PROJECT ALOHA ‘ĀINA

A TEACHER’S GUIDE TO AHUPUA‘A

GRADE 6 - CONSERVATION

Produced by

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THE KOHALA CENTER

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Project Aloha ‘Āina Team

Brenda Colburn – Coordinator
Heather Nahaku Kalei – Curriculum Writer – Hilo
Walt Keale – Cultural Advisor
Herb Lee, Jr. – Project Director
Kaʻohua Lucas – Project Deputy Director, Curriculum Writer
Dr. Verlie Ann Malina Wright – Project Advisor
Dr. Darlene E. Martin – Project Evaluator
Penny Martin – Coordinator – Molokaʻi
Caroline Neary – Coordinator – Kona
Maura O’Connor – Senior Curriculum Writer
Brook Kapūkuniahi Parker – Artist
Joylynn Paman - Curriculum Writer – Maui
Phyllis Murakami-Siu – Curriculum Writer – Molokaʻi
Megan Vertido – Webmaster
Albert Wong – Logistical Support

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The Pacific American Foundation
146 Hekili St. Room 203
Kailua, HI 96734
(808) 263-0081
www.thepaf.org

The Kohala Center
P.O. Box 437462
Kamuela, HI 96743
(808) 887-6411
www.kohalacenter.org

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# TABLE OF CONTENTS

Acknowledgements...........................................................................................................i
Introduction........................................................................................................................vii

**GRADE 6 - CONSERVATION UNIT**

Unit Introduction.................................................................................................................. 1
Unit Map................................................................................................................................. 9
Culminating Activity Rubrics................................................................................................. 13
Learning Log – Student Assessment Overview................................................................. 17

Lesson 1: Where Does All the ‘Ōpala Go?................................................................. 21
  Student Sheets....................................................................................................................... 29
Lesson 2: Waste Audit.......................................................................................................... 41
  Student Sheets....................................................................................................................... 55
Lesson 3: Waste Not............................................................................................................ 59
  Student Sheets....................................................................................................................... 70
Lesson 4: He Mala................................................................................................................ 77
  Student Sheets....................................................................................................................... 83
Lesson 5: ‘Ōpala Outing...................................................................................................... 103
  Student Sheets....................................................................................................................... 109

**APPENDICES**

Oli (Chants)......................................................................................................................... A-1
Field Sites............................................................................................................................... A-15

**MATERIALS IN Binder Pockets**

Pre- Post-Test and Student Answer Sheet
Wai A Kāne Chant and Mo‘olelo (Story)
How to Cultivate Indigenous Microorganisms
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FIELD TEST TEACHERS

Grades 3 through 6
Diane Abraham
Marcia Clinton
Kalei Cosma
Dionne DeCosta
Rose Enos
Diane Hirata
Heidi Jenkins
Kahea Kaohelaui‘i Farias
Adeline Keama
Mary Kalilikane
Audrey Kido
Norbert Larsen
Malia Mataele

Grades 7 through 10
Franklin Allaire
Pauahi Bogac
Tina Chan
Malcolm Cogbill
Melody Cosma
Sheila Cyboron
Dwight Doane
Maile Domingo
Jody Hisaka
Kaui Kanakaole
Kristina Lee
Elaine Mahoney
Mimi Verhoeven
Ulu Victor
Sandra Webb
PARTICIPATING SCHOOLS

Academy of the Pacific
Ali‘iolani Elementary School
James B. Castle High School
Hālau Lōkahi Charter School
Hāna High School
Kapolei High School
Kapunahala Elementary School
Kaunakakai Elementary School
Ke Kula ‘o Samuel M. Kamakau Charter School
Kilohana Elementary School
King Intermediate School
Kualapu‘u Elementary School
Kula Kaiaipuni ‘o Ānuenue
Maunawili Elementary School
Milibani High School
Moanalua Middle School
Pālolo Elementary School
Pū‘ōhala Elementary School
St. Anthony School
Stevenson Middle School

HAWAI’I STATE DEPARTMENT OF EDUCATION CONSULTANTS

Sheila Cyboron
Dwight Doane
Tracy Doane
Naidah Gamurot
Audrey Kido
Kristina Lee
Kawehi Lucas
Amanda Miyamoto
Colleen Murakami
Phyllis Nakasuji
Edna Narimatsu
Elizabeth Shigeta
Donna Therrien
Gwen Takeguchi
Ululani Victor

FIELD SITE ASSISTANCE: REVIEWERS, INSTRUCTORS, AND SITE HOSTS

Dr. Adam Asquith: University of Hawai‘i at Mānoa Sea Grant College Program
‘Ao‘ao O Nā Loko I’a O Maui
Samantha Birch, Caroline Neary, and Cindi Punihaole: The Kohala Center
Dr. Charles P.M. “Doc” Burrows, Ron Walker, Dr. Steve Montgomery, Kaimi Scudder,
and Malia Helelē: ‘Aha Hui Mālama I Ka Lōkahi
Dr. David R. Bybee: Brigham Young University-Hawai‘i
Shayna Carney, Hanalei National Wildlife Refuge
Denby Freeland-Cole, Maui Coastal Land Trust
Andy Collins, Matt Limtiaco, and Ann Bell: Papahānaumokuākea Marine National Monument
Chris Cramer: Maunalua Fishpond Heritage Center
Tom Cummings and Leon Geschwind: Bishop Museum
Conservation Council for Hawai‘i
Arleone Dibben-Young: Ahupua’a Natives
Adrienne Dillard and Theone Kanuha: Kula no na Po‘e Hawai‘i
Kawika Duvachelle: Hoolehua Plant Materials Center
Ati Jeffers-Fabro: Hawai‘i Department of Land and Natural Resources, Division of Aquatic Resources
Jay Franey: Hawai‘i Nature Center, Maui
Eric B. Guinther: Biological Services, AECOS, Inc.
Mark Heckman, Carlie S. Wiener, and Malia Rivera: Hawai‘i Institute of Marine Biology
Greg Hong: Owner Bayview Golf Park and Dan Motohiro: Staff.
Lei Ishikawa, Paeloko
Jon Jokiel: Kaloko Honokōhau National Historical Park, Kona, Hawai‘i
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Linda Koch: Hawai‘i State Department of Health
Kim Langley and Signe Opheim: Coordinating Group on Alien Pest Species
Tweetie and John Lind: Kapahu Farm, Hāna, Hawai‘i
Rene Mansho, Schnitzer Steel Corp.
Dr. Darlene E. Martin: Keauhou-Kahalu‘u Education Group, Kamehameha Schools
Dr. Floyd W. McCoy: Associate Professor of Geology and Oceanography, Windward Community College
Kathleen McGovern-Hopkins: University of Hawai‘i at Mānoa Sea Grant College Program
Carole McLean: Friends of He‘eia State Park
Naomi McIntosh and Patty Miller: Hawaiian Islands Humpback Whale National Marine Sanctuary
Willis Motooka: Retired Castle High School Teacher
Glynnis Nakai: Refuge Manager, Keālia Pond National Wildlife Refuge
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Joe O’Reilly, Malia Rivera and Jennifer I. Barrett: Hawai‘i Institute of Marine Biology Community Education and Outreach Program
Hōkūlani Holt-Padilla, Hawaiian Cultural Advisor
Mahina Paishon Duarte and Lee Ann Ånuenue Punua: Paepae o He‘eia-Friends of He‘eia Fishpond
Kala Ocampo: Naiwa Landfill & Recycle Molokai Center
Papakōlea Community Association
John Reppun and Kaipo Faris: Kualoa-He‘eia Ecumenical Youth (KEY) Project
John Souza: Waste Reclamation Center
Stacy Sproat, Mala Fu, Lea Weldon and Ryan Like: Waipā Foundation
Mark Paikuli-Stride: Aloha ‘Āina Health Center
Rebekah Sluss: County of Hawai‘i Dept. of Environmental Management, Recycling Section
Annette W. Tagawa and Mike Yamamoto: Department of Land and Natural Resources, Division of Aquatic Resources
Fred Takebayashi, Willis Motooka, Kathy McGovern-Hopkins, and Dick Chapman: Waikalua Loko Fishpond Preservation Society
Rick Tamanaha: Tamahaha Organic Papaya Farm
Dr. Clyde S. Tamaru: University of Hawai‘i at Mānoa Sea Grant College Program
Amy Tsuneyoshi, Arthur Aiu and Diane Moses: Honolulu Board of Water Supply
Lea Weldon, Kari Shozuya, Ryan Kaipo Like: Waipā Foundation
Noe Yamashita: Ali‘i Fishpond

HAWAIIAN TRANSLATORS
Jessica Kāhealani Lono
Ululani Makue
Ānuenue Grades K-6 Teachers

CURRICULUM ASSESSMENT
Sara Moshman, MetaLogic, Inc., Lincoln, Nebraska
Colleen Murakami, Hawai‘i DOE Environmental Education Specialist

ASSISTANCE WITH WORKSHOP SITES
Janice Espiritu, Kaunakakai, Moloka‘i
Geraldine and Kuki Ka‘iwi, Hāna, Maui
Dr. Darlene Martin, Kona, Hawai‘i
Penny Martin, Moloka‘i
Patty Miller, Maui
Charles Nā‘umu, Kula Kaiapuni ‘o Ānuenue
Stacy Sproat, Waipā Foundation, Kaua‘i
Dr. Clyde S. Tamaru, O‘ahu
Lehua Mark Vincent, Principal, Keaukaha Elementary School, Hilo, Hawai‘i

PHOTOGRAPHS
Kapono Ciotti
Hawai‘i C’s Aquaculture
Ka‘ōhua Lucas, Pacific American Foundation
Randy Magnus
John P. Hoover, Marine Life Author and Photographer
Joylynn Paman, Pacific American Foundation
Bo Pardau
Doug Sell
Dr. Allison Sherwood, Assistant Professor of Botany, University of Hawai'i at Mānoa
Dr. Jennifer E. Smith, National Center for Ecological Analysis and Synthesis, University of California at Santa Barbara
Russell Sparks, Department of Land and Natural Resources – Division of Aquatic Resources
Forest and Kim Starr, U.S. Geological Survey
Keoki Stender
Annette Tagawa and Mike Yamamoto, Department of Land and Natural Resources – Division of Aquatic Resources
Eric VanderWerf, Pacific Rim Conservation
Andrew Walsh
A CULTURAL FOUNDATION

The words aloha (love, respect, honor) and ‘āina (land, lit., “that which nourishes”) are the heart and soul of Hawaiian culture. Memories of family pā‘ina (parties), backyard jam sessions late into the night, spending time with grandma and grandpa and sunny days working in a lo‘i, mud squishing between your toes—these are just some of the things that might come to mind. Imagine the power of two simple words to say so much. But what do they mean?

