Hawai'i Wildlife Fund: Marine Debris Keiki Education and Outreach (MDKEO) Program

Lesson 1 - What is Marine Debris?

Grade levels: K-5
Time: 60 minutes

Summary

Students are introduced to the subject of marine debris, its composition, its impact on marine wildlife, and the land-to-ocean connection in an informative talk story session utilizing visual aids and activities.

Objectives

- Define "marine debris"
- Discuss ways marine debris enters the ocean by learning the connection between land and sea (*ahupua'a*)
- Understand the difference between natural debris (biodegradable) and manmade (synthetic) debris
- Define single use plastic and its' association with marine debris
- Predict and identify threats to marine wildlife and humans posed by marine debris

Background

Marine debris is any persistent, solid material manufactured or processed, and directly or indirectly, intentionally or unintentionally, disposed of or abandoned in the marine environment (see "Trash Talk").[1] The average proportion of marine debris that is plastic varies between 60-80%.[2] Every year,

[1] "What Is Marine Debris?" *What Is Marine Debris?* National Oceanic and Atmospheric Administration, 22 Oct. 2015.
[2] "Land-based Discharges of Human-made Debris Comprise the Largest Source of Marine Debris in Oceans World-wide (nearly 80%)." *Plastic Debris Rivers to Sea Project*. Algalita Marine Research Foundation and California Coastal Commission, 2005.

between 4.8 and 12.7 metric tons of plastic ends up in the world's oceans.[3] Plastic and other types of marine debris enter the marine environment through improper or accidental disposal of rubbish on land and in the water. Weather events (i.e., wind and rain), tsunamis, streams, storm drains, roadways, animals (i.e., rats and birds), and "you and I" can all play a role in dispersing trash from land and into marine environments.

According to their 2019 report[4], the 10 most common items found during the Ocean Conservancy's 2018 international coastal cleanup events recorded:

1. cigarette butts
2. food wrappers
3. straws & stirrers
4. forks, knives & spoons
5. plastic beverage bottles
6. plastic bottle caps
7. plastic grocery bags
8. other plastic bags
9. plastic lids
10. plastic cups & plates

All the above items are considered single-use and disposable plastic!

In Hawai'i, there is a close connection between the land and sea due to the geographic, geologic, and cultural characteristics of the Hawaiian Islands. Here in Hawai'i this close connection can be demonstrated within the Hawaiian Ahupua'a tradition. An *ahupua'a* is the traditional way that Hawaiians divided land from *mauka* (toward the mountain) to *makai* (toward the sea), connecting both ecosystems. This "pie slice" shaped piece of land contained all the natural resources for a community to survive.[5] Hawaiians recognized that what we do on the land affects our oceans and vice versa. Today, this is no different. Our actions on land affect what happens in the sea, especially in respect to litter. However, not all the marine debris that makes its way to Hawai'i is locally produced. Marine Debris is particularly egregious in Hawai'i due to its nearby location to the North Pacific Gyre, also referred to as the North Pacific Garbage Patch (see NOAA's Garbage patch page for more info).[6] Near the southern end of the southernmost island in the Hawaiian Archipelago, Kamilo Point, is an area famous for debris accumulation of up to 20 tons per year.[7]

Unlike naturally occurring materials, plastic does *not* biodegrade, meaning it is not broken down (decomposed) by living organisms and thus persists in the environment for very long periods of time. Instead, plastic is broken down into smaller, more brittle pieces through photodegradation and is broken

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[3] Jambeck, J. R., R. Geyer, C. Wilcox, T. R. Siegler, M. Perryman, A. Andrady, R. Narayan, and K. L. Law. "Plastic Waste Inputs from Land into the Ocean". *Science* 347.6223 (2015): pp. 768-71; *and* "Summary: Plastic Waste Inputs from Land into the Ocean." Ocean Conservancy, 2016.

[4] "The Beach and Beyond: 2019 Report". Ocean Conservancy, 2019.

[5] "Ahupua'a - Hawaii History." *HawaiiHistory.org - Hawaii History - Home*. Info Grafik, 2016.

[6] Howell, E.A., Bograd, S.J., Morishige, C., Seki, M.P., Polovina, J.J., 2012. "On North Pacific circulation and associated marine debris concentration." Marine Pollution Bulletin 65, 16e22.

[7] Hawai'i Wildlife Fund, unpublished cleanup data, 2016.

down into smaller more brittle pieces via sunlight and physical factors (e.g., waves). Additionally, plastic acts as a sponge and can accumulate heavy metals and other toxins from the environment[8].

