



“Marine plastic pollution is one of the most pressing and preventable problems of our time. That is why I am so eager to be hosting this lesson on marine litter. Educating our kids about this issue and what they can practically do to reduce plastic consumption and pollution is crucial for breaking the plastic habit.”



Lewis Pugh, UNEP
Patron of the Oceans

Life Below Water – Marine Litter

Subject

Science, Biology

Learning Outcomes

- To explore and understand the threats of plastic waste to our oceans
- To generate and explore ideas of how to better control discarded trash from entering our oceans

Preparation

- Print or project *Images of Marine Plastic Pollution*, 1 class set (Appendix 1)
- Print information sheets describing threats of plastic trash to the oceans, enough for one per group (Appendix 2)
- Print or project *What Can Be Done?*, 1 class set (Appendix 3)

55
mins

8-15
years

Lesson Plan Overview

55
mins

Step 1: Review Global Goal 14: Life Below Water

Step 2: Introduce and Explore the Problem – How plastic trash affects marine life

Step 3: Discover Solutions – What is currently being done to address this issue?

Step 4: What will you do? – A Writing Activity

Step 5: Sharing and Debrief

Step 1: Review Global Goal 14 – Life Below Water

5
mins

- Display for the class, either a poster or projection of [Global Goal 14: Life Below Water](#).
- **Think, Pair, Share** - Ask the students what they know about Global Goal 14 and how it affects their lives. Allow approximately 30 seconds for each child to think on their own before turning to a partner to discuss. Teacher should move around and listen to a few partnerships respond to the question. (*Teacher should take note of different ideas and choose a few children to call on later.*) Once the majority of partnerships have finished, ask a few students to share their ideas with the class. The teacher may write down these ideas on a board for everyone to see.

Note: *If the children fail to mention anything in regards to Marine Life and how pollution has a negative effect you may wish to introduce the idea at this point. See Below.*

Global Goal 14: Life Below Water

- Reduce marine pollution by 2025, since much of the pollution comes from human activities on land.
- Enact laws that prohibit illegal fishing, overfishing, and other destructive fishing practices.
- Minimize and address the impacts of ocean acidification, including through enhanced scientific cooperation at all levels
- By 2020, conserve at least 10 per cent of coastal and marine areas,

Step 2: Explore the Problem

20
mins

- Show pupils a series images of damaged seas or oceans, e.g. various forms of ocean life entrapped by plastic, water column photos, polluted beaches, plastic waste (appendix 1).
- As you show each image, ask students to write down what they think happened before and what might have happened after the photo was taken. (Provide each child with a dry erase board if you have them available to you. Alternatively, each child can use a notebook or blank sheet of paper if available.) Students can hold up their responses for the teacher and other students to see. Teacher can call on a few students to expand on their ideas and/or to clarify meaning. Repeat for as many images as desired.

Note: At this point, split the children into groups of 4-6, depending on class size. Arrange the class so that there is space for each group to have their own space to work.

- Provide each group with copies of the information sheets describing threats to marine life. (Appendix 2)
- Allow 5 minutes for students to read through and discuss as a group what they have learned. Encourage them to think about various levels of effect throughout a marine ecosystem.
- Tell students that they need to be ready to present an imaginary journey of how a thrown away plastic item on land travels to the ocean (by wind, waterway, dumping, etc.), is weathered in the ocean, and what happens when it is encountered by marine life (is eaten by the animal, etc.).
- Lead a short class discussion and call on students to briefly describe how the plastic we throw away can have a negative lasting effect on marine life.

Step 3: Discover Solutions

15
mins

- Display Appendix 3 – Marine Plastic Pollution: What can be done to prevent it?
- Direct children to read through each of the solutions, or read them together as a class.
- Point out the various ways people are working to make a difference. Encourage students to volunteer their own ideas and to discuss what they may already be doing to help.
- Show the World's Largest Lesson animation 2016 (6 minutes), in addition or as an alternative for younger students, and focus on the story of Isabel and Melati Wijsen who successfully campaigned against the use of plastic bags in their beautiful island home of Bali: <https://vimeo.com/178464378> (story at 3.28)
- Allow children time to share ideas about what they have learned and how they can use that information to help them make smart choices in the future.



Step 4: What will you do?