The Spirit of Aloha ‘Āina

Lōkahi: Relationship

Aloha ‘āina brings an understanding and perspective that shapes everything we do. Its spirit and essence begin with lōkahi or the sense of being connected to all things. Kupuna Malia Craver spoke of aloha as a ‘triangle’ of relationships between us as individuals and the creator/s and our ancestors (ke akua, nā akua, nā kūpuna), humanity (as caretakers), and creation (‘āina, kai, lani).

This mutuality between all things exists on many levels: spiritual, social, and the scientific.

Ho‘oma‘ama‘a: Practice

The spirit and essence of aloha ‘āina invites each of us into the practice of love and respect within the “lōkahi-triangle.” This idea can be seen in the Hawaiian word ho‘oma‘ama‘a. It means to grow in familiarity with a person, place or idea. This practice must be holistic affecting every corner of the triangle. To look at the ‘āina as just a science project without growing in its spiritual dimension is like needing glasses for reading but choosing not to wear them! At the same time, the benefits of the ‘āina are for those who come with the proper mindset from kindergartener to kupuna!

How can we grow in our understanding of aloha ‘āina, lōkahi and ho‘oma‘ama‘a? How would it shape our lives in ways that are meaningful? What source/sources might help us discover and understand these foundational elements? Words like ‘ike, (knowledge)
and aʻo, (to teach or learn) are good labels, but what are the sources of our learning?

Nā Kumupaʻa: The Sources

Puke: Written Things
Sources that help in understanding the concept and practice of aloha ʻāina are books and curricula like the one you’re holding. The standard works, both Hawaiian and western, play an important part. They also represent the partnering of two cultures. Yet these materials, though they enhance, cannot take the place of keʻala kahiko, the ancient way.

ʻOhana and Moʻolelo: Family Knowledge
It is hard to separate the two sources ʻOhana/Moʻolelo and Wahi Pana since neither can exist without the other when we speak of our ancient Hawaiian culture. ʻIke and aʻo grow from the context of ʻohana (family). For generations, from time immemorial, the relationship between the people and the sky, the land and sea has been remembered and passed down within families. The meaning of the word moʻolelo (foundational story) comes from the word moʻo; often a reference to a person’s family lineage or genealogy.

Knowledge of fishing patterns connected to the moon’s (Hina) cycle, the planting of crops linked to the movement of the sun (lā)—families perpetuated these understandings. Many still do. At the same time, ʻike and aʻo, though they agree on major points of culture, can vary from family to family and region to region. Oʻahu, Kauaʻi and Niʻihau were unique from the southern islands in many ways. We must keep this in mind when we speak of ‘Hawaiian culture’. Like this curricula, Hawaiʻi always embraced different, and often, innovative ways. This too is a reflection of aloha ʻāina.

Wahi Pana: Sacred Land
We must keep our eyes on the land! As the most isolated pae ʻāina or archipelago on planet Earth, Hawaiʻi stands out in many ways. The world comes here! Most would agree that its people, its style; even its smells are beyond compare. “Land of Aloha!” We also use the words wahi pana to remind ourselves that the land is not just a resource; it is sacred, it is family. This too is foundational to understanding and experiencing aloha ʻāina.

ʻĀina – that which nourishes – encompasses land, ocean, heavens, land-based water systems, plants and animals. Aloha ʻāina is a way of life that is evident in Hawaiian practices such as:

- Treating land as a family member
- Showing reverence and respect for all life forms and asking permission to take from the environment
- Taking from the ʻāina only what is needed, and using what is taken
- Living with nature’s cycles by refraining from harvesting
during spawning cycles of marine life, and planting, fishing or harvesting by phases of the moon

- Practicing protocol such as oli (chant) when visiting sites

Shaping the future while preserving a heritage, *Project Aloha ‘Āina* is working to provide Hawai‘i’s youth with culturally relevant curricula to inspire them to embrace *aloha ‘āina* as a way of life. This educational project fosters foundational learning experiences that reflect Native Hawaiian culture and core values. A major goal of the project is to inspire Hawai‘i’s youth to excel in science, math, social studies and language arts standards and to care for resources within their *ahupua‘a* (land division).

The lessons provided in each unit encourage students to explore their individual relationship to the ‘āina and ways that they can care for the place where they live. This multidisciplinary journey will take them through readings, reflections in writing, interviews with *kūpuna* (elders), creative collaborative projects, problem-solving in math and science, and investigations in their *ahupua‘a*. Getting to know the place where they live and giving back to that place in a meaningful way through community service, are essential elements for students participating in *Project Aloha ‘Āina*.

**PROJECT OVERVIEW**

All of the lessons are designed to help students meet selected Hawai‘i Content and Performance Standards developed by the Department of Education, as well as *Na Honua Mauli Ola*, Hawai‘i Guidelines for Culturally Healthy and Responsive Learning Environments, developed by the Native Hawaiian Education Council in partnership with Ka Haka ‘Ula O Ke‘elikōlani College of Hawaiian Language, University of Hawai‘i at Hilo. Hawai‘i DOE General Learner Outcomes (GLOs) are also addressed in students’ culminating projects.
PROJECT-BASED LEARNING

The units in this teacher’s guide are designed thematically and support integrated project-based learning that is anchored in the core curriculum. The units immerse students in scientific inquiry and into related social studies explorations. Math and language arts skills are incorporated as a means for students to interpret and express their findings.

To begin their Aloha ‘Āina journey, students are provided with a “map” to guide their way in the form of a Student Assessment Overview. This document, which is provided in each Unit Introduction, lays out the individual and culminating group projects for students along with the standards that they will be striving to achieve. Students are given this document at the beginning of the unit so that they can chart their course and keep track of their progress as they journey through the lessons. Suggestions for students’ culminating projects are provided in the unit, however the form of those projects is left up to the creativity of the students.

ASSESSMENT

The units employ formative assessments within each of the lessons and summative assessments at the end of the unit. The formative assessments are labeled as Learning Log sheets at the elementary and intermediate level and Journal sheets at the high school level. These sheets may be kept by each student in his or her own Learning Log or Journal. Two summative assessment tools are provided with the unit: 1) the culminating project rubrics, and 2) a pre- and post-test, which is designed to guide instruction and assess each student’s gains. These tests were developed in cooperation with the Hawai‘i Department of Education as a means of helping students to reach standard benchmarks.

PLACE-BASED LEARNING

To enable students to learn about the many aspects of their local environment, the Aloha ‘Āina team worked with teachers and administrators to map out a Grades 3 – 12 program of exploration that covers different environments and practices. The units, which were originally developed for the Kāne‘ohe ahupua‘a on windward O‘ahu have now been adapted for the following sites:

- Kaua‘i Gr. 3 – 7 (Waipā)
- O‘ahu Gr. 3 – 5 (Kalihi; Gr. 3 - 6 (Wai‘anae and Waikīkī)
- Moloka‘i Gr. 3 – 6
- Maui Gr. 3 – 7 (Kīhei and Waihe‘e) and Gr. 9 (Hāna)
- Hawai‘i Gr. 3 – 7 (Hilo)

These adaptations include locally relevant readings, maps, and presentations. Additional units focusing on a local stream exploration and gardening for Grades 7 – 8 were also written in collaboration with the Waipā Foundation in Hanalei, Kaua‘i.
# Overview of the Aloha ‘Āina Units

<table>
<thead>
<tr>
<th>Grade Level Topics</th>
<th>Essential Questions</th>
<th>Values Emphasized</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Grade 3 Wetlands</strong></td>
<td>How do wetlands help our community and how can we kōkua (help) to care for wetlands?</td>
<td>Kōkua (Helping; assisting)</td>
</tr>
<tr>
<td><strong>Grade 4 Ahupua’a – Fishponds &amp; Lo‘i</strong></td>
<td>How do Hawaiian practices nurture a healthy relationship to the ‘āina, and how can we give back to the ‘āina today?</td>
<td>Laulima (Cooperating) Mālama (Caring)</td>
</tr>
<tr>
<td><strong>Grade 5 Stream Life</strong></td>
<td>How is lōkahi (balance) among native stream plants and animals affected by human activities and what can we do to care for the stream community?</td>
<td>Lōkahi (Balance; harmony)</td>
</tr>
<tr>
<td><strong>Grade 6 Conservation</strong></td>
<td>How has technology changed the way we consume and dispose of products and what can we do to reduce waste and hoʻōla (to heal) our ahupua’a?</td>
<td>Hoʻōla (To heal) Kuleana (Responsibility)</td>
</tr>
<tr>
<td>Grade 7</td>
<td>Coral Reefs</td>
<td>How are human activities affecting coral reefs in and what can we do to ho‘ihi (respect) the ocean and promote sustainability?</td>
</tr>
<tr>
<td>---------</td>
<td>-------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Grades 7-8</td>
<td>Gardening</td>
<td>How do we grow healthy foods and malama ʻāina (care for the land) so that the land will continue to nurture us in the future?</td>
</tr>
<tr>
<td>Grades 7-8</td>
<td>Streams</td>
<td>What is the overall health of our kahawai (stream) in our ahupuaʻa, and what is our kuleana to malama (care for) it?</td>
</tr>
<tr>
<td>Grade 8</td>
<td>Landforms</td>
<td>What processes created the natural landforms in our area, what role did these landforms play in Hawaiian culture and history, and how do we show ho‘ihi (respect) for them?</td>
</tr>
<tr>
<td>Grades 9-12</td>
<td>Streams</td>
<td>What issues are affecting our streams and how can we improve water quality and care for these resources?</td>
</tr>
<tr>
<td>Emphasis: physical science</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grades 9-12</td>
<td>Fishponds</td>
<td>How can we increase the productivity of Waikalua Loko and why should we take action to malama the pond?</td>
</tr>
<tr>
<td>Emphasis: biological science</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**Organization of This Teacher’s Guide**

Each grade level unit contains the following elements:

**Unit Introduction** – a general background on the topics presented and a description of the lessons. The Introduction includes the following components:

- **Unit Map** – an overview for the teacher of the standards, essential question, key concept and assessment for each lesson
- **Rubrics** – for assessing students’ performance on the culminating papers and projects
- **Student Assessment Overview** (also referred to as “Our Challenge” in Grade 3) – a “map” of the unit that provides students with expectations and a list of Learning Log sheets that they will complete as formative assessment. The document is referred to as a Journal for Grades 9-12. This overview includes a cover that students can use for their Learning Logs or Journals.

