Human Impact

Photo by Polynesian Voyaging Society

Nānā ka maka; hana ka lima.

Observe with the eyes; work with the hands.
Just watching isn't enough. Pitch in and help!
— Mary Kawena Pukui, *`Ōlelo No`eau* #2267

Human Impact

How is it that so much `ōpala (rubbish) has made its way onto our beaches and into the sea? Are we destined to live with multi-colored sand beaches sprinkled with the broken down plastic bits of our disposable consumerism? What has led to this staggering volume of discarded nets, lines, and plastic trash that takes such a devastating toll on our reefs and marine life? Something is desperately wrong. It is our kuleana (responsibility) to pitch in and help.

Source of Marine Debris

Marine debris originates on land and at sea. Land-based human debris is rubbish that is blown or washed into the ocean from beach litter, landfills, storm drains, streams, and rivers. These land-based activities contributed most of the debris found in the 2002 International Coastal Clean-up conducted by The Ocean Conservancy (TOC, 2002). An analysis of the 8.2 million pounds of debris that were collected in this worldwide effort found over 1 million cigarette butts, 440,000 food wrappers or containers, 220,000 bottles, 32,000 pieces of fishing line, and 8,000 tires (TOC, 2002).

Marine debris that originates at sea comes from commercial fishing and shipping passenger slips, recreational boaters and fishers, and from off-shore oil rigs. In the NWHI, the majority of marine debris comes from the sea. Interestingly, the two most common nets found in the NWHI marine debris (by weight) are trawling nets and monofilament gill nets. Yet these types of fisheries don't occur here (Maragos & Gulko 2002). Where do the nets come from? The islands are situated to trap debris that drifts with the slow-moving North Pacific gyre, which is the current that circles in the North Pacific Ocean. Studies have shown that marine debris in the North Pacific is likely to end up in the convergence zone of the subtropical North Pacific. This zone migrates with the seasons, and in the winter months shifts south to the NWHI where debris accumulates. In El Niño winters, the zone shifts farther south to the main Hawaiian Islands and deposits marine debris on some of our reefs and beaches (Maragos & Gulko 2002).

As the first two instructional activities in this unit illustrate, marine debris is much more than unsightly litter. It causes serious damage to coral reefs as nets and lines drag across coral and marine animals become entangled or ingest debris. Monk seals, turtles, and seabirds that become entangled in the drifting nets and lines may drown, or eventually die of starvation, predation, or infection due to tightening lines on their bodies. Plastic materials that are mistaken as food and ingested by marine animals may accumulate and block their intestines causing death by starvation.

Other Pollutants

A less visible threat to the health of our oceans is water pollution from materials that we apply to the land, wash down our driveways, drain into our wastewater treatment facilities, or release into the air. These include household and industrial hazardous wastes, pesticides and fertilizers, and automotive fluids and gases. These types of pollutants, which enter the ocean from our watersheds, are referred to as non-point source pollutants. They are dispersed in

Between 1996 and 2003, 364 tons of marine debris were removed from the NWHI (NOAA, 2003).

the environment from so many sources that it is difficult to pinpoint where they originate. This brings the issue home to each of us as we consider how our consumer actions and other habits have an impact on the land and sea. Raising awareness about how these substances end up in the ocean and what we can do to pitch in and reduce this pollution is the focus of the third instructional activity in this unit.

Seeking Solutions

Early Hawaiians managed the land and water resources within ahupua`a—land divisions that typically ran from the mountains to the sea. People farming and fishing within the ahupua`a recognized the connection of mountain forests to the coral reefs in the sea. A healthy reef required a healthy forest. Wai (fresh water) was considered sacred. It was essential for all life on land and nutrients from the streams enriched the reef. Returning to a sense of reverence for the environment that sustains us is a critical need as we witness the deterioration of our `āina (land). Realizing the connections between the land and sea and how our actions on land affect the reef, we can learn from the past to mālama (care for) our environment today.

Government and nonprofit agencies are involved in a multi-agency partnership to remove marine debris from the NWHI. In 2003, 16 people worked for 4 months to remove 122 tons of derelict fishing gear from the islands (NOAA, 2003). This kind of cooperation is essential to undertaking such a monumental task. But if each of us looks within the realm of our daily lives, there is much that individuals can do to reduce marine debris and water pollution. Picking up litter, recycling, reducing use of disposable products, opting not to purchase products with excessive packaging, volunteering for stream and beach clean-ups, substituting hazardous chemicals with alternative products, and fertilizing our lawns and gardens organically are all steps we can take to make our island home a healthier place now and for the future.

References

Maragos, J. & Gulko, D. (Eds.). (2002). *Coral Reef Ecosystems of the Northwestern Hawaiian Islands: Interim Results Emphasizing the 2000 Surveys.* Honolulu, HI: U.S. Fish and Wildlife Service, and the Hawai`i Department of Land and Natural Resources.

NOAA Fisheries. (2003).*Multi-Agency Marine Debris Program Synopsis.* Honolulu, HI: Coral Reef Ecosystem Division, Marine Debris Program, Honolulu Laboratory.

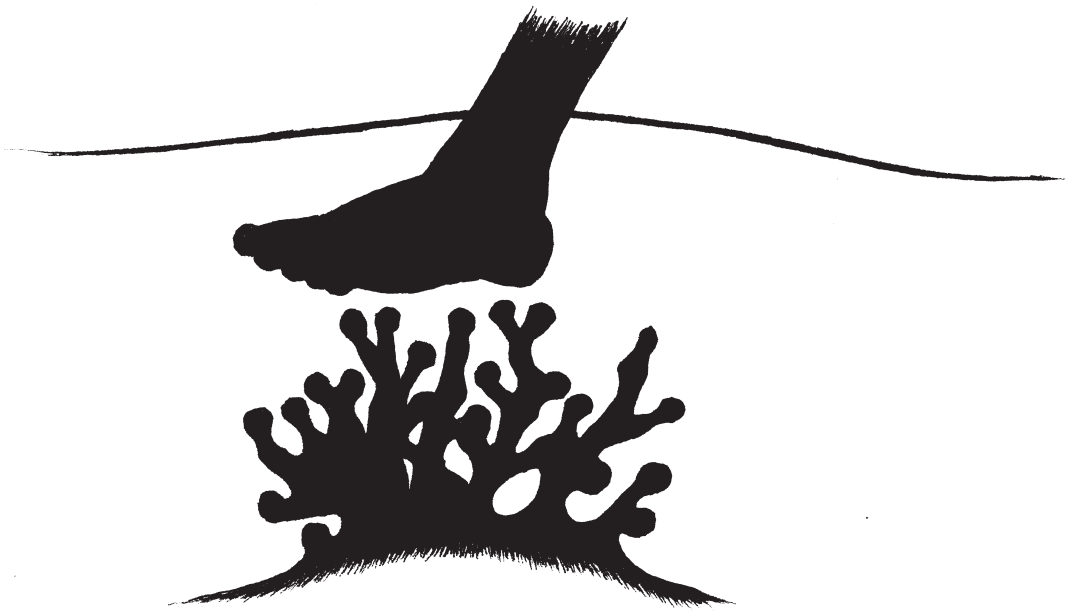
The Ocean Conservancy. (2003). *Marine Debris.* Retrieved 7-13-04 from: *http://www.oceanconservancy.org/dynamic/learn/issues/debris/debris.htm.*

