



Commonwealth
Litter Programme

Education Pack for educators of primary and secondary students India

This section provides an introduction and background information for educators in India on marine litter, related to the material in the CLiP Education Packs, with guidelines for the packs' tasks.



Department
for Environment
Food & Rural Affairs



Cefas



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Introduction

This pack was created for educators, teachers and trainers who can use the CLiP Education Packs, to enable students to broaden their knowledge on the problems caused in seas, oceans, estuaries, coral reefs, mangroves, beaches, marinas, riverfronts, lakeshores, and the impacts on flora and fauna and humans by marine litter in India. The educators and trainers can share the activities included in the CLiP Education Packs with students to raise awareness of the hazards caused by marine litter to the environment.

What is marine litter?

Marine litter is a type of environmental pollution caused by the presence of human waste in the sea. We call 'marine litter' any man-made, long-lasting solid material that humans have incorrectly disposed of and that has ended up on our beaches, in our estuaries, rivers, seas, and oceans.

The waste that can become marine litter is made of many materials including a range of plastics, rubber, paper, processed wood, textile, metal, glass, ceramic, and sometimes a mix of them. Plastics are the main component of marine litter in the world and are estimated to comprise up to 80% of all the items. Some plastic items are particularly frequent in the sea and on the beaches because of their widespread use in today's society: plastic bottles used for cold drinks, soda and mineral water; styrofoam/thermocool plates and packing material; cigarette butts and chewing-tobacco pouches; food wrappers; cotton buds; synthetic portions of sanitary napkins and diapers; and polythene bags are some of the most common examples. Plastic ropes and broken nets from fishing are also found floating, as well as washed ashore. Glass is the second most common material found on beaches, mostly coming from whole and broken bottles. Metal can also be abundant and aluminium drink cans, hardware junk and automobile scrap pieces can frequently be found on beaches and in our seas. Organic waste like food scraps (both vegetable and animal) is not considered marine litter because it decomposes in the environment, disappearing over time. Among paper varieties, normal paper and tissue disintegrate fairly rapidly but glossy polished/laminated paper is a persistent form of litter.

Since early 2020, the COVID-19 pandemic has given rise to an altogether new category of litter now popularly known as "COVID waste". Millions of synthetic masks, gloves, face shields, and other personal protective wear like aprons/gowns are being discarded after very short use, and a fraction of this litter gets into water and reaches rivers and seas, adding to the already huge load of litter.

Marine litter includes both very big and very small items, ranging from tens of meters to millimetres. Microplastics are a particular type of marine litter. They are plastic and polystyrene/thermocool pieces smaller than 5 mm that can be produced when large items break down because of sun exposure (UV rays), salt corrosion, wave and wind action. Some microplastics are released directly into the environment, for example, when cosmetic products containing plastic beads as exfoliating agents are used. Recent studies are also investigating the effects of even smaller fragments called nanoplastics, smaller than one thousandth of a millimetre.



Dumped wastes including plastics float seawards in a river. Photo © Sharad Gaur

Where does it come from?

Approximately 8 million pieces of marine litter enter the marine environment every day! In India, a study in 2015 had pegged just the plastics portion of marine waste at over 600,000 tonnes annually. Marine litter can be created both on land and on the sea, but the general agreement is that the majority comes from land. The principal land-based source is the mismanagement of solid waste such as littering or using unregulated dumpsites. The waste accumulates on the ground without protection, and rainwater runoff and wind can then transport it to the sea. Litter can also arrive in the ocean indirectly, transported by rivers and streams.

Some marine litter can be created directly on the beach by people visiting the coast. Some of the litter commonly created by beachgoers during recreational activities is drinks bottles, food packets and plates, chewing-tobacco pouches and cigarette butts. These are the most frequent recognisable beach litter in India and many other parts of the world, not only because they are produced in high quantities but also because they are small and are often not collected during the beach clean-ups. These items are particularly bad because they are full of toxins from polythene, styrofoam, tobacco and they can break down into microplastics too. In many cities, towns and municipalities solid waste is illegally dumped on seashores or river fronts as the simplest disposal option.

Sea-based activities can also create litter. Fisheries can be a source of a particular type of litter called ALDFG, that stands for 'Abandoned, Lost or otherwise Discarded Fishing Gear'. This includes the nets, ropes, lobster traps, crates and all other object that are used during fishing. ALDFG can be created by accident, for example when fishing nets are lost at sea or traps

that cannot be recovered because of bad weather. However, some ALDFG can be created on purpose when nets break and are discarded in the sea instead of being properly disposed of back on land. Another way of creating litter in the sea is through the incorrect disposal of waste produced by shipping and cruise/tour boats. The items created in this case are very similar to the ones produced on land, including plastic bottles and food wrapping.