**Instructional Activities** – Each unit includes four to six lessons that are designed to be taught sequentially. The lessons include background information for teachers, Hawai‘i DOE benchmarks, and a list of materials needed and materials provided, which include pages that are to be duplicated for students such as:

- Student readings
- Maps
- Learning Log or Journal sheets
- Data sheets
- Activity cards

The teaching suggestions included in each lesson and the estimated time for completing the lesson have been refined based on a field test that was conducted with teachers during the course of the project. The teaching suggestions are designed to help students meet the standards, but they are, of course, only suggestions since there are many different and effective ways to approach the activities.
APPENDICES – The Appendices include the following documents to help prepare your students for field trips:

- Management Tips for Field Trips
- Oli (Hawaiian and English versions of selected chants)
- Safety Guidelines for Field Trips

UNIT CDs

The CDs provided with this teacher’s guide contain files that are designed to supplement the unit. These CDs include the following files:

- **Oli** (Chants) – a folder with audio files of selected oli to introduce students to protocol. The Hawaiian and English versions of these chants are provided in written form in the Appendices.

- **PowerPoint Presentations** – Most of the units have one or two PowerPoint presentations that supplement the lessons and highlight key features of the environments students are investigating.

PROJECT WEB SITE

The project Web site link is at [www.thepaf.com](http://www.thepaf.com) home page. The Web page includes announcements and registration forms for workshops. Contact information for arranging some of the field trips is also located on this site.

ALOHA ʻĀINA VIDEO

The project video, provided on DVD, is designed to introduce your students to the vision of Project Aloha ʻĀina. That vision is that everyone in Hawai‘i lives by the values of aloha ʻāina and that communities work together to achieve their vision of a healthy environment for all in harmony with the land and the sea. This 30-minute program
portrays students discovering the gifts that the ‘āina provides in their ahupua’a. It’s a journey of discovery that includes mo’olelo, ‘oli, wonderful music, beautiful places and meaningful relationships between people and the place where they live. We welcome you to join us in the journey.
The vision of Project Aloha ʻĀina is that everyone in Hawai‘i lives by the values of aloha ʻāina and that communities work together to achieve their vision of a healthy environment for all in harmony with the land and the sea.

After watching the Aloha ʻĀina DVD, take a moment to reflect on your vision of aloha ʻāina. Describe why you think aloha ʻāina is important.

The ʻŌlelo No‘eau that Liko and Kepa learn in the program is

He ali‘i ka ʻāina;
He kauwā ke kanaka.
The land is chief.
People are its servant.
(Mary Kawena Pukui, ʻŌlelo No‘eau No 531)

What does this ʻŌlelo No‘eau mean to you?

Choose one of the values that were emphasized in the video.
• Lökahi
• Kōkua
• Laulima
• Mālama

Write a paragraph giving an example of how you live by this value.
ALOHA ‘ĀINA

GRADE 6 – CONSERVATION

I ka wā ma mua, ka wā ma hope.  
The future is found in the past.  

(Moloka‘i: Future of a Hawaiian Island, Sustainability Conference, July 2009)

Value emphasized in this unit: Hō‘ola (heal)  
How has technology changed the way we consume and dispose of products and  
what can we do to reduce waste to ho‘ola (heal) our ahupua‘a?
CONSERVATION

 HOW CAN WE REDUCE THE AMOUNT OF WASTE WE GENERATE?

Did you know that the plastic bag holding a two-pound bag of poi takes 10-20 years to decompose? It is estimated that a disposable diaper takes 45 times longer—or 450 years. Imagine the glass jar that holds uncle’s inamona (kukui nut relish). It will likely take 1 million years for the jar to decompose (North Western Hawaiian Islands Multi-Agency Education Project. *A Teacher’s Guide to Navigating Change™* 2006).

EARLY HAWAI’I

Early Hawaiians did not have to worry about plastic bags, glass bottles, or disposable diapers. These types of materials were non-existent. They used natural materials to manufacture their tools and products, which later could be easily discarded.

Early Hawaiians were stewards of the ‘āina (land). They consistently cared for the land, realizing that this most valuable resource would produce the food needed to feed their families. It was their kuleana (responsibility) to perpetually mālama this gift bestowed upon them by their gods.

KONA FIELD SYSTEM

In 1200 A.D., the Kona coast was a thriving, fertile land (Bishop Museum, 2010). Dryland agricultural plots extended from Kailua to Hōnaunau. Nā Mala O Kona (The Kona Field System) was the largest of three cultivation sites (Kirch, 1985). It stretched about 20 miles long from north to south, and six miles wide from ma uka (inland) to ma kai (shoreline) (Wolforth, 2008). The Kona Field System was a systematic cultivation of dryland crops that were cultivated in different vegetation zones, which lacked perennial streams.

Early explorers noted that the Kona Field System was well designed. It took advantage of Kona’s warm climate. The location of the fields maximized the available sunlight and periodic rain showers. Mauna Loa protected the cultivated sites from high trade winds. Onshore winds were generally light. So very little water evaporated from the soil or plants (Kelly, 1983).

Long walls called kuaïwi (backbone) ran up and down the slope of Mauna Loa. Shorter walls connected to the kuaïwi walls to form small agricultural plots. Long grasses, kō sugar cane stalks, or lā‘i (tī leaves) were often planted next to the walls. These crops would trap moisture and were an excellent source of water. Rocks placed near the base of plants would serve as mulch. Dirt would be
mounded up around the rocks, which would help retain water.

TOOLS
Equally important were the tools Hawaiians manufactured to help till the soil, catch their fish, serve their foods, fashion their hale (houses) and maintain their health. “Sanitary regulations imposed by kapu controlled the disposal of garbage and human wastes” (Mitchell, 1992). The tools they developed were made from natural materials that could easily be returned to the earth to decompose. Following is a list of some of the tools Hawaiians created from natural materials:

- ‘öpihi (limpet) shells - food scrapers
- stone or shell - hand shredders for grating coconuts
- stone – poi pounders, adze
- pearl shells - fishhooks
- shark teeth and bamboo – knives
- wood - poi pounding boards
- gourds – containers for carrying food and water
- rough lava – pig scrapers
- coconut shells – spoons, ladles and cups
- plant fibers (such as niu and olonà) – nets and ropes

If an ipu (gourd) cracked or a fish net became damaged, it would be repaired. It was uncommon for Hawaiians to unnecessarily toss away items that could be easily fixed and reused. Waste was rare, as tools, nets and utensils took a long time to make. And for those occasions when materials needed to be disposed of, they were returned to the earth to decompose and replenish the ‘āina.

CURRENT CHALLENGES
Today, waste is a serious problem in the United States and worldwide. In the U.S., an average of 4.5 lbs. of waste per person per day is generated (US-EPA, 2009). Of the 250 million tons of waste that were generated by U.S. residences, businesses, and institutions in 2008, 33% was recovered, recycled or composted, 12% was burned, and 54% went into landfills (US-EPA, 2009).

Today, the link between solid waste management and greenhouse gas emissions and climate change is gaining more attention. When wastes decompose in a landfill, methane, which is a greenhouse gas, is released into the atmosphere. Additionally, when wastes are incinerated, carbon dioxide, another greenhouse gas, is released. Finally, carbon is released into the atmosphere by the transportation of wastes to disposal sites (US-EPA, 2009).

The United States Environmental Protection Agency (EPA) sets policies to help regulate waste disposal on a national level. The agency states that the most successful way to manage
waste is through what they call an integrated approach. This means that communities use a combination of different methods to reduce their waste. These methods are source reduction, reuse, recycling, composting, waste-to-energy, and landfills. People in Hawai‘i are already using some of these methods to dispose of our waste.

Hawai‘i County has made it a goal to get ʻōpala (rubbish) under control. Waste management on Hawai‘i Island is a challenge, simply because the island is so large, and people are so far apart. Hawai‘i Island does not have curbside pick up like the lucky residents of O‘ahu. Residents must haul their trash to various transfer stations and redemption centers around the island. And with only two landfills, it is essential for the County to manage its trash wisely.

In 2008-2009, Hawai‘i County was able to divert 30.9% of the amount of waste going into the landfills. By further increasing recycling efforts, developing a waste-to-energy facility and utilizing emerging waste technologies, the County hopes to continue to divert more waste from the landfills.

**Source Reduction**

Source reduction or waste prevention is the best way to mālama our ʻāina. Source reduction simply means producing less waste. If we can create less waste, we can help decrease the amount of ʻōpala (trash, rubbish) that ends up in our landfills and waste-to-energy plants. Waste prevention also helps conserve our natural resources. If we buy fewer products and materials, we use fewer resources.

To help prevent waste and mālama our ʻāina, we can buy products with less packaging, buy items that can be reused, “pre-cycle” by buying items that have been recycled, buy food items in bulk, donate unneeded clothes to charitable organizations, and reuse items.

**Recycling**

Recycling of materials such as plastic containers, metal cans, glass bottles and paper products is another way to reduce waste. These materials are sent to a manufacturing plant where they are made into new products. When we recycle, the materials that were used to manufacture the original product are reused to make new products.

Hawai‘i County commissioned Recycle Hawai‘i, a 501(c) 3 non-profit educational organization, to spearhead the recycling effort in West Hawai‘i. Recycle Hawai‘i offers free public recycling educational services, and established the recycling center at Kona Recycles@Kealakehe as a model for what a comprehensive recycling center should incorporate.

Hawai‘i Island has 21 transfer stations where residential customers take their
trash. At 15 of these stations, there is some kind of recycling bin or center. Most of these transfer stations just have one recycling bin, since the areas where they are located are so sparsely populated. In busy Kona town, the Kealakehe transfer station recycles: green waste, plastic, glass, metal, paper and other reusable items.

There are also 10 redemption centers at these transfer stations and another three at non-transfer station sites. These centers are open for people to drop off recyclable items such as plastic, glass and aluminum under the Hawai‘i Beverage Container Law more commonly known as the HI 5¢ bottle bill law. For the last half of 2006, the redemption rate on Hawai‘i Island was a commendable 82%! (County of Hawai‘i, Dept. of Environmental Management, Recycling Section. Personal conversation with Chris Chin-Chance, Recycling Specialist on April, 16, 2007).

If people can learn to recycle at such high rates, making redemption and recycling centers at all of the transfer stations would greatly decrease the volume of waste going into the island’s landfills.

