



Commonwealth  
Litter Programme

# Secondary School Educational Pack

## India

**4 lessons, with 2 additional lessons for higher grades, to educate  
and influence students around the subject of marine litter**

This pack contains handouts for students aged 10 – 16



Department  
for Environment  
Food & Rural Affairs



**Cefas**



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# Marine Litter Factsheet – Secondary School

## What is marine litter?

Marine litter, or marine garbage, is any item that humans have discarded that ends up on our beaches, or in our rivers, estuaries, seas, and oceans and persists for long. This is a huge problem as around the world, approximately 8 million pieces of marine litter enter the marine environment every day!

Plastic makes up most of marine litter in the world, up to 80% in some places. The term 'plastic' covers a wide range of polymers that can be moulded into many shapes. Plastic bottles, food wrappers, Styrofoam (thermocool), and abandoned fishing gear are among the most common items globally that are found in the marine environment.

In the sea, UV exposure, salt corrosion, multiple heating-cooling cycles, wave and wind action break down larger plastic items into small fragments called microplastics (smaller than 5 mm) and even smaller nanoplastics (smaller than one thousandth of a millimetre).

Glass is the second most common material found on beaches. It mostly comes from bottles and when broken can be a hazard to beach users and animals. Aluminium drink cans and other metal objects are also frequently found on beaches and in our seas.

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.

## Where does it all go?

Different items have different densities which affects whether they sink or float. Large items may initially trap air and float, but over time the material can get brittle and break up into smaller pieces which then sink. Research now suggests that 94% of plastics in the marine environment end up on the sea floor.

Winds, waves, and currents move litter around our globe, depositing items onto our shorelines. Large oceanic currents move items around the oceans like conveyor belts. These currents form five oceanic gyres (large, slowly swirling whirlpools) which bring together large amounts of marine litter. The largest and most famous of these is the Great Pacific Garbage Patch where it is estimated that there are 1.8 trillion pieces of plastic! The Indian Ocean Gyre is smaller in size; however, large amounts of marine litter can be found there.

## How long does it last?

Scientists have estimated how long items take to break down in the marine environment, although the exact times are unknown and depend on the conditions. Times are likely to be longer at sea where conditions are wet and much cooler than on land. Plastic is one of the most durable materials, with harder items such as bottles thought to last in the environment for 450 years!

## How does Marine Litter harm animals?

Marine litter can cause serious damage to marine life. Every year millions of marine animals are entangled, harmed, and killed by marine litter. Animals can mistake litter for food which if consumed can harm them and cause death. Big animals like marine turtles, birds, dolphins, and whales can ingest big items of plastic, while smaller animals like small fish, jellyfish and even plankton can also feed on microplastics. A recent whale washed up in Indonesia had 6 kg of plastic in its stomach, including 100 plastic cups! 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.

Marine animals can become entangled (trapped) in litter. Fishing nets, ropes and strings, and bottle cap rings are common items that cause harm. Animals become tangled and are unable to get out, feed, escape predators and even breathe, which can cause death.

Marine litter can cause damage to habitats too. Large litter items such as lost or abandoned fishing gear can damage fragile areas like coral reefs, particularly during bad weather. Furthermore, marine litter can carry 'alien' invasive species to new shores that can disrupt ecosystems, causing losses in native 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.

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 litter and Indian marine habitats

## Corals

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.

In India coral reefs cover about 2375 sq km, scattered in only a few areas along the country's 7500 km coastline. Coral reefs are a part of balanced ecosystems. When the corals at the foundation of that system lose energy or take up toxins, the processes they support such as predation between fish species are altered. This can lead to dramatic changes in the system as a whole which will impact the corals' 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 carbon dioxide (CO<sub>2</sub>) 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 from the sea rather than from the land. The mangrove forests act as a 'net' that traps marine litter for the long term.

### **What about the mangroves in India?**

India shares with Bangladesh the world's largest mangrove system, the Sunderbans, which 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.

## LESSON 1

# An Introduction to Marine Litter

### Key words

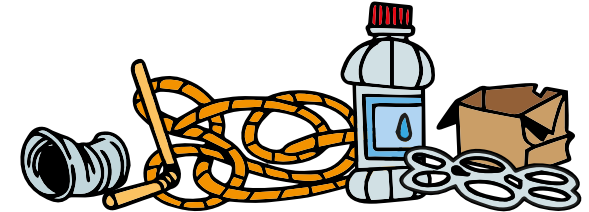
- Marine Litter
- Ecosystem
- Material
- Plastic

### Lesson aim

This lesson will introduce marine litter, how it enters our seas and oceans, and the problems that it causes to marine life and ecosystems.

### What is marine litter?

The Environmental Programme of the United Nations defines marine litter (garbage) or marine debris as any persistent, manufactured or processed solid material discarded, disposed of, abandoned, or lost in the marine and coastal environment. In summary, any solid waste that does not naturally decompose and that ends up in the marine environment.

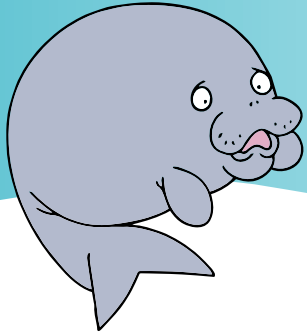


### Where from?

You may ask, how does waste get in the ocean? Litter, or garbage, ultimately comes from humans. When we correctly discard of something after use, it will enter the waste-stream and either be recycled or go to a landfill or to be incinerated (burnt). However, sometimes it ends up loose on the ground and eventually finds its way to the sea.

Garbage found near the beach which could enter the sea by rain, wind or a river.





## How?

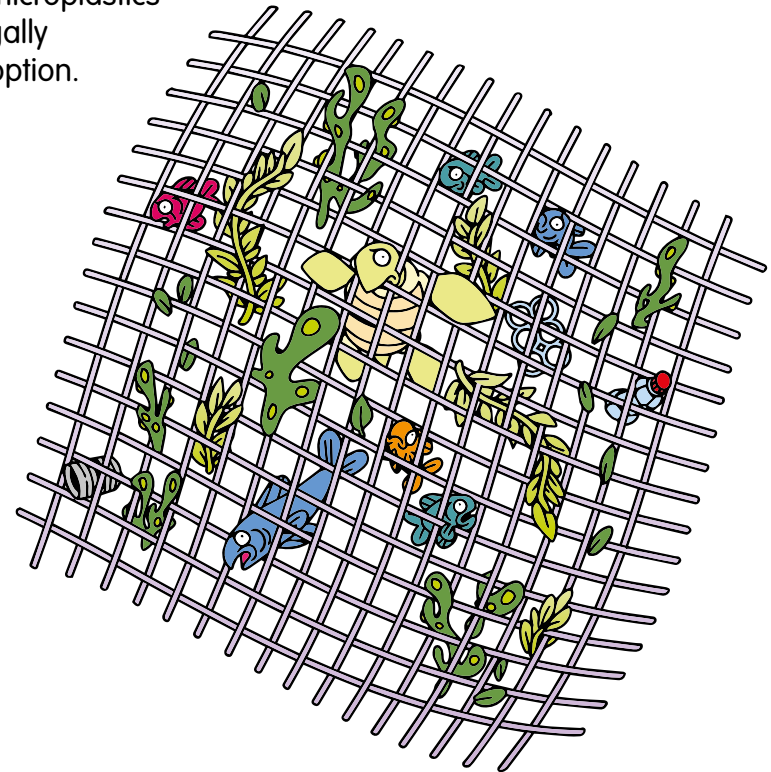
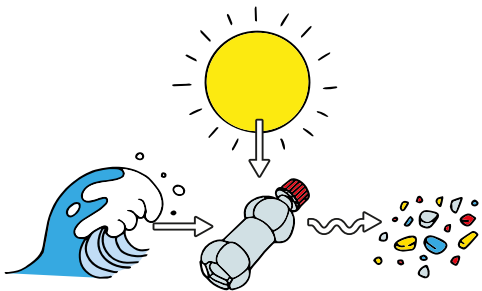
Litter is often dropped by or discarded by humans improperly around their communities and in public places. This means that it is common for litter to arrive in the ocean by transport through rivers, sewage, and stormwater canals. Litter can also enter the marine environment by being blown by winds or it can be also abandoned directly in the sea (as with fishing gear).

People visiting beaches and coasts can also create litter directly on the sites. The most common litter items in India and elsewhere includes drinks bottles, food packets and plates, chewing-tobacco pouches and cigarette butts. 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.