How long does it last?

Scientists have estimated how long plastic items take to break down. Although the exact times are unknown and depend on the conditions, it is likely to be longer in the sea where wet and much cooler conditions than on the land inhibit the natural decomposition process. Plastic is one of the most durable materials with hard items like bottles thought to last 450 years! Some items could last up to 1000 years.

Where does it all go?

Marine litter is a global problem. It has been found in every part of the ocean, on the coasts of all continents, including Antarctica, and in remote islands far from obvious sources and human contact. Marine litter is particularly studied on beaches, where it accumulates. A lot of litter is often accumulated on beaches near cities, rivers or places visited by many tourists. However, remote beaches with less direct human visits can also be full of waste because they are cleaned less often. Some of the litter will stay on the beach for a short time before being moved by waves, tides and wind, either more inland or into the sea. However, some litter can be covered by sand and remain buried there for a long time.

Different items have different densities which affects their final fate once they enter the sea. Some items float on the surface because they are light (for example, pieces of polystyrene) or because they trap air (for example, empty water bottles sealed with lids). Winds, waves, and currents can move this floating litter great distances and sometimes deposit items onto our shoreline. However, currents can also move litter to particular areas in the open ocean called 'gyres' that are like giant very slow whirlpools. There are five main gyres, one being in the Indian Ocean, where large amounts of marine litter can be found. The largest and most famous of them is the Great Pacific Garbage Patch, located in the North Pacific Ocean, where it is estimated that 1.8 trillion bits of plastic are accumulated!

Heavier items sink down to the seafloor, which is now considered the main place where plastic and metal junk is accumulating. Research now suggests that over 90% of plastics in the marine environment end up on the sea floor. Plastics and microplastics can also sink to the bottom because algae and small animals grow on them, making them heavier. Marine litter has sadly even reached the deepest point of the ocean, the Marianas Trench, where a plastic bag was photographed.

How does it affect animals and the environment?

Marine litter can cause serious damage to marine life, wildlife, and the natural environment in several different ways and over one million animals are killed each year due to marine litter. Animals can mistake litter for food and if they ingest it, harm and potentially death might occur.

Marine turtles, mammals and birds can mistake indigestible plastics for prey and eat it, filling their stomach with waste and starving. Sharp and bulky litter can also damage the organs or release toxic chemicals and introduce diseases in the animals' body. A recent whale washed up in Indonesia had 6 kg of plastic in its stomach, including 115 plastic cups, 25 plastic bags, two flip flops and over 1000 pieces of string. However, ingestion of marine litter is not only a problem for big animals with smaller species like fish, jellyfish and plankton being affected too. It is estimated that nearly 90% of seabirds, and over half of the world's sea turtles, have plastics in their guts. The United Nations have a campaign line saying that by 2050, there will be more plastics in the oceans than fish.

Microplastics in particular are inescapable as they are constantly getting ingested, 'respired in' and nanoplastics are surface-absorbed by marine animals. Once inside the body, they accumulate in the tissue and when the animal is eaten by a predator or consumed by humans (for example fish, prawn, oyster), concentrated quantities of nanoplastics are delivered in food. Studies have shown that even the salt on our tables now carries increasing amounts of nanoplastics!

Marine animals can also become trapped in litter, a phenomenon called 'entanglement'. Fishing nets keep trapping fish and other animals even after they have been abandoned in the sea. Animals that become entangled in ropes and nets have their ability to feed reduced and to escape predators, and marine mammals may even drown as they can't surface to breathe air. Some items wrapped around animals' limbs can also affect the animals during its growth, leading to deep wounds. Bottle cap-rings and knotted strings are other common items that can cause this type of harm.

Marine litter can carry 'alien' (also known as 'invasive') species to new shores and can disrupt ecosystems, causing losses in biodiversity. Following an earthquake and tsunami in Japan in 2011, large amounts of litter washed up on the US coastline. Many of these items were carrying Japanese mussels, barnacles, and sea squirts.

Marine litter effects on the human economy and health

There are several human activities that can be affected by the presence of marine litter in the ocean. Vessels fishing in areas full of litter lose a lot of time taking out the waste caught in their nets before being able to fish again. Time and money are also spent on fixing nets and boats that can be damaged by litter. If marine litter affects the fish, fishermen will also catch less and fish from polluted areas might have to be sold at a cheaper price, reducing income.