Many of the materials we recycle are manufactured into useful new products. Some companies are recycling old rubber tires and using them for playground surfaces and as a soil additive to improve drainage on athletic fields. Unusable rubber tires are also put through a cutter and now mixed with asphalt to pave highways. Recycled plastics are being used to build picnic tables, park benches, decks and bridges

**COMPOSTING**

Composting is another way to recycle. Yard waste such as leaves, grass and other small trimmings can be combined with plant wastes from the kitchen and placed in a bin or left in an open pile to decompose. Decomposers break down the organic material, which can later be used as plant fertilizer.

Hawai‘i County has made efforts to increase the recycling of green waste. Green waste can be dropped off at the Hilo, Kealakehe and Kea‘au transfer stations, and at some private composting companies. In fiscal 2006, about 48,300 tons of green waste were saved from the landfills and made into mulch. Mulch is available free at these locations.

Recycle Hawai‘i helped Hawai‘i County to implement a composting program in the County schools to teach our keiki about recycling. Earth Machine composting bins were distributed to 30 county schools and teachers and students have learned to compost shredded office paper, cardboard, cafeteria kitchen scraps and campus
ground clippings. The resulting compost is used in a variety of campus beautification projects. Pa’aulario School currently has 12 Earth Machines at various stages of compost, which are used as a part of their curriculum. Approximately 1,800 pounds of material per Earth Machine is diverted from landfills annually.

**Waste-to-Energy Facility or Plant**

The County reviewed several options and found that a “mass burn” waste-to-energy (WTE) facility offers the most viable technology for Hawai‘i Island. This technology is used at the H-POWER plant on O‘ahu, which processes over 2,000 tons and converts that trash into energy. This energy provides enough electricity for 60,000 homes or the equivalent of 800,000 barrels of oil each year. Not only does WTE generate significant amounts of energy, it also keeps metals from ending up in our landfills, streams and other parts of our environment.

The Hawai‘i Island facility would be smaller than H-Power on O‘ahu but have just as beneficial an impact. Private operators have submitted proposals for a facility that will handle about 200 tons of waste a day and would be located in South Hilo. It is uncertain when a WTE facility would be completed and operational on Hawai‘i Island. After the proposals are reviewed, the County Council needs to provide funding for the $30-40 million plant, an Environmental Impact Statement (EIS) must be prepared, and public hearings heard before final

Studies of the impact of waste-to-energy plants on society are still being conducted, and large-scale municipal waste recycling alternatives to Honolulu’s H-POWER continue to be explored.

**Landfills**

Landfills are the most common way to dispose of waste. Garbage is dumped into a large cavity in the earth at a designated landfill site. The waste is spread out into thin layers, packed down firmly, and covered every day with a fresh layer of soil or plastic foam. (See Diagram of Landfill in the last lesson of this unit.) This is done to prevent the ‘opala from blowing away and to prevent smelly odors!

There are two landfills on the island of Hawai‘i: one at Pana‘ewa in Hilo and one at Pu‘uanahulu in Kona. The Hilo Landfill is subject to closure in 2012 because at that time it is expected to be at full capacity. The Pu‘uanahulu Landfill averages approximately 360 tons of garbage per day and nearly 130,000 tons per year. Old carpets, furniture, mattresses, sewage sludge and dead animals are just a few of the items that end up there.
According to the Zero Waste Implementation Plan prepared for the County of Hawai‘i, 70% of waste currently generated is entering our landfills. The goal of the plan is to provide resources and jobs to support sustainability on Hawai‘i Island. The plan recommends developing the island’s 12 transfer stations into recycling-resource stations; increasing participation in the HI-5 Recycling Program; and encouraging everyone to reduce, recycle, and compost (Recycle Hawai‘i, 2010).

**Hō’ōla Our Ahupua‘a**

The essential question addressed in the unit is: **How has technology changed the way we consume and dispose of products, and what can we do to promote zero waste to hō’ōla (heal) our ahupua‘a?** To address this question, the unit invites students to explore different ways to reduce the amount of waste that ends up in our landfills.

The unit begins with **Where Does All the ‘Ōpala Go?** Students learn about the tools and products that early Hawaiians manufactured from natural materials that easily decompose. They form teams, read about current technologies to manage waste, and sift through their classroom “garbage dump” to identify various types of waste that reflect our consumer habits.

In the second lesson, **Waste Audit**, students form teams and conduct a waste audit of their class and school. They sort and record their results and make inferences about the school populations based on their data.

Students in the third lesson, **Waste Not**, conduct an experiment using waste they collect from a class pūpū (snack) party. They record their observations on a data sheet and share their results with classmates.

In the fourth lesson, **Nā Māla O Kona**, Students learn how the needs of kanaka (people) influenced the development of the Kona Field System. They construct a map that highlights the key cultivation zones and identify crops found in each of the different areas. They learn about traditional Hawaiian planting by the moon and reflect on their own relationship to the ‘āina.

The final lesson, **‘Ōpala Outing**, provides students with a field experience to Recycling and Reuse Center at the Keauhou transfer station. Students write a letter to a site that they visit and describe what they learned and what they can do to help reduce wastes. Student teams then implement school-based projects that reduce waste in their community, presenting their projects in a final hō‘ike (exhibition) to ‘ohana and their school community.
REFERENCES
Recycle Hawai’i. “Backyard Composting.”


Hawaiian Electric Company, Inc.

Honolulu’s Department of Environmental Services. City & County of Honolulu, HI.

Hydromex Technologies.


RESOURCES
Hawai’i Information Consortium, LLC. “Hawai’i Beverage Container Deposit Program.”
Hawai’i State Department of Health.


Waste Management. “West Hawai’i Landfill.”
Unit Essential Question: How has technology changed the way we consume and dispose of products and what can we do to promote zero waste to hoʻōla (to heal) our ahupuaʻa?

Project: Students investigate how technology has changed our consumer habits and the way we manage our waste. They present projects that reflect ways to mālama our ahupuaʻa by practicing waste prevention strategies in our community.

Values Emphasized: hoʻōla (to heal) and kuleana (responsibility)

1. Where Does All the ‘Ōpala Go? [3 Class Periods]
   How did early Hawaiian needs and use of technology compare to our needs and use of technology today?

   Hawaiʻi DOE Standards and General Learner Outcomes (GLOs)
   SC.6.2.2 Explain how the needs of society have influenced the development and use of technologies.
   LA.6.4.3 & LA.6.4.4 Edit writing to correct punctuation and use a variety of strategies and resources to spell grade-appropriate words.
   LA.6.5.1 Select appropriate details, examples, reasons, and/or facts to support an insight, message, or thesis.
   LA.6.6.3 Give short, prepared oral presentations to inform and persuade.
   NHMO 3-16 Apply cultural and traditional knowledge of the past to the present.

   Key Concepts
   Hawaiians manufactured tools made from natural materials that would easily decompose or were easily re-integrated into nature.
   Our consumer habits have made it necessary for us to develop new ways and technologies to manage our waste, much of which is non-biodegradable.
   We can learn from our ancestors and become zero waste consumers by repurposing and recycling organic and non-organic products.

   Assessment
   Oral presentation: Students present their findings to their classmates, reflecting on how our consumer habits have influenced the way we manage our waste.
   Reflection: Students write two paragraphs using correct punctuation, spelling, and grammar to reflect the value of mālama and how traditional knowledge of waste management can be applied to the present.
## 2. Waste Audit

**What inferences can we make from a waste audit about our school's impact on the 'āina?**

<table>
<thead>
<tr>
<th>Hawai'i DOE Standards and General Learner Outcomes GLOS</th>
<th>Hawai'i DOE Benchmarks, GLOs, and Nā Honua Mauli Ola (NHMO)</th>
<th>Key Concepts</th>
<th>Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Science 1: The Scientific Process</td>
<td>SC.6.1.1 Formulate a testable hypothesis that can be answered through a controlled experiment.</td>
<td>We can make inferences about our school population and our impact on the 'āina based on the data we collect about school wastes.</td>
<td>Develop and test hypotheses.</td>
</tr>
<tr>
<td>SCIENTIFIC INVESTIGATION</td>
<td>SC.6.1.2 Use appropriate tools, equipment, and techniques safely to collect, display, and analyze data.</td>
<td>We need to be more thoughtful and actively participate in recycling programs that will help keep our 'āina healthy.</td>
<td>Analyze the data they collect from their school audit and graph the results, using the information to make inferences that apply to the school population.</td>
</tr>
<tr>
<td>Scientific Inquiry</td>
<td>MA.6.13.1 Make inferences about a population based on the interpretation of a sample data set.</td>
<td>We can reduce management costs and promote better use of our limited natural resources.</td>
<td>Write reflections that discuss the process of conducting a waste audit and the potential impact on the 'āina of the waste that we generate.</td>
</tr>
<tr>
<td>Math 13: Data Analysis, Statistics, and Probability</td>
<td>LA.6.5.1 Select appropriate details, examples, reasons, and /or facts to support an insight, message, or thesis.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DATA ANALYSIS</td>
<td>NHMO 8-10: Preserve, protect, and sustain a healthy environment.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Predictions and Inferences</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Language Arts 5: Writing: RHETORIC</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Meaning</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

We can make inferences about our school population and our impact on the 'āina based on the data we collect about school wastes.

We need to be more thoughtful and actively participate in recycling programs that will help keep our 'āina healthy.