## What is the most common type of marine litter?

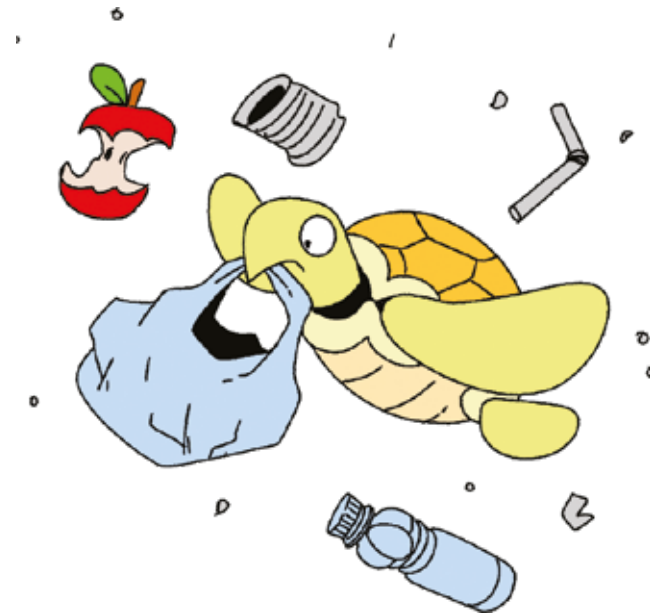
Plastic is the most common material found in the marine environment, sometimes making up to 80% of all litter found on beaches. Over time, due to wave action, sea salt, repeated heating and cooling, and UV exposure (from the sun), plastic breaks down into smaller and smaller fragments called microplastics. Glass is the second most common material found on beaches. It mostly comes from bottles and when broken can be a hazard to beach users and animals.

Aluminium drink cans and other metal objects are also frequently found on beaches and in our seas.



### Can marine litter harm marine animals?

Marine litter has been found in almost all marine environments on the planet and causes serious problems for marine life. Animals often mistake litter for food, which can cause ill effects and sometimes starvation. Litter can also cause entanglement and habitat damage, for example through the introduction of invasive species.



### Can marine litter harm humans?

Marine litter can entangle fish and fishing gear which can prevent fishers from catching food. Microplastics can also end up in the stomachs of fish, which in turn may release toxins and kill the fish, reducing the population that is fished for food! Litter on beaches, riverbanks and in oceans also looks unappealing to people. Therefore, litter can affect tourism and income to areas.



### What does marine litter do when in the oceans?

Marine litter items have a wide variety of properties that affects what happens to them in the oceans. Dense items (glass, heavy plastics) sink to the seabed and become buried in sediment, some items are suspended mid-water column, while some items (usually light plastic items and those that trap air in them) float on the surface. Oceanic currents and winds transport these items around the world, concentrating items in large oceanic gyres.

## ACTIVITY 1

# What are things made of?

The aim of this activity is to understand different materials that we can find around us and explore what happens to these items in water.

Different materials can last for different amounts of time in the environment. Some food waste will disappear over a relatively short time, whereas other materials do not. These long-lasting materials that do not disappear are called marine litter and include plastic, metal, glass, some types of paper, wood, cloth, and sometimes a mix of them!

### Examples:

Plastic is the main component of marine litter around the world. Some plastic items you may find are cold-drink and water plastic bottles, food wrappers, cotton bud sticks, chewing-tobacco pouches, cigarette butts and plastic bags. Glass from broken and entire bottles is the second most common material found on beaches. Metal is also common as marine litter. Aluminium drink and food cans, besides several types of metallic junk can be found on beaches and in our seas.

Natural materials like food scraps (both vegetable and animal) are called organic waste. This type of waste is not considered marine litter because it decomposes and disappears over time, becoming one with the environment.

### Activity:

Compare how 'natural' items and man-made ('synthetic') items act in water. Collect a mix of man-made and natural items, hard and soft, flexible, and brittle.

### You will need:

- A variety of materials found from around the school/ community centre.
- 3 buckets per class
- Water
- Pencils and Paper



### Instructions:

Work together and each pick three objects from around your classroom, school, or community space. Once you have collected them, fill in the table below. What did other classmates choose as their objects? Add them to your table too.

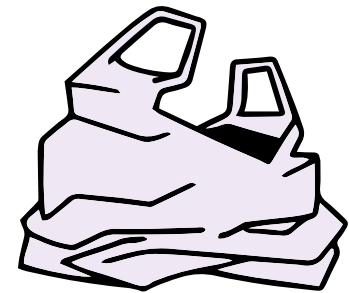
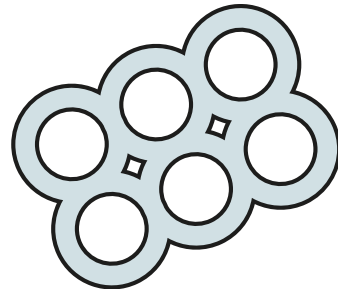
[illegible]

If space permits in your classroom, and with the guidance of an adult, set up three buckets of water.

In the table below, write the name of your item, e.g. plastic bottle, and guess what will happen when you place it in the bucket of water.

Take turns placing some more items in each bucket of water one by one and watch what happens! Did you guess correctly? Did the item you chose sink or float?

What do you think will happen to these items if they were left in the water for 1 month, or even a year?



[illegible]



**When completed answer these questions:**

- 1. Which items sank so slowly that they would be suspended in the water column for possibly days?**
- 2. What are the characteristics of items that sank or floated?**
- 3. What items do you think would be more difficult to remove from the sea once they become marine litter?**
- 4. Research some marine animals that would feed on plastic litter at or near the surface, suspended in the mid-water column, and on the bottom.**
- 5. How might your litter items affect these animals?**

## LESSON 2

# Marine Litter in India

### Key words

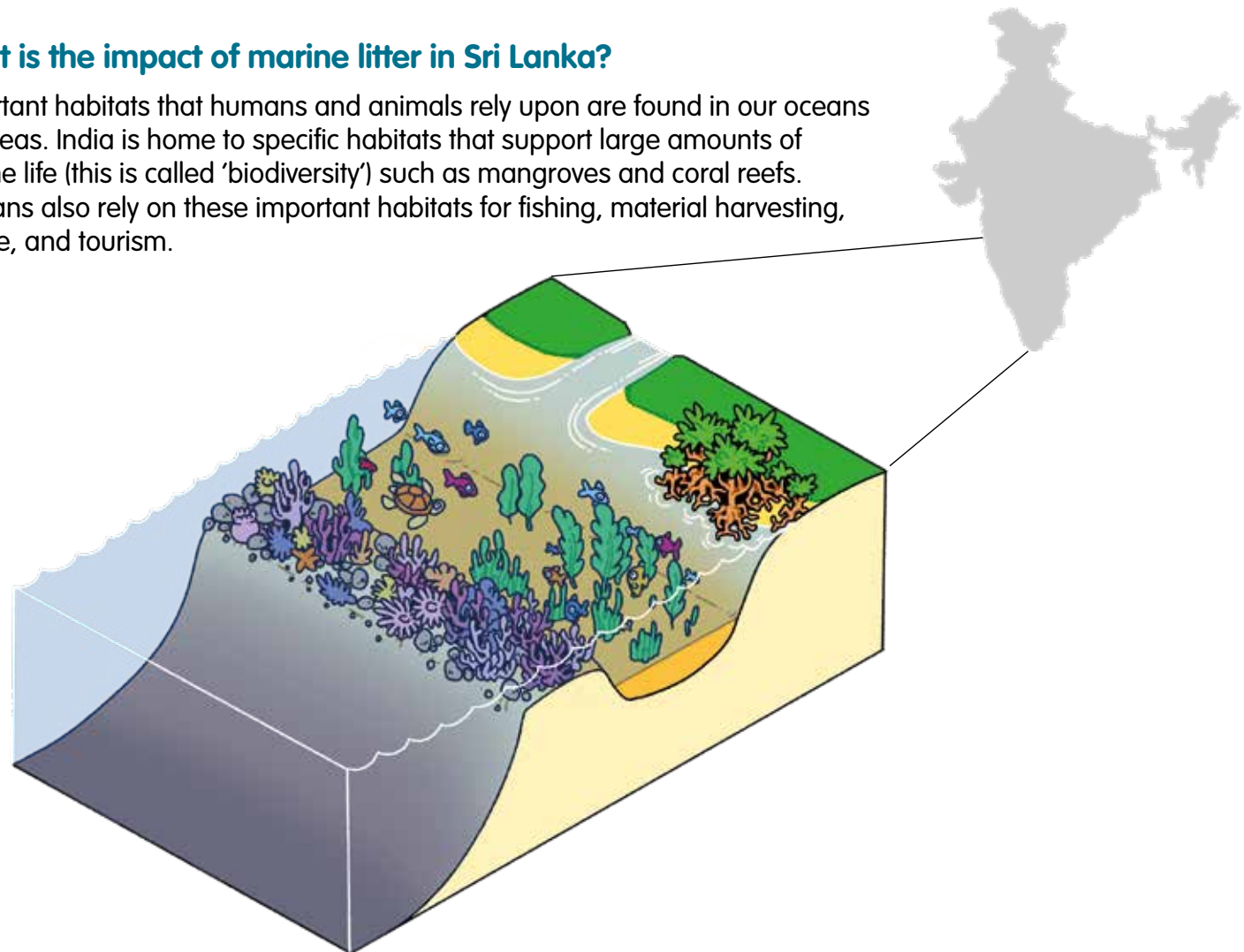
- Beach clean
- Field trip
- Community
- Beach and river
- High-tide
- Coral reefs
- Mangroves
- Biodiversity

### Lesson aim

Through this lesson we will explore marine litter and how it enters important habitats and environments in India.

