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

TEACHER RESOURCE 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

Teacher Resource Book

Ministry of Environment, Sri Lanka
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Marching with the Next Generation Towards a Plastic Waste Free Future in Sri Lanka: Teacher Resource Book

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Message from the Secretary of Ministry of Environment

Plastics have undeniably revolutionized our world, permeating every aspect of modern life with the versatility and convenience. 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 Teacher Resource Book titled "Marching with the Next Generation Towards a Plastic Waste Free Future in Sri Lanka" was prepared by the Ministry of Environment in collaboration with the Institute for Global Environmental Strategies (IGES) and the Ministry of Education under the project on "Marine Litter and Microplastics (Norad-1)". The objective of this book is to use it as a resource book for teachers to empower the next generation of Sri Lankans to become responsible citizens and advocates for a plastic waste-free future. Simultaneously, a Student Activity Book with the same title has also been produced for students to refer to parallel with the resource book for teachers. Consequently, these books are intended to be used at Science Field Study Centers as resource material required for extracurricular activities for schooling student to carry out the plastic waste management activities outlined in the book.

I am enchanted to share this message upon completion of Teacher Resource book which shows clear path for guiding students to understand and manage plastics which is essential for fostering a sustainable future. As young minds are the architects of tomorrow, educating them about the impacts of plastic pollution implants a sense of responsibility within them and thereby empowers them to act. Through lessons on reducing single-use plastics, practicing recycling, and adopting eco-friendly alternatives, students learn practical strategies to minimize their environmental footprint. Moreover, guiding students in plastic management cultivates their ability for critical thinking and problem-solving skills 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 preserving the beauty and integrity of our natural world for generations to come.

I take this opportunity to thank 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.

B.K. Prabath Chandrakeerthi
Secretary
Ministry of Environment

Message from the Secretary of 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 imperative that we, as a nation, address the pressing issue of the critical impact of microplastics on the environment.

In today's world, where environmental sustainability is paramount, empowering our students with knowledge and actionable solutions is not just an option but a necessity. Integrating 21st-century skills such as critical thinking, creativity, communication, and collaboration within this period of educational transformation can play a pivotal role in advancing the agenda of marching towards a plastic waste-free future in Sri Lanka. Through our schools, we have the opportunity to cultivate a generation of environmentally conscious citizens by integrating formal education with co-curricular activities related to achieving a plastic waste-free Sri Lanka.

As we march alongside our students, we form the opportunity to seek solutions for present environmental issues. These books would enrich our future generation, filling the gaps in their knowledge and empowering our students to become ambassadors of change within their communities. They will drive initiatives that promote sustainable living and reduce plastic consumption. With their combined resources and expertise, they have developed a sustainable and robust program that seamlessly integrates into the curriculum. This program will be implemented through the science field study centers and the Science Branch of the Ministry of Education across the country. By working together, we can implement innovative solutions, such as recycling programs, plastic alternatives, and waste management initiatives, paving the way towards a cleaner, healthier future for our nation.

"The earth does not belong to man, man belongs to the earth."
-Chief Seattle-

These profound words encapsulate a timeless truth that resonates across generations and cultures. Chief Seattle's words serve as a guiding light, reminding us of our interconnectedness with nature and the imperative to live in harmony with the Earth. Together, let us embark on this transformative journey towards a sustainable future.

J.M. Thilaka Jayasundara,
Secretary,
Ministry of 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 the 1950s and are set to increase by 70 per cent 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 per cent 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 CO2 equivalent, 10 per cent 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 gigatonnes 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 $13billion 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-management-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)

The following figure depicts how plastic leakage is produced at different lifecycle stages, including how plastic wastes enter the natural environment, its impacts on humans and ecosystems as well as ways plastic pollution can impose economic costs and disruptions.

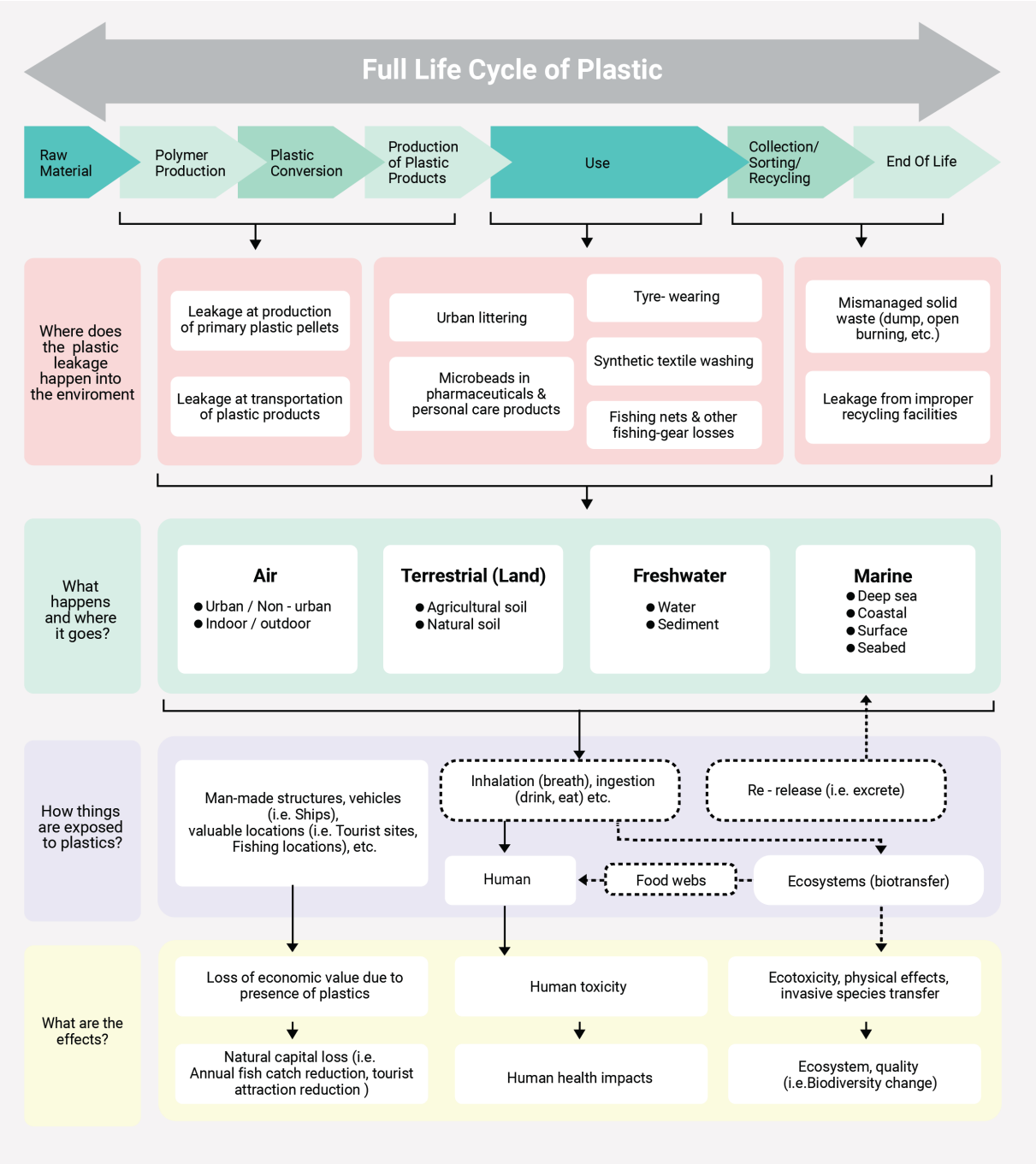

Figure 1 : Full lifecycle of plastic

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

7 Training Needs Assessment Report (TNA): Towards Microplastic Monitoring and Evidence-Based Policy Measures in Sri Lanka (iges.or.jp)

The issue of plastic pollution is of critical importance for Sri Lanka. Annually Sri Lanka imports approximately 300,000 tonnes of virgin raw materials for varying plastic applications as well as 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. These figures highlight that over 50% of uncollected waste, much of it containing valuable plastics, often is sent to open dumps, littered in the surrounding environment, or burned without appropriate controls.

The Ministry of Environment of Sri Lanka adopted the country's National Action Plan on Plastic Waste Management 2021-2030 (NAPPWM) in August 2021. The NAPPWM outlines a national approach for managing plastic waste in line with 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 the following pages provide some instructive examples of how schools, and specifically students, can contribute to the greater 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.

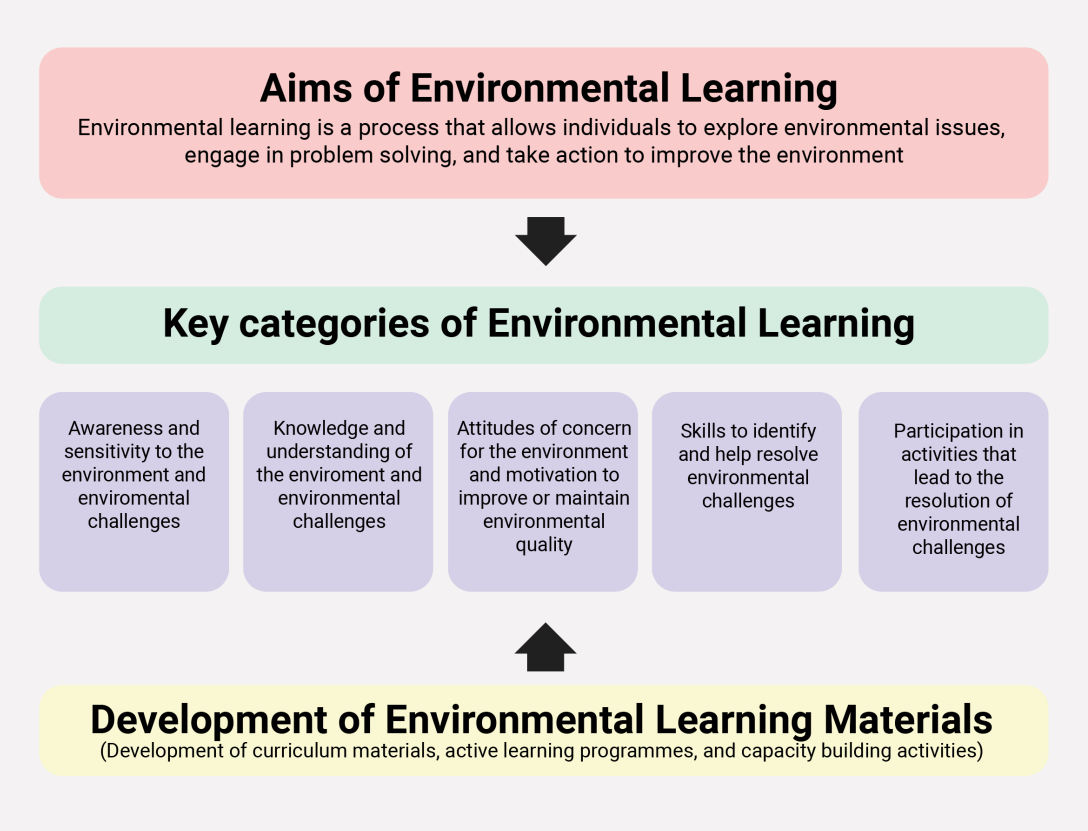

Figure 2: Aims of environmental learning and the need for learning materials to support these objectives.

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

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, together with its 17 Sustainable Development Goals (SDGs) provides a shared blueprint for peace, prosperity, people and the planet, now and into 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, efforts to address plastic pollution touch on all 17 Goals, with clear implications for achieving the entirety of the SDGs.

8 Development of Environmental Learning Programme for Establishing a Sustainable Solid Waste Management System in Mandalay City, Myanmar (iges.or.jp)

Figure 3: Plastic Pollution

Who is The Target of This Resource Book?

This Teacher Resource Book was prepared by updating the original resource book prepared by United Nations Environment Programme - Basel Rotterdam Stockholm Convention Secretariat (UNEP-BRS), through a consultative and participatory process involving key administrators, school curriculum developers, and teachers.

Several follow-up progress review sessions were held to review comments received by administrative and school officials. Many Science, technology, engineering and mathematics (STEM) teachers were also engaged in this process, with comments obtained through consultations and one-on-one sessions to validate the book's content and activities in line with the school curriculum and extracurricular activities within different age categories. Taken together, this resource book is targeted toward students of all ages, levels, and disciplines in the hope that it will empower learners to make informed decisions on plastic waste reduction.

The following materials were developed with the financial and technical assistance of the United Nations Environment Programme - Basel, Rotterdam and Stockholm (UNEP-BRS) Convention Secretariat and the Institute for Global Environmental Strategies (IGES) together with the support of the Ministry of Environment, Sri Lanka.

How Should This Resource Book Be Used?

Teachers may wish to carry out the activities outlined in the following sections working in cooperation with their school's respective Student Parliament, Environmental Brigade, and Scouting Clubs, which may enable them to identify opportunities for wider collaboration with other educational institutions across Sri Lanka.

Teachers and Educators Can Help Turn the Tide on Plastic Pollution

To address the plastic waste crisis, different stakeholder groups must work together, ranging from scientists, tasked with examining the issue; policy makers, responsible for introducing relevant legislation on reduction and prevention; citizens, who must make efforts to change behaviours; and private businesses, who must shift work practices and operate in a different way to tackle plastic pollution. In this regard, citizen science-led activities have become a focus of major importance for raising public awareness around plastic marine pollution world wide. Students and young people are increasingly engaging in efforts to identify solutions to environmental challenges (demonstrated by growing action on climate change) and as such represent critical change agents for resolving the global plastic crisis. Seen in this light, educators play a valuable role in disseminating knowledge and helping students understand the plastic crisis from a scientific and civic point of view.

