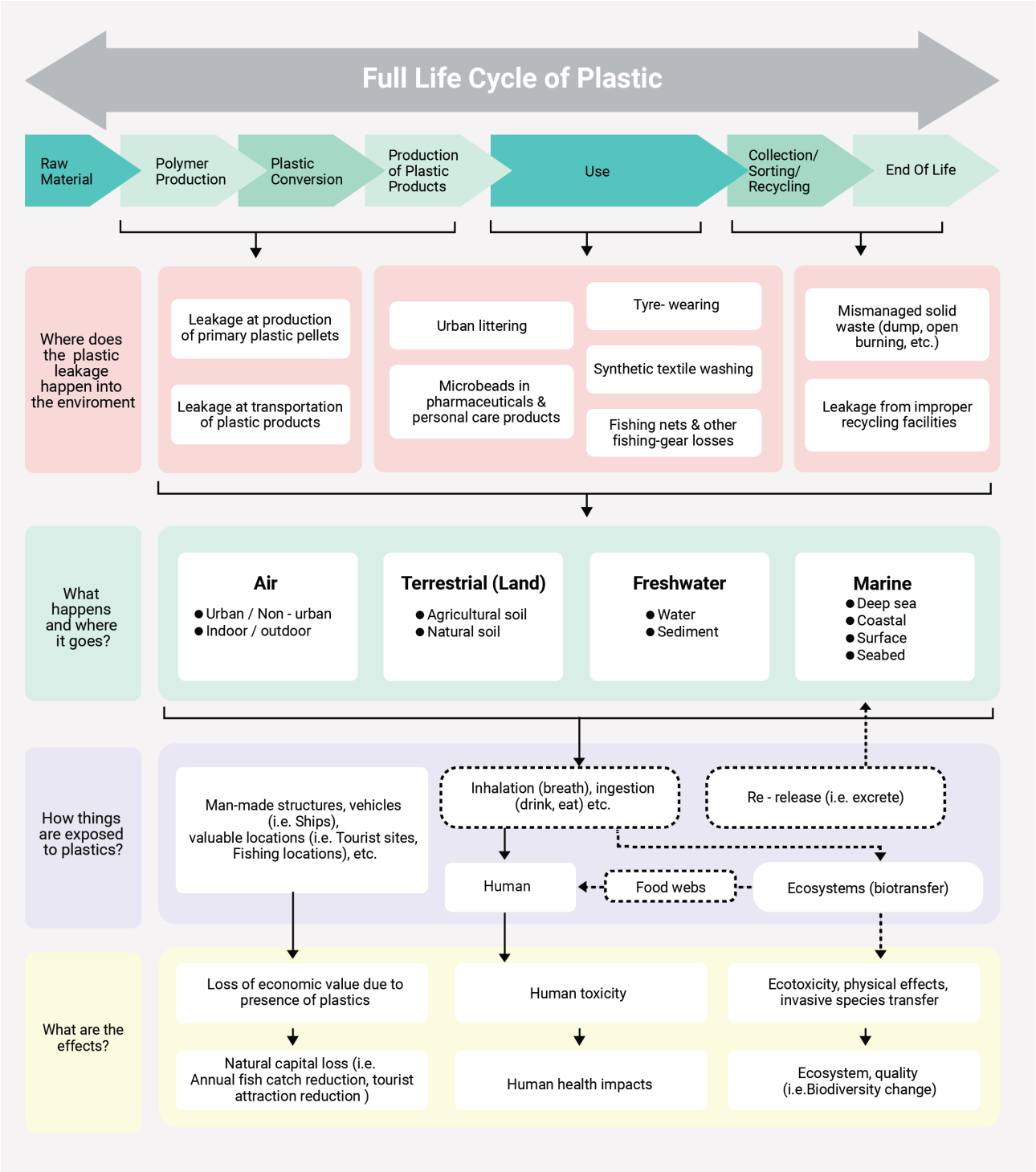
Introduction: The age of plastics – why we need to change?

The characteristics of plastics, including its low cost and versatility, have led to a boom in the production of such materials since 1950. Since that time, there has been emerging global concerns over the continuous leakage into the world's oceans, contributing to growing volumes of marine pollution and degrading the health and functionality of coastal ecosystems. Recent studies suggest that more than 80% of marine plastics are attributed to land-based sources[1]. Without further action, studies forecast that accumulated plastic waste in the marine environment may reach 850 million tonnes by the year 2040[2]. Moreover, greenhouse gas emissions associated with conventional fossil fuel-based plastic production, use, and disposal are estimated to comprise approximately 19% of the global carbon budget (2.1 giga tonnes of carbon dioxide equivalent) by 2040. In this context, the environmental burden imposed by plastics must be taken seriously, and efforts should be made to raise public awareness and encourage responsibility among producers and consumers. To this end, environmental education plays a central role in motivating young people to address the challenge of plastic waste and take action to minimise pollution affecting both land and sea.

Most of the plastic we produce is designed to be thrown away after being used only once. As a result, plastic packaging accounts for about half of the plastic waste in the world. Less than ten per cent of the plastic waste the world has ever produced has been recycled[3]. Consequently, a majority of plastic waste is deposited in landfills, openly dumped, or burned on land due to a lack of proper disposal systems, impacting the integrity of habitat and local communities through the degradation of materials and the release of toxic pollutants such as furans and dioxins.

Further, marine plastics slowly break down into smaller fragments, leading to the generation of microplastics and nanoplastics which can be detrimental to environmental and human health[4]. In addition, plastic leakage in city centres has the potential to cause urban floods by blocking drainage systems while also providing breeding grounds for mosquitoes and other pests by trapping rainwater and wastewater. There is also evidence that plastic wastes, particularly single-use plastic (SUP) bags, are digested by marine life such as turtles, whales, and dolphins, as well as terrestrial species such as elephants. Newer studies have identified that toxic chemicals used in the manufacture of plastic are biomagnified through food chains, eventually reaching humans and absorbed by way of digestion[5]. Beyond its impacts on ecosystems and human well-being, there is also a range of socioeconomic damages associated with plastic pollution. Plastic waste has visible effects on tourism, fishing, and shipping industries with estimates that total economic damage caused to global marine ecosystems by plastic amounts to a minimum of USD 13 billion every year[6].

1. https://www.ipcc.ch/report/ar6/wg3/downloads/report/IPCC_AR6_WGIII_SPM.pdf
2. https://www.pewtrusts.org/-/media/assets/2020/10/breakingtheplasticwave_mainreport.pdf
3. https://www.oecd.org/environment/plastic-pollution-is-growing-relentlessly-as-waste-manage ment-and-recycling-fall-short.htm
4. What are microplastics? (noaa.gov)
5. Microplastics in food commodities (fao.org)
6. Plastic Waste Causes Financial Damage of US$13 Billion to Marine Ecosystems Each Year as Concern Grows over Microplastics (unep.org)



Source: Modified from Abeynayaka et al. (2022)[7]

The issue of plastic pollution is of critical importance to Sri Lanka. Annually, Sri Lanka imports approximately 300,000 tonnes of virgin raw materials for varying plastic applications, large quantities of plastic items, and semi-finished goods. Current daily municipal solid waste generation stands at around 10,768 tonnes, whereas collection on the part of local authorities is estimated at 3,458 tonnes per day.

7. Training Needs Assessment Report (TNA): Towards Microplastic Monitoring and Evidence-Based Policy Measures in Sri Lanka (https://ccet.jp/publications/training-needs-assessment-report-tna-towards-microplastic-monitoring-and-evidence-0)

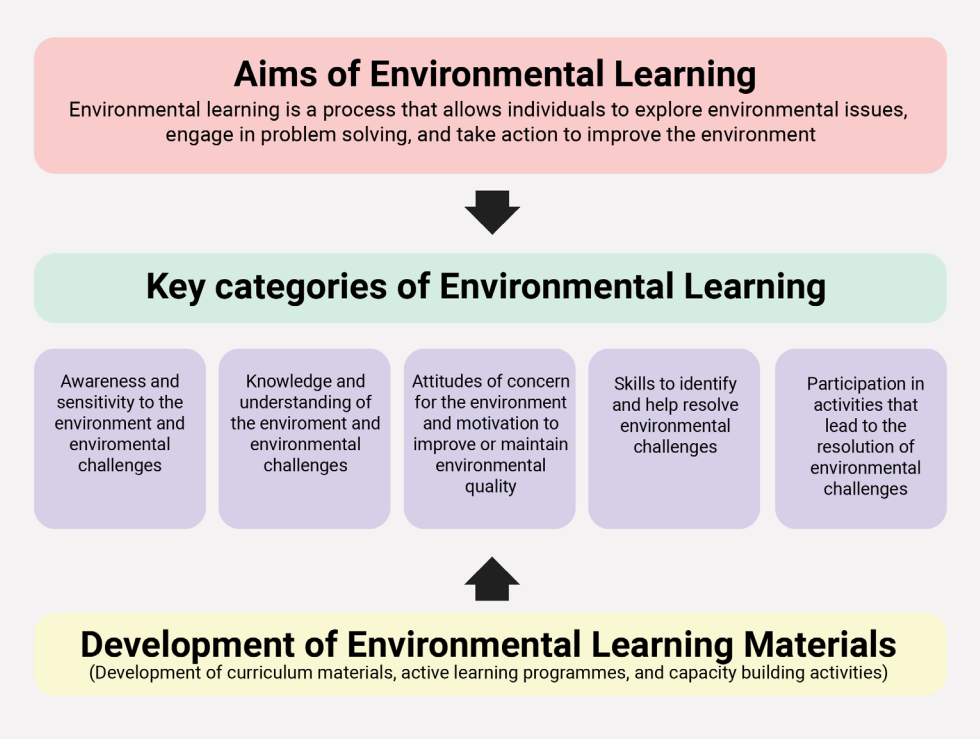
These figures highlight that over 50% of uncollected waste, much of it containing valuable plastics, is often sent to open dumps, littered in the surrounding environment, or burned without adequate controls.

The Ministry of Environment of Sri Lanka adopted the National Action Plan on Plastic Waste Management 2021-2030 (NAPPWM) in August 2021. The NAPPWM outlines a national approach to managing plastic waste through a 3R (Reduce, Reuse, and Recycle) based strategy while also working to enhance knowledge and more widely engage with consumers, producers, and managers alike.

The activities described in this book provide some instructive examples of how schools, and specifically students, can contribute to the more significant objective of reducing plastic waste across the country.

In this connection, students play an integral role in the delivery of what has come to be known as "Environmental Learning", "Environmental Education", or more recently, "Education for Sustainable Development" (ESD). ESD seeks to engage students in critical reflection about the natural world: it aims to enhance their literacy and awareness about environmental challenges while strengthening their determination to acquire the knowledge, skills, values, and experiences to change society and care for the planet.

Note: Aims of environmental learning and the need for learning materials to support these objectives



Source: Premakumara et al. (2016)[8]

8 Development of Environmental Learning Programme for Establishing a Sustainable Solid Waste Management System in Mandalay City, Myanmar
https://www.iges.or.jp/jp/pub/development-environmental-learning-programme-0/en

ESD is, therefore, instrumental in achieving the aspirations set out by the 2030 Agenda for Sustainable Development. Adopted by all United Nations Member States in 2015, the agenda and its 17 Sustainable Development Goals (SDGs) provide a blueprint for peace, prosperity, people and the planet, now and in the future. The SDGs outline a set of interconnected priorities, made up of measurable goals and targets, designed to address interrelated social, economic, and environmental challenges for advancing sustainable development at the global level. As seen below, the efforts to address plastic pollution touch on all 17 Goals, with clear implications for achieving the entirety of the SDGs.

Who is the target of this activity book?

This Student Activity Book has been adapted from the Teacher Resource Book. Initially prepared by United Nations Environment Programme - Basel Rotterdam Stockholm Convention Secretariat (UNEP-BRS), the original resource book underwent modifications to align with the content of the student activity book.

The Teacher Resource Book was updated through a consultative and participatory process involving key administrators, school curriculum developers, and teachers, including education experts.

As part of the review process, the feedback of administrative and school curriculum officials and teachers in the science subject stream was gathered through one-on-one sessions. This was done to validate the content and activities aligned with the school curriculum and extracurricular activities, focusing on the specific age categories associated with each activity. This Student Activity Book is intended for students of all ages, levels, and disciplines. It aims to empower learners to make informed decisions regarding plastic waste reduction.

The development of these materials received financial and technical assistance from the United Nations Environment Programme - Basel, Rotterdam, and Stockholm (UNEP-BRS) Convention Secretariat and the Institute for Global Environmental Strategies (IGES) and The Ministry of Environment, Sri Lanka.

How should this activity book be used?

Students are encouraged to engage in the activities outlined in the following sections in collaboration with their respective Student Parliament, Environmental Brigade, and Scouting Clubs. This cooperation may facilitate identifying opportunities for broader collaboration with other educational institutions across Sri Lanka.

This education toolkit, composed of a Teacher Resource Book with guided activities and selected resources and a Student Activity book, proposes different education activities in six sections.

Sections 1 – 5 include educational activities to be carried out through laboratories, games, and investigations led by the students. They relate to 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-based activities of Social studies, Health and Science subjects as applicable, or through a longer-term project related to extracurricular activities like Environmental Brigades, Scouting & School Parliament, etc., at the pilot scale.

Section 6 includes ideas for organising an awareness-raising festival/ campaign on the impacts of human activities on the marine environment, including activities dedicated to raising awareness about marine litter and guidance on developing citizen science activities. These activities require external collaboration from the school, all or part of which are carried out outside the school.

This educational toolkit has been developed by collating existing educational activities, adapting scientific research studies, and developing new educational activities.

List of educational activities
Contents

Glossary and Definitions

Term	Description/ Definition
Abrasion	The process of wearing or scraping away a surface by friction
Absorb	The process of taking something in gradually
Additive	A substance that is gradually added to something in small amounts
Amendment	A change made to something
Archimede's Principle	The physical law of buoyancy. It states that a body immersed in a fluid experiences an upthrust equal to the weight of the fluid displaced
Artistic	Natural creative skill
Aspect	One part of a situation/ problem/ subject, etc.
Avoid	Stay away from someone or something
Awareness	Having knowledge or experience of a particular thing
Ban	An official order that prevents someone doing something, or something from happening
Bead	A small, usually spherical piece of material
Buoyancy	The tendency of an object to float in a fluid
Circular Economy	A substitute for a linear economy, we can keep using our resources within our system for as long as possible
Compostable	Capable of being used as compost
Cons	A disadvantage or a reason for not doing something
Consent	Permission for something to happen or agreement to do something
Consequence	A result of a particular action or situation
Contamination	To make something less pure or make it poisonous
Context	The general situation in which something happens, and that can help explain it
Convention	An agreement between nations for regulation of matters affecting all of them
Cosmetic	Substances or treatments that are intended to improve your appearance
COVID-19	An infectious disease caused by the SARS-CoV-2 virus
Debris	Scattered pieces of rubbish or remains
Decompose	Breakdown or cause to breakdown into component elements or simpler constituents
Deficiency	The lack of something that is needed to meet a specific standard or quality
Degradation	The process in which the quality of something is destroyed
Demonstrate	To show or prove something clearly
Density	The quantity of something per unit volume

Term	Description/ Definition
Depict	To represent or show something in a work of art
Depletion	Reduction in the amount or number of something
Descriptor	A word or phrase used to describe or refer to something
Disposable	Capable of being thrown away after being used
Dissolve	To cause to disperse or disappear
Distinguish	To recognize as distinct or different
Dump	To put (something) somewhere in a quick and careless way
Efficacy	Capacity for producing a desired result or effect
Electron	The part of an atom with a negative electrical charge
Equilibrium	A state of balance
Estimate	To form an approximate judgment
Eutrophication	Excessive plant and algal growth due to the increased availability of plant nutrients, primarily phosphorus and nitrogen
Evaluation	The process of evaluating something
Evidence	Anything that can be used to prove something
Exposure	The fact or condition of being exposed
Fate	What happens to them
Feedback	Statements of opinion about something
Film	A thin layer of something
Flame	The hot light of a fire
Flexible	Able to bend easily without breaking
Float	To rest on the surface of a fluid without sinking
Formulate	To come up with a plan
Fragment	A small part of something
Harmful	Causing or capable of causing damage
Hazard	A potential source of danger
Implement	To put a plan or system into operation
Implication	Possible effect or result of an action or a decision
Import	To buy or bring in products from another country
Incinerate	To burn something completely
Indicate	To point out
Ingest	Take into the body by swallowing or absorbing it
Interfere	To stop something from happening
Intervention	The action or process of intervening.
Investigation	Process of trying to find out about something

Term	Description/ Definition
Landfill	Sites designed to store garbage
Limit	A restriction on the size or amount of something permissible or possible
Literacy	Knowledge in a specified area
Magnifying lens	A lens that produces an enlarged image of an object
Manufacture	The process of making goods or materials using machines
Marine Litter	Any anthropogenic persistent, manufactured or processed solid material discarded, disposed of or abandoned in the marine and coastal environment. One of the major components of marine litter is plastic.
Microbead	Tiny plastic particles of less than one millimeter in their largest dimension
Microfiber	A very fine synthetic yarn
Microplastic	A very small fragment or piece of plastic, less than 5 mm in length
Microscope	A device that produces a magnified image of objects too small to be seen with the naked eye
Mismanage	To handle something wrongly
Mixture	A combination of substances
Morphology	The study of the forms of things
National Action Plan on Plastic Waste Management 2021–2030	A plan was prepared by the Ministry of Environment (MOE), Sri Lanka, considering the importance of addressing plastic pollution in Sri Lanka. This plan was prepared considering the preventative approach and using the 3R (Reduce, Reuse and Recycle) principle related to plastic wastes.
NGOs	Non-governmental organizations
Non-parametric statistics	A statistical method where a particular data is not required to fit in a normal distribution
Non-renewable	Not able to be restored
Observation	Act of noticing
Opaque	Not able to be seen through
Originate	To start or create something
Pellet	A small, rounded, or spherical body
Plankton	A set of organisms drifting or floating in the sea or freshwater, microscopic
Plastic footprint	The amount of plastic that someone uses
Plasticizers	A substance is added to plastics to make them more flexible
Plastic resin	The main base of plastics
Policy	An officially accepted set of rules
Polymer synthesis	A chemical reaction in which monomers are joined together by covalent bonding to form polymer structures
Potential	Future possibility to develop or achieve something

Term	Description/ Definition
Prevent	To stop something from happening or someone from doing something
Pros	An advantage or argument in favour of something
Protocol	A system of rules that explain the correct conduct and procedures to be followed
Recreation	Something did conducted for pleasure
Recycle	Recovery and reprocessing of waste materials into new materials or products
Reduce	To bring down to a smaller extent
Refuse	To decline to accept
Regulation	An official rule or the act of controlling something
Renewable	Capable of being renewed
Reuse	To use something again
Riverbank	The land along the edge of a river
Rot	To decompose gradually by the action of bacteria, fungi, etc.
Sampling	The action or process of taking samples of something for analysis
Saturated	Filled with something
Sieve	A tool with meshes
Single-Use Plastic (SUP)	Plastic items that are used only once before they are thrown away or recycled
Sphere	A ball shape
Stakeholder	Any individuals, groups, or parties affected by a project, initiative, policy, or organization
Stiff	Hard and not bending or moving easily
Stir	To mix something up
Supernatant	The liquid fraction that lies above the insoluble solids after centrifugation or precipitation
Threat	Situation or activity that could cause harm
Toughness	The quality of being strong
Transboundary	Crossing the border between two or more countries
Translucent	Not completely clear or transparent but clear enough to allow light to pass through
Transportation	The act of transporting
Treaty	A formal agreement between two or more nations
UV radiation	Invisible rays with shorter wavelengths that are part of the energy that comes from the Sun

01 Plastic Waste and Microplastics

Activity 1.1: What Do You See?

First, Let's talk about plastic waste, which has become a challenge for all of us.
Then, let's see how we can help to solve the problem.

You Will Need

- Student worksheet 1.1.1
- Two photographs/ images per small group, given by the teacher

Procedure

STEP 1

- First, let's observe/ recall the items brought to our homes last week from the market. Identify how many items are made of polythene or plastic materials among them. Record the information in Student Worksheet 1.1.1.
- Next, let's form small groups (4–8 members) and discuss our findings. Afterwards, we'll summarise the data on our worksheets and conclude.
- Using the collected data, create a graph to represent our findings visually. It's an excellent time to consider how much plastic waste is accumulated in our homes. Let's discuss the different types of plastic waste and where they come from.
- Then, let's discuss and present how we would dispose of these accumulated plastic wastes from our homes and their impact on our lives. Let's watch this video for further understanding. https://youtu.be/DHg291KeFls

Worksheet 1.1.1: Item brought and its packing material

Item brought	Packing material
e.g., Yoghurt	Plastic

STEP 2

- Let's observe the photos/ images provided by the teacher carefully, discuss what we see, and spot the problems in them.
- Let's find more information on the impact of plastic waste accumulated in the environment from different sources.
- Then, let's prepare to present the effects of plastic waste at both local and global levels and various ways to minimise the impact.
- Then, we'll come up with ideas for solutions to these problems. You can give feedback on each other's ideas, too.
- Use the pictures 1 – 8 in the following few pages that show plastic waste and animals affected by it. Look at the pictures, think about what you see and spot the problems in them.
- You can write your ideas on paper or sticky notes.

STEP 3

- Next, we'll come together as a whole class and talk about the problems you found. We'll also discuss the different types of plastic waste, where it comes from, and how we can manage it.
- Then, we'll come up with ideas for solutions to these problems. You can give feedback on each other's ideas.

STEP 4

- Let's learn more about plastic waste and how we can help to solve the problem.
- We can make changes by following laws and regulations and taking action to help.
- Please share your thoughts on how we should act on this.

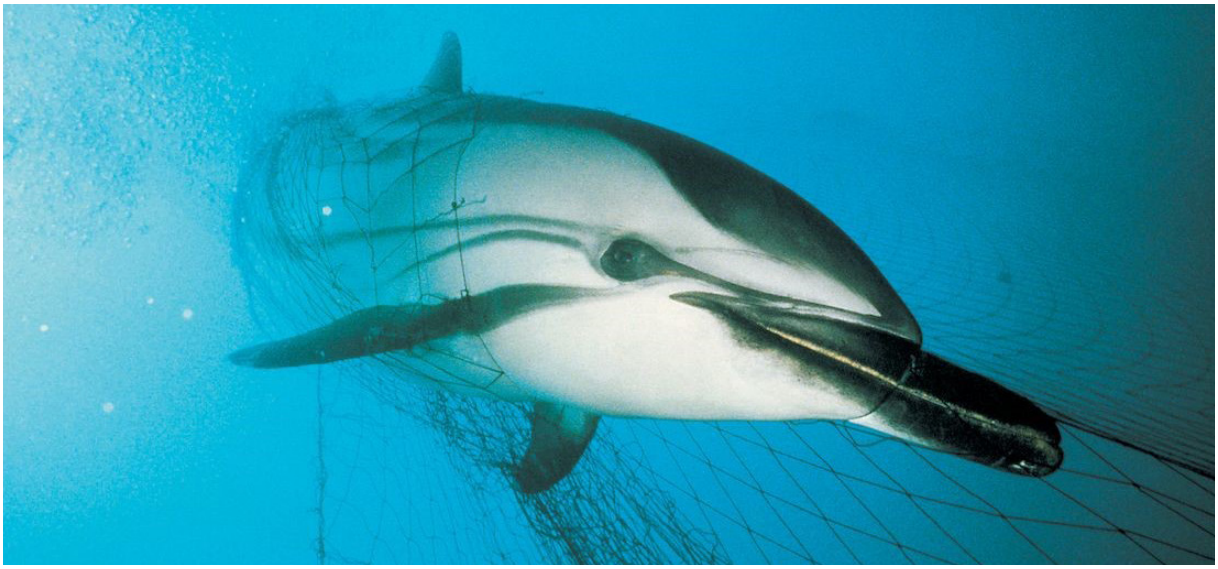
Picture 1

Picture 2

Picture 3

Picture 4

Picture 5



Picture 6

Picture 7

Picture 8

Definitions

Plastic: an artificial material produced from polymers, long chains of repeating molecules.

Plastic waste: a leftover or thrown-away plastic material that is no longer needed. Instead of breaking down naturally, it can stay in the environment for a long time, causing pollution if not disposed of properly.