### What is the impact of marine litter in Sri Lanka?

Important habitats that humans and animals rely upon are found in our oceans and seas. India is home to specific habitats that support large amounts of marine life (this is called 'biodiversity') such as mangroves and coral reefs. Humans also rely on these important habitats for fishing, material harvesting, leisure, and tourism.



India shares with Bangladesh the world's largest mangrove system, the Sunderbans, which 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.

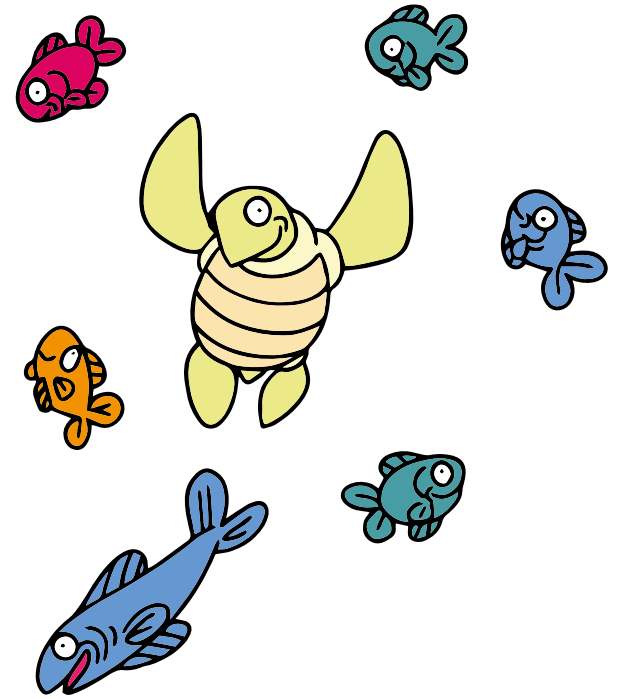
Mangroves are among the most productive ecosystems in the world and have been defined as the 'rain forests of the sea'. These woody tree species have the unique ability to live in saltwater. Mangroves provide many ecosystem functions: they are feeding, breeding and nursery grounds for many animals that can obtain food and shelter. Mangroves reduce erosion from wind and waves, protecting lagoons and estuaries. They are also important to fight climate change since they absorb a lot of carbon dioxide from the atmosphere and store it in their biomass. The mangroves also provide human communities with fuel wood, medicines, timber for construction, and boat building material. The other important habitat of India is coral reefs, although we have only about 2375 sq km of them. 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!

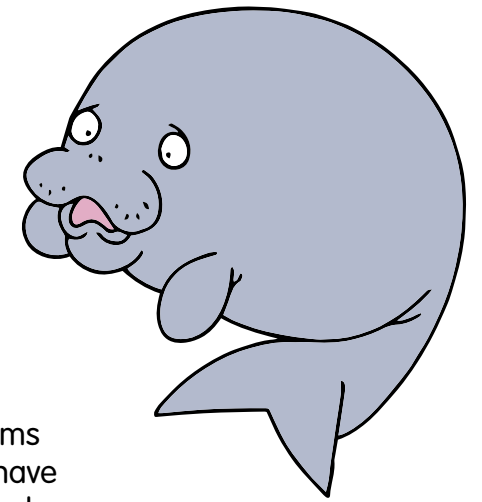
Any impacts on these habitats and species can have long-lasting and negative effects on these environments that can be bad for the marine animals and humans relying on them.

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 can also be a problem if it clogs storm pipes, decreasing the amount of flood water that can be drained away.

### **What does this mean for the marine habitats of India?**

The entanglement of large pieces of marine litter such as bags and nets can trap animals such as fish, turtles, dolphins and sharks. Coral reefs can be particularly affected by all sizes of marine litter. Small pieces of marine litter such as the microplastics can also pass up the food-chain from the coral, to grazing fish, to larger predators. Being entangled by, and eating plastic, can kill the animals by starvation, lack of oxygen, make them easy prey for predators and even cause illness and diseases.





### **How are coral reefs impacted by large pieces of 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 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.

### **How are coral reefs impacted by marine litter such as microplastics?**


Coral animals catch small zooplankton particles from the water to eat, therefore small microplastics can easily be trapped and eaten by them instead. Studies have found that confused corals eat microplastics when normal food items are also present. This can stop corals from eating their normal food afterwards. Other research also found that potentially harmful chemicals (which make plastics more flexible) ended up in coral tissues.

### **Can marine litter affect coral reef habitats in any other ways?**

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 if they had full bellies but do not get any nutrition.

### **How are mangroves impacted by large pieces of marine litter?**

Mangrove 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.



The impact of marine litter on mangroves and on 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.

Recent studies showed that mangroves can trap marine litter. Big pieces of plastics are frequently found among the mangrove's trees, often caught by the aerial roots (pneumatophores) that stick out of the ground. Object that can wrap around these roots such as plastic films, plastic bags and food wrappers are particularly abundant.

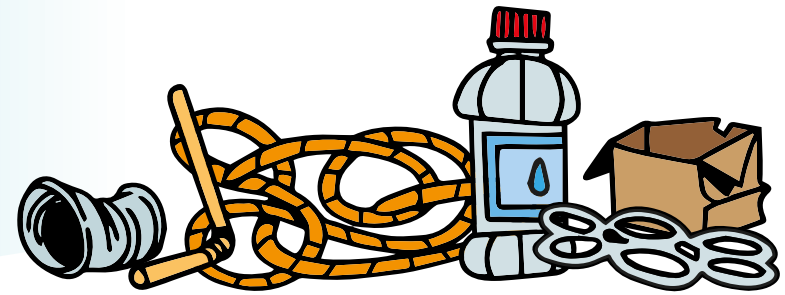
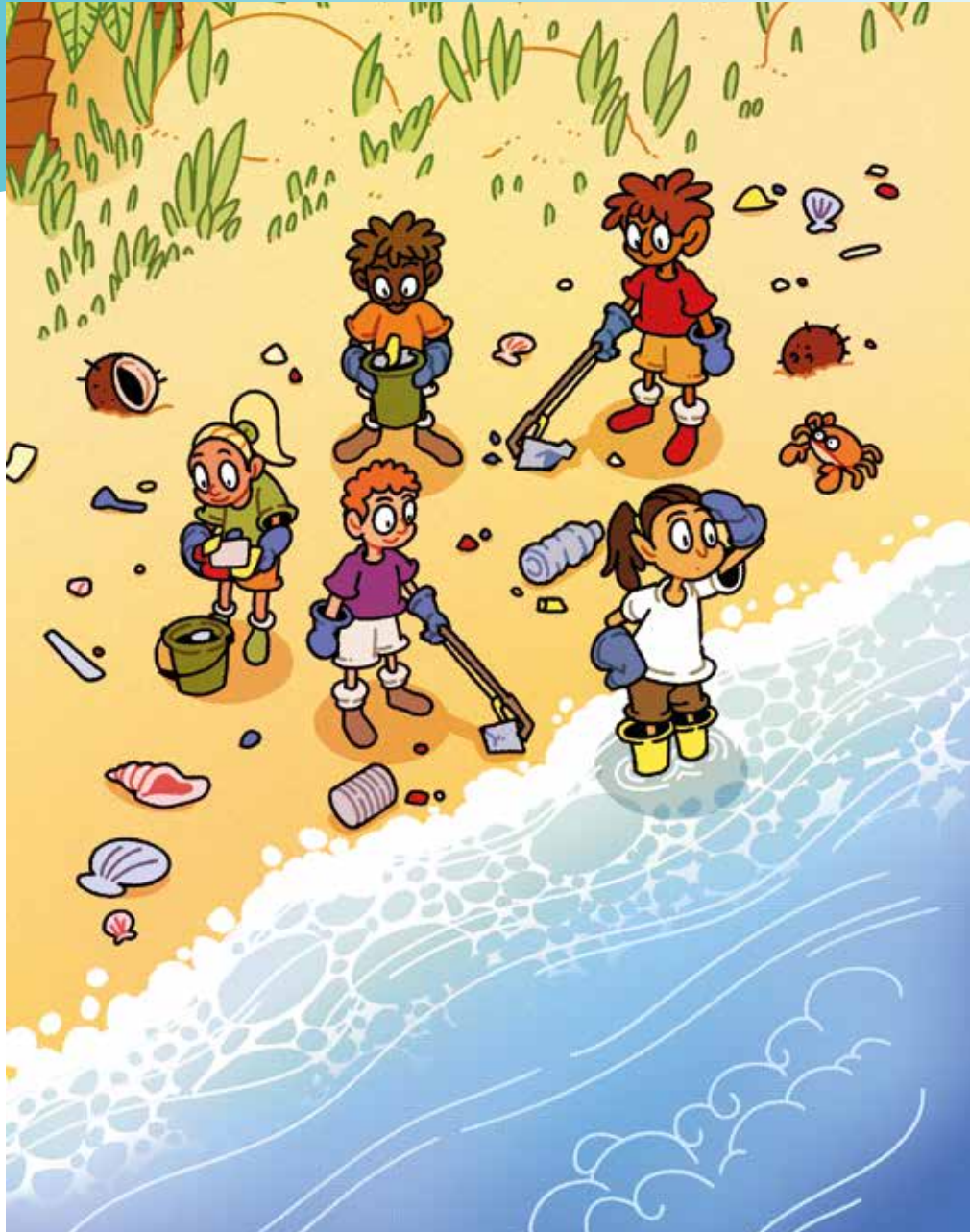
### **How are mangroves impacted by small pieces of marine litter?**