Tourism can also suffer because of marine litter. Tourists do not like to spend their time on beaches surrounded by a lot of waste. It is ironical that a lot of that litter is generated in the first place by tourism. There are more visitors in locations where the environment is pristine. The same happens for coral reefs, which lose their appeal when they are damaged by waste. Cities and resorts often clean their beaches to attract tourists, but this means that a lot of money must be spent for that activity.

How does marine litter affect India?

Data on the amounts and types of marine litter in India are increasingly becoming available both from anecdotal as well as research sources. A study by the Central Marine Fisheries Research Institute has published data on 254 Indian beaches that were surveyed, and it revealed that our beaches have litter ranging from as low as 0.31 gm per square metre (state of Odisha) to as high as 205.75 gm per square metre (Goa coast). We have over 7500 kilometres of coastline in India, covering diverse habitats such as mangroves, coral reefs, estuaries and backwaters, lagoons, sand beaches, rocky cliffs, and forested mountain slopes. A number of large and small islands also come within the Indian territory, each with their coastal zones.

Coral reefs

Coral reefs have some of the highest levels of biodiversity in the world. A quarter of all species in the ocean rely on coral reefs at some point in their lives. Worldwide, more than 500 million people rely on coral reefs for their food or income through fisheries. Coral reefs have a complex three-dimensional structure that creates a high surface area for photosynthetic corals to catch sun rays as energy, and many specific niches for creatures to live. Their upright structure traps food particles washed by in the currents and many forms of life on coral reefs filter these particles to feed. This highly efficient particle trapping has earned coral reefs the label of a “wall of mouths”. However, this characteristic structure makes coral reefs particularly sensitive to marine litter.

The branching and plate corals which form much of the reefs’ surface can easily catch large litter items such as plastic bags, ropes and nets as they wash by. This can lead to breakage of coral colonies which have taken decades to reach their size, or to smothering which takes away their access to solar energy and ability to catch food particles, leading to starvation. Abrasion of coral tissue leading to wounds can also occur as the litter items get dragged around the colony by the ocean surge. It was even discovered that plastic litter can build up a layer of bacteria as they float around the sea which they then transfer to the corals they entangle on. This leads to higher levels of disease in coral reefs with more litter.

As corals and many other species in coral reefs catch particles from the water to eat, small microplastics can easily be trapped by them. Studies have found that confused corals eat microplastics when normal food items are also present. This may impact their energy uptake as corals which had been eating microplastics did not want to eat normal food afterwards. Other research also found that potentially harmful chemicals which make plastics more flexible ended up in coral tissues. Reef fish are also affected, and some specimens sometimes show more dangerous behaviour after they eat microplastics. They end up being eaten more often by predators because they swim about more as they had full bellies but do not get any nutrition.

In India, despite the coastline of over 7500 km, coral reefs are estimated to cover only 2375 sq km. Coral reefs are balanced ecosystems and when the corals at the foundation of that system lose energy, or take up toxins and processes such as predation between fish species are altered, this can lead to dramatic changes in the system as a whole, which will impact its capacity to support so much life and people's livelihoods.

In Sri Lanka coral reefs are estimated to cover 2% of the coastline. Coral reefs are balanced ecosystems and when the corals at the foundation of that system lose energy, or take up toxins and processes such as predation between fish species are altered, this can lead to dramatic changes in the system as a whole, which will impact its capacity to support so much life and people's livelihoods.

Mangroves

Mangroves are among the most productive ecosystems in the world and have been defined as the 'rainforests of the sea'. They are a group of woody tree species living in the Tropics with the unique ability to live in saltwater. Mangroves create an important habitat that provides many ecosystem functions. These areas are feeding, breeding and nursery grounds for many animals, providing food and shelter. Mangroves reduce erosion from wind and waves, and therefore support and protect the lagoons and the estuaries. They are also important to fight climate change since they absorb CO₂ (carbon dioxide) from the atmosphere more efficiently than terrestrial habitats. The mangroves also provide communities with fuel wood, medicines, timber for construction, and boat building material.