Additional Resources

- Investigating Plastic Pollution - The Basics : https://youtu.be/DHg291KeFls

Activity 1.2: Plastics in Sand/ Soil

In this activity, we will explore and learn about tiny bits of plastic in the sand/ soil.

You Will Need

- Magnifying lenses
- A sieve (about 1 mm)
- A ruler
- A pair of tweezers
- Student worksheet 1.2.1
- A pair of gloves
- Plastic trays
- A computer or smartphone to watch a video (you can do this in the classroom or at home later)

Procedure

STEP 1

- First, let's form small groups and prepare for practical experience. For that, let's go outside and look at the sand/ soil in a selected area with our naked eyes. Then, let's collect the plastics that we can see clearly.

Area of observed place: .....
Number of plastics found: .....

Can you look at the sand/soil with your naked eye? Do you see any tiny bits of plastic in it?

_____

_____

_____

_____

STEP 2

- Now, let's take a few sand/ soil samples from our area and sieve the sand/ soil using a sieve. Let's separate large particles from the sand/ soil. Then, let's identify plastic-like particles.
- Next, identify plastic particles in sieved sand/ soil (<1 mm). We can use magnifying lenses to identify them.
- Let's determine the size, observe the colour and shape of all particles found, and write down our observations in the student worksheets 1.2.1 and 1.2.2. Let's take photos if we have a camera.

Worksheet 1.2.1: Plastics in sand/ soil

No.	Colour	Size/mm	Shape

Worksheet 1.2.2: Plastics in sand/ soil

Type of plastic found in the sand/ soil	Number found in sand/soil samples	Estimated number in the whole area
Microplastics		
Mesoplastics		
Macroplastics		

Note:
Plastic Size-Based Classification: Plastic can be divided into several categories based on size.
Nanoplastics (smaller than 1 µm)
Microplastics (plastic particles between 1 µm and 5 mm)
Mesoplastics (plastic particles between 5 mm and 2.5 cm)
Macroplastics (plastic pieces between 2.5 cm and 1 m)
Megaplastics (plastic pieces larger than 1m)

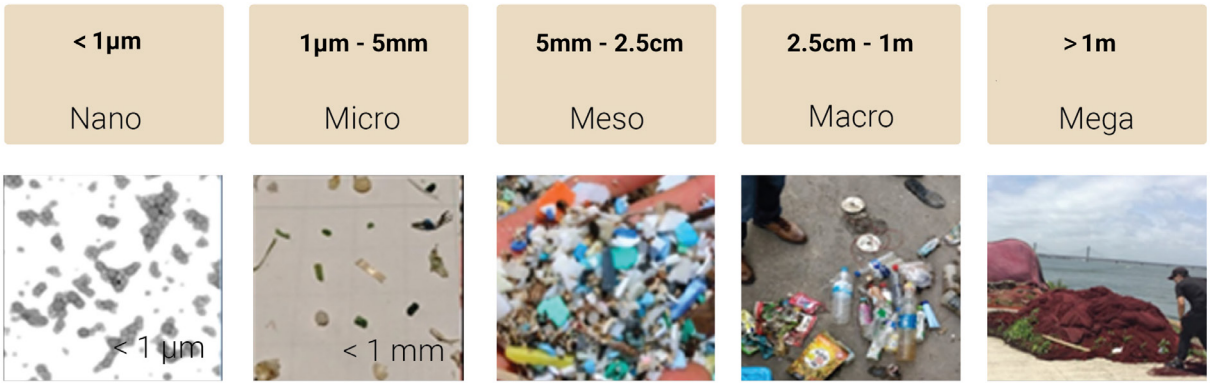


Figure 1.2.1: Size-based classification of plastics (Source: Abeynayaka et al. 2022b) (https://www.iges.or.jp/en/pub/microplastics-wastewater/en)

Morphology: Next, sort the plastic pieces into different groups based on appearance. We can use five categories: fragments, fibres, beads/ spheres, and films/ sheets, pellets. These categories will help us describe what the plastic pieces look like and how they might affect the environment.

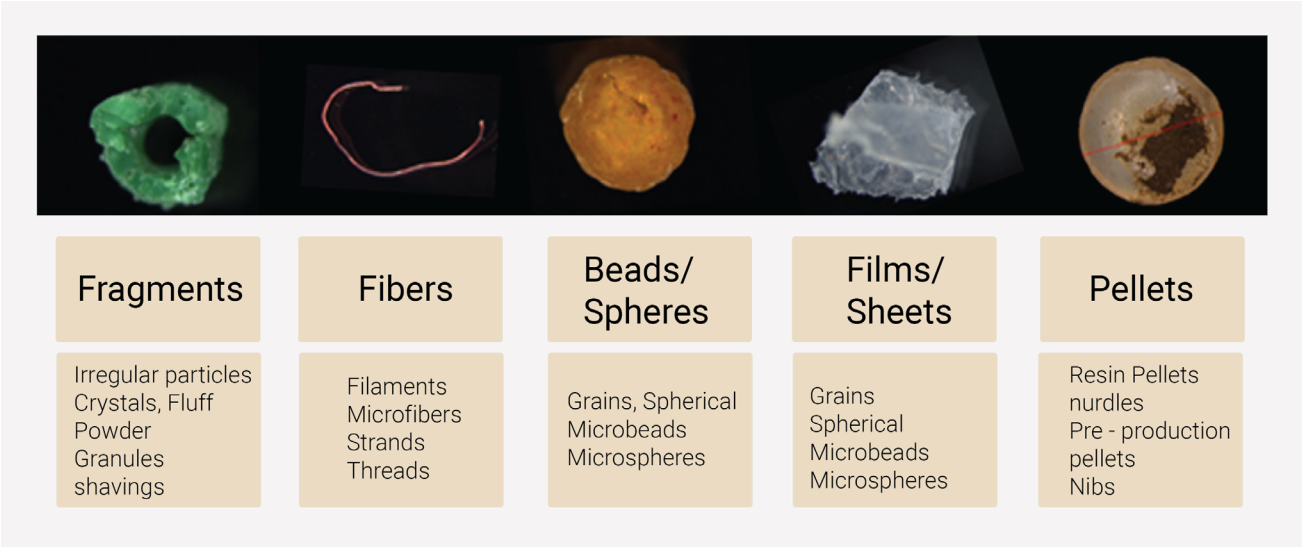


Figure 1.2.2: Morphology of microplastics
Source: Abeynayaka et al. 2022a

Colour: 8 colour classes are suggested, as per GESAMP - 2019.
black/ grey, blue/ green, brown/ tan, white/ cream, yellow, orange/ pink/ red, transparent, multicolour

Toolkit integration

Let's enhance our understanding of plastic pollution with the help of a toolkit! Let's dive deeper into the microplastics issue through a hands-on activity. We'll analyse sand samples, differentiate between synthetic and natural materials using the provided clues, and categorise items based on size. The toolkit provides detailed instructions and safety tips, enriching our learning experience in Activity 1.2. Let's refer to the tool for additional resources and a more comprehensive understanding of microplastics (https://algalita.org/wayfinder-society/toolkit/synthetic-sand/)

STEP 3

Let's consider the amount of plastic particles in our surroundings. Where do these plastic particles come from? Why is it essential to prevent plastic pollution, and how?

STEP 4

We will go into the classroom and create a poster to educate the school community on the importance of preventing plastic pollution in our school premises and how it can be done. Finally, we will watch a video about plastic pollution and plastic around us.

Definitions

Beads/ Spheres: spherical/ round shape particles in variable sizes (broken styrofoam etc.).
Fibre: long fibrous plastic materials with a length significantly higher than its width.
Films: flat and flexible plastic particles with angular or smooth edges.
Fragments: Irregularly shaped pieces of hard plastic particles that look broken off from a more significant piece.
Macroplastics: plastic pieces between 2.5 cm and 1 m
Meso-plastics: plastic particles between 5 mm and 2.5 cm
Microplastics: plastic particles between 1 µm and 5 mm - You will observe mainly particles larger than 1 mm
Nanoplastics: smaller than 1 µm - Too small to observe during your activity.
Pellets: hard particles of small granules usually have a spherical or cylindrical shape.

Additional Resources

- Videos of plastic in the environment
- Plastic pollution in Sri Lanka and Elephants - https://www.youtube.com/watch?v=OpiR6c5nl3Q
- "How microplastics affect your health" by UNEP https://www.youtube.com/watch?v=aiEBEGKQp_I
- "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
- https://algalita.org/wayfinder-society/toolkit/synthetic-sand/

Let's try to answer these questions based on what we have learned.
Where do you think these plastic particles come from?

_____

Do you think plastic particles pose some threats to wildlife, the environment, and human health?

_____

After watching the video, are you surprised by the possible threats to wildlife, the environment, and human health?

_____

What can you do to prevent plastic pollution?

_____

Activity 1.3: Microbeads from Cosmetics and Personal Care Products

In this activity, we will do a fun experiment to find and look at tiny beads in cosmetics and personal care products. We will also learn what happens to them when they enter the environment.
Have you ever used a face scrub, hand-washing cream, or toothpaste with little beads? Those tiny beads are called microbeads, and they are made of plastic.

You Will Need

- Some cosmetics and personal care products that are available on the market
- Clear sheets/ transperent sheets or a flat, firm, single-colour surface
- Microscope or magnifying lens
- Transparent reusable plastic cups
- Tap water, dishwashing detergent and table salt
- Spoons
- Computer
- Worksheet 1.3.1

Procedure

STEP 1

- First, let's divide into small groups.
- Let's take cosmetics and personal care products brought to the classroom and observe labels and whether these products contain microbeads.
- Let's count how many of the items contain microbeads.
- Let's select an item that has microbeads.
- Let's take a small amount of the product and put it on a transparent sheet.
- Let's touch the liquid gently with our hands to feel the product's texture.
- Also, let's observe them closely using a magnifying lens or microscope. We can repeat the practical for other selected items, too.

Read the composition of the products given to you by the teacher. Which one contains microbeads?

_____

_____

_____

_____

Choose one of the products. Spread it on a transparent sheet and examine it. Look at the product using a magnifying lens or a microscope and explore it by touching it. Can you see/ feel the microbeads?

_____

_____

_____

STEP 2

- Now, let's make three different liquids/ solutions to test the microbeads.
- We will use tap water, water with some detergent, and water with some salt in three different cups.
- Then, we'll put a small amount of the product with the microbeads into each cup to see if the beads float or sink.
- We can repeat the practical for other selected products, too.

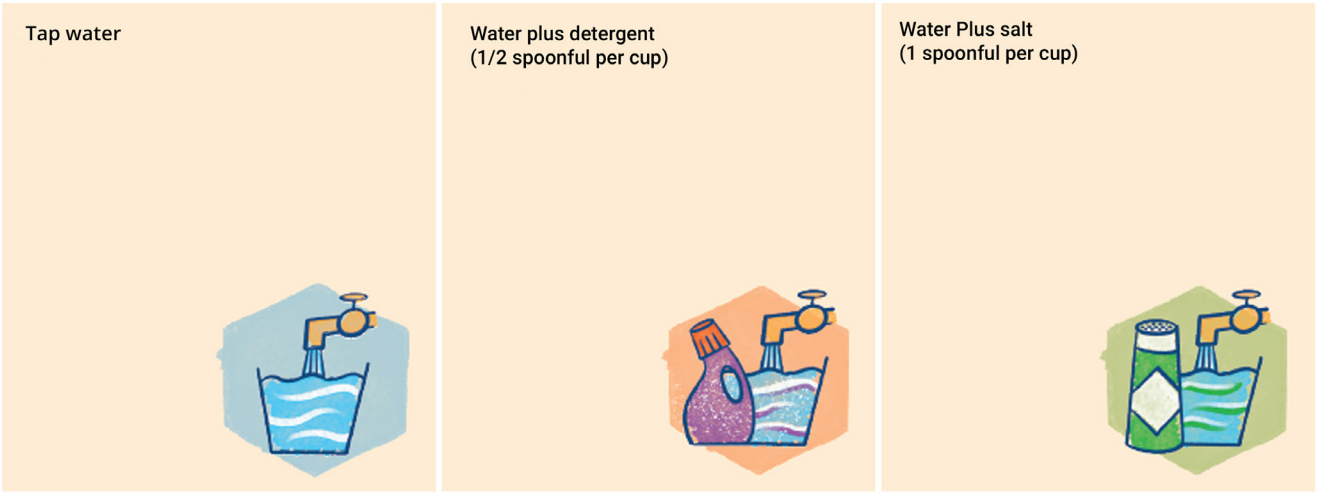


Figure 1.3.1: Behaviour of microbeads on different liquids/ solutions

Worksheet 1.3.1: Behaviour of microbeads in different liquids/ solutions

Put a tick mark (✓) in the appropriate column.

Liquid/ Solutions	Item no. 1 (.....)		Item no. 1 (.....)	
	Float	Sink	Float	Sink
Water (Tap water)				
Water + Detergent (1/2 spoonful of detergent per cup)				
Water + Salt (1 spoonful of salt per cup)				

- After that, let's discuss what might happen to the microbeads in aquatic environments, like rivers, seas, and lakes, and make predictions about whether they will float or sink. Let's also discuss how microbeads are added to the natural environment and what will happen after they are added to aquatic environments.

Based on the observations, what do you think the microbeads will do in the natural environment? Will microbeads sink or float in freshwater (e.g., in a lake)? Will microbeads sink or float in saltwater (e.g., in the sea)?

_____

_____

_____

STEP 3

- Let's discuss how we can help our family and school community understand why we should avoid using products that contain microbeads.
- Let's watch two videos about microbeads in different countries and see if products in Sri Lanka have information about microbeads on their labels.

How can we avoid using products containing microbeads?

_____

_____

_____

How can we raise awareness among our family and friends about the dangers of microbeads?

_____

_____

_____

Extra Activity

Let's prepare a wallpaper on the impact of microbeads on the environment to make the community aware.

Definitions

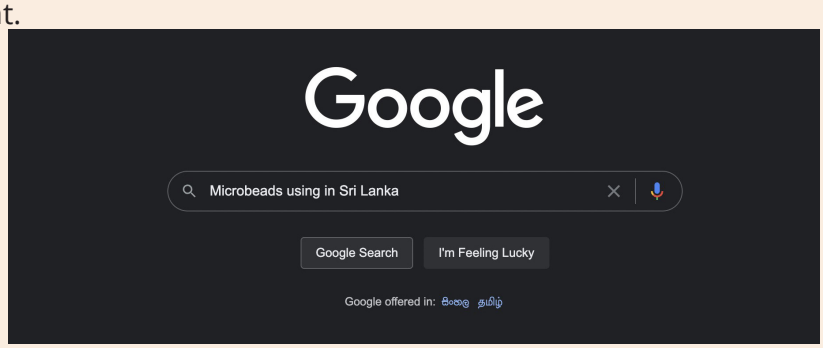
Buoyancy: a body's tendency to float or rise when submerged in a fluid.
Microbeads: manufactured tiny solid plastic particles that are less than 1 mm (one millimetre) in their largest dimension
Salinity: the saltiness or dissolved salt content of a body of water.

Additional Resources

- "The story of microbeads" by the Story of Stuff - https://www.storyofstuff.org/movies/lets-ban-the-bead/

Activity 1.4: How Many Microbeads are We Dumping to The Environment?

Let's research to estimate how many microbeads people throw away every year. We'll use the Internet to do this. This activity will help us understand how big of a problem microbeads can be for the environment.



Let's work together to determine how many microbeads people throw away yearly. We'll also talk about how this can harm the environment and have a debate to share our thoughts. This activity will help us understand why it's essential to be careful about using products with microbeads.

You Will Need

- Some cosmetics and personal care products that are available on the market
- Clear sheets/or a flat, firm, single-colour surface
- Microscope or magnifying lens
- Transparent reusable plastic cups
- Tap water, dishwashing detergent and table salt
- Spoons
- Smartphone or a computer
- Spoons marked with a volume of 5 ml (the spoon gets syrups from the pharmacy/ teaspoon)
- Tea strainer, filter paper or white colour cloth to use as a filter

Procedure

STEP 1

- Let's work together in groups of two to five (preferably three) members.
- We will add a little dishwashing liquid to a cup of water.
- Then, we will mix a small amount of a microbead product into the same cup of soapy water.
- We will stir the mixture for one minute and then use a filter to separate the microbeads from the liquid/ solutions.
- We will put the microbeads onto a transparent sheet and count them using a magnifying lens.

STEP 2

- Let's figure out how many tiny microbeads are in our products. Then, let's estimate the following.
- The time duration for one person to use the product.
- The number of products needed per year per person.
- A total number of products needed per family.
- The total number of microbeads release to the environment by one family.
- The total number of microbeads release to the environment by families of our group members.
- Next, let's estimate the total number of microbeads released by the families of all students in the classroom.
- Finally, estimate how many microbeads are released by school community families into the environment annually.

STEP 3

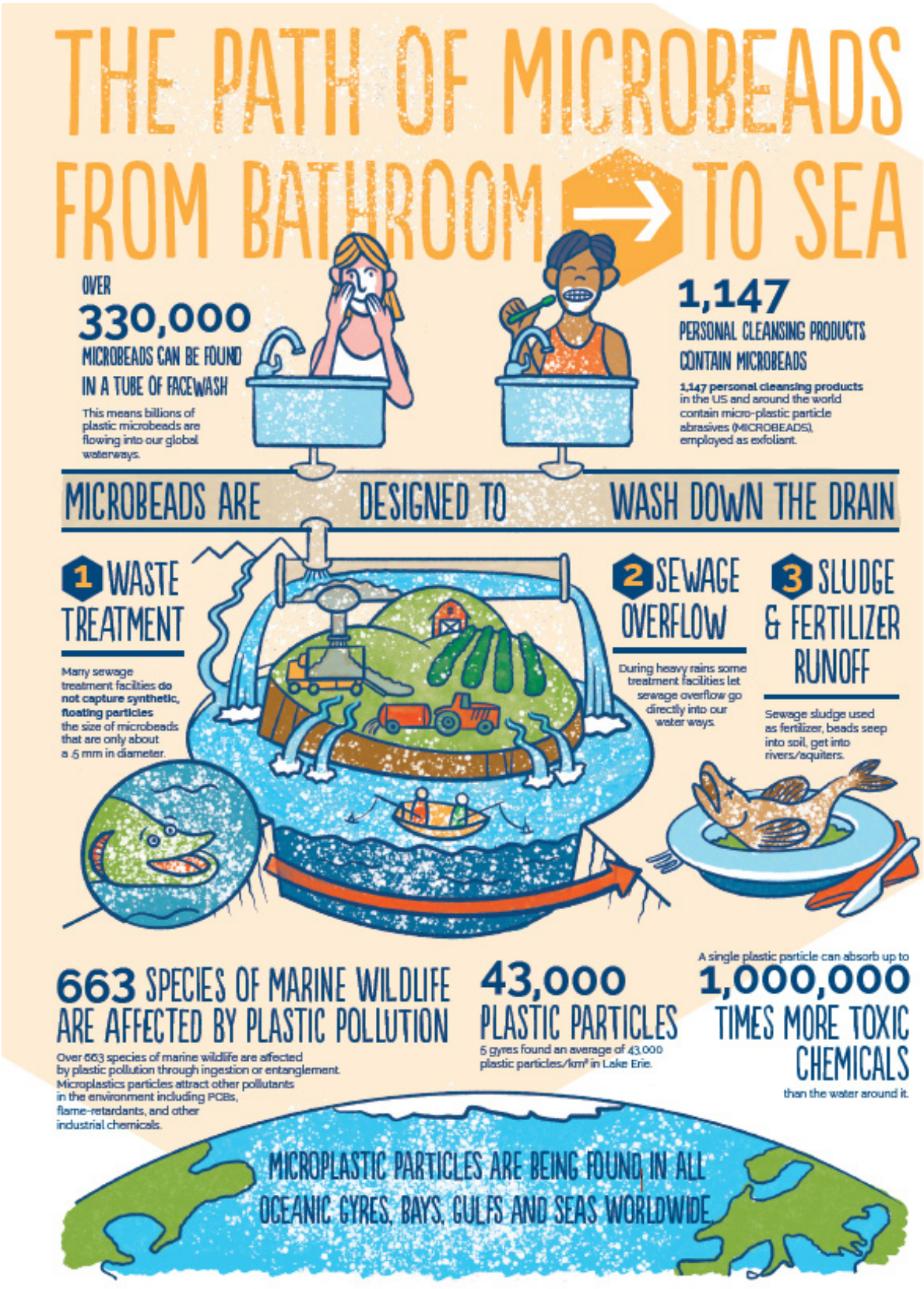
- Let's visit a cosmetics shop/ salon located in our/ selected area. Let's prepare a questionnaire and conduct a survey to determine how many microbeads containing products are sold/ used in the shop/ salon per week/ month and how many they buy cosmetics and personal care products annually. We can get relevant information verbally, too. Based on the findings, let's fill the activity sheet 1.4.1

Worksheet 1.4.1: Cosmetics used in shop/ salon in ..... area per weekly/ monthly

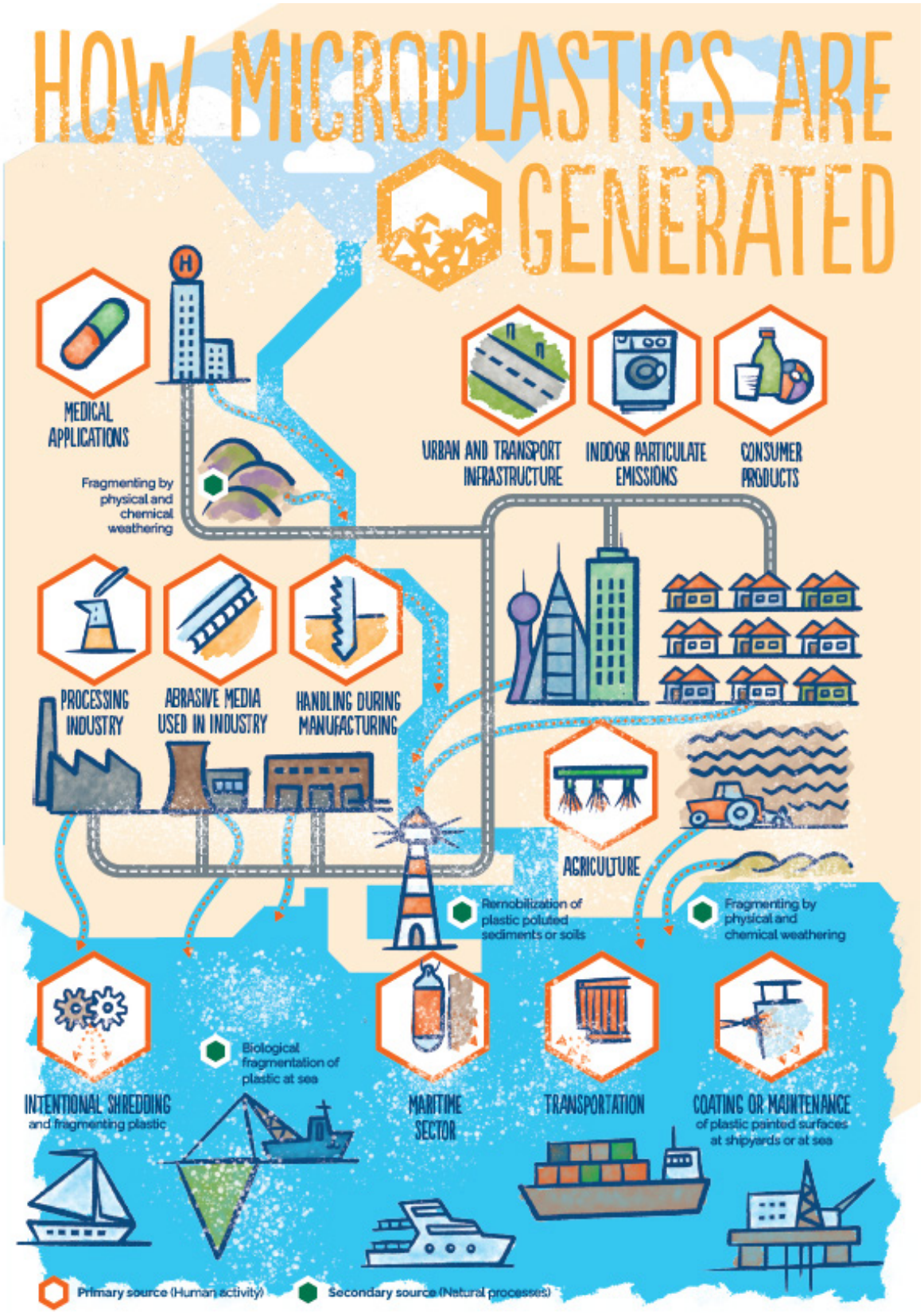
Name of the item containing microbeads	Volume per container/ tube	The total number sold/ used per month	Total number of microbeads release to the environment per month

- Then, let's estimate the amount of microbeads released to the environment by living area and town annually. We can also find out how much cosmetics and personal care products are imported by referring to various sources. Then, we can get an idea of the amount of microbeads released into the environment annually in Sri Lanka.
- Let's research information about the issue of microbeads in the environment, as well as ongoing debates and actions regarding their restriction or ban on products.
- Finally, prepare to present/submit a report based on our findings.