We can reduce management costs and promote better use of our limited natural resources.
### 3. Waste Not

**How can we use technology to speed up the decomposition of wastes?**

<table>
<thead>
<tr>
<th>Science 1: The Scientific Process: SCIENTIFIC INVESTIGATION</th>
<th>SC.6.1.1 Formulate a testable hypothesis that can be answered through a controlled experiment.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scientific Inquiry</td>
<td>SC.6.2.1 Explain how technology has an impact on society and science.</td>
</tr>
<tr>
<td>Science 2: The Scientific Process: NATURE OF SCIENCE</td>
<td>SC.6.3.1 Describe how matter and energy are transferred within and among living systems and their physical environment.</td>
</tr>
<tr>
<td>Science, Technology, and Society</td>
<td>NHMO 6-11: Acquire technological skills and dispositions for improving the quality of life.</td>
</tr>
<tr>
<td>Science 3 Life and Environmental Sciences: ORGANISMS AND THE ENVIRONMENT</td>
<td>In the decomposition process, matter is broken down, nutrients are returned to the physical environment, and heat is released.</td>
</tr>
<tr>
<td>Cycles of Matter and Energy</td>
<td>When microorganisms are combined effectively they can accelerate the decomposition process in a healthy, organic way.</td>
</tr>
<tr>
<td></td>
<td>Write a one-page lab report, describing their hypothesis, methodology, results and conclusions.</td>
</tr>
<tr>
<td></td>
<td>Diagram how matter and energy are transferred in the decomposition process.</td>
</tr>
<tr>
<td></td>
<td>Explain their conclusion about the potential of Effective Microorganisms (EM) to improve the quality of life in the school community.</td>
</tr>
</tbody>
</table>

### 4. Nā Māla O Kona

**How did the needs of the people influence the development of the Kona Field System?**

<table>
<thead>
<tr>
<th>Science 2: Scientific Process: NATURE OF SCIENCE</th>
<th>SC.6.2.12 Explain how the needs of society have influenced the development and use of technologies.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Language Arts 3: Reading: LITERARY RESPONSE AND ANALYSIS Interpretive Stance</td>
<td>LA.6.3.1 Analyze plot, setting, characterization, or conflict to interpret theme in a literary text.</td>
</tr>
<tr>
<td>Language Arts 4: Writing: CONVENTIONS AND SKILLS</td>
<td>LA.6.4.1 Write in a variety of grade-appropriate formats for a variety of purposes and audiences, such as pieces to reflect on learning and to solve problems.</td>
</tr>
<tr>
<td>NHMO 8-1 Be keen observers of their natural environment.</td>
<td>Kanaka (people) designed the Kona Field System to increase food production.</td>
</tr>
<tr>
<td></td>
<td>Kanaka took advantage of the different elevations to maximize crop yields.</td>
</tr>
<tr>
<td></td>
<td>Water was collected from rain, intermittent streams, and the plants themselves to nourish the ʻāina.</td>
</tr>
<tr>
<td></td>
<td>Kulaʻwi walls and other agricultural terraces were initially designed for food production and to control soil erosion.</td>
</tr>
<tr>
<td></td>
<td>Students create an enlarged map of the Kona Field System, label the different agricultural zones, including the terraces and water sources.</td>
</tr>
<tr>
<td></td>
<td>Explain how the needs of the people influenced the development of the Kona Field System.</td>
</tr>
<tr>
<td></td>
<td>Reflect on how kanaka were connected to their environment and followed the phases of the moon to determine the best growing conditions for their crops.</td>
</tr>
</tbody>
</table>
# Grade 6 Unit Map

## Conservation

### 5. ‘Opala Outing – Culminating Activity

How has technology changed the way we consume and dispose of products and what can we do to promote zero waste to ho’ōla (to heal) our ahupua’a?

<table>
<thead>
<tr>
<th>Hawai‘i DOE Standards and General Learner Outcomes (GLOs)</th>
<th>Hawai‘i DOE Benchmarks, GLOs, and Nā Honua Mauli Ola (NHMO)</th>
<th>Key Concepts</th>
<th>Assessment</th>
</tr>
</thead>
</table>
| Science 2: The Scientific Process NATURE OF SCIENCE  
Science, Technology and Society | SC.6.2.2 Explain how the needs of society have influenced the development and use of technologies.  
SC.6.3.1 Describe how matter and energy are transferred within and among living systems and their physical environment. | Technology has changed the way we consume by allowing us to purchase many new products that are shipped over long distances and often manufactured from new human-made materials.  
Technology impacts the way we dispose of and recycle products. | Create a diagram to represent how landfills are designed to minimize impact on the environment.  
Write a one-page letter to a recycling center to summarize learning and address the unit essential question.  
Work with a hui (group) to complete a project that reduces waste and reflects caring for and healing our ahupua’a.  
Present projects (e.g., computer presentation, video, model, story, or song) to peers and ‘ohana and explain ways in which technology has changed our society.  
Complete a self-assessment of contributions to group work and personal commitment to care for the ‘āina. |
| Science 3: Life and Environmental Sciences: ORGANISMS AND THE ENVIRONMENT  
Cycles of Matter and Energy | LA.6.5.2 Use an organizational structure to support meaning.  
LA.6.6.1 Explain how appropriate participation affects the productivity of group activities.  
LA.6.6.3 Give short prepared oral presentations to inform and persuade.  
LA.6.6.4 Use appropriate listening strategies (e.g., listening attentively, taking notes, asking questions) to learn from an oral presentation.  
GLO 5: Communicate effectively and clearly through speaking, using appropriate forms, conventions, and styles to convey ideas and information. | We can make consumer choices that will reduce waste, and we can take action to recycle and compost more of the materials we use. | |
| Language Arts 5: Writing: RHETORIC  
Design | NHMO 8-2 Maintain a clean and healthy environment, i.e., waste management.  
NHMO 8-13 Teach others about the concept of mālama through example.  
NHMO 8-14 Participate in conservation and recycling practices and activities. | | |
| Language Arts 6: Oral Communication  
CONVENTIONS AND SKILLS  
Discussion and Presentation  
Critical Listening | | | |
**RUBRIC FOR CULMINATING PAPER** – How has technology changed the way we consume and dispose of products and what can we do to promote zero waste to ho’ola (to heal) our ahupua’a?

| Name: ___________________________ | Date: _________________ | Total Points: ______ |

**Science 2: NATURE OF SCIENCE**

Did I explain how technology has an impact on society by changing the way we use and dispose of products?

<table>
<thead>
<tr>
<th>Kūlia (Exceeds Standard)</th>
<th>Mākaukau (Meets Standard)</th>
<th>’Ano Mākaukau (Almost at Standard)</th>
<th>Mākaukau ‘Ole (Below Standard)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Points: ____</td>
<td>Points: ____</td>
<td>Points: ____</td>
<td>Points: ____</td>
</tr>
</tbody>
</table>

- I clearly explained how technology has changed the way we consume and dispose of products. I wrote a thoughtful description of ways to reduce waste and heal our ahupua’a.
- I explained how technology has changed the way we consume and dispose of products. I described ways to reduce waste and heal our ahupua’a.
- I did not clearly explain how technology has changed the way we use and dispose of products. I described an idea about reducing waste, but I needed to develop it more.
- I did not explain how technology has changed the way we use and dispose of products. I need to think about reducing wastes and develop my ideas.

**Language Arts 5: Writing RHETORIC**

Did I organize my ideas to communicate my key points effectively?

| Points: ____ |

- My own ideas are effectively combined with useful information to organize my key points effectively.
- My own ideas are organized to effectively communicate my key points.
- Some of my ideas are organized to effectively communicate my key points.
- I did not organize my ideas to effectively communicate my key points.

**Language Arts 6: Writing CONVENTIONS AND SKILLS**

Did I correct my spelling, punctuation and grammar?

| Points: ____ |

- My final paper has no errors in spelling, punctuation or grammar!
- My final paper is almost free of spelling, punctuation and grammatical errors.
- I corrected some of my errors but not all of them.
- I never revised my paper to correct errors in spelling, punctuation or grammar.

**Nā Honua Mauli Ola 8-2**

Did my paper identify healthy cultural behaviors to practice in our ahupua’a to promote zero waste and ho’ola (heal) the environment?

| Points: ____ |

- My paper clearly explained a few different behaviors and cultural practices that would promote zero waste and ho’ola (heal) the environment.
- My paper identified and described at least two different behaviors and cultural practices that would promote zero waste and ho’ola (heal) the environment.
- My paper identified at least one behavior and/or cultural practice that would promote zero waste and ho’ola (heal) the environment.
- My paper did not identify or describe any behavior or cultural practice that would promote zero waste and ho’ola (heal) the environment.
Rubric for Team Presentation - How has technology changed the way we consume and dispose of products and what can we do to promote zero waste to *ho'ōla* (to heal) our *ahupua'a*?

<table>
<thead>
<tr>
<th>Team Members: ___________________________</th>
<th>Evaluator(s): ___________________________</th>
<th>Date: ____________</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Hawai'i DOE Standards</strong></td>
<td><strong>Kūlia</strong> (Exceeds Standard)</td>
<td><strong>Mākaukau</strong> (Meets Standard)</td>
</tr>
<tr>
<td><strong>Benchmarks, GLOs, and Nā Honua Mauli Ola</strong></td>
<td>Points: ___</td>
<td>Points: ___</td>
</tr>
<tr>
<td><strong>Science 2: NATURE OF SCIENCE</strong> Did your team explain how technology has changed the way we use and dispose of products?</td>
<td>The group clearly explained with good examples, how technology has changed the way we use and dispose of products to reduce waste in our <em>ahupua'a</em>.</td>
<td>The group explained how technology has changed the way we use and dispose of products to reduce waste in our <em>ahupua'a</em>.</td>
</tr>
<tr>
<td>Visual Aids / Resources Did your team use visual aids that would enhance the presentation and clarify key points?</td>
<td>Computer-generated or handmade visual aids were clear, creative, and helped to explain key points.</td>
<td>Computer-generated or handmade visual aids illustrated key points.</td>
</tr>
<tr>
<td>GLO 5: Effective Communicator Did your team communicate effectively and clearly deliver information to the audience?</td>
<td>The team had a great connection with the audience. Students spoke clearly and loudly and made eye contact with the audience. The team’s presentation was enjoyable and easy to follow!</td>
<td>The team communicated clearly. Students spoke loud enough for people to hear and made eye contact with the audience. The presentation was easy to follow.</td>
</tr>
<tr>
<td>GLO 5: Effective Communicator Did team members effectively listen to each other’s ideas and opinions?</td>
<td>Students actively listened to each other’s ideas and opinions. Cooperation and teamwork was excellent. <em>Maika’i!</em></td>
<td>Students actively listened to each other’s ideas and opinions. Students worked well together as a team.</td>
</tr>
<tr>
<td><strong>Language Arts 6: Oral Communication CONVENTIONS AND SKILLS</strong></td>
<td>The team worked very well together. Everyone participated and the cooperation paid off in a great presentation!</td>
<td>Everyone participated and worked together well to create a good presentation.</td>
</tr>
</tbody>
</table>

*Points:* ___
LEARNING LOG

ALOHA ‘ĀINA – CONSERVATION

Hōʻōla: Healing Our Ahupuaʻa

STUDENT’S NAME: ________________________________________

SCHOOL: ________________________________________________

DATE STARTED: ____________________________

DATE ENDED: __________________________________________
STUDENT ASSESSMENT OVERVIEW

UNIT ESSENTIAL QUESTION
How has technology changed the way we consume and dispose of products and what can we do to promote zero waste to hoʻōla (heal) our ahupuaʻa?

NĀ HONUA MAULI OLA (NHMO) – HAWAIIAN GUIDELINES IN THIS UNIT
• Apply the cultural and traditional knowledge of the past to the present.
• Preserve, protect, and sustain a healthy environment. (i.e., environmentally sound legislation, mālama ʻāina)
• Acquire technological skills and dispositions for improving the quality of life.
• Be keen observers of their natural environment.
• Maintain a clean and healthy environment (i.e. waste management).
• Teach others about the concept of mālama through example.
• Participate in conservation and recycling practices and activities.

