

Educator's Guide



Eco 360

Activity 6: Plastics in the Environment
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Table of Contents

1. Backgrounder

2. Curriculum Connections

3. Activity Number and Title

- a. Overall Objective**
- b. Materials**
- c. Time Required**
- d. Learning Outcomes**
- e. Grade Level**

4. Activity Outline

- a. Steps Involved**
- b. Learner Assessment**
- c. Teaching Tips**

Backgrounder: Plastics in the Environment

Sources of Plastic in the Environment

Plastic waste enters the environment through two main sources – either through land-based sources or through marine-sources. Land based plastic pollution is caused by mismanagement of plastic waste on the land. This can happen on an individual level as people irresponsibly discard plastic waste directly into the environment; or through local management authorities (such as municipalities) mismanaging plastic waste due to lack of proper disposal channels such as waste bins taking plastic waste to a landfill; or in similar vein, corporations or other businesses discarding plastic waste improperly if there is no mechanism provided to responsibly discard plastic waste. Absence of a proper waste management system or lack of its implementation is the case in many countries around the globe, which causes plastic waste to enter the environment.

In many cases, a waste management system might be existing, but it is poorly managed – as such if a landfill is not properly managed, plastic waste could be carried by wind from that landfill to a nearby stream, which then enters the waterways and ultimately enters our oceans. Given the durability and strength of plastics, once they enter the environment they remain there for hundreds of years, causing many hazards.

Marine-sources of plastic waste includes plastic waste discarded directly into the oceans. This is typically caused when fishing nets and other plastic fishing gear is discarded irresponsibly directly into the oceans. Although there is still research going on to understand the sources of plastic waste in our oceans, the best estimates shows that about 80 percent of plastic waste in our oceans come from land-based sources, while the remaining 20 percent of plastic is from marine-based sources (LI, Tse, & Fok, 2016).

Plastic in the Environment

Plastic production began some six decades ago in 1907, with estimates showing that to-date about 8.3 billion metric tons of non-recyclable plastic have been produced in the world. This has generated about 6.3 billion of plastic waste. Of this amount, only 9% has been recycled, 12% has been incinerated whereas the remaining 79% of the plastic has accumulated in landfills and the natural environment. To put things in context, if the current rates of plastic consumption were to continue then by 2050 there will be 12 billion metric tons of plastic in landfills – which amounts to 35,000 times as heavy as the Empire State Building (National Geographic Society, 2019).

This interactive tool from Our World in Data shows the amount of global mismanaged waste that ends up in landfills and the environment: <https://ourworldindata.org/grapher/mismanaged-waste-global-total>

Plastic waste that ends up in the environment makes its way to water bodies and eventually our oceans. Globally, around 8 million tons of plastic end up in our oceans every year, which make up about 80% of all marine debris surface waters to deep-sea sediments (IUCN, 2018).

"The most visible and disturbing impacts of marine plastics are the ingestion, suffocation, and entanglement of hundreds of marine species. Marine wildlife such as seabirds, whales, fishes, and turtles, mistake plastic waste for prey, and most die of starvation as their stomachs are filled with plastic debris. They also suffer from lacerations, infections, reduced ability to swim, and internal injuries. Floating plastics also contribute to the spread of invasive marine organisms and bacteria, which disrupt ecosystems" (IUCN, 2018).

Although much has been documented of the effects of plastic waste on marine life, there are also severe negative impacts of plastic pollution on land and air. Plastic pollution on land poses a severe threat to land animals, similar to the threats posed to marine life.

"Plastic waste that never makes its way to the ocean still ends up being very dangerous to both wild animals and domesticated ones...They can suffer from various forms of entanglements as well as accidental consumption which may be deadly" (Macklin, 2021). Plastic is being ingested by land animals by being mistaken for food, which is causing severe negative impacts. These effects include frequent headaches, bellyaches, suffocation, and starvation. Plastic pollution on land also causes limited mobility of land animals and birds due to plastic entanglement—as such plastic getting stuck in animal paws and birds not being able to fly getting caught in plastic trash (Macklin, 2021).

"Single-use plastics can have a significant impact on the terrestrial food chain. Plastic bags and food containers every so often carry food particles and smell that attract vermin to eat the plastic. The plastic becomes perpetually embedded in the animals' digestive tracts, blocking the passage of food, and leading to death by starvation or infection. Birds and large mammals especially farm animals are documented as being found dead after feeding on plastic bags. Furthermore, birds use pieces of plastic in building their nest. In a nest, freshly hatched chicks will peck away at pieces of plastic, which they may swallow up. Ecosystems are increasingly damaged when plastic litter mounds up along the shores of lakes, reservoirs, and inland waterways, disrupting the nesting patterns of waterfowl and other aquatic animals. This will have flow-on impacts on other animals along the food chain, such as tiny insects

and other small animals, which are a primary source of food for higher carnivores and reptiles occupying wetlands" (Kyeremanteng, 2020).

