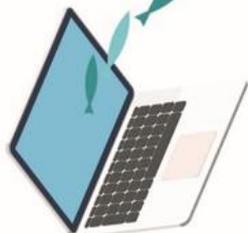




**S.E.A. AQUARIUM
EDUCATOR
RESOURCES**

PRIMARY SCHOOL

The Last Straw



The Last Straw

The Last Straw covers the topic of Mankind's Impact on the Environment and aims to support teachers with Primary 5 and 6: *Interactions within the Environment*. This resource is recommended as an introductory resource for students. Students will learn more about existing anthropogenic (human-related) effects, as well as the subsequent effects on the marine ecosystem. It also focuses on the topic of plastic pollution as an example of an anthropogenic effect and how plastic pollution can affect marine organisms.

Target Group: Primary 5 & 6

Duration: 40 minutes

- Introduction: 20 minutes
- Activity on Plastic Pollution: 20 minutes

Learning Objectives:

- Identify human impacts on the environment
- Explain how plastic pollution can affect marine organisms

Required Resources:

- Corresponding *The Last Straw* slides
- 1 paper bag
- 50 blue marbles
- 50 red marbles
- 1 plastic sieve

Note for educators:

- Educators need not complete the entire lesson in one sitting and can spread them out across 2 class periods if preferred.
- Educators may use any opaque bag and sieve for the activity as they see fit.

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Introduction: Human Impacts on the Environment

(20 minutes)

Human Beings and the Environment

Slide 2:

Educators are to start off the lesson by explaining that human beings and the environment are **dependent on each other**.

- Human beings help to plant seeds.
- Human beings help to water plants.
- Plants provide oxygen for human beings to breathe.
- Plants provide fruits for human consumption.

Slide 3:

Educators will explain that human beings can affect the environment in **positive** and **negative** ways.

Educators can encourage students to identify the human actions from the 6 pictures and whether they are beneficial or harmful to the environment.

Beneficial:

- Planting trees
- Picking up litter
- Opting for reusable bags



Harmful

- Industrial emissions
- Deforestation
- Littering



Human Impacts on the Environment

Educators are to introduce 2 examples of **negative effects** that human activities can have on the environment.

1. Human actions contribute to excessive greenhouse gases emissions

Slide 4:

Explain that human actions are huge contributors to excessive **greenhouse gas** emissions throughout the world. Several examples of greenhouse gases can be found in the *Appendix*.



Transportation



Excessive
electrical usage



Coolants &
Refrigerants



Deforestation

- **Transportation** is one of the largest contributors of carbon monoxide, carbon dioxide, and nitrous oxide emissions.
- Excessive **electrical usage**, which is primarily powered by the combustion of fossil fuels, leads to large emissions of carbon dioxide.
- **Coolants & refrigerants** contribute to chlorofluorocarbon (CFC) emissions.
- **Deforestation** leads to high carbon dioxide levels as it removes trees, which leads to smaller forested areas and lesser absorption of carbon dioxide from the atmosphere.

Slide 5:

Explain that greenhouse gases lead to a warming effect on Earth, known as the greenhouse effect.

- Greenhouse gases in the earth's atmosphere **trap heat** from the sun by forming an insulating layer around the earth and prevents all of its heat from leaving the atmosphere.
- Under normal circumstances, the greenhouse effect is essential in keeping the earth sufficiently warm for life to flourish.
- However, excessive release of greenhouse gases from human actions enhances the greenhouse effect, which causes more heat to be trapped.
- With more heat trapped within the atmosphere, temperatures around the world gradually increase, giving rise to the phenomenon known as **global warming**.



Slides 6 – 9:

What are the consequences of global warming?

Explain that global warming can lead to a series of environmental events:

- **Melting of sea ice** (e.g. glaciers and ice shelves) due to increased temperatures around the globe.
- **Sea level rise** due to increased water volume from the melted sea ice.



These environmental changes can impact marine animals.

- Increased water temperature:
 - Some animals, such as corals, thrive in tropical waters.
 - However, when water temperatures increase due to global warming, corals will expel their symbiotic zooxanthellae. This causes:
 - Corals to lose their color and become white in a process known as coral bleaching.
 - Corals may not obtain sufficient nutrients from the symbiotic zooxanthellae for growth and survival.
 - With the degradation of coral reef habitats, numerous marine species may lose their shelters, breeding grounds, and food sources.
 - This may result in an **overall decrease** in population of marine species and diversity.
- Melting of sea ice:
 - Melting of sea ice can be detrimental to animals (e.g. polar bears and seals) that rely on these habitats as their homes.
 - Increased temperatures from global warming exacerbate the melting of these sea ice, which threatens the survival of these animals due to the **loss of their habitat**.