How to Use the Teacher Resource Book

This education toolkit, composed of a Teacher Resource Book with guided activities and selected resources, and a Student Activity Book, proposes different types of education activities organized into seven sections.

Sections 1 – 5 include educational activities to be carried out in class 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. The teacher can carry them out alone in their class or extracurricular activities at appropriate age groups as prescribed in the book to perceive its effectiveness and also to assess the adaptability with the school curriculum in later stages.

Section 6 includes ideas on how to organise 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 how to develop citizen science activities. These activities require external collaboration from the school and with all or part of these activities carried out outside the school.

Section 7 includes the Annex I. This educational toolkit has been developed by the collating existing educational activities, adapting scientific research studies, and developing new educational activities. Attribution for each activity are available in Annex I.

LIST OF 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

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Term	Description/Definition
Landfill	Sites designed to store garbage
Legacy environmental contaminants	Chemicals, often used or produced by industry, which remain in the environment long after they were first introduced
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

Term	Description/Definition
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
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
Tiny	Very small

Term	Description/Definition
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?

Subject areas: Biology, Ecology, Health, Social studies, Mathematics
Activity time: 60 min or less
Skills: Interpret, present
Vocabulary: Context, Depict, Feedback, Impacts, Mixture, Regulation

You Will Need

- Student worksheet 1.1.1
- Two Photographs per small group (may use the provided photographs in the student activity book or your own photos/pictures related to plastic pollution. Ensure that one photo/picture in each pair shows plastic waste in natural environments like coastal areas, while the other depicts an animal affected by plastic waste. Choose images that will capture the attention of students and include a mix of global and local context-related photos.)

Procedure

STEP 1

- Instruct students to observe/recall the things brought to their homes last week from the market and complete students' worksheet 1.1.1
- Divide the students into small groups (4–8 members).
- Instruct them to summarize all data in their worksheets.
- Ask students to present their findings/conclusions graphically.
- Based on their presentations, emphasize that a considerable percentage of plastic waste are accumulated in our homes.
- Ask students to present how plastic waste is disposed from their houses and the impact of them on their lives.
- Show the video on 'Plastic Pollution Basics' at https://youtu.be/DHg291KeFls. This video will introduce students to the man-made materials called 'plastics' and explain why they are so problematic.

STEP 2

- Organize students into groups consisting of two to five.
- Assign two photographs/pictures to each group and prompt students to identify problems.
- Encourage students to consider the impact of plastic waste.
- Allow students to find the impact of plastic waste at both local and global levels using relevant sources such as websites.
- Ask the students to find and discuss the actions to be taken at home, locally and globally to minimize the impact of plastic waste.
- Give each group to disseminate their ideas.
- Provide feedback on each group's ideas.
- Students discuss:
  - what they see
  - any problems they can identify.
- Ask them to record the identified problems on a paper/notebook or sticky note.

STEP 3

- Ask students to present the problems they identified.
- Discuss and list identified problems.
- Have students suggest solutions to the problems and provide feedback on each other's ideas.
- Elaborate the types and sources of plastic waste.

Assessment Strategies

Observation, Output/product, Verbal communication

Additional Resources

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

Activity 1.2: Plastics in Sand/ Soil

Subject areas: Biology, Chemistry, Ecology, Health, Social studies
Activity time: 120 min or less
Skills: Analyse, Interpret, Evaluate
Vocabulary: Macroplastics, Meso-plastics, Microplastics, Nano plastics, Morphology, Fragments, Fibre, Beads/spheres, Films, Pellets, Colour

In this activity, students investigate plastics contained in sand/ Soil.

You Will Need

A field visit to a nearby local beach, lakeside, or riverbank. (Almost every sandy beach worldwide contains plastics, along with larger plastic fragments).

Note: In case you do not have access to the above places, you can provide sand from school premises such as a playground. Alternatively, you could provide a pre-collected sand sample.

- A magnifying lens
- A sieve (Approximately 1 mm)
- A ruler
- A pair of tweezers
- Student worksheet 1.2.1 on plastics in sand/soil
- A pair of gloves
- Plastic trays
- Computers/ smartphones to show a videos (this may be needed after returning to the classroom)
- If you were provided with a "Microplastics Community Science Toolkit", use it for the sampling and observation activities

Procedure

STEP 1

- Organize students into groups consisting of two to five.
- Assign a place/small area on school premises for each group.
- Ask each group to observe the given sample sand/ soil carefully using their naked eye and ask, "Do you see any plastic pieces?"
- Ask students to inspect the sand/ soil with magnifying lenses.

STEP 2

- Instruct students to sieve and collect plastic pieces to measure their size and observe colour, and shape.
- Ask them to record their findings in the worksheets 1.2.1 and 1.2.2.
- Encourage the students to take photos, if they have cameras or smartphones.
- Prompt a discussion by asking, "Where do these plastic pieces come from?"

STEP 3

- Explain to students that when plastic debris enters the environment, it undergoes a degradation process. Over time, large plastic pieces break down into smaller plastic particles.
- Scientists categorize plastic debris using three key criteria: colour, size, and appearance.
- Size - Instruct students to separate the plastic particles from sand/soil and classify them into sizes as mega-plastic (plastic pieces larger than 1 m) macroplastics (plastic pieces between 1 m and 2.5 cm), meso-plastics (plastic particles between 5 mm and 2.5 cm) and microplastics (plastic particles between 1 µm and 5 mm) and nanoplastics (smaller than 1 µm).

Picture: Size-based classification of microplastics

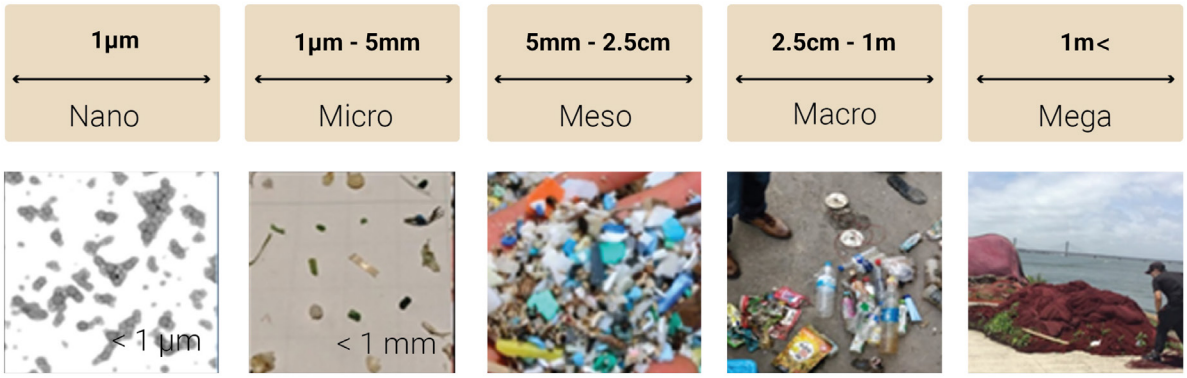


Figure 1.2.1: Size-based classification of microplastics (Source: Abeynayaka et al. 2022b (https://www.iges.or.jp/en/pub/microplastics-wastewater/en)

Appearance: Then tell students to categorize plastic pieces into 5 morphological descriptors: 5 morphological descriptors (fragments, fibres, beads, spheres, films, sheets, pellets) as indicated in the following figure.

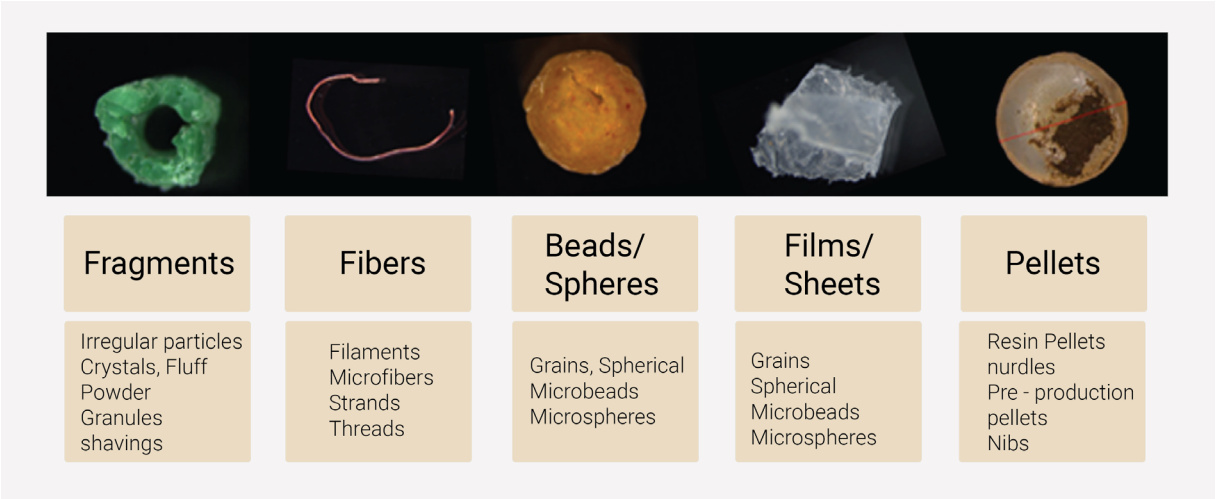


Figure 1.2.2: Morphology of microplastics (Source: Abeynayaka et al. 2022a)

Colour: 8 colour classes (black/grey; blue/green; brown/tan; white/cream; yellow; orange/pink/red; transparent; multicolour) as suggested in GESAMP (2019).

STEP 4

- Engage students in a discussion about the hazards of plastics and the importance of preventing plastic pollution through the separate collection, reuse, and recycling of plastic items.
- Ask the students to watch videos on plastics in the environment and encourage them to answer the provided questions (links are provided under additional resources).

Toolkit integration

For a deeper understanding of plastic pollution, utilizing a toolkit is recommended. This resource enhances Activity 1.2 by providing a hands-on approach to exploring the microplastics issue. Analyze sand samples, distinguish between synthetic and natural materials using the toolkit's clues, and categorize items by size. The toolkit comes with detailed instructions and safety tips, enriching the overall learning experience.

Refer to the toolkit for additional resources and a more comprehensive understanding of microplastics: (https://algalita.org/wayfinder-society/toolkit/synthetic-sand/).

Assessment Strategies

Observation, Verbal communication

Additional Resources

- Plastic pollution in Sri Lanka and Elephants - https://www.youtube.com/watch?v=OpiR6c5nl3Q
- Closing the loop of Plastic Pollution. https://www.youtube.com/watch?v=Hie3voACLQ0
- "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
- Toolkit for additional resources and a more comprehensive understanding of microplastics https://algalita.org/wayfinder-society/toolkit/synthetic-sand/

Activity 1.3: Microbeads from Cosmetics and Personal Care Products

Subject areas: Biology, Chemistry, Ecology
Activity time: 60 min or less
Skills: Analyse, Evaluate
Vocabulary: Buoyancy, Cosmetic, Impact, Indicate, Microbead, Microscope, Potential, Tiny, Transparent

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

You Will Need

- Some cosmetics and personal-care products available in the market
- Clear sheets/or a flat strong single-colour surface
- Microscope or magnifying lens
- Transparent reusable plastic cups
- Tap water, dishwashing detergent, and table salt
- Spoons
- Smartphones or a computer
- Student worksheet 1.3.1 on the behaviour of microbeds in different liquids

Procedure

STEP 1

- Divide students into groups of two to five (ideally three).
- Provide various products listed above and instruct students to examine the product's composition on the packaging for any information about containing microbeads.
- Guide the students to spread a portion of the product on a clear sheet and to inspect it with a magnifying lens (or microscope).
- Let them observe the products gently by feeling the product with their hands.

STEP 2

- Allow students to prepare three different solutions as follows:
  - Tap water only
  - Water mixed with detergent (1/2 spoonful per cup)
  - Water mixed with salt (a few spoons per cup)
- Ask students to place the product in these three liquids using transparent cups to test the buoyancy of the microbeads.
- Encourage them to predict how microbeads would behave in natural aquatic environments, such as rivers, seas, and lakes (i.e., whether microbeads will float or sink).

- Let the students think about the different ways of adding microbeads to the natural environment and the fate/impact of them when adding to the natural environment.

STEP 3

- Initiate a discussion on the importance of avoiding products containing microbeads and explore ways to raise awareness among family and school community.
- Show two videos given below and encourage students to compare the presence of microbeads in Sri Lankan products to those in the USA and Europe.
- Guide to creating a wallpaper about the ill effects of microbeads as a classroom activity (For students' awareness).

Assessment Strategies

Observation, Output/product, Verbal communication, Self/peer evaluation

Additional Resources

- "The story of microbeads" by the Story of Stuff - https://www.storyofstuff.org/movies/lets-ban-the-bead/
- What You Need To Know About Microbeads https://www.youtube.com/watch?v=D_bfwNwGx-o
- The Story of Microbeads https://www.youtube.com/watch?v=uAiIGd_JqZc

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

Subject areas: Mathematics, Biology, Chemistry, Ecology
Activity time: 60 min or less
Skills: Gather,Organize, Analyze
Vocabulary: Ban, Cosmetic, Dissolve, Dump, Estimate, Limit, Stir

In this activity, students will make a rough estimate of how many microbeads are being dumped each year by people. They will also investigate and debate the environmental issues involved.

You Will Need

- The same materials as for "Activity 1.3: MICROBEADS FROM COSMETICS AND PERSONAL CARE PRODUCTS"
- 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

PRE-STEP

If you are unsure which products contain microbeads, complete activity 1.3.