Grades 4 - 5 Unit Overview

Hawai`i DOE Content Standards & Nā Honua Mauli Ola	Essential Questions & Activities	Key Concepts	DOE Benchmarks
Science 2: The Scientific Process: Nature of Science Science, Technology, and Society Unifying Concepts and Themes	How does human debris have a negative impact on marine life, and what can we do to solve this problem? **Activity: Singing the `Ōpala Blues**	• Marine debris comes from: 1) the land, as rubbish that drifts on air currents and washes into the ocean from storm drains, landfills, and beaches; and 2) the ocean, as fishing lines, nets, and other materials discarded by ships, boaters, and fishers. • Discarded fishing nets and lines damage coral reefs and entangle seabirds, monk seals, turtles, and other marine life. • Discarded plastics can be mistaken for food and limit the amount of digestible material in an animal's stomach, causing death by starvation. • We can help to solve the problem of marine debris by reducing consumption of plastic disposable goods, reusing or recycling the products we do buy, and preventing fishing lines and nets from becoming waste.	4.2.1 Describe how the use of technology has influenced the economy, demography, and environment of Hawai`i. 5.2.1 Use models and/or simulations to represent and investigate features of objects, events, and processes in the real world.
Science 1: The Scientific Process: Scientific Investigation **Nā Honua Mauli Ola #15** Teach others about the concept of mālama through example. Participate in conservation and recycling practices and activities.	What can we learn from a bolus about seabirds and human impact on seabird habitat? **Activity: What's for Dinner?**	• Indigestible material found in a bolus regurgitated by a seabird provides clues to human impact on the marine environment. • We can all make a difference by picking up rubbish in our environment and teaching others about the dangers of marine debris.	4.1.1 Describe a testable hypothesis and an experimental procedure. 5.1.2 Formulate and defend conclusions based on evidence.

Science 1: The Scientific Process: Scientific Investigation	How do products we use on land affect our ocean and beaches? How effective are some alternative products that have less impact on the environment? **Activity: From the Land to the Sea**	• Detergents, oils, paints, and other materials that we wash down our driveways can end up in storm drains and in the ocean. Household cleaners and chemicals that we wash down drains can also end up in the sea from cesspools and overloaded wastewater treatment plants. • Fertilizers and pesticides that we apply to our lawns and gardens can percolate down to groundwater and/or end up in our streams and ocean. • We can prevent these (non-point source) pollutants from entering our environment where they have a negative impact on our health and the health of other species.	4.1.1 Describe a testable hypothesis and an experimental procedure. 5.1.2 Formulate and defend conclusions based on evidence.

Student Journal
Unit 4 – Human Impact



Nānā ka maka; hana ka lima.

Observe with the eyes; work with the hands.
Just watching isn't enough. Pitch in and help!
—Mary Kawena Pukui, *`Ōlelo No`eau* #2267

Student's Name: _____

School: _____

Date started: _____

Date ended: _____

Student Assessment Overview

Unit Essential Questions

- How does human debris have a negative impact on marine life, and what can we do to solve this problem?
- What can we learn from a bolus about seabirds and human impact on their habitat?
- How do products we use on land affect our ocean and beaches? How effective are some alternative products that have less impact on the environment?

How you will be graded for this unit:

Individual Journal

It is your responsibility (kuleana) to complete a journal for this unit. Following is a checklist of the pages you will need to include in your journal. Place this page in your journal and make a check next to each item when you complete it. You will be given more details during each lesson.

Journal Pages	✓Completed
Gr. 4	
Singing the `Opala Blues – Standard: Science 2 • Write a one-page journal entry that describes how the use of plastic materials affects the marine environment, people, and economy of Hawai`i. Include suggestions for reducing plastic waste in the ocean.	
What's for Dinner? – Standard: Science 1 • Write a lab report that follows the steps involved in scientific inquiry (purpose, hypothesis, materials, procedure, results, and conclusion).	
From the Land to the Sea – Standard: Science 1 • List the products in your home that could contribute to water pollution in your community. • Write a lab report describing your research question about an alternative product. Describe your hypothesis, materials, procedures, results, and conclusions.	
Gr. 5	
Singing the `Ōpala Blues – Standard: Science 2 • Develop a model or simulation to show how plastic affects the marine environment. Describe the model or simulation in your journal. • Write a summary of the problem and suggest solutions to reduce plastic waste in the ocean.	
What's for Dinner? – Standard: Science 1 • Write a lab report that follows the steps involved in scientific inquiry (purpose, hypothesis, materials, procedures, results, conclusions). • Formulate and defend conclusions based on evidence gathered.	
From the Land to the Sea – Standard: Science 1 • List the products in your home that could contribute to water pollution in your community. • Write a lab report describing your research question about an alternative product. Describe your hypothesis, materials, procedure, results, and conclusion. Defend your conclusion by showing how it is supported by evidence.	

Culminating Activity – Group Project

As you work on your journal, you will be working toward completing the culminating activity for this unit. Your Challenge: Design and carry out a project to reduce the impact of a household product or lawn and garden product on the marine environment. Work in teams to develop a creative way to mālama (care for) the environment and share what you have learned with other classes in the school. Team projects should include:

- A written report that summarizes your project. The report should include the problem you are trying to solve, the action you took to solve the problem, and your conclusions about how well your project worked.
- A description of how the use of a product has affected the environment, people, and the economy (Gr. 4)
- Visual aids such as photographs, video, or drawings that show your group in action (Gr. 4)
- Models or simulations to demonstrate how your project will reduce the impact of a product on the environment (Gr. 5).

Use the rubric on the following page to guide you as you develop your presentation.

Unit 4 Culminating Activity Rubric - Gr. 4

Rubric for Self Assestment

Team Names_____ **Student Name**_____

DOE Benchmarks, GLOs, & Nā Honua Mauli Ola	Kūlia (Exceeds Standard)	Mākaukau (Meets Standard)	`Ano Mākaukau (Almost at Standard)	Mākaukau `Ole (Below Standard)
Science 2: The Scientific Process: Nature of Science Science, Technology, and Society Describe how the use of technology has influenced the economy, demography, and environment of Hawai`i. Points ___	Our project clearly explained how the use of a product has affected our environment and suggested ways to conserve the environment. We also explained how the product affects people and the economy.	Our project described how the use of a product has affected our environment. We also described how the product affects people and the economy.	Our project gave examples of how the use of a product has affected our environment. We also gave an example of how the product affects people and the economy.	We recognize that the use of the product we chose affects the environment, people, and the economy. But our project didn't clearly show this.
Nā Honua Mauli Ola #15 – 3 Learners teach others about the concept of mālama through example. Points ___	Our project taught others about ways to mālama the environment and provided excellent examples of taking actions to care for our island.	Our project taught others about a way to take action and mālama the environment.	We had ideas about ways to mālama the environment, but our project didn't clearly explain the ideas.	Our project did not clearly show others about ways to mālama the environment
GLO #5 Effective Communicator Communicates effectively and clearly through speaking, using appropriate forms, conventions, and styles to convey ideas and information for a variety of audiences and purposes Points ___	Our team understood the purpose of our presentation, and organized and presented information very clearly to our audience.	Our team understood the purpose of our presentation, and organized and presented information clearly to our audience.	Our team understood the purpose of our presentation, but we needed to work on organizing our information to communicate more clearly to our audience.	Our team presentation was not clear to the audience because we weren't organized or clear about the purpose of our presentation.
Visual Aids Points ___	The visual aids we used enhanced our project message.	Our visual aids were a good way to teach others.	Our visual aids could have been much better.	We did not use visual aids.

