



**BEAT  
PLASTIC  
POLLUTION**



**WORLD  
ENVIRONMENT  
DAY**



**INDIA  
2018**



# Towards Responsible Use of Plastics

## Reduce, Reuse, Recycle

A Manual for Schools



**CEE**

Centre for Environment Education, India

करेंगे संग  
प्लास्टिक  
प्रदूषण से जंग



विश्व  
पर्यावरण  
दिवस



भारत  
2018

UN  
environment

# Towards Responsible Use of Plastics

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# Acknowledgement and Credit

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**Towards Responsible Use of Plastics: Reduce, Reuse, Recycle** is a Kit for schools across India, containing a Teachers Manual, three posters and a booklet for students, which provides information about Plastics, plastic pollution and promotes Handprint activities towards their responsible use as part of a sustainable lifestyle.

We wish to thank the UN Environment for giving us this opportunity to work on this Kit that focuses on this year's World Environment Day theme – Beat Plastic Pollution.

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# Preface

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Over the past three hundred years, technology has unquestionably enhanced the life and wellbeing of a greater portion of humanity than in all of the human history that went before. Ordinary people can now live longer, healthier and more fulfilling lives than even the mightiest potentates of earlier times.

Yet, despite bringing enormous benefits, some technology solutions carry their own seeds of failure and rejection by causing problems that are greater than the solutions they first offered. Fossil fuels, DDT, leaded gasoline, CFCs are among the “miracle” products that have in due course bitten the dust of environmental backlash. The Green Revolution comes fairly high in this list.

One with the greatest promise, comparable to that of the coal and oil which fueled the industrial revolution, and the Green Revolution which saved so many from starvation, is the wide spectrum of materials called Plastics. Life today, whether in the richest or poorest communities, is unthinkable without these materials. They pervade every activity, every nook and corner, of human existence. From materials to build houses, through buckets to carry and store water, to automobiles and appliances for mobility and productivity, finally to packaging for preserving food – human survival is hard to imagine today without the use of plastics.

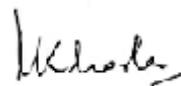
Unfortunately, the very properties that make them valuable – versatility, durability, multiple uses, resistance to degradation – have, within a century after their introduction into the market, made them into a life-threatening menace.

Plastics now also pervade every habitat and every nook and corner of the planet’s environment. In the home, tiny particles of plastic (“micro-plastics”) pervade the indoor air and settle on food and eating utensils, creating health hazards that are only now beginning to be recognized, but already thought to be quite dangerous.

In the streets and landfills of cities and villages, remnants of plastic bags get eaten by animals, only to strangulate their internal organs. In the oceans, from the surface to the bottom of the deepest trenches, pieces of plastic testify to the presence, possibly far away, of human “civilization”. The Pacific Gyre, a (continent-sized) island made entirely of waste plastics 1.6 million sq. km – three times the size of France – floats aimlessly feeding sea-birds, fish and whales with an indigestible diet of non-degradable plastic. No sea life can survive such poisoning.

The solution is not to ban all plastics all of a sudden. That was necessary and possible in the case of DDT, CFCs and leaded petrol. What is now needed is an immediate stoppage of plastics use that is either not essential or is substitutable by other more environmentally benign materials. And, of course, urgent support must be given to research and innovation to develop alternatives that bring the same benefits but do no harm.

Governments, businesses, civil society and academia each have major roles to play in this effort to bring together policies, funding, R&D, monitoring and all the other functions that will rescue plastics for the uses they are most valuable for, and finding substitutes for the ones that should follow the sunset.



**Dr. Ashok Khosla**

Chairman, Governing Council, CEE

**Earth Day 2018 - Theme:  
End Plastic Pollution**

Earth Day 2018 focussed on fundamentally changing human attitude and behaviour about plastics and catalyzing a significant reduction in plastic pollution.

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**World Environment Day 2018 -  
Theme: Beat Plastic Pollution:** If you can't reuse it, refuse it.

The theme of the World Environment Day 2018 invites all to consider how we can make changes in our everyday lives to reduce the heavy burden of plastic pollution on our natural places, our wildlife – and our own health.

---

**UN Environment Assembly (UNEA)  
– December 2017, Nairobi:** During the closing plenary of the UNEA-3, the member states adopted 11 resolutions submitted by Member States, calling for accelerated action and strengthened partnerships on, *inter alia*, combating the spread of marine plastic litter and microplastics.

# An Introduction to Plastics

## Introduction

The invention of plastics has been nothing short of miracle. It would be difficult to think of our modern world without plastics. From commonplace domestic articles to sophisticated scientific and medical instruments, they are an integral part of everyone's lifestyle in varying applications. Plastics are widely used by designers and engineers because they offer combinations of properties not available in any other materials. They are light, resilient, resistant to corrosion, colour fast, and easy to process, and although they have their limitations, their utilization is limited only by the ingenuity of the designer. Lightweight and good for insulation, plastics help save fossil fuels used in heating and in transportation. Most importantly, the easy availability of low cost plastics has helped raise the standard of living for people all over the world. Replacing natural materials with plastic has made many of our possessions cheaper, lighter, stronger and more durable.

The word plastic comes from the Greek word *plastikos*, which means 'able to be shaped or moulded'. Shaping plastics by using heat is a basic part of its manufacturing process.



## What are Plastic made of?

### Polymers

Plastics are usually considered as a relatively recent development but in fact, as part of the larger family of polymers, they are a basic ingredient of animal and plant life. Polymers encompass a large class of natural and synthetic materials with a wide variety of properties.

Different polymers exhibit different properties based on the characteristics of the molecules that they are made of. Hence we have things made of polymers that can look and feel rubbery (like a bouncing ball), sticky and goeey, or hard and tough (like furniture).

Because of the extraordinary range of properties of polymeric materials, they play an essential role in everyday life. This role ranges from the familiar synthetic plastics and elastomers (those that exhibit elastic properties, like rubber) to natural biopolymers such as proteins, cellulose and DNA. Naturally occurring polymers have been used for thousands of years throughout the world. However, it was not until the 19th century that attempts were made to develop synthetic plastics.

#### Polymer

'Poly' means 'many' and 'mer' means 'segment' or 'part'. Hence polymers are long chains formed of tiny molecules. Molecules or groups of them which can be made into polymers are called monomers.

### Natural and Synthetic Polymers

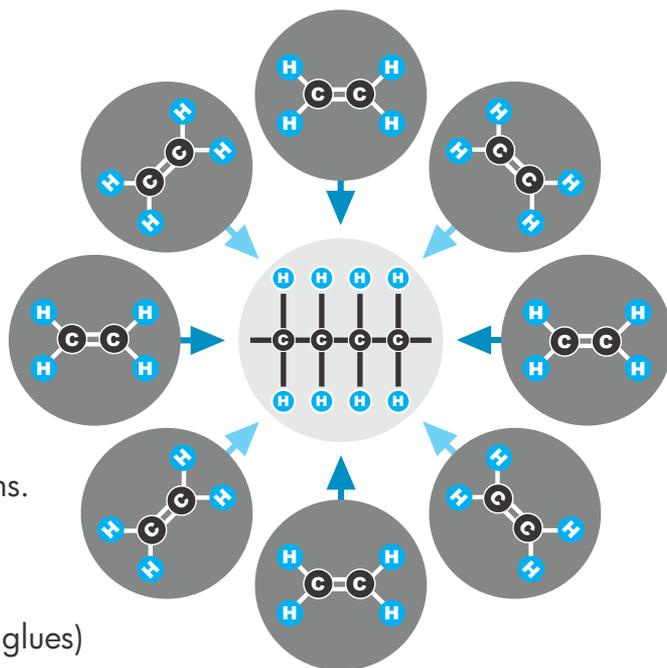
Polymers are of two types: natural and synthetic.

#### Natural Polymers

Natural polymers occur in nature and can be extracted. They are often water-based. Most natural polymers are condensation polymers, i.e., they are formed through a condensation reaction, with water or methanol being the by-products. Examples of naturally occurring polymers are silk, wool, DNA, cellulose and proteins.

Polymers are widely found in nature and occur in:

- Plants – as cellulose
- Trees – as latex, amber and resin (used to make glues)
- Animals - as horn and milk
- Insects – as shellac (used to make polish)



Ethylene is a monomer molecule, several of them joining together to make polyethylene, a polymer, the most common plastic.

**Table: Natural Polymers**

<b>Natural Polymers</b>	<b>Found in</b>	<b>Characteristics</b>	<b>Use</b>
Proteins	All animals	Large complex molecules, which like fats and carbohydrates, are long polymers chains. They are made from amino acids.	Wool, silk are mainly used for clothes
Cellulose	Plant fibres (cotton, hemp, flax, jute) and wood	It has no taste, is odorless, is insoluble in water and most organic solvents is biodegradable	Major constituent of paper, paperboard, card stock; main ingredient in textiles made from cotton, linen and other plant fibres
Chitin	Cell walls of fungi; exoskeletons (rigid outer covering of animals, like some arthropods) of crustaceans, insects and spiders; shellfish waste	Polysaccharide (a carbohydrate like starch made up of bonded sugar molecules) similar to cellulose; second most abundant organic compound on earth	Making of edible plastic food wrap and cleaning of industrial waste water
Starch	Plants – it is the food reserve for all plants	Most abundant carbohydrate food material in the biosphere. It is white, tasteless and odourless and is insoluble in cold water or alcohol	Converted to sugars by malting; Used to produce sugars that are used in processed foods; Used to produce ethanol in the manufacture of beer, whisky and biofuel; Made into a thickening, stiffening and gluing agent by mixing with warm water; Used as adhesive in the paper making process

Natural Polymers	Found in	Characteristics	Use
Rubber	Tree latex	Sticky, non durable (rots easily); Usually vulcanized (heated in the presence of sulphur) to improve its elasticity, resilience and durability. Rubber can also be made (synthesized) by the polymerization of different monomers mixed in various proportions to give a wide range of physical, chemical and mechanical properties	Synthetic rubber is used widely for making tyres and tubes, belts, matting, flooring, medical gloves, as adhesives in industrial applications, etc.
Pectin	Citrus peels and remains of apples	A carbohydrate polymer which is present in virtually all plants where it contributes to the cell structure	Main use is as a gelling agent, thickening agent and stabilizer in food. Its classical application is giving the jelly like consistency to jams and marmalade

## Synthetic Polymers

Synthetic polymers are derived from petroleum oil, and manufactured by scientists and engineers. Examples of synthetic polymers include nylon, polyethylene, polyester, Teflon, polyvinyl chloride, Bakelite and synthetic rubbers.

Synthetic polymers are chemically manufactured in industry, for which the raw materials are obtained from petroleum, after the refining and cracking processes. The types of synthetic polymers include plastics, fibre and elastomers.

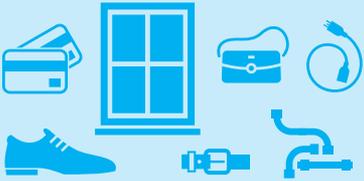
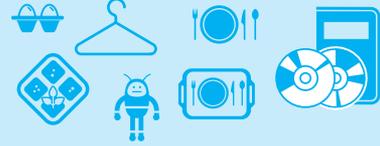
Plastic is a synthetic material made from a wide range of polymers that can be moulded into shape when soft and then set into a rigid or slightly elastic form.

Plastics are divided into two distinct groups based on their thermal processing behaviour: **thermoplastics** and **thermosets**. **Thermoplastics**, once formed, can be heated and reformed over and over again. This property allows for easy processing and facilitates recycling. **Thermosets** cannot be reformed, remoulded or reshaped. Once these polymers are formed in a particular shape, it remains the same.

**All plastics are polymers,  
but all polymers are not plastics.**

## Types of Plastics

The Society of the Plastics Industry (SPI) established a classification system in 1988 to allow consumers and recyclers to identify different types of plastic. Manufacturers place an SPI code, or number, on each plastic product, usually moulded into the bottom. The table below provides a basic guide to the different plastic types associated with each code number.

Plastics Type		General Properties	Household Uses
Polyethylene Terephthalate		Commonly recycled. High heat resistance, clear, hard, tough, microwave, transparency, solvent resistant	
High Density Polyethylene		Commonly recycled. Chemical resistant, semi flexible and strong, stress resistant	
Polyvinyl Polyethylene		Sometimes recycled. Chemical resistant, hard and rigid (can be made flexible too), stable in the long term, good weathering, harmful if ingested	
Low Density Polyethylene		Sometimes recycled. Tough and flexible, durable, low melting point	
Polypropylene		Occasionally recycled. Chemical resistance, hard but flexible, strong, high melting point	
Polystyrene		Commonly recycled. Rigid or foamed, hard, brittle, affected by fats and solvents	
Other		Difficult to recycle. Miscellaneous types of plastics not defined by the six codes above, including Polycarbonate and Polylactide	

## The Evolution of Plastics – Some Milestones

Prevailing over the traditional and natural materials, plastics evolved as a strong alternative. It seeped its way into various uses, much of which was a fall-out of the World War II.

Due to their low cost, ease of manufacture, versatility, and imperviousness to water, plastics is used in a multitude of products of different scales, ranging from paper clips to spacecraft.

The multi-purposeness was also because of the constant innovation in the development of synthetic polymer materials juxtaposed to the naturally occurring polymers such as the cellulose, proteins and starches. This gave way to various materials such as Kevlar, nylon, polyester and many more.

Moreover, the improvement in polymers, while using existing technologies, pioneered the extensive use of plastics in the medical field.

### The First Synthetic Plastic – Celluloid

**John Wesley Hyatt**, an American inventor and industrialist, discovered the process for making celluloid, the first practical artificial plastic. In 1863, attracted by a reward of \$10,000 offered by a New York billiards company to anyone who could invent a satisfactory substitute for ivory billiard balls, Hyatt experimented with several compositions, none of which produced a successful billiard ball, but eventually discovered an attractive and practical plastic material, which he and his brother patented in **1870 as celluloid**.

### The First Thermosetting Plastic – Bakelite

**Leo Baekeland**, a U.S. industrial chemist, found the modern plastics industry through his invention of **Bakelite**, the first **thermosetting plastic**. His search, begun in 1905, for a synthetic substitute for shellac (an electric insulator) led to the discovery of **Bakelite** in **1907**, which was not only a good insulator, but could also be moulded and shaped as required, and was suitable for mass production. It was used to make bowling balls, phonograph records, telephone housings, cookware and billiard balls, besides several other applications in industry, many of which are still in use in the 21st century.