10
mins

- Tell the students it is now their turn to make a difference. Ask the following question:
What can you do to prevent plastic from having a negative lasting effect on marine life?
- Encourage students to think through their average day, visits to the market or shops, to a restaurant, to buy a drink or a snack, and all the times they can encounter plastic as a convenience as opposed to a necessity (e.g. use of a straw, eating an ice cream with cup and spoon as opposed to a cone, buying plastic bottles of water instead of using filters and a refillable, non-plastic container, using a reusable carry bag instead of a plastic bag) and where they can opt out of accepting it.
- Students focus on their chosen issue and write a paragraph explaining what the threat is, why it damages the ocean and beyond (e.g. effect on the wider environment and on people) and how their solution can help. They should make sure they include real-world examples in their answer.

Note: As an alternative, student can complete this assignment at home. They can use textbooks, the internet (see links in appendix 4) or pre-prepared materials to add detail to their writing.

Step 5: Debrief

5
mins

- Gather the class together. Remind students of the purpose Global Goal 14: Life Below Water. Display the Targets for all to see.

Global Goal 14: Life Below Water

- Reduce marine pollution by 2025, since much of the pollution comes from human activities on land.
- Enact laws that prohibit illegal fishing, overfishing, and other destructive fishing practices.
- Minimize and address the impacts of ocean acidification, including through enhanced scientific cooperation at all levels
- Call on a few students to share their ideas with the class. As the students share, encourage the rest of the class to consider whether or not the solution is viable. Ask the class: *Is this something you can see yourself doing? Why or why not?*
- Encourage the students to share their new learning with family, friends and community members.

For students who are interested in learning more, you may direct them to explore the links provided in Appendix 4.



Bottlecaps gathered from the oceans
(Source: NOAA)



Tangle of floating plastic netting and other plastic debris
(coastalcare.org)



Seal entangled in discarded fishing gear (Source: NOAA
<https://pifsc-www.irc.noaa.gov/cruise/se1103.php>)



Polluted beach (Source unknown)

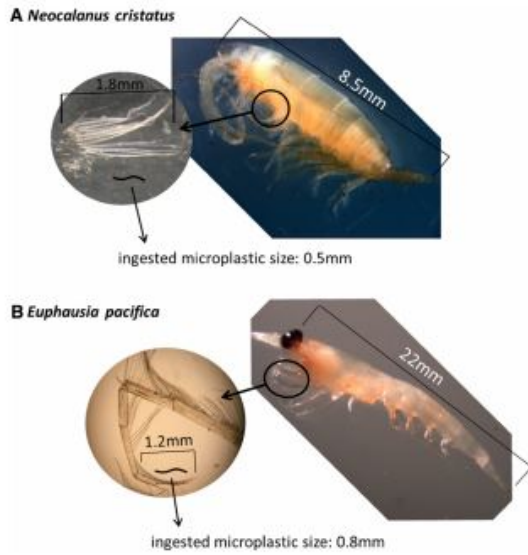


This rainbow runner had consumed 17 plastic fragments. Marine plastic pollution plays an unknown role in human exposures to toxic chemicals. Regardless of what that role may turn out to be, sources for this story believe we have options for realizing the benefits of plastics without the hazards of marine pollution. © 5 Gyres Institute

Source: 5 Gyres Institute (<http://www.5gyres.org/>)



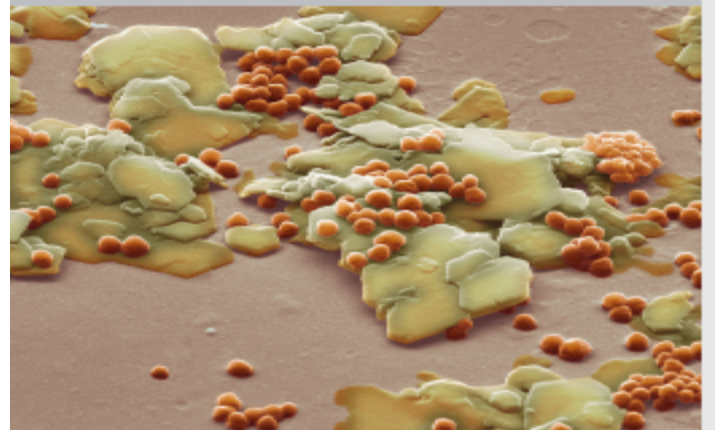
Even isolated, uninhabited islands, such as Midway Atoll in the Pacific, are affected. Here are the remains of an albatross that died from accidental eating of plastic. Of the Laysan Albatrosses on Midway, nearly all have plastic in the stomachs, and one third of chicks die due to being fed plastic by their parents. (Source: <http://www.midwayfilm.com/index.html>)