Note:
The filter cannot catch all microbeads. Therefore, a part of the microbeads can go through the filter. Similarly, all microbeads cannot be counted, as some are invisible. Thus, the amount of microbeads entering the environment during our daily activities is much higher than what students estimated.



Infographic 1.4.1: The path of microbeads from bathroom to sea



Infographic 1.4.2: How are microplastics generated?

Definitions

Filter: something that separates particles or elements from a substance, like a sieve that lets through what is wanted and holds back what is not.

Questionnaire: a set of written questions used to gather information or opinions from people.

Additional Resources

- Is bioplastic the better plastic?
  https://www.youtube.com/watch?v=-_eGOyAiNIQ
- Truly Biodegradable Plastic
  https://www.youtube.com/watch?v=m8aEoD29nTM
- 4 Facts You Need To Know About Bioplastics & Biodegradable Plastics
  https://www.youtube.com/watch?v=mc5rVMG8aow

02 Exploring Plastics

Activity 2.1: Identifying and Categorizing Plastics

Let's learn to sort and identify the different types of plastics.

You Will Need

- A bag of plastic waste items (better pre-prepare, i.e., bring from home)
- Scissors
- Torches
- Worksheet 2.1.1

Procedure

Let's get into groups of two to seven.

STEP 1

- Let's take a bag of plastic waste items. Sort out the plastic waste in a way you think will get the most money from plastic recyclers.

STEP 2

- Let's ask, "Why are the plastics sorted out in that particular order?" Spot the symbol on at least four plastic objects and record them on the worksheet.
- Next, let's identify the types of plastic using the Plastic Information (Chart 2.1.1) and record the information on the worksheet 2.1.1.

STEP 3

- Let's observe plastics' physical characteristics (transparent, translucent, opaque, flexible, stiff, hard). Cut a small piece (about 5 cm^2) from the plastic object (Be careful when cutting the plastic). Then, record your observations on the worksheet 2.1.1. After that, let's share our findings with other groups.

Definitions

Flexibility: able to bend easily without breaking

Hard: firm to the touch and not easily compressed or bent

Opaque: preventing light from travelling through, and therefore not transparent or translucent

Translucent: an object or substance that is almost transparent, allowing some light to be drawn through it attractively

Transparent: see-through or clear, allowing light to pass through easily

Stiff: hard and not bending or moving easily

Column 1	Column 2	Column 3		
Material	Abbreviation of the material	Symbol options		
		1	2	3
(01) Polyethylene terephthalate	PET or PETE			
(02) High-density polyethylene	HDPE or PE-HD			
(03) Polyvinyl chloride	PVC or V			
(04) Low-density polyethylene, Linear low-density polyethylene	LDPE or PE-LD			
(05) Polypropylene	PP			
(06) Polystyrene, expanded polystyrene, Styrofoam	PS			
(07) Other plastics, such as acrylic, nylon, polycarbonate, and mutilayer combinations of different plastics	OTHER or O			

Chart 2.1.1: Plastic Information Chart 1

		User	Type of plastic	Recycling
01		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.
02		Chemical drums, jerrycans, 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.
03		Windows frames, drainage pipe, water service pipe, medical, devices, automotive interiors and seat coverings, cling film and credit cards	Polyvinyl chloride unplasticised polyvinyl chloride	Typically not accepted by curbside recycling providers it's occasionally accepted by plastic lumber maker
04		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
05		Coffee pot and washing m/c parts (where high temperature and moisture are critical)	Polyethylene (PP)	Picked up through most curbside recycling programs
06		Toys and novelties, rigid packaging, refrigerator trays and boxes, cosmetic packs, and costume jewelry	General purpose polystyrene (GPPS)	Often not recycled through curbside programs as it is too lightweight to be economical to recycle usually incinerated instead
07		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

Chart 2.1.2: Plastics Information Chart 2

Worksheet 2.1.1: Physical charachteristics of plastics

Sample	Symbol moulded on the plastic waste item Draw/ Paste it	Full name of the identified plastic type.	Appearance of the plastic piece (translucent/ opaque)	Flexibility (stiff/flexible/challenging to bend)	Nature of scratch on the plastic piece (white mark along the cut /clear cut)	Floating nature in water (float/ sink) in the water?
01						
02						
03						
04						

Activity 2.2: How Long Does it Take for Plastic to Degrade?

Let's do an experiment where we see how long it takes for different kinds of plastic to degrade (break down).

You Will Need

- Different materials (Ex, Banana peel, a PET bottle, a newspaper, a used CD/ hard disk, a piece of fabric, a plastic toy, etc.) available at home
- Worksheet 2.2.1

Procedure

Let's get into groups of two.

STEP 1

- Let's keep the materials (e.g., banana peel, PET bottle, newspaper, used CD/ hard disk, piece of fabric, etc.) brought from home in the desk. consider the fate of these items if they are all discarded together in soil.
- Discuss what will happen if these items end up in environments such as landfills, open dumps, open burning, or even disposed of in rivers.

STEP 2

- Let's define the term 'decomposition'.
- Next, let's arrange materials brought in an order according to the nature of degradation and complete worksheet 2.2.1.
- Discuss their timelines and think, "Why do some materials degrade more quickly than others?"
- Let's guess and compare each item's time to degradation with the actual values of the degradation times given by the teacher.
- Let's think about and discuss how plastics and electrical goods take years to degrade. Suggest potential solutions to minimise this.

Worksheet 2.2.1: Time taken for the degradation of different materials

Item	Time taken for the degradation

STEP 3

Let's watch the video provided and present the critical viewpoints on the video.

Definitions

Degradation: The complete or partial breakdown of polymers owing to UV radiation (photodegradation), biological activity (biodegradation), moisture (hydrolytic degradation), and oxygen and heat (thermo-oxidative degradation). The properties of the plastic are altered due to degradation (e.g., surface cracking, discolouration, and fragmentation).

Biodegradation: Polymers are degraded through the metabolic activities of microorganisms (e.g., bacteria, algae, fungi, and algae) into CO_2/ methane, water, energy, and new biomass.

Additional Resources

- Learning about Biodegradable and Non-Biodegradable Wastes: https://www.youtube.com/watch?v=G-Mtk4gOB9c

Activity 2.3: Investigating the Degradation of Plastics

In this fun experiment, let's study how long it takes different things to break down by looking at how they change over time.

You Will Need

- Plastic bags (one of the following):
  - Traditional polyethylene plastic bags (HDPE)
  - Compostable plastic bags
- Journal paper on paper packaging
- The skin of a fruit (apple/ banana / local fruit)
- Worksheet 2.3.1
- A hand shovel
- Pair of gloves

Let's get three of the same items for each experiment. We'll use one set to compare their toughness, one as a control, and the last for the composting experiment.

Procedure

STEP 1

- This activity can be done alone or with friends. We will bury the selected items in the soil and check on them weekly to see what happens. We can do it together if our school has a good spot for this. But if not, we can do it at our own homes by ourselves.

- Let's compare how tough each item is by seeing how much they can bend before breaking. We'll take one of each type of item, A, B, and C and test them out. Based on what we observe, we'll make a guess (a hypothesis) about which items will break down faster or slower in the environment. Let's record the observations in worksheet 2.3.1.

STEP 2

- Let's store one item, A, B, and C, away from sunlight and soil.

STEP 3

- We will now bury the remaining three items in a particular soil area in our school garden. If we don't have access to a garden, we can use a box of soil in our classroom instead. We need to keep the soil moist by watering it regularly.
- We'll review the three items weekly and see if they look different. Do they show signs of breaking down? We should take pictures and write down our observations in our worksheet 2.3.1. We'll also compare how they look to the control samples. Based on what we observe, we can try to guess how long it will take for the items to break down completely. We can write down our predictions and compare them to our initial guess.

STEP 4

- Let's present our observations along with our suggestions.
- Next, based on our findings, we will formulate a hypothesis regarding the relative resistance of different materials to environmental degradation.
- After that, try to identify and predict the total time required for complete degradation based on the percentages of decomposition observed.
- Finally, let's compare the estimations with our initial hypothesis.

An example of a hypothesis

H_0 - Plastic degradation increases with direct sunlight

Worksheet 2.3.1: Colour and physical changes in plastic with the time

Week	Material Category					
	A		B		C	
	Colour change	Physical toughness	Colour change	Physical toughness	Colour change	Physical toughness
1						
2						
3						
4						
5						
6						
7						

Definitions

Hypothesis: A hypothesis is a statement that suggests a possible explanation for a phenomenon. It can be tested to see if it's true or false.
Physical toughness: The ability of a material to withstand both deformation and fracture.

Additional Resources

- Learning about Biodegradable and Non-Biodegradable Wastes: https://www.youtube.com/watch?v=G-Mtk4gOB9c

Activity 2.4: Know Your Plastics (Recommended for Grade 11 Students)

In this experiment, you'll learn how to tell apart six different types of plastic using a unique code called the Resin Identification Code (RIC). Density and flame tests will help you identify the type of plastic and which resin.

You Will Need

Density Test

- 3 Graduated 250 ml beakers per group
- A solution of ethanol 200 ml
- A saturated solution of NaCl 200 ml
- six types of plastic (PET, HDPE, PVC, LDPE, PP, PS) samples (2x2 cm) (identified using the recycling codes)
- A tweezer
- A chart of plastic recycling codes
- worksheet 2.4.1

Flame Test

- A face mask and a safety goggle
- Copper wire (about 5 cm long)
- HDPE, PVC and PET plastic samples (already given to students for density test)
- A Bunsen burner
- A wooden peg/test tube holder to hold copper wire
- Tongs or forceps
- Ring stand and ring with wire gauze
- Worksheet 2.4.2

Procedure

STEP 1

- Let's get into groups of 4 or 5.
- Let's identify different types of plastic using density and flame tests.
- Discuss the challenge of recognizing plastic types by polymer type.

Note:

Certain plastic resin types release toxic chemicals when heated. Therefore, suggest using a face mask and safety goggles for the flame test. By identifying the different types of plastics, you will find it easier to separate collection and recycle plastics, conserve energy and develop environmental protection policies.

Discuss the challenge of recognizing plastic types by polymer type, as many everyday items are made from different plastics (e.g., beverage containers - PET, bags - LDPE, water transmission pipes - PVC).

STEP 2

A. Density test- Which plastic floats and which plastic sinks?

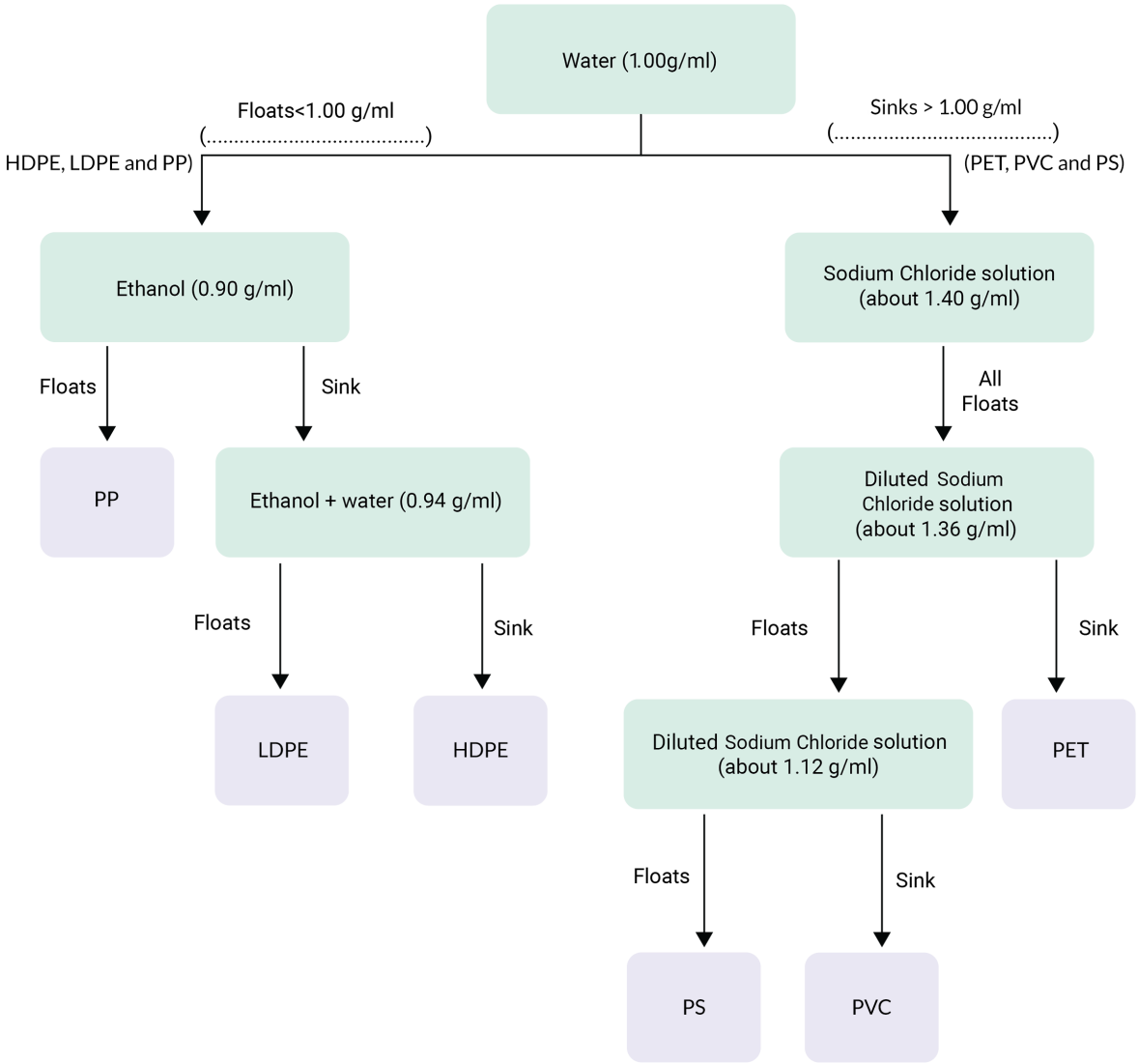
- Let's conduct a density test based on Archimedes' Principle[9] with the six polymer samples given by teacher with unique plastic resin identification codes using the following steps.
  - I. Pour 175 ml of tap water into a 250 ml graduated beaker and add all six plastic pieces one at a time.
  - II. Next, dry the floated materials and place them into the 250 ml beaker containing 175 ml of ethanol. Separate the floating material.
  - III. Then, add water (a denser liquid) to the ethanol solution (0.5 ml at a time) until the density becomes about 0.94 g/ml.
  - IV. Separate the floating material/ materials.
  - V. Then, retrieve three sunken materials and dry them.
  - VI. Then, take the third beaker, containing 1.40 g/ml sodium chloride solution, place three dried sunken in water into it, and observe the floating/ sinking nature of the resins.
  - VII. Add more water to the solution (its density will become about 1.36 g/ml). Then, select the sunken materials.
  - VIII. Add more water to the beaker until density lowers 1.12 g/ml. Then, separate the sunken and floating materials.
- With the teacher's assistance, let's complete worksheet 2.4.1 and flowchart 2.4.1. We can also use figure 2.4.1, videos, or other resources to identify and classify plastic samples.
- Let's begin by discussing how an object sinks if its density is higher than that of the surrounding fluid, floats if its density is lower, and remains in equilibrium if the densities match.

Worksheet 2.4.1: Separation of plastics according to the density.

Put a tick mark (✔). Which type of plastic will float on water, Ethanol solution and Sodium Chloride solution?

Plastic sample	Water		Ethanol solution				Sodium Chloride solution					
	Float	Sink	About 0.90 g/ml solution		About 0.94g/ml solution		About 1.40 g/ml) solution		About 1.36 g/ml) solution		About 1.12 g/ml) solution	
			Float	Sink	Float	Sink	Float	Sink	Float	Sink	Float	Sink
A												
B												
C												
D												
E												
F												

9. 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".



Flowchart 2.4.1: Separation of plastics according to the density

Note:

- Some plastics are mixtures of several materials and may behave differently than expected.
- Plastic waste can be effectively recycled only if it is composed of a single type of plastic resin; a mix of plastic resins cannot be easily recycled, and food contamination alters the quality of the material and prevents it from being recycled.
- PVC and PET have similar densities, potentially caused by additives and plasticisers. However, a flame test can identify them separately.

B. Flame test

- Let's perform the flame test on PVC, HDPE and PET using the following steps.
  I. Wrap the copper wire around a wooden peg or use a test tube holder to hold it (this will keep your fingers away from the hot flame).
  II. Heat the copper wire in the burner flame until it is red hot, and the flame no longer has a green colour.
  III. Remove the wire from the flame and touch the hot wire to the plastic sample you want to be tested.A small amount of the plastic should melt onto the wire. If the wire sticks to the plastic sample, use a pair of tongs to remove it.
  IV. Expose the copper wire to the flame again to continue.
  V. Let's repeat this test for each remaining plastic sample sunk in the water.
- Let's record conclusions based on the observations on worksheet 2.4.2.

Worksheet 2.4.2: Separation of plastics according to the density

Flame test behaviour	Name of the plastic
	PET
	HDPE
	PVC

Note:

- The flame test involves recognising certain substances (metallic salts) based on the flame's colour when it is in contact with the test compound. In this specific case, the recognition concerns the formation of Copper Chloride ($CuCl_2$). When a copper wire is in contact with polyvinyl chloride (PVC-which contains Chlorine) and then placed in the flame, the latter takes on the characteristic green colour typical of Cu^{2+}.
- In fact, through thermal energy, electrons contained in the metal become excited and reach a higher energy frequency. However, they tend to return to a lower energy level, resulting in a more stable state and the emission of radiation. These characteristics for each are perceived as coloured light.
- Polymer recycling is part of the policy for energy-saving and environmental protection. Identifying the different types of plastic allows for a separate collection, ensuring mechanical recycling. However, it is difficult to determine the various types of plastic, such as whether beverage containers are usually made of PET, bags are made of LDPE, or pipes are made of PVC. An additional problem in separating and recycling plastic waste is the presence of additives.

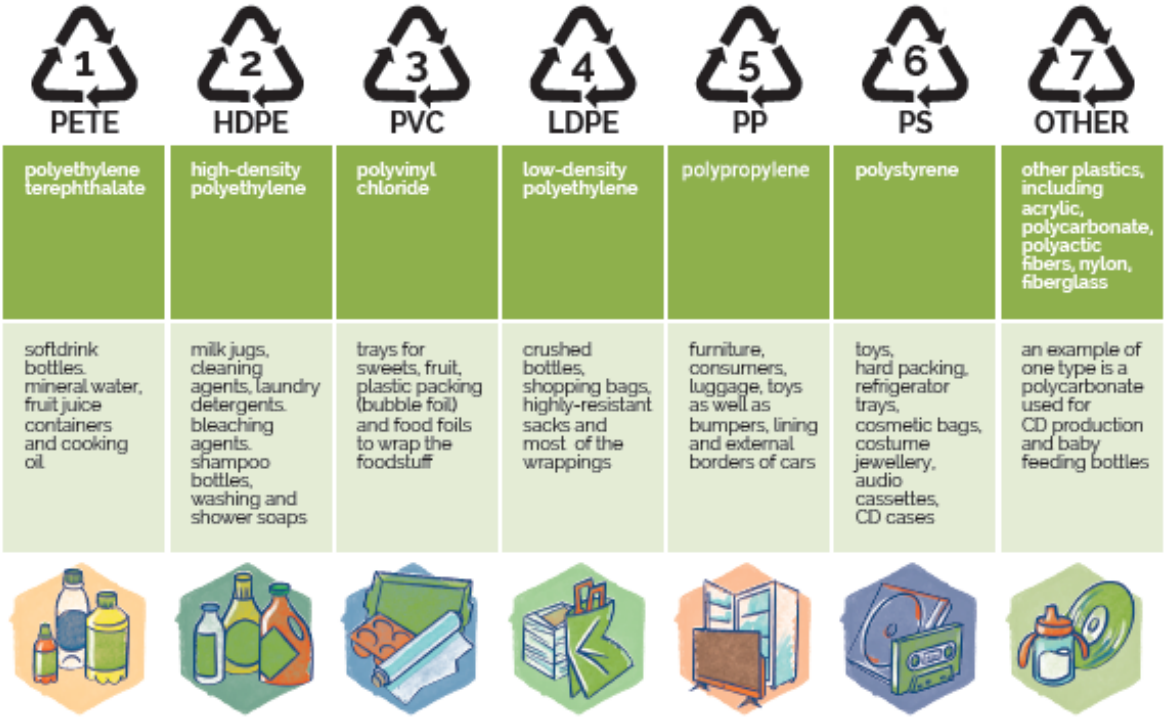


Figure 2.4.1: Chart of plastic recycling codes (Resin identification codes)

POLYMERS	Poly(ethylene terephthalate)	PETE 1	1.38-1.39
	Polyvinyl chloride	PVC 3	1.16-1.35
	Polystyrene	PS 6	1.05-1.07
	High-density polyethylene	HDPE 2	0.95-0.96
	Low-density polyethylene	LDPE 4	0.92-0.94
WATER			1
SOLUTIONS	Ethanol-water (60-40)		About 0.9
	Saturated NaCl solution		About 1.2

Figure 2.4.2: Density of polymers, water, and of solutions

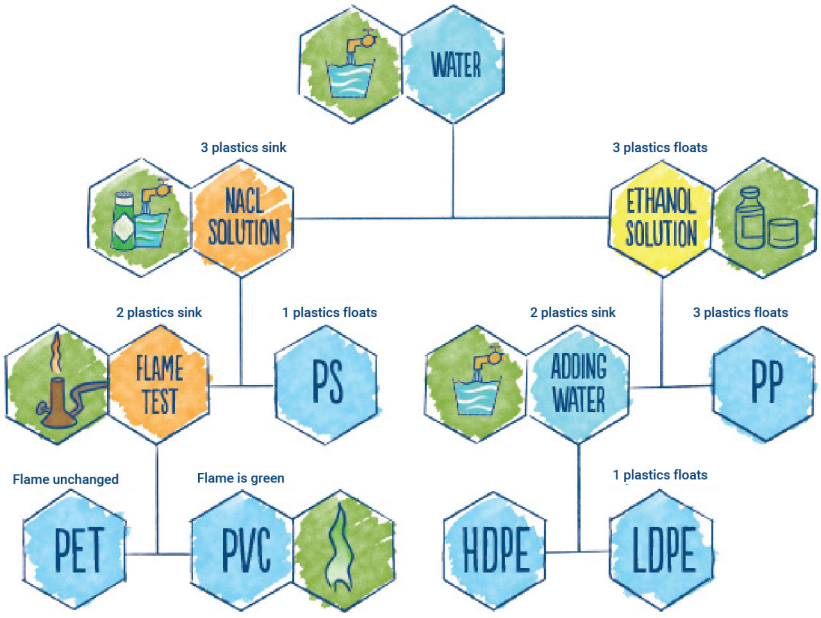


Figure 2.4.3: Dichotomic process to identify polymers

Definitions

Additives: chemical substances added to a plastic polymer to provide desired properties, such as colour, stiffness/flexibility, and water/flame resistance.

Archimedes Principle: the physical law of buoyancy. It states that a body immersed in a fluid experiences an upthrust equal to the weight of the fluid displaced.

"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".

Electrons: subatomic particles that carry a negative electric charge.

Environmental protection policy: is a set of guidelines, regulations, and initiatives governments or organisations implement to safeguard the environment and natural resources.