### The First Synthetic Fibre – Nylon

**Wallace Hume Carothers**, an American chemist, Director of Research in Organic Chemistry with DuPont, developed **nylon** in **1938**, the first synthetic polymer fibre to be produced commercially and one that laid the foundation of the synthetic-fibre industry. Nylon is an artificial fibre with properties similar and in many ways superior to such natural fibres as wool, cotton and silk, and to neoprene, a synthetic rubber derived from vinylacetylene.

# A Miracle Product

1950



Polyethylene bags with handles make their first appearance.

1969



The first man on moon, Neil Armstrong, plants a nylon flag of the United States to mark his landing.

2010



An e-reader, Amazon Kindle, designed using a resilient plastic outer body case

1958



Lego patented its stud and block coupling system and went on to produce toys.

1973



Motorola's Martin Cooper designs DynaTAC, the first ever handheld and portable phone.

2000

Nanotechnology starts being applied to polymer and composite applications.

1885



EASTMAN American Film was patented to be further produced by George Eastman Kodak

1965



'Kevlar' is first developed by DuPont and used in tyres.

1977



PET (Polyethylene terephthalate) bottles introduced

1941



Henry Ford's 'Soybean Car', that used soybean fibre in a phenolic resin with formaldehyde for the plastic panels, was unveiled.

1940



With the introduction of PVC, radar cable insulations started using Polyethylene.

1988



Recycling symbols for plastics introduced

1925

Leo Baekeland introduces the word 'Plastic'.

1997



Captain Charles Moore discovered the 'Great North Pacific Garbage' patch formed due to ocean currents

## But...



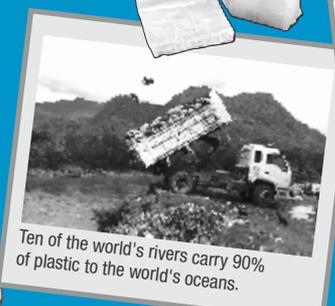
India generates 5.6 million tonnes of plastic waste annually



8 millions tonnes of plastic is estimated to enter ocean



Greenpeace, an environmental NGO, stated that at least 267 different animal species are known to have suffered from entanglement and ingestion of plastic debris



Ten of the world's rivers carry 90% of plastic to the world's oceans.



## Advantages and Disadvantages

We live in an age of plastics - bright, attractive, colourful, long-lasting, relatively inexpensive substances whose invention has revolutionized the manufacturing industry. Plastics certainly have advantages. Unfortunately, they also bring problems to our world, not the least among these being the generation of vast quantities of waste material.

### Advantages of Plastics

- Durable
- Low cost
- Water resistant
- Corrosion proof
- Light weight but strong
- Can be easily moulded and given any shape and good finish
- Less wear and tear
- Can be roughly handled (as compared to glass)
- Unbreakable
- Odourless
- Wide range of use in industry, agriculture, construction, electronics, packaging, transportation and household sectors

### Disadvantages of Plastics

**Non-degradable:** takes anywhere from 500-1000 years to degrade; hence, causes a huge waste problem – especially in landfills and oceans. It is said that about 97% of plastics ever made, still exists!

**Accumulation of plastics in the oceans:** Plastic waste (including carry bags) reaches the oceans through the coast, causing problems for marine life. Microplastics (eg. microbeads in toothpaste, gels, face wash) gets released into rivers, lakes and oceans.

**Air pollution:** Manufacture of plastics (releases high amounts of CO<sub>2</sub>), incineration (emits CO<sub>2</sub>, methane, etc.), as well as burning (releases gases harmful to the environment and the health of human and other life).

**Threat to life forms:** Since plastics are non-degradable and persists in the environment for hundreds of years, they cause blockages in water bodies and systems, death of animals and birds due to ingestion of plastics.

*Because of its harmful effects on the environment, it is essential that we reduce the use of plastics and not use disposable or single-use plastics.*

## What happens to the plastic we use?

Every year, we throw away enough plastic to encircle the Earth four times. According to the UN, in 1950, the world's population of 2.5 billion produced 1.5 million tonnes of plastic whereas in 2016, a global population of more than 7 billion produced over 300 million tonnes of plastics. Roughly half of the annual plastic produced is used in the making of single used products. Where do all these plastics go once we are done with it?

As of 2015, the grand total of all plastic ever made since 1950 amounts to 8.3 billion metric tonnes.

The problem with plastics is they do not easily degrade. They only break down into smaller pieces called microplastics, which enter the food chain and cause harm to living beings and the environment.

The three major options to dispose plastic waste are landfills, thermal destruction and recycling, each of which have unique consequences.

**Landfills and the Natural Environment:** The final destination of more than three quarters of non-degradable plastic waste – around 4.9 billion metric tonnes - is landfills and the natural environment. The plastics in landfills take as long as thousand years to break down into smaller pieces called microplastics that are extremely hazardous to the environment. Animals, both marine and land, eat the plastic pieces mistaking them for food and thus they eventually enter our food chain. A large part of the plastics lands up in our water bodies and may ultimately get trapped in one of the five plastic-filled gyres in the world's seas, where the ocean currents trap millions of pieces of debris.

**Thermal destruction:** People find burning household garbage a convenient way to get rid of accumulating trash, including plastics waste. But, incineration or burning in the open releases hazardous substances like dioxins into the atmosphere which creates a significant public health risk. Dioxin is extremely toxic to humans and animals as it is known to cause cancer and birth defects that are passed from generation to generation. Dioxin also ends up in the soil poisoning the food of humans and animals.

**Recycling:** Recycling is one of the most important methods currently available to reduce the impacts of plastic on the environment and also represents an opportunity for the plastics industry. But recycling has its limitations too. The different types of plastics cannot be mixed while recycling as they can contaminate the recycled material. Separating plastics from non-plastics before the recycling process, and the different types of plastics from each other, is labour-intensive.

The best solution, therefore, for our plastics problem is to reduce our use of plastics, and to reuse and recycle whenever possible.

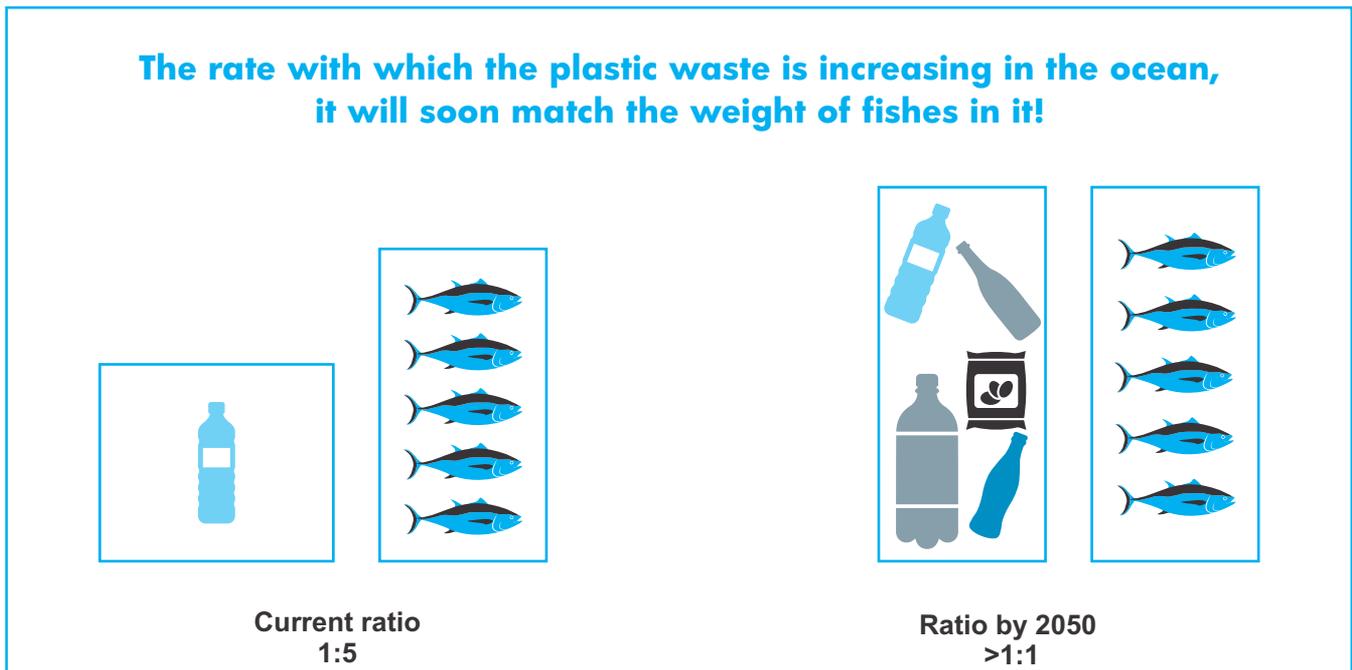
## Plastics and Our Oceans

Plastic pollution is a global problem and one of the top concerns of ocean health. Most of the marine debris (80%) comes from land based sources.

According to the Independent, a leading newspaper in UK, it is estimated that our seas now contain about 51 trillion microplastic particles – 500 times more than the number of stars in our galaxy. Also, as per a study by the Ellen MacArthur Foundation, there will be more plastic in the ocean than fish by 2050, while researchers believe the amount of ocean plastics will be 10 times greater by 2020.

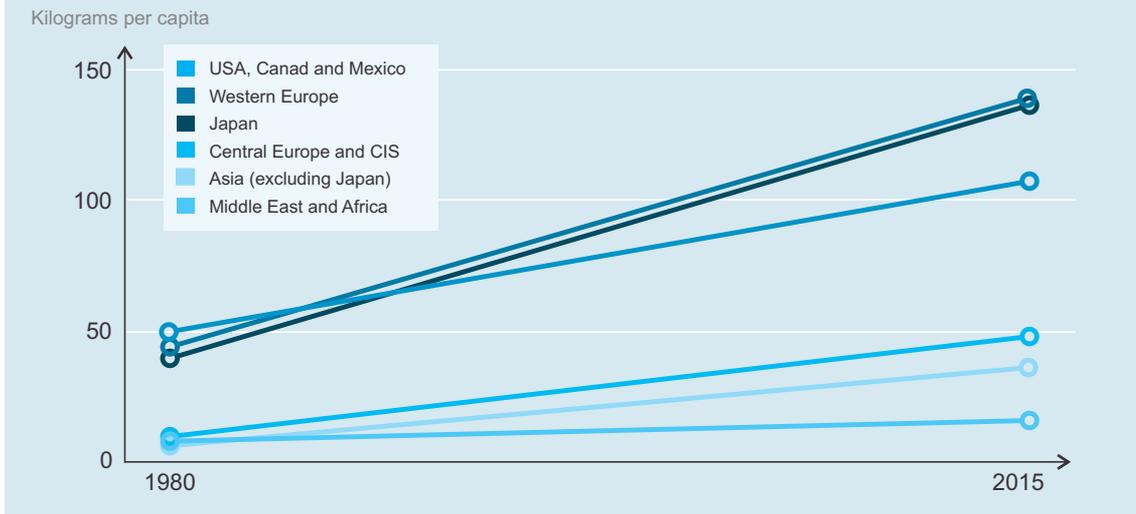
A sizeable fraction, some 8 million metric tonnes per year, of plastics that reach our oceans, leads to 'garbage patches' in the major ocean central gyres as well as visible impacts on nearly all the world's coasts and beaches. UN Environment estimates that plastics in the oceans already cause considerable damage to ecosystems, valued at \$13 billion per year!

According to UNEP, actions to tackle marine plastic pollution could include reducing the use of single-use plastics at the individual level such as by using reusable shopping bags and water bottles, choosing products without micro beads and plastic packaging and not using straws to drink.



**Each year, minimum 8 million tonnes of plastic end up in the oceans, the equivalent of a full garbage truck every minute.**

## The use of Plastics in the world



### India

More than 15,000 tonnes of plastic waste are generated in India everyday, of which 6,000 tonnes remain uncollected and littered.

According to Central Pollution Control Board (CPCB), India generates 15,342 tonnes of plastic waste annually, with Delhi accounting for a staggering 689.5 tonnes a day. Total plastic waste which is collected and recycled in the country is estimated to be 9,205 tonnes per day (approximately 60% of total plastic waste) and 6,137 tonnes remain uncollected and littered.

**India's plastic consumption is one-tenth of that of the US's**



**Per capita plastic consumption in 2014-15 (in kgs)**



## Sustainable Development Goals



In 2015, the UN adopted 17 Sustainable Development Goals (SDGs) that establish a new framework for the global development efforts towards 2030. The SDGs, otherwise known as the Global Goals, are a universal call to action to end poverty, protect the planet and ensure that all people enjoy peace and prosperity.

The 2030 Agenda for Sustainable Development and its 17 Sustainable Development Goals (SDGs) with 169 targets define global sustainable development priorities and aspirations for 2030 and seek to mobilize global efforts around a common set of goals and targets. The SDGs call for worldwide action among governments, business and civil society to end poverty and create a life of dignity and opportunity for all, within the boundaries of the planet.

Waste management and plastic pollution impacts several of the SDGs. Some of the targets that directly link to pollution are:



**Target 3.9:** By 2030, substantially reduce the number of deaths and illnesses from hazardous chemicals and air, water and soil pollution and contamination.

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**Target 6.3:** By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally.

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**Target 11.6:** By 2030, reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management.

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**Target 12.4:** By 2020, achieve the environmentally sound management of chemicals and all wastes throughout their life cycle, in accordance with agreed international frameworks, and significantly reduce their release to air, water and soil in order to minimize their adverse impacts on human health and the environment.

**Target 12.5:** By 2030, substantially reduce waste generation through prevention, reduction, recycling and reuse.

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**Targets 14.1** By 2025, prevent and significantly reduce marine pollution of all kinds, in particular from land-based activities, including marine debris and nutrient pollution.

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## Activity 1.1

# Plastics beginnings (Plastics - Then & Now)

## Introduction

Many children, as they grow up, take the current use and disposal of plastic for granted. Milk in pouches, use and throw pens, polythene carry bags to bring purchases in, are a part of how they have seen it happening around them. It can be often a discovery for them when they come to know that this was not the case during their parents' and grand parents' time.

Plastics, because of their very nature, have over the years become an intrinsic part of life. Students need to understand why people have shifted to plastics and whether there are still some alternatives which are possible to use.