Unit 4 Culminating Activity Rubric - Gr. 5

Rubric for Self Assestment

Team Names_____ **Student Name**_____

DOE Benchmarks, GLOs, & Nā Honua Mauli Ola	Kūlia (Exceeds Standard)	Mākaukau (Meets Standard)	`Ano Mākaukau (Almost at Standard)	Mākaukau `Ole (Below Standard)
Science 2: The Scientific Process: Nature of Science Unifying Concepts and Themes Use models and/or simulations to represent and investigate features of objects, events, and processes in the real world Points ___	Our team's model or simulation was a very effective way to demonstrate how to reduce the impact of a product on the environment.	Our team's model or simulation was an effective way to demonstrate how to reduce the impact of a product on the environment.	Our team's model or simulation did not clearly demonstrate how to reduce the impact of a product on the environment.	Our team's model or simulation did not demonstrate how to reduce the impact of a product on the environment.
Nā Honua Mauli Ola #15 – 3 Learners teach others about the concept of mālama through example. Points ___	Our team's model or simulation was a very effective way to demonstrate how to reduce the impact of a product on the environment.	Our project taught others about a way to take action and mālama the environment.	We had ideas about ways to mālama the environment, but our project didn't clearly explain the ideas.	Our project did not clearly show others about ways to mālama the environment
GLO #5 Effective Communicator Communicates effectively and clearly through speaking, using appropriate forms, conventions, and styles to convey ideas and information for a variety of audiences and purposes Points ___	Our team understood the purpose of our presentation, and organized and presented information very clearly to our audience.	Our team understood the purpose of our presentation, and organized and presented information clearly to our audience.	Our team understood the purpose of our presentation, but we needed to work on organizing our information to communicate more clearly to our audience.	Our team presentation was not clear to the audience because we weren't organized or clear about the purpose of our presentation.

Singing the `Ōpala Blues

Essential Question: How does human debris have a negative impact on marine life and what can we do to solve this problem?

Hawai`i DOE Content Standard

Science 2: The Scientific Process: Nature of Science – Science, Technology, and Society; Unifying Concepts and Themes

- Understand that science, technology, and society are interrelated.

Grades 4 - 5 Benchmarks

4.2.1 Describe how the use of technology has influenced the economy, demography, and environment of Hawai`i.

5.2.1 Use models and/or simulations to represent and investigate features of objects, events, and processes in the real world.

Nā Honua Mauli Ola #15

Engage in experiences that mālama the entire learning community and the environment to support learning and good practices of stewardship, resource sustainability, and spirituality.

- Learners participate in conservation and recycling practices and activities.

Key Concepts

- Marine debris comes from: 1) the land as rubbish that drifts on air currents and washes into the ocean from storm drains, landfills, and beaches; and 2) the ocean as fishing lines, nets, and other materials discarded by ships, boaters, and fishers.
- Discarded fishing nets and lines damage coral reefs and entangle seabirds, monk seals, turtles, and other marine life.
- Discarded plastics can be mistaken for food and limit the amount of digestible material in an animal's stomach, causing death by starvation.
- We can help to solve the problem of marine debris by reducing consumption of plastic disposable goods, reusing or recycling the products we do buy, and preventing fishing lines, nets, and other plastics from becoming waste in the ocean.

Activity at a Glance

Students participate in an entanglement demonstration and play a marine debris game. They summarize what they have learned in their journals and Gr. 5 students develop models or simulations.

Time

3 – 4 class periods

Assessment

Students:

- Write a one-page journal entry that describes how the use of plastic materials affects the marine environment, people, and economy of Hawai`i. Include suggestions for reducing plastic waste in the ocean. (Gr. 4)

- Develop a model or simulation to show how plastic affects the marine environment. Write a summary of the model or simulation and suggest solutions to reduce plastic waste in the ocean. (Gr. 5)
- Report to the class on their plastic consumption and how they implemented recycling and conservation practices.

Rubrics

Gr. 4

Advanced	Proficient	Partially Proficient	Novice
Explain how the use of technology has influenced the economy, demography, and environment of Hawai`i and suggest ways to conserve the environment.	Describe how the use of technology has influenced the economy, demography, and environment of Hawai`i.	Give examples of how the use of technology has influenced the economy, demography, and environment of Hawai`i.	Recognize that the use of technology has influenced the economy, demography, and environment of Hawai`i.

Gr. 5

Advanced	Proficient	Partially Proficient	Novice
Consistently select and use models and simulations to effectively represent and investigate features of objects, events, and processes in the real world.	Use models and/or simulations to represent and investigate features of objects, events, and processes in the real world.	With assistance, use models or simulations to represent features of objects, events, or processes in the real world.	Recognize examples of models or simulations that can be used to represent features of objects, events, or processes.

Vocabulary

biodegradable – capable of being broken down by the action of microorganisms
non-biodegradable – not capable of being broken down by the action of microorganisms
marine debris – human-made solid material that is dumped or washed into the marine environment
`ōpala – rubbish, trash

Materials

- student journal and assessment pages (provided in Unit Overview)
- photo CD (provided)
- game cards (provided in Unit 2, Land to Sea Survival Shuffle activity)
- 6 clipboards
- box of rubber bands
- colored stickers (three different colors to represent different kinds of marine debris)
- samples of marine debris (pieces of plastic, disposable lighter, styrofoam popcorn, plastic six-pack rings, fishing net, and fishing lines)
- samples of biodegradable materials (cardboard, paper, banana peels)

Advance Preparation

Use the game cards from the Land to Sea Survival Shuffle activity in Unit 2 (see Preparation on page 85). In addition, prepare five more pages of food cards for each type of animal. Attach different color stickers to one-fourth of the food cards to represent marine debris. For example, blue = plastic lighters, red = food wrapper, yellow = fishing line. Gather samples of marine debris and biodegradable items to display in the classroom. Also make a copy of the student journal and assessment pages from the Unit Overview for each student.

Background Information

A walk down the aisle of a supermarket or discount retailer reveals the vast array of plastic packaging and disposable plastic containers and products that are so prevalent in our society. In 1986, the U.S. produced *six billion tons* of disposable plastic packaging (Pacific Whale Foundation, 2004). A stroll along the beach reveals where too much of those plastics end up—in our marine environment. Since plastics are non-biodegradable, they persist in the environment for centuries. While wave action may cause the plastics to break into smaller and smaller pieces, even these small bits can accumulate in the intestines of seabirds.

Each year, millions of sea turtles, marine mammals, and seabirds ingest plastics that are mistaken as food or become entangled in marine debris (EPA, 2004). Plastic harms marine animals in a number of ways. They become entangled in discarded fishing lines, nets, and six-pack rings, or develop infections from the tightening material. Plastics that are mistaken for food clog the animals' intestines and may lead to death by starvation. In addition, toxic substances in marine debris may disrupt reproduction in marine animals or cause death.

Hawaiian Monk Seals

Marine debris is very hazardous for the endangered Hawaiian monk seal. Nets can entangle the seals and they may drown before they can free themselves. The Northwestern Hawaiian Islands provide primary habitat for monk seal birthing and weaning, and each year seals, particularly weaned pups, are found entangled in nets and lines.