Zooplankton eating plastic.
 (Source: <http://thinkprogress.org/climate/2015/07/14/3679715/zooplankton-eating-plastic/>)



Small plastic pellets known as nurdies are used as a feedstock for producing plastic goods. In July 2012 Typhoon Vicente swept more than 165 tons of nurdies from a cargo ship off the coast of Hong Kong.¹³ © Nigel Curtis/Science Source



Polyethylene microbeads (orange, shown with yellow flakes of silica) are used as exfoliants in many personal care products. In June 2014 Illinois became the first U.S. state to ban the manufacture and sale of products containing microbeads, which are small enough to slip through filters at wastewater treatment plants.
 © Steve Cachel/Getty/Science Source

Examples of microbeads (from a cargo spill) and microplastics (seen as orange under the microscope amongst yellow sand grains originating from personal care products like body cleansers with scrubbing/exfoliating properties).
 (Source: 5 Gyres Institute)



Peanut, the turtle teaching mascot of the Missouri Department of Conservation (<http://mdc.mo.gov/>), who was trapped in the plastic ring of a 6-pack drink holder as a baby, affecting shell formation.

Threats to the Ocean: Waste in the Ocean

What is it?

It is estimated that 8 million tonnes of plastic waste end up in the ocean every year. Jenna Jambeck, at the University of Georgia, says it is like having five shopping bags of trash on every foot of coastline around the globe*. Plastic is one of the main waste products that end up in the sea, although marine waste can include anything from glass to cans to abandoned sailing boats. Many of the objects in the ocean end up in giant accumulation zones called 'gyres'. These are massive areas where waste gathers, that are formed by ocean currents. Much of it is actually 'invisible' or under the surface, made up of 'microplastics'. There are five known gyres, two in the Pacific Ocean, two in the Atlantic Ocean and one in the Indian Ocean.

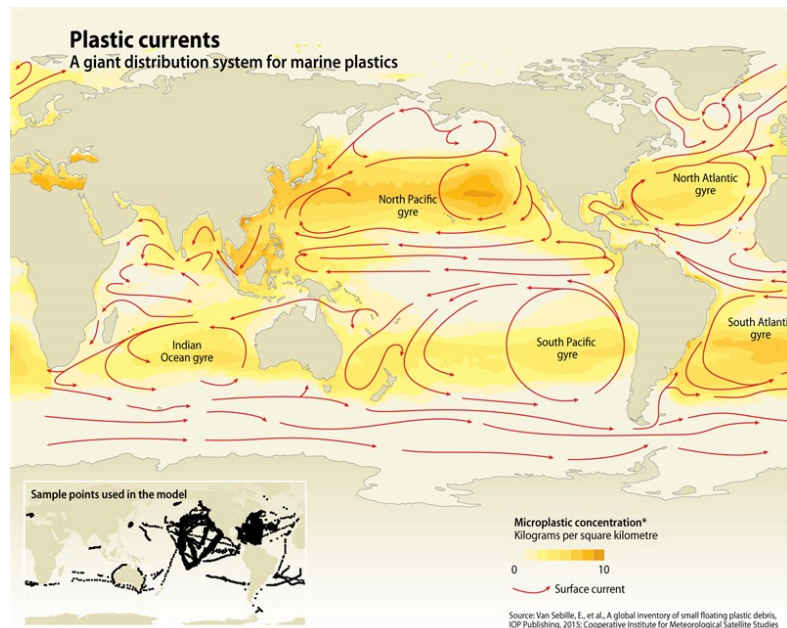


image credit: GRID-Arendal and Maphoto/Riccardo Pravetton
Find out more at: http://www.grida.no/graphicslib/detail/plastic-currents_e63c#



How is it caused?

Waste ends up in the ocean for a number of reasons. Sometimes it is intentionally dumped into the sea (garbage from ships or fishing gear). Sometimes it is carelessly dropped on land and ends up in the sea. Natural disasters, such as a hurricane or tsunami, can also result in waste ending up in the sea.

What is the effect on the ocean?

Marine life is often affected, by ocean waste. This can happen in a number of ways:

- Birds, fish and other sea creatures can become trapped in plastic bags, netting or packaging and may get injured or die.
- Marine mammals and birds can end up swallowing waste in the water. It has been well documented that turtles, for example, mistake plastic bags for jellyfish. Eating waste can lead to illness or starvation.
- Some of the marine debris is made up of material that contains chemicals that are harmful to fish and other species. Whilst this may not directly harm the sea life that swallows the waste, it can result in harmful toxins entering the food chain.