<b>Objective</b>	To help students understand that much of the plastic use which is treated as essential, is relatively a recent phenomenon
<b>Grade level</b>	Primary
<b>Group size</b>	Individual
<b>Place</b>	At home followed by group discussion in classroom
<b>Duration</b>	20 minutes in classroom, survey over the weekend at home
<b>Materials</b>	Black board, chalk, survey sheet, list of plastic products

## Methodology

1. The teacher should write the names of commonly used disposable plastic items at home on the black board. Each student, should be asked to give one name and once everyone has contributed, anyone can add more names if needed.
2. The teacher should share the Home Survey Sheet with the students and explain how they should use it.
3. The students should fill up the survey sheet after discussion with their grand-parents, parents and siblings. The list they made in the class can be used as a reference to discuss with the respondents to understand whether the items in it were the same in each generation or a different item was used for the same purpose.
4. The teacher should discuss the timeline of these items in class as to when the use of a particular disposable plastic item began and in which generation.
5. The teacher should discuss in groups the possible reasons for why plastic items replaced natural products or have become such an intrinsic part of life.

## Conclusion

At the end of this activity, the students will be able to understand that plastic use is relatively a new phenomenon and many of the naturally degradable products used earlier that were replaced by non-biodegradable disposable plastic products can still be used in the place of plastics.

## Evaluation

Discuss the alternatives and check which one students think can be easily replaced.

### Survey Sheet (answer Yes or No and if No, name/describe the alternatives used)

Name of product	Either of the parents used it when they were of the student's present age	If no, what was the alternative they had?	Either of the grandparents used it when they were of the student's present age	If no, what was the alternative they had?
Polythene bags Chips and snack pouches Disposable diapers Disposable ball point pens Disposable cups Disposable shaving razor Disposable water bottles/soft drink bottles Plastic shampoo/oil bottles Plastic toothbrush Plastic buttons Band-aid Ear buds Styrofoam (Thermocol) Plastic straw Tetra pak Milk pouches Disposable plates and spoons Plastic toys Balloons Plastic flip-flops Plastic wraps for books and notebooks Products with plastic packaging Rubber bands				

## Activity 1.2

# When do they degrade?

### Introduction

Different materials in the environment take different periods of time to degrade. Some materials like plastics, thermocol, etc. do not biodegrade and continue to be in the environment. Materials such as wood, grass and food scraps can break down in the presence of microbes, and transform into useful compounds. Plastics on the other hand cannot be degraded by microbes and these generally end up in landfills or water bodies, thus polluting them. Despite the problems associated with its disposal, we cannot avoid using plastics because of their use in a variety of areas. It is, therefore, essential that we use and dispose these responsibly.

<b>Objective</b>	To make students understand what is degradation and the time different materials take to degrade
<b>Grade level</b>	Middle school
<b>Group Size</b>	Class
<b>Place</b>	School and Home
<b>Duration</b>	<ul style="list-style-type: none"><li>• 20 minutes for introduction to the activity, instructions and making of groups</li><li>• 10 minutes at school (once every week) for 12 weeks (the groups can do this activity during recess time)</li></ul>
<b>Materials</b>	Waste materials produced by students during school hours (plastic, paper, food scraps, glass, metal items like pins etc), small shovel, metal scale, gloves, record book/worksheet, pen

### Before you begin

Introduce the term bio-degradable and non-biodegradable materials in the class. Explain how degradation takes place and mention about the agents of degradation in nature. Explain about the role of bacterial and other microbes in decomposition. Ask the students to help in digging out a small pit in the garden area of the school, about 8-10 inches in depth. Also give a copy of the worksheet provided below to every group to enter their observations.

## Methodology

1. The teacher should ask the students to place the different kinds of waste collected in the pit. Close the pit once there is a variety of waste in it.
2. Students should dig out the pit after a week to see the condition of each waste item they have buried and enter their observations on the worksheet. They should continue the cycle for 12 weeks and note the gradual changes (if any), they observe in each item buried. They should also record changes in terms of quantity, colour, texture, smell, etc.
3. At the end of the experiment, students should make a chart presenting their observations and recordings of: what has degraded, which material has not and the gradual changes they have observed in the items, if any.

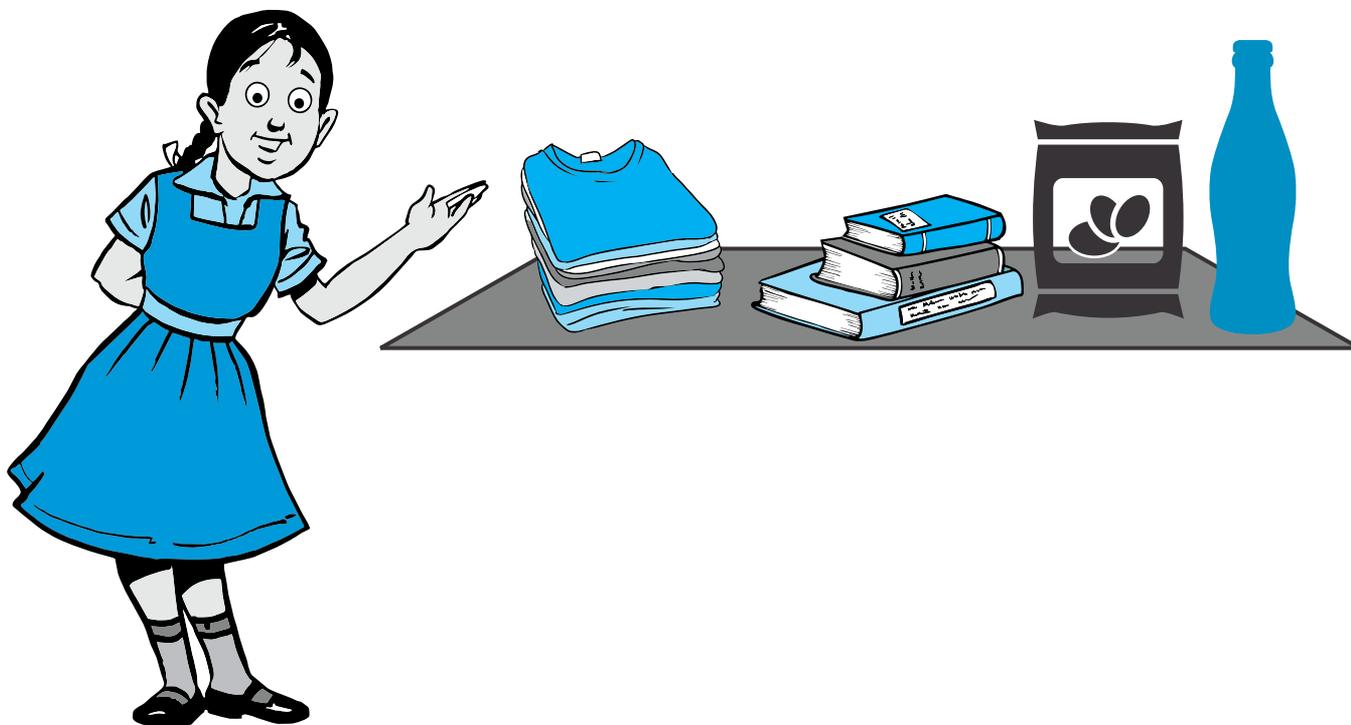
Week	Observation
1	Paper:
	Food:
	Plastic:
	Metal:
	Glass:
	Others (specify):
2	Paper:
	Food:
	Plastic:
	Metal:
	Glass:
	Others (specify):
.....	
12	Paper:
	Food:
	Plastic:
	Metal:
	Glass:
	Others (specify):

## Conclusion

Students understand that degradation is a natural process and different materials take different periods of time to degrade.

## Evaluation

Discuss which material are biodegradable based on the experiment.



## Activity 1.3

# Categorization of plastics

### Introduction

Most of the items used everyday consist of plastics. It is present in our clothing, the pen that we write with, the chair that we sit on or the wrapping of the food that we eat. Different plastics are made from different monomers and accordingly divided into different categories. This activity will help students to identify the different types of plastics and understand their characteristics.

<b>Objective</b>	To make students understand different categories of plastics and their properties
<b>Grade level</b>	Middle school
<b>Group size</b>	5-6 students
<b>Place</b>	School
<b>Duration</b>	40 minutes
<b>Materials</b>	<ul style="list-style-type: none"><li>• Chart on types of plastics</li><li>• List of commonly used disposable items (Activity 1.1)</li></ul>

### Before you begin

The teacher should give a brief introduction about how plastics are made, how different plastics are identified for recycling and discuss the plastics identification list with the students. The teacher must ensure that items made from different categories of plastics are available in the classroom before beginning the activity.

### Methodology

1. The teacher should divide the class into groups of 5-6 students.
2. Ask groups to look around and list the plastic items they see around them.
3. Based on the appearance, texture and other characteristics observed, the students are asked to group the items listed into different categories.
4. The students try to code the categories based on the plastics identification list and background information given by the teacher.
5. The teacher should then guide the groups to organize their information collected into categories of plastic waste (the list of commonly used items is available in Activity 1.1).
6. The groups can also identify and list the recyclable products from the list using the plastics identification code.
7. The groups then present their findings in the classroom.

### Conclusion

Plastics are petroleum products and different types of synthetic monomers are used in the manufacturing of different plastics. Knowledge about the type is essential to understand the plastics and their properties.

### Evaluation

Discuss which item is used for different material and what could be the reason.

## Activity 1.4

# Segregation at Source

### Introduction

Segregation of waste must begin at home. Some amount of segregation already happens in most of our homes. For example, old newspapers and magazines, used bottles, metal cans etc are kept aside and sold to the *kabadiwallah* (junk dealer). This is a form of segregation that children get to observe usually at their homes.

According to the Municipal Solid Waste Management Rules 2016, solid wastes must be segregated into dry and wet waste. Segregation at source is critical to its recycling and disposal. Lack of segregation, collection and transportation of unsegregated mixed waste to the landfills has an impact on the environment. When we segregate waste, it reduces the amount of waste that reaches landfills, thereby taking up less space. Pollution of air and water can be considerably reduced when hazardous waste is separated and treated separately.

The rules also specify the colour coding for the bins which should be used for Dry waste, Wet waste and Hazardous waste. It is essential that the waste is put in the correct colour bins so that it can be appropriately dealt with.

<b>Objective</b>	To help students understand the importance of waste segregation and learn to categorize and dispose waste correctly.
<b>Grade level</b>	Primary
<b>Group size</b>	Class
<b>Place</b>	School
<b>Duration</b>	40 minutes
<b>Materials</b>	<ul style="list-style-type: none"><li>• Three Dustbins: (Blue for dry waste, Green for wet waste and Red/Black for hazardous waste)</li><li>• Paper chits – one chit per student</li><li>• Pen</li></ul>

## Before you begin

- The teacher should prepare paper chits with names of different degradable and non-biodegradable waste as given: vegetable, fruits, flowers, leaves from garden, plastics, paper, glass, tetrapacks, aluminium foil, pencil shavings, band aid, pins, metal clips, chip packet, chocolate wrapper, polythene bag, plastic water bottle, plastic soft drink bottle, cotton U pins, used battery, etc.
- The teacher may add a few more names if required to ensure that each student has one chit. Some of the names can be repeated.

## Methodology

1. The teacher should introduce the topic to the class and show them the three coloured bins and explain which kind of waste will go into each of the bins.
2. After the topic has been introduced, the teacher should ask each student to pick one chit from the pile of chits placed in a box.
3. The teacher should then ask the students to put their chits in the appropriate bins (Blue labelled for Dry Waste, Green labelled for Wet Waste and Red/Black labelled for hazardous).
4. The students to identify the right bins for each product in the chit and put them accordingly in the bin.

## Conclusion

After the activity has been completed the teacher should check the chits thrown into the dustbins and in case of a mistake, the teacher should make the students aware about the composition of that particular product and in which dustbin it should have been thrown into.

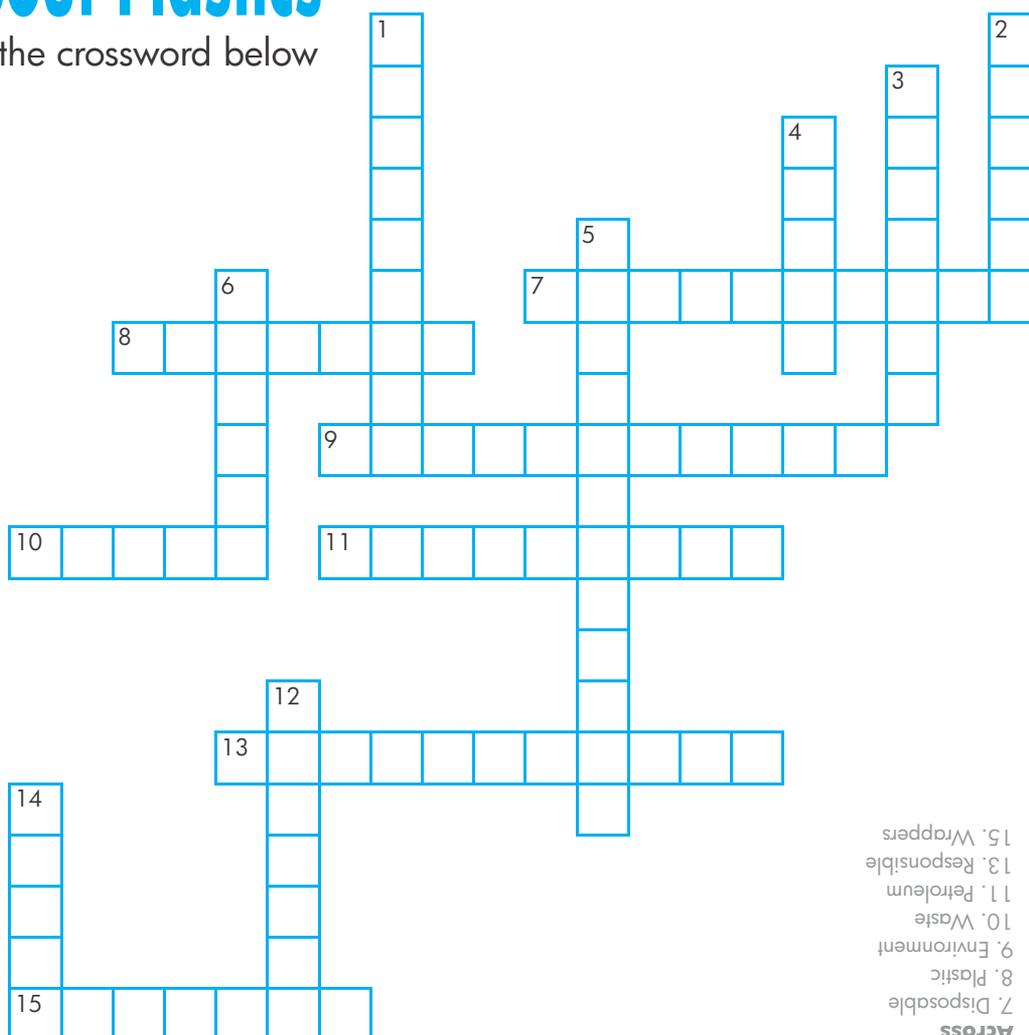
## Evaluation

The students would have understood the concept of segregation and the categories into which it needs to be segregated.