Seabirds

Seabirds become entangled in disposed nets, gear, and plastic trash such as soda rings. They also ingest disposable cigarette lighters and other small plastics.

Green Sea Turtles

When they are active, Hawaiian green sea turtles must swim to the ocean surface to breathe every few minutes. When they are resting, they can remain underwater for as long as two and one half hours without breathing. Turtles that become entangled and pulled down by nets struggle to get free and need to surface for air. Marine debris, like nets, cigarette lighters, plastic bags, and ballpoint pens can clog their digestive system and cause turtles to starve to death. Sea turtles may mistake discarded balloons as food, which can then block their airways and cause death by suffocation.

See Unit 2, "Land to Sea Survival Shuffle," for more information on the feeding behaviors of the animals featured in this instructional activity.

Teaching Suggestions

Introducing the Unit:
Distribute the student journal and assessment pages and use these documents to introduce students to the unit. Review the projects and assignments and discuss the journals that students will be producing. Set a deadline for the culminating project and review the sample rubric.

1. Have students imagine that they are turtles swimming through the water and that their hands are turtle flippers. Give each student a rubber band. Ask students to place the rubber band around the pinky finger, across the back of the hand, and around the thumb.
2. Explain that the rubber band is discarded fishing net that is pulling the turtle under water. Note that while the turtle is active, it must come to the surface every few minutes to breathe. So challenge the "turtles" to hold their breath while trying to remove the "net" without the use of their other "flipper."
3. Discuss student reactions to this demonstration. How difficult was it to remove the "net"? How would a turtle become untangled in a net?
4. Show the images of marine debris on the photo CD provided and discuss the types of `ōpala (trash) and materials that are entangling marine life—abandoned nets, fishing line, and six-pack rings.

5. Form six teams—two each of seabirds, turtles, and monk seals. Distribute the animal cards for students to wear around their necks. Appoint a recorder for each team and give those students a clipboard. Ask them to collect their team's food cards at the end of each round of the game and place the cards on the clipboard. Teams should give themselves a name and place the name on the clipboard to identify it.
6. Go outside to a cleared grassy area and play the game. See game instructions provided at the end of this activity. Note that this is a modified version of the Land to Sea Survival Shuffle in Unit 2. This game focuses on marine debris, but the players (just like the marine animals) don't know the marine debris is in the water.
7. After playing the game, have teams return to the classroom and count the number of food cards they retrieved. Ask students to count the number of cards they had with each color of sticker. Debrief and explain what each of those colors represents. Ask teams to report on their marine debris count and record these totals on the board.
8. Have teams subtract the number of cards with marine debris from their total food count. Ask for their totals and record these on the board. Teams must have at least three food cards without marine debris for each animal on the team in order to survive. The team with the "healthiest" animals (those with the most food) is the winner!

9. Discuss how not knowing which foods had marine debris mimics the feeding activity of these animals. (They don't know they are consuming plastic or other marine debris.)
10. Display the biodegradable materials you collected earlier along with the plastic items that are often found as marine debris in the ocean. Lead a general discussion about how the technology that led to the development and use of plastics has affected the environment, people, and the economy.
    - What material is used to manufacture plastic? (It is manufactured from fossil fuels.)
    - How does the use of plastics affect people? (Lightweight materials are used in medical devices, computers, food containers, etc. Disposable plastics are convenient for consumers.)
    - How does the use of plastics affect the economy? (Jobs are created to manufacture and recycle plastics. Many plastic items are inexpensive for consumers. Lightweight materials used in vehicles can lower fuel consumption, etc.)
    - How does the use of plastics affect the ocean environment? (Marine debris entangles wildlife and plastics are ingested by animals, which can lead to their death.)
    - How do plastics and other forms of pollution get into the ocean?
    - How is the plastic marine debris different from the biodegradable materials?
    - What do the three "Rs" (Reduce, Reuse, Recycle) of pollution control mean?
11. Challenge students to keep track of all of the disposable plastic items, including packaging on products, they use during one full day. Have them list each item and make note of what they do with it when they are finished using the product.
12. Ask students to share with their classmates and describe how they disposed of plastics, including ways that they reduced (used alternative products), reused, or recycled.
13. Have students complete the assessment activities by recording in their journals. Challenge Gr. 5 students to develop models or simulations that show how plastic affects the marine environment, e.g., simulate how animals can become entangled in debris, or develop a model that shows how plastics from land can be washed into the ocean.

Extended Activity

Go outside and collect rubbish around the school and/or empty the rubbish can in the classroom. Sort the trash into piles (plastic, paper, rubber, metal, etc). Ask students to identify which items would most likely end up at the ocean and become marine debris. Which items float and which are blown in the wind? Place items in a bucket of water to see which float. How could the various items affect marine life? Could they become entangled in it? Could they swallow it? Which items could be recycled?

References

Pacific Whale Foundation. (2004). *Marine Debris Fact Sheet.* Retrieved 7-13-04 from http://www.pacificwhale.org/childrens/fsdebris.html

U.S. Environmental Protection Agency. (2004). *Marine Debris Abatement.* Retrieved 7-13-04 from htpp://www.epa.gov/owow/oceans/debris

Other Sources of Information

The Ocean Conservancy. (2003). Marine Debris. http://www.oceanconservancy.org/dynamic/learn/issues/debris/debris.html

PEW Oceans Commission. (n.d.) Marine Pollution. Retrieved 7-14-04 from http://www.pewoceans.org/inquiry/marine

Kamehameha Schools has posted information about the impact of marine debris, particularly cigarette lighters, on the birds of Midway. http://kms.kapalama.ksbe.edu/projects/2003/albatross/

Objective:

To find enough food for survival*

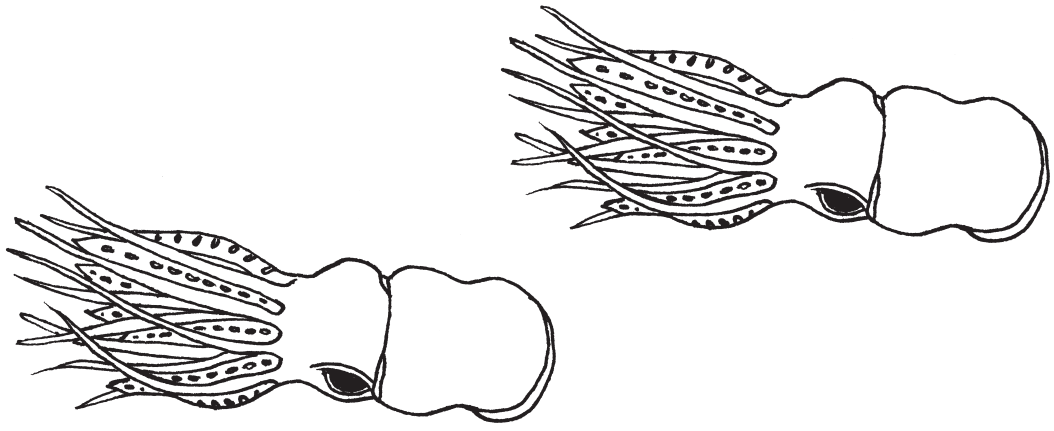
Game Set-up:

- Animal food cards are distributed randomly and widely around the playing area.
- Six teams of students (two each of monk seals, green sea turtles, and seabirds) wear identifying tags around their necks and search for food that is the same color as their tags.