Very little pieces of plastic also accumulate in the mud and sand in between the mangroves' roots. Most of this litter seems to arrive here from the sea rather than from the land. The mangrove forests are then a 'net' that traps marine litter for the long term. Grazing animals such as crabs, fish and snails can then ingest them from the sea floor or mud.

### **Monsoons can increase the amount of marine litter entering our marine environments.**

The summer monsoon in India is intensive from June to mid-September each year 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 can also be a problem if 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.



### What is a beach clean-up?

We now know that different materials can become marine litter and how they might enter the environment. In lesson 4 we will discover how we can prevent waste from becoming marine litter, disposing of it in the proper way and producing less of it. However, we can remove the one that has already been created, via community litter picks and beach clean-ups.

Beach clean-ups have a lot of functions on top of removing litter from the environment. For example, they are a great way to make people aware of the marine litter that is present in your local community and environment. Through clean-ups, you can also help scientists who collect and categorise marine litter. You can learn where litter comes from. Nets, for example, could have been lost or abandoned by fishermen. You might be also able to notice that the frequent use of disposable medical equipment, like face masks, due to COVID-19 means that masks are increasingly being found in some areas and on beaches.

Sometimes you might find a lot of similar items all together. These might come from containers falling off ships. In some past incidents, large numbers of specific items, such as rubber ducks or Lego, washed up on beaches around the world after having been lost at sea in this way.

During beach clean-ups, shells and small animals on the beach should not be disturbed. They are part of the natural environment and not marine litter, so they should not be collected.

## ACTIVITY 2 – FIELD TRIP

# Finding Litter in your Community

The aim of this exercise is to get out into your local community, be that the school grounds, riverbank, beach, village, or park to see litter first-hand and record the types of litter you find. If you are going to the beach, make sure that the class know the tide times!

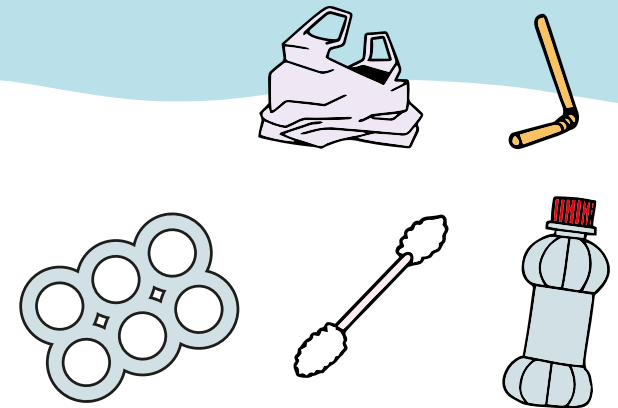
### What to do on a field trip:

Record the type and number of litter items found. This helps you to monitor and understand where litter comes from. Official agencies like municipalities and Pollution Control Departments similarly survey and collect data to find out about sources, quantities and kinds of litter.

Think about some questions before you go:

**What litter are you most expecting to find?**

**Do you think there will be a lot of litter around your community that could end up in the ocean?**



## Helpful Tip

If you are at the beach, start from the top of the beach where the plants and bushes start to grow, and go down to where the sand changes colour. Seaweed and shells normally collect there, and it is called the 'high-tide mark' on the beach.



Groups of marine litter organised after a beach clean trip.

## You will need:

- A location to search for litter: beach, river, village.
- Notebooks and pencils.
- Gloves.
- Litter-pickers if available (tongs or large forceps).
- Bags/buckets to collect litter.

## Instructions:

Make sure you go with your teacher and other adult helpers, and with your parent or guardian's permission.

With your teacher and maybe other adult helpers, go to your chosen location. Please make sure you have permission from your parent or guardian, the school, and from the landowner for access if it is a private area.

If you are going to the beach: check the tide times. The beach is best to visit 2 hours or more after high-tide, and not when the tide is coming back in.

At your chosen location, get into groups set by your teacher.

- Select a large area (up to 100 metres) and mark out the area to look for litter.
- Record, count and pick up any of the marine litter you can find in the area.

Be careful as some objects may be sharp, ask an adult to collect these items. Please wear gloves, if possible, to reduce the risk of injury.

Sort marine litter on a nearby table or bench or on the ground, grouping together the items that are made of the same material (plastic, metal). Create smaller groups if you would like (small plastic, large plastic).

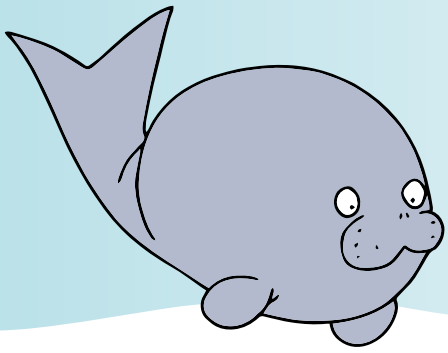
Once completed, make sure you dispose of the rubbish responsibly and bring a selection of clean, safe litter items back to the classroom for additional activities and lessons!

## Categorisation exercise

Material	Object	Tally
Plastic	Plastic food Container	
	Plastic bottles	
	Plastic straws	
	Fishing gear	
	Polythene bags	
	Other	
Metal	Drinks can	
	Other	
Rubber		
Glass		
Wood	Broken furniture	
	Other	
Cloth		
Other		



Collection of marine litter in groups after a beach clean.



### **Back in the classroom**

Collect all the records together and add up the numbers of all the items found. Try to work out the most common groups and items you found.

**What was the most common object found?**

**Did you expect to find this?**

**Have you ever used this item before?**

**What did you bring back to the classroom?**

**Do you recycle in the classroom or at school?**

**Were any items found on the beach found in your classroom?**

### **Higher grades**

Can you draw a bar graph to identify the most common categories? On the x-axis would be your type of litter, on the y-axis the number of items you found.

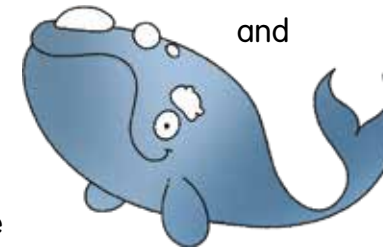
## LESSON 3

# How does Litter impact Marine-Life?

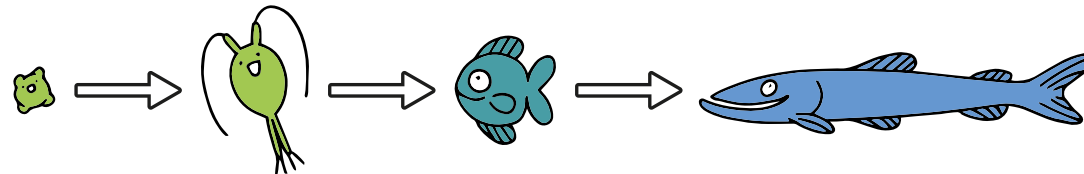
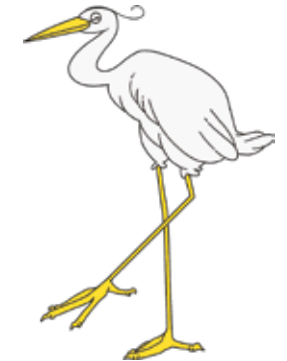
### Key words

- Food-chain
- Food-web
- Phytoplankton
- Microplastics
- Toxins
- Habitats
- Coral reef
- Climate change
- Sea level rise

Our seas and oceans are bursting with life, hosting plants and animals of all shapes and sizes. These organisms range from tiny algae ('phytoplankton') which you would need a microscope to see, to larger fish, sea turtles, shore and sea birds, manta rays, dugongs, and whales! They are all linked in a giant marine food-web which can be affected by marine litter at many different levels.