# All about Plastics

Complete the crossword below



## Across

7. Use of \_\_\_\_\_ plastics should be completely avoided
8. \_\_\_\_\_ is made up of synthetic polymer
9. Irresponsible use of plastic harms the \_\_\_\_\_
10. Segregation of \_\_\_\_\_ is necessary for clean environment
11. Plastic is a byproduct of \_\_\_\_\_
13. \_\_\_\_\_ consumption of plastic is necessary for a cleaner planet
15. You should dispose the \_\_\_\_\_ of food items in the appropriate bin

## Down

1. Burning of plastic causes air \_\_\_\_\_
2. We should \_\_\_\_\_ the use of plastic bag and always use a cloth bag for shopping
3. Waste should always be disposed in the appropriate \_\_\_\_\_
4. It is always advisable to \_\_\_\_\_ plastic items
5. Plastic less than the size of 5 mm diameter is called \_\_\_\_\_
6. Plastic in water bodies harms the \_\_\_\_\_ ecosystem
12. 3R's of waste management include Reduce, Reuse & \_\_\_\_\_
14. Use of \_\_\_\_\_ for drinking cold drinks should be completely avoided

- Answers**
- Across**
7. Disposable
  8. Plastic
  9. Environment
  10. Waste
  11. Petroleum
  13. Responsible
  15. Wrappers
- Down**
1. Pollution
  2. Reduce
  3. Dustbins
  4. Reuse
  5. Microplastic
  6. Marine
  12. Recycle
  14. Straw

# Word Search

A collection of words related to things made of plastics is hidden in this puzzle. Try to find as many as you can by searching across and down. Answers are given below.

A	D	S	H	U	W	V	P	X	S	T	V	U	F	A	U
P	C	H	A	I	R	Z	Z	O	M	P	L	A	T	E	S
O	Q	O	G	X	O	Y	G	Z	M	E	D	O	I	A	C
L	M	E	I	M	Y	R	U	I	V	N	K	Q	F	A	W
M	S	S	J	L	N	B	H	K	I	S	E	H	F	M	R
N	L	T	M	R	B	R	U	S	H	B	D	C	I	A	A
F	R	R	K	Q	O	M	A	C	G	S	T	H	N	X	P
J	O	I	L	P	T	A	B	A	T	O	P	R	G	R	P
G	N	I	O	S	T	J	C	L	I	P	S	M	L	A	E
Z	N	S	P	B	L	U	K	E	G	I	R	C	S	D	R
L	P	T	S	C	E	K	F	A	D	B	N	Q	O	Q	S
O	L	I	U	F	N	E	C	A	C	B	U	C	K	E	T
D	U	S	T	B	I	N	U	B	Q	P	T	I	P	L	O
I	T	N	E	O	W	M	P	D	L	M	O	J	B	T	Y
L	K	Y	H	X	D	L	O	F	W	Y	Z	K	A	P	S
O	R	W	F	U	Q	Y	X	C	T	A	B	L	E	B	C

**Down:** SHOES, PEN, TIFFIN, WRAPPER, TOYS, BOX, BOTTLE, SCALE  
**Across:** CHAIR, PLATES, BRUSH, CLIPS, BUCKET, DUSTBIN, TABLE

# Issues and Challenges

## Introduction

The earth's ecosystem, with its various resources like water, soil and air, makes our survival possible. Unfortunately one of our own discoveries – plastic - has become a major threat to our ecosystem. It has many adverse impacts on both living and nonliving organisms. It is a fact that plastics take several hundred years to degrade. They remain as they are in our environment. As per an estimate by the Central Pollution Control Board (CPCB), about 25,940 tonnes per day of plastics are produced in our country. Much of these is discarded and enters our waste management system and places a strain on it. Plastic waste management involves collection, storage, transportation, reduction, reuse, recovery, recycling and disposal in an environmentally safe manner.

## Issues and Challenges of Plastic Waste Management

As we saw in Chapter 1, plastics are a very useful material with applications in domestic and industrial sectors. Then why have plastics suddenly become a challenge to our environment? It is the indiscriminate use and irresponsible disposal of plastics that pose the challenge and not plastics by themselves. Let us look at how plastics have become a problem.

## Proliferation of Plastics – A Lifestyle Issue

### (i) Widespread Use of Plastics in all Sectors

The use of plastics in today's life is widespread. They have found a place in everyday things like toothbrushes, water bottles and storage containers in households, to pipes, tubes and fittings in the electrical and plumbing industry. Plastics are also being widely used in the packaging of consumer products including food products. Their durability and strength make them ideal for packaging and transporting all kinds of consumer and industrial products.

### (ii) Disposable, One Time Use Plastic Items

While plastics have amazing qualities, what is causing havoc to the environment is the use of disposable or single use plastics which include food packets, cups, water bottles, soft drink bottles, cutlery (plates, spoons, forks and straws) and others. With lifestyle changes like eating out and take aways/food delivery, plastics is becoming the material for packaging, storing and delivering food items. Disposable cups, plates, spoons, drinking straws, and other items are made of plastics or plastics fused with other materials. Weddings, parties and other community events are also major consumers of this kind of plastics. Plastic wastes such as multilayer, metallic pouches and thermoset plastics which are disposed after a single use, are generally non recyclable.

There are areas where disposable plastics are needed for health and other reasons. Disposable plastics has a major role in the medical field, for instance, disposable syringes, surgical instruments, blood and saline bags, gloves, surgical gowns etc. In such cases the focus has to be on the proper disposal, not to create plastic pollution or a health risk.

### **(iii) Plastic Carry Bags**

One of the most commonly used disposable plastic item is the carry bags that are used to carry anything from vegetables, fruits and milk, to textiles and other lifestyle products. Added to this, most of the everyday groceries are packed in plastic bags or covers. The widespread use of this kind of plastics has also led to manufacturers making very thin plastic bags (of 50 microns or less) to reduce the cost although poly-bags under 50 micron thickness are banned in many places.

### **(iv) Sanitary and Cosmetic Products**

Disposable menstrual products and diapers get mixed with municipal solid waste. These products contain cotton and rayon but also a significant amount of plastics or polymers. These plastics cannot be recycled or reused. Cosmetic products also use a lot of disposable plastics – containers for cosmetics and even microplastics in the form of microbeads in face cleansers, body washes etc. These needs to be disposed of in the hazardous waste bin.

## **Problems of Plastics Waste Disposal**

Plastic waste is freely thrown on roadside and natural areas that people visit. Much of these plastics end up as a part of the municipal solid waste and since they are not biodegradable, they pose a challenge to the solid waste management system. Others litter our environment. Plastics get into our waterways and rivers and eventually find their way into the oceans. It is estimated that nearly eight million tonnes of plastic waste end up in our oceans each year.

Plastic waste can be controlled if their use is reduced, they are reused and recycled. The kind of plastics being used is also a concern. But most importantly, the quantity of waste that is not disposed and does not even enter the waste management system is the major problem. Waste plastic must be thrown into the appropriate bin or sold to kabadiwala (scrap dealer).

### **(i) Lack of Waste Segregation at Source**

Segregation of waste at source ensures that different kinds of wastes are disposed of appropriately. But segregation of waste at source is not commonly being practised – food and wet waste (which can be composted) is mixed with dry waste like plastics and paper (which can be recycled but cannot be composted). The practice of segregation has to become a habit.

### **(ii) Plastics Waste Mixed with Municipal Solid Waste**

When plastic waste is mixed with municipal solid waste, it reduces the efficiency of municipal waste management. When waste is segregated and collected, the wet/food/organic part of it is composted; items like paper, plastics, metal, glass, etc. are sent for recycling. Some municipal corporations employ innovative ideas like generating power out of waste or converting them into

art and craft items that can be sold. The waste that cannot be used in any way is what is sent to the landfills. But when plastics and other wastes are mixed, they cannot be utilized well and so the major part of wastes will be dumped in the landfill. This, on one hand, strains the capacity of the landfills, and on the other, non biodegradable plastics takes up space without a chance of degrading for a few hundred years.

With land becoming more valuable and less available, finding a place to dump garbage is itself becoming a problem.

## **Plastics Pollution**

Plastics are a major pollutant, especially when not disposed of responsibly. It pollutes water, land and air when not disposed of in the right manner. Excess pollution can also lead to decrease in tourism, significantly affecting the economy of the region, not to mention the loss of life on land, air and water.

### **(i) Water Pollution**

Oceans, rivers, lakes and ponds have become sites for dumping waste and are in great danger because of leachates from the plastics waste. Chlorinated plastics can release harmful chemicals into the surrounding soil, which then seep into the groundwater and cause serious harm to the species that drink the water. It was observed that 83 percent of tap water samples were found to contain plastic particles out of 159 samples collected from around the world.\*

Plastics in oceans usually degrade within a year and generate toxic chemicals such as bisphenol A (BPA) and polystyrene. These have adverse consequences on marine species, often leading to death. Other living beings including humans who eat fish and other marine species are also affected by this.

### **(ii) Land Pollution**

When plastics are dumped in unscientifically managed landfills, the chemical leachate produced by plastics or the landfill leachate containing chemicals from plastic decomposition, enters the soil, making it dangerous for other organisms. Some of the key chemicals thus leached include Bisphenol A (cause negative impact on reproductive systems), Phthalates (disrupt endocrine function), and Brominated Flame Retardants (affect hormones involved in the development of the reproductive and nervous systems).

### **(iii) Air Pollution**

One of the ways people tend to dispose of plastics is by burning them. But burning of plastics in the open leads to air pollution as they release poisonous gases like carbon monoxide, dioxins and furans into the air. Carbon monoxide is a well-known poison; dioxins and furans are Group-1 carcinogens, which means that they are known to cause cancer and are responsible for a variety of abnormalities in gender development and behaviours, and reproductive capabilities.

## Effects on Ecosystem & the Food Chain

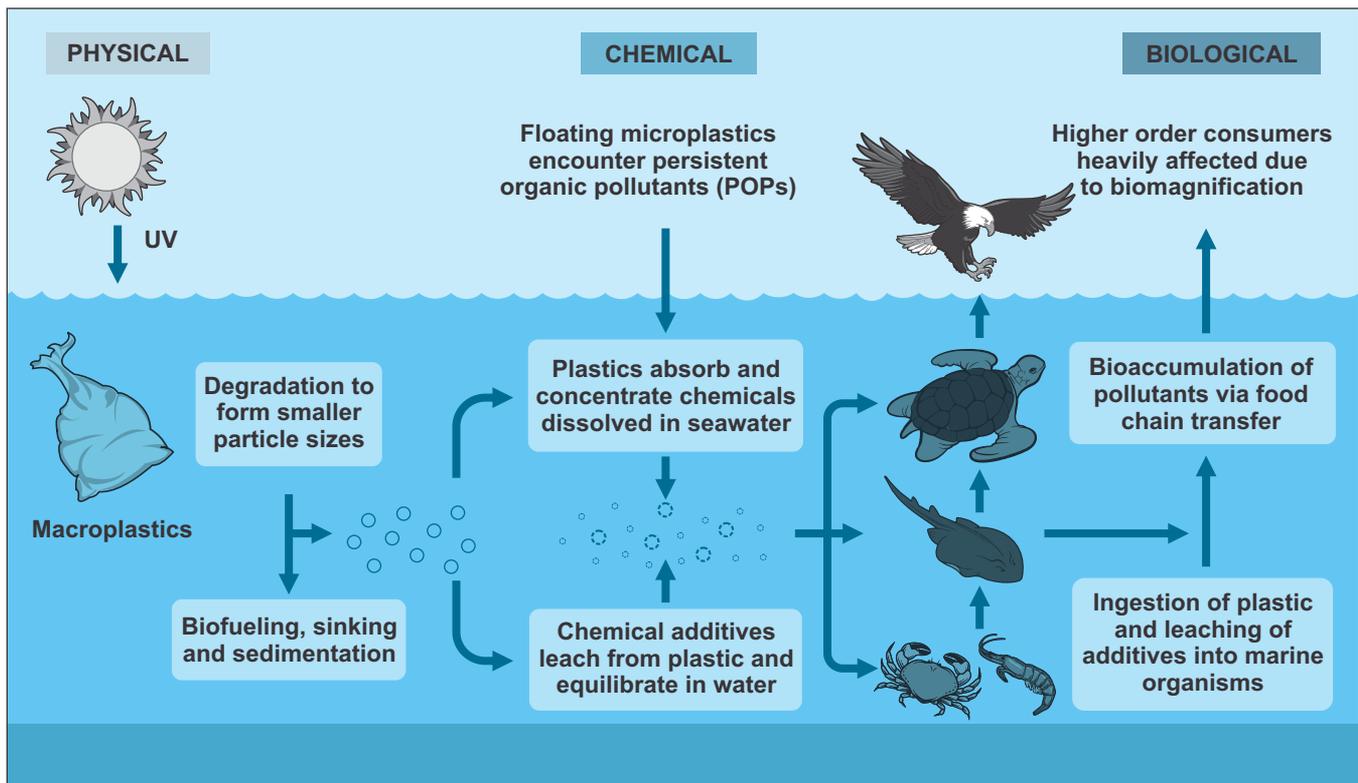
About 300 million tonnes of plastic are produced globally each year. It is estimated that 8 million tonnes of plastics find their way into the world's oceans each year. Once in the ocean, they break down into smaller pieces known as micro plastics, and act as carriers for chemicals such as Persistent Organic Pollutants (POPs). They further get into the food chain of marine organisms such as phytoplankton and small fishes.

This affects the larger animals that prey on them for food, causing a chain of problems at each step along the food chain. Additionally, it also affects human beings as plastics are present in the fish that many people eat every day. It is estimated that plastic debris kills 1 lakh marine mammals, and millions of fish and seabirds, every year.