To Play:

- At the signal, teams begin searching for food and collecting food cards.
- After 30 seconds, the teacher calls time. At that time, each team clips its food cards together and places them on a clipboard.
- Continue playing for two more 30-second rounds or until all food cards are gone.
- At the end of the third round, students collect all remaining cards from the playing area and hand them to the teacher.
- Return to the classroom and debrief.

* *Students should play the game without knowing what the stickers on the food cards represent. These cards will be subtracted from their total food count. The winning team will be the one with the most food that does not have marine debris.*



What's for Dinner?

Essential Question: From a bolus, what can we learn about seabirds and human impact on their habitat?

Hawai`i DOE Content Standard

Science 1: The Scientific Process: Scientific Investigation

- Discover, invent, and investigate using the skills necessary to engage in the scientific process.

Grades 4 - 5 Benchmarks

4.1.1 Describe a testable hypothesis and an experimental procedure.

5.1.2 Formulate and defend conclusions based on evidence.

Nā Honua Mauli Ola #15 - 3

Engage in experiences which mālama the entire learning community and the environment to support learning and good practices of stewardship, resource sustainability, and spirituality.

- Learners teach others about the concept of mālama through example.

Key Concepts

- Indigestible material found in a bolus regurgitated by a seabird provides clues to human impact on the marine environment.
- We can all make a difference by picking up rubbish in our environment and teaching others about the dangers of marine debris.

Activity at a Glance

Groups of students collaborate to dissect an albatross bolus and discover what it reveals about human impact on the seabird's habitat. Students write a laboratory report, and create a display of items found in their boluses. They share their findings and their displays with others in the school.

Time

2 - 4 class periods (Plan for a double period to dissect the boluses.)

Assessment

Students:

- Write a laboratory report that follows the steps involved in scientific inquiry (purpose, hypothesis, materials, procedures, results, conclusions).
- Formulate and defend conclusions based on evidence gathered (Gr. 5).
- Create a display of items found in the bolus and share that display with others in the school.

Rubrics

Gr. 4

Advanced	Proficient	Partially Proficient	Novice
Create a testable hypothesis and an experimental procedure to test it.	Describe a testable hypothesis and an experimental procedure.	Identify, with assistance, a testable hypothesis and an experimental procedure.	Recognize, with assistance, a testable hypothesis or an experimental procedure.

Gr. 5

Advanced	Proficient	Partially Proficient	Novice
Formulate and defend conclusions that are supported by detailed evidence and make connections to the real world.	Formulate and defend conclusions that are supported by evidence.	Make conclusions that are partially supported by evidence.	Make conclusions without evidence.

Vocabulary

bolus – fat, cigar-shaped mass that is regurgitated by some types of seabirds and contains indigestible materials (e.g. plastics, squid beaks)
foraging ground – place from which an animal gets its food
indigestible – digestible with difficulty or impossible to digest
purpose – goal
hypothesis – educated guess
procedures – sequence of actions used in an experiment
results – outcomes, what happened
conclusions – general statements about findings
marine debris – human-made solid material that is dumped or washed into the marine environment

Materials

- lab report sheet (provided)
- marine debris fact sheet (provided)
- bolus (see Advance Preparation)
- Navigating Change video segment "Human Impact" (provided)
- photograph of Laysan Albatross (provided on photo CD)
- shallow boxes or styrofoam trays (one per group of four students and one for sample)
- acetate sheets (one per group and one for sample)
- glue, tape, and push pins
- rulers, pencils, and colored pens
- paper
- scissors
- tweezers or chopsticks (one or two per group)
- surgical gloves (one set per group of four)
- face masks (optional: one per student)
- goggles (one pair per group)
- soda case boxes (optional: to use for dissecting the bolus)
- paper towels and old newspaper

Advance Preparation

Order boluses by calling Ann Bell, U.S. Fish and Wildlife Service, 300 Ala Moana Blvd., Room 5-311, Honolulu, HI 96850. Telephone: 808-792-9532, or e-mail at Ann_Bell@fws.gov.

Gather enough shallow boxes or styrofoam trays to have one per group of four students. Cut a sheet of light-colored paper to fit inside each box. Cut pieces of acetate to fit over the box or tray to create a display model. Make a sample display box to show students. Place a couple of small objects in the box and secure them with glue, tape, or push pins. Number the items. Tape the acetate over the box. Glue a piece of paper on the side of the box that identifies each object by number.

Be prepared to air out the room during the activity and after it. Allow enough time for clean up. This activity is highly engaging but it does create a mess!

Background Information

Laysan albatross eat squid, fish, fish eggs, and crustaceans. They sit on the surface of the water and pick up their prey with their sharp, hooked beaks. Adult albatross return to land to feed their chicks by regurgitating their stomach contents. They feed their fast-growing chicks regurgitated squid, flying fish eggs, and fish larva. Juvenile albatross chicks regurgitate indigestible material in a fat, cigar-shaped mass that is called a bolus. When we dissect a bolus, we find clues to the health of the foraging ground where thousands of albatross gather food for their hungry chicks. Boluses often contain squid beaks, small bits of pumice, wood, and a soft, string-like substance that keeps flying-fish egg masses intact.

Unfortunately, boluses also often contain plenty of unnatural materials. The U.S. Fish and Wildlife Service employees find boluses laced with plastics by the hundreds in the NWHI. Some of those plastics come from thousands of miles away. The albatross adults ingest the plastics along with flying fish eggs. Flying fish attach their eggs to floating materials in the ocean; these materials used to be all natural, such as wood or pumice, but within the last 20 years, more and more of these floating materials are plastics. When the albatross scoop up the eggs they scoop up the plastics as well. The concentration of plastics in the boluses is representative of a large number of plastics floating in the ocean, and plastics that have displaced natural substances as anchoring substrate for flying fish eggs. Adult albatross have the ability to purge these consumed plastics by throwing them up, but the chicks have to reach a certain size, or age, before they are able to throw up a bolus. If the chicks consume too many plastics before they are able to throw them up, then they are in danger of dehydration or starvation. It is not uncommon to come upon an albatross chick carcass containing intact toothbrushes, plastic toys, bottle caps, cigarette lighters, and fishing line. Some albatross chicks that are presumed dead from plastics can have as much as 400 grams of plastic in their stomachs.

People can only confirm that a particular seabird produces a bolus when they see the evidence in the birds' nesting colony. In the world's largest Laysan albatross colony on Midway Atoll National Wildlife Refuge, thousands of boluses are scattered around the landscape in June near the albatross, which will soon fledge. Other types of seabirds may produce boluses; however, biologists have not noted such except for the bone and feather-laced boluses produced by `iwa (great frigate birds). Since seabirds spend the majority of their time at sea, they may be producing boluses and depositing the evidence at sea.

Seabirds have become a good ecological indicator as to the health of our oceans because they are visible, especially when thousands come to nest on land. However, recent evidence shows that even the smallest sea creatures at the base of the food chain ingest minute particles of broken-down plastic.