Threats to the Ocean: Microplastics

What is it?

Microplastics are small plastic particles less than 5 mm (~0.2 in) in size. There are two main sources of microplastics:

- 1) **Primary microplastics** - manufactured for use in a variety of household and industrial applications. The most common are those used as exfoliants in facial cleansers and abrasives in toothpaste.
- 2) **Secondary microplastics** - small plastic particles that have been formed from the breakdown of larger plastic waste (e.g. by UV radiation from sunlight making larger plastic items brittle, so that they can then be broken up by waves or worn down with coastal sand and rocks) They can also come from synthetic clothing fibres: as many as 1900 go down the sink with every item washed!

The combination of these sources has resulted in the accumulation of microplastics in our oceans and on our coastlines worldwide.

How is it caused?

About 311 million tonnes of plastic were produced globally in 2014 (Plastics-Europe 2015), with an estimated 8 million tonnes of this ending up in the ocean.

The numbers are mind-boggling. Plastics are entering our oceans due to poor control and disposal of trash on land or by boats at sea. They can come from personal care products (cosmetics, toothpastes, skin exfoliants etc). Plastics that do not sink can travel by ocean currents to either: the world's great ocean gyres; or be washed onto your local beach. If you go to any beach, you will be sure to find plastic!

Source: <http://microplastics.science/what-are-microplastics/>

What is the effect on the ocean?

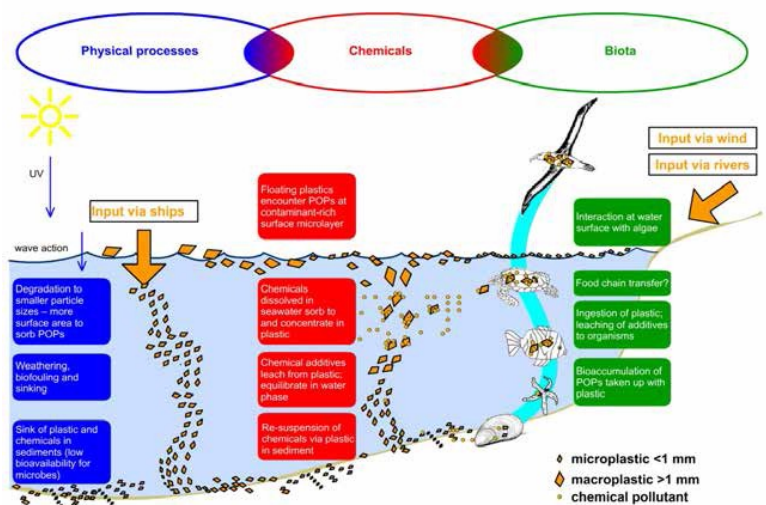
(Image Source: UNEP (2015) Report on Plastic in Cosmetics)

Microplastics are especially damaging, because they are the way that plastic enters our food chain, and can do a lot of damage to ecosystems.

An ecosystem is all the living things, from plants and animals to microscopic organisms, that share an environment. So in a marine ecosystem, the tiny plastic particles can be eaten by zooplankton, tiny creatures that are in turn eaten by fish larvae, small shrimp, mollusks and other small creatures. These small fish and animals are eaten by bigger fish, and these bigger fish are eaten by even bigger fish, as well as sea birds, seals, whales and other oceanic creatures. And of course, humans eat many of the species in the food chain. So the plastic eaten by the zooplankton could end up moving through the food chain into top predators. An animal that eats plastic instead of food will have poor nutrition, and this can mean unhealthy reefs, fish.....and people!

Plastics also contain harmful chemicals, which leak into the ocean waters as the plastic degrades. The plastic particles can also adsorb toxic chemicals (e.g. pesticides and industrial chemicals) that have run off from the land to the sea. This makes the plastic particles even more toxic for the animals that eat them.

Plastic can act as a raft for small animals to move from their home environments to new parts of the ocean, making them invasive species. The introduction of invasive species to ecosystems not used to them can cause the ecosystem to fail, with loss of important reef and oceanic life.



1 - Information from GESAMP (2015). "Sources, fate and effects of microplastics in the marine environment: a global assessment" (Kershaw, P. J., ed.). (IMO/FAO/UNESCO-IOC/UNIDO/WMO/IAEA/UN/UNEP/UNDP Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection). Rep. Stud. GESAMP No. 90, 96 p. and <http://microplastics.science/what-are-microplastics/>

What Can Be Done to Protect Our Oceans?