STEP 1

- Organize students into groups of two to five, preferably with three members in each.
- Instruct each group to:
  - Add 5 ml of dishwashing liquid to a cup filled halfway with tap water.
  - Take 5 ml of a product containing microbeads and dissolve it in the same cup.
  - Stir the mixture for one minute, then filter it using a filter.
  - Transfer the microbeads from the filter onto a transparent sheet and count them using a magnifying lens.

STEP 2

- Assign students to make the following calculations and assumptions:
  - Number of microbeads contained in 5 ml of the product selected
  - Total number of microbeads in whole product (container/tube)
  - Time duration to use the product by one person
  - The number of products needed per year per person
  - 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 group members

- Allow students to estimate the total number of microbeads released by the families of all students in the classroom.
- Then ask them to estimate how much microbeads are released by families of the school community to the environment annually.

STEP 3

- Instruct the students to visit a cosmetics shop/saloon located in their/selected area.
- Conduct a survey using a questionnaire or verbally to find out how much microbeads containing products are sold/used in the shop/saloon per week/month.
- Ask them how many cosmetics and personal care products they buy annually.
- Ask them to fill out student activity sheet 1.4.1
- Ask them to estimate how many microbeads are released into the environment by their living area and the town annually.
- Ask the students to find out how many cosmetics and personal care products are imported by referring to various sources and get an idea of the amount of microbeads released to the environment annually in Sri Lanka.
- Assign students to research information about the issue of microbeads in the environment, as well as ongoing debates and actions regarding their restriction or ban on products.
- Instruct the students to present/submit a report based on their findings.

Note: Emphasize that filters cannot capture all microbeads, and some may pass through. Similarly, not all microbeads are visible, so the actual amount entering the environment during daily activities is likely higher than their estimations.

Assessment Strategies

Observation, Output/product, Verbal communication, Written communication, Self/peer evaluation

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

Subject areas: Chemistry
Activity time: 60 min or less
Skills: Organise, Analyze, Interpret, Evaluate, Present
Vocabulary: Flexible, Opaque, Recycle, Stiff, Translucent

In this activity, students will categorize and examine the properties of different types of plastics.

You Will Need

- Bags of plastic waste items (pre-prepare, or ask students to bring from home)
- Pairs of scissors or hacksaw blades
- Torches
- Clear water glasses or plastic cups
- Tap water

Procedure

STEP 1

- Organize students into groups consisting of two to seven members. Provide each group with a bag of various clean plastic waste items.
- Instruct each group to sort the plastic waste in a way they believe would yield the highest value for a plastic recycler.

STEP 2

- Ask students "Why did they sort the plastics in that particular order?".
- Ask students to identify and record symbols on at least four plastic objects in their Worksheet 2.1.1.
- Guide the students to determine the types of plastics using the Figure 2.1.1: "Plastic Information Chart 1".

STEP 3

- Let the students cut a small piece (about $5cm^2$) from each plastic object carefully.
- Ask them to observe the outer appearance physical properties (transparent, translucent, opaque, flexible, stiff, hard) of plastics.

- Ask them to observe the nature of the scratch on the plastic piece and record their observations on worksheet 2.1.1.
- Instruct the students to put them in a glass, and fill it with half of the tap water.
- Ask them to observe whether they are floating or sinking and to record the observations on worksheet 2.1.1.
- Allow them to discuss and share the findings with other peer groups.

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			

Figure 2.1.1: Plastics Information Chart 1

Source: PG 5277 - 11 (E)1-1 Environmental Act pmd (cea.lk)

		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

Figure 2.1.2: Plastics Information Chart 2

Assessment Strategies

Observation, Output/product, Verbal communication, Self/peer evaluation

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

Subject areas: Chemistry, Ecology
Activity time: 60 min or less
Skills: Organise, Analyze, Interpret, Present
Vocabulary: Decompose, Fate,Impact, Landfill, Mixture

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

You Will Need

- Some materials (Ex: Banana peel, a PET bottle, a newspaper, a used CD/hard disk, a piece of fabric, a plastic toy,etc.)
- Student worksheet 2.2.1 on Time taken for the degradation of different materials.

Procedure

STEP 1

- Divide the students into groups of two to five.
- Bring some materials from home (e.g., Banana peel, a PET bottle, a newspaper, a used CD/ hard disk, a piece of fabric, etc) to the class or instruct the students to bring them.
- Prompt students to consider the fate of these items if they are all discarded together in the soil.
- Encourage them to think about what will happen if these items end up in environments such as landfills, open dumps, open burning, or even disposed in rivers, etc.

STEP 2

- Ask students' ideas about what is degradation.
- Using their answers, guide students to build a definition for degradation.
- Instruct them to arrange materials brought in an order according to the nature of degradation.
- Engage in a discussion about their timelines and ask "Why do some materials degrade more quickly than others?".
- Encourage students to guess and compare the time taken by each item to degrade.
- Show the actual values of the times of degradation taken from a reliable source.
- Ask the students to compare the real values with the estimated values.
- Highlight the students that plastics and electrical goods take years to degrade and prompt them to consider potential solutions.

STEP 3

- Let the students watch the video provided.
- Encourage them to present their critical viewpoints on the video from their perspective.

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

Figure 2.2.1: Plastics Information Chart 2

Assessment Strategies

- Observation, Output/product, Verbal communication, Self/peer evaluation

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

Subject areas: Mathematics, Chemistry, Ecology
Activity time: 60 min or less
Skills: Analyse, Interpret, Apply, Evaluate
Vocabulary: Bury, Compostable, Decompose, Degradation, Formulate, Investigation, Observe, Toughness

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

You Will Need

- Plastic bags (one of the following):
  - Traditional polyethylene plastic bags (HDPE)
  - Compostable plastic bags
- A magazine paper
- The peel of a fruit (apple/banana / local fruit)
- Students worksheet 2.3.1
- A hand shovel
- A pair of gloves

Procedure

This activity can be instructed to be done individually or in groups.

STEP 1

- Provide the following materials or ask the students to bring them and categorize the materials as follows.
  - Category A - Plastic bags
  - Category B - Journal paper on paper packaging
  - Category C - The peel of a fruit (apple/banana / local fruit)
- For each of the items, get three replicates of the same items.

STEP 2

- Ask the students to take a set of materials.
- Instruct them to assess their physical toughness by observing.
- Instruct the students to record their observations in Worksheet 2.3.1

STEP 3:

- Ask the students to keep the second set of materials in a place where away from direct sunlight and soil.

STEP 4

- Ask the students to bury the third set of materials in the soil.
- Ask the students to observe weekly, the changes that can occur (Ex: appearance - colour, physical toughness) in dug materials by comparing them with control samples.
- Instruct them to record their observations in Worksheet 2.3.1.

STEP 5

- Ask the students to present their observations.
- Let them suggest reasons for their observations.
- Guide the students to formulate a hypothesis regarding the relative resistance of different materials to environmental degradation based on their findings.
- Encourage students to extrapolate and predict the total time required to complete degradation based on the percentages of decomposition observed.
- Let students compare their estimations with the initial hypothesis.

Assessment Strategies

Observation, Output/product, Verbal communication, Written communication, Self/peer evaluation

Additional Resources

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

Activity 2.4: Know Your Plastics

Subject areas: Chemistry
Activity time: 90 min or less
Skills: Organise, Analyze, Interpret, and Apply Technology
Vocabulary: Archimedeis Principle, Density, Distinguish, Equilibrium, Expose, Flame, Saturate, Supernatant

In this activity, students learn to distinguish the 6 different types of plastic with a unique resin identification code on the base of their different densities and through a flame test.

You Will Need

Density Test – per group

- 3 graduated beakers (250 ml)
- A glass rod
- A pipette
- An electronic balance
- Pure water
- Ethanol 200 ml
- Sodium Chloride 300 g
- 6 types of plastic (PET, HDPE, PVC, LDPE, PP, PS) samples (2x2 cm parts; have identified using the recycling codes)
- A tweezer
- A chart of plastic recycling codes
- Student Worksheet 2.4.1.

Flame Test – per group

- 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 the copper wire
- Tongs or forceps
- Ring stand and ring with wire gauze
- Student Worksheet 2.4.1

Procedure

STEP 1

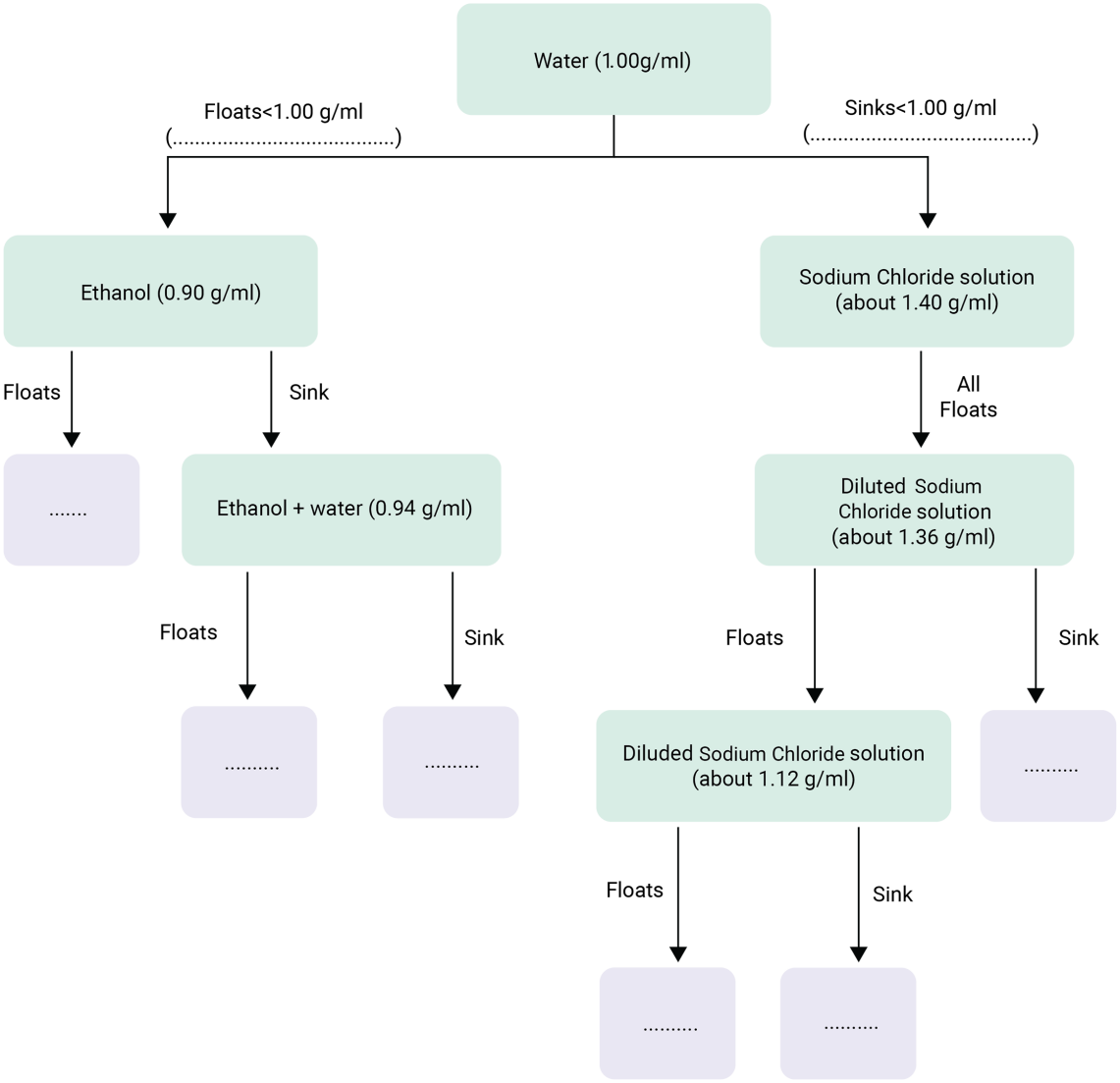
- Form groups of 4 or 5 students.
- Provide an explanation that certain plastic resin types release toxic chemicals when heated. suggest therefore that students use a face mask and safety glasses for the flame test.

- Emphasize that identifying different types of plastic allows for separate collection and recycling, aligning with: energy-saving and environmental protection policies.
- Note 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 sinks?

- Take 6 pieces of plastic samples and label them as follows.
  - PP - A
  - LDPE - B
  - HDPE - C
  - PET - D
  - PS - E
  - PVC - F
- Prepare a solution of ethanol and pure water (Density about 0.90 g/ml). This can be obtained by mixing 6 parts 96% ethanol, and 4 parts of water.
- Prepare a saturated solution of NaCl (the common kitchen salt) with, a density of about 1.40 g/ml. A saturated salt solution can be obtained by dissolving an excess amount of salt in warm water and taking the supernatant after letting it be cooled.
- Provide a set of plastics per group and ask them to identify them.
- Guide the students to conduct a density test with six polymers having unique plastic resin identification codes,with the following steps.
  - In a 250 ml graduated beaker, pour 175 ml of tap water and place six plastic pieces.
  - Separate the materials as floating and sinking.
  - Next, dry the floated materials (HDPE, LDPE and PP) and place them into the 250 ml beaker, containing 175 ml of ethanol solution, and separate the floated material (PP)
  - Then, add water (water is denser than ethanol) to the ethanol solution (0.5 ml at a time), until the density becomes about 0.94 g/ml.
  - As the observation HDPE still sinks in the solution, but LDPE floats.
  - Retrieve three sunken materials (PETE, PVC, and PS) and dry them.
  - Then, take the third beaker, containing 1.40 g/ml sodium chloride solution, and place three dried sunken in water into it.
  - All three plastic pieces will float since they are less dense than the 1.40 g/ml solution in Sodium Chloride.
  - Add more water to the solution (density becomes about 1.36 g/ml). As water is added to the dense solution, the solution becomes less dense and then PETE will sink.
  - Add more water to the beaker, until density lowers 1.12 g/ml. Then PVC sinks and PS stays floating.