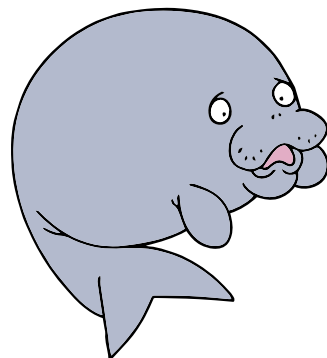


and



### Lesson aim

This lesson will help explore the effects marine litter can have on marine life.



### How does marine litter fit into the food-web?

Different sized animals eat different things, e.g. some large fish eat smaller fish. However, with marine litter, the tiny zooplankton and small fish can ingest 'microplastics', that we mentioned a few lessons ago. Sea turtles and whales can ingest larger litter items, such as plastic bags.

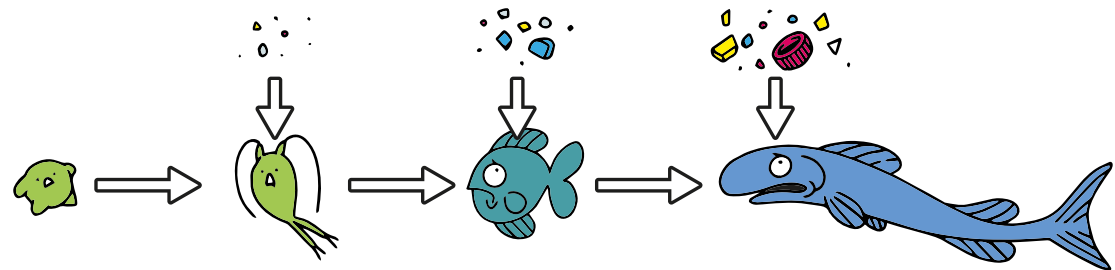




Photo of fishing wire removed during a beach clean. Fishing wires and nets can be eaten by animals or entangle animals.

### What happens when animals eat plastics?

Plastics release toxins, harmful chemicals, which can cause animals to become ill. Plastic can also take up a lot of space in an animal's stomach, this means there is less space for food, then the animal does not eat enough and can become very ill. These side effects can last in the animals and plastics can even be passed to predators if the prey they eat have eaten plastic themselves! Unfortunately, this can also be passed to people who eat seafood.

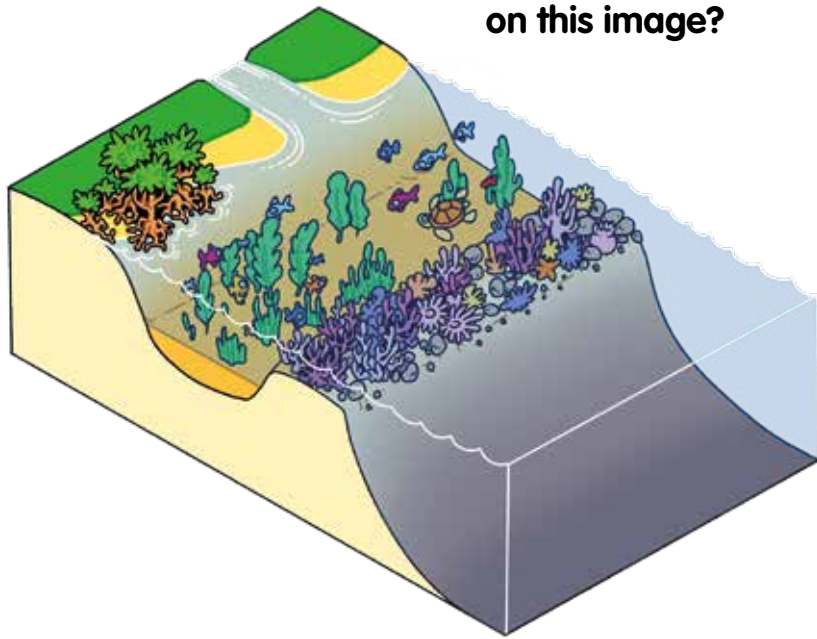


### Higher grades:

Plastics release toxins, which can cause negative side effects to animals. As animals get larger and are higher up the food-chain, these toxins bioaccumulate (become larger in concentration) and can cause greater and greater effects. Such effects include illnesses and disease like the presence of pathogens or inflammation of the organs.

India is home to specific habitats that support large amounts of marine life such as mangroves and coral reefs. You may have learnt already about the harmful effects of climate change and rising sea water temperatures on mangroves and coral reefs but litter also poses a serious threat, which can have serious impacts on the biodiversity that these important habitats can support.

Can you point to the  
mangrove and coral reef  
on this image?



Healthy coral reefs with many fishes. Photo Courtesy of Daisy Buzzoni.

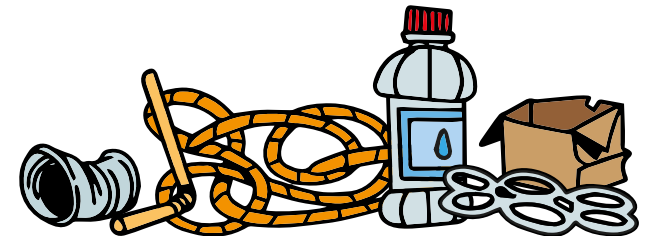
## Habitats impacted by marine litter in India

### Coral reefs

Coral reefs are made up of small animals ('polyps') that live together in hard structures that can look like a large rock or branches. Each hard structure is home to thousands of polyps that share their home with small organisms called microalgae. These organisms work together to provide food and shelter for each other. The coral animal feeds from the water column, whereas the algae use 'photosynthesis' to get their food and energy from the sun like a plant would do in its leaves.

### Higher grades:

The hard structures created by the polyp colonies are made of a material called calcium carbonate, which also commonly makes up seashells. Polyps live in symbiosis with algae, and they both benefit from each other. The algae photosynthesise for food and provide energy for the coral, and the coral provides shelter and protection for the algae. The animal part of the coral will feed directly from the water column on microscopic particles, such as zooplankton. The polyp's tentacles are highly efficient particle trapping mechanisms, which has led to coral reefs being called a 'wall of mouths'.





Before and after the starvation and “bleaching” of a coral reef. Photo credit: The Ocean Agency



It may not be possible to see the impact of microplastics on a reef until it is too late! Photo Courtesy of Daisy Buzzoni.

## How are coral reefs impacted?

In India coral reefs are estimated to cover about 2375 sq km. Coral reefs are balanced ecosystems and when the corals lose energy or take up toxins ingesting microplastics this can lead to dramatic changes because they are at the foundation of the whole system as a whole. This can also happen when plastic covers the corals stopping the light from reaching the algae, blocking the photosynthesis ('smothering'). Other processes such as predation between fish species are also altered. These impacts reduce the capacity of coral reefs to support so much life and people's livelihoods.

Corals can either be a branching type, or large flat dome types. 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 colonies which have taken decades to reach their size. On top taking away the access to solar energy, smothering also interfere with the polyps' ability to catch food particles, leading to starvation.

Litter can scratch and wound the living tissue of corals and these wounds can then be infected by bacteria. It was even discovered that plastic litter can build up a layer of bacteria as they float around the seas and ocean which they then transfer to the corals they entangle on. This leads to higher levels of disease in coral reefs with more litter.

## How are mangroves impacted?

Mangrove's 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's 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. Little pieces of plastic also accumulate in the mud and sand in between the mangroves' roots. The mangrove forests are then a 'net' that traps marine litter for the long term.



Image of mangroves and their many branching aerial roots which can trap marine litter.

## Higher grades:

### From Sacred Cow to Distant Whales, Plastic Kills Them All

Marine litter is only part of the problem. Litter is affecting wildlife on land as much as those at sea. Walk in the streets of any Indian city today, and you will come across the unattractive 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.

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.