Mangroves' plants contribute to reducing pollution of near-shore coastal waters by trapping pollutants before they can enter the estuaries and lagoons, leading to improved water quality. Recent studies showed that mangroves can also trap marine litter. Big pieces of plastics are frequently found among the mangrove trees, often caught by the aerial roots (pneumatophores) that stick out of the ground. Objects that can wrap around these roots such as plastic films, plastic bags and food wrappers are particularly abundant. Very little pieces of plastic also accumulate in the mud and sand in between the mangroves' roots. The majority of this litter seems to arrive here from the sea rather from the land. The mangrove forests are then a 'net' that traps marine litter for the long term.

India shares with Bangladesh the world's largest mangrove system, the Sunderbans, that spreads over 10,000 sq km, with the Indian portion being about 4200 sq km. The total area of mangroves in India is about 6750 sq km.

The impact of marine litter on mangroves and to the species that live in this ecosystem has yet to be fully investigated, and the interest of scientists is growing, along with the number of published studies.

Monsoons

The intensification of the rainfall due to the monsoons occurs every year in India. The Summer Monsoon in India lasts from June to mid-September and affects almost the entire peninsula except the rain-shadow areas in the Indian Himalaya. The abundant rain increases the water

runoff from land to the oceans and in the rivers. This water transports the litter accumulated on land to the sea and disperses it in the marine environment. The litter also becomes a problem when it clogs storm pipes, decreasing the amount of flood water that can be drained away. Episodes of severe flooding and choking of drainage occur frequently in coastal cities such as Mumbai, Kolkata and Chennai.

From Sacred Cow to Distant Whales, Plastic Kills Them All

Walk in the streets of any Indian city today, and you will come across the ugly sight of cows, buffalos and other animals munching plastic along with other garbage. Much as it offends anyone's sensibilities, it is a sad fact that Indian society especially the urban populace, freely throws waste food mixed with household garbage, and mostly in polybags since those are so convenient. Trying to get at the scraps of food, foraging cattle and other animals munch on polythene and other plastics, ingesting quantities that eventually block and choke their guts, resulting in painful deaths.



Cows, pigs and egrets consume plastic while foraging for food in a garbage dump. Image © Sharad Gaur

Among wildlife too, animals such as nilgai (bluebull) and wild boar that venture to the edges of habitations frequently die in this manner and their autopsies reveal large tangles of plastics in their stomach or intestines. There are increasing instances similarly, of aquatic animals ingesting plastics and other non-degradable garbage material, confusing these for food. Whale carcasses have recently washed ashore, inside which several kilos of plastics were discovered.

What can we do to reduce marine litter?

There are several things you can do to tackle the problem of marine litter. The first one is removing the litter from the environment where possible. Beach clean-ups have become popular around the world and the scientific community has recognised their importance not only to decrease the amount of waste that can enter (or re-enter) the sea, but also to increase the awareness of participants about the effects of marine litter. Beach clean-ups can also be useful to collect data, and millions of citizens around the world have volunteered to help scientists carry out surveys picking and recording litter on beaches over several years.

However, cleaning is not enough. What we should aim at instead is stopping the marine litter at its generation stage. Some countries have decided to ban some items completely, prohibiting production, import, sale and use. With this type of legislation governments hope to reduce the production of waste, pushing towards the use of more sustainable alternatives like reusable containers.

India has seen several initiatives towards the regulation of plastics and minimization of environmental damage from them.

On 18th March 2016, the Ministry of Environment, Forest & Climate Change banned the production and use of polythene bags under 50 microns thick. This superseded the earlier law of 2002 where the limit had been 20 microns.

In October 2019, the Indian Government passed new legislation curtailing single-use plastics, and declaring its intent to phase them out from the country by 2022.

India's Director General of Shipping (DGS) issued an Order on 16 October 2019 (No. 5 of 2019) promulgating that single-use plastics would not be allowed on ships in Indian waters with effect from January 2020.

India has nominated over a dozen of its beaches to get the coveted Blue Flag certification. This internationally known label is granted on the basis of very high standards of cleanliness, water quality, biodiversity, and other environmental parameters maintained by a site.