Resin identification code (RIC): a set of symbols that appear on plastic products to represent the resin used to manufacture them.

Recycling: reprocessing plastic waste materials to produce new and valuable products through mechanical shredding and remoulding.

Additional Resources

- This work is a derivative of Cossu C., Deck N., Hermans S., Mura C. Growing Plastics & New Life for Plastic, Future Classroom Scenario, The BLOOM School Box. This work is licensed under Attribution-Share Alike 4.0 International (CC BY-SA 4.0) license. This work is available at https://bloom-bioeconomy.eu/repository/ls5/
- Plastic Density Lab
  https://www.youtube.com/watch?v=Om9R9hPz3i4
- Archimedes Principal Test
  https://www.youtube.com/watch?v=K2ugHgJngN0
- Beilstein test (prove chlorine in pvc)
  https://www.youtube.com/watch?v=Cjdj0kFlsKY
  https://www.youtube.com/watch?v=ZDTcQArIiMU

Activity 2.5: Making and Investigating Bioplastics

Today, we will learn about plastic made from natural materials, like corn or potato starch, instead of oil. This kind of plastic is called "bioplastic."

You Will Need

- 1.5 tablespoons cornstarch
- A teaspoon vinegar
- A teaspoon glycerine
- five tablespoons of water
- food colouring (optional)
- A saucepan
- A wooden spoon
- A knife
- Scissors or a set of pastry cutters
- Non-stick baking sheets or oil paper
- Smartphone or computer (with an internet connection)
- Worksheet 2.5.1, 2.5.2

Procedure

STEP 1

- Let's learn about bioplastics. We'll watch a video about bioplastics—plastic made from plants instead of oil. It's supposed to be better for the environment!
  https://www.youtube.com/watch?v=-_eGOyAiNIQ

- Let's define bioplastics and discuss their differences from fossil fuel-based plastics. We can also discuss their different applications.

STEP 2

- Let's get into groups of 4 or 5. The plastics we previously examined derive from fossil fuels (oil). Let's observe the samples of bioplastics the teacher gave and compare them with fossil-based plastics. We can use different sources, like the internet, too.

STEP 3

- Now, we're going to do a fun activity where we'll make our bioplastic.
- Let's prepare bioplastics in the laboratory by following, procedure.
- Take the saucepan and place all the ingredients on it.
- Add a few drops of food colouring if you want to colour the plastic.
- Stir all the ingredients until they are all combined
- Place the saucepan on low heat.
- Carry on stirring until the mixture turns sticky and translucent.
- Allow the mixture to cool slightly.
- Using a spoon, drop the sticky mixture onto oil paper or a non-stick baking sheet.
- Spread the mixture using the knife to get the required thickness.
- Allow to cool.
- After cooling, the bioplastic can be cut with a pastry cutter.
- Left them to dry (drying takes about 4–5 days).
- When we do the practical, we should be aware of and follow safety precautions for cutting, heating, and handling hot materials.
- There are various methods and ingredients for making bioplastics. Let's experiment with different techniques, perhaps through internet research.

STEP 4

- Let's research information about bioplastics (both their pros and cons). We can use worksheet 2.5.1: "Graphic Organizer" in the workbook to structure the research and document findings.
- Let's do a Plus (positive) - Minus (negative) - Interesting (PMI) analysis of fossil fuel-based plastic and bioplastics and then take a class vote on which material we feel, on balance, is best for the environment.
- Let's use worksheet 2.5.2 to record data. "Why is it important to consider all sides of an issue or idea?"
- Let's identify PMI aspects of bioplastics. By defining these aspects, we will clearly understand the issue.
- Let's present our information.

Worksheet 2.5.1: Graphic organizer

Oil-based plastic	Questions	Bioplastic
	Do you think what it is made from?	
	Do you think it is made from a renewable source?	
	What can you make using it?	
	How long does it take to degrade?	
	Do you think it is recyclable?	
	Are there infrastructures to recycle it in your country?	
	What are the problems associated with recycling it?	

Positive, Minus, Interesting (PMI) analysis of bioplastics

PLUS List all the positive aspects of bioplastics Advantages/benefits/ strengths/ positives/ Good aspects	MINUS List all the negative aspects of bioplastics Disadvantages/ Deficiencies/ Weaknesses/ Minuses/ Negative aspects	INTERESTING List anything that you think is interesting about bioplastics and needs future investigation. Implications and possible outcomes/ Attention grabbing/Special/Appealing

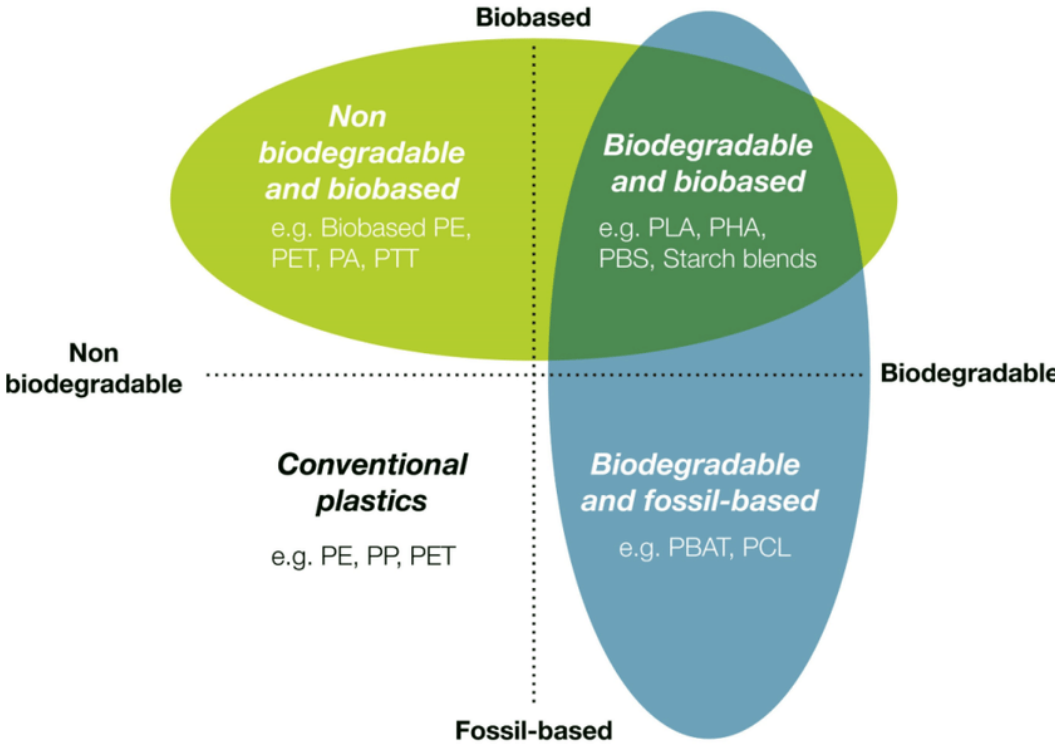


Figure 2.5.1: Fact Sheet European bioplastics
Source: Modified from EU-Bioplastic[11]

11. https://www.european-bioplastics.org

Definitions

Bioplastics: made from renewable resources, such as corn starch, sugarcane, or other plant-based materials

Conventional plastics: regular plastics made from oil or gas.

Experiment: a test or investigation designed to gather information, demonstrate a known fact, or validate a hypothesis.

Fossil-based plastics are derived from fossil fuels, primarily petroleum or natural gas. These materials are synthesised through chemical processes that transform hydrocarbons extracted from fossil fuels into polymer chains.

Research: systematically gathering, analysing, and interpreting information to gain knowledge, answer questions, or explore a topic.

Renewable resource: a natural resource that continues to exist despite being consumed. (**Examples:** solar energy, wind energy)

Graphic organiser: a visual tool or chart that helps organise information, ideas, or data clearly and structured. It typically uses shapes, colours, and connections to represent relationships between concepts or categories.

Non-renewable: a natural substance that is not replenished at the speed at which it is consumed. (Example: coal)

Non-biodegradable: substances, like certain plastics, that don't break down naturally and stay in the environment for a very long time.

PMI chart: a tool used to evaluate the Plus (positive aspects), Minus (negative aspects), and Interesting (other or noteworthy aspects) factors associated with a particular topic or idea.

Additional Resources

This work is a derivative of Cossu C., Deck N., Hermans S., Mura C. Growing Plastics & New Life for Plastic, Future Classroom Scenario,

- Is bioplastic the "better" plastic? https://www.youtube.com/watch?v=-_eGOyAiNIQ
- Truly Biodegradable Plastic https://www.youtube.com/watch?v=m8aEoD29nTM
- 4 Facts You Need To Know About Bioplastics & Biodegradable Plastics https://www.youtube.com/watch?v=mc5rVMG8aow
- What is bioplastic by Chemistry Bioplasticity https://www.youtube.com/watch?v=acluFG0kNLg
- 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
- What is bioplastic by Chemistry Bioplasticity https://www.youtube.com/watch?v=acluFG0kNLg

Activity 3.1: How Do Microplastics Enter Our Food?

Practical tips to avoid exposure to plasticisers.

You Will Need

Let's watch this exciting video together: "Why We Eat Plastic Every Day: Microplastics in Your Food!" by Daxon. You can find it on this link:
https://www.youtube.com/watch?v=-yzm6aB0YiU

Roles

- Two students
  - Teacher: will tell the story and ask questions.
  - First student: will play the role of a girl in the story.
  - Second student: will play the role of a boy in the story.
- The rest of the students will be divided into three groups with different sizes of fish.
  - One student will be the big tuna
  - A group of medium-sized fish (3-5 students)
  - A group of small fish (rest of the students)

Setting

- We can do this activity indoors or outdoors on a sunny day. We'll need the following:
  - A couple of desks to represent the houses of the girl and the boy.
  - A chair for the fishing location on the beach.
  - A few other chairs for the young girls' and boys' dining room.

Props and Costumes

Let's use materials that we can reuse for this roleplay

- The 'Big Tuna Fish' costume (refer to the video).
- Small and medium-sized costumes are similar to "Big Tuna Fish" for small and medium-sized fish.
- A rod and a rope with a rounded, safe hook to catch the tuna.
- 15–25 plastic balls made by taping together the bases of small plastic bottles collected at school or home.
- Disposable plastic items collected and cleaned at home: bottles, cups, trays, and food containers.
- 4–6 hula hoops (one per medium-sized fish).

- 15–25 plastic plates (one per student and two each for the young girl and the young boy).
- Two pieces of cheap blue fabric, each about 1.5 m × 2.5 m.

- Now, let's start this activity and have fun learning about microbeads and their environmental impact!

Procedure

STEP 1

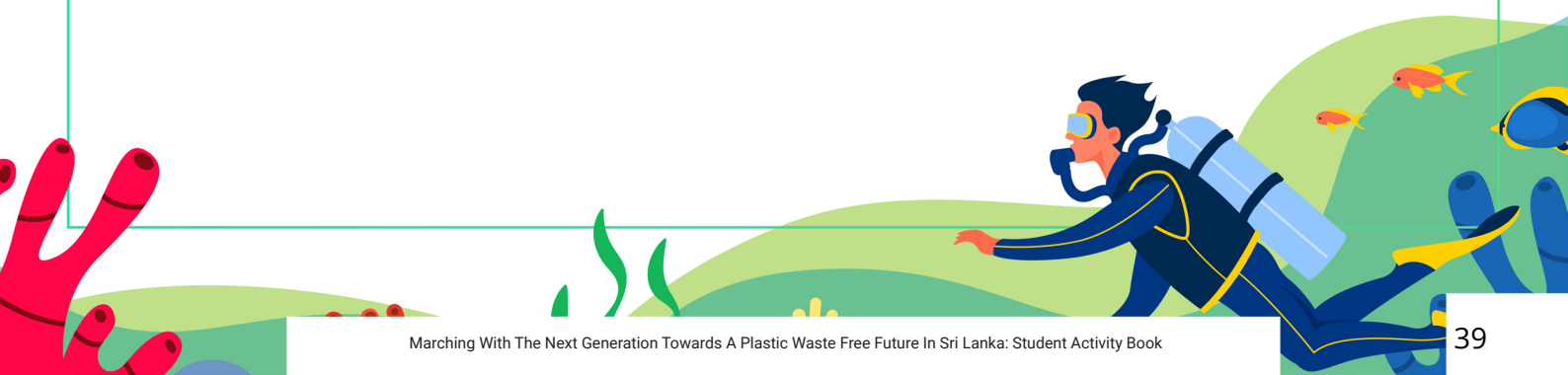
- Let's start by introducing the characters of the girl (give a name) and the boy (give a name).
- They live in a small house near the sea and often go fishing for food. When they return home, they also take care of their housework.
- One day, they had an extensive house cleaning. They gathered many things they no longer use and dumped them into the sea. These discarded items include lots of plastic objects. To make this part more engaging, let's place these plastic items on a blue fabric, representing the ocean.
  Here's a question: Was the young girl's and the young boy's behaviour acceptable? What do you think will happen to plastic objects? Will they disappear?
- After that, what happens to plastic in the sea? We will act out how the sun, wind, and waves break the plastics into tiny pieces called "microplastics."

STEP 2

- Now, once the storyteller (the teacher) mentions that microplastics form in the ocean, we will remove the first piece of blue fabric with plastic objects and place another fabric on the floor with plastic balls.
- Imagine some small fish swimming and playing in the water. When they spot something that looks like food, they eat it. The students acting as small fish, can pretend to eat the microplastics. Each of the student can take a plastic ball. What's on each student's plate?
- Now, some medium-sized fish come along. They eat the small fish! Each medium-sized fish can put a hula hoop around two small fish and take their plastic balls. So, what's on their plate now?
- Suddenly, a giant tuna fish swims by and spots the medium fish – and guess what? It eats them all! The 'big tuna' takes all the balls from the other students and swims away. What's on it's plate now?
- Then, the big tuna fish took the bait. The boy and girl catch the tuna fish.

STEP 3

- Afterward, the boy and girl take the tuna fish home to eat.
- But here comes the surprise! When they prepare the fish, they find lots of tiny pieces of plastic inside it.
- To conclude the activity, we will discuss how to prevent microplastics from polluting the sea.



STEP 4

Let's chat about how we can stop microplastic pollution in the sea. We may have some questions to get us thinking:

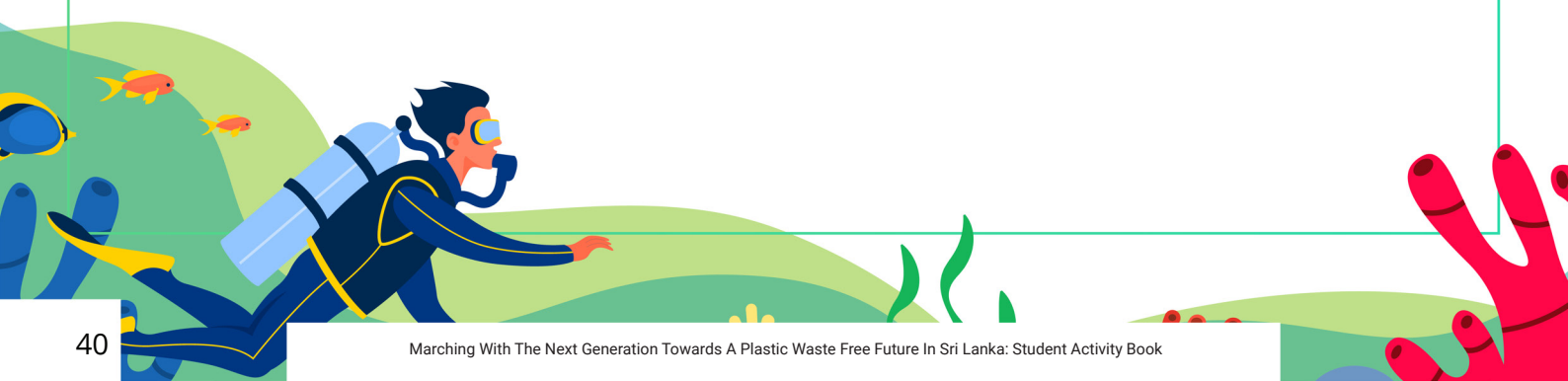
- Do you enjoy eating fish?
- What happened to the plastic objects the boy and girl threw away, and how did they become the tiny plastic balls the fish ate?
- Do you think we should stop eating fish, even though it's so tasty and good?
- How can we dispose of plastic objects better?
- Remember that microplastics can also end up in the air and soil. They can even be in the water and food we drink, not only fish.

Let's brainstorm some ideas to help prevent microplastic pollution.

1. Use fewer single-use plastics like silverware, glasses, dishes, and food containers.
2. When possible, choose products made of materials other than PVC.
3. Limit the time spent playing with plastic toys, including electronic games.
4. Reduce takeaway food packaged in plastic containers.
5. Avoid using plastic containers in the microwave.
6. Do not eat hot food in plastic dishes and with plastic silverware, but prefer alternative materials.
7. Cut down on drinking water from plastic bottles.
8. Minimize the use of plastic wrap and choose safe alternatives.
9. Get active outdoors in green spaces to reduce plastic use.

Additional Resources

- Kids Stay Home project #07: Make a wearable fish costume! https://www.youtube.com/watch?v=cyAYIlmqPN0
- 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. doi: 10.1016/j.marpolbul.2012.11.028
- Thompson RC et al. (2004) Lost at sea: where is all the plastic? Science 304: 838. doi: 10.1126/science.1094559



Activity 3.2: How Microplastics Affect Your Health

In this activity, we will learn about the impacts of microplastics and the substances they contain on human health.

You Will Need

The video is titled "How Microplastics Affect Your Health" by UNEP. You can find it here: https://www.youtube.com/watch?v=aiEBEGKQp_I

Procedure

- Let's start by watching a video titled "How microplastics affect your health". After watching, let's answer some questions. You can watch the video a second or even a third time to help answer the questions.
- Then, let's have a discussion together with the answers.

How microplastics affect your health

Q1. What are microplastics?

_____

Q2. How do they originate?

_____

Q3. How many plastic particles float in the ocean?

_____

Q4. According to scientists, what are the two types of chemicals added to plastics that may impact health?

_____

Q5. Why would it be bad if microplastics were toxic?

_____

Q6. Can you give an example of a food chain with microplastics in it?

_____

Q7. In which food items have been found microplastics?

_____

Q8. What types of additives have been found in human bodies?

_____

Q9. Where have these additives been found, and in what quantities?

_____

Q10. Should we panic?

_____

Q11. What can be done?

This question is not answered in the video. Let's discuss your answers with your classmates.

Further Knowledge

Human Exposure to Phthalates due to plastic packaging

Humans are mainly exposed to phthalates by consuming food and beverages that have come into contact with containers and products containing phthalates. These phthalates are converted into breakdown products (metabolites) quickly excreted in urine.[11]

Determinants of exposure [12]

- Data on lifestyle and food consumption habits as determinants of exposure were collected through a dedicated questionnaire and food diary.
- The questionnaire's analysis established which behaviours are significantly associated with a higher risk of exposure for mothers and children or, in some cases, only for one of the two groups.
- **For children: Higher levels of Phthalates are associated with:**
  I. single-use and reusable plastics (plates, cups, etc.)
  II. use of plastic containers in microwaves
  III. Playing with plastic toys many hours daily, especially for children 4-6.
- **For mothers: Higher levels of phthalates are associated with:**
  I. single-use and reusable plastics (plates, cups, 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 (Bisphenol A).
- Physical or recreational activity is a protective factor, with lower phthalate levels in children and mothers who engage in physical activities.

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 and determining, some practical tips for the population have been elaborated to limit exposure to phthalates and BPA.

11. Phthalates Factsheet https://biomonitoring.ca.gov/sites/default/files/downloads/FactSheet-Phthalates.pdf

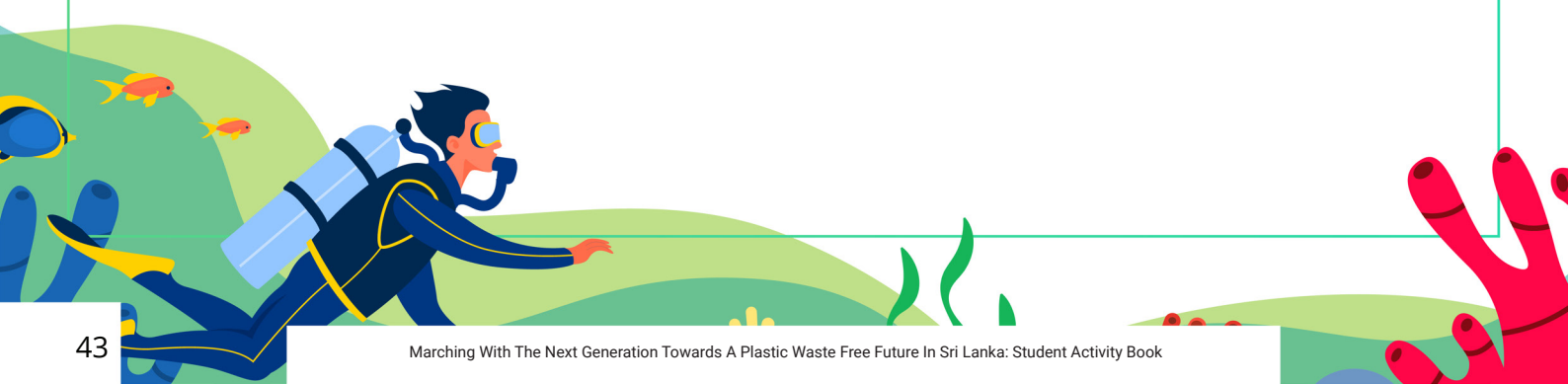
12. LIFE PERSUADED project https://webgate.ec.europa.eu/life/publicWebsite/index.cfm?fuseaction=search.dspPage&n_proj_id=4972

Definitions

- **Additives**: chemical substances added to a plastic polymer to provide desired properties, such as colour, stiffness/flexibility, and water/flame resistance.
- **Plasticisers**: various chemical substances that provide flexibility, workability, or stretchability to plastics in several fields (construction, pharmaceutical, fashion and design sectors, furnishing articles, containers, including food).
- **Bisphenol A (BPA)**: produces rigid plastics and resins - such as polycarbonate - used for food containers (bottles, plastic pottery, etc.)
- **Phthalates (DEHP)**: widely used to make plastics because they are versatile and inexpensive. They are often known as plasticisers. DEHP makes plastic durable and is used in every flexible PVC category, including medical devices (blood bags and medical tubing), food packaging, footwear, electrical cables, cosmetics, and flooring.
- **Trillion:** 1 000 000 000 000, or one million, or 10^{12}

Additional Resources

- CIEL et al. 2019 Plastic & Health: The Hidden Costs of a Plastic Planet – available at www.ciel.org/ plasticandhealth
- Phthalate's factsheet - https://www.cdc.gov/biomonitoring/Phthalates_FactSheet.html



04 Policies to Reduce Plastic Waste

Activity 4.1: What is MARPOL?

In this activity, we will learn how the International Convention for the Prevention of Pollution from Ships (MARPOL) helps prevent plastic waste pollution in the marine environment.

You Will Need

- A couple of clear plastic bags
- A copy of the world map
- The list of countries that are signatory to MARPOL
- Video: MARPOL Annexes (3-D Animation) - https://www.youtube.com/watch?v=J1B8bXygvps
- Computer (to watch the video).

Procedure

STEP 1

- Let's watch MARPOL Annexes (3-D Animation) - YouTube
- Read and discuss with teacher and class <BOX 1>

STEP 2

- Let's begin by discussing MARPOL, mainly focusing on Annex V (Regulations for the Prevention of Pollution by Garbage from Ships).
- Now, imagine many countries worldwide joining forces to protect our precious oceans.
- Let's talk about how this law influences the behaviour of ship crews and the practices they follow for handling trash.
- Let's label the world's oceans first and then locate and label some of the countries in the MARPOL.

STEP 3

- First, let's discuss the five R's – Refuse, Reduce, Reuse, Recycle, Rot – and see how they apply to managing waste on a ship.
- Now, imagine we're on a ship and can't quickly eliminate our garbage after lunch, except for food waste.
- To make it more accurate, we will choose two students as our lunchtime monitors. They'll have an essential job: collecting the classroom's garbage after lunch. We'll give the monitors a clear plastic bag for the trash.
- These monitors must collect the class's garbage daily during lunch until the ship returns to port (either at the end of one week or one month).