## Invasive species

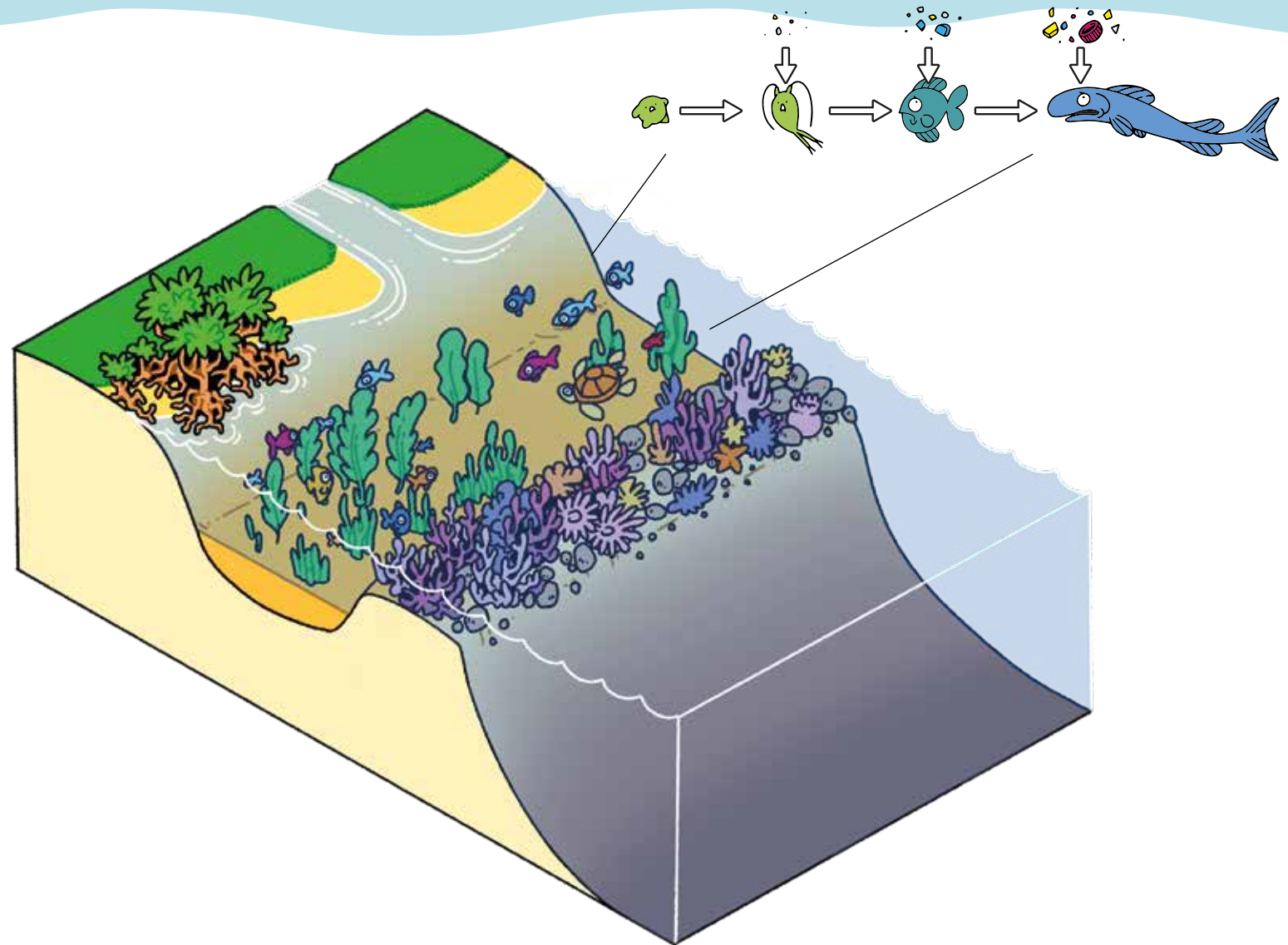
Plants and animals that do not belong to a habitat can be transported there by humans or natural factors. If these organisms survive and thrive, they can become invasive. The invasive species can create problems to the equilibrium of those habitats. The species that originally lived there ('native species') might be impacted in several ways, finding less food, less space to nest, or they might be even eaten by the new invasive species. You can learn about invasive species in lesson 6, which is dedicated to this topic.

### ACTIVITY 3

## How does Litter affect the Food-Chain?

Pick a few animals and write a few sentences for each animal about the ways that you think they are affected by marine litter.

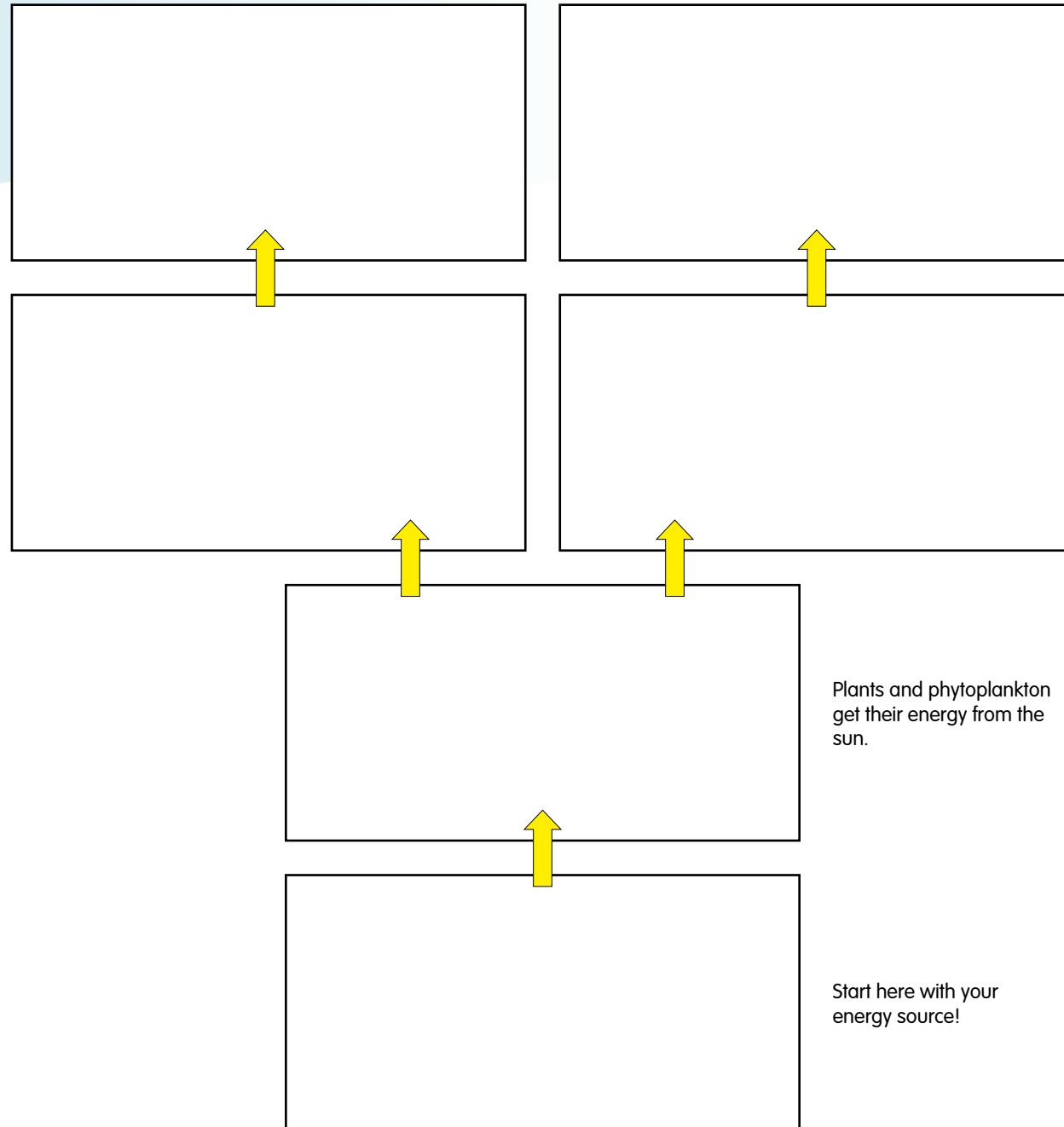
If you get stuck, don't forget to use the Marine Litter Factsheet included in this pack as well as the resources listed on the previous page.



In the boxes below  
draw some marine  
animals you know that  
live in your country.

Do any of them eat  
the other animals? For  
example, sharks eat  
fish.

Do you know any  
animals who eat only  
plants?



Predators go  
here, at the  
top of the  
food-web!

Plants and phytoplankton  
get their energy from the  
sun.

Start here with your  
energy source!

## LESSON 4

# What are the Solutions?



### Key words

- Food-chain
- Food-web
- Phytoplankton
- Microplastics
- Toxins
- Habitats
- Climate change

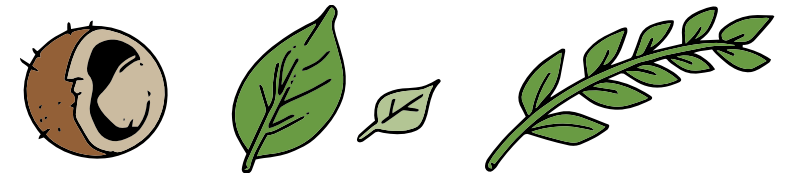
### Lesson aim

This lesson will help explore solutions to the marine litter problem and help us understand how our actions can help.