The indiscriminate disposal of plastic bags and other plastic waste material in public spaces like roadsides and water sources also affect the flora and fauna of the area, and thus the food chain itself. Cows dying due to feeding on plastic waste, marine organisms like whales being found dead with their bellies full of plastic waste, turtles and other beings getting caught in plastic bags and nets, are now common lore.

The challenge of plastics waste can be mitigated through their responsible use and disposal. Plastic waste reaching the municipal waste management system can be reduced and delayed if we follow the principle of the 3 R's – Reduce, Reuse and Recycle.





## Disposal of plastic bags <50 microns – a challenge

In view of the hazards to the environment created due to plastics, the government has passed a regulation banning manufacture and use of plastic bags of below 50 microns thickness as they are very commonly used due to their low cost. They are usually discarded after a single use, leading to the clogging of drains, pollution of the environment and even death of cattle. But there are unauthorized units manufacturing plastic bags of less than 50 microns thickness, which are highly problematic and cause environmental pollution problems.

### Banning of Plastic Bags of < 50 microns thickness

The National Green Tribunal, in August 2017, banned the use of non biodegradable plastic bags of less than 50 microns in New Delhi.

The reasons given were:

Plastic waste have been identified as one of the major sources of environmental pollution as they don't decay naturally. Besides choking drains, water-bodies and adding to the load of the already-exhausted landfill sites, there are instances of cattle eating and dying after choking on plastic bags.

It is the most common shopping accessory, is cheaper to produce and has almost zero reusable value. Also, the market share of thin bags is about 25%.

## Health Hazards of Plastics

Plastics have become an integral part of our daily life. For example, plastic containers help keep food fresh, but if the right kind of plastics is not used, they can release neurotoxins such as BPA in the human body. BPA is associated with a number of health problems in human beings such as reproductive health issues, rapid changes in immune system, Type 2 diabetes, cardiovascular disorder, obesity, etc. Some studies also claim that BPA increases the risk of cancer and metabolic disorders. Phthalates, the main component of PVC, have been implicated in reproductive disorders in human beings, increased fat accumulation and insulin resistance. Dioxins, released when plastics is burnt, are a known cancer producing chemical.

Some of the more familiar compounds related to plastics include vinyl chloride (in PVC), dioxins (in PVC), benzene (in polystyrene), phthalates (in PVC and others), formaldehyde, and Bisphenol-A (BPA, in polycarbonate). Many of these are persistent organic pollutants (POPs) — some of the most damaging toxins on the planet, owing to a combination of their persistence in the environment and their high levels of toxicity. Their unmitigated release into the environment affects all terrestrial and aquatic life with which they come into contact.

As many as 51 trillion microplastic particles — 500 times more than the stars in our galaxy — litter our oceans and seas, seriously threatening marine wildlife.

## Activity 2.1

# Needs & Wants

### Introduction

India is developing rapidly; hence there is also a rapid growth in consumption of resources. While this is especially happening in our cities, villages too are increasingly following the same path. However, the ease and convenient availability of resources leads to haphazard consumption, especially of disposable plastics. This activity aims to differentiate between the needs and wants of disposable plastic products, some of which may not be necessary but are bought anyway.

<b>Objective</b>	To help students conclude that use of certain disposable plastic products can be avoided.
<b>Grade Level</b>	Middle school
<b>Group size</b>	4 to 5 students in each group
<b>Place</b>	School and Home
<b>Duration</b>	<ul style="list-style-type: none"><li>• 30 minutes for a brainstorming session with students</li><li>• 8 days in total for the following tasks<ul style="list-style-type: none"><li>○ Audit of household disposable plastic consumption (1 week)</li><li>○ Reflection and action worksheet (1 day)</li></ul></li></ul>
<b>Materials</b>	<ul style="list-style-type: none"><li>• Writing material</li><li>• Observation sheet for household consumption</li><li>• Reflection and Observation worksheet</li><li>• Access to Internet</li></ul>

### Before you begin

1. The teacher should introduce students to the concept of sustainable consumption and its importance.
2. The teacher should discuss with the students the difference between necessary, long term plastic products and disposable ones.

## Methodology

1. The teacher should ask each student to prepare a personal household consumption checklist using the exemplar sheet provided.
2. In groups, the students should then prepare a consolidated list using their personal consumption checklists.
3. The teacher should ask the groups to share their consumption checklist with another group of students in the class.
4. Each group will come forward and share their list.
5. The teacher should discuss how choice of products, packaging, usage, etc contribute to the differences in the lists arrived.
6. Following the discussion, the teacher should provide the Reflection and Action Worksheet to each student.
7. The teacher should at random ask a few students to share what they have written in these sheets with the class.

### Task 1: Household plastic consumption checklist

Fill in the observation sheet to note your household plastic consumption pattern (over a period of a week)

Date of Purchase	Type of items purchased			
	Food and Drinks	Toys/Games	Stationery	Others
E.g. 1/2/2018	Packet of Cookies	Blocks (Plastic)	Ball-point pen	Disposable razors
	Bottled water – plastic bottle	Laminated board games with plastic dice	Pencil box	Photo frames

### Task 2: Reflection and Action Worksheet - Think about the following

Refer to Task 1, think about the different plastic products mentioned in the table below and fill in with appropriate actions that you can take

Product or does it have to be disposed?	Can the packaging/product be used again to be disposed?	If disposed, how?	Could I do without this? Yes/ No	Is there a better alternative? Mention it
Bottled water–plastic bottle	Disposed	Separately from biodegradable waste	Yes	Install a water purifier

## Conclusion

Students would understand their household consumption patterns of plastic products and products with plastic packaging.

They would conclude that certain disposable plastics are completely avoidable.

## Evaluation

Students can be asked to suggest alternatives to disposable plastics use.



## Activity 2.2

# Litter... Why does it Matter?

### Introduction

Littering is one of the biggest environmental as well as a social challenge faced today. It is important for the students to know about the impacts of littering as plastic is present in every product that is bought. This activity will help students understand how litter contributes to the problem of plastic pollution.

<b>Objective</b>	To make students understand: <ol style="list-style-type: none"><li>1. The impact of littering.</li><li>2. Co-relation of plastic pollution with littering.</li></ol>
<b>Grade Level</b>	Middle & Secondary
<b>Group size</b>	Individual
<b>Place</b>	Home assignment
<b>Duration</b>	<ul style="list-style-type: none"><li>• 10 min for background introduction and screening a film</li><li>• 30 min to discuss the problem of littering and how it contributes to plastic pollution.</li><li>• Writing an essay - home assignment</li></ul>
<b>Materials</b>	<ul style="list-style-type: none"><li>• An award winning short film on the impact of litter - Khat Aaya Hai (<a href="https://www.youtube.com/watch?v=6SZ-ZWjdrO8&amp;t=93s">https://www.youtube.com/watch?v=6SZ-ZWjdrO8&amp;t=93s</a>)</li><li>• Stationery material - notebooks, writing material</li><li>• Access to Internet</li></ul>

### Before you begin

The students need to be shown a short film about littering and the impact of plastic pollution mainly on wildlife and marine organisms. They should also be briefed about how littering contributes to plastic pollution.

### Methodology

1. The teacher should facilitate a discussion with students about the problem associated with littering and how it leads to plastic pollution.

2. The students then should be asked to monitor littering behavior of people. They could choose to monitor littering on roads, in commercial places, in open places and parks or in schools.
3. The students to select a suitable spot which they think might have a littering problem.
4. The teacher should guide students to “observe people’s behaviour of littering” at that spot. Some indicators for observation could include:
  - o Are there waste bins in this spot?
  - o Whether people throw waste in the waste bins?.
  - o The type of material littered most frequently
  - o Was the littered material consumed by any animal?
5. Following this, students should track how littering leads to a set of problems which ultimately contribute to polluting the land, water and atmosphere.
6. Based on their observations and background research, students should write their views in the form of an essay depicting the co-relation between littering and plastic pollution.

## Conclusion

The students will be able to co-relate how littering behavior contributes to the problem of plastic pollution.

## Evaluation

Discuss the impacts of littering.



## Activity 2.3

# Litter Blitz

## Introduction

Litter is an environmental as well as a social challenge. It is important to know the reason behind this behavior. This activity will give an idea about littering behavior to the students. This questionnaire can help students know about certain challenges associated with the habit of littering.

<b>Objective</b>	To help students identify the causes that trigger littering and perspective of people towards litter and how it affects them.
<b>Grade Level</b>	Middle & Secondary
<b>Group size</b>	6-8 Students
<b>Place</b>	Public Places, Home and School
<b>Duration</b>	<ul style="list-style-type: none"><li>• 15 min to contextualize and discuss the survey questionnaire with students</li><li>• 3 days for the survey;</li><li>• 60 min for analyzing the results of the survey. (Homework)</li><li>• 40 min for classroom interaction and discussion.</li></ul>
<b>Materials</b>	Pre-survey questions

## Before you begin

The teacher should brief the students about the process of conducting the survey.

The teacher should also introduce the students to the method for making a data sheet for the answers obtained during the survey.

## Methodology

1. The teacher should divide the class into groups so that each group would have 4-5 members.
2. The teacher should ask the groups to will select a spot and conduct a local survey. The students can also do it individually at public spots near their respective homes.
3. Each group will survey 2-3 spots and interview people of different age groups. They may

interview around 10 people at each spot.

4. The students should compile their individual results with their group and make a data sheet.
5. The groups should then compare their data with the other groups

## Survey Form for Interviews at Litter Spots

Name of the person being interviewed (optional):

Age:

Ask the following questions and note the responses :

1. Do you think that there is a problem associated with litter?
  - The problem has become much more
  - It is the same as before
  - There never was a problem

2. Have you ever littered?

- Yes
- No

If yes, why?

- It was convenient.
- Didn't think it was bad.
- Didn't care.
- It was by accident.

3. If there was a law against Littering, would you still litter

- Yes
- No

- Couldn't be bothered

4. Why do you think people litter?

- Inadequate dustbins at public spaces.
- It's culturally imbibed
- Dirty public spaces trigger people to litter more

5. Whose responsibility do you think it is to keep the public spaces clean?



- People
  - Ragpickers
  - Municipal Corporation
6. What do you think are the major problems with litter? (this question can have more than 1 option as answer)
- It looks unaesthetic
  - It stinks
  - It causes environmental pollution
  - It might be consumed by stray animals.
7. Do you think plastic pollution can be controlled if people stop littering?
- Yes
  - No
  - Partially
8. Will you carry your trash with you to throw in a waste bin if you don't find one immediately?
- Yes
  - No
- If no, why?

## Conclusion

The data that is generated as a result will help students understand how peoples' attitude differs when it comes to littering. The students will also learn some triggering factors due to which people litter.

## Evaluation

Discuss the triggering factors due to which people litter.

## Activity 2.4

# Making a Poster on Marine Pollution

### Introduction

While plastic pollution affects all life on the planet, the situation in the ocean is particularly bad. This is because the ocean is the final sink for all the plastics that flow into the rivers and eventually into the sea. If access to the internet is available, there is considerable information available online about marine pollution along with graphic images of the damage it is doing to our ocean and marine life. This activity aims to get students to make a poster about marine pollution. Two options are given. If the school is near the coast, or any water body like a river or lake, a field trip is also suggested. The activity can otherwise be done through an internet search, or consulting reference books, articles or materials which can then be discussed.

<b>Objective</b>	To help communicate awareness through a creative exercise about plastic pollution in the oceans.
<b>Grade Level</b>	All
<b>Group size</b>	Small groups
<b>Place</b>	School or school plus a field trip
<b>Duration</b>	One period
<b>Materials</b>	Paper and sketch pens/pencils to make a poster

### Before you begin

The teacher can introduce the issue of marine pollution and ask students how and why it happens, whether they know the extent of it and the possible harm it causes.

The teacher can then instruct them about the activity and get them started on developing a poster that will create awareness on this issue.

### Methodology

- If internet is available, the teacher should ask the students to search for images and short films or alternatively go to the school library to review books and magazines for ideas.
- The teacher can then get the students to form small groups in which they can discuss the issue they want to take to design and create their poster.

## Conclusion

Display the posters at school and get other students to evaluate how effective the posters were in communicating their message

## Evaluation

The content of poster and design will help in understanding the key issues identified by the students.



# Solutions to Plastic Waste

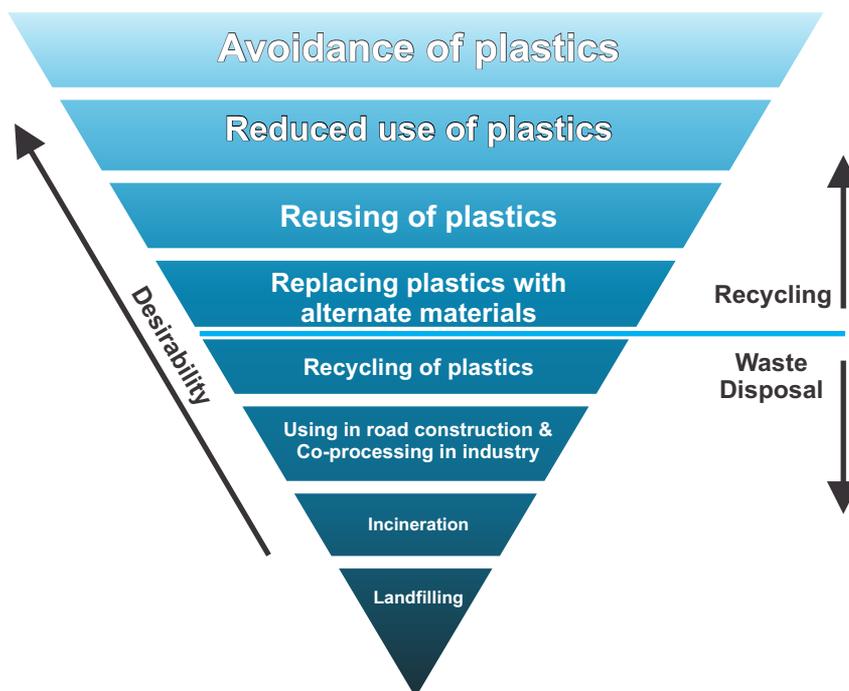
Managing plastic waste in a responsible manner ensures that it does not cause environmental and health problems. Waste management, including plastic waste management, requires collective efforts from all stakeholders – individuals, organizations and institutions, communities, producers and manufacturers, local/state/central governments and enforcing agencies. The various issues that we learnt in the previous chapter can be addressed through an integrated plastic waste management system for which all these stakeholders need to be actively involved.