Report Preparation

- Let's discuss MARPOL and then supervise them to create a report based on the discussion.

Box

MARPOL (Annex V) is the legal tool to stop the dumping of plastic trash at sea. It went into effect on 31 December 1988. According to Annex V, dumping all plastics into the ocean is prohibited. All vessels should carry their plastic waste to a port for proper disposal. The law that implements Annex V authorises the respective port authority to specify rules and regulations regarding the display of placards to notify crew and passengers of the requirements of Annex V.

Each vessel should keep a log book describing its garbage disposal activities. A log entry should be made when a vessel's garbage is off-loaded at a port or incinerated on board. Large ports, marinas, private docks, and fish processing plants must provide facilities for trash disposal.

Who must comply with this law? All ships, from rubber rafts to tankers, including crew boats that travel to and from oil rigs; commercial fishing vessels; recreational boaters; passenger cruise ships; ports, marinas, and private docks; fish processing facility owners; oil and gas exploration workers; public vessels, including the military (put name of the navy); and merchant ships.

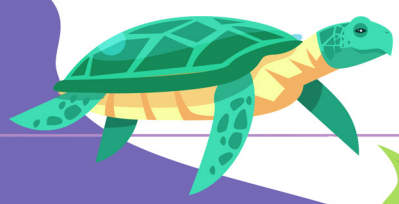
Annex V only applies to ships from countries that are signatories to MARPOL. Still, the law empowers the Coast Guard to prosecute any vessel operator who dumps plastic within 200 nautical miles of the country's coast. Violators caught dumpings can face a penalty.

Life onboard a ship is very different from life on land. The main obstacle to overcome is space. There is very little extra space to store trash on a ship. The average person generates approximately 1.5 to 2.5 kg per day. Some ships could be at sea for a few months, serving meals four times daily. So, storing plastic trash is a real challenge for the crew. Plastics that are contaminated with food begin to smell after a few days and attract pests.

The crew on board could reduce their waste by thinking about the 5 R's:

Refuse to buy products in single-use packaging and prefer products made with materials that can be recycled
Reduce the amount of trash generated by purchasing items in bulk quantities with minimal packaging
Reuse products to minimise waste
Separate products for sending to **Recycling**
Rot the organic material that can be composted.

Add **Remember**: We can all make a difference in how our homes, cities, beaches, and oceans look. Be part of the solution, not part of the problem!



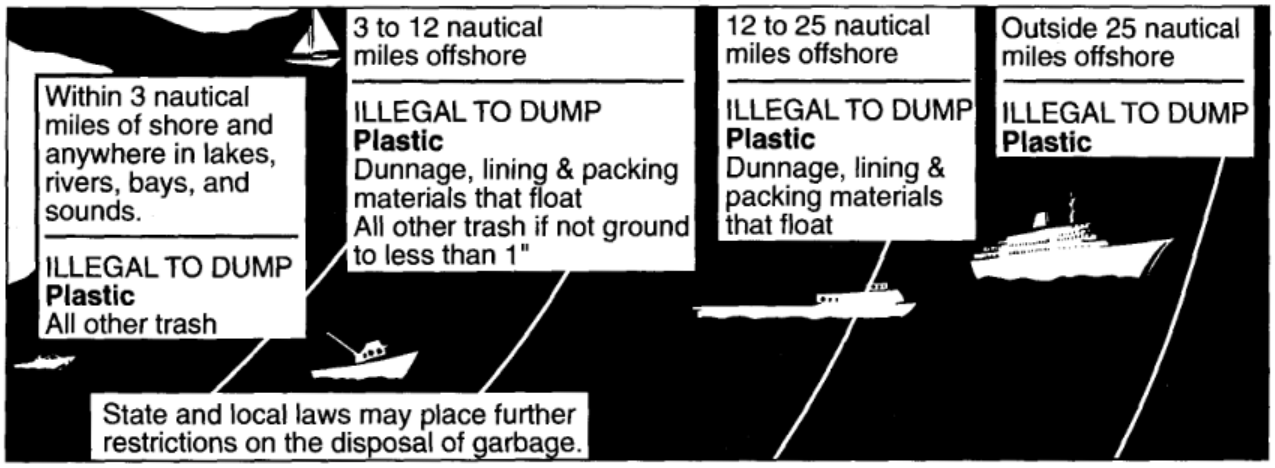
Map 4.1.1: World countries

Let's mark and label the MARPOL countries on the map below.

List of countries that are parties to MARPOL

https://shorturl.at/DnDb9

Infographic 4.1.1: How does MARPOL work?



Drawing from Save Our Seas curriculum, modify.

Report Preparation

Discuss about the MARPOL with your friends and prepare a group report from it.

Activity 4.2: The Basel Convention and Its Plastic Waste Amendments

In this activity, we will learn about the Basel Convention and its plastic waste amendments, emphasising the concept of Prior Informed Consent (PIC) and the importance of environmentally sound waste management through interactive activities.

You Will Need

- Information about the Basel Convention, its recent plastic waste amendments, and the PIC procedure (Annexes II, VIII, and IX of the Basel Convention)
- Puzzles or puzzle pieces
- A map of world countries that indicates if they are members of the Basel Convention or not
- A list of countries that are signatories to the Basel Convention
- Mock waste items (plastic waste representations)
- Role-playing props (e.g., labels and props representing different countries)
- A chronometer

Procedure

Other types of plastic waste are subject to specific provisions called the 'Prior Informed Consent' (PIC) procedure. You will learn about international trade in plastic waste and the Basel Convention and its recent Plastic Waste Amendments.

STEP1

- We're going to have some fun! Gather your friends and create teams with 4 to 5 students in each.
- Each team will be from a different "country".

STEP 2

- Time to learn about the Basel Convention and its new rules for plastic waste.
- It's like a significant agreement that many countries have agreed to follow.
- We'll also understand how PIC works.

STEP 3

- Get ready to explore the world! We'll give you a map, and you'll learn to find continents and oceans.
- Then, you'll locate your team's country on the map.

STEP 4

- This part is like a puzzle game. You'll receive pieces that represent different steps in the PIC process.
- Your team needs to assemble them to complete the process.

STEP 5

- Each team will have some toy plastic waste items.
- Once you've solved the PIC puzzle, you can start a pretend plastic waste shipment.
- The other team, pretending to be another country, will decide whether to allow the shipment based on the rules.

STEP 6

- We have a time limit! You have 45 minutes for the entire game.
- Within this time, you must solve the PIC puzzle, get the PIC, and send your pretend plastic waste.

STEP 7

- After the game, we'll sit down and chat.
- Share your experiences and discuss your challenges during the PIC process.
- We'll also discuss the Basel Convention and its role in preventing plastic waste from being dumped incorrectly.

  Example: in 2019, Sri Lanka Customs discovered illegally imported waste materials, including plastic waste, clinical waste, used cushions and mattresses, plant parts, and other uncategorised and hazardous waste from the United Kingdom (UK). However, by the court order issued in June 2020, the involved parties agreed to return the waste materials to the UK[13].

Definitions

Basel Convention: The convention's primary aims are to control transboundary movements of hazardous wastes and their disposal. It is an international agreement that seeks to protect the environment and human health against the adverse effects of generation, transboundary movements and management of hazardous and other wastes.

The Basel Convention provides a legally binding framework that obliges the States that signed the Convention to do three things:

1. Minimizing the generation of hazardous and other wastes;
2. Treat and dispose of hazardous and other wastes as close as possible to their source of generation;
3. Minimizing the international movements of hazardous wastes.

13. ipen.org/sites/default/files/documents/plastic_waste_management_in_sri_lanka.pdf

ANNEX I - Categories of wastes to be controlled

ANNEX II - Categories of wastes requiring special consideration (for plastic waste, see entry Y48)

ANNEX III - Hazardous characteristics of wastes

ANNEX IV - Disposal operations

- Section A - Operations which do not lead to the possibility of resource recovery, recycling, reclamation, direct re-use or alternative uses
- Section B - Operations which may lead to resource recovery, recycling, reclamation, direct re-use or alternative uses

ANNEX V A - Information to be provided on notification

ANNEX V B - Information to be provided on the movement document

ANNEX VI - Arbitration Procedures

ANNEX VII - not yet entered into force

ANNEX VIII - Hazardous waste (for plastic waste, see entry A3210)

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

Environmentally Sound Management (ESM): A series of rules/ recommendations to ensure that waste is managed to protect human health and the environment against adverse effects. The Basel Convention prescribes ESM of garbage, including plastic waste. In the transboundary movement of hazardous wastes, exporters and disposers shall ensure that the wastes are disposed of in an environmentally sound manner.

Harmonised Commodity Description and Coding Systems (HS): A multipurpose international nomenclature for classifying products traded among countries. Participating countries are allowed to classify traded goods every day for customs purposes. This system is used internationally to classify goods as a six-digit code system. Currently, for the category “plastic waste, parings, and scrap”, there are four codes:

- 3915.10 for PE
- 3915.20 for PS
- 3915.30 for PVC
- 3915.90 For all other plastics, including some common and abundant ones such as PP and PET.

The exporters and importers of plastic waste, pairings, and scrap are legally required to use the HS code for the plastic waste they trade.

Mechanical recycling: Involves processing plastic waste mechanically into secondary raw materials. This process involves a mechanical process (e.g., grinding) to reduce the waste into smaller particles without changing the chemical structure. The resulting granules are known as recycled and can be melted and remoulded into different products.

Plastic Waste Amendments: During the Conference of the Parties from 29 April to 10 May 2019, amendments were made to Annexes II, VIII, and IX to the scope of the plastic wastes covered by the Basel Convention. These amendments ensure that the global trade of plastic waste is regulated and more transparent and that its management is safe for human health and the environment.

Prior Informed Consent (PIC): A mechanism with strict requirements applies to hazardous waste or waste that requires special consideration before transboundary movements of hazardous wastes and other wastes, especially for the types of plastic waste listed in Annex II and Annex VIII. This process must be followed by the exporter, importer, and any transit state. Trade is permitted only when all relevant parties have consented before starting the trade.

Resin identification code: A set of symbols on plastic products that represent the type of resin used to manufacture them.

Additional Resources

- UNEP (2002/2005) Minimizing hazardous wastes: a simplified guide to the Basel convention
- CIEL article on Basel Convention - https://www.ciel.org/empowering-countries-stop-plastic-flood-basel-amendment/

Activity 4.3: Bans to Microbeads, Plastic Bags, and Single-use Plastic Products

In this activity, we will learn which countries have imposed bans on microbeads, single-use plastic bags, and single-use plastic products.

You Will Need

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

Procedure

STEP 1

- First, let's visit a website called " The World Counts/Planet Earth / Number of plastic bags produced," which tracks the number of plastic bags produced worldwide daily, weekly, monthly, and yearly. You can find it here: https://www.theworldcounts.com/challenges/planet-earth/waste/plastic-bags-used-per-year
- Today, right at the beginning of our class, let's record the number of plastic bags produced. We'll write down this number.

STEP 2

Let's explore the impact of human activity on our planet.

Box

Since the early 1900s, our footprint on Earth has increased, doubling every 20 years. In 2020, the total mass of plastic objects reached a staggering 8 billion tonnes, which is twice the mass of all the land and sea animals combined, estimated at 4 billion tonnes. This massive increase has raised concerns among governments worldwide, prompting them to take action to reduce the harmful effects of plastic, especially microbeads that harm marine life.

Now, let's discuss how governments are taking steps to tackle plastic-related issues. We'll take the example of Sri Lanka, where plastic bags have been banned[14].

If properly planned and enforced, bans on single-use plastic bags can be powerful tools to combat excessive plastic use and the pollution it causes.

14. Sri Lanka to Expand the List of Banned Plastic Products- Minister of Environment https://scientist.lk/2021/06/16/sri-lanka-to-expand-the-list-of-banned-plastic-products-minister-of-environment/

Around the world, governments are waking up to the enormity of plastic pollution. More than 60 countries have introduced bans and charges to reduce the use of single-use plastic items.

While plastic bags and, to some extent, foamed plastic products like Styrofoam have been the primary targets of government actions, the European Union (EU) has also extended its bans to cover other single-use plastic items. This demonstrates a growing global effort to address the problem of plastic pollution and its impact on our environment.

STEP 3

- Let's work in groups or individually
- Look at these maps 4.3.1, 4.3.2, 4.3.3 and answer questions 1–4.
- Respond to questions 5–8.
- Share your thoughts on whether similar bans should be applied in our country. Also, brainstorm how to avoid using microbeads, single-use plastic bags, foamy plastics, and other one-time-use plastic items.

01. Which Countries have banned the use of microbeads in cosmetics?

02. Which Countries have banned the use of single-use plastic bags?

03. Which Countries have banned the use of foamed plastics?

04. Which Countries have banned the use of single-use plastic packaging?

05. If your country has not banned microbeads in cosmetics, do you think it should?
What would you tell to policy makers to ask them to ban microbeads form cosmetics?
What alternative options are available?

06. If your country has not banned the use of single-use plastic bags, do you think it should?
What would you tell to policymakers to ask them to ban single-use plastic bags?
What alternative options are available?

07. If your country has not banned the use of foamed plastics, do you think it should?
What would you tell to policymakers to ask them to ban foamed plastic?
What alternative options are available?

08. If your country has not banned the use of single-use plastic packaging, do you think it should?
What would you tell to policymakers to ask them to ban single-use plastic packaging?
What alternative options are available?

STEP 4

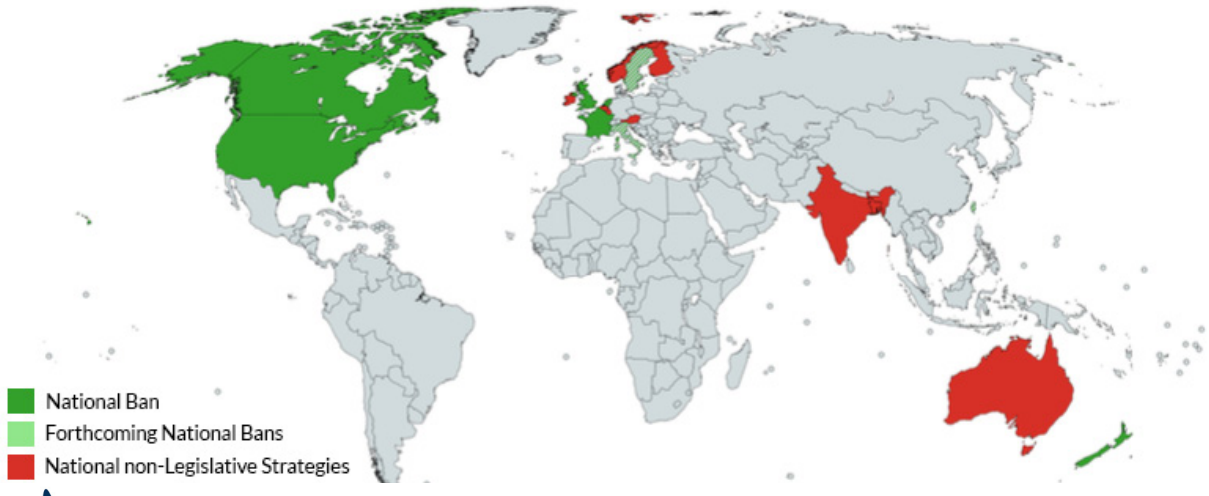
- We're going back to "The World Counts" website now. Write down the number of plastic bags produced in your student activity book.
- Let's try to make the algebraic subtraction.

Extra Activity

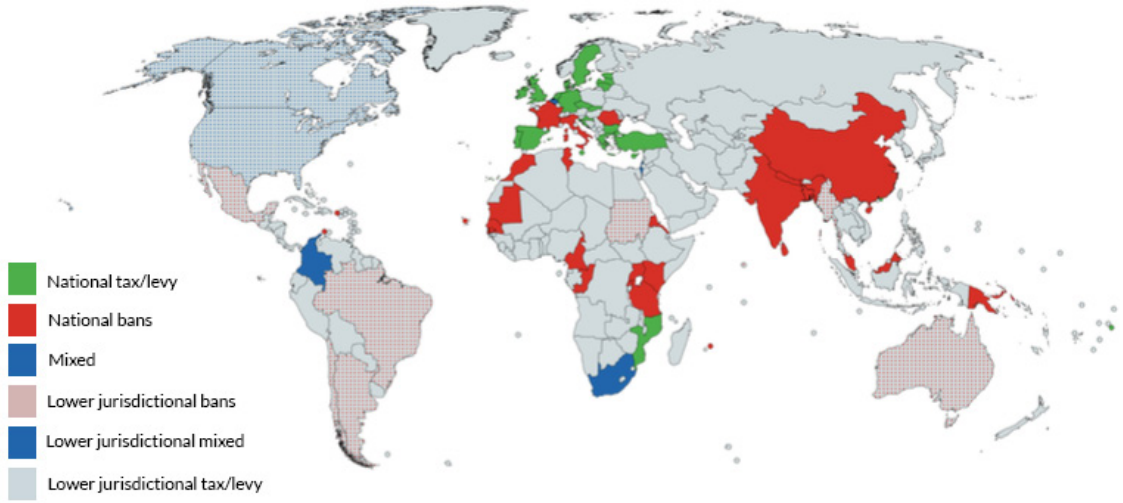
- You can work on identifying relevant policies and regulations in Sri Lanka regarding banning plastic items.
- Discuss the challenges people at different levels face due to these bans. If you have personal experiences, feel free to share them with the class.
- Also, share your knowledge about alternatives to the banned products. Let's see what creative ideas you can come up with!

Map 4.3.1: Countries that have banned microbeads

[Ask GRID- Arendal if they can make the three maps below based on their map "What countries are doing to combat litter" https://www.grida.no/resources/6919 and with updated jurisdictions]

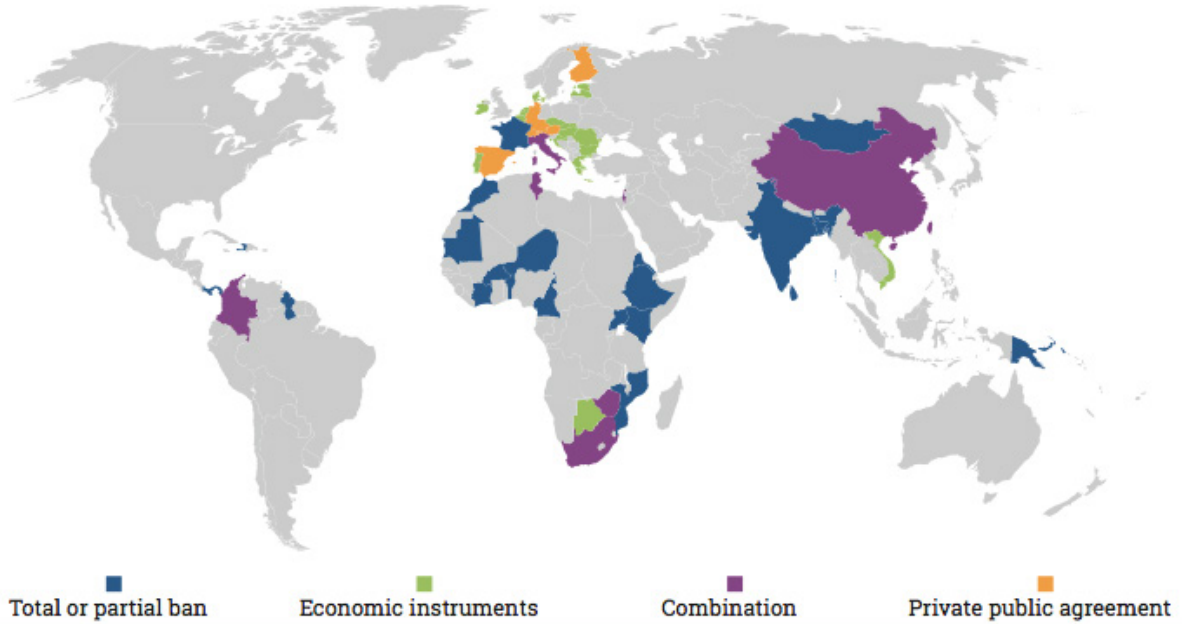


Map 4.3.2: Countries that have banned plastic bags



Map 4.3.3: Countries that have banned plastic bags and Styrofoam around the world

A roadmap for single - use plastic sustainability



NOTE: Do you have some information on the SUPs ban (other than plastic bags) at the world level? Do you have access to this resource: https://www.researchandmarkets.com/reports/5007804/global-single-use-plastic-packaging-regulations?utm_source=dynamic&utm_medium=GNOM&utm_code=htlcfv&utm_campaign=1383010+-+Global+Single-Use+Plastic+Packaging+Regulations%3a+Bans%2c+Fees+and+Preemptions&utm_exec=cari18gnomdOtherwise%20I%20suggest%20removing%20this%20map.

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://doi.org/10.1038/s41586-020-3010-5
- UNEP (2018). SINGLE-USE PLASTICS: A Roadmap for Sustainability
- https://www.cea.lk/web/?option=com_content&view=article&layout=edit&id=1080

Activity 5.1: Life Cycle of a Plastic Beverage Bottle

In this activity, we will understand the environmental impact of a plastic drink bottle at different stages of its lifecycle.

You Will Need

- Life cycle assessment (LCA) of the plastic bottle by Life Cycle Thinking & Environmental Management https://www.youtube.com/watch?v=lltCnpK4rpQ
- Lifecycle assessment picture cards – 1 per small group
- The life story of a plastic beverage bottle – 1 per small group
- Lifecycle assessment sheet (copied to A3 size) – 1 per small group

Procedure

STEP 1

Let's discuss how many plastic beverage bottles each uses in a typical week or month. Share your numbers.

- Each group will be given a plastic beverage bottle and a "Lifecycle assessment picture card set."
- Your task is to put these cards correctly to create a story of the beverage bottle from beginning to end.
- This story should tell us about the whole life of a plastic bottle, from the very start to the end.

STEP 2

- First, ask your friends in your peer groups to discuss how plastic bottles are made and what happens to them from start to finish. You can also show them an infographic that explains the entire life cycle of plastic bottles. This will help you understand how most plastic bottles are created and processed.
- Now, let's introduce a nifty concept called "Lifecycle Assessment" (LCA). Many companies use this tool to determine how their products affect the environment. It's pretty handy because you can compare how different products used for the same thing impact the environment.
- Each group, here's your mission: Each group will be given a big sheet of paper (A3 size), and you will discuss some questions together and write down your answers on the sheet. These questions will help you think about the environment and the impacts of plastic bottles. When answering these questions, consider what can happen at each plastic bottle's life cycle stage. We're talking about climate change, water getting dirty (eutrophication), using freshwater, and more.
- After you've completed your questions, it's time to use your brains! We'll use the LCA to determine where a plastic bottle has the most significant environmental impact in the life cycle.

- What are your ideas for making plastic bottles kinder to our planet? Let's hear them out! And don't be shy—everyone can share their thoughts. Then, let's have other students comment on their friends' ideas. This way, we can all learn and develop better ways to reduce our environmental impact!

Here are The Steps to Follow

Step 1

How many plastic drink bottles do you use every day or week?

_____

_____

If you do not use plastic drink bottles, in which container do you keep water?

_____

_____

Step 2

- Let's cut out the cards in the Lifecycle assessment picture cards sheet and arrange them in a way that tells the story of the drink bottle from beginning to end.
- Please watch a short video with the class on how most plastic bottles are made and processed and compare it to your storyline.
- Look at the Story of a plastic bottle sheet to see the stages many companies use to calculate the environmental impact of their products.

Step 3

Answer the questions in the Life Cycle Assessment sheet.

In which step of its life cycle do you think a plastic drink bottle has the most significant environmental impact?

