What's for Dinner?

What do the contents of a bolus reveal about seabirds and human impact on their habitat?

Hawai'i DOE Standard Benchmarks

Grades 4-5

- **Science 1: The Scientific Process: Scientific Investigation** - Scientific Inquiry
  SC.4.1.1 Describe a testable hypothesis and an experimental procedure.
- **SC.5.1.2** Formulate and defend conclusions based on evidence.

Language Arts 5: Writing: Rhetoric - Meaning

- **LA.4.5.1** Use appropriate facts and interesting details that develop the intended meaning and anticipate the needs of the audience.
- **LA.5.5.2** Use significant details and relevant information to develop meaning.

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 using fewer disposable plastic items such as water bottles and shopping bags, 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, which they share with others in the school. They write captions for their displays that include actions that we all can take to reduce marine debris.

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.
- Write captions for their bolus displays that describe conclusions about human impact on seabirds and suggestions for reducing plastic waste in the ocean.

Hawai‘i DOE Rubric

Advanced	Proficient	Partially Proficient	Novice
Science Grade 4			
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.

Language Arts Grade 4			
Use appropriate facts and interesting details that creatively develop the intended meaning and clearly anticipate the needs of the audience	Use appropriate facts and interesting details that develop the intended meaning and anticipate the needs of the audience	Use some trivial facts and obvious details that relate to but do not develop the intended meaning or anticipate the needs of the audience	Use inappropriate facts and irrelevant details that do not develop the intended meaning or anticipate the needs of the audience

Science Grade 5			
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.

Language Arts Grade 5			
Use significant details and clear, relevant information to insightfully develop meaning	Use significant details and relevant information to develop meaning	Use some obvious details and typical information that are related to but do not develop meaning	Use insignificant details and irrelevant information that do not develop meaning

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

- student journal - 21 (provided)
- marine debris fact sheet (provided)
- bolus (see Advance Preparation)
- Navigating Change video segment “Human Impact” (provided)
- photograph of Laysan albatross and video clips (provided on 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.
- Make a copy of student journal - 21 and the marine debris fact sheet for each student. Make additional copies of the marine debris fact sheet for students to distribute to other classes.
- 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!
- Preview the video clips provided on the CD that comes with this guide. See the following files: Laysan_Alb_Dance.mov, Laysan_Alb_Chick_Feeding.mov, and Laysan_Alb_Hatching.mov.
- A video of a bird necropsy (an examination and dissection of a dead body to determine cause of death) is available in the curriculum DVD Packet. View it beforehand to determine whether it is appropriate for your students.

Teacher 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 4, "Human Impact," and discuss students' reactions to it.

2. Introduce students to the Laysan albatross.

- 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?

Photo by Matt Limtiaco

4. Distribute student journal - 21 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.

- Explain the procedure that will be used to dissect the bolus and remind students that their hypotheses should be testable by this procedure.

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 needed to dissect the bolus. Have them cover their desks or tables with old newspaper.
- 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.
- clean-up their tables and discard the dissected boluses.

8. Discuss students' findings from the bolus investigation.

- Discuss students' conclusions about what the boluses reveal about human impact on the albatross.
- Show students the photographs by Susan Middleton and David Liittschwager (provided at the end of this activity). Read some of David Liittschwager's account of "Shed Bird" and finding dead juvenile birds with plastic debris in their bodies.
- Discuss what we should all do to reduce this impact.

9. Ask students to work individually to complete journal - 21 with a full laboratory report, including their research question, hypothesis, procedure, findings, and conclusion.

10. Plan group presentations for other classes as part of the culminating activity for this unit.

- Ask students to write a caption for their display that includes a summary of their findings and suggestions for reducing marine debris.
- Arrange for student teams to go to different classes and present their displays and findings.

11. 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.
- Make additional fact sheets available near the students' displays so that other students may share them with their families.

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 and suggestions for reducing use of disposable plastics with others.

Conduct one of the albatross activities described below:

Walk a Mile in Albatross Shoes

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…

Source: The Albatross Project. www.wfu.edu/albatross

Albatross Egg Hunt

Help students to discover how to use transects in a small area to make an educated guess about the number of nesting albatross in a larger area.

Every year on Midway Atoll, National Wildlife Refuge biologists and volunteers tally albatross that come to Midway to nest. They do this by counting each nest that an albatross is sitting on. When an albatross is sitting on a nest, two things can be assumed using previous observations: 1) Each nest represents two mature adult albatross; one albatross is sitting on the nest while the other is either nearby or out to sea gathering food; and 2) The albatross on the nest is incubating a single egg (albatross lay only one egg per season). Albatross that are not on a nest with an egg (standing or wandering) are not counted as they may move around, which would make the count inaccurate.