Marine plastic pollution can be tackled in two ways:

Downstream solutions: This relates to making sure plastic waste is managed properly, recycled and/or properly disposed of rather than released to the environment. However, only about 10% of plastic ends up recycled right now, and with the current rate of growth of plastic production, it is hard to keep up with that amount of trash generated, and it will require a lot of money!

So, many people are looking at...

Upstream Solutions: These focus on avoiding plastic in the first place.

1. Use Fewer Plastic Products:

Plastics that end up as ocean debris contribute to habitat destruction and entangle and kill tens of thousands of marine animals each year. To limit your impact:

- ✓ Don't drop litter,
- ✓ Carry a reusable water bottle,
- ✓ Store food in non-disposable containers,
- ✓ Bring your own cloth or other reusable bag when shopping,
- ✓ Consider the packaging before buying an item (eg fruit laid out on Styrofoam with plastic film over it, or loose fruit items that you can put directly into your reusable bag?)
- ✓ Eat an ice cream cone (instead of a cup and spoon)

- ✓ Be careful how you throw away your fishing line
- ✓ Carefully choose toothpastes, cosmetics, soaps and detergents to make sure that there are no microbeads included (see information below on the Beat-the-Bead app)
- ✓ Recycle whenever possible



Find out more at:
<http://www.unep.org/NewsCentre/default.aspx?DocumentID=26827&ArticleID=35180>

2. Volunteer to help keep Waterways trash free, and be an activist for your community:

Keeping waterways (streams, lakes, rivers) cleared of trash is especially important since this is a fast route for plastic to get to the oceans. Also important, is keeping a record of the types of plastic and sources, and working with local government or community leaders, retailers and other community groups to think about how to avoid plastic that originates from the various sources.



The World's Largest Lesson 2016 animation stars young change-makers Isabel and Melati Wijzen who took a stand and took action to stop plastic waste harming their beautiful island home of Bali.



You can watch their story here: <https://vimeo.com/178464378> (at 3.28)
 And listen to their TED talk:
https://www.ted.com/talks/melati_and_isabel_wijzen_our_campaign_to_ban_plastic_bags_in_bali?language=en



Why did it matter to them?

"In Bali we generate 680 cubic metres of plastic a day. That's about a 14-storey building," Isabel says in their TED talk. "And when it comes to plastic bags, less than five percent get recycled!"

What did they do about it?

Beginning when they were just 10 and 12, Melati and Isabel galvanized support from their classmates, and their efforts — including petitions, beach cleanups and protests — paid off when they convinced their governor to commit to a plastic bag-free Bali by 2018. They developed a sticker that local shops can use to declare that they're plastic bag free.

What do they have to say to other aspiring activists?

are burned in garbage piles, where they release harmful dioxins into the atmosphere. "Don't ever let anyone tell you that you're too young or you won't understand," Isabel says "We're not telling you it's going to be easy. We're telling you it's going to be worth it."

3. Be creative!

Ordinary people all over the world who have a love of nature and science have been coming up with incredible alternative materials to plastics. Universities and other innovation groups sponsor global competitions for anyone with a good idea to show their ideas and win prizes and support to bring their inventions to market. Solutions don't all have to come from big industrial labs!

For example:



A selection of packaging products made with agar from seaweed instead of plastic as the primary ingredient, so that they dissolve in sea water. Algal Plasticity project (Japan) - <http://www.kosuke-araki.com/#/blank/rb0s1>



Edible Cutlery – (See <http://www.bakeys.com/>) baked savoury, sweet or plain edible spoons, created in India, mainly made from sorghum, a hardy crop with low water needs. The demand for plastic cutlery is increasing and plastic, a petroleum by-product is more harmful to human body because of the presence of several toxins and carcinogens. Its application as food consumption utensil enhances the chances of these chemicals to get into the human system.

Innovations for the ocean



Examples of various products (e.g. toothbrushes, ring holders for cans, food and other packaging, toys) where non-degradable plastic has been replaced, promoted by innovation incubators and business accelerators, such as ThinkBeyondPlastic™.

What has been done?