- Conduct a discussion on how an object sinks if its density is higher than the surrounding fluid, floats if its density is lower, and remains in equilibrium if the densities match.
- Show that these findings are based on Archimedes' Principle.
- Guide the students to perform a flame test on sunken materials, HDPE, PVC, and PET, and to identify them.

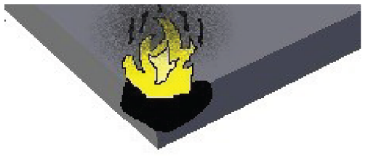
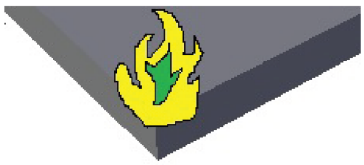
Note:

Some plastics are mixtures of several materials and may behave differently than expected to the above. In addition, it is recommended that the teacher needs to conduct the test before the activity with several plastic samples and arrange a good collection of plastic items in advance. Plastic waste can be recycled effectively only if they are composed of a single type of plastic resin; a mix of plastic resins cannot be easily recycled; food contamination alters the quality of the material and prevents it from being recycled.

B. Flame Test

- Explain the flame test, which is based on the colour the flame takes when in contact with specific substances (metallic salts).
- Explain to the students that recognition is based on the formation of Copper Chloride ($CuCl_2$) when a copper wire is put in contact with PVC (characteristic green colour, typical of Cu^{2+}).
- Guide the students to perform the flame test on HDPE, PET, and PVC using the following steps.
  - Wrap the copper wire around a wooden peg or use a test tube holder to hold the wire (this is to keep your fingers away from the hot flame).
  - Heat the copper wire in the burner flame until it is red hot and the flame no longer has a green colour.
  - Remove the wire from the flame and touch the hot wire to the plastic sample 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.
  - Expose the copper wire to the flame again.
  - Ask sudents for repeat this test for each of the remaining plastic samples that sank in the water.
  - Ask sudents for record conclusions based on the observations on worksheet 2.4.2.
- Point out that due to their similar densities of plastics potentially caused by additives and plasticizers.

Table 2.4.1: Plastics identification through burning test

Plastic - type	Burning test behaviour	Smoke odour	Burning illustration
HDPE	Due to their similar densities of plastics potentially caused by additives and plasticizers	Paraffine	
PET	Yellow flame. It produces a little black smoke	Characterisic. use the odour of a burnt bottle as a reference	
PVC	Yellow flame with green vertex. Self-extinguishing flame	Cholorine	

Note:

The flame test is based on the recognition of certain substances (metallic salts) based on the colour the flame sets when it is put in contact with the testing compound[10]. In this specific case, the recognition concerns the formation of Copper Chloride ($CuCl_2$). When a copper wire is put in contact with the polyvinyl chloride (PVC- which contains Chlorine) and then placed in the flame, the latter takes on the characteristic green colour, typical of Cu^{2+}.

The plastic will melt and stick to the copper wire (you can watch videos to see how to do this and what colour the flame should be for PVC). If the plastic material is PVC, the flame will turn green. If it's PET, the flame will stay the same colour.

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, in to a more stable state, and resulting in the emission of radiation. These characteristics for each are perceived as coloured light.

Recycling of polymer is part of energy saving and environmental protection policy. The identification of the different types of plastic helps to separate in collection process. Hence the possibility of mechanical recycling is ensured. However, it is not easy to identify the different types of plastic, whether all the 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 due to the presence of additives.

Instruct the student to Handle the bunsen burner with care, keeping flammable items away from the flame.

Assessment Strategies

Observation, Output/product, Verbal communication,Self/peer evaluation

Additional Resources

- Plastic Density Lab
  https://www.youtube.com/watch?v=Om9R9hPz3i4
- Archimedes Principle Test
  https://www.youtube.com/watch?v=K2ugHgJngN0
- Beilstein test (prove chlorine in pvc)
  https://www.youtube.com/watch?v=Cjdj0kFIsKY
  https://www.youtube.com/watch?v=ZDTcQArIiMU

Activity 2.5: Making and Investigating Bioplastics

Subject areas: Chemistry
Activity time: 60 min or less
Skills: Interpret, Apply, Technology
Vocabulary: Cons, Demonstrate, Evaluation, Observation, Pros, Fossil fuel-based plastics, Conventional plastics, Graphic organizer, Pros and cons, Research, PMI chart, Non-biodegradable, Renewable resources, Non-renewable resources

In this activity, students learn how to make bioplastic through a video. Let them discuss about it

You Will Need

- 1.5 tablespoons cornstarch
- 1 teaspoon vinegar
- 1 teaspoon glycerine
- 5 tablespoons of water
- food colouring (optional)
- 1 saucepan
- 1 wooden spoon
- 1 knife
- Scissors or a set of pastry cutters
- Non-stick baking sheets or oil paper
- Smartphone or a computer
- Student worksheet 2.5.1 and 2.5.2

Procedure

STEP 1

- Ask students' ideas about the meaning of bioplastics.
- Guide students to formulate a definition for bioplastics.
- After the students have developed a definition of bioplastics, display Figure 2.5.1 or draw it on the board.
- Discuss the difference between bioplastics and fossil fuel-based plastics.
- Discuss the different applications of bioplastics.

STEP 2

- Divide students into groups of 4 or 5 individuals.
- Remind the students that they've previously examined plastics derived from fossil fuels (oil).

- If you have sourced any items made from bio-plastics, let students handle them to see any differences between bio and fossil fuel-based plastics.
- Emphasize that bioplastics are good for the environment because it doesn't create as much pollution as regular plastic.

STEP 3

- Guide the students to 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 the all ingredients until they are all combined.
  - Place the saucepan over a 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 the students do the practical, instruct them to follow safety precautions related to cutting, heating, and handling hot materials.
- Point out that there are various methods and ingredients for making bioplastics. Encourage students to experiment with different methods, perhaps through internet research.

STEP 4

- Ask the students to research information about bioplastics (both pros and cons of bioplastics).
- Recommend them to use the worksheet 2.5.1: Graphic Organizer in their Student activity books to structure their research and document their findings.
- Prompt students to conduct a Plus (positive) - Minus (negative) - Interesting (PMI) analysis of both fossil fuel-based plastics and bioplastics. Have the class vote on which material they believe is better for the environment.
- Ask them to fill out worksheet 2.5.2.
- Guide the students to conduct a discussion on why it's important to consider all aspects of an issue or idea.
- Ask students to identify PMI aspects of bioplastics, ensuring they have a comprehensive understanding of the issue.
- Instruct the students to present their information.

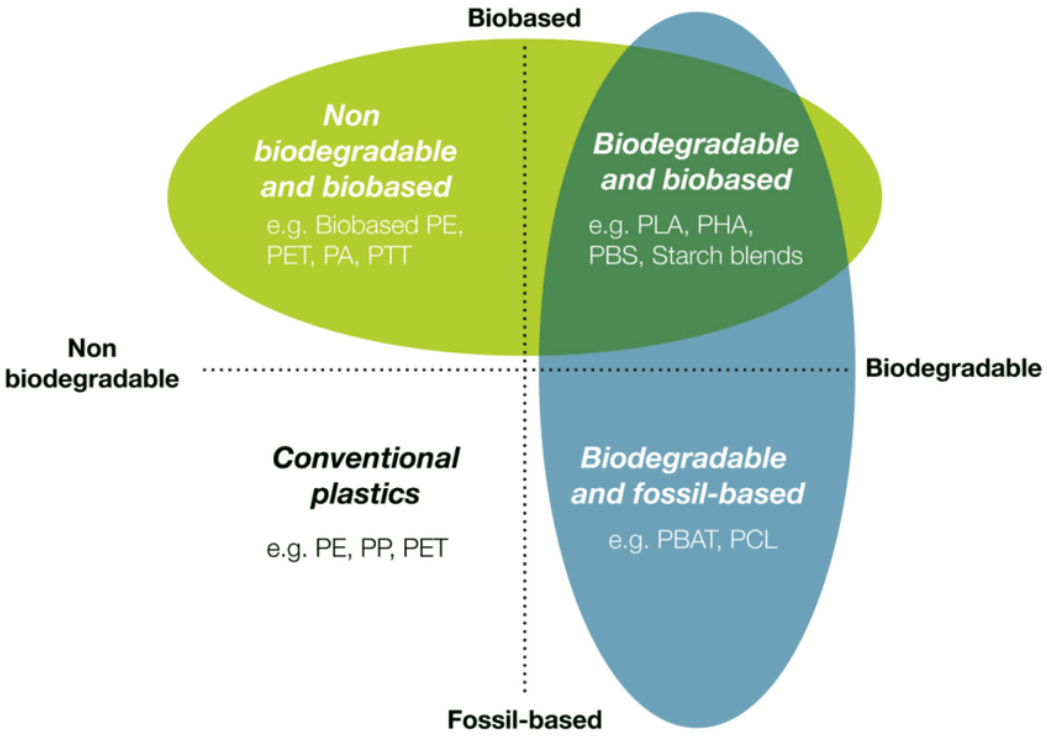


Figure 2.5.1: Fact Sheet European bioplastics Source: Modified from EU-Bioplastic[11]

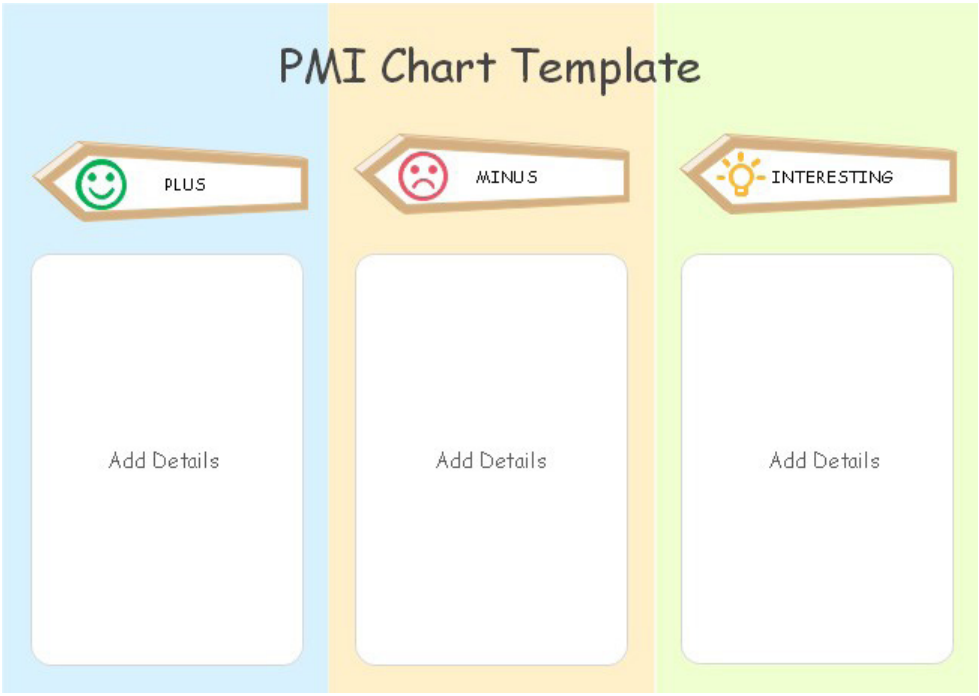


Figure 2.5.2: PMI Chart Template

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

Assessment Strategies

Observation, Output/product, Verbal communication, Written communication, Self/peer evaluation

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
- explainthatstuff.com/bioplastics.html
- explainthatstuff.com/plastics.html
- 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.

03 Human and Environmental Health

Activity 3.1: How Do Microplastics Enter Our Food?

Subject areas: Biology, Chemistry, Health
Activity time: 120 min or less
Skills: Interpret, Evaluate
Vocabulary: Avoid, Disposable, Dump, Object, Tiny

In this dramatized activity, young students act out the story of how microplastics find their way into our food.

You Will Need

(Please note that this activity does not have a sheet in the Student activity book)

Video: "Why We Eat Plastic Every Day. Microplastics in Your Food!" by Daxon - www.youtube.com/watch?v=-yzm6aB0YiU

Roles:

- The teacher acts as the storyteller and the person who coordinates the play.
- Two students play the main roles.
  - The second student acts as a girl.
  - The third student acts as a boy.
- The rest of the students are divided into three groups of different sizes of fish before the story starts:
  - one big tuna (one student)
  - a group of medium-sized fish (3–5 students)
  - a group of small fish (rest of all students)

Setting:

- Arrange a room or an outdoor area (weather permitting) with:
  - a couple of desks representing the two houses of the girl and boy.
  - a chair for the fishing location on the beach.
  - a few other chairs for the young girl and boy's dining room.

Props and Costumes:

The following costumes and props are required for the play.

Costumes:

- The "Big Tuna Fish" costume (refer to the video).

- Small and medium-sized costumes with similar patterns to the “Big Tuna Fish” for small and medium-sized fish.