Materials:

- albatross body cut-out (copy four per student; provided with this lesson)
- chick, leg, and chick cut-outs (one sheet per student; provided)
- chopsticks
- glue or tape
- four cones (to mark off an area in your playground or field)
- oak tag or other cardstock paper

Activity:

Have students cut out four copies of the albatross body and glue them onto oak tag or other heavy paper and then cut the birds out.

1. Have students cut out the eggs, chicks and legs from the second illustration provided, glue these onto heavy paper, and cut them out.
2. Ask students to use their cut-outs to make any type of albatross they want: albatross standing without eggs, sitting with eggs, sitting with chicks.
3. Tape a chopstick to the leg of each albatross so that you can stick the bird cut-out in the ground standing up.
4. Take students' albatross cut-outs out to an open field and place the albatross randomly in an area marked off by cones measuring 20' x 20'.

6. Have the students break into 3 teams (one team will count all the albatross with an egg, one will count albatross with a chick, and one team will count standing albatross).

7. Return to the classroom and have students tally their numbers.

8. Discuss students' findings:

- How many nesting albatross did you count? (Add the number of albatross with eggs to the number of albatross with chicks.)
- How many albatross with a mate were in your transect? (Multiply the number of nesting albatross by two.)
- How many albatross would be in this general area if we had counted all the albatross in a 200 foot area? (Multiply their total number by 10.) Explain that transects are used by scientists to measure approximate numbers of things in very large areas. While the numbers are not exact, they do provide general data.
- Why don't we see thousands of albatross nesting in the Main Hawaiian Islands?

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.

Resource

NOAA Marine Debris Program. Web site features photographs, projects, funding opportunities, and global updates on marine debris issues. http://marinedebris.noaa.gov/

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.)

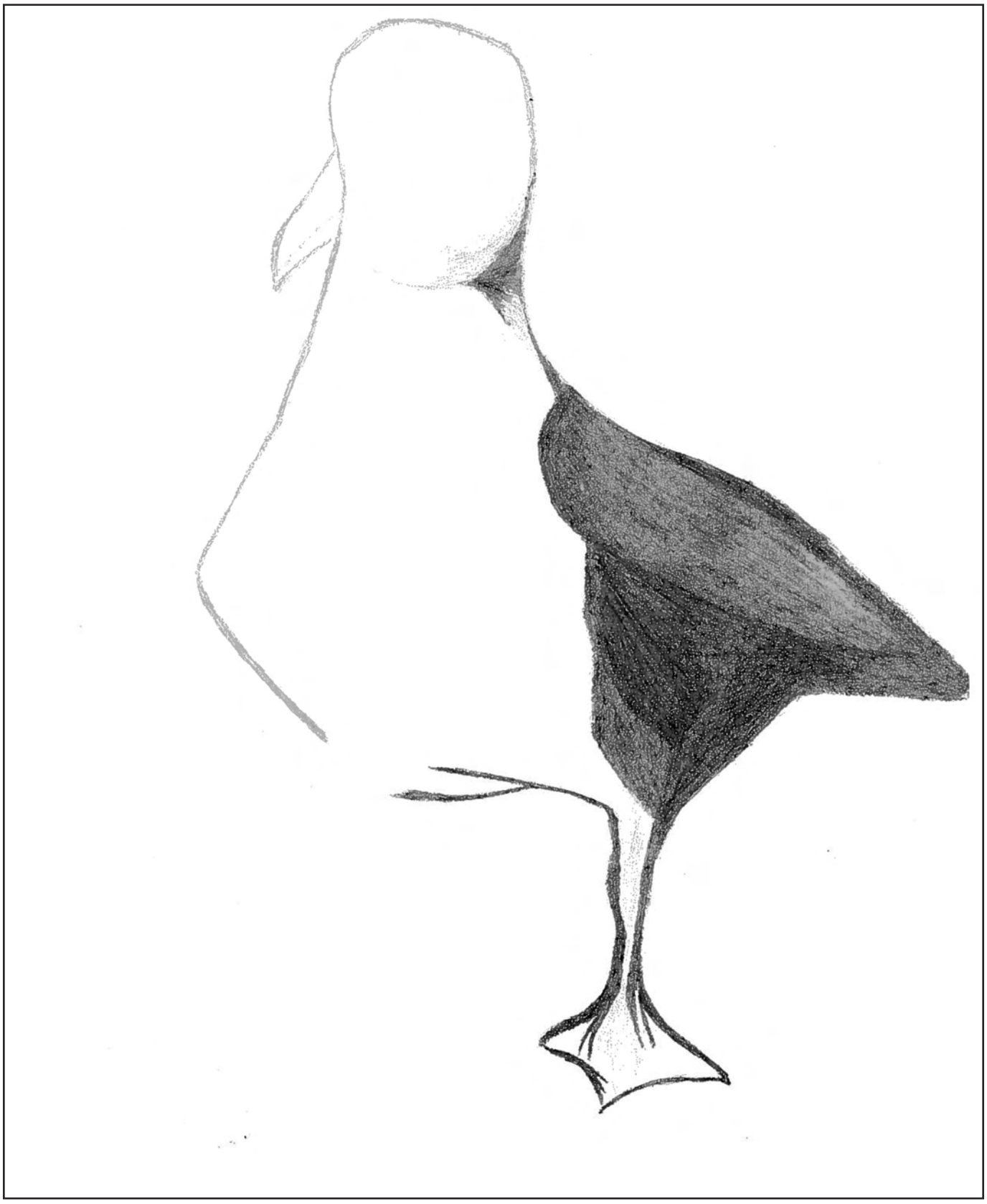
Method (How did you study the bolus?)