Teaching Suggestions

1. Show the Navigating Change video segment, "Human Impact," and discuss students' reactions to it.
2. Show the photographs on the Photo CD of the Laysan albatross and juvenile albatross next to a bolus. Discuss a few of the physical characteristics of this seabird—webbed feet for paddling and "running" on the water's surface to become airborne, a sharp, hooked beak to catch prey, and a tube on the top of the beak from which salt is extruded/shaken. Ask students what they think the bird eats and how it feeds its chicks.
3. Hold up a bolus and provide students with some clues to help them discover what it is and what they might learn by studying it.
   Clues:
   - This is a natural object that comes from juvenile albatross chicks in the NWHI. What do you think it is?
   - What do albatross chicks eat? (squid, flying fish eggs and fish larva regurgitated by their parents)
   - What do the chicks do with the hard, indigestible parts in their food, such as squid beaks? (throw them up in a bolus)
   - What could we learn about the albatross and its habitat by taking apart the bolus and studying it?
   - Scientists are concerned about how plastic rubbish in the ocean affects marine life. Do you think the bolus could provide us with information about plastics in the ocean habitat? How?
4. Distribute the lab report sheets and review the scientific method with students. Ask each student to record a research question and a hypothesis regarding what will be found in the bolus.
5. Form investigative teams of four students. Make sure that each team has at least one student who won't mind dissecting the bolus (although by the end of the class, most students will want to have a chance to do this). Give each team a shallow box or tray and the materials it needs to dissect the bolus. Explain that the boluses have a strong smell, and distribute masks for those who want to wear them.
6. Review preparation and safety measures that should be followed for handling a bolus as noted on information sent with the boluses.
   - Wear protective gloves.
   - Place the bolus on a paper towel or newspaper.
   - Place found items in a closed box.
   - Discard the remaining bolus in the garbage.
7. Give each group a bolus to dissect and ask students to work together to complete the group tasks.
   Group tasks
   - Dissect the bolus.
   - Arrange the items found in the bolus in the display box and identify each item found using a piece of paper on the side of the box.
   - Write the laboratory report.
   - Present findings and conclusions to the class.
8. Invite another class to listen to groups make their presentations. Discuss the findings and conclusions. What do the boluses reveal about human impact on the albatross? What should we do to reduce that impact?
9. To spread the word about marine debris, have students' displays placed in a central location, such as the library in the school. Distribute the marine debris fact sheet and ask students to take it home and share it with their families.
10. Ask students to complete their lab reports with their findings and conclusions.

Extended Activities

Have students investigate the currents in the Pacific, especially those that lead to the deposit of so much debris in the NWHI. For more information on currents, see the following web site for a map detailing ocean currents in the Pacific: http://www.pmel.noaa.gov/np/pages/seas/npmap4.html.

Encourage students to write letters to the editor of the local newspaper to share their concerns about marine debris with others.

Visit the Albatross Project web site at www.wfu.edu/albatross and conduct one of the educational activities described on the site. The activity, "Walk a Mile in Albatross Shoes," is summarized below:

Measure a distance of one mile around the school. Ask students to pick up trash they see along this one-mile area. During the walk, have students think about how much more trash the albatross might find over its long journey. Bring the trash back to the classroom and weigh it. Add all of the measurements together to figure out the total weight of trash that was collected. Albatross chicks that are presumed dead from plastics can have as much as 400 grams of plastic in their stomachs. Figure out how many chicks your class possibly saved by picking up that much trash. Students could also categorize the rubbish (paper, plastics, aluminum, glass, etc.) and graph it by weight found in each category.

To include other birds and wildlife in your discussion, have each student pick a color of trash that they will pick up exclusively. This illustrates the fact that every type of wildlife has specific tastes and will choose certain types of foods. This means that some species are more likely than others to pick up plastics but might be more vulnerable to other hazards.

Have students select one of the following journal prompts and write a paper or poem for extra credit:

- I can help reduce plastic marine debris by…
- As an albatross chick, I would like to send this message to humans…
- It is our kuleana (responsibility) to mālama (care for) the environment because…

Reference

Wake Forest University. (1999). *Walk a Mile in Albatross Shoes.* Retrieved July 27, 2004 from http://www.wfu.edu/albatross/activity/walk.htm. The Albatross Project. Other excellent reference material including foraging maps from a recent tracking project are also located on this site.

What's for Dinner? Student Lab Sheet

Name _____ **Date** _____

Research Question (What is the question you want to answer with this study?)

Hypothesis (Write a complete sentence describing what you think you will find.)

Method (How did you study the bolus?)

Findings (What was in the bolus?)

Conclusion (What do your findings tell you about the albatross and its habitat?)

Did your findings support your hypothesis? Explain.

What do you recommend we do to mālama (care for) the albatross and other species that share its environment?

Debris litters the windward shores of Laysan Island. At any given time only about 50 people live in the Northwestern Hawaiian Islands, yet these uninhabited islands and shallow reefs are littered with debris, plastics and nets that have traveled thousands of miles to get here. Even the most remote places on Earth feel the impacts from human industry, and careless disposal of trash. Copyright David Liittschwager and Susan Middleton

The body of a fledgling Laysan albatross nicknamed "Shed Bird" who died just before this picture was taken. To determine the cause of death Cynthia Vanderlip, manager of the State of Hawaii's Kure Atoll Wildlife Sanctuary, cut the dead bird open to reveal a stomach full of plastics. Copyright David Liittschwager and Susan Middleton

Plastic pieces found in Shed Bird's stomach. All the items in this picture came from one bird. Plastic lighters, bottle caps, and other plastics that are carelessly discarded float in the ocean where they are occasionally consumed by albatross' foraging for food; these plastics are then fed to their young. Copyright David Liittschwager and Susan Middleton

The following page was excerpted with permission from *Archipelago: Portraits of Life in the World's Most Remote Island Sanctuary* (Hardcover), pp. 212-213, by David Liittschwager, Susan Middleton

A study at Midway Atoll in the mid-1990s attempted to determine the effect of plastics ingestion on Layson albatross chick mortality. Research showed that approximately 75 percent of the chicks examined had up to ten grams of plastic in their proventriculi—part of the birds' complicated stomach system. One chick had ingested 140 grams. Still, the study concluded that "ingested plastic probably does not cause significant direct mortality in Layson albatross chicks."

What we observed a decade later on Kure, Midway's closest neighbor, suggests another story. The contents of Shed Bird's proventriculus weighed 340 grams, more than 80 percent of this was plastic. Imagine: Three plastic bottle caps weigh approximately 5 grams, and a regulation baseball weights about 140 grams—two baseballs' worth of plastic in Shed Bird's stomach!

An albatross chick's proventriculus is designed to hold huge amounts of food, as there may be many days between meals while the parents are out foraging. Chicks eat whatever their parents feed them, plastic included; if these items accumulate in their proventriculi, they will feel full and may not beg properly. Albatrosses eat indigestible items that exist in nature, like squid beaks, and a well-fed chick will have a proventriculus full of these items, which it eventually throws up as a bolus at about the time it's ready to fledge. A normal bolus is about five inches long and two inches wide. Shed Bird had six times that amount of material, most of it plastic, in his proventriculus.

After the death of Shed Bird, I found and examined 60 Laysan albatross chick carcasses on Kure Atoll. Most to them contained more than 200 grams of plastic, with only five chicks registering ten grams or less. These chicks appeared to have succeeded in throwing up their boluses, as nothing—not even squid beaks—was present in their proventriculi. I observed this same phenomenon on Pearl and Hermes Atoll and Laysan Island. Plastic is invading the habitats where parent albatrosses forage. Albatrosses feed where currents come together, and the currents that concentrate food at the surface simultaneously bring in plastic as well.