There are, however, initiatives that everyone can embrace to improve the way in which we deal with waste. Some of the most effective actions you can take are popularly known as the 7 Rs:

1. REDUCE: produce less waste and, in particular, use less single-use items. Do not buy food that is excessively wrapped in plastic, like fruit that could be easily sold protected just by its natural peel. Avoid buying single-use cutlery and cups if you can use metal and glass ones instead. Packaging made from several materials fused together, such as the single-dose

sachets for condiments, should also be avoided because they are impossible to recycle and have to go in landfills. Remember, waste mismanagement is the main source of material ending up in the ocean so if we produce less waste, we are automatically producing less marine litter;

2. REUSE: if you can choose, buy packaging or items that can be reused. For example, if you have access to clean water, refillable water containers can be used over and over again instead of plastic bottles. You can also reuse your plastic bags instead of binning them after a single-use. Every time we reuse an item instead of binning it, we are saving it from becoming municipal garbage and potentially becoming marine litter;

3. RECYCLE: plastics, glass, aluminium and other metallic items, batteries, electronic waste, and paper are examples of items that might be recycled in your area. If recycling is occurring, remember to separate these items from the rest of the waste to make the collection and the recycling easier, as the aim of recycling is to recover the raw materials, elements or basic components from each category of waste. You can also separate organic food and 'recycle' it through composting. Your waste will become fertilizer to grow more food again. You will give new life to the material, preventing it from lying rotting in a landfill or, worse, in the sea;

4. REPAIR: if something gets damaged or broken, check whether it can be repaired before discarding it. Think about repairing also when buying new products: some objects might be designed to last longer and to be repaired more easily. Why not buy them instead of single use items?

Teacher tip: ask students an item they could have recently repaired instead of throwing away. Such as sewing up a hole in your clothes or gluing something back together.

5. REFUSE: saying 'no' can sometimes be a powerful tool against marine litter. Say 'no' to useless single-use plastics that are offered to you. You can do this by not accepting plastic bags when you buy items that you can transport in your purse or backpack, and saying 'no' to plastic straws if you can drink directly from the glass.

6. REPURPOSE: we stop using many items for their original purpose, but they are still good for other purposes. A slightly damaged bucket, a wooden crate, a canister that you don't need any longer; all of these will make perfect pots for plants. Old upholstery removed from your sofa or car seats is not always for the garbage truck; it could become some mechanic's ground sheet or maybe your pet's bedding. People also use the terms Refurbish or Reinvent to describe this particular R.

Teacher Tip: Using several examples, discuss with children how recycling is different from repurposing.

7. REGIFT: Children outgrow clothes, toys lose their novelty, some books are no longer needed; almost all such items are discarded and reach the wastebin. Most children of the modern generation, especially urban children from well-off families, do not understand the tradition and concept of 'hand-me-downs' that we and our elder generations lived with so naturally. If the discarded items are in usable condition, it makes perfect sense to gift them away to someone needy, instead of trashing them and adding to the already huge mountains of waste.

Teacher Tip: You have a crucial role in inculcating such value systems in children. Hold a discussion where children can narrate if they have any real-life experiences and everyone can learn about this concept.

There is a beautiful example of Turkish trash collectors who set up a public library with all the books people throw out in garbage.

Last, but not least, you can raise awareness and educate! Speaking about marine litter in the school during lessons and to the wider community around you will help kids and other people to open their eyes to the problems that marine litter is creating. The more people that change their behaviour towards reducing the production and the mismanagement of waste (for example, reducing littering or using single-use plastics), the better chances we have to tackle marine litter. The activities developed in the CLiP Education Packs will help you introduce pupils to marine litter and to the possible ways of solving the problem.