GENERAL LEARNER OUTCOME IN THIS UNIT
• GLO 5: Communicate effectively and clearly through speaking, using appropriate forms, conventions, and styles to convey ideas and information.

YOUR KULEANA (RESPONSIBILITY) - INDIVIDUAL LEARNING LOG:
You are responsible for completing individual activity sheets and reflections focused on various lessons and keeping them in your Learning Log. All drawings, graphs, and completed written work for this unit should be included in your Learning Log. Total possible points for each of these products will be discussed as we go through the unit.

LESSONS, STANDARDS, AND LEARNING LOGS

<table>
<thead>
<tr>
<th>LESSONS, STANDARDS, AND LEARNING LOGS</th>
<th>✓ COMPLETED</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Where Does All the ‘Ōpala Go?</td>
<td>✓</td>
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<tr>
<td>Science 2; Language Arts 4, 5, and 6</td>
<td></td>
</tr>
<tr>
<td>• Learning Log 1 – Thinking About ‘Ōpala</td>
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<tr>
<td>• Learning Log 2 – Reflection / Assessment</td>
<td>✓</td>
</tr>
<tr>
<td>2. Waste Audit</td>
<td>✓</td>
</tr>
<tr>
<td>Science 1, Math 13, Language Arts 5</td>
<td></td>
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<tr>
<td>• Graph</td>
<td></td>
</tr>
<tr>
<td>• Learning Log 3 – Reflection / Assessment</td>
<td>✓</td>
</tr>
</tbody>
</table>
### 3. Waste Not
Science 1, 2, and 3
- Learning Log 4 – From Waste to Wonderful
- Learning Log 5 – Designing an Experiment
- Learning Log 6 - Observations
- Learning Log 7 – Reflection / Lab Report

### 4. Na Mala O Kona
Science 2
- Learning Log 8 – Kona Field System and Technology

### 4. ʻOpala Outing
Science 2 and 6; Language Arts 5 and 6
- Learning Log 9 - ʻOpala Outing
- Learning Log 10 - Letter
- Learning Log 11 - Group Project Plan
- Learning Log 12 – Self Assessment

**INDIVIDUAL PROJECT: Due Date: ______________________**
Write a one-page thank you letter to the site we visit in our ʻOpala Outing. Your letter should answer the unit essential question and summarize what you have learned. Details will be provided after the field trip.

**GROUP PROJECT (TO BE COMPLETED BY THE END OF THE UNIT)**
**Due Date: ______________________**
- Work in a team to develop a project to reduce waste in our school community.
- Develop a presentation to share your ideas and your project before an audience of your peers, ʻohana (family), and school administrators.
- Collaborate with your team to decide how you would like to present your project. You may choose to do a computer presentation, video, story, song or storyboard. You will receive more instructions during the unit.
- Combine ideas learned in this unit and answer the unit essential question.
- Explain what you have learned about how technology has changed the way we consume and dispose of products
- Provide and example of mālama (caring) by describing what your team is doing to reduce waste and help hoʻōla (heal) our ahupuaʻa.

Your grade will be based on a rubric that we will review.
WHERE DOES ALL THE ‘ŌPALA GO?

How does early Hawaiian use of technology compare to our use of technology today?

HAWAI’I DOE STANDARD BENCHMARKS

Science 2: The Scientific Process: NATURE OF SCIENCE
• SC.6.2.2 Explain how the needs of society have influenced the development and use of technologies.

Language Arts 4: Writing:
CONVENTIONS AND SKILLS
• LA.6.4.3 & LA.6.4.4 Edit writing to correct punctuation and use a variety of strategies and resources to spell grade-appropriate words.

Language Arts 5: Writing: RHETORIC
• LA.6.5.1 Select appropriate details, examples, reasons, and/or facts to support an insight, message, or thesis.

Language Arts 6: Oral Communication
CONVENTIONS AND SKILLS
• LA.6.6.3 Give short prepared oral presentations to inform and persuade.

NĀ HONUA MAULI OLA
• NHMO: ‘Ike Mauli Lāhui – Cultural Identity Pathway 3-16 Apply the cultural and traditional knowledge of the past to the present.

KEY CONCEPTS
• Hawaiians manufactured tools made from natural materials that would easily decompose or were easily reintegrated into nature.
• Our consumer habits have made it necessary for us to develop new ways and technologies to manage our waste, much of which is non-biodegradable.
• We can learn from our ancestors and become “Zero Waste” consumers by repurposing and recycling organic and non-organic products.

ACTIVITY AT A GLANCE
Students learn about tools and products that early Hawaiians manufactured from natural materials that easily decompose. They form teams, read about current technologies to manage waste, and sift through their classroom “garbage dump” to identify various types of waste that reflect our consumer habits. They identify ways to become “Zero Waste” consumers and develop projects for the classroom.

ASSESSMENT
• Oral presentation: Students present their findings to their classmates, reflecting on how our consumer habits have influenced the way we manage our waste.
• Reflection: Students write two paragraphs using correct punctuation, spelling, and grammar, to reflect the value of mālama and how traditional knowledge of waste management can be
applied to the present. They reflect on ways they can become “Zero Waste” consumers.

**TIME**

3 class periods

**SKILLS**

analyzing, collaborating, reflecting, writing, presenting

**MATERIALS**

Provided:

- Learning Log cover sheet (provided in the Unit Introduction)
- Student Assessment Overview (provided in the Unit Introduction)
- ‘ōpala technology cards
- Learning Logs 1 – 2
- Student Reading 1
- Letter to Families
- PowerPoint presentation (provided on CD)

Needed:

- folders (one for each student’s Learning Log)
- tarp (to display ‘ōpala)

Hawaiian materials:

- dried ti leaf (used for cordage)
- coconut (used as cordage and utensils)
- small smooth stone (used as a bath stone to cleanse the skin)
- a small finger of white coral (used for sandpaper)
- an ‘ōpihi shell or similar type (used as a food scraper)
- a small calabash or ipu (used as a water gourd or food server)

**VOCABULARY**

- integrated approach – in this context, using a combination of different methods to help reduce waste
- ‘ōpala – trash, rubbish, litter
- recycling – the method involving collecting, separating, processing and marketing a material that would have been thrown away
- source reduction – (also known as waste prevention) any change in the design, manufacturing, purchase, or use of materials or products to reduce the amount of toxicity or the amount of waste before materials become municipal solid waste
- technology – the study, development and application of devices, machines, and techniques for manufacturing and productive processes
- waste prevention – the reuse of products or materials, or reduction of use
- zero waste – is a way of life that promotes the RRRRs (reduce, reuse, rot, and recycle). It reincorporates the by-product of one system for use in another system. The goal is to eliminate or drastically reduce waste that could have ended up in the landfill.

**ADVANCE PREPARATION**

- Make one copy of the ‘ōpala technology cards. Cut and laminate cards.
- Copy a Learning Log cover sheet and Student Assessment Overview (from the Unit Introduction), the Letter to Families, Learning Logs 1 – 2, and Student Reading 1 for each student.
- Before beginning this unit, distribute the Letter to Families and ask each
student to bring three items from the modern-day materials listed in the letter.

☐ Collect the materials that Hawaiians used to make things in their everyday lives.

☐ On the day you plan to teach the lesson, set up your classroom “garbage dump.” Display all of the items your students brought from home on a tarp.

3, and 6, as well as hard plastic bottles (#7), have been shown to release toxins into food or liquids under certain conditions. It is not recommended that containers made from these plastics be reused because of potential health risks (About.com, 2007).

**Recycling Plastics**

Since plastics are made from fossil fuels, it would seem that recycling them would help to conserve energy. However, it is not always possible to find a place that will accept the different types of plastics for recycling. The chasing arrows symbol on plastic containers does not mean the plastic is recyclable; it is just the indication of the type of plastic material. Most recycling centers are only accepting Plastic #1 PET (Polyethylene Terephthalate) and Plastic #2 HDPE (High Density Polyethylene) for recycling. These are the two types of plastics we can place in curbside recycling containers in Hawai‘i.

- Plastic #1 (soda and water bottles) is being recycled into a number of products including fiberfill for jackets and sleeping bags, rope, car bumpers, cassette tapes, furniture, and new plastic bottles.
- Plastic #2 (heavier containers such as bleach or milk jugs) is being recycled into plastic lumber, rope, toys and piping.
• Plastic #3 (shower curtains, toys, medical tubing, pipes); Plastic #4 (grocery and sandwich bags); and Plastic #5 (containers such as Tupperware) have a very low rate of recycling.
• Plastic #6 (Styrofoam cups and containers, egg cartons) is recycled into foam insulation and cassette tapes.
• Plastic #7 is made from combinations of different plastics and these items are not usually accepted for recycling.

Alternative types of packaging that are similar to plastic are being developed from renewable natural resources such as corn. A product known as PLA (polylactic acid) is produced from corn and developed into a resin that can be melted and reshaped into fibers or containers. While this new material has the advantage of using less energy and being biodegradable, some have raised concerns about converting food crops to nonfood uses when so many people in the world are going hungry (Royte, 2006). There are also concerns about the feasibility of recycling this new material.

A Hawai‘i business is selling biodegradable and compostable service-ware products. These products are made from bagasse, which is sugar-cane fiber left over after extracting the juice from the cane. It is formed into products such as plates, cups, bowls and take-out containers. It takes anywhere from 30 to 90 days for these products to decompose, depending on the conditions.

Polystyrene – a petroleum-based product – takes years to break down. Polystyrene and benzene are combined to produce the product most commonly known as Styrofoam. Styrofoam is an inexpensive, convenient and sanitary product. But it poses great environmental and health risks. One Styrofoam cup can take 50 years to break down in the environment!

Ultimately, in order to reduce the amount of plastics and polystyrene products that we dispose of in landfills or burn in waste-to-energy plants, we can examine our own consumer habits. This would include reducing our consumption of disposable plastic products (including excessive packaging), purchasing non-polystyrene products that are compostable, buying things in bulk, and reusing or refilling containers.

We can support the “Zero Waste” campaign by practicing the traditions and values of our ancestors. We can do this by reincorporating items into another useful life cycle. By doing this, we will help divert waste from our landfill and help to hō`ola (heal) the ‘āina (land).