It is important that we all help to reduce the amount of litter that enters the marine environment. In the first lesson, we learnt the difference between natural and synthetic materials. In the second lesson, we learnt about marine litter entering the seas and oceans and about conducting beach cleans. In our third lesson, we learnt about the harsh impacts marine litter can have on our marine ecosystems and the biodiversity they are home to. Now we shall learn what we can do to prevent marine litter.

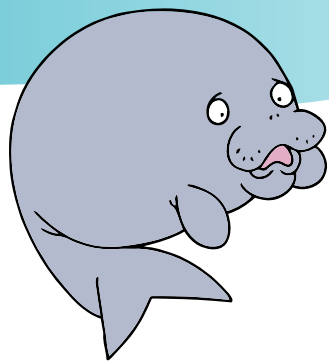
Years ago, people of our elder generations would drop their rubbish on the ground, but they were using natural materials like leaves and coconut husks that over time would biodegrade and become one with the soil. Instead, materials we use these days are increasingly synthetic and can last a long time so we must dispose of these items properly, starting with putting them in the bin for proper handling by waste treatment agencies, or recycling whatever we can. Nobody knows exactly how long plastic will take to disappear, but scientists think it could take between 450 to 1000 years!

There are seven actions that individuals can do to help reduce the amount of waste we produce and, in turn, the amount of plastic and other items that enter the marine environment. These actions all start with R and are therefore called the **7 Rs: Refuse, Re-use, Reduce, Recycle, Repair, Re-purpose and Regift!**



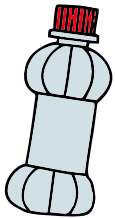
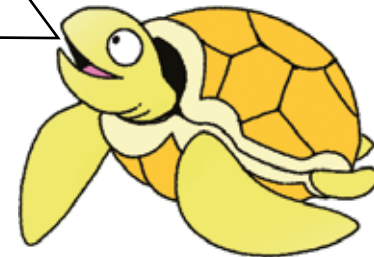
Litter on the ground surrounded by natural materials such as leaves





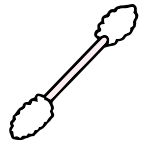
*Nobody knows exactly how long plastic will take to disappear, but scientists think it could take up to several hundreds of years!*

*It is important to be individually responsible for your litter. This is so you know where it goes and what impact you are having!*



## Refuse

Saying "no" can sometimes be a powerful tool against marine litter. Say "no" to useless single-use plastics that are offered to you if you buy items that you can transport in your backpack. You can also say "no" to plastic straws if you can drink directly from the glass.



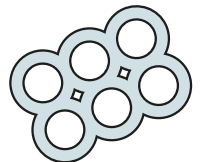
## Re-use

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. Similarly glass bottles can be washed and re-used. Every time we reuse an item instead of binning it, we are saving it from becoming municipal garbage and potentially becoming marine litter.



## Reduce

You can produce less waste reducing the number of items that you discard. Some items like single-use items end up in the bin very quickly, but there are alternative products that can last longer without creating any waste. Simple ways to reduce waste are bringing reusable bags to the shop when you buy your groceries, bringing water from home in a reusable water bottle and not using plastic straws. Do not buy food that is excessively wrapped in plastic. 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.



## Recycle

Many of the items that end up in our landfill sites can yield raw material for being re-made into similar or other items. 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.

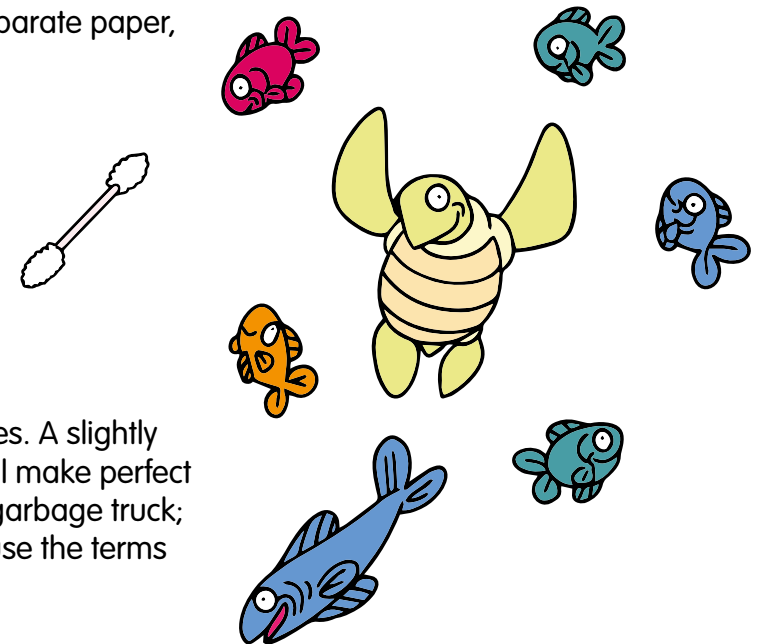
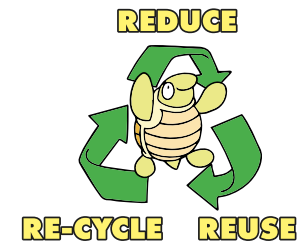
Some schools might have a recycling scheme. If your school does, pay attention that you separate paper, plastic, metals from your normal waste and hand the recyclables over to the proper agency.

## 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 the long-lasting options instead of single-use items?

## Re-purpose

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.



### Regift:

You must have outgrown some clothes, your childhood toys would have lost their novelty, some books are no longer needed. You discard almost all such items and they reach the wastebin. If such 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. You may want to discuss and learn from some elders about the practice of 'hand-me-downs', that was so helpful in sharing items and reducing litter in their childhood days.

### Recent actions in India for reducing plastic waste and marine litter

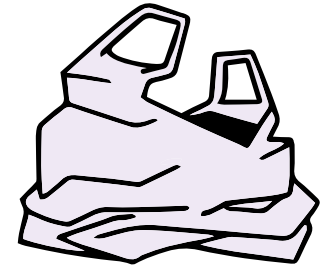
India has taken several initiatives towards the regulation of plastics and minimization of environmental damage from them.

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 marine site, and so it automatically involves elimination of marine litter as well.



## ACTIVITY 4

# Make your own Marine Litter Solutions



The aim of this activity is to become aware of the several ways that you can make sustainable everyday choices to help combat marine litter by implementing the seven Rs- Refuse, Re-use, Reduce, Recycle, Repair, Repurpose and Regift.

### You will need:

A variety of cleaned marine litter items collected from previous lessons or examples of clean litter from home or school.

### Instructions:

Locate seven spots in your classroom that represent the 7 Rs and mark them.

In turn, select an item from the litter that you have collected from the beach and consider whether you can re-use, recycle, repair it, or if someone could have refused it and reduced its use, or given it to someone for using. Then, place it in the correct pile.

### After the activity, you will need:

- Worksheet
- Pencils

### Can you answer these questions?

**Do you know where you can take the different items for recycling?**

**Can you re-use anything in these piles?**

**Is there anything in this pile that did not need to be used and/or thrown away?**

**Can you make some art item out of the marine litter for your classroom? Or a piece of jewellery?**

**What can we do as individuals?**

**What can we do in our communities?**

**What can the government do in our country?**

### Higher grades:

Use the list you came up with to put into action some of the suggestions. Write a letter to a business or the government highlighting ways they could carry out some of your suggestions.

Write a 250 – 500 word answer to this question.



Photo of beach and mangroves before a beach clean. Can you spot the marine litter?

## LESSON 5

# What are the issues around the Globe?

### Key words

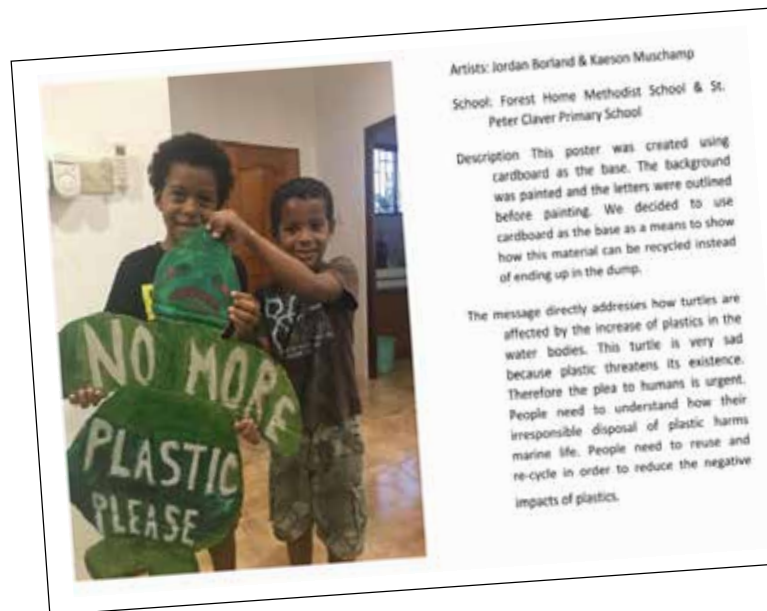
- Global issues
- Innovation
- Solutions

### Lesson aim

This lesson will raise awareness of the global issue of marine litter, and of the innovative solutions that have been adopted.