Plastic is a synthetic material made from a wide range of organic polymers such as polyethylene, PVC, nylon, etc., that can be molded into shape while soft and then set into a rigid or slightly elastic form. A Nurdle is a very small pellet of plastic that serves as raw material in the manufacture of plastic products, it can be mistaken as fish eggs and consumed by marine animals. Many plastic and other commonly used and/or discarded items (e.g., plastic bottles, metal food cans, detergents, flame retardants, toys, cosmetics) contain known endocrine disruptors. Endocrine disruptors are "chemicals that may interfere with the body's endocrine system and produce adverse developmental, reproductive, neurological, and immune effects in both humans and wildlife." [9]

Plastic poses problems to marine wildlife and humans. Marine animals and ecosystems are impacted by marine debris in several ways, including:[10]

1. **Ingestion** - when an animal or organism mistakes marine debris for food. Ingestion of plastic can lead to intestinal blockage, starvation, and dehydration. For example, Albatross (Mōli) are seabirds that feed on the surface of the ocean (dippers and scavengers) and often mistake plastic pieces as food and also feed plastics to their chicks. Albatross chicks usually regurgitate a bolus right before they leave the nest and go to sea (fledge). (see footnote for Albatross Bolus Dissection activity)[11]
2. **Entanglement** - Derelict nets, ropes, line, or other fishing gear, packing bands, rubber bands, balloon string, six-pack rings, and a variety of marine debris can wrap around marine life. Entanglement can lead to injury, illness, suffocation, starvation, and even death.
3. Scouring, breaking, smothering or otherwise **damaging** of marine habitat. Many of the habitats damaged are important for the survival of many species.
4. **Hitchhiking** - Animals or plants that attach to marine debris. Invasive species can have devastating effects on fisheries and local ecosystems.

Activities List

Optional: "Follow Along Activity" sheet (grades 3-5) - printed handout

"All Tangled Up" (grades K-5)

"Is Plastic Bad?" (grades K-5) - Find on slide show (slide 15-16)

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[8] Rios, L.M., Moore, C. and Jones, P.R., 2007. "Persistent organic pollutants carried by synthetic polymers in the ocean environment." *Marine Pollution Bulletin*, *54*(8), pp.1230-1237.

[9] "Endocrine Disruptors." *Endocrine Disruptors*. National Institute of Health Sciences, 15 July 2016.

[10] Gregory, M. R. "Environmental Implications of Plastic Debris in Marine Settings--entanglement, Ingestion, Smothering, Hangers-on, Hitch-hiking and Alien Invasions." *Philosophical Transactions of the Royal Society B: Biological Sciences* 364.1526 (2009): 2013-025.
"| OR&R's Marine Debris Program:Impacts." | *OR&R's Marine Debris Program*. National Oceanic and Atmospheric Administration, 28 July 2016.

[11] "Hawai'i PRISM Curricula : NWHI Albatross Bolus Dissection." University of Hawai'i-Hilo/Hawai'i Department of Education, 2004.

Materials

Rubber bands
Optional: debris examples, especially commonly used items (e.g., plastic ware, toothbrushes, lighters)
Lesson 1 slide show (projection ability)

Procedure

1. Begin slideshow utilizing the information found in the “Background” section as a guide. *Optional*: Hand out “Follow Along Activity Sheet” (grades 3-5) which can be used to guide students through the slideshow, in Lesson 2 as a review guide, and discussion aid. (10 min)
2. Introduce the first activity “All Tangled Up” with the slide showing photographs of marine animals impacted by marine debris via entanglement (Note: may use any entanglement photo other than the one provided – as these photos may be graphic for really young kids). (see slide 12; 6 min)
    a. Pass out one rubber band to each student or if the class size is too large, select 5 volunteers to come up to the front of the class. (1 min)
    b. Instruct students on how to put on the rubber band. “Put your left hand in the air, with the back of your palm facing your face. Put rubber band on pinkie finger, pull toward face and hook around the thumb. (1 min)
    c. Make sure each student has put the rubber band on correctly and that they put their right hand on their left elbow so as not to use it during the activity. (1 min)
    d. Give students 45 sec - 1 min to attempt to take the rubber band off without using *any* other body part. (1 min)
    e. Discuss how students felt about being “entangled” in a derelict fishing net. Have a classroom discussion. (2 min)
3. Continue through slide show until the “Is All Plastic Bad?” slide showcasing a turtle stuck in a 6-pack ring and proceed to the activity on the next slide. (slides 15-16; 3 min)
4. Begin the “Is All Plastic Bad?” activity. Instead of ranking plastics as “good” or “bad” we have updated this activity to have the students assess how essential various plastic products might be. Have students “vote” if certain plastic products are luxury (not essential) or a necessity (needed for survival). Plastic can be very useful, especially in the medical field, but it must be used with kuleana or responsibility! Some plastics are only used once before they are disposed of and they are called “single-use” or disposable plastics. (10 min)
    a. Work your way down the list (on slide show) and discuss each product as needed for student understanding. *Optional* discussion question: Do you think using something once and throwing in the trash is hoʻo kuleana (taking responsibility) for that item?
5. Upon completion of “Is All Plastic Bad?” list, continue through the powerpoint to the degradation section. (slide 22)
    a. Explain the differences between biodegrade and photodegrade and natural materials versus manmade (synthetic) materials. (10 min) (slides 17-21)

b. Plastics haven't been around for that long, and scientists don't know yet exactly how long it may take for various different types of plastics to degrade in the environment[12]. As we have learned today, plastics are made of different polymers (chemical composition) and depending on their environmental exposure to different factors like sunlight or waves they may or may not ever break down but instead break up into smaller pieces like microplastics (slide 22) and accumulate in certain places (slide 23).