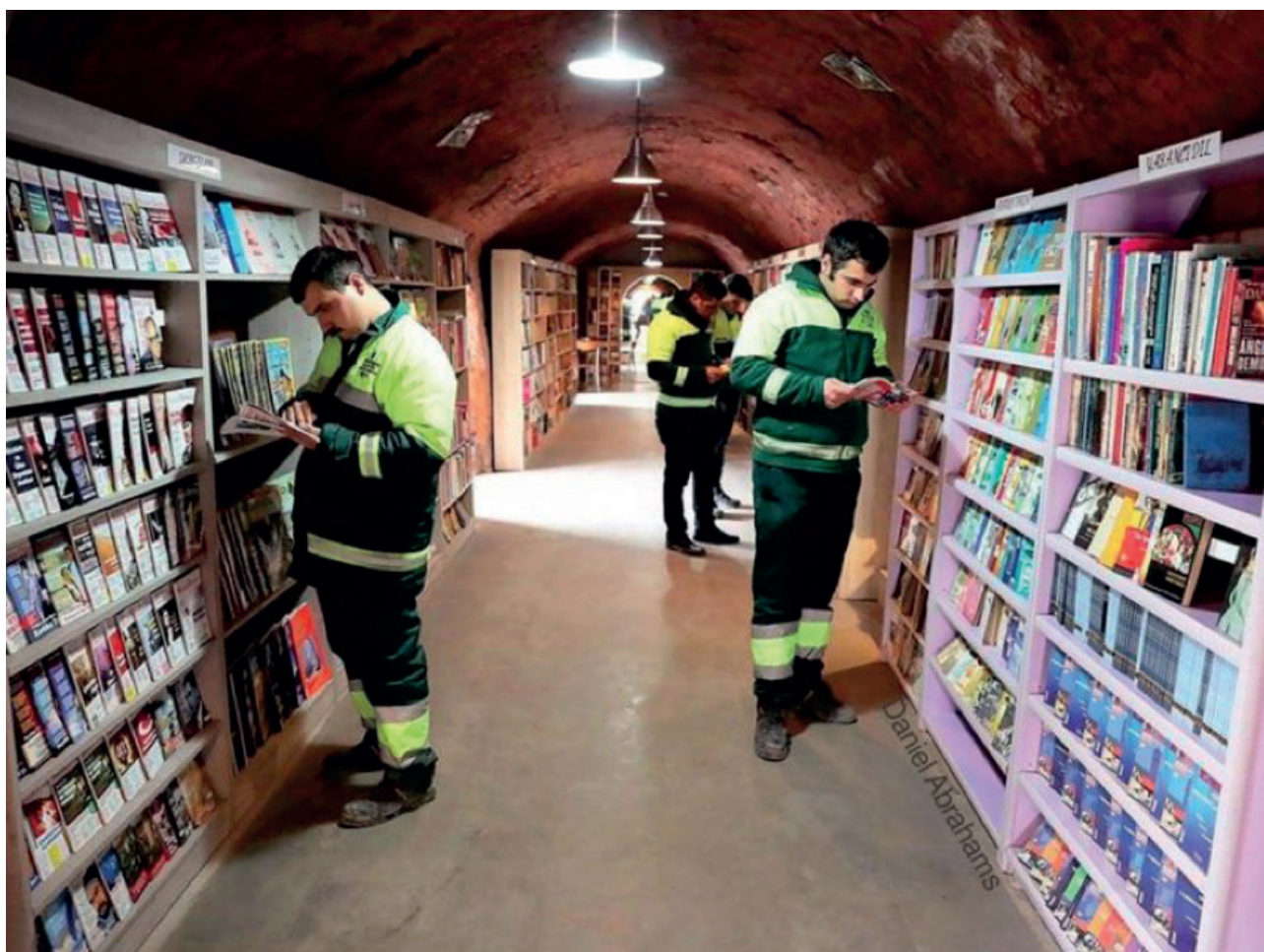


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CLiP Education Packs

Primary School Pack

4 lessons around the subject of marine litter.

1. Introduction to marine litter

Marine litter is introduced to students. There is information on its composition, origin and detrimental effects, with a particular focus for India and its habitats. There are two activities. The first is a colouring page where students can colour or otherwise mark the marine litter items as opposed to marine life.

The second activity is to allow the students to understand the properties of different materials and explore what happens to these items in water and over time (e.g. break-up, rust, biodegrade, or persist). Compare natural items which include food scraps and leaves, with man-made, synthetic items such as plastics and metals and show whether they would float or sink in the oceans. Mention how food waste and natural products will breakdown and decompose over time. Different densities of materials, whether they have air in them, or their shape all affect whether they float, sink slowly, or sink quickly.

Activities tips: in the colouring page, do not forget that food scrap is not marine litter! This could be the time to explain the difference between organic waste (food, leaves) that can be decomposed and marine litter that will stay in the environment for a long time.

2. Helping to keep your community clean

This lesson explores marine litter origins, and it is focused on a field trip and clean-up of a beach, riverbank, or another waterfront. The aim is to focus students on their community and the local environments that will be familiar to them. It focuses on the habitats impacted (coral reefs, mangroves, rivers, forests, village or city landscapes) and why it is important we do not lose these habitats as they are vital to healthy ecosystems and livelihoods. The students will also be invited to speak about marine litter to their families and communities to spread the message even further.

For the activity of this lesson, students will be brought outdoor to replicate the work of marine litter scientists, who collect and categorise marine litter. Please pay attention during the collection because sharp and contaminated items could be hazardous. Use thick gloves if possible or litter pickers (tongs or large forceps) if available. Correct clothing and footwear is advised for all when outside the classroom, including sun protection. To reduce the risks of this activity, please consider the characteristics of the location you are visiting: beaches will have tide times to consider (better time is after the high tide) while rivers should be checked for floods. Community spaces, traffic, and security aspects should be also assessed.