There has been a growing interest in studying the effects of microplastics (small pieces of plastics) on air. A study done in the mountains of the French Pyrenees concluded clear evidence of airborne microplastic being deposited onto the ground every day. In this study, samples were collected and analyzed over a five-month period, which showed atmospheric microplastic depositing in both wet and dry conditions on land. They documented approximately 249 fragments, 73 films, and 44 fibres per square meter deposited on the study area (Allen, et al., 2019). Much like the problem of marine plastic pollution, this study shows the microplastic was able to travel up to 95 km with the wind. This study concludes that atmospheric microplastic can travel long distances to sparsely inhabited areas through the wind – taking plastic pollution to remote lands that have not generated the plastic pollution. This microplastic when ingested by terrestrial life enters the food chain, which severely affects human health as well.

Additional resources to learn about the effects of plastic pollution on the environment:

- Our World in Data: <https://ourworldindata.org/plastic-pollution>
- IUCN Brief: <https://www.iucn.org/resources/issues-briefs/marine-plastics#why>
- The Plastic Problem – A PBS Documentary:
<https://www.youtube.com/watch?v=1RDc2opwg0I>
- Impacts of Plastic and Microplastic waste on the Dry Land Environment:
<https://solarimpulse.com/news/impacts-of-plastic-and-microplastic-waste-on-the-dry-land-environment#>
- Plastic & Land:
<https://www.theconsciouschallenge.org/ecologicalfootprintbibleoverview/plastic-land>
- An underestimated threat: Land-based pollution with microplastics:
<https://www.sciencedaily.com/releases/2018/02/180205125728.htm>

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- Macklin, M. (2021). *5 Ways Plastic Pollution Impacts Animals on Land* . Retrieved from One Green Planet: <https://www.onegreenplanet.org/environment/ways-plastic-pollution-impacts-animals-on-land/>
- National Geographic Society. (2019). *A Whopping 91 Percent of Plastic Isn't Recycled* . Retrieved from National Geographic: <https://www.nationalgeographic.org/article/whopping-91-percent-plastic-isnt-recycled/>

Curriculum Connections

Activity 6: Plastics in the Environment

Alberta

- ❖ Grade 9 Unit C: Environmental Chemistry
 - 1. Investigate and describe, in general terms, the role of different substances in the environment in supporting or harming humans and other living things
- ❖ Bio 20 and 30
 - All units in Bio 20/30 have an STS outcome (science, technology and society) - explain how science and technology have both intended and unintended consequences for humans and the environment

Ontario

- ❖ Grade 9 Biology (B2.3, B2.4)

Activity 6: Plastics in the Environment



Overall Objective

Learners will explore the negative effects of plastic waste on our environment - focusing on how plastic waste impacts our land and water bodies and air.



Materials

- Internet-enabled device
- Topic backgrounder
- Eco 360 notebook (we recommend asking learners to maintain a notebook for this program to write down reflections as they go through the program)



Time Required

1.5 hours - 2 hours



Learning Outcomes

By the end of this activity, learners will:

- describe the amount of plastic waste currently found in the environment
- identify the areas of environment most impacted by plastic waste
- describe how plastic waste affects the land, air, and water bodies



Grade Level

Suitable for Grades 9 to 12

Activity Outline



Step One

Using the backgrounder, explain to learners how plastic pollution causes negative impacts in the environment. Shedding light on its impacts in our water bodies, land and air, highlight the amount of plastic currently in our oceans which has had severe negative impacts on ocean life.



Step Two

Watch a documentary on plastic pollution and its impacts on the environment:

- a. 'The Plastic Problem' <https://www.youtube.com/watch?v=1RDc2opwg0I&t=1s>
(1 hour)



Learner Assessment

Consolidation: Have learners answer the following questions individually by recording responses in their Eco 360 notebooks or discussing as a class:

- a. What are some of the environmental impacts of plastic waste discussed in the documentary?
- b. What did the researcher from University of Toronto conclude from her sampling of fish from Lake Ontario? What implications does this have for people eating fish?
- c. What are some of the challenges in recycling plastic mentioned in the documentary?
- d. Do you think banning single use plastic is sufficient in combating the problem of plastic waste? Why or why not? How would this ban support a circular economy for plastics?
- e. Discuss the
- f. Considering the global recycling average is only 9% as mentioned in the documentary, what is the solution to global plastic waste?



Teaching Tips

Additional resources for educators:

- a. <https://www.unenvironment.org/news-and-stories/story/plastic-planet-how-tiny-plastic-particles-are-polluting-our-soil#:~:text=Toxic%20effects,species%20that%20drink%20the%20water>
- b. <https://onlinelibrary.wiley.com/doi/full/10.1111/gcb.14020>
- c. <https://www.nationalgeographic.com/environment/habitats/plastic-pollution/>
- d. <https://advances.sciencemag.org/content/6/44/eabd0288>