_____

_____

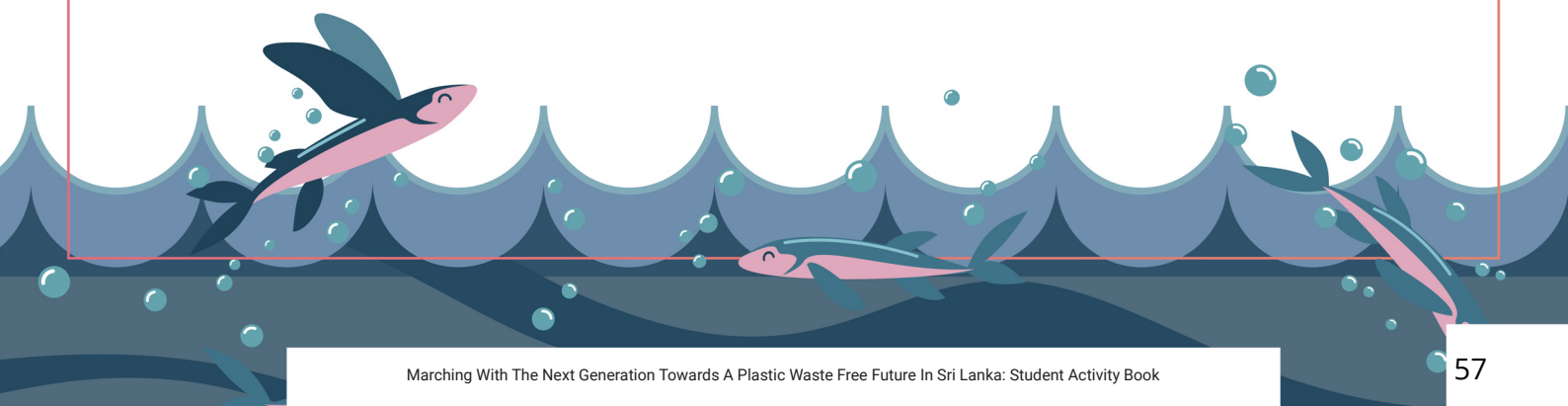
Do you have any idea on how to reduce the environmental impact?

_____

_____

Definitions

Life Cycle Assessment (LCA): a tool used to work out the environmental impact of a product throughout its whole life.



Let's understand the environmental impact of a plastic beverage bottle at different stages of its lifecycle and inquire about the number of plastic beverage bottles we typically use in a week or a month.

Note: This activity comes before Activity 5.2, "4R's (Rethink, Reduce, Reuse, Prepare for Recycle)," and Activity 5.3, " Is recycling worth it?" Depending on your curriculum focus or areas of students' interest, the LCA and 4R activities can be continued and extended in various ways. They target plastic beverage bottles here, but this can be done with other single-use plastic products, such as plastic bags, food containers, etc.

You Will Need

- Lifecycle assessment (LCA) of the plastic bottle by Life Cycle Thinking & Environmental Management https://www.youtube.com/watch?v=lltCnpK4rpQ
- Lifecycle assessment picture cards – 1 per small group
- The life story of a plastic beverage bottle – 1 per small group
- Lifecycle assessment sheet (copied to A3 size) – 1 per small group

Procedure

STEP 1

- Let's watch the video on Life cycle assessment (LCA).
- Let's cut out the pictures and arrange them in a way that tells the story of a plastic drink bottle.

Life cycle assesment picture cards

STEP 2

- Let's discuss the life cycle of plastic bottles.
- Then, make a story about the life of a plastic bottle considering its entire lifecycle (picture: Life Cycle of a Plastic Bottle).

Life story of a plastic bottle

STEP 3

- Let's discuss why we need to consider impacts related to the entire life cycle (in other words, Life Cycle Assessment) of bottles rather than only considering the used bottles.

Answer the questions:

Which step of its lifecycle do you think a plastic drink bottle has the most significant environmental impact?

_____

_____

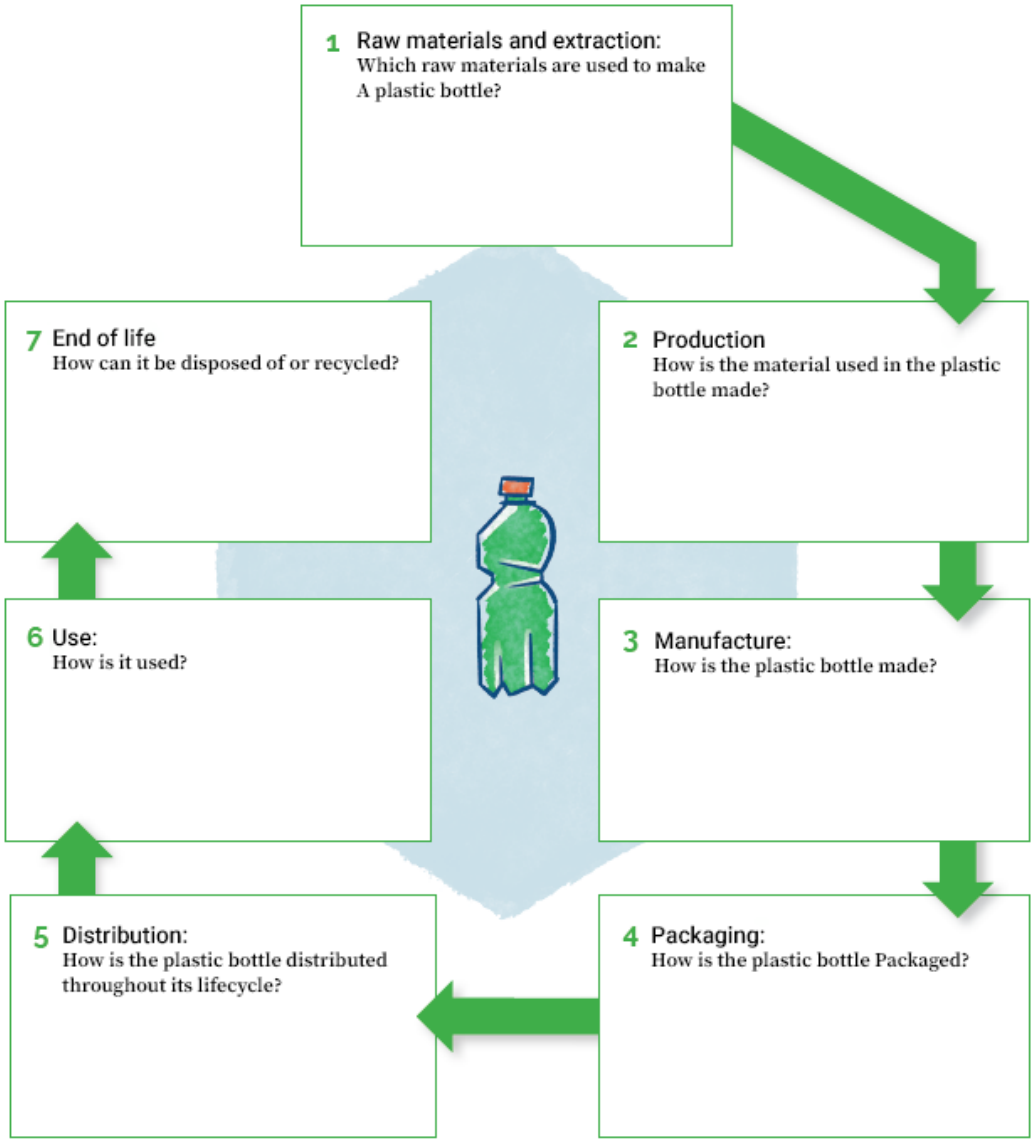
Do you know how to reduce the environmental impact of plastic drink bottles?

_____

_____

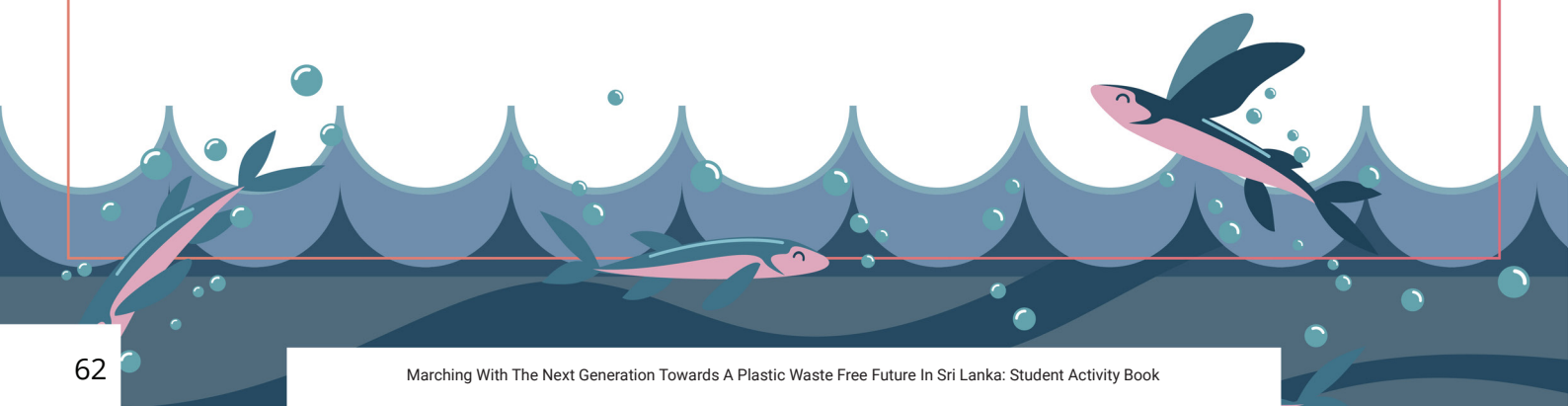
Fill in the information you know under each stage of the life cycle of plastics.

Life cycle assessment sheet



Additional Resources

- Case study done in Sri Lanka: Kamalakkannan, S., Abeynayaka, A., Kulatunga, A.K., Singh, R.K., Tatsuno, M. and Gamaralalage, P.J.D., 2022. Life Cycle Assessment of Selected Single-Use Plastic Products Towards Evidence-Based Policy Recommendations in Sri Lanka. Sustainability, 14(21), p.14170.
  https://www.mdpi.com/2071-1050/14/21/14170



Activity 5.2: 4R's (Rethink, Reduce, Reuse, Recycle)

In this activity, we will learn about rethinking, reducing, reusing, and recycling plastics to reduce their negative impacts on the environment and humans.

You Will Need

- Student Worksheet
- Students completed Lifecycle assessment sheets
- 4R's definition sheet - 1 per student

Procedure

STEP 1

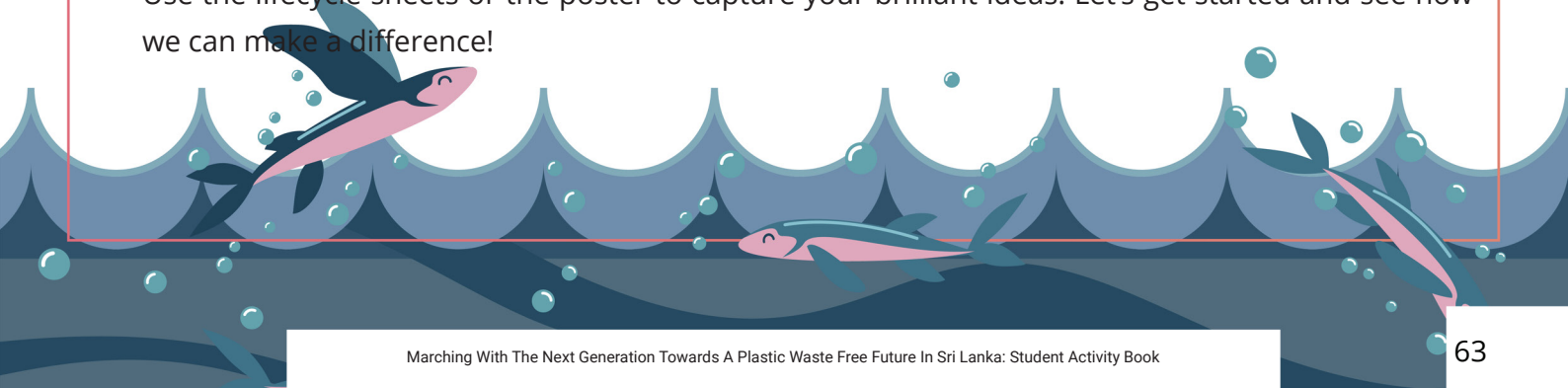
- First, let's take a moment to remember what we learned in activity 5.1 about the life cycle of a plastic bottle. Think about all the different stages it goes through, from making it to using it, and what happens when we're done with it.
- Now, we will introduce an idea called the 4Rs: Rethink, Reduce, Reuse, and Recycle. These four magic words can help us make a big difference in using plastic bottles (or alternative products).
- Here, "Rethink" covers the alternative (or substitute) products and the product design and manufacture stage, "Reuse is associated with consumption and end-of-life stages, and "Recycle" covers the end-of-life stage. "Reduce" is a lifestyle-related aspect. Also, mention that 4R, 5R, etc., are derived from the 3R concept.

STEP 2

- Let's divide into two groups.
- An each group, you have a particular task. Use the "4R's Definition Sheet" to define each 'R' clearly.

STEP 3

- Let's wear our thinking caps and become like designers or consumers. We have an exciting task ahead!
- Imagine you're looking at a plastic bottle, and your mission is to find ways to make it kinder to the environment. We'll approach this from a life cycle perspective, which means we'll consider everything from when the materials are gathered to when we're done with the bottle.
- Here's an idea: we can divide into different groups, and each group can focus on one or two of the "R's." These are essential aspects like Reduce, Reuse, and Recycle.
- Use the lifecycle sheets or the poster to capture your brilliant ideas. Let's get started and see how we can make a difference!



The following questions support you in expanding your thinking:

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: How can we reduce the plastic usage of bottles (reduce consumption and new technology to make the bottles thinner)?

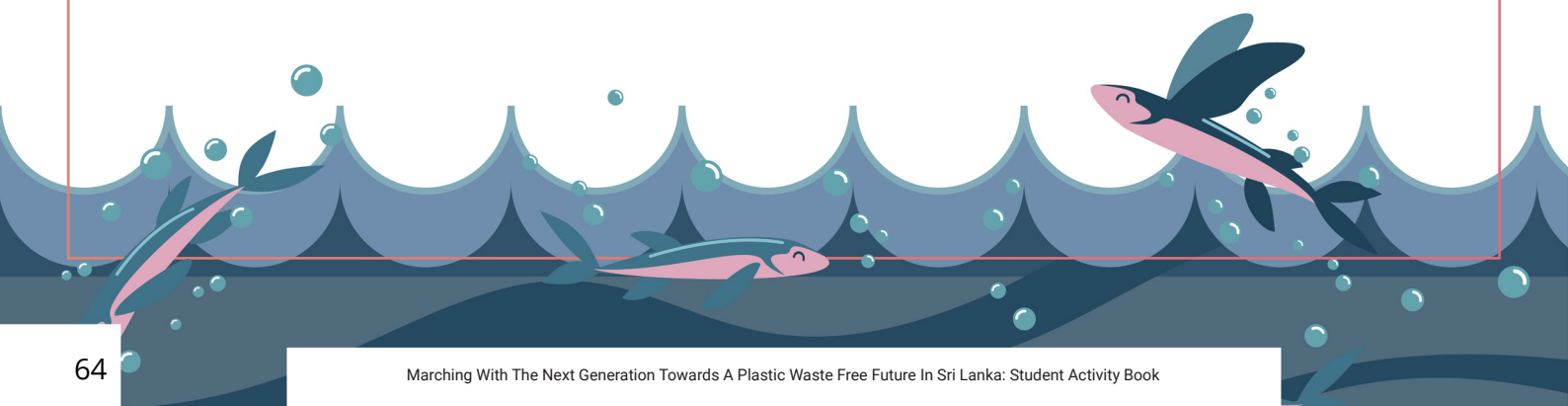
Reuse: Is it safe to reuse a plastic (PET) bottle? What could we do to encourage people to reuse a reusable bottle (in this case)?

Recycle: How can we encourage people to sort more plastic bottles and send them correctly so they can be recycled easily? Can a bottle be designed to make recycling easier, improving the efficacy of recycling? What products can be made by recycling plastic (PET) bottles? In Sri Lanka, what are the available recycling options (have you heard/observed them)?

Add one of the 4Rs: **Rethink, Reduce, Reuse, and Recycle** to match their definition

Worksheet 5.2.1: 4R principle

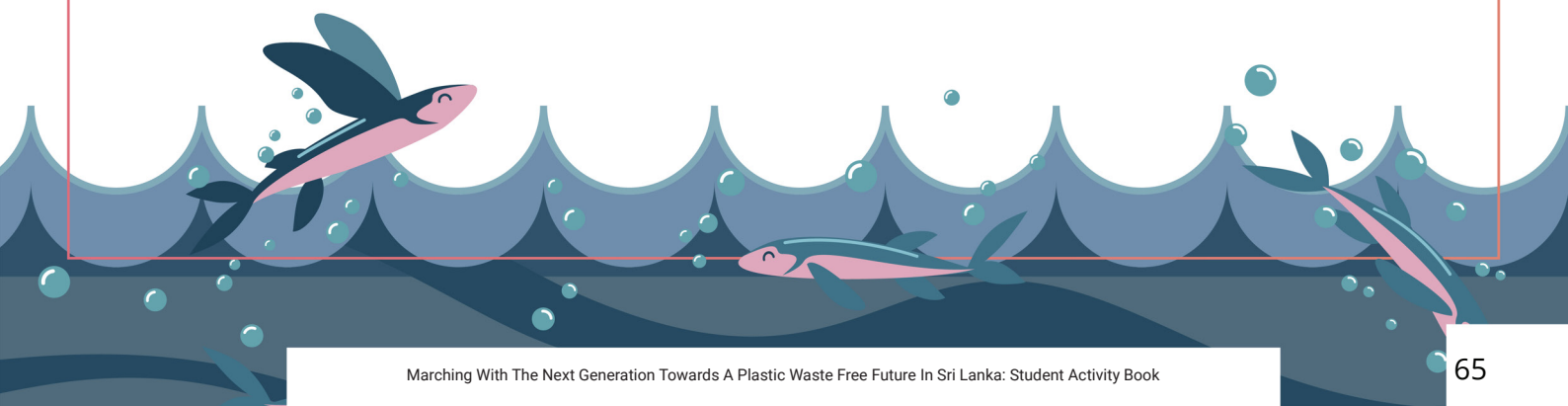
	Means	Looking at the whole system for the product and exploring ways to improve it that considers people and the environment
	Means	Reprocessing the product or some of its parts to make something else
	Means	Using the whole product or some parts of it to make something else
	Means	Cutting down the amount of energy and materials used to make the product



Together with your teammates, develop a Plus, Minus, Interesting (PMI) analysis of recycling.

Worksheet 5.2.2: Plus, Minus, Interesting (PMI) analysis

PLUS	MINUS	INTERESTING
List all the positive aspects of the product Advantages/benefits/ strengths/positives / Good things	List all the negative aspects of the product Disadvantages / Deficiencies / Weaknesses / Minuses / Negatives	List anything that you think is interesting about the product and needs future investigation. Implications and possible outcome / Attention-grabbing / Out of the ordinary / Appealing



Activity 5.3: Is Recycling Worth It?

In this activity, we will learn about the efficacy of recycling plastic beverage bottles.

You Will Need

- Environmental impact of recycling plastic beverage bottles sheet - 1 per small group
- Global plastic production and its fate map
- Plastic recycling: True or False? Sheet - 1 per small group

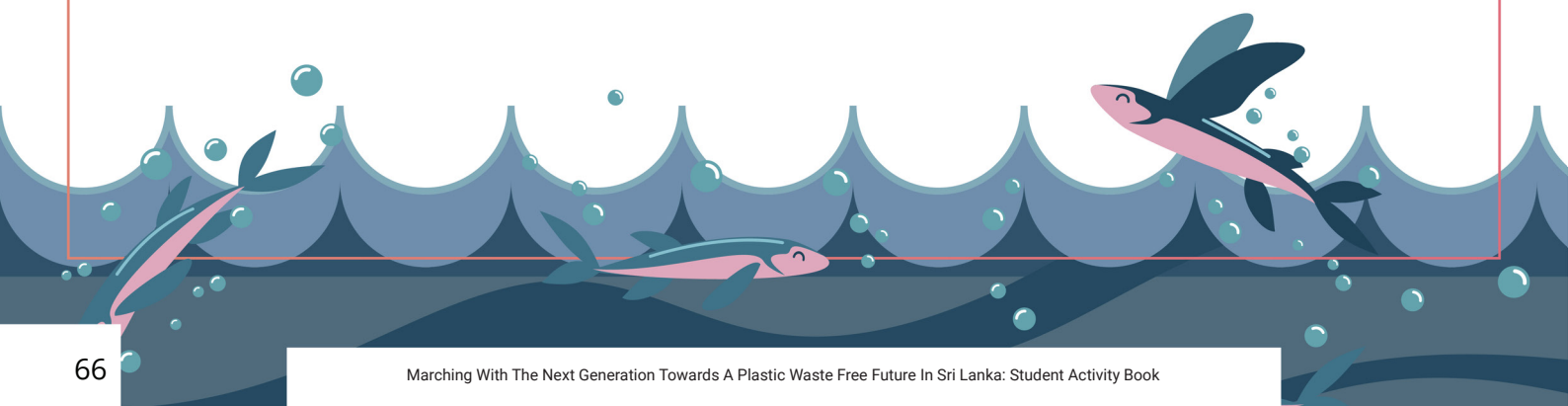
Procedure

STEP 1

- Remember the 4Rs activity we talked about earlier? Many of you suggested recycling plastics to reduce their impact on our environment. It's time to investigate this idea further and determine if recycling plastic makes a difference.
- Please grab some scissors and carefully cut out the cards from the enviromental impact of recycling plastic beverage bottle sheet.
- Now, let's get creative! Place those cards on the appropriate sections of your LCA (Life Cycle assessment sheet. Think carefully about how and where recycling plastics can help reduce the environmental impact throughout a product's life.

STEP 2

- Now, let's talk about what we discovered.
- To make this more fun and informative, we have a "Plastic Recycling: True or False?" Card activity. This will reinforce what you've learned about plastic recycling. And here's a little secret: All the facts on these cards are actual!
- So, let's start by discussing our findings, and then we'll dive into the exciting "True or False" activity to put your knowledge to the test!



Extension ideas

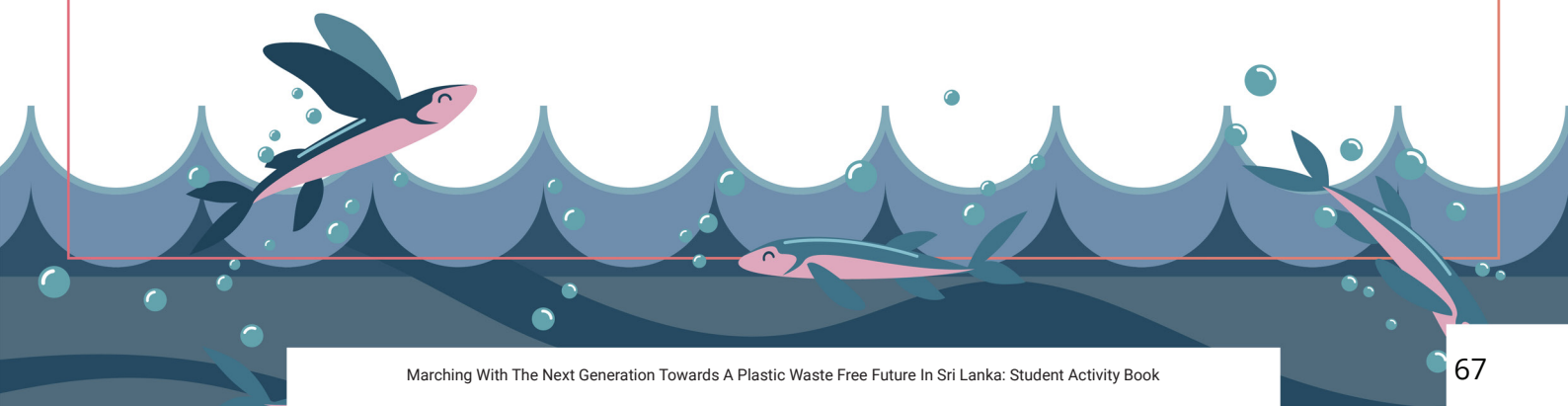
- Let's develop a Plus (Positive), Minus (Negative), Interesting (PMI) analysis of recycling
- In the Plus section, list down all the positive aspects of recycling. Think about the advantages, benefits, strengths, and anything good related to recycling.
- In the Minus section, list all the negative aspects of recycling. This includes disadvantages, weaknesses, and anything that isn't so great about recycling.
- Now, in the Interesting section, note anything that catches your attention and seems worth investigating further about recycling. This could be implications, possible outcomes, something unusual or captivating.
- Think about recycling in the context of the different types of plastics you've studied in Activity 2.1. Remember how we identified plastics and learned about them? Also, remember that, so far, only 9% of plastics have been recycled worldwide.
- So, put all of this together and explore the Plus, Minus and Interesting characteristics of recycling, especially concerning different types of plastics. Get creative with your ideas and think about how we can make recycling even more effective and impactful.