## The Three R's: Reduce, Reuse, Recycle

There is no single or simple solution to manage plastics waste. A variety of waste management practices are required to ensure that plastic waste does not become a threat to the environment and the health of human beings and other organisms on the Earth.

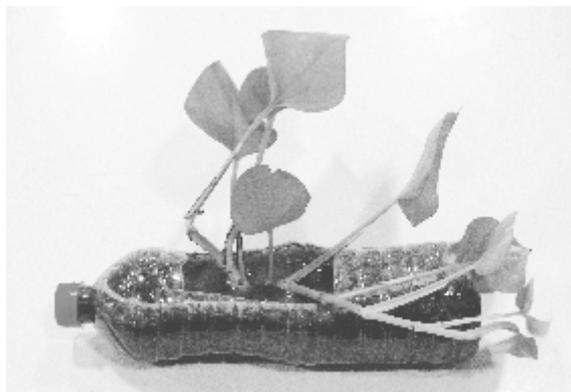
The 3 R's – Reduce, Reuse, Recycle – are a commonly adopted formula that will help manage plastics waste in a sustainable manner. Besides these three, there are also variations on this theme like refuse, repurpose, replace and repair.

Sometimes we do not even realize that the products we use in our daily life are made from plastics. This includes materials such as polyester textiles, toothpastes, artificial turf, laminated paper and other stationery. These also lead to plastic pollution and contamination. Choices we make in our personal lives can and do affect the environment. By reducing, reusing, and recycling, we can help conserve the Earth.



**(i) Reduce:** Reducing the use of plastics in our lives is the first step to managing plastic waste. We can start with reducing single use plastics like disposable cups and cutlery, and carry bags. We can carry our own containers when buying food and cloth bags when going shopping. Plastic bottles for drinking water and soft drinks are recommended for single use, but this adds to the waste generated. We need to change this habit and carry reusable water bottles made of recyclable plastic or metal. This will reduce plastic waste considerably.

**(ii) Reuse:** We need to change our habit of disposing plastics to reusing them. This will reduce plastic waste generation and its impact on the environment. Instead of throwing away the plastic bag you have, reuse it a few times for shopping or carrying things. Storage containers can be reused for long, for storing various items, around the house or school/classroom. Reusing will ensure that the plastics entering the waste system is delayed and new items are not bought to replace them immediately. We can also give the plastic items to the *kabadiwallah* (junk dealer) who will be able to reuse some of them. We can use our creativity to come up with ideas to reuse plastic items – one such example is shown in the picture here.



**(iii) Recycle:** Recycling refers to the process of recovering waste plastic and processing them to make useful materials/products. A considerable amount of plastic waste can be recycled to make newer products. Plastic containers, buckets, etc. are recycled to make similar products for storage. Plastic water bottles are often converted to pellets which are then used in other industries including construction. There are also looms that have been developed to make recycled products out of shredded plastic bags.

Recycling is now an industry by itself, with all waste material being segregated and then processed to make them useful; it provides employment to people including rag pickers and those working on recycling itself. Recycling helps reduce the use of valuable resources which can then be put to use for other purposes and are available for longer period.

Recycling has several benefits. It reduces the amount of waste that reaches the roadside bins, reduces the amount of energy needed to make new products and reduces the requirement for original material. Recycling reduces pollution and the destruction caused while obtaining new raw materials.

Recently, concerns have been raised about the processes in recycling which could be harmful to the environment and human health. So it is important to ensure that the technology used for recycling is safe.

Besides the three R's, several other R's are also popular in dealing with plastics waste.

**(iv) Refuse:** A large part of plastic waste usually consists of discarded polyethene bags. As plastic or carry bags take years to degrade, and will never degrade in a human life cycle, not using them is the best solution. We could carry our own bags for shopping and refuse plastic bags. Another important item to refuse are products that contain micro-beads like cosmetics (plastic scrubbers, facial scrubs, body wash) as these micro plastics slip through water-treatment plants and enter the water bodies, affecting the aquatic ecosystem. Good hotels and restaurants have their own water purifying system. In such places there is no need for mineral/bottled water. It should be refused.

**(v) Replace:** Several of the plastics items that we use in our daily life can be replaced with more sustainable and less harmful options. Many of the substitutes mentioned below are more biodegradable and/or recyclable and hence less harmful to the environment. Many of these have also been used widely in the era before plastics became the most popular material.

- **Glass:** It is made from sand (a renewable material) and is easily reused and recycled. Glass containers and bottles have always been used for storage of food items and water and other beverages.
- **Cloth:** Bags made from cloth are an easy substitute for plastic bags and can be carried with us for shopping to avoid use of plastic ones. There are also other options like jute which are made from natural fibre and can also be trendy.
- **Paper:** It can be a good packaging and carrying material for items like clothes, stationery, cosmetics and others. Food items used to be wrapped in paper before plastic bags and covers became popular.
- **Reusable containers and utensils:** Containers and utensils made of metals and other materials like ceramic, can be used in place of plastics.
- **Starch based polymers:** These bioplastics are becoming more popular as a substitute for plastic bags as they are biodegradable.

Besides these, researchers are trying to find viable options to replace plastics, and a few such findings are:

- **Milk protein:** It can help produce a biodegradable plastic to make insulation, packaging, etc.
- **Chicken feathers:** Made of keratin, chicken feathers can produce strong plastics as compared to those made from agricultural sources like soy and starch.
- **Liquid wood:** It is made from plastic polymers and wood fibres, is biodegradable and suitable for packaging.

**(vi) Repair:** In today's consumerist world, we find it easier to buy a new product than to repair and use an existing product. This is true of especially electronic goods like mobile phones and domestic appliances, which can last a long time if repaired when necessary.

Reducing, reusing and recycling, decrease both the demands on natural resources, as well as the rate at which they are consumed. Fewer resources are used, limited supplies are conserved, and regeneration of renewable resources can occur. In addition, less waste is generated, thereby reducing the amount of trash that must be landfilled or incinerated. As the amount of trash buried or burned decreases, so, too, does the potential for water and air pollution which can occur as a result of burning or improper disposal of wastes.

Our world has a limited supply of natural resources, including land used for landfills. All these techniques help us conserve such natural resources.

## Modern Technologies for Reuse of Plastics on a Large Scale

While the 3R's and others are actions that any individual or organization can take, industry has the potential to reuse/recycle larger quantities of plastics. Four such examples are given here.

A few technologies have been developed to minimize the adverse effects of plastics on the environment. While an accepted technology for plastic disposal is incineration, it is not a preferred option as it releases toxic gases like chlorinated dioxins and furans, raising several environmental and health issues. The Central Pollution Control Board (CPCB) has consolidated a few innovative technical options for safer disposal of plastic waste. For adopting any such technology, the prerequisite is that the plastic waste should be segregated and cleaned.

**(I) Utilization of Plastic Waste in Road Construction:** As per a study by CPCB, India generates more than 56 lakh tonnes of plastic waste annually, with 60 large cities generating over 15,000 tonnes of plastic waste everyday. To reduce the problem of plastics disposal, the government has now made it mandatory for road developers to use waste plastic along with bituminous mixes for road construction. This is being implemented successfully for the

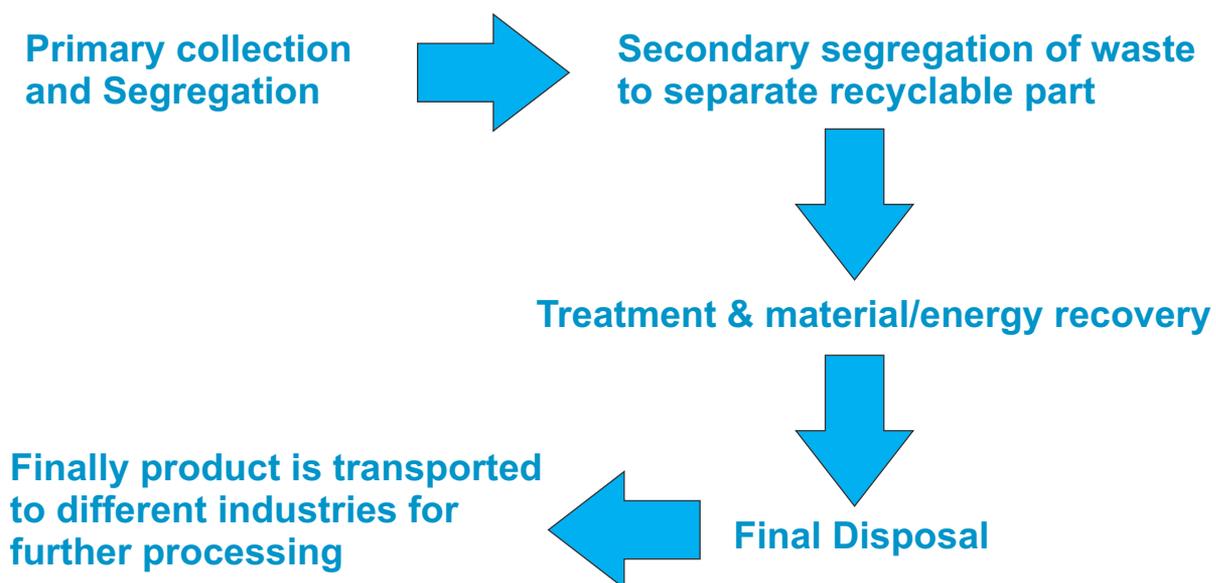
The technology for utilization of plastic waste in road construction was developed by the 'Plastic Man' of India, Prof. Rajagopalan Vasudevan, Professor of Chemistry at Thiagarajar College of Engineering, Madurai, India, who has come out with a patented method to reuse plastic waste to construct roads and has laid around 1 lakh kilometres of the road across 11 states in the country with support from the government.



construction of roads in various places in India. The use of plastic in roads is believed to add to their longevity by making them water resistant and increasing their resistance to changes in weather. A kilometre of road can use about 1.0 tonnes of plastics.

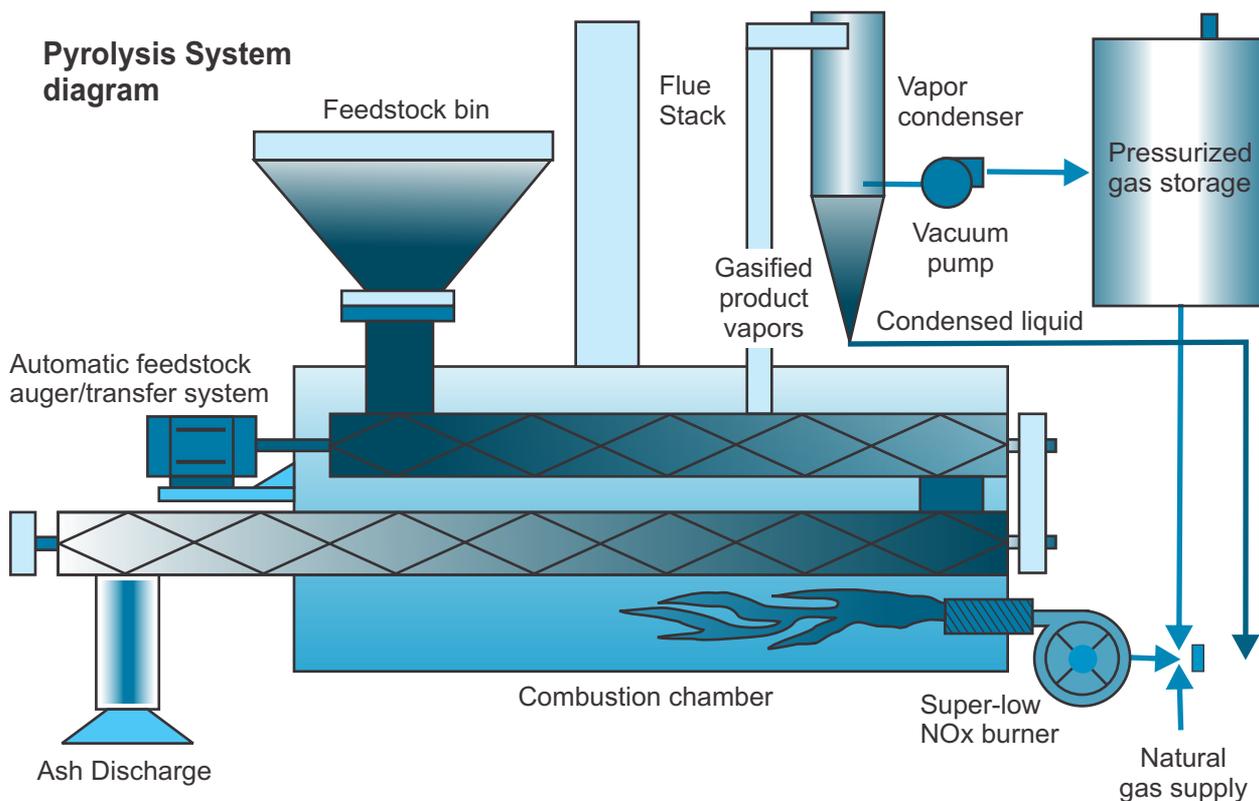
**(ii) Co-processing of Plastic Waste as Alternative Fuel and Raw Material (AFR) in Cement Kilns, Steel and Power Plants:** Co-processing is the use of plastic waste materials either as a fuel or as raw material(s) in cement, steel and power plants. The cement producers or power plants can save valuable fossil fuel and raw material consumption leading to more eco-efficient production and less environmental pollution.

## CO-PROCESSING OF PLASTICS



**(iii) Conversion of Plastic Waste into Liquid RDF – Refuse-Derived Fuel (Oil):** This involves segregation of plastic waste from municipal solid waste, removing dust and impurities from high and low density plastics except PVC, processing the plastic waste using additives and collecting the liquid RDF. This fuel can be used in various industries like cement and coal power plants as secondary or substitute fuels.

**(iv) Plasma Pyrolysis Technology (PPT):** Plasma Pyrolysis is a process that integrates the thermochemical properties of plasma with the pyrolysis process (decomposition of materials brought about through high temperatures). The intense and versatile heat generation capabilities of PPT enable it to dispose of all types of plastic wastes including polymeric, biomedical and hazardous waste, in a safe and reliable manner.