6. Upon completion of the power point, ask the students what they learned, assign homework, and segue into the next visit: "Sorting Marine Debris." (5 min)

Homework:
Ask a parent/grandparent/aunty/uncle (someone from an older generation) if they remember what life was like before plastic was created?

Resources

TRASH TALK: Special Feature | Ocean Today

NOAA's Garbage Patches: What and Where Are Garbage Patches?

Turning the Tide On Trash: A Learning Guide on Marine Debris (All Tangled Up, p. 56)

Additional Resources

An Educator's Guide to Marine Debris

Hawai'i PRISM Curricula

NOAA: Guidebook to Beach and Waterway Cleanups

Protect Our Ocean Activity Book

Understanding Marine Debris: Games and Activities For Kids Of All Ages

Vocabulary

Ahupua'a	Derelict Fishing Gear (DFG)	Hitchhiking
Biodegrade	Endangered	Honu
Biologist	Entanglement	Honu'ea
Bolus	Fledge	Ingestion
Buoyancy	Gyre	Litter

[12] Ward, C. P, and C. M. Reddy. 2020. "We need better data about the environmental persistence of plastic goods." Proceedings of the National Academy of Sciences 117 (26) 14618-14621; DOI: 10.1073/pnas.2008009117

Makai	Mōlī	Single-use Plastic
Marine Biologist	Nurdle	Storm Drain
Marine Debris	Photo-degrade	Storm Water (or Stormwater)
Mauka	Plastic	Storm Water Runoff
Microplastics	Rubbish	Trash

Benchmarks

NGSS Lead States. (2013). Next Generation Science Standards: For states, by states. Washington, DC: The National Academies Press.

Grade K:
K-ESS3- 1. Use a model to represent the relationship between the needs of different plants or animals (including humans) and the places they live.

K-ESS3- 3. Communicate solutions that will reduce the impact of humans on the land, water, air, and/or other living things in the local environment.

Common Core State Standards Connections:
ELA/Literacy – RI.K.1 With prompting and support, ask and answer questions about key details in a text. SL.K.5 Add drawings or other visual displays to descriptions as desired to provide additional detail.

Mathematics – K.MD.A.2 Directly compare two objects with a measurable attribute in common, to see which object has “more of”/”less of” the attribute, and describe the difference.

Grade 1:
1-LS1- 1. Use materials to design a solution to a human problem. LS1.A: Structure and Function. All organisms have external parts. Different animals use their body parts in different ways to see, hear, grasp objects, protect themselves, move from place to place, and seek, find, and take in food, water and air. LS1.D: Information Processing. Animals have body parts that capture and convey different kinds of information needed for growth and survival. Animals respond to these inputs with behaviors that help them survive.

Common Core State Standards Connections:
ELA/Literacy RI.1.1 Ask and answer questions about key details in a text. RI.1.2 Identify the main topic and retell key details of a text. W.1.8 With guidance and support from adults, recall information from experiences or gather information from provided sources to answer a question.

Mathematics – MP.2 Reason abstractly and quantitatively. MP.5 Use appropriate tools strategically.

Grade 2:

2-PS1- 1. Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties.

K-2- ETS1-1. Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.

2-LS4- 1. Make observations of plants and animals to compare the diversity of life in different habitats.

Common Core State Standards Connections:
ELA/Literacy W.2.8 Recall information from experiences or gather information from provided sources to answer a question.

Mathematics- MP.5 Use appropriate tools strategically.

Grade 3:
3-LS4- 3. Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all.

3-LS4- 4. Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change.

Common Core State Standards Connections:
ELA/Literacy – RI.3.1 Ask and answer questions to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers. RI.3.2 Determine the main idea of a text; recount the key details and explain how they support the main idea.

Mathematics – MP.5 Use appropriate tools strategically.

Grade 4:
4-LS1- 2. Use a model to describe that animals receive different types of information through their senses, process the information in their brain, and respond to the information in different

Common Core State Standards Connections:
ELA/Literacy – SL.4.5 Add audio recordings and visual displays to presentations when appropriate to enhance the development of main ideas or themes.

Mathematics –MP.4 Model with mathematics.

Grade 5:
5-ESS3- 1. Obtain and combine information about ways individual communities use science ideas to protect the Earth’s resources and environment.

Common Core State Standards Connections:
ELA/Literacy – RI.5.7 Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. SL.5.5 Include multimedia components (e.g., graphics, sound) and visual displays in presentations when appropriate to enhance the development of main ideas or themes.
Mathematics – MP.2 Reason abstractly and quantitatively. MP.4 Model with mathematics.