Take Home Activity

Engaging in an activity to understand the Current Plastic Recycling Industry in Sri Lanka and locally available Plastic Waste Collectors for Recycling would be beneficial. Examples for Benefits of plastic recycling Green.

RECYCLING reduces the need for non-renewable fossil fuels (oil)	RECYCLING reduces the use of water	RECYCLING reduces the emission of gases like carbon dioxide in the atmosphere
RECYCLING reduces the use of energy by 90%	RECYCLING reduces the amount of plastic waste going to landfill	RECYCLING minimises the cost of producing plastic drink bottles

Figure 5.3.1 on Environmental impact of recycling plastic beverage bottles sheet



Global plastic production and its fate

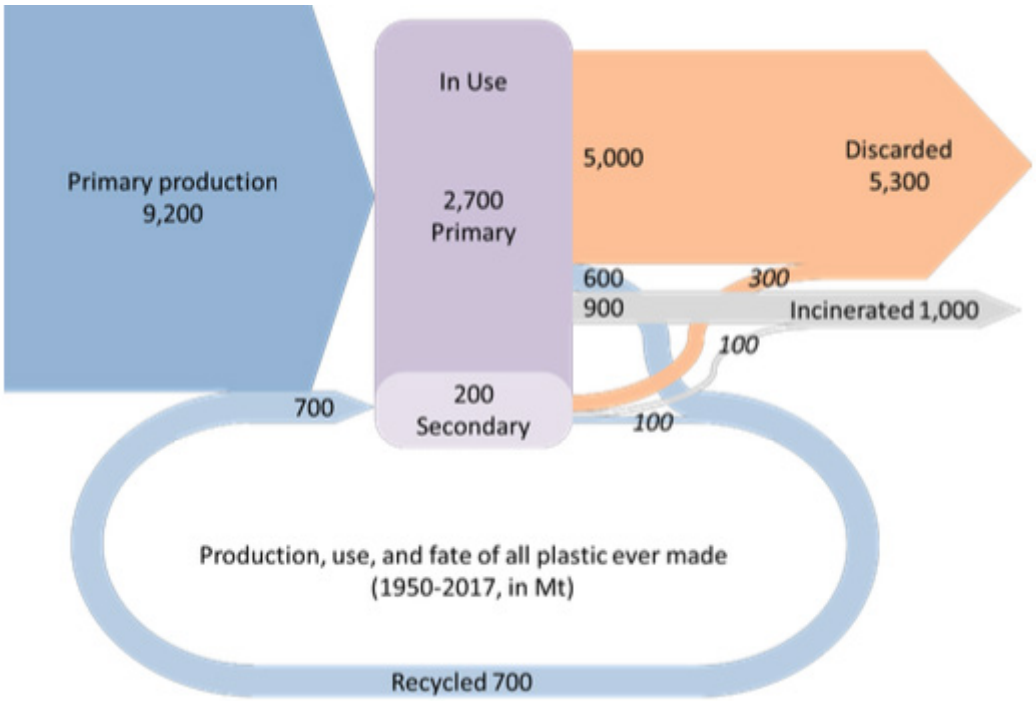


Figure 5.3.2: Production, use and fate of all plastic made from 1950 - 2017 in Metric tonnes (Source: Geyer, 2020)

Recycling one plastic bottle saves enough energy to power a 60W bulb for 3 hours.	Fleece fabric can be made from recycled plastic	Only 9% of plastics ever made since the 1950s have been recycled	If you lined up all the polystyrene foam cups made in just one day, they would circle the Earth
The 12% of all plastics made from the 1950s have been sent to incineration.	Recycling a plastic bottle saves 90% of the energy taken to produce one	70% of plastics ever made have become waste	1.8 tons of oil are saved for every ton of recycled polyethene produced

Figure 5.3.3 on Plastic recycling: True or False? sheet

Activity 5.4: Everyday Comparison Debate - Life Cycle Thinking and Circular Economy

In this activity, we will explore the impact of everyday objects and see the relationship between our choices and the environmental impact.

You Will Need

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

Procedure

STEP 1 **Life Cycle Assessment**

- Let's kick off an exciting activity! We'll divide into two teams and choose two everyday objects to compare. Here are some examples of pairs you can consider:

  I. Pen vs. Pencil
  II. Cotton bag/ paper bag vs. plastic bag
  III. Plastic packaging for food vs. bee wraps
  IV. Plastic bottle vs. reusable bottle
  V. Plastic container for yoghurt vs. glass container
  VI. Styrofoam food container vs. steel lunch box

- We're focusing on everyday items to help us see how our daily choices can impact the environment. Each team has 20 minutes to research the environmental impact of their chosen products. Use reliable sources like respected newspaper articles and scientific studies. You can use Google Scholar to do scientific research.

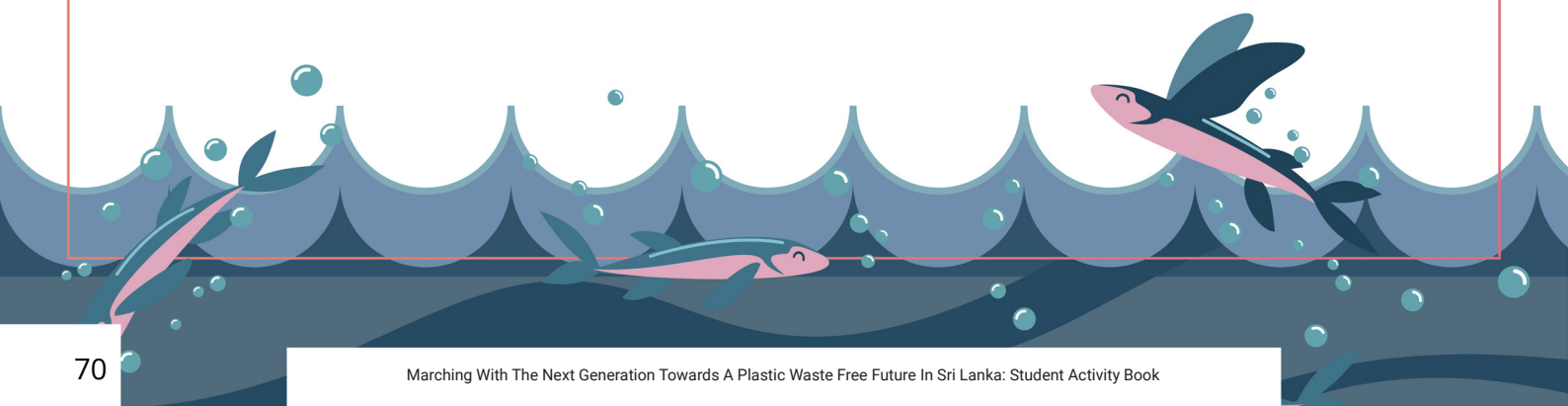
- To make sure you cover all aspects of a product's life cycle, consider these different factors:
  I. Raw materials and extraction: What materials are used to make the product?
  II. Production (including Design/Manufacturing): How are the raw materials turned into the product?
  III. Packaging: How is the product packaged?
  IV. Transportation/distribution: How does the product get from the factory to where it's sold?
  V. Use: How is the product used, and for how long?
  VI. End of life: What happens to the product after use? Can it be recycled? Are there recycling options in your area? How should it be disposed of properly if it can't be recycled?

Step 2 **Develop a Plus, Minus, Interesting (PMI) analysis of the product**

- Now, examine the products you've been researching more closely. We'll use a unique tool called the Plus, Minus, Interesting (PMI) analysis to understand these products better.
- In the Plus section, list all the product's positive aspects. Think about its advantages, benefits, strengths, and other positive aspects.
- In the Minus section, jot down all the product's negative aspects. Consider its disadvantages, weaknesses, and anything that's not so great.
- Lastly, in the Interesting section, note anything that catches your attention and seems worthy of future investigation. This could include potential outcomes, unique features, or anything that's out of the ordinary and intriguing.
- Here's the twist: We will apply this PMI analysis to your chosen everyday objects throughout their life cycle. Consider how these products impact the environment at each stage, from raw materials to disposal.
- This will help you better understand your chosen products and how they fit into our world. It's a great way to evaluate the choices we make in our daily lives and their consequences. So, let's start analysing!

Step 3 **Scoring the pairs of products**

- Now that both teams have conducted their Life Cycle Assessment (LCA) and Minus Interesting (PMI) analysis for their chosen products, it's time to share your findings.
- Team A, please present your LCA and PMI analysis for your chosen product to Team B, and vice versa. This will allow you to hear different perspectives and gather insights from your peers.
- After both teams have presented, take some time to revise your analyses based on the input and feedback you received from the other team. Make sure your assessments are well-rounded and consider all aspects of the products' life cycles.
- Once you've refined your analyses, it's time to score each product. We'll do this as a class discussion. Each idea in the Plus, Minus, and Interesting categories will be scored from +5 to -5. Remember, this scoring is subjective, and further discussion and debate may occur during the assessment.
- As a class, we'll total the scores for each product based on the Plus, Minus, and Exciting categories. This will help us decide whether to continue producing and using these products.
- During the discussion, we'll allocate 3-5 minutes for each step to keep things moving efficiently.
- Finally, we'll compare the scores of the two pairs of products to see which one comes out on top. It's a chance for us to collectively evaluate the environmental impact of these everyday objects and make informed decisions. Let's get started!



Further Discussion

- Discuss: What are all the different ways a product can impact the planet? What other perspectives should we take into account when we create products?
- If time permits, each team can propose redesigning this product to participate in the circular economy.

Procedure

Step 1 **Chose a product and make a Life Cycle Assessment**

- In this exciting activity, we'll select an everyday object to investigate. Your teacher will provide suggestions for the product you'll study.
- Once you've chosen your product, it's time to do some research! You'll work with your teammates to explore its various environmental impacts.
- Here's your mission: Conduct an internet search using reliable sources, such as articles from respected newspapers and scientific studies. Google Scholar is a fantastic resource for finding scientific studies.
- Your goal is to uncover your chosen product's characteristics throughout its life cycle. To ensure you cover every aspect, consider these various stages in a product's life cycle:

1. Raw materials 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 where it is sold?

_____

_____

_____

5. Use: How is it used? For how long?

_____

_____

_____

6. End of life: What happens after using the product? Can it be sent to recycling? Are there recycling plans for the product in your area? How can it be disposed of properly if it cannot be recycled?

_____

_____

_____

Step 2 **Develop a Plus, Minus, Interesting (PMI) analysis of the product**

- Now that you've completed your research on the chosen product and have a comprehensive understanding of its environmental impact across its life cycle, it's time to analyse it using the Plus, Minus, Interesting (PMI) framework.
- Gather your team and work together to create a PMI analysis

Worksheet 5.4.1: Plus, Minus, Interesting (PMI) analysis

PLUS	MINUS	INTERESTING
List all the positive aspects of the product Advantages/benefits/ strengths/positives / Good things	List all the negative aspects of the product Disadvantages / Deficiencies / Weaknesses / Minuses / Negatives	List anything that you think is interesting about the product and needs future investigation. Implications and possible outcome / Attention-grabbing / Out of the ordinary / Appealing

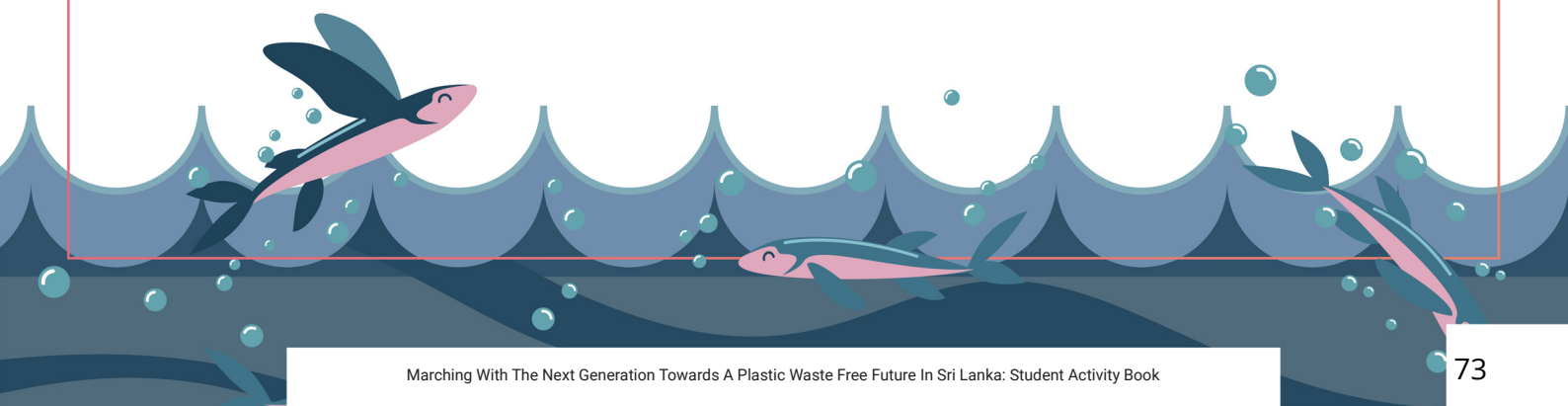
Step 3 **Score the pairs of products**

- You've done a fantastic job researching, analysing, and creating PMI charts for your chosen products. Now, it's time to share your findings with the entire class.
- First, one team will present their Life Cycle Assessment (LCA) and PMI analysis for their chosen product to the class. Explain your research, the positive aspects (Plus), negative aspects (Minus), and anything interesting you discovered.
- After the presentation, open the floor to your classmates. Ask them to contribute their assessments regarding your LCA and PMI analyses. This will provide additional perspectives and insights.
- Once you've received input from your classmates and made any necessary adjustments to your PMI chart based on their feedback, it's time to score the product. We'll do this as a class discussion.

- Each idea listed in the Plus-Minus-Interesting category will be scored from +5 to -5. Remember, this scoring is subjective, so feel free to explain why a particular notion scores well or poorly.
- After scoring each idea, total the scores to decide whether the product should be continued in terms of production and use.
- We'll also compare the scores of the two pairs of products: the one you researched with your team and the one analysed by the other team. This will help us make informed decisions about the environmental impact of these products. Your thoughtful analysis and scoring will guide us toward making sustainable choices. Let's continue our evaluation!

Additional Resources

- Explaining the Circular Economy and How Society Can Re-Think Progress
  https://www.youtube.com/watch?v=zCRKvDyyHml&t=45s
- Circular Economy Resource Box (KS3/4)
  https://zone.recycledevon.org/circular-economy-resource-box/



Activity 5.5: Reduce Your Plastic Footprint

In this activity, we will discover how much plastic waste you generate daily, weekly, and yearly. By calculating your plastic footprint, you will find that you produce a lot of plastic waste that is difficult to recycle (either because it is not technically recyclable or because there are no recycling structures where you live). This awareness is the first step toward reducing your plastic footprint and making more sustainable choices.

You Will Need

Internet access is available using the plastic footprint calculator developed by the Basel Action Network (Plastic Waste Transparency Project (Copy) — Basel Action Network (ban.org)). The calculator takes into account plastic use from several categories:

- Food and kitchen needs
  - PET bottles
  - Plastic bags
  - Food wrappers
  - Yoghurt 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

Procedure

STEP 1

- Let's begin by calculating your plastic footprint. You'll find out how much plastic you use daily, weekly, and even over your entire lifetime.

STEP 2

- Next, compare your daily, weekly, and yearly plastic footprint with your classmates. This will give you an idea of how your plastic consumption compares to others.

STEP 3

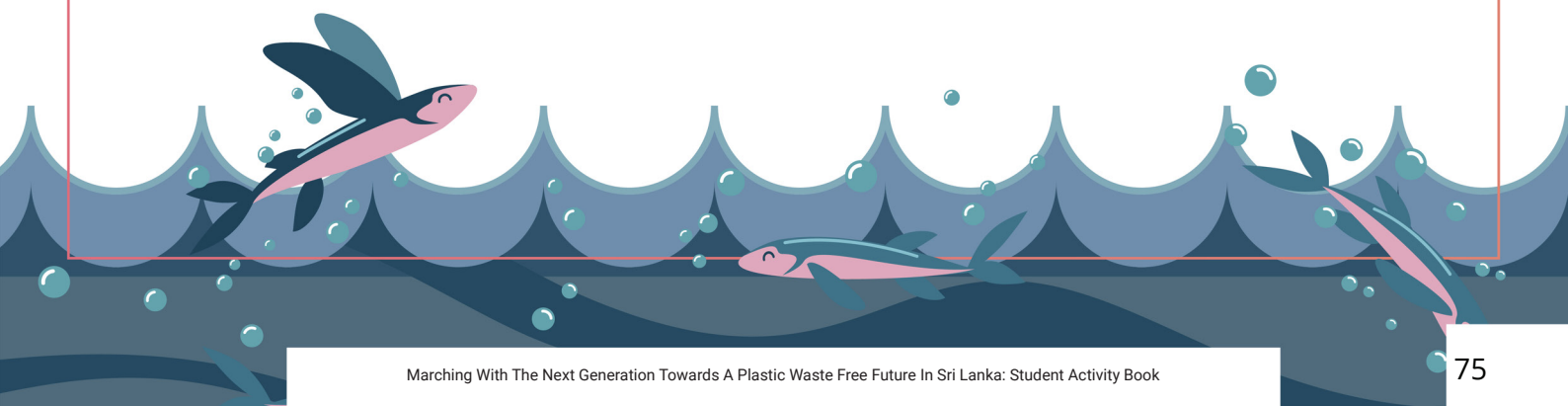
- Now, let's take it a step further. Calculate the average yearly plastic footprint for all the students in your school. You can even extend this calculation to include the citizens in your city and country.

STEP 4

- It's time to brainstorm and discuss how you can reduce your daily plastic footprint. Focus on four categories of plastic waste: Food and kitchen needs, bathroom and laundry, disposable containers and packaging, and other plastic items. Identify which items you can eliminate from your consumption next week.
- To track your progress, make a note of everything you use in the following week.

STEP 5

- After a week of trying to reduce your plastic consumption, let's re-calculate your plastic footprint. See if you've been successful in cutting down your plastic waste. Compare your results with your classmates and determine who has reduced their plastic footprint the most.



Extension Ideas:

- Apply the Knowlege you're gained from the plastic footprint activity to the plastic products you use most in daily life.

Here are the steps we'll follow

- Let's calculate our plastic footprint using the calculator developed by the Basel Action Network. You can access it here: https://www.ban.org/plastic-waste-transparency-project-1. It takes into account plastic use from several categories of daily use.

STEP 1

- Let's use the calculator to determine how much plastic you use in a day/week/year.
- Then calculate your plastic footprint for your whole life

STEP 2

- Next, compare your daily, weekly, and yearly plastic footprint with your classmates. See how your plastic consumption measures up to theirs.

STEP 3

- Now, let's extend our comparison. Calculate the average yearly plastic footprint for all the students in your school. You can even go beyond and calculate this for citizens in your city and country.

STEP 4

- It's time to take action! Focus on reducing your daily plastic footprint. Start by looking at four categories of plastic waste: Food and kitchen needs, bathroom and laundry, disposable containers and packaging, and other plastic items.
- Identify which category you can eliminate from your consumption next week. Record everything you use during the following week.

STEP 5

- After a week of conscious efforts to reduce your plastic consumption, revisit the plastic footprint calculator. Recalculate your plastic footprint and see how it has changed.
- Compare your results with your classmates and determine who has reduced their plastic footprint the most.

Extension Ideas:

- Students can do the life cycle assessment activity of the plastic products they use the most.

Activity 5.6: Packaging Free Lunch

In this activity, we will identify your packaging use and see if you can reduce it.

You Will Need

You must retrieve information about your country's plastic waste to prepare for the class. If recent data is available for your country, you can use it. Otherwise, to extract those data, look at the charts on Our World in Data /Plastics (https://ourworldindata.org/plastic-pollution). 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)

Procedure

STEP 1

- Let's start our activity by discussing the benefits of packaging.

The 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

- During lunchtime, we will have some fun with a little project. Ask your friends in class to join in!
- We'll use a unique bucket to collect all the leftover food scraps and packaging waste from our lunch.
- Let's count how much of it is food scraps, recyclable stuff, and non-recyclable items.
- Then, we'll turn those numbers into graphs!

STEP 3

- We have seen that packaging is handy. It preserves food and prevents it from being wasted, and it ensures that the contents of packages are delivered without being damaged. The problem is that many packaging and plastics are used, and a high proportion is wasted.

In Sri lanka we produce about 5.7 kg of packaging per person per year, of which 96% is mismanaged (e.g., double or triple your weight). Much of this is plastic. Packaging makes up 36% of total plastic waste. We recycle about 4% of our packaging.

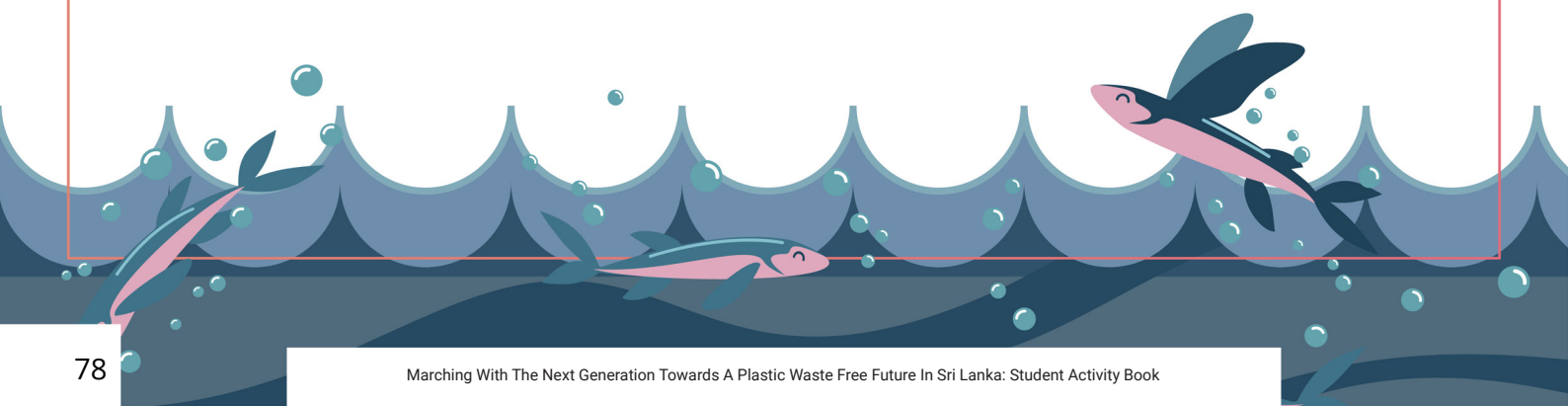
Many problems associated with plastic have arisen because single-use or disposable items have often replaced reusable, refillable containers. In fact, around 36% of the total amount of plastic used in Sri lanka is used for manufacturing single-use disposable packaging, including plastic bottles/ water sachets, cups, and bags.

The demand-driven supply of plastic material for the convenience of consumers in the market (jointly with wrong usage by people and lack of control by governments) tends to increase lightweight plastic material's low recovery rate, leading to an increase in pollution potential.

<u>Can you think of the problem with waste plastic packaging?</u>

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

- Now, here's where the real fun begins! We will plan a day when we bring lunch without wasteful packaging—a Packaging-Free Lunch Day or Nude Food Day!
- First, consider using reusable plates, forks, and glasses instead of throwaway plastic stuff.
- Then, we can develop awesome ideas to reduce the packaging in our school lunches. If you're in the younger grades, your teachers will write down your ideas on the blackboard and even send a letter to your parents with some no-packaging food ideas.

- Examples of packaging free lunches could include:
  - Bring lunch from home rather than buying it at the canteen.
  - Reusing, e.g., bread wrappers instead of getting a new lunch wrap every day.
  - Bring yoghurt in reusable containers rather than buying individually wrapped yoghurt pots.
  - Buying chips (crisps) in large bags, not individually wrapped.
  - Harvesting veggies 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 water bottle.