Inside dead chicks, I found, to my disgust, a printer cartridge, shotgun shell casings, paint brushes, pump spray nozzles, toothpaste tube caps, clothespins, buckles, toys, and shards from larger plastic items such as laundry baskets and buckets. If a bucket ends up on a beach, or a bottle ends up in a river, or a lighter is discarded into a lake, it may eventually wash out to sea, joining the plastic dumped from ships. Over time plastic becomes brittle in sunlight and breaks into smaller and smaller chards. For every pound of naturally occurring zooplankton in the North Pacific's subtropical gyre, there are six pounds of plastic. This debris affects not only the health of Laysan albatrosses but the well-being of the entire world. –David Liittschwager

Dealing with Debris — Marine Debris Fact Sheet

During a one-day beach clean-up in Hawai`i people picked up 16 tons of rubbish from 82 miles of beach. This weighs as much as 12 Volkswagen Beetles!

Albatross feeding at sea scoop up plastics along with their food and then regurgitate them to their waiting chicks. The plastics can fill the bird's stomach and cause death by starvation.

From 1982 to 2003, 238 Hawaiian monk seals were found entangled in nets and lines in the NWHI. Most were pups that were freed; however, eight seals were found dead. No one knows how many other animals became entangled and drowned.

Plastic debris on our beaches and in the ocean can last a very long time. Did you know that it takes a plastic water bottle 450 years to decompose? Recycle it!

Nylon fishing lines and nets can take up to 600 years to decompose. "Ghost-nets" can continue to float through the ocean and trap and kill marine life for years.

A floating plastic bag or balloon can look like a jellyfish meal to a sea turtle. When they eat these plastics, they can suffocate or starve.

Between 1996 and 2003, 364 tons of marine debris was removed from the "kūpuna" islands. This is as heavy as 73 elephants!

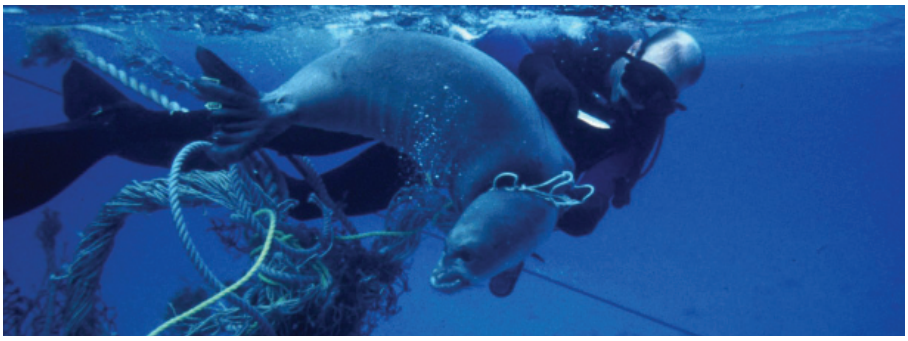
Each year, millions of sea turtles, marine mammals, and seabirds ingest plastics that are mistaken as food or become entangled in marine debris. It doesn't have to be this way! Each one of us can help to solve the problem of marine debris!

How does our plastic debris end up in the stomach of an albatross?

Photo by Robert Shallenberger/ USFWS

What Can You Do?

- Reduce the amount of disposable plastic products you use.
- Pick up litter.
- Reuse and recycle.
- Volunteer for beach and stream clean-ups.
- Teach others about marine debris.
- Let others know why you should not intentionally release any type of balloon outside.



Leaving fishing nets and lines in the ocean is very harmful to wildlife.

Sources:

- *http://www.pacificwhale.org/childrens/fsdebris.html*
- *http://www.oceanconservancy.org/dynamic/learn/issues/debris/debris.htm*
- *http://www.epa.gov/owow/oceans/debris/*

From the Land to the Sea

Essential Questions: How do products we use on land affect our ocean and beaches? How effective are some alternative products that have less impact on the environment?

Hawai`i DOE Content Standard

Science 1: The Scientific Process: Scientific Investigation

Discover, invent, and investigate using the skills necessary to engage in the scientific process.

Grades 4 - 5 Benchmarks

4.1.1 Describe a testable hypothesis and an experimental procedure.

5.1.2 Formulate and defend conclusions based on evidence.

Key Concepts

- Detergents, oils, paints, and other materials that we wash down our driveways can end up in storm drains and in the ocean. Household cleaners and chemicals that we wash down drains can also end up in the sea from cesspools and overloaded wastewater treatment plants.
- Fertilizers and pesticides that we apply to our lawns and gardens can percolate down to groundwater and/or end up in our streams and ocean.
- We can prevent these (non-point source) pollutants from entering our environment where they have a negative impact on our health and the health of other species.

Activity at a Glance

Students conduct a survey of their household products that could contribute to water pollution and test the effectiveness of alternative products that have less impact on the environment.

Time

2 - 3 class periods

Assessment

Students:

- Complete an analysis of products in their homes that could contribute to water pollution in their community.
- Select an alternative product, develop a hypothesis, test its effectiveness, and make recommendations.
- Write a lab report describing their research question, hypothesis, procedure, results, and conclusion.

Rubrics

Gr. 4

Advanced	Proficient	Partially Proficient	Novice
Create a testable hypothesis and an experimental procedure to test it.	Describe a testable hypothesis and an experimental procedure.	Identify, with assistance, a testable hypothesis and an experimental procedure.	Recognize, with assistance, a testable hypothesis or an experimental procedure.

Gr. 5

Advanced	Proficient	Partially Proficient	Novice
Formulate and defend conclusions that are supported by detailed evidence and make connections to the real world.	Formulate and defend conclusions that are supported by evidence.	Make conclusions that are partially supported by evidence.	Make conclusions without evidence.

Vocabulary

alternatives – one of two or more choices
fertilizers – substances (natural or chemical) that supply nutrients to the soil
hazardous – potentially harmful
mālama ʻāina – care for the land
pesticides – substances used to control pests

Materials

- take-home sheet (provided)
- some common household cleaning products and garden products
- healthy alternative products (see take-home sheet)
- mixing bowls
- measuring cups and spoons
- gloves and safety goggles
- spray bottles
- sponges

Advance Preparation

Make a copy of the take-home sheet for each student. Gather some of the products listed on the sheet for class discussion.

Background Information

What's under your sink or in your shed that could pose a hazard to your health or the environment? Chances are that there are a variety of chemicals lurking in these hidden places, many of which need to be "disposed" of. Do we dilute, flush, drain, stuff, trash, or stash them? It's a dilemma that all conscientious consumers confront as we deal with the consequences of our consumerism.

When we follow the potential pathways that materials can take if they are flushed or washed down our drains or washed down our driveways, it's clear that there is no "away." Our drains lead to wastewater treatment plants that use only primary treatment to remove solids. The effluent is then released several miles from shore. Honolulu's Sand Island treatment plant is one of the few facilities in the U.S. where the Environmental Protection Agency (EPA) allows only primary treatment of waste. The effluent from this facility is noted by the EPA as among the most polluted in the country (Moriwake, 2004). When there are heavy rains, our wastewater treatment plants can be overwhelmed, causing raw sewage, pesticides, and other wastes to run off directly into nearshore waters.