- Rising sea levels:
 - Sea level rise could result in flooding of intertidal zones, hence marine organisms that inhabit these intertidal zones would **lose their homes**.
 - E.g. Sea turtles use intertidal zones as nesting grounds.
 - With the intertidal zones lost to sea level rise, sea turtles will have no suitable nesting grounds, thus leading to the decline of sea turtle populations.

2. Human actions contribute to marine pollution

Slides 10 – 11:

Using pictures provided, explain that trash and fishing equipment can ultimately end up in the sea and harm marine life.

Educators are to introduce marine pollution: the release of harmful and toxic substances such as chemicals or plastic items into the marine environment.

What are the consequences of marine pollution?



Oil spills



Industrial & domestic waste



Surface runoff



Litter

- **Oil spills** from oil tankers can coat the gills and feathers of fish and birds respectively, hindering their ability to breathe or fly.
- **Industrial and domestic wastes** in the sewage that can enter the ocean can adversely affect the health of marine organisms.
- **Surface runoffs** carry fertilisers into the ocean.
 - Fertilisers serve as nutrients for algae in the ocean, leading to uncontrolled algal growth and formation of algal blooms. These can be harmful to other marine organisms.
- **Litter** left behind can pose dangers such as entanglement, suffocation, and accidental ingestion to marine organisms.
 - Using the statistics on slide 12, introduce different types of litter commonly found in our oceans.
 - Educators should highlight that plastic items make up a majority (~80%) of the top 10 litter found in the ocean.



Activity: Plastic Pollution (20minutes)

Introduction

Slide 13:

Introduce plastic pollution: “Plastic pollution refers to the discarding and subsequent accumulation of plastic objects and materials in the environment, which adversely affects wildlife and their habitats.

Ask the students: “So how does plastic pollution affect marine organisms?”

Activity in detail (~ 10 minutes)

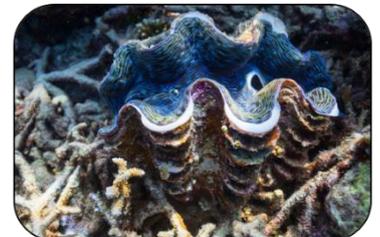
The aim of the activity is to illustrate how the survival of filter feeders are impacted as a result of plastic pollution in the marine environment.



Slide 14:

Introduce filter feeders to the students:

- Animals that feed on tiny animals such as plankton and krill.
- Have adaptations such as **specialised filtering structures** to filter food items from the sea water.
- Examples of filter feeders: baleen whales, manta rays, bivalves, and some species of fish.



Procedure

1. Prepare a paper bag (or opaque bag), 50 red marbles, 50 blue marbles, and a sieve (or any object that can be used to scoop the marbles).
 - Blue marbles will represent food items while red marbles will represent plastic waste.
 - For the first round, place the 50 blue marbles in the bag.
2. Assign 6 students as “filter feeders”. They will stand in a line in front of the class.
3. Every turn, the bag containing the marbles will be passed down along the line.



4. Upon receiving the bag, the student has to “feed” by using the sieve provided to scoop out marbles from the bag.
 - Each student can only “feed” **once per turn**.
 - Students are **not allowed** to look into the bag when “feeding”.
5. Once each student has “fed”, record the number of red and blue marbles collected by each student.
6. All marbles are returned to the bag and the bag is returned to the beginning of the line, commencing the next round.
 - Ten additional red marbles are added to the bag at the start of every new round.
 - The addition of red marbles at every new round represents the gradual pollution of the ocean with plastic wastes.
7. Repeat steps 3 – 6 five times. The goal is to **try to get as little red marbles as possible** by the end of all 6 rounds!

Round	No. of marbles (Blue : Red)
1	50 : 0
2	50 : 10
3	50 : 20
4	50 : 30
5	50 : 40
6	50 : 50

8. Once all 6 rounds have been completed, tally the number of red and blue marbles of each student
 - Student with the **least** total number of red marbles in total win!