## Creating Awareness about Plastic Waste

The school can create awareness about managing plastic waste involving community members and local government representatives. Different kinds of waste – Municipal Solid Waste (MSW), Electronic Waste (E-waste), Bio Medical Waste (BMW), Construction and Demolition (C&D) waste – the need for segregation at source; ways to reduce, reuse and recycle plastics and other waste; the dangers of improper disposal of plastic waste like burning; sustainable options for packaging and storing items in place of plastics: these are some of the topics that could be dealt with in awareness programs. Campaigns to clean up plastic waste in the neighbourhood and to advocate substitutes to plastic items like cloth bags can be conducted with the help of school children. Awareness sessions to understand the law related to plastic waste management help people take actions to prevent misuse of plastics (such as bags of less than 50 microns thickness).

### Some tips to reduce plastic waste

- Buy in bulk – in a bigger container/bag to avoid several smaller ones
- Provide cloth bag when taking garments to laundry/dry cleaning
- Choose home made meals instead of junk food which use a lot of plastic packaging (it is also good for health and saves money!)
- Buy second hand items like toys, electronic gadgets, etc. if feasible
- Use reusable menstrual and sanitary products instead of disposable ones

### **My Responsibilities: Actions I can take**

- I will segregate the plastic waste at my residence from other wastes.
- I will use cotton/jute bags for shopping instead of plastic bags.
- I will not use the plastic bags that have less than 50 microns thickness.
- I will oppose the burning of waste in the open and report to the competent authorities.
- I will dispose of plastic/paper or any other waste in a responsible manner.
- I will not use 'one time use plastic bottles' for drinking water or for any other purpose; instead I will use metal/reusable plastic bottles.
- I will prefer home cooked food to readymade food from outside to reduce plastic waste generation.
- I will avoid the use of all single use plastic goods.
- I will try to purchase second hand items, commodities in bulk and support tax on plastic use.

## **Law on Plastic Waste Management**

The Ministry of Environment, Forest and Climate Change (MoEFCC) has notified new Plastic Waste Management Rules, 2016, and amended it in 2018. Some of the key features of these rules are:

- The rules are applicable to every waste generator, local body, *gram panchayat*, manufacturer, importer and producer.
- The minimum thickness of plastic carry bags made of virgin or recycled plastics shall be 50 microns.
- Carry bags or products made of recycled plastic shall not be used for storing, carrying, dispensing or packaging ready to eat or drink food stuff.
- The concept of Extended Producer Responsibility (EPR) says that the primary responsibility for collection of multi-layered plastic sachets or pouches or packaging is of producers, importers and brand owners; they are required to establish a system for collecting back the plastic waste generated due to their products.
- Carry bags or recycled plastic bags or multilayered packaging can be manufactured only by registered manufacturers/producers/recyclers.

## Roles and Responsibilities of Various Agencies

**(I) Local Bodies** (such as municipal corporations, municipalities, *gram panchayats*, etc.) have to:

- Develop and set up infrastructure and system for segregation, collection, storage, transportation, processing and disposal of plastic waste.
- Send recyclable plastic waste to recyclers.
- Create awareness among all stakeholders about their responsibilities.
- Ensure there is no burning of plastic waste in the open.

### **(ii) Waste Generator**

- Take steps to minimize the generation of plastic waste.
- Segregate plastic waste at source and handover this segregated storage of waste to the local body/*gram panchayat*, or authorized waste processing facilities/agencies.

### **(iii) Producers, Importers & Brand Owners**

Establish a system for collecting back the plastic waste generated due to their products and implement the same.

#### **Help End Plastic Pollution !**

1. Reduce - Use Less
2. Refuse - Say No to Single-Use Plastic Items
3. Reuse - Ask for Reusable Products
4. Recycle - Learn How to Recycle Properly
5. Remove - Pick Up Trash & Recyclables and Put in the Right Places

## Activity 3.1

# A pen has many lives!

### Introduction

The easy availability of inexpensive plastics has made it possible for people to casually dispose products that are reusable. One such example is a ball pen which is meant to be reused with a refill. However, this is rarely done, as most people tend to toss it away once it runs out of ink, only to grab a new pen.

This activity is intended to create awareness about how a product's life can be extended.

<b>Objective</b>	To make students find effective ways of reusing products
<b>Grade Level</b>	Middle school
<b>Group size</b>	10
<b>Place</b>	School
<b>Duration</b>	1 week
<b>Materials</b>	Collection of used or discarded pens, boxes for collection, refill for pens, paper and paint to make posters

### Before you begin

Discuss the impact of plastic pollution and how recycling can make a difference



## Methodology

The students should form groups and undertake a collection drive for old pens, using a carton as the collection unit. Each group should prepare an informative and colorful poster requesting everyone to drop their used pens in the unit. Students can also be encouraged to bring used pens from their homes.

Once there are enough pens in the unit, the students can sort through the pens and procure appropriate refills for the pens that are reusable. After the replacement of the used refills in the new pens is complete, the students can sell them within and outside the school and use the proceeds for environmental activities at the school.

## Conclusion

The students will learn that with proper care and responsible use, the refilled pens not only saves money but can also last much longer, without adding waste to the landfills.

The students will also learn about devising sustainable business models.

## Evaluation

Identify other products and methods for daily utility items that can be reused.

## Activity 3.2

# Regulating the use of plastics

## Introduction

Laws play an important role in regulating the use and disposal of plastics. For instance, India has regulations regarding the use of plastic bags below 50 microns. This activity is designed to create a discussion in class about developing a set of rules for the school that will help reduce the use of plastics and its appropriate disposal.

<b>Objective</b>	To help students understand how laws are made in a parliamentary process and how different point of views need to be solicited and incorporated before it is approved in the legislature.
<b>Grade Level</b>	Secondary school
<b>Group size</b>	Class to be divided into 2 groups
<b>Place</b>	School
<b>Duration</b>	45 minutes
<b>Materials</b>	Pen, Book

## Before you begin

The teacher can start by explaining the importance of legislation and current rules and regulations for plastic waste disposal. Students can then be asked to draft their own laws regarding the use and disposal of plastics.



## Methodology

A group of students should be chosen to lead the discussion. Their task will be to prepare a draft set of rules and legislation for the use and disposal of plastics in the school.

Meanwhile, the rest of the class can elect a student to play the role of a speaker who will conduct the proceedings. The speaker should then invite discussion on the draft rules. All students must be encouraged to argue, and suggest modifications to the draft. The group that has drafted the legislation can also present their suggestions. Finally, the class can vote on the corrected draft.

In case of no agreement, item wise votes can be taken to decide which of the suggestions should form a part of the school rules.

The approved draft as the recommended set of rules which govern the use and disposal of plastics for the school can then be handed over to the principal.

## Conclusion

The students will derive a clear understanding of the parliamentary process of lawmaking.

This activity will also help the students to comprehend the need for and impact of laws and regulations on the plastic use and disposal.

## Evaluation

It can focus on the quality of the discussion:

- 1) Whether the different point of views are being articulated and received and how?
- 2) How these views are being integrated towards a consensus?

The following questions such can be used for discussion:

Is it possible to get a unanimity on the plastic policy?

Is there any part of the suggested rules that might affect some students unfairly? If yes, how can the rules be modified to avoid doing so?

## Activity 3.3

# Smart shopping choices based on packaging

## Introduction

Plastic packaging is becoming an increasingly large part of the total waste generated. Nearly half of polymer plastics that are produced are used as packaging materials with a short shelf life. They are redundant once the package is opened. The amount of plastic packaging waste is dependent on how we buy and is reflected in the shopping choices of every household. This activity will help us understand the quantity of waste generated through a student's own household shopping choices and the scope for reduction.

<b>Objective</b>	<ol style="list-style-type: none"><li>1. To help students identify packaging waste is dependent on where and how we buy.</li><li>2. Ways to reduce plastic waste through smart shopping choices by individuals</li></ol>
<b>Grade level</b>	Middle & Secondary
<b>Group size</b>	Class
<b>Place</b>	School, shops and home
<b>Duration</b>	<ul style="list-style-type: none"><li>• 20 minutes of class time per week for two weeks</li><li>• 20 minutes for background, introduction and questions related to the activity</li><li>• One week's time provided to each student/group to undertake the activity</li><li>• 20 minutes discussion in the following week on result and conclusions</li></ul>
<b>Materials</b>	Survey sheets, Stationery

## Before you begin

The teacher can start by talking about the problems caused by plastic packaging waste and then present and discuss the survey sheets with the students.

## Methodology

- Throughout the first week, the teacher should guide students to work on their own, over one week using the survey sheets to evaluate the amount and the type of packaging material that they find in their homes, while discussing with their parents, the possible ways to reduce the amount of packaged products being purchased by the family. In case of on online purchases, the students should evaluate these for the amount of packaging involved in these purchases.
- The students should present their findings and initiate a discussion on how the purchase of products with excess packaging, could be reduced.
- The teacher should guide students to work on developing an effective campaign to reduce packaging waste based on the analysis of the data compiled from the survey sheets.

## Consumer Survey Form

1. It will help assess the amount of disposable plastic packaging and how it varies from shop to shop and product to product.
2. It will help understand whether the consumers are concerned about how the packaging waste affects the environment.
3. It is designed to lead to the ways of making smart shopping choices based on packaging.

**Packaging Waste Survey** (The students should fill out this form in consultation with their parents)

Do you purchase from

Street vendors /small kirana shops /supermarkets / online (circle the ones which are applicable)

Name any 3 products which generate the most amount of packaging waste

	Name of the product	Bought from
1)		
2)		
3)		

Name any 3 products which generate the least amount of packaging waste

	Name of the product	Bought from
1)		
2)		
3)		

Name 5 different types of packaging material that you can think of

How do you dispose milk pouches, tetrapaks and/or soft drink PET bottles?

- 1) Milk pouches
  - Common garbage bin
  - Garbage bin for plastics
  - Sell to a *Kabadiwala*
  - Return to the supplier
- 2) Tetra pak
  - Common garbage bin
  - Garbage bin for plastics
  - Sell to a *Kabadiwala*
  - Return to the supplier
- 3) Soft drink PET bottles
  - Common garbage bin
  - Garbage bin for plastics
  - Sell to a *Kabadiwala*
  - Return to the supplier

When you buy a product, do you think of the waste it generates? Yes / No

When you go for shopping, do you carry a bag with you Yes / No

When you shop, do you look for packaging which is made from recycled material?  
Yes / No

Do you save the packaging material for reuse? Yes / No

How do you dispose of different packaging items like plastic bottles, corrugated sheets, glass bottles, tetra pak, aluminium cans etc. Please mention the names of the packaging waste against the options that apply to you.

Segregate for recycling

Throw away as mixed garbage

Sell to a *kabadiwalla*

Return to the supplier

What kind of packaging material are you most likely to return for recycling?

Plastic bottles

Corrugated sheets

Glass bottles

Tetra pak

Aluminum cans

## Conclusion

This activity will demonstrate how packaging waste is a function of the products we buy and establish that there is scope for reduction.

## Evaluation

- They should be able to analyze with the help of their families, the shopping practices and choices made in their own households and come up with ways of reducing plastic waste.
- The students can also be evaluated on the effectiveness of the ideas in their campaign.



## Activity 3.4

# Identifying alternatives to plastics

## Introduction

This activity focuses on identifying alternatives to the most commonly used disposable plastic products while making students aware of the harm caused by disposable plastics.

<b>Objective</b>	To get the students to reduce the use of plastic products by finding better alternatives for disposable plastics
<b>Grade level</b>	Middle school
<b>Group size</b>	Individual
<b>Place</b>	Home and School
<b>Duration</b>	45 minutes
<b>Materials</b>	Blackboard and chalk

## Before you begin

The teacher should introduce the concept of disposable plastic.

## Methodology

1. Following the introduction of the concept, the teacher should ask the students to name any disposable plastic products they can think of. One of the students can be given the responsibility of writing the names of these products on the board.
2. Initially each student should be asked to name only one product so that each student has a chance to give her/his contribution to the list on the board. .
3. After all the answers are up on the board, the teacher should initiate a discussion on whether and why any of the products need to be removed from the list.
4. The teacher should begin the second round. Taking each item on the list and ask any of the students to suggest an alternative to that product and explain why the alternative is a better option. If the class agrees that this product is indeed a better alternative, then erase that product from the list. Go through the entire list in this way.
5. The teacher should check all the products have disappeared from the list? If not then how many still remain?



## Activity 3.5

# Swap your stuff

## Introduction

If we just looked into our cupboards, we would probably find a number of things that we do not need any longer. These could be given away or exchanged for something else that may be useful to us thus sharing resources and help reduce the overall consumption.

<b>Objective</b>	To demonstrate to the students that 'one person's waste can be another person's resource', and that a product's life can be extended by treating it as a resource
<b>Grade level</b>	Secondary
<b>Group size</b>	An entire class
<b>Place</b>	In school
<b>Duration</b>	30 minutes
<b>Materials</b>	Tables, containers to display used products, space for the swapping centre, banner or poster

## Before you begin

Teacher should discuss the issue of consumption with the students. To initiate the discussions questions can be asked:

- o What are some of the things you have in excess or do not use and which could possibly be used by others?
- o Have you ever received or exchanged any used product?
- o Have you ever thrown something away that someone else could have used?

## Methodology

1. The teacher should introduce 'Swap your stuff' activity to the students. The activity would include setting up a space in the school to exchange the used products by students with each other.

2. Form groups of students to plan the activity in the school. The planning would need to include a) deciding the time and the place for the activity; b) setting up the space for 'Swap your stuff'; c) developing the mailers, announcements, banners and posters; d) getting the information to the parents or the students; and e) managing the event on the day of the execution.
3. Discuss and set rules for the classification of products that can be brought as well as the terms and measure of exchange.
4. On the activity day, get the students who have brought products to display these at the 'Swap centre'. The class would need to identify a couple of students to be stationed at the display centre to oversee the exchange. This activity can be organised for an hour during the school assembly or recess.
5. All the items that are not exchanged can be donated to a charitable trust.

## Conclusion

As a result, the class can review the number of items that did not go to the landfill. They can design a chart and put it up on the school bulletin board.

## Evaluation

Discuss whether each and every student understood the concept of one's waste can be another's resource.



# 1 - Bottle cap mosaic

## Introduction

The caps of plastic bottle come in the varieties of colours and sizes. These caps can be used creatively in art and craft activity in the school.