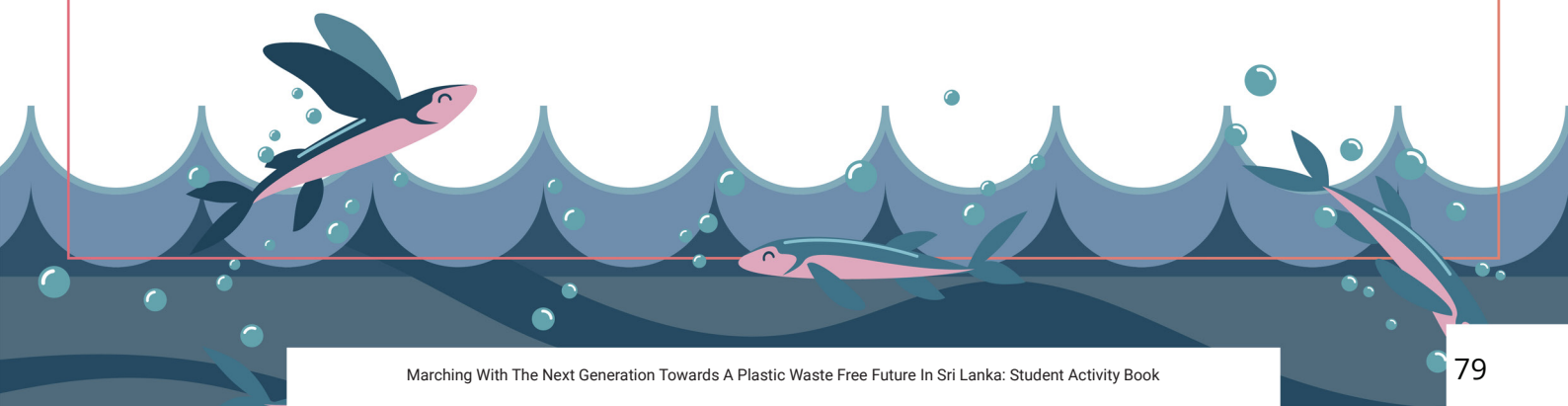
- On the day of the Packaging Free Lunch, we will place all lunch scraps and packaging waste in a bucket. Then, we will count all food scraps and recyclable and non-recyclable packaging and graph the results.

Step 5

- After our Packaging-Free Lunch Day, we'll chat about the difference we made. How much less trash did we make compared to before? And what about the energy we saved and the healthier food we had?
- We'll also discuss whether we want to do this again, maybe once a term. Could they convince the whole school? What about changing everyday habits? Should we include morning tea in the Packaging-free lunch?

Extension Ideas:

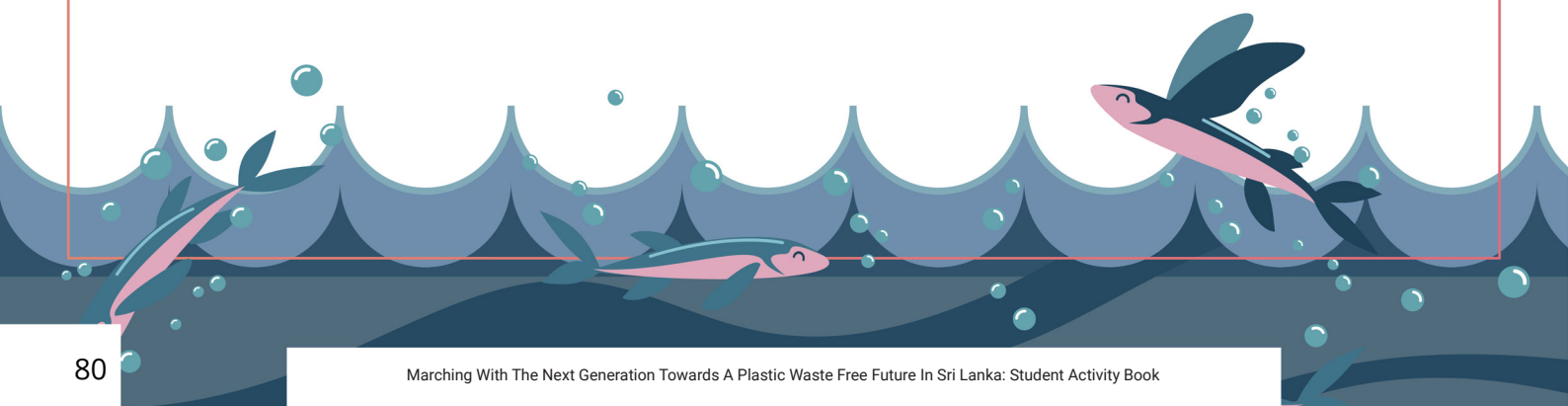
- For our older students who love getting hands-on, how about a super cool project? We can make our very own bee wraps to package our sandwiches. It's like a reusable, eco-friendly sandwich hug!
- Promote the Packaging Free Lunch to the whole school. After having your lunch, observe what trash is left behind.
- Count the different types of trash you have made from your lunch on the table below.



Worksheet 5.6.1: Lunchtime trash survey

Type of Trash	How Many?
Paper	
Plastic	
Metal	
Glass	
Other(describe)	

- Also, how can they plan plastic-free morning tea? Plastic-free picnic? Plastic-free birthday party? etc.?



Activity 5.7: Change Is In Our Hands

In this activity, we will learn the primary sources of marine pollution and their degradation time and reflect on the significant threats to the aquatic environment. You will understand that you can help reduce plastic pollution.

You Will Need

- Notebooks
- 1 type of marine litter for each group (e.g., plastic cup, water bottle, balloon, cotton swab, aluminium can, fishing net, glass bottle, straws, cigarettes, plastic dishes)
- Worksheet "Know, Think, Act". This worksheet has two columns and eight rows. The first column already has some information filled in for you, including:
  - Type of marine litter
  - Source of pollution
  - Slogan of the campaign
  - Campaign goals
  - Entities involved
  - Actions
  - Target Audience
  - Expected Outcomes

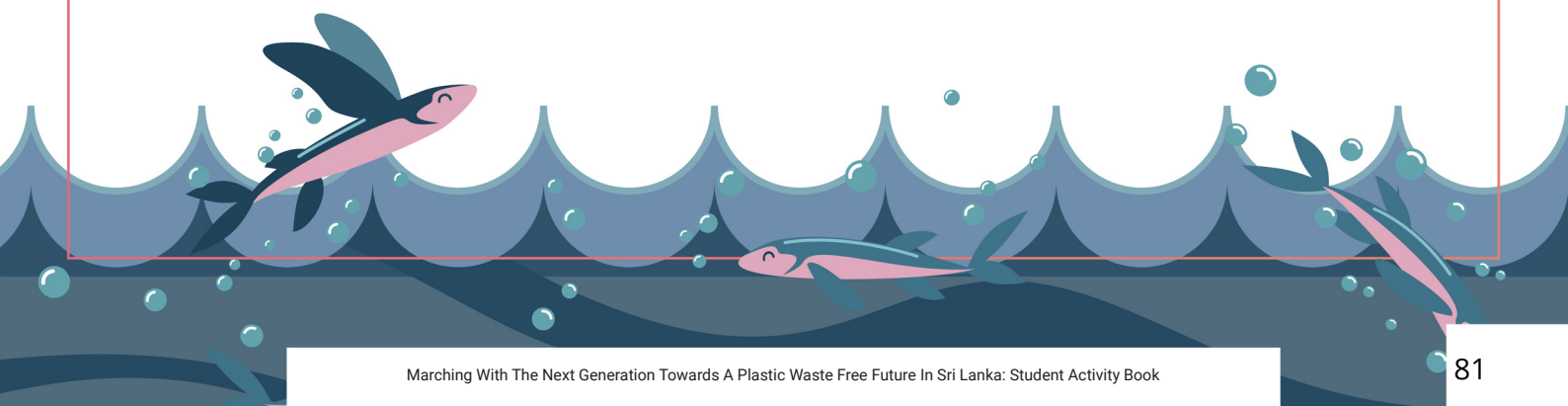
During the activity, the students must fill out the second column rows.

Procedure

The activity lasts about 90 minutes.

Suggested script:

Marine pollution is one of the main issues of our time. It can be defined as the 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 from garbage dumped into the sea or spills from vessels, as well as other sources, such as domestic sewage, industrial discharges, and urban and industrial surface runoff.



STEP 1

- We'll start with a short film called "Sources and Impacts of Marine Litter." You can watch it here (https://goo.gl/d9sJii).
- After watching the film, we'll discuss our thoughts and what we've learned.

STEP 2

- Now, you'll work in groups, and each group will receive a piece of marine litter.
- You'll also get a worksheet called "Know, Think, Act."
- Your mission is to fill out the worksheet and develop an excellent campaign idea to prevent pollution or inform people about your specific type of marine litter.

STEP 3

- Each group will present their campaign to the whole class.
- We'll have a voting session to pick the best campaign.

STEP 4

- The most exciting part is here: We'll put the winning campaign into action

STEP 5

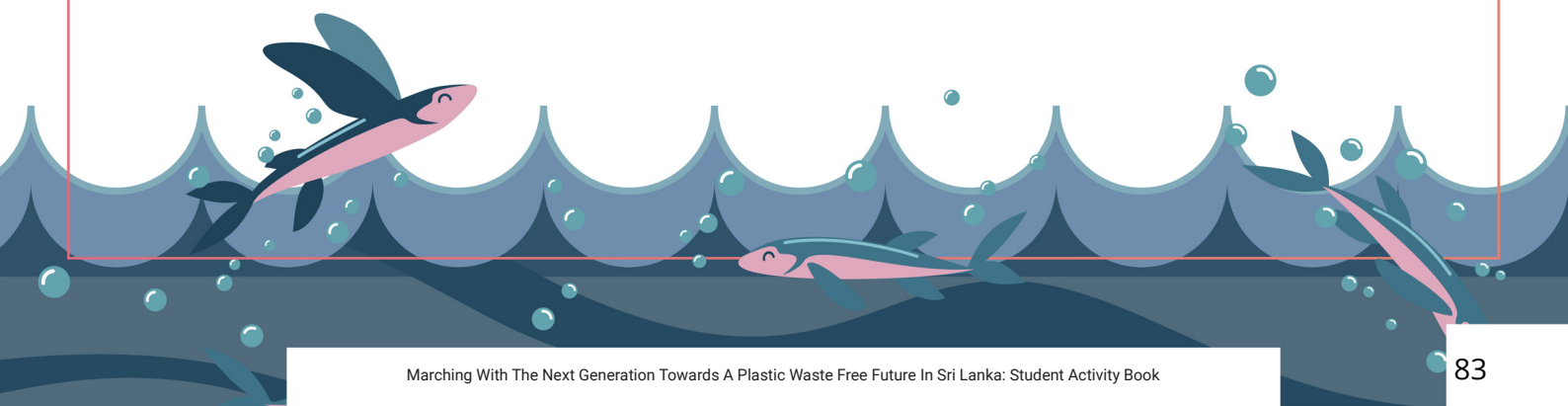
- We'll evaluate what we've learned by looking at the campaigns we've created.
- We might also conduct a survey to understand our perceptions better.

Worksheet 5.7.1: "Know, Think, Act"

Type Of Marine Litter	
Source Of Pollution	
Slogan Of The Campaign	
Campaign Goals	
Entities Involved	
Actions	
Target Audience	
Expected Outcomes	

Additional Resources

- The PIRIKA app
- Pirika is the world's most popular litter collection and social contribution app.
- By enabling the users to visualise the act of litter collecting, we can motivate each other through this app to spread the word and make the world a cleaner place.
- The pollution caused by litter in nature is a worldwide issue nowadays. This is especially serious because litter leaks into rivers, oceans, and seas, destroying ecosystems and affecting humans by polluting our food.
- Download links
  Android - https://play.google.com/store/apps/details?id=com.epirka.mobile.android
  IOS - https://apps.apple.com/us/app/pirika-clean-the-world/id434984120
- Some additional resources include:
  https://www.eea.europa.eu/themes/coast_sea/marine-litterwatch
  https://goo.gl/duXZQa
  http://www.marlisco.eu/
  http://www.noaa.gov/resource-collections/ocean-pollution
  https://www.youtube.com/watch?v=KpVpJsDjWj8
  https://www.youtube.com/watch?v=kQ3jP86QpHA
  https://www.youtube.com/watch?v=mGzIz9Ld-sE
  https://goo.gl/SMujNy
  https://www.sas.org.uk/campaign/return-to-offender/



Activity 5.8: Video Making to Fight Plastic Pollution

In this activity, you will create a short video to raise awareness about plastic pollution.

You Will Need

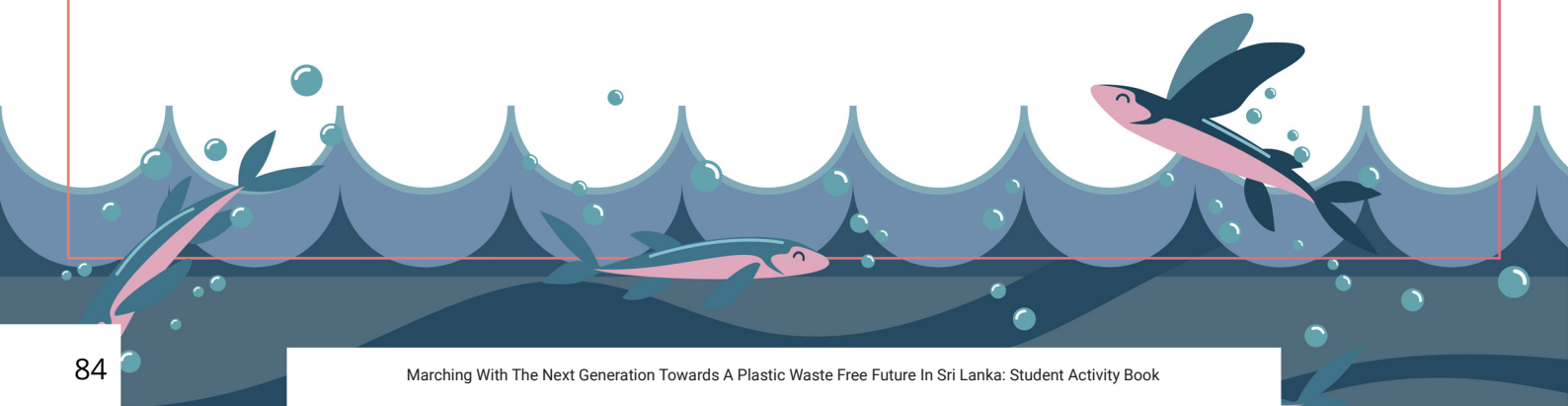
❖ Smartphones

Procedure

- You're about to become filmmakers on a mission! We'll focus on creating a 2 minute video about the problem of marine litter.
- Think about these critical points:
  - Why is marine litter a big concern?
  - What can we do to combat it?
  - Have we taken any steps in our school or community to address this issue?

Other ideas can include:

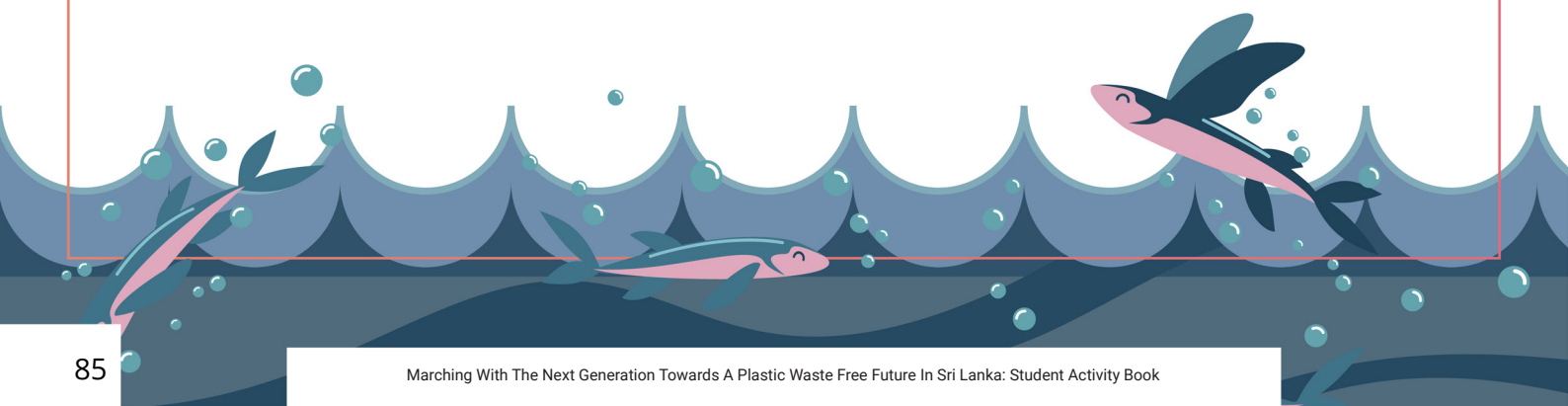
- Results from the "Packaging Free Lunches" project to show how much plastic packaging is used on regular days compared to plastic-free days.
- Present the campaign proposal(s) from the "Change Is in Our Hands" activity.
- Depending on your age, you can create the video independently or get some help with filming.
- Prepare your speech for the video. You can write down your script and practice reading it to ensure it fits within 2 minutes. Remember to hold your smartphones horizontally for better quality.
- Make sure to speak clearly and passionately about the issue of plastic pollution and the solutions.
- Once all the videos are ready, we'll have a judging panel within the class or school to select the best videos.
- You can even consider sharing the videos on YouTube for a public vote to see which captures hearts beyond our school community.



Additional Resources

If you need inspiration, you can watch some related videos.

- Microplastic madness - https://www.youtube.com/watch?v=s0jIH1fUqZU
- Microplastic madness – Youth comments from Around the world https://www.youtube.com/watch?v=dAByVOIowo0&feature=youtu.be
- 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 http://www.byebyeplasticbags.org/



Activity 5.9: Tweet It, Haiku It, Draw It

In this activity, you will present what you have learned about plastic pollution and possible solutions using art.

Procedure

- Let's get ready to have some fun and show off your creativity in this fantastic activity! We'll use art to express what we've learned about plastic pollution and share possible solutions with others. We're going to make a positive impact using our imagination!
- First, create a Twitter account (Mastodon or Threads).
- The entire class can work on the same type of art expression, like Tweeting (Mastodon, Threads), creating Haikus, or Drawing. If you want to explore more, you can have multiple sessions dedicated to one or two of these art forms. Or, if you like, you can let the students choose which art expression they prefer.

Tweet: You'll have to synthesise and summarise what you've learned into 1-3 tweets, keeping them within a 140-character limit. #creative and #funny #hashtags are #encouraged

- Twitter (https://twitter.com)
- Mastodon (https://joinmastodon.org/)
- Threads (https://www.threads.net/)

Haiku: Let's summarise our work as a haiku (poem).

Draw: Let's draw an image representing and summarising what we've learned.

06 Awareness Raising Festival and Citizen Science Projects

Activity 6.1: The Ocean Festival

An Awareness festival on society's impacts on the marine environment will be developed. Children will participate in interactive activities about marine litter organised by experts from a local university, research institute, aquarium, or museum. This activity aims to raise awareness about marine litter and promote understanding of the causes, impacts, and solutions to the problem.

Description of the Festival

We will have a fantastic festival about understanding and protecting our marine environment. At this significant event, we'll learn how our society affects the ocean and all its creatures. There will be lots of fun things to do to make us feel closer to the sea.

Some of the festival activities will be outdoor adventures, like sea kayaking and helping to keep the beach clean. We can also explore the ocean's wonders with a visit to an aquarium or a protected marine area.

Beach Cleaning

Sea Kayaking

Visit to an aquarium or protected area

These activities will help us connect with the natural aquatic world.

However, the festival is also focused on something significant: marine litter. Notable experts from universities, research institutes, and NGOs will guide us through four exciting activities about marine litter. They'll use posters, artwork, demos, and experiments to teach us all about it. We'll do these activities in small groups and spend about 45-50 minutes learning and having fun.

We want to know how much you've learned and how you feel about marine litter, so you'll also take a quick survey before and after these activities. It'll help us see how your awareness and concern about marine litter change and your understanding of its impacts and causes. Plus, we'll find out if your behaviour changes to reduce litter.

Here's a quick overview of the festival.

1. Pre-activity perception survey (5 minutes)

2. Marine litter activities (not important the order followed. 45–50 minutes)
    i. Learn about macro-litter
    ii. Observe microplastic litter and plankton through a microscope
    iii. Learn about global distribution and transport over long distances
    iv. Mock shop with traffic light labelling 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 two weeks after the event)

Table 6.1.1: Activities and people in charge

ACTIVITY	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 activites 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	Schools to find local partners for the outdoor activities. Local/ national governments could also be in charge of this
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 activties. The same sets of questions will be administered to children before the interactive activites 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.

Procedure

Activity 1: Learn about macro-litter

- In this activity, we will learn about big pieces of trash called “macro-litter” that people have picked up from the beach. But don’t worry; experts will make sure everything is safe!
- First, we’ll examine the marine litter. We’ll sort things like plastic, paper, wood, metal, cloth, and glass and try to guess where they came from

Did you know that 75% of marine litter is plastic? That’s a lot. Marine litter can be harmful to animals and our beaches. It can hurt animals and make the sea dirty. It’s not good at all. But we can all help by recycling, picking up trash, and telling others to do the same.

Activity 2: Observe microplastic litter and plankton through microscopes

- Now, let’s use microscopes to look at tiny bits of plastic called “microplastic.”

It takes a long time for plastic to break down into these little pieces. These little bits can be eaten by sea creatures, which is unsuitable for them.

- We can even watch a short video to see plankton eating plastic.

The short video “Plankton eating plastic caught on camera for the first time” https://www.youtube.com/watch?v=mGzIz9Ld-sE&feature=emb_logo

Activity 3: Learn about the global distribution and transport over long distances

- Now, we’ll learn how trash can travel worldwide in the ocean.
- We’ll look at maps and pictures to see how trash can end up in faraway places like the Antarctic.

Some marine trash gets caught in local ocean currents and floats on the ocean. Through that, it can go to unique places called oceanic gyres and is transported for a very long distance. Due to this, plastic parts have been found even in the stomachs of birds living on islands very far away from the mainland such as Midway Islands.

- The visualisation “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 NASA visualisation “Perpetual Ocean” (https://svs.gsfc.nasa.gov/3827/) shows surface floating currents and can be used to teach children that floating plastic waste is 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 how far these islands are from the mainland and how many people live there. Then, Chris Jordan shows pictures of albatross chicks with bellies full of plastic waste items such as cigarette lighters and bottle caps. Pictures can be found here:
- https://www.chrisjordan.com/Midway/1/thumbs-caption

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

- Now, we have a pretend store with unique labels. Green dots mean good for the environment, and red dots mean not so good.
- We'll "shop" and see how much trash we buy. We'll even get an "eco-price" for our shopping.

Try to make better choices and buy things with less packaging.It's all about learning to shop in a way that helps reduce marine litter.

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).
Examples:
- plastic bottle vs refillable bottle
- plastic silverware vs bamboo or metal silverware
- rice or other food to be bought in small single-use packages vs rice to be purchased in bulk
- shampoo sachets vs shampoo bottle or solid shampoo
- sandwich in plastic packaging vs sandwich in bee wrap

Final interactive session

At the end, we'll have a 10 minute Q&A session to remember what we learned:

- Is marine litter a problem?
- Where does it come from, and where can we find it?
- How can we help and take action?

Follow-up Activities in the Class

The teacher will administer the post-activity perception survey two weeks after the event. After doing this, they can do some follow-up activities on marine litter, such as the "Change is in our hands" activity in the Teacher Resource Book. They mustn't carry out this specific activity on marine litter before the post-activity perception survey so that they can evaluate the activities carried out during the awareness-raising festival.

FURTHER INFORMATION

MINISTRY OF ENVIRONMENT

SOBADAM PIYASA, NO. 416/C/1, ROBERT GUNAWARDANA
MAWATHA, BATTARAMULLA, SRI LANKA

INSTITUTE FOR GLOBAL ENVIRONMENTAL STRATEGIES (IGES)

2108-11, KAMIYAMAGUCHI, HAYAMA, KANAGAWA, 240-0115, JAPAN
240-0015, JAPAN
PHONE: +81-46-855-3840; FAX: +81-46-855-3709