Fishing props:

- A rod and a rope with a rounded (safe) hook to “catch” the tuna.
- 15-25 plastic balls: Ask students to create these by taping together the bases of small plastic bottles (e.g., 0.5 L PET bottles) collected at school or home.
- Disposable plastic items: Ask students to collect and clean items such as plastic bottles, cups, trays, and other containers, especially from food packaging.
- Hula-hoops: Ask students to find 4–6 hula-hoops (one per medium-sized fish).
- 15–25 plastic plates: one per student and two for the young girl and young boy roles).
- Blue fabric: Ask students to find two pieces of cheap blue fabric, each about 1.5× 2.5 m in size.

Procedure

STEP 1

- Introduce boy and girl characters to the audience.
- Ask the girl and boy characters who live in a small house near the sea to introduce themselves as they go fishing for food and manage their housework. Discuss with students where they go and what they need for fishing.
- One day, they decide to clean their house, collect items they no longer want and dump them into the sea.
- Ask students to suggest what are the items they will dump from their houses. Discuss the discarded items which may contain many plastic objects. Ask students to represent them by throwing collected disposable plastic items onto a piece of blue fabric symbolizing the ocean.
- Ask the students whether the girl and boy’s behaviour was acceptable and what they think will happen to the plastic objects.
- Encourage them to discuss what happens to plastic in the sea, especially how the sun, wind, and waves break them into tiny pieces called “microplastics”.

STEP 2

- Ask students to lay plastic balls on the piece of blue fabric representing microplastics.
- Ask students who act as small fish to play in the water, and when they see food (items in blue fabric) to eat them (pick them). Students acting as small fish should pretend to eat the microplastics (take plastic balls).
- Ask them, “What’s on your plate ?” and get their responses.
- Ask one of the students who acts as medium-sized fish to come along and eat the small fish (each medium fish puts a hula-hoop around two small fish and takes their plastic balls). Ask these students, “What’s on your plate ?” then.

- Finally, ask the student who acts as the big tuna fish to eat the medium fish, taking all the plastic balls from them. Ask these students, "What's on your plate ?"
- Ask the students who act as the girl and the boy to catch the big tuna fish.

STEP 3

- Ask students who act as the girl and boy to take the tuna fish home to eat and they discover many tiny pieces of plastic in the tuna fish.
- Discuss how plastics accumulate within fish bodies.
- Conclude the activity (the play) by discussing how to prevent microplastic pollution in the sea.

STEP 4

- Discuss with the students how to prevent microplastic pollution in the sea using the following questions:
- Do you enjoy eating fish?
- What happened to the plastic objects the girl and boy threw away, and how did they turn into microplastics that the fish ate?
- Should we stop eating fish, even though it's delicious and nutritious?
- How can we dispose of plastic objects more responsibly?
- Explain that microplastics can also end up in the air and soil and can be present in the water we drink and the food we consume, not just fish.

Discuss the ideas to help prevent microplastic pollution (the points to discuss are given in the Student activity book).

Assessment Strategies

Observation, Verbal communication, Self/peer evaluation

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/scence.1094559

Activity 3.2: How Microplastics Affect Your Health?

Subject areas: Chemistry, Ecology
Activity time: 60 min or less
Skills: Evaluate, Present
Vocabulary: Abrasion, Additive, Affect, Avoid, Evidence, Exposure, Harmful, Interfere, Microfiber, Originate, Plasticizers, Radiation, Recreation, Transparent, UV radiation

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

You Will Need

- Video "How microplastics affect your health" by UNEP
  https://www.youtube.com/watch?v=aiEBEGKQp_I

Procedure

- Show the video "How microplastics affect your health" to the students and then have them answer the questions. You can replay the video a second or third time if necessary.
- After students have individually answered the first 10 questions, ask a student to come to the blackboard and discuss the answers collectively.
- Discuss their answers collectively.

Note: Students may have information from other sources, and there may not be a single "correct" answer to these questions. The answers provided here are based on the information available at the time of the video.

Q1. What are microplastics?
A1. Microplastics are pieces smaller than 5 mm (or in more detail, plastic pieces between 1 µm and 5 mm).

Q2. How do they originate?
A2. Some microplastics come from cosmetics and personal care products as microbeads. Others enter the environment during usage (e.g., tyre abrasion particles, and synthetic textile microfibers). Most microbeads originate from plastic waste exposed to UV radiation, breaking into smaller pieces.

Q3. How many plastic particles are floating in the ocean?
A3. It is estimated to be about 51 trillion, although this number can vary based on new scientific findings.

Q4. What are the two types of chemicals added to plastics that may have impacts on health according to scientists?

A4. The two types of chemicals are bisphenol-A (BPA), which makes plastic bottles transparent but is thought to interfere with our hormonal system, and bis (2-ethylhexyl) phthalate (DEHP), which makes the plastic more flexible but may cause cancer.

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

A5. Microplastics are toxic because they travel up the food chain.

Q6. Give an example of a food chain with microplastics in it.

A6. microplastics > zooplankton > small fish > predatory fish > humans;
microplastics > oysters > humans; and microplastics > crabs > humans.
(one of the above)

Q7. In which food items have microplastics been found?

A7. Microplastics have been found in beer, clams, honey, table salt, tap water, and many more. They have also been found in household dust.

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

A8. Phthalates and BPA.

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

A9. Phthalates are found in the bodies of 8 out of 10 babies and nearly all adults.
BPA is found in the urine of 93% of people.

Q10. Do we have to panic?

A10. No, but it's important to understand that plastic is a manmade material with many chemical additives. Even though we didn't plan for these harmful effects, we have lost control of the harmful effects of plastic and related chemicals.

Q11. What can we do?

A11. This question is not answered in the video. Discuss it with the students and then show the list of advice.

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

Figure 3.2.1: Practical tips to avoid exposure to microplastics

Discussion elements:

Discuss the following with the students for further knowledge.

Human Exposure to Phthalates due to plastic packaging:

- Phthalate exposure primarily occurs through the consumption of food and beverages that have come into contact with phthalate-containing containers and products.
- Once inside the body, phthalates are converted into metabolites and quickly excreted in urine.[12]

Determinants of exposure[13]

- Data on lifestyle and food consumption habits as a determinant of exposure were collected through a dedicated questionnaire and food diary. From the analysis of the questionnaire, it was possible to establish which behaviours are significantly associated with a higher risk of exposure for mothers and students or in some cases only for one of the two groups.

12. Phthalates Factsheet https://www.cdc.gov/biomonitoring/Phthalates_FactSheet.html

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

- Children: Higher levels of phthalates are associated with:
  - use of single-use and reusable plastics (plates, cups, etc.)
  - use of plastic containers in microwaves
  - playing many hours, a day with plastic toys, especially for students 4–6 years old.
- Mothers: Higher levels of phthalates are associated with:
  - use of single-use and reusable plastics (plates, cups, etc.)
  - use of plastic containers in microwaves
  - consumption of water from plastic bottles
  - frequent consumption of takeaway food
- Increased exposure to BPA is linked to frequent consumption of pre-cooked foods and the use of food films.
- Physical or recreational activity is a protective factor, resulting in lower phthalate levels for both students and mothers.
- Lifestyle and dietary habits significantly influence exposure, and changing certain behaviours can help limit exposure

Conclusions from the study of the exposure-lifestyle determinants have led to practical tips for the population to minimize exposure to phthalates and BPA. Please refer to the "Student worksheet: Practical Tips to Avoid Exposure to Plasticizers" for more information.

Assessment Strategies

Observation, Output/product, Verbal communication, Written communication, Self/peer evaluation

Additional Resources

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

04 Policies to Reduce Plastic Pollution

Activity 4.1: What is MARPOL?

Subject areas: Social studies
Activity time: Up to one week/month
Skills: Organize, Analyze, Evaluate, Present
Vocabulary: Debris, Dispose, Dump, Incineration, Influence, Protocol, Refuse, Reduce, Reuse, Recycle, Rot

Students will learn about a solution to the marine debris problem; they will understand what it is like to hold trash onboard a ship. Students learn about the law that regulates the dumping of trash into the sea. Students will locate the Parties to the treaty on a world map. Then, students pretend their classroom is a ship and the students are the crew. The students begin a waste characterization study of the ship's garbage.

You Will Need

For each student / for small groups:

- A couple of clear plastic bags
- A copy of the world map
- The list of countries that are signatories to MARPOL

Procedure

STEP 1

- Divide the students into small groups.

STEP 2

- Initiate a discussion with the students about what MARPOL means, specifically focusing on Annex V (Regulations for the Prevention of Pollution by Garbage from Ships)[14].
- Point out that many countries work together to protect the world's oceans through this treaty.
- Discuss how this international law influences the behaviour of ship crews and shipboard practices for managing trash.
- Distribute a world map and a list of countries that are parties to MARPOL.
- Ask the students to label the world's oceans and then locate and label some of the countries that are party to the MARPOL treaty.

14 Annex V- Regulations for the Prevention of Pollution by Garbage from Ships
http://www.marpoltraining.com/MMSKOREAN/MARPOL/Annex_V/index.htm

STEP 3

- Discuss the five R's – REFUSE, REDUCE, REUSE, RECYCLE, ROT – as they apply to shipboard solid waste management.
- Point out to the class that they are now on a ship and cannot easily dispose of their garbage, except for food waste, after lunch.
- Appoint two students as lunchtime monitors responsible for collecting the classroom's garbage from lunch.
- Provide the monitors with a clear plastic bag for the garbage.
- Instruct the monitors to collect the class's garbage every day during lunch until the ship returns to port (at the end of one week or one month).

STEP 4

- Ask the groups to discuss MARPOL and to prepare a report. Guide the student for that.

Assessment Strategies

Observation, Output/product, Verbal communication, Self/peer/ group assessment

Countries/ Territories	Entry into force	Ratification	Simple signature
South Africa	Feb 28, 1985	Nov 28, 1984 (2)	-
Spain	Oct 06, 1984	Jul 06, 1984 (1)	May 16, 1979
Sri Lanka	Sep 24, 1997	Jun 24, 1997 (2)	-
Suriname	Feb 04, 1989	Nov 04, 1988 (2)	-
Sweden	Oct 02, 1983	Jun 09, 1980 (1)	Mar 01, 1979
Switzerland	Mar 15, 1988	Dec 15, 1987 (2)	-
Syrian Arab Republic	Feb 09, 1989	Nov 09, 1988 (2)	-
Tanzania, Un. Rep. of	Oct 23, 2008	Jul 23, 2008 (2)	-
Thailand	Feb 02, 2008	Nov 02, 2007 (2)	-
Togo	May 09, 1990	Feb 09, 1990 (2)	-
Togga	May 01, 1996	Feb 01, 1996 (2)	-

Source: International Convention for the Prevention of Pollution from Ships (MARPOL) as modified by the Protocol of 1978 (MARPOL 73/78) (ecolex.org)

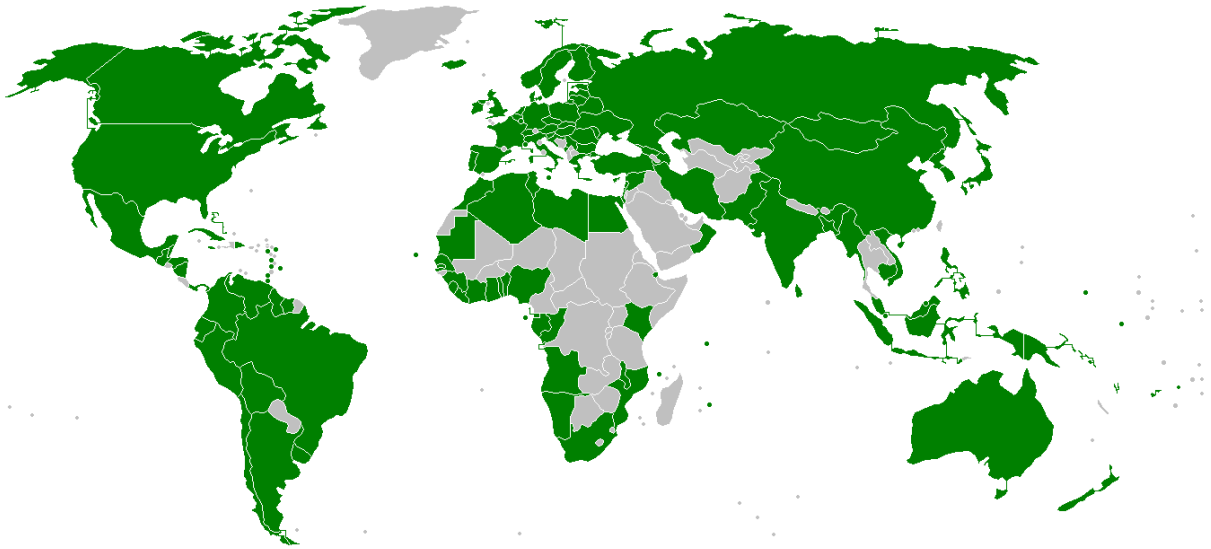


Figure 4.1.1: Countries that are parties to MARPOL

Definitions

MARPOL: MARPOL is the main international convention aimed at preventing marine environmental pollution from both accidental causes and routine vessel operations. As of 2020, the Convention has 158 Parties. Adopted by the International Maritime Organization (IMO), MARPOL consists of six annexes, each addressing specific types of pollution from ships:

Annex I - Oil Pollution: Establishes regulations to prevent oil pollution from ships, including rules on oil tankers, oil discharge criteria, and the mandatory carriage of an oil record book.

Annex II - Noxious Liquid Substances: Addresses the control of pollution by noxious liquid substances carried in bulk, providing criteria for categorizing substances and regulations for their handling and discharge.

Annex III - Harmful Substances in Packaged Form: Regulates the discharge of harmful substances packaged as cargo, prescribing labelling requirements and providing guidelines for the handling, storage, and disposal of such substances.