<b>Objective</b>	To encourage students to understand about reuse and recycling through activity
<b>Grade Level</b>	Primary
<b>Group size</b>	5-6 students per group
<b>Place</b>	Art and Craft class
<b>Duration</b>	30 minutes
<b>Materials</b>	<ul style="list-style-type: none"><li>• Plastic bottle caps in various colours and sizes</li><li>• Cardboards from used cartons</li><li>• Box cutter</li><li>• Glue</li><li>• Optional: pencil, paper, permanent markers</li></ul>

## Before you begin

Teacher should ask students to collect as many plastic bottle caps as they can from their family and neighbours and bring them to school.

## Methodology

2. The teacher should get the students into small groups and provide each group with a cardboard. The students can then sketch a design on the cardboard. They can arrange the bottle caps around the sketch and glue them on to the cardboard.
3. They can use the coloured markers to highlight or create details.
4. Ask each student group to put their bottle cap mosaic on display.

## Evaluation

Have the students understood the concept of reuse? Can they come up with other creative ideas for the reuse of plastic waste?

# 2 - Bottle planters

## Introduction

Soft drink PET bottles come in different shapes and sizes. These bottles can be used creatively to create planters as an art and craft activity.

<b>Objective</b>	To Introduce students to creative ways of using packaging waste.
<b>Grade Level</b>	Middle
<b>Group size</b>	Individual
<b>Place</b>	Home
<b>Duration</b>	20 minutes
<b>Materials</b>	<ul style="list-style-type: none"><li>• Plastic water bottle (1 ltr size), scissors, seeds, soil, string</li></ul>

## Before you begin

The teacher should ask the students to collect at least one used PET bottle and bring it to the class.

## Methodology

1. A student can do this activity even at their home. Placing the bottle horizontally, the student can cut out a rectangular section from one side of the plastic bottle. The bottle should have its cap on. The following steps are suggested:
2. Fill the bottle with soil.
3. Plant seeds of flowers or vegetables in the soil.
4. Use the string to hang the bottle in an appropriate place with maximum sunlight.
5. Water the plant to see them grow.
6. The teacher should encourage the students to share pictures of the reusable bottle planters in the class.

## Evaluation

Did the students understand the concept of reusing a plastic product? Did they come up with more ideas for the reuse of plastic waste?

# 3 - Bubble wrap print

## Introduction

Bubble wrap packaging received with different electronic or other daily use items is generally discarded. This packaging can be stored and used again for wrapping or it can be reused creatively.

<b>Objective</b>	To get students to understand the importance of thinking creatively about reusing waste
<b>Grade Level</b>	Primary school
<b>Group size</b>	Individual
<b>Place</b>	Home
<b>Duration</b>	45 minutes
<b>Materials</b>	<ul style="list-style-type: none"><li>• Bubble Wrap, paint/water colours, paper, scissors, sponge</li></ul>

## Before you begin

The teacher should explain the students to store packaging waste in order to use it later for craft activities.

## Methodology

1. Encourage the students to color a particular piece of bubble wrap using the sponge.
2. Once they are done painting, flip the bubble wrap over a piece of paper and press it down to create an interesting design.

## Evaluation

The teacher should evaluate the students on their creativity and their understanding of the importance of reusing waste.

# Handprint Activities

## Handprint for Responsible Use of Plastics

In a short span of time, products made from plastics have become part of our everyday life. It is present in our clothing, the pen that we write with, the chair that we sit on or the wrapping of the food that we eat. Plastics offer advantages such as lightness, resilience, resistance to corrosion, colour fastness, transparency, and ease of processing. But, plastics also carry a lot of disadvantages. It does not degrade quickly and hence it is filling up our landfills, natural environment and oceans causing serious ecological, human and economic impacts.

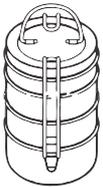
As consumers, the overuse of plastics and their careless disposal is a problem. Therefore, it is important to use plastics responsibly. We can make a difference to this situation through our actions. This booklet suggests some easy Handprint actions which each one of us can take in our everyday life and contribute to the responsible use of plastics. <http://www.handprint.in>

## The Basic 5

1. Always segregate waste! Remember that nothing can be done if we mix it up.
2. Audit plastic use and waste and set an achievable target for plastic waste reduction at both school and home.
3. Resolve to not litter our surroundings with plastic waste during any of our outings or picnics. Always carry a garbage bag to collect and dispose of plastic waste in the dustbin or designated garbage collection point.
4. Remember to waste less; and segregate recyclables before handing over to waste collectors; to compost wet/green waste and to carefully deposit e-waste with authorized collectors!
5. Never burn or allow anybody to burn plastic waste.

## For school

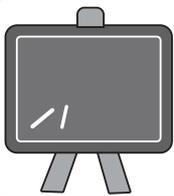
### Reduce



1. Reduce food package waste
  - Carry homemade food and do not wrap it in plastic
  - Minimize the consumption of packaged foods
  - Dispose of food wrapping in the right bin

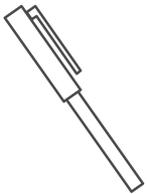


2. Refuse disposable cups/cutlery
  - Carry your own ceramic or reusable cup/cutlery; wash after use and store in your own bag or desk



3. Avoid plastic marker pens
  - Ask your school to install chalkboards instead of white-boards

### Re-use



1. Refill and reuse Pens
  - Buy ball pens that are refillable or ink pens if available
  - Do not throw away/discard pens which can be refilled



2. Reuse paper
  - Use newspapers/old magazines/old calendars to cover books
  - Also use for wrapping gifts

### Re-cycle



2. Segregate waste
  - Throw wet waste (left over food, fruit peels), recyclable (plastic, paper, tin, etc.) and hazardous (sanitary pads, battery, other electronic items) in separate bins designated for each category of waste

## For Home

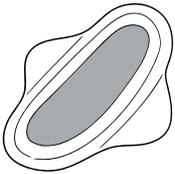
### Reduce



1. Carry your own bags
  - Refuse plastic bags from shops
  - Always carry a shopping bag with you which can be used for various purposes



2. Minimize buying bottled water
  - Carry your own refillable water bottle while traveling
  - In hotels and restaurants which have a water purifying system in place, ask for regular water and not bottled water



3. Avoid plastic lined sanitary napkins
  - Use organic disposal cotton pads or cotton layered knitted pads



4. Reduce waste at parties
  - Store decorations after use for your next party
  - Avoid using disposable plastics, use reusable, recyclable or natural material



7. Disposable plates
  - When disposable plates are necessary, use bowls and plates made from the leaves and sheaths of trees



6. Avoid plastic lined diapers
  - If there is an infant in your family, suggest that cloth diapers be used instead of synthetic diapers



8. Minimize or avoid the use of plastic and thermocol in projects/models and decorations

## Re-use



1. Repair
  - Repair toys and increase their life span instead of buying a new product.
  - Ensure proper disposal when they are beyond repair



2. Carry your own containers
  - If buying food from outside, take your own containers along instead of asking the restaurant to pack it in plastic or foil containers.



- Avoid disposable razors
- Ask your family members to avoid using disposable razors



2. Upcycle clothes
  - Don't throw clothes with polyester fabrics. Try making other products like bags

## Re-cycle



1. Collect separately
  - Separate plastics from wet waste before disposing of wet waste. Do not carelessly throw them in together.

**Talk about your Handprint with friends and family!  
Motivate them to take Handprint actions!**

## Project ideas

- Make a list of all the plastic products around you at home, school and the neighborhood. Try to find out what products were in use before plastics appeared in your home, school or neighborhood. How were those products made?
- Ask people at home and in the neighbourhood what impact industrial plastic products have had on their lives and livelihoods. Share your knowledge about the problems with plastics if they are not aware of them. Talk about how large scale, industrial, cheap plastic products end up polluting the environment. Explain how they harm humans and animals and how they have often destroyed local economies of eco-friendly, de-centralised cottage industries.
- 'Not just individual level action but political education too is needed to 'beat plastic pollution'. Learn about and discuss with peers, family, teachers about the responsibility of local, state and central governments towards creating a plastic free and pollution free environment for all citizens.
- Invite an expert or state pollution control body representative for an interactive talk in your school or community to better understand the various laws and rules related to plastic manufacturing, waste management responsibilities and pollution.
- Be an alert and aware citizen who understands the Right to Information (RTI) Act. You can try learning more about it by actually filing an RTI query, e.g. seeking information about budget allocation/expenditure and human power related to waste management in your local Panchayat or Municipality.
- Learn about the National Green Tribunal (NGT), the NGT Act and the tribunal's role in ensuring the 'beat plastic pollution' goal as well as the regulations put in place by the Ministry of Environment, Forest and Climate Change (MoEFCC), Government of India.
- Investigate patterns of plastic product consumption at your home, apartment complex, neighbourhood and school and develop a waste reduction and management plan for implementation with help from all involved.
- Take up action projects such as creating cloth bags from old and clean clothes, as well as paper bags of various sizes from newspapers or used paper to replace plastic bags wherever they are being used.
- Get in touch with women self-help groups in your neighbourhood and interest them in the business of making and selling eco-friendly bags and other alternative packaging products. Help them get orders and support them in whatever way you can.
- Research on trade in plastic waste.
- Organise a clean up drive.

## Activity 4.1

# The School 100m Campaign

## Introduction

It is important that schools are kept clean and free from plastic pollution. Keeping the school and its vicinity clean is one of the most efficient ways to contribute to “Swachh Bharat Abhiyan.” Besides the campuses, it is also important to keep the surroundings outside the campus clean.

<b>Objective</b>	<p>The “100 Metres Clean-up Challenge” promotes the idea that keeping the school surroundings clean lies in the hands of students and the school authorities. The challenge encourages students to identify a 100 metre stretch outside school and ensure that it is clean.</p> <p>The students as well as the school management, both have to ensure that the stretch becomes “Plastic and Litter Free Zone”. It should also be ensured that regular maintenance of the stretch is done in order to keep it clean and plastic free.</p>
<b>Grade Level</b>	Middle and secondary
<b>Group size</b>	All classes
<b>Place</b>	School and 100 meter stretch outside the school
<b>Duration</b>	One year and ongoing
<b>Materials</b>	<ul style="list-style-type: none"><li>• Two sign boards to mark the 100 meter stretch</li><li>• Cleaning material</li><li>• Three bins to segregate the waste</li></ul>

## Before you begin

For this activity, a stretch of 100 meters outside the school premises should be identified. Each grade in middle and secondary level can engaged in this activity.

The school would also need to provide safety equipment like mask, gloves etc. It is also recommended that colored bins are provided so that the collected waste is kept appropriately (Blue for dry waste, Green for wet waste and Black for hazardous waste).

## Methodology

The classes in the middle and secondary school should be given the responsibility of ensuring different parts of the school has been kept plastic and litter free. They may be encouraged to put up necessary signage posters and bins to achieve this. Together and along with the school management a 100 meter stretch ideally the road length 50 meters on either sides of the school gate can be selected. A sign board should be put up on either side stating this area is being kept clean by the school.

School children should also be encouraged to talk to the Municipal and other cleaners who normally cleaning this stretch and getting them to say what types of problems they face.

If there is a problems of not having bins correctly marked as Blue, Green and Black, these needs to be installed or the existing bins colour coated with proper signage.

The students should work out a budget required for the activity and think of creating that resource from the community with the assistance of school management.

Once progress is made, these needs to be reported in the two websites details of which are given below.

## Conclusion

All those who fulfill this activity will get a join certificate from CEE and UNEP. The best schools in each State will be given a prize

## Evaluation

If you take up this project, please report on <http://worldenvironmentday.global/en/register-event> during 1-5 June, 2018 and also register at <http://www.handprint.in/register>



# Learning Outcomes

### Learning Outcomes for Addressing the Problem of Plastics

This publication is intended to enhance literacy with respect to Plastics amongst the students and to achieve the same by setting the expectations for performance and achievement. The expectations, expressed as learning outcomes, can be easily integrated or infused with the existing curriculum. The content and activities of the publication are designed in a way that the students are active participants in building the required knowledge, attitude, competencies to influence the behaviours or actions of addressing the problems associated with plastics. It is important that the students are encouraged to think independently, act responsibly and develop communication skills and resolve to demonstrate their learnings and influence people in their immediate surroundings. Creative and critical thinking are two aspects that are important for any environmentally literate students as these help in logically organizing the new information with the previous experience and knowledge to make reasoned judgement and solve real world problems.

The expected learning outcomes would also aid the teachers assessing the literacy of students and see the change. They can design formative and summative assessment based on the expected learning outcomes. The learning outcomes to Beat Plastic Pollution are listed below:-

#### Students will be able to

- Appreciate the properties that has made plastic such a strong and versatile material
- Recall the history and evolution of plastic as a material
- Conclude that chemical composition of the 'monomers' determines the properties including degradability
- List the impacts of plastic pollution on water bodies, flora, fauna and human health
- List the alternatives that were being used before the plastic era
- List the reasons for the problem associated with plastic waste
- Explain the problems associated with one time plastic use
- Identify the challenges associated with plastic waste
- Identify problems associated with micro plastics
- Estimate the scale of the problem
- Compare the impact of plastics based on the use/product
- Explain the R's (Reduce, Reuse and Recycle)
- Recall innovative ways to reduce, reuse and recycle plastic waste
- Identify the challenges in plastic waste disposal
- Draw the process for an effective waste management

- Identify strategies to regulate use of plastic in school
- Conduct a survey/audit of plastic use
- Set up a collection system
- Conclude that our choices/behaviour can manage the problem of plastic
- Describe the individual handprint positive actions towards sustainability that can beat plastic pollution
- Resolve for minimizing plastic use in one's life
- Demonstrate behaviour to reduce consumption and littering
- Identify a 100 meter stretch outside school and take part in the 100 metre plastic free challenge

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स्वच्छ भारत अभियान का लक्ष्य भारतीय शहरों, छोटे कस्बों और ग्रामीण क्षेत्रों की गलियों, सड़कों और ढाँचों को साफ-सुथरा रखना है। विश्व पर्यावरण दिवस 2018 – प्लास्टिक प्रदूषण से जंग के अन्तर्गत, हैण्डप्रिन्ट कार्य स्वच्छ भारत के प्रयास में एक योगदान हैं।

Swachh Bharat Abhiyan is a campaign in India that aims to clean up the streets, roads and infrastructure of India's cities, smaller towns, and rural areas. The Handprint actions to Beat Plastic Pollution as part of World Environment Day 2018 contribute towards a Swachh Bharat.

## CEE

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