Around the world, there are some great examples of innovative solutions to solve the global marine litter crisis. If you have internet access, research, and present your findings to your class. Try to gather this information about initiatives happening in Sri Lanka or around the world:

1. Where has the initiative been started? Where is it currently active?
2. Who made it? Who is in charge of it? Who is the initiative aimed at?
3. What is the invention / innovation?
4. Can you replicate this at home, at school or in your community?



Some examples of marine litter initiatives include making artwork to spread the word around school.

## ACTIVITY 5

# Invent a Marine Litter Solution

Time to be creative and invent a solution to help combat marine litter. Use the examples you have learnt about and plan or draw your initiative or invention.

### You will need:

- Paper
- Pencils
- What we have learned together about marine litter.

### One example from our CLiP National Marine Litter Innovation Contest in Belize

"Vanity Belize Eco Friendly line aims to promote beauty and wellness products that are eco-friendly. The line will focus on reusable packaging and/ or no packaging and will utilize Belize's natural resources while being sustainable.

Our Values are:

- Ethical Sourcing of Ingredients and Sustainability
- Harvesting ingredients responsibly is important for the natural resources to regenerate for multiple harvest seasons. This will also help in building a close relationship with the environment and the communities who source these ingredients.
- Handmade – To create products that are handmade, ensuring high quality products which will reduce the use of electricity and cut down on carbon footprint.
- Environmentally Friendly Packaging - We aim to use packaging that can be reused or biodegradable to reduce the amount of plastic and toxic waste in the sea and surrounding environment."

**VANITY**  
BELIZE

Make Up - Skin Care - Hair Care

## FINAL ACTIVITY

# Spread the word!

### Instructions:

Can you think of an effective way to communicate what you have learnt in recent lessons and to educate your community? You could produce a poster, a photo bulletin board, a song, a dance, or artwork. Be creative! You could even use some of the litter you saved in lesson 2 and use social media to reach as many people as possible.

### You will need:

- Creativity

## LESSON 6

# Invasive Species

Optional for higher level grades

### Key words

- Invasive species
- Native range
- Ballast water
- Aquaculture
- Biodiversity
- Ecosystem
- Rafts
- Filter feeder

### What is an 'invasive species'?

Invasive species can be any animals or plants that are introduced, accidentally or intentionally, outside of their native range into areas where they do not naturally occur, and that cause negative impacts on either the environment or people. Invasive species are moved around the world by humans, for example on the bottom of boat hulls, in ballast water (water carried in the bottom of boats to stabilise them), via aquaculture, by the aquarium trade or stuck to drifting marine litter. Recently, this has become even more of a global problem due to increases in the movement of people and goods, and increased shipping around the world. Invasive species can have severe negative effects on the invaded environments and detrimental human health impacts and can result in high costs to local and national economies.

### What impact can invasive species have on an environment?

Invasive species are considered one of the greatest threats to global biodiversity. They can eat or compete with native species, sometimes causing them to become extinct. For example, in Africa the release of Nile Perch into Lake Victoria for fishing caused some fish species that were found only there to die out. In India, varieties of eucalyptus were planted some decades ago under a government-sponsored massive social forestry programme. Over the years these have edged out the native forest species, reducing biodiversity-rich forests to monoculture stands. The water hyacinth, brought in by someone as a garden-pond plant, ran wild in no time and has today choked countless water bodies, affected native aquatic plants and fish fauna. Invasive species can also act as carriers of disease, which can be devastating to native wildlife, and to people. For example, in Sri Lanka, introduced ship rats spread the Leptospirosis virus, and feral cats and dogs are vectors of rabies. Invasive species also have the potential to change whole ecosystems. For example, the Green Seaweed



*Caulerpa taxifolia*, a popular aquarium species, now carpets huge areas of seafloor in the Mediterranean. India has very biodiverse marine ecosystems including island forests, coral reefs, seagrass, and mangroves, which could be harmed by invasive species.

### How do invasive species and marine litter interact?

The interaction between invasive species and marine litter has only recently been discovered. Some marine animals and plants, like seaweeds and barnacles, have always travelled across oceans stuck to natural floating objects like logs or clumps of vegetation, in a process known as 'rafting'. With the recent increase in the amount of plastic and other marine litter in the sea, these 'rafting' species now have many more opportunities to move further than they would naturally. Plastic lasts longer in the sea than natural substances, so invasive plants and animals can be transported to more locations where they are not native, and potentially cause negative impacts on these new ecosystems. The distances that invasive species can travel on marine litter 'rafts' can be huge, and there have even been cases of fishes travelling in floating containers across the whole Pacific Ocean, from Japan to the North American coast.

We do not yet fully understand what types of plants and animals travel on what types of marine litter, but it is thought that the size of the object and how it floats will affect what animals and plants can travel on it.

Do you know of any invasive species in India/Indian Ocean/Asia?

We do not yet fully understand what types of plants and animals travel on what types of marine litter, but it is thought that the size of the object, and how it floats will affect what animals and plants can travel on it.

**Do you know of any invasive species in Sri Lanka/Indian Ocean/Asia?**

## LESSON 7

# Case Studies

Examples of Invasive Species that could raft on marine litter/plastic in the Indian Ocean

### 1) Caribbean False Mussel (*Mytilopsis sallei*)

#### Where is its native range?

The Caribbean False Mussel is native to the Caribbean islands and the Gulf of Mexico.

#### Where is its invasive range?

The species is now present in many areas outside its native range, mostly in Africa (e.g. Egypt, Gabon) and Asia (e.g. China, India, Israel, Japan, Singapore, Taiwan, Thailand).

#### When was the species first reported outside its native range?

This animal was first known to have moved outside its native range in the 1960s, when a population of the mussel was found in India. It is thought that it was carried there by boats.

#### What problems can it cause?

The mussel can cover huge surfaces at very high densities, smothering other animals! It is thought that because it is a filter feeder, it can change the quality of the water where it lives.

### 2) Titan Acorn Barnacle (*Megabalanus coccopoma*)

#### Where is its native range?

The Titan Acorn Barnacle is native to the Pacific, from Mexico down to Peru.

#### Where is its invasive range?

The species has been introduced into the United States, Europe, West Africa, Japan, Australia and Brazil.

#### When was the species first reported outside its native range?

Titan Acorn Barnacles were first found in Europe in the 1970s, on shipping buoys in Holland. Nobody really knows how the species first got there, but it may have travelled across the oceans attached to the bottom of ships. Since then, it has spread to many places around the world.

#### What problems can it cause?

These barnacles grow on lots of man-made structures, such as ropes, shipping buoys and boats. It can be a problem when these man-made structures are used for important tasks, such as aquaculture. It therefore costs a lot to remove this species to keep structures clean.

### 3) Asian Kelp (*Undaria pinnatifida*)

#### Where is its native range?

This seaweed occurs naturally in Japan.

#### Where is its invasive range?

Asian Kelp is invasive in many parts of the world, including Taiwan, North and South Korea, Australia, North America, and Europe.

#### When was the species first reported outside its native range?

The species was first found in France in 1971. It is thought that it is transported on boats, and with aquaculture. It was also found attached to Japanese dock debris washed ashore in Oregon, USA after the Tohoku tsunami in 2011.

#### What problems can it cause?

Asian Kelp often decreases the number of native species present by competing for space on shores. It may also damage man-made structures where it occurs in high numbers.



*Undaria pinnatifida* Photo courtesy of John Bishop at Marine Biological Association, UK

### 4) The European Shore Crab (*Carcinus maenus*)

#### Where is its native range?

No surprises, the European Shore Crab occurs naturally in Europe.

#### Where is its invasive range?

The species has been transported by humans to many parts of the world, into Africa e.g., South Africa, Asia e.g. Japan and North America e.g. Canada and the United States.

#### When was the species first reported outside its native range?

The European Shore Crab was first detected outside its native range as long ago as the early 1800s. It often moves to new places on ships, including in ballast water and on the bottom of boats. It can also be moved with aquaculture and with live food used as bait for fishing.

#### What problems can it cause?

The crab is a predator and eats many native species, sometimes wiping them out completely!



*Carcinus maenus* Photo courtesy of David Fenwick