Annex IV - Sewage Pollution: Focuses on preventing pollution from sewage by regulating the discharge of sewage from ships and setting standards for treatment systems.

Annex V - Garbage Pollution: Aims to control the disposal of garbage from ships, prohibiting the dumping of certain materials and outlining requirements for the management and disposal of ship-generated waste.

Annex VI - Air Pollution: Addresses air pollution from ships by imposing limits on emissions of sulfur oxides (SOx) and nitrogen oxides (NOx), as well as setting guidelines for energy efficiency measures and the use of alternative fuels.

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 the Annex V, the dumping of 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 authorizes the respective port authority to specify rules and regulations regarding the display of placards (see example) to notify crew and passengers of the requirements of Annex V.

Each vessel should keep a log book describing their ship's garbage disposal activities. A log entry should be made each time a vessel's garbage is off-loaded at a port or incinerated on board. Large ports, marinas, private docks, and fish processing plants have to 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 facilities owners; oil and gas exploration workers; public vessels, including the military (put name of the navy); merchant ships.

Annex V only applies to ships from countries that are signatories to MARPOL, but 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.

MARPOL Annexes (3-D Animation) - YouTube

Activity 4.2: The Basel Convention and Its Plastic Waste Amendments

Subject areas: Social studies, Ecology
Activity time: 90 min or less
Skills: Organize, Interpret
Vocabulary: Amendment, Consent, Convention, Transboundary

In this activity, students will learn about the Basel Convention and its plastic waste amendments, emphasizing the concept of Prior Informed Consent (PIC), and the importance of environmentally sound management of waste 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. Students will learn about international trade in plastic waste as well as about the Basel Convention and its recent Plastic Waste Amendments.

STEP 1

- Divide the students into small groups (4 to 5 students). Each group represents each country seperately.

STEP 2

- Provide an overview of the Basel Convention, emphasizing the recent plastic waste amendments and the role of PIC.
- Explain that the game will simulate the process of obtaining PIC for the transboundary movement of plastic waste.

STEP 3

- Distribute a world map and a list of countries that are parties to the Basel Convention.
- Ask the students to label the world's continents and oceans on the map.
- Have the teams locate and label their respective countries on the map.

STEP 4

- Each team is given a set of puzzle pieces representing the components of the PIC process.
- The puzzle pieces include elements shown in the Figure (e.g., application, prior notice, etc.).
- Teams must assemble their PIC puzzle in the correct order to complete the PIC process.

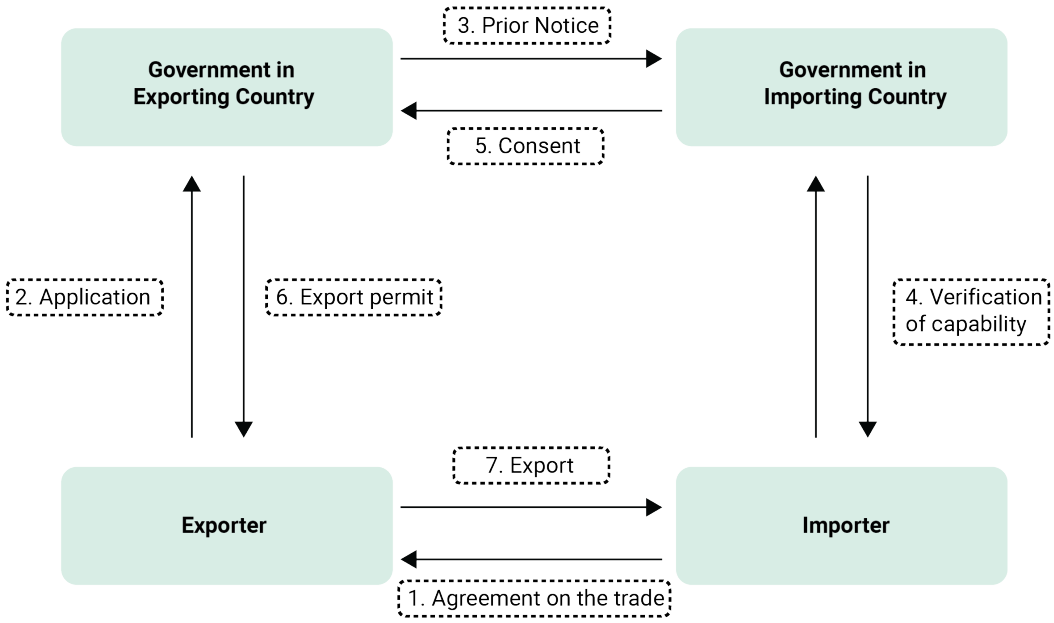


Figure 4.2.1 : Steps of PIC Process

STEP 5

- Each team has mock plastic waste items.
- Once a team completes its PIC puzzle, they can initiate a mock plastic waste shipment.
- The receiving team, representing another country, will decide whether to grant or deny PIC based on their evaluation of environmental and regulatory factors.

STEP 6

- Set a time limit for the entire game (45 min). The teams must complete the PIC puzzle, obtain PIC, and conduct the mock plastic waste shipments within the given time.

STEP 7

- After the game, gather the teams to discuss their experiences.
- Encourage a discussion about the challenges and considerations faced during the PIC process, including environmental impact assessments (EIA) and waste management plans.

- Highlight the importance of environmentally sound management of waste and the role of the Basel Convention in preventing improper disposal of plastic waste.
    - As an example, in 2019, Sri Lanka Customs discovered illegally imported waste materials, including plastic waste, clinical waste, used cushions and mattresses, plant parts, and other uncategorized and hazardous waste from the United Kingdom (UK). However, by the court order issued in June 2020, the involved parties reached an agreement to return the waste materials to the UK[15].

Assessment Strategies

Observation, Output/product, Verbal communication, Self/peer evaluation

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/

15 Report on Plastic waste management in Sri Lanka (ipen.org) - https://ipen.org/sites/default/files/documents/plastic_waste_management_in_sri_lanka.pdf

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

Subject areas: Social studies
Activity time: 60 min or less
Skills: Interpret, Evaluate
Vocabulary: Ban, Policy, Regulation, Stakeholder, Transboundary, Treaty

In this activity, students learn about which countries have imposed bans on the use of microbeads, single-use plastic bags, and single-use plastic products. The activity also focuses on the ongoing international negotiations including the prospective international treaty to address transboundary plastic pollution.

You Will Need

- Internet connection to show the website "The World Counts"
- Students worksheets
- Bans on microbeads, plastic bags, and single-use plastic products
- Map: countries that have banned microbeads
- Map: countries that have banned plastic bags
- Map: countries that have banned single-use plastic products

Procedure

STEP 1

- Introduce the activity by showing the website "The World Counts/Planet Earth/Number of plastic bags produced," which tracks daily, weekly, monthly, and yearly counts of plastic bags produced worldwide (https://www.theworldcounts.com/challenges/waste/plastic-bags-used-per-year).
- Instruct students to record the current count at the beginning of the class in their Student activity book.

STEP 2

- Disscuss the increasing human impact on Earth since the 20th century, particularly the massive volume of plastic objects produced, doubling every 20 years. In 2020 the mass of plastic objects was 8 Giga tonnes, i.e., double the mass of all terrestrial and marine animals, estimated at 4 Giga tonnes.
- Share information about government initiatives to reduce plastic pollution, including actions like banning microbeads, plastic bags, and foamed plastics.
- Mention specific examples, such as Sri Lanka's plastic bag ban[16]. Highlight that governments worldwide are taking steps to address plastic pollution through bans and levies.

16 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/

STEP 3

- Instruct the students to study three maps and respond to questions 1–4 individually.
- Divide the students into small group (4-5)
- Then, have each group work together to answer questions 5–8.
- Guide the students to study whether similar bans should be applied in their own country and how to avoid the use of microbeads, single-use plastic bags, foamed plastics, and other disposable plastic items.

STEP 4

- Return to "The World Counts" website and have students record the updated number of plastic bags produced in their Student activity book.
- Guide them through the process of performing algebraic subtraction to determine the change.

Extra Activity:

- Teachers can assign students to identify relevant policies and regulations in Sri Lanka concerning the banning of plastic items.
- Encourage students to discuss potential challenges faced by various stakeholder groups due to these bans (if students have their own experiences ask them to share them with the class).
- Additionally, inquire about the alternative plastic products students are aware of that can replace the banned items.

Tips for the teacher:

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

Assessment Strategies

Observation, Output/product, Verbal communication, Self/peer evaluation

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

05 Solutions to Plastic Pollution

Activity 5.1: Lifecycle of A Plastic Beverage Bottle

Subject areas: Ecology
Activity time: 60 min or less
Skills: Analyse, Interpret, Evaluate, Present
Vocabulary: Depletion, Eutrophication, Impact, Reduce, Reuse, Recycle

In this activity, students understand the environmental impact of a plastic beverage bottle at different stages of its lifecycle.

Note: This activity comes before Activity 5.2 "4R's (RETHINK, REDUCE, REUSE, RECYCLE)" and Activity 5.3 "IS RECYCLING WORTH IT?". Depending on your curriculum focus or areas of students' interest, the LCA and 4R's activities can be continued and extended in a variety of ways. Here they target plastic beverage bottles, but they 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 Lifecycle 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

- Inquire about the number of plastic beverage bottles students typically use in a week or a month.
- Distribute a plastic beverage bottle and a set of "Lifecycle Assessment Picture Cards" to each group.
- Instruct students to arrange the cards to create a visual narrative describing the entire lifecycle of a beverage bottle.
- Encourage them to express the life of a plastic bottle as a story, considering its full lifecycle.

STEP 2

- Assign peer groups to discuss the lifecycle of plastic bottles, using an infographic to illustrate the key stages.

Figure 5.1.1: Key Elements of Plastic Bottle Lifecycle[17]

- Introduce the concept of Lifecycle Assessment (LCA), which companies use to assess the environmental impact of their products. Explain that LCA can also compare the environmental impacts of different products serving the same purpose.
- Provide each group with an LCA sheet (preferably A3 size) and instruct them to collaborate on answering the questions, considering various environmental impact categories, such as climate change, eutrophication, and freshwater depletion.
- Encourage students to contemplate the potential environmental impacts at each stage of the bottle's lifecycle while addressing the questions.
- After the groups complete the questions, introduce the idea that LCA can help identify the stages of the lifecycle with the most significant environmental impact.
- Prompt students to share their ideas for reducing the bottle's environmental impact[18].
- Encourage other students to provide comments and feedback on their peers' suggestions.

Assessment Strategies

Observation, Output/product, Verbal communication, Written communication, Self/peer evaluation

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. Lifecycle 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

17 Key Elements of Plastic Bottle Lifecycle https://www.lifecycleinitiative.org/life-cycle-approach-to-plastic-pollution/

18 They might include, using different materials, thinner plastic, encouraging more people to recycle bottles, etc.

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

Subject areas: Ecology
Activity time: 60 min or less
Skills: Analyse, Interpret, Apply, Evaluate, Present
Vocabulary: Analysis, Impact, Interpret, Manufacture, Recycle

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

Note: This activity follows Activity 5.1. LIFECYCLE OF A PLASTIC BEVERAGE BOTTLE and before Activity 5.3. IS RECYCLING WORTH IT ?. Depending on your curriculum focus or areas of students' interest, the LCA and 4R's activities can be continued and extended in a variety of ways. Here they target plastic drink bottles, but they can be done with other single-use plastic products, such as food containers, etc.

You Will Need

- Students completed Lifecycle assessment sheets used in Activity 5.1
- Worksheet 5.2.1 on 4R's definitions - 1 per student

Procedure

STEP 1

- Begin by reviewing the students' discussion in Activity 5.1 regarding the lifecycle assessment (LCA) of a plastic bottle. Highlight key learning points throughout the lifecycle.
- Introduce the concept of the 4Rs (Rethink, Reduce, Reuse, and Recycle) as a framework for identifying opportunities to reduce the environmental impact of a plastic bottle or alternative products. Clarify that "Rethink" pertains to alternative products and product design, "Reuse" relates to consumption and end-of-life stages, and "Recycle" focuses solely on the end-of-life stage. Mention that the 4Rs are an extension of the original 3Rs concept and that there are variations, such as the 5Rs principle.

STEP 2

- Divide students into groups of two
- Assign each student group to use the 4Rs definition sheet to create a clear definition for each of the 4Rs (Rethink, Reduce, Reuse, Recycle).

STEP 3

- Encourage students to think like designers or consumers and identify opportunities to reduce the environmental impact of plastic bottles.
- Ask them to consider a lifecycle perspective and think about what modifications can be made from material sourcing to disposal.

- Suggest that different groups focus on one or two of the 4Rs. Students can express their ideas on lifecycle sheets or posters.
- Provide guiding questions for each "R":
- RETHINK: Do we need plastic bottles at all (i.e. water vending machine)? What are alternative options? Can we explore different raw materials for plastics?
- REDUCE: How can we reduce plastic bottle usage (e.g., through consumption reduction or thinner bottle production)?
- REUSE: Is it safe to reuse plastic (PET) bottles, and how can we encourage people to do so (e.g., promoting reusable bottles)?
- RECYCLE: How can we boost plastic bottle recycling and ensure proper sorting? Can bottle design facilitate recycling, and what products can be made from recycled plastic bottles?
- Highlight that students should also consider the recycling options available in their local context, such as Sri Lanka.

Assessment Strategies

Observation, Output/product, Verbal communication, Written communication, Self/peer evaluation

Activity 5.3: Is Recycling Worth It?