Our storm drains carry materials from streets and driveways directly into streams and down to the ocean. This pathway provides a direct link from our homes to the sea. Materials that we release into our yards can either run off into streams or percolate down to groundwater. It is

vital that we recognize these connections and think carefully about our actions. It is best to read labels and follow directions for safe disposal. Many household cleaners can be flushed down the drain with plenty of water. Paintbrushes should be cleaned in a sink with plenty of water instead of in the yard. Used paint and oil can be disposed of in the rubbish, but should be allowed to dry out or be absorbed with rags or newspaper before disposing. Flammable materials like gasoline, or hazardous materials like pesticides, may require special handling. See the City and County of Honolulu's web site at www.opala.org for more information or contact the Hawai`i Department of Health.

Teaching Suggestions

1. Display some common household cleaning and garden products in the classroom and conduct a discussion.
   Discussion Questions:
   - Are any of these products familiar? What are they used for and how are they helpful?
   - Do you think any of these products could pollute local streams or the ocean?
   - How would they get from our yards or homes into the streams or ocean?
2. Ask students to describe where they believe water and wastes go after they are washed down the drain or flushed down the toilet. Draw a diagram on the board that traces water and wastes from a kitchen sink to the pipes that connect our homes to the wastewater treatment plant. (Good resources to teach this connection to young students are *The Magic Schoolbus at the Waterworks* or the color poster produced by the Hawai`i Department of Health. See Suggested Resources.)
3. Discuss how water and wastes are treated before being released a few miles offshore. Note that our treatment plants are sometimes overwhelmed by storm runoff and that raw sewage and other chemical wastes can spill into the nearshore environment.
4. Add storm drains to your illustration and discuss how materials we wash down our driveways or release in our yards (soaps, fertilizers, pesticides, paints etc.) can end up in storm drains that empty into streams and into the ocean. (This is why it's better to wash paintbrushes in the sink and limit use of chemicals on our lawns and gardens.)
5. Distribute the take-home sheet and review it. Ask students to work with a parent to conduct an inventory of products used in and around their homes and to consider some of the healthy alternatives.
6. Display the ingredients for alternative products that have less of an impact on our health and the environment. Have students work in groups to investigate the effectiveness of an alternative product. Students will need to:
   - Select an alternative product from the take-home sheet.
   - Develop a testable hypothesis, for example, "Mixing ¼ cup of baking soda and ½ cup white vinegar with warm water will create a product that will clean our school sink."
   - Use safety procedures to mix the ingredients for the alternative product.
   - Decide on a method for testing its effectiveness.
   - Write a summary and report on their findings.
   - Propose recommendations or modifications based on their findings.
7. When groups complete their investigations, ask them to report to their classmates and discuss their results. Discuss tradeoffs that arise when healthy alternatives are not as effective as some of the commercial products that contain harsh chemicals.

Extended Activities

Have students conduct research to find out how household cleaners, paints, and automotive products such as batteries and used oil should be safely disposed of to avoid risks to people and the environment. See www.opala.org for a kid-friendly site with practical suggestions for reducing, reusing, and recycling. This site also offers guidelines on what to do with used cans of paints and other potentially hazardous materials. Ask students to summarize what they learn and make informational fact sheets to distribute to families.

Conduct investigations in the watershed where your school is located. Have students use water test kits to measure nitrates and phosphates in streams and at the beach. Excess nitrates in the water results from fertilizers that run off into streams and the ocean. Excess phosphates may result from detergents in runoff. These "nutrients" can cause algae to overgrow coral, causing the reef ecosystem to be out of balance. Inexpensive test kits that are easy for students to use are available from:

- LaMotte Company. www.lamotte.com/ P.O. Box 329, 802 Washington Avenue, Chestertown, MD 21260. (800) 344-3100.
- Hach Company. www.hach.com/ P.O. Box 389, Loveland, CO 80539. (800) 227-4224 or (970) 669-3050.

Have students enter the watershed contest sponsored by Protect the Planet and the City and County of Honolulu. See http://www.protecttheplanet.org/ for more information.

Allow students to earn extra credit by responding with a one-page journal entry to the following prompt: Because of the connection between land and sea, I have to be careful to…

References

Moriwake, Isaac. (2004, July). O`ahu Awash in Sewage. *Mālama i Ka Honua. Journal of the Sierra Club,* Hawai`i Chapter. Vol. 36. No. 3.

Carey, E. (2004, May). Pesticide-Free Ways to Keep Lawn, Garden Healthy. Reprinted from the *Toronto Star.* Retrieved 7-13-04 from http://www.beyondpesticides.org/main.html.

City and County of Honolulu HI: (n.d.). Household Hazardous Waste. Retrieved on 7-16-04 from www.opala.org.

Steelsmith, L. (2004, June). Nonlethal Weapons. Honolulu, HI: *The Honolulu Advertiser.*

Suggested Resources

Cole, J. (1986). *The Magic School Bus at the Waterworks.* New York: Scholastic.

Hawai`i Department of Health. (1996). Potential Groundwater Contamination Sources. [poster]. Honolulu, HI: Hawai`i Department of Health, Groundwater Protection Program.

Honolulu Board of Water Supply. (n.d.) *Water for Life: The History and Future of Water on O`ahu.* Honolulu, HI: Info Grafik, Inc. / EMA, Inc. / Honolulu Board of Water Supply.

Moanalua Gardens Foundation and Hawai`i Department of Education. (2001). Watershed Watch. [video] *Exploring the Islands Series.* Honolulu, HI: Available from DOE Teleschool Branch.

From the Land to the Sea Student Take-Home Sheet

Did you ever think about how harmful chemicals in products your family uses in the house or in the yard could affect your health? Or that some of these chemicals could make their way into the ocean where they harm our reefs? Your child is participating in the Navigating Change program at school. This program is focused on raising awareness and ultimately motivating people to mālama `āina (care for the land). Please take a few moments to work together to check off the items you use and think about alternatives. Mahalo!

Check If Your Family Uses It.	Common Household Products	Some Healthy Alternatives
Home		
	Drain cleaner	Mix 1/4 cup baking soda and 1/2 cup vinegar. Let stand in drain for 5-10 minutes. Flush with hot water.
	Toilet-bowl cleaner	Mix baking soda and castle soap.
	Tub and tile cleaner	Mix 1/4 cup baking soda and 1/2 cup white vinegar with warm water.
	Window cleaner	Mix equal parts vinegar and salt. Use some elbow grease (scrub)!
	Mildew remover	Mix 2 T. white vinegar with 1 qt. warm water and 2 T. of lemon juice. Wipe windows clean with newspapers.
	Furniture polish	Mix 2 parts olive oil to 1 part lemon juice.
	Mothballs	Use cedar chips or dried lavender.
	Rodent poison	Use glue or spring traps.
Yard		
	Chemical fertilizer	Use compost to build up the soil and organic fertilizers such as dried manure and bone meal.
	Bug sprays – pesticides	Place two cayenne peppers, a large onion, and a whole garlic bulb into a blender and mix. Pour into a large container, cover with a gallon of water, and allow to stand for 24 hours. Then strain and spray on plants. (Use caution when handling cayenne peppers!)

Sources: Steelsmith, L. (2004, June). Nonlethal Weapons. The Honolulu Advertiser.
Carey, E. (2004, May). Pesticide-Free Ways to Keep Lawn, Garden Healthy. Reprinted from the Toronto Star. Retrieved 7-13-04 from http://www.beyondpesticides.org/main.html.
City and County of Honolulu (n.d.) Household Hazardous Waste. Retrieved 7-16-04 from www.opala.org.

For information on how to dispose of household and garden chemicals safely, see the City and County of Honolulu's web site at www.opala.org. Neighbor Islands should contact their local state Department of Health office.