Findings (What was in the bolus?)

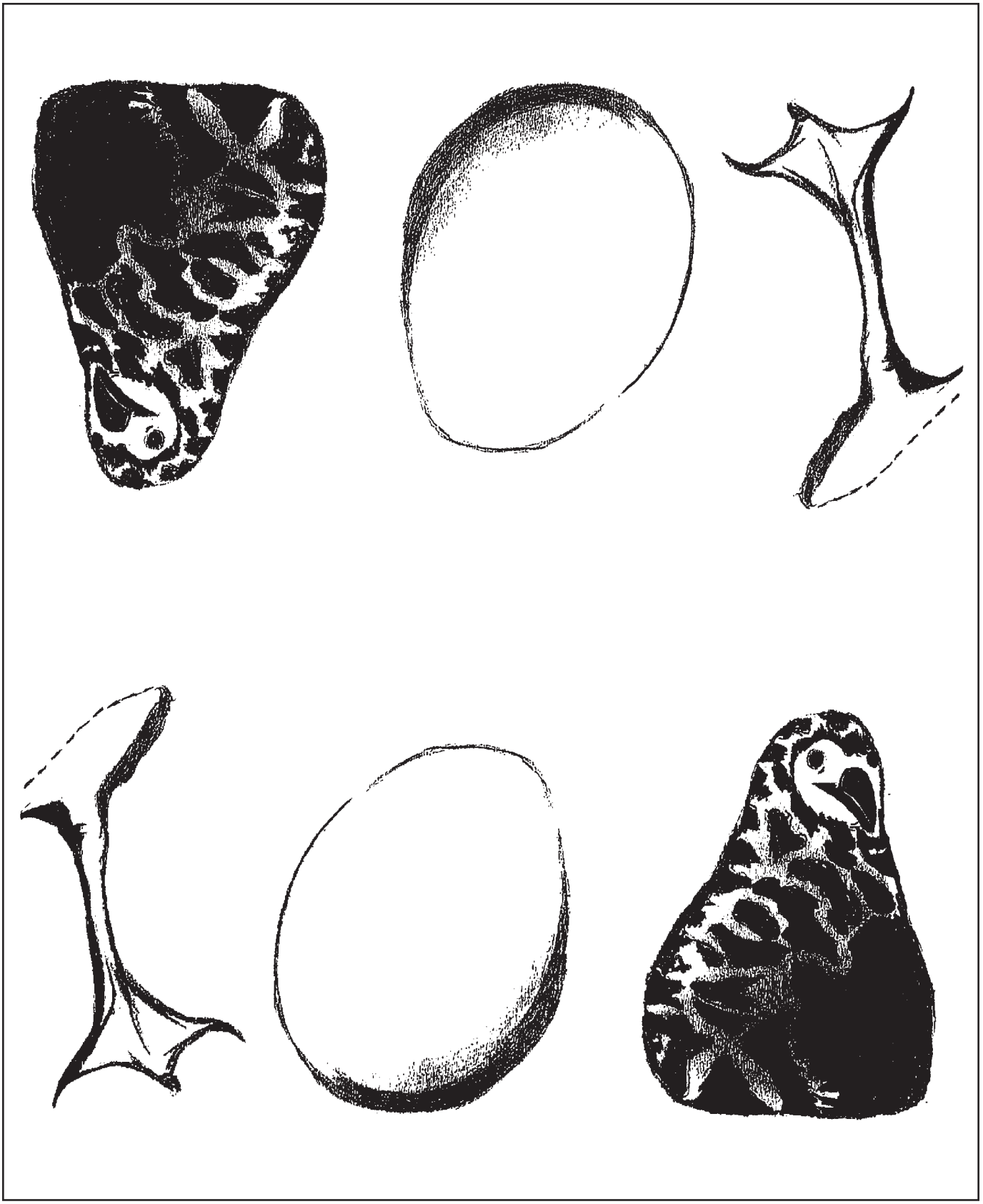
Conclusion (What do your findings tell you about the albatross and its habitat?)