Subject areas: Ecology
Activity time: 60 min or less
Skills: Analyse, Interpret, Evaluate, Present, and Technology
Vocabulary: Deficiency, Efficacy, Impact, Implication, Recycle

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

Note: This activity follows **Activity 5.1, Lifecycle Of A Plastic Beverage Bottle and Activity 5.2, 4R's (Rethink, Reduce, Reuse, Recycle),** Depending on your curriculum focus or areas of students' interest, the LCA and 4R's activities can be continued and extended in a variety of ways. Here they target plastic beverage bottles, but can also be conducted with other single-use plastic products, such as water sachets, food containers, etc.

You Will Need

- Figure 5.3.1 on Environmental impact of recycling plastic beverage bottles sheet - 1 per small group
- Figure 5.3.2 on Global plastic production and its fate map
- Figure 5.3.3 on Plastic recycling: True or False? sheet - 1 per small group
- Student worksheet 5.3.1 on Plus, Minus, Interesting (PMI) analysis

Procedure

STEP 1

- Students may have suggested recycling as a means to reduce the environmental impact of plastics during the 4Rs activity. This step helps students explore the actual environmental effects of recycling plastics.
- Distribute "Environmental Impact of Plastic" sheets. Have students cut out the cards, and place them on their LCA sheets. Encourage them to think about how and where recycling affects the environmental impact in the product lifecycle.

STEP 2

- Ask students to describe their findings. You can supplement the card information with the Plastic Recycling: True or False? activity to reinforce their understanding of plastic recycling. It's important to note that all the facts on the cards are accurate.

- Now, instruct students to conduct a Plus (Positive), Minus (Negative), or Interesting (PMI) analysis of recycling. In the PLUS section, have them list the positive aspects of recycling, including its advantages, benefits, and positive impacts. In the MINUS section, they should list the negative aspects, such as disadvantages and negative impacts. In the INTERESTING section, encourage students to note anything intriguing that warrants future investigation about recycling, like implications, attention-grabbing facts, or appealing details.
- Tell students to consider the PLUS, MINUS, and INTERESTING characteristics of recycling as they relate to various types of plastics studied in Activities 2.1 (Identifying Plastics) and 2.4 (Know Your Plastic). Highlight the fact that only 9% of plastics have been recycled.
- Suggested follow-up activities might involve assignments to understand the current status of plastic recycling in the local context, such as the plastic recycling industry in Sri Lanka and initiatives related to plastic waste collection.

Assessment Strategies

Observation, Output/product, Verbal communication, Written communication, Self/peer evaluation

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

Subject areas: Ecology
Activity time: 60 min or less
Skills: Analyse, Interpret, Evaluate, Present, and Technology
Vocabulary: Deficiency, Efficacy, Impact, Implication, Recycle

In this activity, students will observe the items they use everyday and then critically assess the impacts of their choices on the environment. This critical assessment while developing a dialogue among peers is highly encouraged. Students are supposed to think about their everyday choices and the consequences through lifecycle thinking. Further, the activity can develop a dialogue on solutions through a circular economy.

You Will Need

- Commuter, Smartphone
- Internet access
- Whiteboard, paper, etc.
- Marker, pen and/or pencil
- Student worksheet 5.4.1 on PMI analysis

Procedure

STEP 1

- Select two similar everyday objects for comparison (e.g., pen vs. pencil, cotton bag or paper bag vs. plastic bag
- Plastic packaging for food vs. paper wraps, Plastic bottles vs. reusable bottles, Plastic containers for yoghurt vs. glass containers (with re-use option), and Styrofoam food containers vs. steel lunch boxes.
- Assign students to analyze the environmental, social, and economic aspects of their chosen products using reputable sources (scientific papers if possible). Give them about 15-20 minutes to search and discuss. In case of limited internet access, printed articles are acceptable.
- Have students consider these aspects:
    - Raw materials used for the product.
    - Production, including raw material sourcing.
    - Packaging.
    - Transportation/distribution.
    - Product use and lifespan.
    - End-of-life options, including recycling and disposal

STEP 2

- The PMI analysis can be applied to various aspects, including products, actions, and ideas. In this case, we will apply the PMI analysis to everyday objects. In the PLUS section, all the positive aspects should be listed, including advantages, benefits, and strengths In the MINUS section, all the negative aspects should be listed, including disadvantages, deficiencies, weaknesses, minuses, and negatives. Finally, in the INTERESTING category, anything that seems interesting and that requires future investigation should be listed.
- Tell the students to consider the PLUS, MINUS, and INTERESTING characteristics of the object they are studying throughout its entire lifecycle.

STEP 3

- Have student teams present their Lifecycle Assessment (LCA) and PMI analysis to each other, and allow for revisions based on inputs from the other team.
- After discussions, score each product in the PMI categories.
- The scoring is subjective and can involve class discussion.
- Give a time limit of 3-5 minutes for the discussion of each step.
- Compare the scores for the two product pairs.

STEP 4

- Ask groups to brainstorm ideas for redesigning their products to be more environmentally friendly.
- Introduce the concept of a circular economy.
- Discuss questions such as the product's impact on the planet and the various perspectives to consider when creating products. If time allows, use the "Circular Design Group Activity" sheet from the Student Activity book to design products in line with circular economy concepts (this can be a take-home activity).

Assessment Strategies

Observation, Output/product, Verbal communication, Written communication, Self/peer 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

Subject areas: Mathematics, Sociology, Ecology
Activity time: Overall several weeks
Skills: Gather, Organize, Analyze, Interpret, Apply, Evaluate, and Present, Technology
Vocabulary: Cosmetic, Footprint, Disposable

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

You Will Need

Internet access to use the plastic footprint calculator developed by the Basel Action Network (https://www.ban.org/plastic-pollution-prevention). The calculator considers plastic use from several categories:

Food and kitchen needs

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

Bathroom and laundry

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

Disposable containers and packaging

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

Other

- Toys
- Furniture

Procedure

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

STEP 1

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

STEP 2

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

STEP 3

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

STEP 4

- Discuss with the students the possible ways to reduce their daily footprint. For each of the four categories of plastic waste (Food and kitchen needs, bathroom and laundry, disposable containers and packaging, and others) inspect which one could be eliminated next week from consumption.
- Tell the students to take note of everything they use in the following week.

STEP 5

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

Assessment Strategies

Observation, Output/product, Verbal communication, Written communication, Self/peer evaluation

Additional Resources

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

Activity 5.6: Packaging free Lunch

Subject areas: Ecology
Activity time: 60 min or less
Skills: Gather, Organize, Analyze, Interpret, Evaluate, Present
Vocabulary: Harm, Mismanage, Prevent, Transportation, Recyclable

In this activity, students look at their use of packaging, especially Single-Use Plastic (SUP) Packaging, and see if they can reduce it. The scope is not limited to what they bring to the school, but also the transportation and supermarket storage stages of the lifecycle as well.

You Will Need

To prepare for the class you have to retrieve information about plastic waste in your country. If recent data are available for Sri Lanka, you can use them (you may refer to the National Action Plan on Plastic Waste Management 2021–2030 https://www.iges.or.jp/en/pub/national-action-plan-plastic-waste-management/en). Otherwise, look at the charts on Our World in Data / Plastics (https://ourworldindata.org/plastic-pollution) to extract those data. In particular:

- Internet and a display device such as a computer or smartphone.
- 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)
- Plastic Packaging - Behind the News (https://www.youtube.com/watch?v=e4z7GKGBVYk)

Procedure

STEP 1

- Ask students to recall the benefits of plastic packaging:
  - Minimizes food losses.
  - Protects goods during transportation.
  - Protects food from germs (e.g., COVID-19).
  - Protects sensitive products from temperature extremes (e.g., medicine).
  - Safeguards fragile and expensive items (e.g., computers, mobile phones).
  - Promotes product and brand recognition.
  - Prevents accidental poisoning.

STEP 2

- Show the "Plastic Packaging video" and have students observe their lunch, listing packaging items (use Student activity book or paper).
- Count food scraps, recyclable packaging, and non-recyclable packaging.

STEP 3

- Begin the discussion by highlighting the importance of packaging, especially during the COVID-19 pandemic, for minimizing contamination and preserving food. Emphasize that while packaging is essential in everyday life, much of it, especially single-use plastic (SUP), becomes waste.
- Explain that in Sri Lanka, the country produces about 5.7kilos of packaging per person each year, with 96% being mismanaged. A significant portion of this waste is plastic. Packaging constitutes 36% of total plastic waste, with only 4% being recycled. (If the teacher cannot find these values for Sri Lanka, please use the global and some other country information at "Plastic Atlas Japan Special Edition" https://www.iges.or.jp/en/pub/japans-plastic-waste-management/en)
- Mention that a substantial part of the plastic pollution problem is linked to SUP and disposable items that have replaced reusable containers. In Sri Lanka, about 36% of plastic is used for manufacturing single-use disposable packaging, such as plastic bottles, supermarket vegetable packaging, cups, straws, lunch sheets, and shopping bags. The demand-driven supply of plastic materials for consumer convenience, coupled with wrong usage and inadequate government controls, results in a surge of lightweight plastic waste with low recovery rates and increased pollution potential.

STEP 4

Ask students to think about the problems with waste plastic packaging:

- Wasting a recyclable resource.
- The cost of importing plastics.
- Pollution and environmental damage.
- Plastic waste eventually occupies landfill and disposal sites, and over time, it breaks down into smaller fragments, becoming microplastics. This poses a threat to ecosystems and has the potential to impact human health.

STEP 5

- Plan a plastic-free lunch day at school.
- Discuss using reusable dishes, silverware, and glasses to replace single-use plastic.
- Brainstorm with students on reducing food packaging in school lunches.
- Share packaging-free lunch ideas and communicate with parents.

- Examples include using reusable lunch boxes, home-cooked meals, and bringing reusable containers and water bottles.

STEP 6

- Discuss fresh foods vs. packaged food in terms of packaging, energy consumption, and nutrition.
- Encourage students to make a statement about the exercise of having a plastic-free lunch.
- Ask students how they'd like to communicate with their families and the school community to promote plastic-free lunches in the future.

Assessment Strategies

Observation, Output/product, Verbal communication, Self/peer evaluation

Additional Resources

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

Subject areas: Ecology
Activity time: 90 min
Skills: Organise, Analyze, Present
Vocabulary: Affect, Degradation, Ecosystem, Evaluation, Implement, Marine litter, Threat

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

You Will Need

- Internet and devices such as computers and smartphones
- Notebooks
- 1 type of plastic or common marine litter for each student group (e.g. plastic cup, PET bottle, balloon, aluminium can, waste fishing net, glass bottle, plastic straws, shopping bag)
- Worksheet 5.7.1 on "KNOW, THINK, ACT". The worksheet is composed of 2 columns and 8 rows.
- During the activity, the students will have to fill the rows of the second column.

Procedure

Marine plastic pollution is a significant global concern primarily originating from land-based sources. These sources contribute over 80% of marine plastics. The language and objectives in this activity can be adjusted to suit various age groups and competencies, either by simplifying concepts or incorporating more detailed information.

STEP 1

- Watch the video "Sources and Impacts of Marine Litter" (https://goo.gl/d9sJii).

STEP 2

- Divide the class into small groups, assigning each group a specific type of plastic and marine litter.
- Provide each group with the "KNOW, THINK, ACT" worksheet.
- Task each group with completing the worksheet to plan an original awareness campaign. The campaign's objective is to inform people about the specific type of plastic and marine litter they have been assigned, to prevent its impact on the environment.

STEP 3

- Ask each group to present its campaign to the class considering other groups as the target audience.
- At the end of all the presentations, you may ask the class to vote for the best campaign.

Evaluation

- The evaluation of the acquired knowledge can be done through the presentation of the campaigns developed by the students.
- The evaluation can also be done through the perception survey (see later).

Assessment Strategies

Observation, Output/product, Verbal communication, Self/peer evaluation

Additional Resources

- This is the big challenge: To implement the best campaign!
- Using this kind of litter-picking app, conduct a brand auditing to identify the most polluting brands in your area. Then design a campaign to reduce pollution. Students may think about how to get the support of polluting brands to implement their campaigns.

- Pirika is one of the world's most popular litter collection and social contribution apps.
- By enabling the users to visualize 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 plastic litter is a worldwide issue nowadays. This is especially problematic for litter leaking into rivers, oceans, and seas, as they not only destroy the ecosystems but also affect humans by entering our bodies.

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
- Additional resources include:
- http://www.beatthemicrobead.org/
- https://ed.ted.com/lessons/how-big-is-the-ocean-scott-gass
- https://www.aplixomarinho.org/
- 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.surfrider.org/programs/rise-above-plastics
- https://www.youtube.com/watch?v=017bBeXhYz4
- 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

Subject areas: Ecology
Activity time: 90 min or less
Skills: Analyse, Present
Vocabulary: Marine litter

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

You Will Need

- Smartphones

Procedure

- In this activity, students will create a 2 to 3-minute video on the issue of plastic litter and their solutions. Some key themes to be considered:
- Why is plastic litter a concern?
- Their observations on plastic litter
- What can be done to address plastic pollution?
- Additional ideas may include:
  - Showing a comparison of plastic packaging used on a typical day versus a plastic-free lunch.
  - Presenting a video about the campaign proposals generated in the “Change Is in Our Hands” activity.
- Depending on the student’s age and capabilities, they can either create the video independently or with your assistance.
- Offer guidance on speech preparation, which may involve writing a script, timing it to ensure the video is within the 2–3 minutes range, and using smartphones in a horizontal position for recording.
- Once the videos are completed, establish a judging panel within the class or school to select the best videos. Consider holding a public vote on YouTube to determine the top videos.