- The “Beat the Microbead” app was launched in 2012, by the North Sea Foundation and the Plastic Soup Foundation – the App allowed Dutch consumers to check whether personal care products contain microbeads by scanning a products barcode. In the summer of 2013, the United Nations Environment Programme and UK based NGO Fauna and Flora International supported the partnership to further develop the App for international audiences. The App, which is available in **nine** languages, has been very popular, convincing a number of large multinationals such as Unilever, Johnson & Johnson and the Body Shop to announce their intent to stop using microbeads. The App is available at <http://get.beatthemicrobead.org>
- In the U.S., Illinois became the first state to **enact legislation** banning the manufacture and sale of products containing microbeads. This two-part ban will enter into effect in 2018 and 2019. The Netherlands, Austria, Luxembourg, Belgium and Sweden have issued a joint call to ban the microplastics used in personal care products, saying the measure will protect marine ecosystems – and seafood such as mussels – from contamination. The joint statement that was forwarded to the EU’s 28 environment ministers was stating that the elimination of microplastics in products, and in particular, in cosmetics and detergents, “is of utmost priority”.

Examples of product bans range from grass roots campaigns to remove goods from a well-defined source, such as shops on university campuses, to bans imposed by national governments on certain types of plastic bags.

Several governments in Africa have introduced, or are planning to introduce legislation to ban or restrict the use of conventional plastic shopping bags, usually below a certain minimum thickness (South Africa, Tanzania, Kenya, Rwanda, Mauritania and Uganda¹). This has been prompted by the severe problems discarded bags have caused, for example by blocking drains and open sewers or causing the death of livestock, in countries where solid waste disposal is poorly developed and regulated. In other sub-Saharan countries, such as Ghana, Nigeria and Sierra Leone, plastic bags are considered essential to provide clean drinking water and they are much more affordable than plastic bottles. This illustrates why those promoting litter reduction measures have to take account of the economic and social dimensions of the local communities.

Alternatives to outright product bans are voluntary agreements, which may be easier to achieve. The industry body Cosmetics Europe has issued a recommendation to all its members to phase out the use of microplastics in wash-off cosmetic products.

- Student interventions have been successful in banning the sale of bottled water on several University and College campuses in the USA, accompanied by the refurbishment of drinking water fountains. In the USA a student-led campaign, at the Univ. California Los Angeles, resulted in the removal of all PCCP products containing microbeads². The message of this grassroots campaign has been matched by a number of States in the USA which moved to ban microbeads from PCCPs. However, these efforts have been superseded by the 'Microbead-Free Waters Act, passed unanimously by the US House and Senate in December 2015, and signed into law by President Obama on 4 January 2016. The phase out is due to begin on 1 July 2017.

¹ <http://www.bbc.co.uk/news/world-africa-20891539>

² <http://www.5gyres.org/blog/posts/2015/8/12/ucla>

Links for Student Research

Ocean waste:

- UNEP Global Partnership on Marine Litter <http://www.unep.org/gpa/gpml/gpml.asp>
- UNEP Plastics in Cosmetics <http://www.unep.org/NewsCentre/default.aspx?DocumentID=26827&ArticleID=35180>
- 5 Gyres Institute <http://www.5gyres.org/>
- Greenpeace <http://www.greenpeace.org/international/en/campaigns/oceans/fit-for-the-future/pollution/trash-vortex/>
- National Geographic <http://education.nationalgeographic.co.uk/encyclopedia/great-pacific-garbage-patch/>
- Eco Kids http://www.ecokids.ca/pub/eco_info/topics/oceans/risks_to_oceans.cfm
- World Watch Institute <http://www.worldwatch.org/global-plastic-production-rises-recycling-lags-0>
- Stow It Don't Throw It <http://www.stowitdontthrowitproject.org>

Plastic Alternatives and Awareness Tools

- Beat the Microbead <http://www.unep.org/gpa/gpml/BeattheMicrobeadProject.asp>
- Think Beyond Plastic (includes July 2016 Innovation competition) <http://www.thinkbeyondplastic.com/>
- Edible Cutlery example: <http://www.bakeys.com/>
- Algal Plasticity Project - <http://www.kosuke-araki.com/#!blank/rb0s1>

Take Action for the Global Goals

As an educator you have the power to channel students' positive energies and help them believe that they are not powerless, that change is possible, and that they can drive it.

Taking Action - Right Now:

- Students can **write** to their local government representative, and **tell** them why the Global Goals are so important to their future and **ask** them what action they are taking toward a specific Goal.
- Ask students to **summarise** what they have learned about the **#GlobalGoals** and share it with World's Largest Lesson on Twitter or Instagram
@theworldslesson or Facebook
@TheWorldsLargestLesson

Taking Action - Deeper Engagement:

For deeper learning and impact, students can also take part in **projects** to make change for the Goals in their local communities.

Visit the "**Take Action**" page on our website: www.globalgoals.org/worldslargestlesson and find organisations, resources and lesson packs to help you get started.