**Teaching Suggestions**

1. **Introduce the unit with the Learning Log and the Student Assessment Overview.**
   - Pass out one folder and a copy of the Learning Log cover sheet and the Student Assessment Overview to each student.
• Instruct students to glue the cover sheet to the outside of their folder and to glue the assessment sheet to the inside cover of the folder—this will serve as each student’s Learning Log or portfolio.
• Review the unit topic, standards, assessment procedures and expectations.
• Introduce the unit essential question and standards you will be addressing.

  **Unit Essential Question:** How has technology changed the way we consume and dispose of products and what can we do to promote zero waste to ho‘ola (heal) our ahupua‘a?

• If students are unfamiliar with the concept of ahupua‘a, help them to define it and locate your ahupua‘a on a map of your island (see Resources).
• Review expectations for culminating projects.

2. **Define and identify different types of technology found at home and in school.**

• Ask students to define “technology” and identify different kinds of technology that are found around the home and school, for example, computers, telephones, stove, refrigerator, car, boat, etc.
• List their responses on the board under the heading **“Technology Today” (column A).**

3. **Display types of ancient Hawaiian materials and have a discussion.**

• Explain to students that each item represents an early form of Hawaiian technology.
• Hold up each object and ask students to identify the item and how it may have been used.
• List their responses on the board under the heading **“Early Hawaiian Technology” (column B).**

4. **Discuss the difference between traditional and modern-day materials.**

  **Discussion Questions**

• How do the materials in column A and B differ? *(Most of the items in column A are made of plastic, nylon and aluminum or synthetic materials, which do not easily decompose. The items in column B are primarily biodegradable; made of wood, stone and other natural materials.)*

• How do you think early Hawaiians disposed of their waste materials? *(Pits were dug and covered with earth to dispose of food leftovers. Stone implements and some woods do not break down as easily, and as a result, fragments of these artifacts have been recovered in archaeological digs.)*

• What are some ways that we dispose of our waste products today? *(Reducing and reusing items. Establishing recycling centers. Composting of green waste. Developing waste-to-energy combustion facilities. Creating landfills.)*

5. **Distribute the Student Reading.**

• Ask students to read the material and initiate a discussion.
• Discuss what students know about reducing our waste stream.
6. **Share the PowerPoint presentation with the class and review the main points:**
   - Humans have produced an incredible amount of waste; an average of 4.5 lbs of waste per person per day in the U.S.
   - Society has had to figure out a way to deal with it.
   - New technology has helped deal with the problem.
   - Humans have also developed ways to reduce waste.

7. **Divide the class into five teams.**
   - Distribute an ‘*opala technology card* to each group and Learning Log 1 to each student.
   - Have each group read the information on the card.

8. **Have students “sift” through the class garbage dump (see Advance Preparation).**
   - Ask each group to choose two items that could be disposed of, eliminated, or reduced using the technology described on the card.
   - Show them how to read the chasing arrows on the plastic items and discuss those that can be recycled (see Teacher Background Information).
   - Have each student complete Learning Log 1.
   - Ask students on each team to present their findings.

9. **Complete the assessment.**
   - Distribute Learning Log 2 to each student and review the reflection (assessment).
   - Ask students to complete the reflection and set a due date.

**ADAPTATIONS / EXTENSIONS**

Distribute an ‘*Ohana* sheet (provided at the end of this lesson) to each student. Have students choose an item from the list and challenge the students and their families to reduce their amount of waste at home. Refer them to the Kanu Hawai‘i Web site: [http://www.kanuhawaii.org/](http://www.kanuhawaii.org/) where people are voicing their commitments to reduce wastes and *malama* our island home. Ask students to write a two-page reflection based on their experience.

Set up a recycling drive at your school. There is a website for Hawai‘i Island about more recycling locations. Go to [www.recyclehawaii.org](http://www.recyclehawaii.org) for further information.

Challenge other grade level classes to

Have students research the problem of marine debris. Student activities are available in *A Teachers Guide to Navigating Change*. To download lessons, see: [http://www.hawaiianatolls.org](http://www.hawaiianatolls.org).
REFERENCES

City and County of Honolulu Department of Environmental Services. 2006. City and County of Honolulu, HI. www.opala.org (accessed January 5, 2010).

Honolulu Advertiser. “Bio-good to Go.”


U.S. Environmental Protection Agency. “Municipal Solid Wastes – Basic Facts”.

RESOURCES


WHERE DOES ALL THE ‘ŌPALA GO?  

LETTER TO FAMILIES

Aloha 6th Grade Students and ‘Ohana,

We are about to embark on an adventure into learning about how technology has changed the way we use items and dispose of waste. We will be discovering how we can help to hō‘ola (heal) our ahupua‘a by reducing, reusing and recycling. And learning about “Zero Waste.”

Your assignment is to gather some of the items we will need to compare the products and technology of ancient Hawai‘i to our products and technology today.

Please bring in three (3) items from the list below.

Please make sure these items are clean so they will not attract pests. Do not bring sharp objects that could cause injury.

- plastics
- glass
- aluminum or metal
- rubber
- yard trimmings
- food packaging (clean, empty cereal boxes, food containers, etc.)
- old toys
- discarded clothing

Please list the items you brought below:

1. ____________________________________

2. ____________________________________

3. ____________________________________

BONUS: Bring one (1) item from your home, yard, or beach that you think could have been used as a tool in early Hawai‘i.

Your items are due in class by ____________________________

Mahalo!
WHERE DOES ALL THE ‘ŌPALA GO?

EARLY HAWAIIAN TOOLS AND PRODUCTS

Early Hawaiians were inventors of many tools. They were very skilled at creating tools and products using the materials in their environment. They fashioned fishhooks from bones, shells and wood.

They made strong cutting tools (adzes) by shaping dense lava rock into a blade, and attaching it to wooden handles with cordage made from natural plant fibers. The adzes were used to cut trees for houses and canoes.

Hawaiians designed clever lures for he’e (octopus) using a cowry shell, wood, a bone hook, cordage and a “skirt” of ti leaves or kapa. They engineered fishponds to grow fish using stonewall enclosures. In the ‘auwai kai (channels) they placed innovative structures known as mākahā (grates). These were made from wood and cordage and they were designed to let small fish in and trap the fish when they grew large.

Hawaiians wove sails and fine mats with the leaves of hala trees. They used gourds to store and carry materials. They did not have to worry about plastic bags, glass bottles, or disposable diapers. These kinds of materials did not exist.

The tools they developed were made from natural materials that could easily be returned to the earth to decompose. If an ipu (gourd) cracked, they would repair it. If a fish net became damaged, they would mend it. It was uncommon for our kūpuna to unnecessarily toss away items that could be easily fixed and reused. Waste was rare, as tools, nets and utensils took a long time to make. And when materials needed to be thrown away, they were buried in the earth or returned to the ocean to replenish the ‘āina.

“Sanitary regulations imposed by kapu controlled the disposal of garbage and human wastes” (Mitchell, 1992).

MODERN TOOLS AND PRODUCTS

If we compare the tools that Hawaiians developed with the tools and products we use today, it is clear that innovation continued over time. It is also clear that modern innovation has both positive and negative effects on our lives today.
Brief History of Plastics
The American Chemistry Council claims that the first human-made plastic was invented by Alexander Parkes in 1862. The material, which was named for its inventor, was called Parkesine. It was made from plants (cellulose). In a process that involved heat, the material could be molded into new shapes that kept their shape when cooled (ACC, 2007).

In the late 1800s there was a need to find a material to replace ivory in billiard balls (for playing pool). Ivory came from elephant tusks and thousands of elephants were killed for their tusks. With the growing popularity of billiards, there needed to be an alternative. The solution came from John Wesley Hyatt in 1869. This American inventor spilled a bottle of a material called collodion in his workshop. It congealed into a tough, flexible material that he used to make a billiard ball (ACC, 2007). The good news was that he could now make a billiard ball without ivory; the bad news was that the balls would shatter and break when they hit each other! But inventors figured out that they could add a substance from the laurel tree called camphor to the solution. This created celluloid, which was later used in photographic film.

Creations from Chemists
In 1907, Leo Baekeland, a New York chemist, developed the first human-made synthetic material. It was a liquid resin that could be poured into a container and harden to take the shape of that container. He called this material Bakelite. It was different from celluloid, which could be melted down and reformed. Bakelite kept its shape. The U.S. military found this new material to be very useful. Bakelite was used as a key ingredient in weapons for World War II (ACC, 2007).

Wrap it up!
Cellophane was invented in 1913 by Swiss textile engineer, Dr. Jacques Edwin Brandenberger. He added rayon (modified plant material) to cloth and developed a machine that could produce thin sheets of clear, waterproof wrap known as cellophane (ACC, 2007).

Nylon
A young Harvard chemist, Wallace Hume Carothers, was the head of DuPont’s lab in 1939 when the company produced nylon fibers (ACC, 2007). These fibers would replace animal hairs in brushes and silk in stockings.
OUR WASTES TODAY
Plastics and other modern materials don’t easily break down and only some of the plastics can be recycled. A number of products are also disposable or come heavily wrapped in packaging.

In 2008, people in the United States threw away an average of 4.5 lbs. of ōpala (rubbish) per person every day (EPA, 2009). Where does it all go? The ōpala that we don’t recycle is taken to the Pu‘uanahulu landfill. The landfill releases methane (a greenhouse gas) that contributes to global warming.

The Hawai‘i County is considering building a waste-to-energy plant in Hilo similar to the one on O‘ahu. This would help alleviate the waste that ends up in the landfill. The H-Power plant would burn about 230 tons of rubbish a day – about 40% of the waste generated on the island. County officials will have to take into account the expense, which will cost taxpayers $125 million to build. The other less expensive options are hauling rubbish to the Pu‘uanahulu Landfill, sending trash off island, or building a new landfill in the Hilo area. But what are other options that we should consider?

ZERO WASTE
Recycle Hawai‘i is a non-profit organization on the Island of Hawai‘i. They are dedicated to educating and informing the public about managing resources properly and recycling opportunities. One of the plans they have adopted is the goal of Zero Waste.

Zero Waste is a national campaign that was adopted by the Hawai‘i County Council in 2007. Its mission is to reduce Hawai‘i’s ecological footprint on the ʻāina. Recycle Hawai‘i is helping to share the message and get schools and communities involved in diverting waste from the landfill. Ancient Hawaiians practiced zero waste. We, too, can practice zero waste habits. It will help to mālama (care for) our environment, save money, and protect our keiki’s future.

How much rubbish would your class throw away in one year if each of you threw away 4.5 lbs. of ōpala per day? _____________lbs. of ōpala/ per year. Can you think of other ways your school can support the “Zero Waste” campaign?
### How Long Will It Take to Break Down?