Assessment Strategies

Output/product, Verbal communication, Self/peer evaluation

Additional Resources

- If needed, you can show these videos to students to get inspiration.
- 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 (Toot) It, Haiku It, Draw It

Subject areas: Ecology
Activity time: 120 min or more
Skills: Present, Technology
Vocabulary: Artistic

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

Procedure

- Tell the students to get artistic and create some art related to what they have learned about plastic pollution and possible solutions and share them with others.
- The class can collectively focus on a specific art form, like an Instagram post, Tweet, Toot, Haiku, or drawing. You can schedule separate sessions for each art form or allow students to choose their preferred medium.
- **Tweet (Mastdon, Threads):** Instruct students to summarize their ideas into a few sentences, with a strict 140-character limit per tweet (toot). Encourage the use of relevant keywords and hashtags, such as #microplastic, #myocean, #Srilanka, and #plasticpollution.
  - Twitter (https://twitter.com)
  - Mastodon (https://joinmastodon.org/)
  - Threads (https://www.threads.net/)
- **Haiku:** Ask students to summarize their work in the form of a Haiku, which is a type of short-form poetry originating from Japan. Alternatively, students may use similar Sri Lankan poetry forms like Poem, Kavi, or Nisadas Kavi.
- **Draw:** Provide large paper and colour to students, allowing them to create an image that captures their understanding.
- Encourage students to share their drawings on social media platforms like Facebook or Instagram to express their ideas.

Assessment Strategies

- Output/product, Written communication, Self/peer evaluation

06 Awareness Raising Festival and Citizen Science Projects

Activity 6.1: The Ocean Festival

Subject areas: Ecology
Activity time: Half – one day
Skills: Present
Vocabulary: Awareness, Evaluate, Footprint, Impact, Intervention, Marine litter, NGOs, Plankton

An awareness-raising festival on the impacts of society on the marine environment will be developed. Students will participate in interactive activities about marine plastic litter organized in collaboration with experts from a local university, research institute, aquarium, or museum. The goal of this activity is to raise awareness about marine plastic litter and promote understanding of the causes, impacts, and solutions to the problem. The LITTER TRAP component is to build awareness of the plastics flowing from waste streams to the oceans. Moreover, the communities that live far from the coastal areas can use litter traps across the rivers to observe the contribution of land-based sources to marine plastic pollution. Nevertheless, the main activity is built around the ocean festival.

Description of the Festival

Ideally, a large-scale event (the festival) will be orchestrated to raise awareness regarding human responsibility for marine plastic pollution. Activities during this event may encompass outdoor pursuits (beach play and turtle conservation) and discovery experiences (such as guided tours of aquariums or visits to protected marine areas) to foster a sense of connection with the natural marine environment.

Within the festival's framework, four specific activities will be dedicated to increasing awareness about marine litter. Ideally, local experts in marine litter will oversee these activities, hailing from universities, research institutes, and non-governmental organizations (NGOs). These specific activities will employ a variety of techniques to heighten awareness and engage students in the subject of marine litter, including the use of posters, drawings, demonstrations, and mini-experiments. Students will participate in each activity for approximately 10 to 15 minutes, grouped in teams of five to ten members. The total duration of the intervention on marine litter will span 50 to 60 minutes.Moreover, students will take part in a perception survey (refer to Activity 7.1: Perception Survey) to evaluate their awareness and concern about marine plastic litter, their comprehension of the impacts and causes, and their self-reported behaviours related to litter reduction. This survey will be administered both before and after their participation in the specific activities centred around marine litter.

The following is a summary of the process:

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

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

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 as sessed 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 material that local experts use in their Outreach and Education activities about marine litter.

Procedure

Activity 1

- Students will explore recently collected macroplastic litter from a beach (or trap) by the organizers. The litter will be cleaned, with any potential hazards handled by experts.
- Students will observe the types of marine litter and sort materials in a mini-experiment to identify their sources.
- They will note the composition of marine litter samples (approximately 75% plastic globally).
- Students will learn about the negative impacts of marine plastic litter, such as harm to wildlife, tourism, and fishing, and also discover actions to reduce plastic litter (e.g., 3R - Reduce, Reuse, Recycle).

Tip: Display pictures of animals affected by plastic, like marine mammals, turtles, and seabirds entangled in debris.

Activity 2

- Organisers may pre-arrange microplastics and plankton for this activity.
- Students will examine microplastics and plankton under microscopes, understanding how litter breaks down into tiny particles over time, including plastic.
- They will learn about the risks of small marine organisms and wildlife ingesting microplastics.

Tip: Show a 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

- Students will explore global maps and short videos to understand how marine plastic litter can travel vast distances, reaching even remote regions like the Antarctic.
- Visual aids, such as maps, pictures, and videos, will be used.

Tips: Share visualizations like "Plastic adrift" [http://plasticadrift.org/?lat=18.6&lng=-40.6&center=-1.1&startmon=jan&direction=fwd] and "Perpetual Ocean" by NASA [link]. Discuss the impact on places like Midway Islands with Chris Jordan's pictures of albatross chicks filled with plastic waste [http://www.chrisjordan.com/gallery/midway/#CF000313%2018x24].

Activity 4

- Students will visit a model shop with products labelled using a labelling system to represent their plastic waste footprint. In the labelling system, the green dots signify a life cycle with a lower environmental footprint. Red dots represent products that use more material than necessary, packaging that does not use recycled content or is difficult to recycle, etc.
- Initially, students shop without seeing the labels and then receive a receipt with the labelling.
- They will be tasked with revising their shopping to attain a specific number of green dots.
- This activity aims to teach shopping practices that reduce marine plastic litter.

Tips: Offer products for sale, including both single-use plastic items (red dot) and sustainable alternatives (green dot). 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 bought in bulk; shampoo sachets vs. shampoo bottle or solid shampoo; sandwich in plastic packaging vs. sandwich in bee wrap.

Final Interactive Session

- A 10-minute Q&A to summarize key messages:
  - Did you find evidence of marine plastic litter?
  - What are the sources of marine plastic litter?
  - What are the impacts of marine plastic litter?
  - How can we reduce marine litter?

Assessment Strategies

Observation, Verbal communication, Self/peer evaluation

Additional Resources

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

Annex I - Guide

Time Required

ACTIVITY		Time
Section 1 - Plastic Waste and Microplastics		
1.1	What do you see?	60 minutes or less
1.2	Plastics in sand/soil	120 minutes or less
1.3	Microbeads from cosmetics and personal care products	60 minutes or less
1.4	How many microbeads are we dumping into the environment?	60 minutes or less
Section 2 - Exploring Plastics		
2.1	Identifying and categorizing plastics	60 minutes or less
2.2	How long does it take for plastics to degrade?	30 minutes or less
2.3	Investigating the degradation of plastics	Several weeks
2.4	Know your plastics	90 minutes or less
2.5	Making and Investigating Bioplastics	60 minutes or less
Section 3 - Human and Environmental Health		
3.1	How do microplastics enter our food?	120 minutes or less
3.2	How microplastics affect your health?	60 minutes or less
Section 4 - Policies to Reduce Plastic Waste		
4.1	What is MARPOL?	Up to one week/ month
4.2	The Basel Convention and its Plastic Waste Amendments	90 minutes or less
4.3	Bans on microbeads, plastic bags, and single-use plastic products	60 minutes or less
Section 5 - Solutions to Plastic Pollution		
5.1	Lifecycle of a plastic beverage bottle	60 minutes or less
5.2	4R's (Rethink, Reduce, Reuse and Recycle)	60 minutes or less
5.3	Is recycling worth it?	60 minutes or less
5.4	Everyday comparison debate: life cycle thinking and circular economy	60 minutes or less
5.5	Reduce your plastic footprint	Over several weeks
5.6	Packaging free lunch	60 minutes or less
5.7	Change is in our hands	90 minutes
5.8	Video making to fight plastic pollution	90 minutes or less
5.9	Tweet it, Haiku it, Draw it	120 minutes or more
Section 6 – Awareness Raising Festival and Citizen Science Projects		
6.1	The ocean festival	Half – one day

Subject Areas

ACTIVITY		Maths	Biology	Chemistry	Ecology	Health	SST
Section 1 - Plastic Waste and Microplastics							
1.1	What do you see?						
1.2	Plastics in sand/soil		O	O	O	O	O
1.3	Microbeads from cosmetics and personal care products	O	O	O	O	O	O
1.4	How many microbeads are we dumping into the environment?		O	O	O		
Section 2 - Exploring Plastics							
2.1	Identifying and categorizing plastics			O			
2.2	How long does it take for plastics to degrade?	O		O	O		
2.3	Investigating the degradation of plastics			O	O		
2.4	Know your plastics			O			
2.5	Making and Investigating Bioplastics	O		O			
Section 3 - Human and Environmental Health							
3.1	How do microplastics enter our food?		O	O		O	
3.2	How microplastics affect your health?			O	O	O	
Section 4 - Policies to Reduce Plastic Waste							
4.1	What is MARPOL?						O
4.2	The Basel Convention and its Plastic Waste Amendments						O
4.3	Bans on microbeads, plastic bags, and single-use plastic products	O					O
Section 5 - Solutions to Plastic Pollution							
5.1	Lifecycle of a plastic beverage bottle	O		O	O		
5.2	4R's (Rethink, Reduce, Reuse and Recycle)				O		
5.3	Is recycling worth it?	O		O	O		
5.4	Everyday comparison debate: life cycle thinking and circular economy				O	O	
5.5	Reduce your plastic footprint	O		O	O		
5.6	Packaging free lunch				O		
5.7	Change is in our hands				O		O
5.8	Video making to fight plastic pollution		O	O	O		O
5.9	Tweet it, Haiku it, Draw it				O		
Section 6 – Awareness Raising Festival and Citizen Science Projects							
6.1	The ocean festival	O	O	O	O	O	O

Skill

	ACTIVITY	Gather	Organise	Analyse	Interpret	Apply	Evaluate	Present	Tech
Section 1 - Plastic Waste and Microplastics									
1.1	What do you see?				O			O	
1.2	Plastics in sand/soil			O	O		O		
1.3	Microbeads from cosmetics and personal care products		O	O					
1.4	How many microbeads are we dumping into the environment?			O			O		
Section 2 - Exploring Plastics									
2.1	Identifying and categorizing plastics		O	O	O		O	O	
2.2	How long does it take for plastics to degrade?		O	O	O			O	
2.3	Investigating the degradation of plastics			O	O	O	O		
2.4	Know your plastics		O	O	O	O			O
2.5	Making and Investigating Bioplastics				O	O			O
Section 3 - Human and Environmental Health									
3.1	How do microplastics enter our food?				O		O		
3.2	How microplastics affect your health?						O	O	
Section 4 - Policies to Reduce Plastic Waste									
4.1	What is MARPOL?	O	O	O			O	O	
4.2	The Basel Convention and its Plastic Waste Amendments		O		O				
4.3	Bans on microbeads, plastic bags, and single-use plastic products				O		O		
Section 5 - Solutions to Plastic Pollution									
5.1	Lifecycle of a plastic beverage bottle			O	O		O	O	
5.2	4R's (Rethink, Reduce, Reuse and Recycle)			O	O	O	O	O	
5.3	Is recycling worth it?			O	O		O	O	
5.4	Everyday comparison debate: life cycle thinking and circular economy	O	O	O	O		O	O	
5.5	Reduce your plastic footprint	O	O	O	O	O	O	O	O
5.6	Packaging free lunch	O	O	O	O		O	O	
5.7	Change is in our hands		O	O			O		
5.8	Video making to fight plastic pollution			O				O	
5.9	Tweet it, Haiku it, Draw it							O	O
Section 6 – Awareness Raising Festival and Citizen Science Projects									
6.1	The ocean festival							O	

Assessment Strategies

ACTIVITY		Observation	Output/ product	Communication: Verbal	Communication: Written	Self/Peer Evaluation
Section 1 - Plastic Waste and Microplastics						
1.1	What do you see?	O	O	O		
1.2	Plastics in sand/soil	O		O		
1.3	Microbeads from cosmetics and personal care products	O	O	O		
1.4	How many microbeads are we dumping into the environment?	O	O	O		O
Section 2 - Exploring Plastics						
2.1	Identifying and categorizing plastics	O	O	O		O
2.2	How long does it take for plastics to degrade?	O	O	O		O
2.3	Investigating the degradation of plastics	O	O	O	O	O
2.4	Know your plastics	O	O	O		O
2.5	Making and Investigating Bioplastics	O	O	O		O
Section 3 - Human and Environmental Health						
3.1	How do microplastics enter our food?	O		O		O
3.2	How microplastics affect your health?	O		O		O
Section 4 - Policies to Reduce Plastic Waste						
4.1	What is MARPOL?	O	O	O		O
4.2	The Basel Convention and its Plastic Waste Amendments	O	O	O		O
4.3	Bans on microbeads, plastic bags, and single-use plastic products	O	O	O		O
Section 5 - Solutions to Plastic Pollution						
5.1	Lifecycle of a plastic beverage bottle	O	O	O	O	O
5.2	4R's (Rethink, Reduce, Reuse and Recycle)	O	O	O	O	O
5.3	Is recycling worth it?	O	O	O	O	O
5.4	Everyday comparison debate: life cycle thinking and circular economy	O	O	O	O	O
5.5	Reduce your plastic footprint	O	O	O	O	O
5.6	Packaging free lunch	O	O	O		O
5.7	Change is in our hands	O	O	O		O
5.8	Video making to fight plastic pollution		O	O		O
5.9	Tweet it, Haiku it, Draw it		O		O	O
Section 6 – Awareness Raising Festival and Citizen Science Projects						
6.1	The ocean festival	O		O		O

FUTURE INFORMATION

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