Post Activity

Discussion questions for students:

- As more red marbles were added into the bag, how likely was it to scoop out red marbles?
- How does this apply to filter feeders and plastic pollution?
 - Plastics can take up to hundreds of years to decompose completely!
 - Discarded plastics can end up in the ocean and break down into smaller plastics called microplastics.
 - Animals may **ingest** microplastics unintentionally and it remains in their digestive tracts for years!
 - Plastic litter such as nets and plastic bags can **entangle** and **suffocate** marine animals (e.g. sea turtles, manta rays, whales, corals).



What can we do?

Slide 16:

Introduce some actions students can take to lessen the negative impacts of human beings on the marine ecosystem.



Use public transport



Switch off electrical appliances



Dispose trash into the bin



Reduce, Reuse, Recycle

- Use **public transportation** or **carpool** whenever possible.
 - This reduces the amount of greenhouse gases released into the atmosphere, slowing down the effects of global warming.
- **Switch off** electrical appliances when not in use.
 - This reduces the amount of fossil fuels consumed to provide electricity to our homes, therefore reducing greenhouse gases released into the atmosphere.
- **Do not litter** and pick up litter that we see.
 - Litter can potentially end up in the ocean, posing harm to the marine ecosystem. Ensure that litter is properly disposed.
- Practice the **3Rs**: reduce, reuse, and recycle
 - Using plastics as an example:
 - Reduce the use of single-use plastics by considering re-useable alternatives such as bringing your own bags or utensils.
 - Reuse plastic products such as plastic bags or containers to store food or household items.
 - Recycle plastic products properly by ensuring that they are clean and dry, sorting them correctly, and placing them into designated recycling bins.

Reflection

Ask students: What is one thing you will do from today to help conserve our marine environment?



Appendix

Additional information on greenhouse gases emissions:

- Greenhouse gases absorb and emit infrared radiation.
- Examples of greenhouse gases:
 - Carbon dioxide
 - Nitrous oxide
 - Methane
 - Chlorofluorocarbons (CFCs)
 - Fluorinated gases (HFCs, PFCs, etc.)
- Greenhouse gases also lead to ocean acidification
 - Increased carbon dioxide in the atmosphere is absorbed by the oceans, dissolving to form carbonic acid
 - Acidic waters affect the development of crustaceans, bivalves and corals
 - Acidity wears down calcium carbonate commonly found in shells and the skeleton of some marine animals.

Additional information on marine pollution:

- Industrial and domestic waste effects on marine ecosystem:
 - Minerals such as copper can interfere with the coral growth and development
 - Certain chemicals can consume oxygen and create low oxygen conditions known as hypoxia.
 - Heavy metals and other toxic compounds are toxic even at low concentrations
 - When ingested, toxic compounds can accumulate in the tissues of marine organisms and become magnified as it goes up the food chain.
 - These toxic compounds would also affect us when we consume seafood that has accumulated large amounts of pollutants
- Agricultural run-off can contain chemicals found in fertilisers, which can serve as nutrients for algae in the ocean, leading to uncontrolled algal growth and form algal blooms.
 - Algal blooms block sunlight from reaching deeper waters and are harmful for sunlight dependent organisms such as corals



- Algal blooms also consume large amounts of oxygen in the water, giving rise to hypoxic conditions.
- Some algal blooms, known as harmful algal blooms (HABs / red tides) have also been known to be able to produce toxins that can harm other organisms and the environment.

Additional information on filter feeders:

Filter feeders are adapted to feed using specialized filtering structures that filter food items from seawater.

Examples of some of these adaptations in detail:

- Baleen Whales
 - The mouth of baleen whales contains baleen, bristle-like structures made of keratin, the same material found in fingernails and hair.
 - Firstly, the baleen whales opens its mouth to draw in large amounts of seawater, containing krill, plankton, and even small fishes.
 - It then partially closes its mouth and uses its tongue to force water through the baleen, filtering small animals from the mouthful of seawater
 - The baleen whale then ingests the filtered food items.
- Manta Rays
 - Manta rays feed as they swim and channel seawater into its mouth with the help of its cephalic lobes.
 - The gill rakers of the manta rays then trap the small food items before passing the seawater out of its gill slits.
 - The small food items are then ingested.
 - Manta rays also maximize their food intake by somersaulting in water columns where there are high densities of krill or plankton in order to channel more food into its mouth.
- Bivalves
 - Many bivalves are filter feeders and they use their gills to capture phytoplankton from seawater.
 - Some bivalves have specialised organs such as a siphon or cilia that draws the seawater over its gills to filter it.