Activity tip: this activity can be also used to teach the importance of not disturbing the natural environment, leaving shells and small animals on the beach rather than collecting them. If the whole activity takes too much time, you can carry out the collection and the counting at different times.

Beach and community cleans not only help remove the marine litter that has washed up on the beach, but recording the type and number of litter items found can also be fed into national and global programmes to help understand the sources of litter to the area. Look among the suggested further readings to discover how to join these campaigns.

3. How does litter impact marine life?

The activity for this lesson wants to teach that marine animals are harmed by marine litter. In particular, the lesson focuses on the problems generated when animals ingest litter.

The activity is based on the concept of food chain and on how plastics and microplastics can disrupt this important process. Let students draw animals in the food chains (plankton->small fish->big fish->shark for example) and then discuss with them on what happens if any of the animals eats some plastic. Remember, every time an animal eats another animal that has plastic in its stomach, it ingests both food and litter. This is how plastic accumulates in predators.

Activity tip: Students might include humans in the food chain since many people eat fish, lobster, clams and other seafood. Let them note that we remove the guts of many species and we eat only their flesh. Therefore, the exposure to microplastics and plastic is limited, and marine litter is not a reason to reduce seafood consumption.

4. What are the solutions?

This lesson will help explore solutions to the marine litter problem and help students understand how their actions can help tackling this issue. Students will be invited to pay more attention to how they manage their waste, providing examples of Reduce, Reuse and Recycle and initiatives based on the other Rs too. If the school has any programme for recycling, this would be a perfect time to introduce it to the students.

The activity is based on items found during beach clean-ups and aims at raising awareness of the beneficial impact they would have making sustainable choices in their everyday life. The activity shows how much reduction in marine litter could have been achieved if items they found on the beach had been disposed of correctly through reducing, reusing and recycling. When handling waste, please pay attention to sharp or contaminated items.

Activity tip: if your school does not have a recycling scheme, you can sort items like metal cans, metal caps, plastic bottles, plastic caps, hard plastic containers/drums and glass bottles in the 'recycling' pile, since these are all recyclable. If your school has a recycling scheme, divide the 'recycling pile' between what is actually recycled in your school and what can be potentially recycled. If you have not collected any litter, you can also let students draw the type of litter they have observed or they produce in their household and use those drawings to do the sorting.

Secondary School Pack - Aged 10–16

4 lessons around the subject of marine litter, with 1 extra aimed towards higher grades

This pack is aimed in the middle of this age range to cater for all – some activities will be split between lower and higher grades. E.g. lower grades can also do the higher-grade activity as an extension, but higher grades will focus on the one higher-grade activity.

1. An introduction to marine litter

Marine litter is introduced to students. There is information on its composition, origins and effects, with a particular focus for India and its habitats. Plastic is introduced as the main marine litter type in the marine environment. It is the most diffuse and problematic marine litter in the world, including in India. Microplastics are also introduced explaining how they are formed through degradation of larger pieces due to wave action, corrosion by salts, multiple cycles of heating-cooling, and UV exposure.

The activity is to allow the students to understand the properties of different materials and explore what happens to these items in water and over time (e.g. break-up, rust, biodegrade, or persist). Compare natural items which include food scraps and leaves, with man-made, synthetic items such as plastics and metals and show whether they would float or sink in the oceans. Mention how food waste and natural products will breakdown and decompose over time. Different densities of materials, whether they have air in them, or their shape all affect whether they float, sink slowly, or sink quickly.

2. Marine Litter in India

This lesson explores marine litter origins, and it is focused on a field trip and clean-up of a beach, riverbank, or another waterfront. The aim is to focus students on their community and the local environments that will be familiar to them. It focuses on the habitats impacted (coral reefs, mangroves, rivers, forests, village or city landscape) and why it is important we do not lose these habitats as they are vital to healthy ecosystems and livelihoods. The students will also be invited to speak about marine litter to their families and communities to spread the message even further.

For the activity of this lesson, students will be brought outdoor to replicate the work of marine litter scientists, who collect and categorise marine litter. Please pay attention during the collection because sharp and contaminated items could be hazardous. Use thick gloves if possible or litter pickers (tongs or large forceps) if available. Correct clothing and footwear is advised for all when outside the classroom, including sun protection. To reduce the risks of this activity, please consider the characteristics of the location you are visiting: beaches will have tide times to consider (better time is after the high tide) while rivers should be checked for floods. Community spaces, traffic, and security aspects should be also assessed.