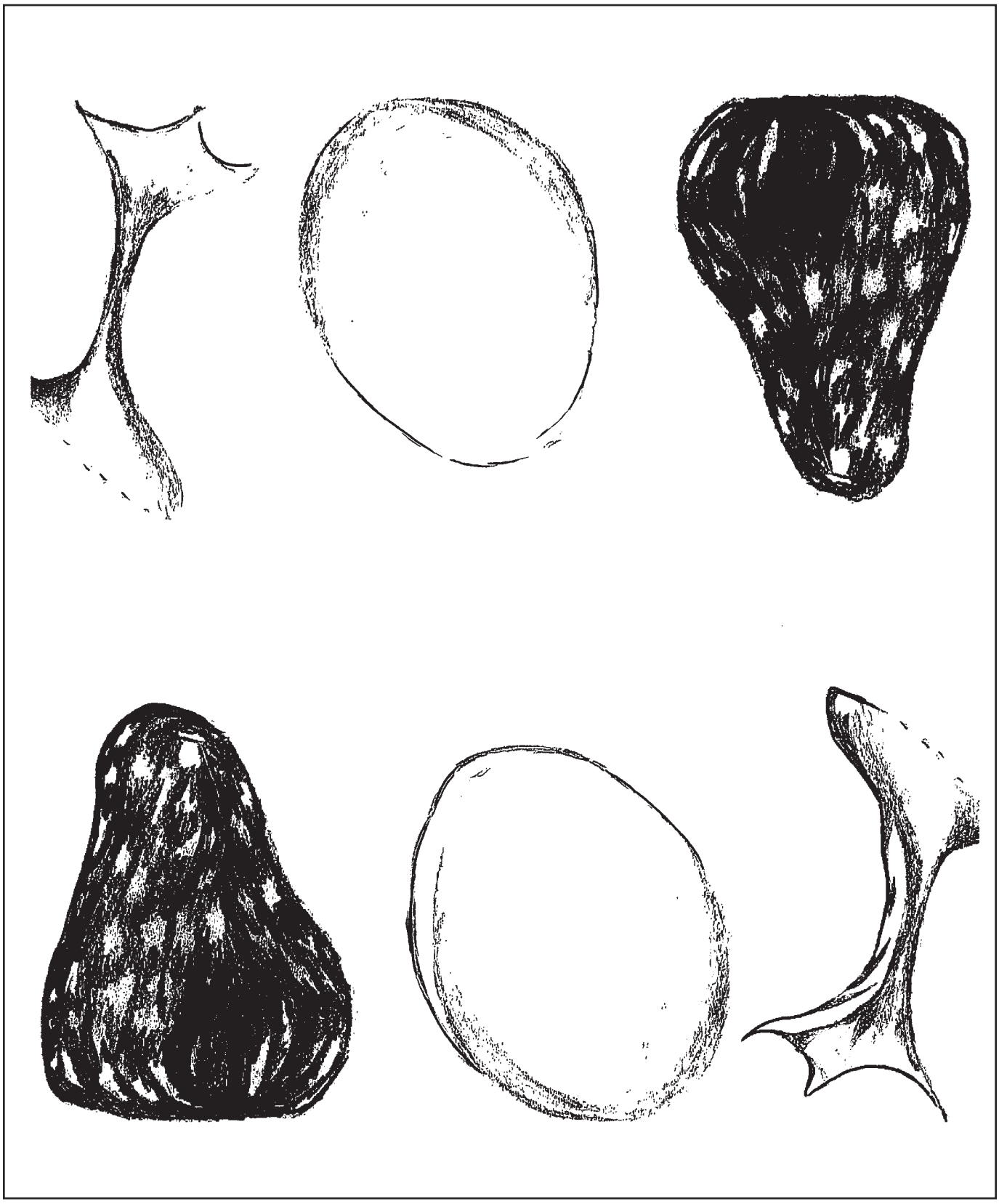
- Did your findings support your hypothesis? Explain.