Activity tip: this activity can be also used to teach the importance of not disturbing the natural environment, leaving shells and small animals on the beach rather than collecting them. If the whole activity takes too much time, you can carry out the collection and the counting at different times.

Beach and community cleans not only help remove the marine litter that has washed up on the beach, but recording the type and number of litter items found can also be fed into national and global programmes to help understand the sources of litter to the area. Look among the suggested further readings to discover how to join these campaigns.

A few graphs could be produced. For example, students can produce a bar graph with x-axis including type of litter, and y-axis being number the students found.

3. How does litter impact marine life?

This lesson wants to teach that marine life is harmed by marine litter. It introduces the detrimental effects that litter has on two important ecosystems (coral reefs and mangroves), and on food chains when animals ingest waste. The lesson also explains how monsoon increases litter discharge in the sea and how it can transport invasive species.

The lesson splits up topics on learning levels for younger and higher grades.

The activity is based on the concept of food chain and on how plastics and microplastics can disrupt this important process. Let students draw animals in the food chains (plankton->small fish->big fish->shark for example) and then discuss with them on what happens if any of the animals eats some plastic. Remember, every time an animal eats another animal that has plastic in its stomach, it ingests both food and litter. This is how plastic accumulates in predators. Since plastics can release toxins, which can cause illness and diseases in animals, larger animals at the top of the food chain might be more exposed because they accumulate larger quantities of plastic ("bioaccumulation").

Activity tip: Students might include humans in the food chain since many people eat fish, lobster, clams and other seafood. Let them note that we remove the guts of many species and we eat only their flesh. Therefore, the exposure to microplastics and plastic is limited, and marine litter is not a reason to reduce seafood consumption.

4. What are the solutions?

This lesson will help explore solutions to the marine litter problem and help students understand how their actions can help tackling this issue. Students will be invited to pay more attention to how they manage their waste providing examples of the 7 Rs. If the school has any programme for recycling, this would be a perfect time to introduce it to the students.

The activity is based on items found during beach clean-ups and aims at raising awareness of the beneficial impact they would have making sustainable choices in their everyday life.

The activity shows how much reduction in marine litter could have been achieved if items they found on the beach had been disposed of correctly using the 7 Rs. When handling waste, please pay attention to sharp or contaminated items.

Activity tip: if your school does not have a recycling scheme, you can sort items like metal cans, metal caps, plastic bottles, plastic caps, hard plastic containers/drums and glass bottles in the 'recycling' pile, since these are all recyclable. If your school has a recycling scheme, divide the 'recycling pile' between what is actually recycled in your school and what can be potentially

recycled. If you have not collected any litter, you can also let children draw the type of litter they have observed or they produce in their household and use those drawings to do the sorting. Ask students to identify these initiatives and to think of more ways that they could help their communities reduce, reuse and recycle.

5. Innovative solutions from the students (For Higher Learners)

The fifth lesson is meant to be an expansion for students of higher grades of the secondary school system. The lesson will raise awareness of the global issue of marine litter, and will stimulate the research for innovative solutions.

There are three activities. The first one will involve the active research of initiatives from around the world about the removal of marine litter or the correct management of waste. The research of initiatives that could be reproduced in the students' communities should be encouraged. Students should understand where the initiatives are occurring, what type of organisation carry them out, what are the costs involved and how they can be replicated locally.

The second activity will ask students to invent a marine litter solution or to adapt one of the solutions found in the previous activity.

The third activity is for awareness-raising purposes. Students should think of a method to communicate what they have learnt in the previous four lessons and to educate their school and community. Suggest to them a poster, a photo bulletin board, a song, a dance, or artwork. Creativity is at the centre of this activity! The litter saved from lesson 2 could also be used as part of the art.

Further reading

A list of websites linked to some beach clean-ups organised around the world is provided below. These websites are useful tools to understand how to organise a clean-up, how to connect with the international community, how to collect data and to have general information about marine litter.

UK: Marine Conservation Society - www.mcsuk.org/beachwatch/

South Africa: The Beach Co-op - www.thebeachcoop.org/

US: Ocean Conservancy - www.oceanconservancy.org

Australia: Tangaroa Blue - www.tangaroablue.org/

For more information about the Commonwealth Litter Programme, please visit www.cefas.co.uk/clip/

References

www.researchgate.net/publication/279916346_Mangroves_in_India_A_Unique_Marine_Ecosystem

<https://www.blueflag.global/>