- On the back of this page, write your recommendations of what we can do to mālama (care for) the albatross and other species that share its environment.



Albatross Egg Hunt Cut-outs





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

What Happened to "Shed Bird"?

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 Laysan 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!

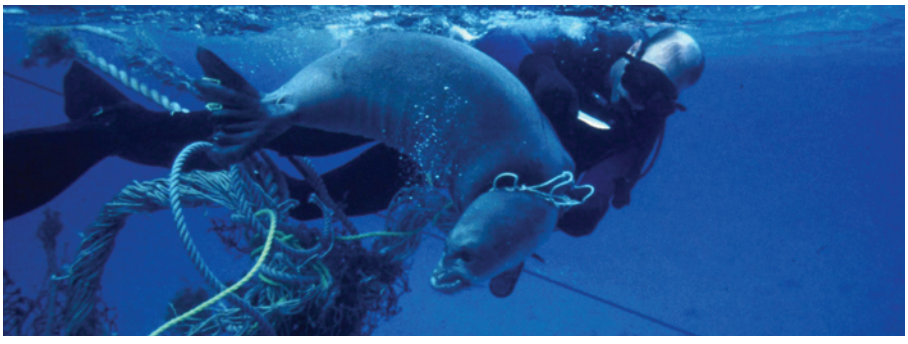
Each year, millions of sea turtles, marine mammals, and seabirds ingest plastics that are attached to their food or become entangled in marine debris. It doesn't have to be this way! Each one of us can help to solve the problem of marine debris!

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 that you use, such as shopping bags or water bottles.
- 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/

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 Standard Benchmarks

Grades 4 - 5

Science 1: The Scientific Process: Scientific Investigation - Scientific Inquiry

- **SC.4.1.1** Describe a testable hypothesis and an experimental procedure.
- **SC.5.1.2** Formulate and defend conclusions based on evidence.

Language Arts 7: Oral Communication: Rhetoric - Meaning

- **LA.4.7.1** Use prior knowledge, input from others, and text resources to develop ideas for speaking.
- **LA.5.7.1** Combine ideas from prior knowledge, input from others, and text resources to elaborate on and support ideas.

General Learner Outcomes

Community Contributor: The understanding that it is essential for human beings to work together

- **GLO 2** Cooperates with and helps and encourages others in group situations.

Effective Communicator: The ability to communicate effectively

- **GLO 5** Listens to, interprets, and uses information effectively.

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. They complete the culminating activity for the unit and share what they have learned with other classes in the school.

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.
- Complete the culminating activity for the unit. (See Student Assessment Overview in the Unit Introduction.)

Hawai‘i DOE Rubric

Advanced	Proficient	Partially Proficient	Novice
Science Grade 4			
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.
Language Arts 4			
Use relevant information from prior knowledge, input from others, and text resources to creatively develop ideas for speaking	Use relevant information from prior knowledge, input from others, and text resources to develop ideas for speaking	Use some obvious or trivial information from prior knowledge, input from others, and text resources that relate to but do not develop ideas for speaking	Use very little information from prior knowledge, input from others, and text resources or use information that does not help develop ideas for speaking
Science Grade 5			
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.
Language Arts Grade 5			
Smoothly combine ideas from prior knowledge, input from others, and text resources to creatively elaborate on and thoroughly support ideas	Combine relevant ideas from prior knowledge, input from others, and text resources to elaborate on and support ideas	Use some predictable or trivial ideas from prior knowledge, input from others, and/or text resources that relate to but do not elaborate on and support ideas	Do not use ideas from prior knowledge, input from others, and text resources or use ideas that do not help elaborate on and support ideas

Vocabulary

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

Materials

- take-home sheet (provided)
- student journals - 22 and 23 (provided)
- some common household cleaning 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 and student journal pages for each student.
- Gather some of the products listed on the sheet for class discussion.
- Download color posters from the Department of Health Clean Water Branch to show how polluted runoff affects water quality. (See Resources at end of activity. DOH has three color posters available online.)
- Copy a rubric for the culminating project (provided in the Unit Introduction) for each student or prepare to project it and review it with students.

Teacher 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?

2. **Trace where our wastewater and storm runoff goes with a diagram and discussion.**

- Draw a simple 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 posters produced by the Hawai'i Department of Health. See Resources listed at the end of this activity.)

- Add a simple storm drain to your illustration to show a connection from a street to a stream and into the ocean.

  Discussion Questions:
  - Where do wastes go after they are washed down the drain or flushed down the toilet? (Water and wastes are treated at a treatment plant before being released a few miles offshore.)
  - What sometimes happens to our wastewater during heavy rainfall? (Treatment plants can be overwhelmed by storm runoff and raw sewage and other chemical wastes can spill into the nearshore environment.)
  - How could pollutants from our driveways or yards (soaps, fertilizers, pesticides, paints etc.) end up in the ocean? (Storm drains empty into streams and into the ocean, which is why it's better to wash paintbrushes in the sink and limit use of chemicals on our lawns and gardens.)

3. 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.
- Discuss what students found at home and their thoughts about alternative products.

4. Distribute student journal - 22 and review it with students.

- Divide the class into groups and challenge student groups to select an alternative product from the take-home sheet and test its effectiveness. (Have groups choose different products.)
- Help students to 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 as well as a commercial cleaner."

5. Display the ingredients for alternative products that have less of an impact on our health and the environment.

- Review methods students will use in their investigations and safety procedures (gloves, goggles) to mix the ingredients for the alternative product.
- Have students record their findings and conclusions on their journal sheets.

6. 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.

7. Review the culminating projects in the Student Assessment Overview (provided in the Unit Introduction).

- Check students' progress with their group culminating projects and remind them of the due date for their presentations. They may wish to present their bolus displays or demonstrate their alternative products as part of their project. Review the rubric to help guide their project presentations.

8. Distribute student journal - 23 and review it with students.

- Ask students to use at least five of the words

Unit Culminating Team Project: Student teams design and carry out a project to reduce the impact of a particular product, such as a disposable plastic item, fertilizer, pesticide or cleaning product on the marine environment, and present it to other classes in the school. Team presentations should include:

- New vocabulary words from this unit
- A description of the problem students are addressing and how students' actions affect the environment, people, and the economy
- An explanation of how their project promotes Hawaiian values such as kōkua, reciprocity, aloha 'āina, mālama 'āina
- Visual aids such as photographs, video, or drawings that show the project in action
- Models or simulations to demonstrate how the project will reduce the impact of human activities on the marine environment (Gr. 5)

Individual Project: Students write a report that summarizes their group's project and answers the unit essential question.

in their culminating reports that address the unit essential question. (See Student Assessment Overview in the Unit Introduction.)

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.

Challenge students to conduct an investigation into water quality to determine how pollutants on land affect the marine environment. See the Mālama i ke Kai activity in Unit 5 of this teacher's guide.

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…

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From the Land to the Sea Student Take-Home Sheet

Did you ever think about how harmful chemicals in products under your sink or in your garage 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 ʻāina (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 castile soap.
	Tub and tile cleaner	Mix 1⁄4 cup baking soda and 1⁄2 cup white vinegar with warm water.
	Window cleaner	Mix 2 T. white vinegar with 1 qt. warm water and 2 T. of lemon juice. Wipe windows clean with newspapers.
	Mildew remover	Mix equal parts vinegar and salt. Use some elbow grease (scrub)!
	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.
	Plastic shopping bags, disposable bottles	Reusable cloth shopping bags and bottles
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.

Name_____**Date**_____

Group Challenge: Select an alternative product from the take-home sheet, make it, and test its effectiveness.

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 make and test the alternative product?)

Findings (Was the product you made effective? Did your findings support your hypothesis? Explain.)

Conclusion (What do your findings tell you about the product you created?)

Name_____**Date**_____

Unit Essential Question: How do our actions on land affect marine life and what can we do to mālama the marine environment?

Write a definition for the vocabulary words from this unit. Then use at least five of your new vocabulary words in your report that answers the unit essential question.

ahupua‘a –

‘āina –

kōkua –

biodegradable –

kapu –

lawai‘a –

mālama ‘āina –

mahai‘ai –

non-biodegradable –

marine debris –

‘ōpala –

bolus –

foraging ground –

indigestible –

alternatives –

fertilizers –

hazardous –

pesticides –