<table>
<thead>
<tr>
<th>Item</th>
<th>Breakdown Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glass bottles</td>
<td>1 million years</td>
</tr>
<tr>
<td>Monofilament fishing line</td>
<td>600 years</td>
</tr>
<tr>
<td>Plastic beverage bottles</td>
<td>450 years</td>
</tr>
<tr>
<td>Disposable diapers</td>
<td>450 years</td>
</tr>
<tr>
<td>Aluminum can</td>
<td>80 - 200 years</td>
</tr>
<tr>
<td>Foamed plastic buoy</td>
<td>80 years</td>
</tr>
<tr>
<td>Rubber boot sole</td>
<td>50 - 80 years</td>
</tr>
<tr>
<td>Foamed plastic cup</td>
<td>50 years</td>
</tr>
<tr>
<td>Tin can</td>
<td>50 years</td>
</tr>
<tr>
<td>Leather</td>
<td>50 years</td>
</tr>
<tr>
<td>Nylon fabric</td>
<td>30 - 40 years</td>
</tr>
<tr>
<td>Plastic film canister</td>
<td>20 - 30 years</td>
</tr>
<tr>
<td>Plastic bag</td>
<td>10 - 20 years</td>
</tr>
<tr>
<td>Cigarette filter</td>
<td>1 - 5 years</td>
</tr>
<tr>
<td>Wool sock</td>
<td>1 - 5 years</td>
</tr>
<tr>
<td>Plywood</td>
<td>1 - 3 years</td>
</tr>
<tr>
<td>Waxed milk carton</td>
<td>3 months</td>
</tr>
<tr>
<td>Apple core</td>
<td>2 months</td>
</tr>
<tr>
<td>Newspaper</td>
<td>6 weeks</td>
</tr>
<tr>
<td>Orange or banana peel</td>
<td>2 - 5 weeks</td>
</tr>
<tr>
<td>Paper towel</td>
<td>2 - 4 weeks</td>
</tr>
</tbody>
</table>

(Reprinted from North Western Hawaiian Islands Multi-Agency Education Project. A Teacher’s Guide to Navigating Change. 2006.)

## REFERENCES


WHERE DOES ALL THE ‘ŌPALA GO?

NAME: ______________________________ DATE __________________

THINKING ABOUT ‘ŌPALA

1. What are the two items you chose from the class garbage dump?

__________________________  __________________________

2. What kinds of materials are your products made of (paper, plastic, metal, wood, etc.?)

3. List three interesting facts you learned after reading your technology card.

4. Can you reach the “Zero Waste” goal with the products you have chosen? How can you re-incorporate the items you have chosen back into another useful life cycle?

5. How do the items you have chosen compare to one or two of the items from the Hawaiian materials on display? Write on the back of this sheet or on a separate paper for more room.
WHERE DOES ALL THE ‘OPALA GO?  LEARNING LOG 2

NAME _______________________________  DATE ________________

In this lesson we have:
• Looked at some types of technology used by the ancient Hawaiians
• Studied waste management technologies and systems used today
• Analyzed our class “garbage dump” to decide how best to dispose of our wastes

To assess your learning, write a two-paragraph reflection.
• First paragraph should discuss the value of mālama (caring): How did Hawaiians mālama their environment? How did their choices of technology reflect and affect the way they cared for the environment?
• Second paragraph should discuss how we could apply traditional methods of waste management to our own society today. How can we better mālama our environment today?
• Paragraphs may be written on this Learning Log, or word-processed.

Grading will be as follows:
  Mechanics: Spelling, neatness, punctuation and grammar  _____/5
  Content: Clearly address the topics, include examples, and have supporting details
          Paragraph 1:  _____/10
          Paragraph 2:  _____/10
          Total  _____/25

To help organize your thoughts, you can use the following:
  o List examples of Hawaiian technologies. How did the choice of technology reflect how they cared for the environment?
  o Describe modern technologies that correspond to the early Hawaiian ones.
  o Describe the modern waste management techniques you have learned about.

Use the back of this page (or work on a computer) to continue your reflection.

My Reflection
WHERE DOES ALL THE ‘ŌPALA GO?  ‘ŌPALA TECHNOLOGY CARDS

TECHNOLOGY CARD #1 - SOURCE REDUCTION

Source reduction or waste prevention is the best way to malama our ʻāina. Source reduction is not a form of technology. It’s just a better system of managing waste. Source reduction simply means producing less waste. If we can create less waste, we can help decrease the amount of ʻōpala that ends up in our landfills and waste-to-energy plants. Waste prevention also helps conserve our natural resources. If we buy fewer products and materials, we use fewer resources.

Some ways we can be more active in source reduction and waste prevention and to help malama our ʻāina are to:

1. Buy products with less packaging.
2. Buy items that can be reused.
3. “Pre-cycle” by buying items that have been recycled.
4. Buy food items in bulk.
5. Buy locally made items to save on shipping, which uses oil.
6. Recycle old clothes by donating them to charitable organizations.
7. Reuse items and buy fewer products.

Fast Fact: Did you know that the U.S. uses enough paper every year to build a 12-foot wall from Los Angeles to New York City?

TECHNOLOGY CARD #2 - RECYCLING

When we recycle, the materials that were used to manufacture a product are reused to make new products. Recycling materials such as plastic containers, metal cans, glass bottles and paper products involves collecting and sending these materials to a manufacturing plant where they are made into new products. Recycling prevents materials from ending up in our landfills or waste-to-energy plants.

The Kealakehe Transfer Station accepts recycling materials from businesses and residents. The facility features a HI-5 deposit redemption center and free recycling drop off. The Center accepts cardboard, newspaper, mixed paper, glass, aluminum, plastic #1, #2, and #5. Some companies are recycling old rubber tires. The recycled rubber is being used for playground surfaces and as a soil additive to improve drainage on athletic fields. Recycled plastics are being used to build picnic tables, park benches, decks and bridges. Fast Fact: Did you know that 1,500 aluminum cans are recycled every second in the United States?
**WHERE DOES ALL THE ‘ŌPALA GO?**  

**‘ŌPALA TECHNOLOGY CARDS**

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**TECHNOLOGY CARD #3 - COMPOSTING**

Composting is another way to recycle. Yard waste such as leaves, grass and other small trimmings are placed in a bin or left in an open pile to decompose. A natural process breaks down the organic material, which can later be used as plant fertilizer.

The Kealakehe Transfer Station allows residents to dump their green waste for free. Mulch is also available for free at the transfer station.

We can help mālama our ‘āina by creating a compost bin at our home or in our school.

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**TECHNOLOGY CARD #4 - WASTE-TO-ENERGY PLANT**

A waste-to-energy plant turns waste into energy. Materials that cannot be reused, recycled or composted end up in a waste-to-energy plant.

In Hawai‘i, the only waste (or garbage)-to-energy plant is on O‘ahu. The city manages a plant called H-POWER. The plant processes more than 2,000 tons of garbage a day. The ‘ōpala is burned in a furnace at 1,800 degrees Fahrenheit, which produces steam. The steam operates a machine called a turbine generator. The movement of the turbines produces electricity. The amount of electricity the H-POWER plant produces provides power to 45,000 O‘ahu homes. Government officials are exploring the idea of building a waste-to-energy plant on Maui and Hawai‘i islands.

There are some risks involved in operating a waste-to-energy plant. Some experts say that the pollutants released into the atmosphere can be harmful to our health and our environment. Studies are still being done to find out what kind of impact the waste-to-energy plants have on society.

**Fast Fact:** In the U.S., over 108,000 tons of waste is burned in waste-to-energy facilities.
 TECHNOLOGY CARD #5 - LANDFILLS

Landfills are the most common way to dispose of waste. Garbage is dumped into a large cavity in the earth at a designated landfill site. A plastic liner is placed in the hole to prevent toxic materials from getting into the groundwater. The waste is spread out into thin layers, packed down firmly and covered every day with a fresh layer of soil or plastic foam. This is done to prevent the ‘ōpala from blowing away and to prevent smelly odors!

On Hawai‘i, there are two landfills, one at Pana‘ewa in Hilo and one at Pu‘uanahulu in Kona. County officials say that the Hilo landfill will be full to capacity by the year 2012. The mayor’s advisory committee has been asked to search for other sites on the island to expand the landfill operation. But community groups argue that instead of building a new landfill, the city should require residents to reuse, recycle, and compost their items.

Fast Fact: There are only two human-made structures that can be seen from outer space. One is the Great Wall of China. The other is a landfill located in New York City.
WHERE DOES ALL THE ŌPALA GO?  OCTANA EXTENDED ACTIVITY

How Can My ‘Ohana Help Mālama Our Ahupua’a?
Make a check ✓ next to actions you can take!

☐ Buy locally grown food and other local products whenever possible. There is a farmer’s market somewhere on Hawai‘i Island every day of the week!

☐ Buy less! Ask yourself, “Do I really NEED this?” every time you’re in the checkout line.

☐ Cut the garbage in your weekly trash by composting your food scraps and recycling.

☐ Use a reusable water bottle and cloth shopping bag.

☐ Walk and cycle more and carpool.

☐ Do multiple errands at once to avoid unnecessary shopping trips and driving.

☐ Reduce your energy use by investing in energy efficient products, such as CFL or LED light bulbs.

☐ Be an active and informed participant in local government.

☐ If you plan to have a family event, use non-polystyrene products. Check out Styrophobia’s website at www.styrophobia.com. They offer fully biodegradable and compostable products. You may have to pay a little more but you will be protecting the environment as well as your health!

☐ Get involved with an organization or issue that matters to you. Attend a quarterly Eco-Roundtable meeting or use Recycle Hawai‘i’s website at www.recyclehawaii.org or Orchidland Community Association website at www.orchidland.org to learn more about recycling, reusing, and reducing on Hawai‘i Island.

☐ Check out the Kanu Hawai‘i Web site where people are getting actively involved in making commitments to mālama our island home: http://www.kaahuwayi.org/ and add your actions to this growing list.
WASTE AUDIT

What inferences can we make from a waste audit about our school’s impact on the ‘āina?

HAWAI’I DOE STANDARD BENCHMARKS

Math 13: Data Analysis, Statistics, and Probability DATA ANALYSIS
• MA.6.13.1 Make inferences about a population based on the interpretation of a sample data set.

Science 1: The Scientific Process: SCIENTIFIC INVESTIGATION
• SC.6.1.1 Formulate a testable hypothesis that can be answered through a controlled experiment.
• SC.6.1.2 Use appropriate tools, equipment, and techniques safely to collect, display, and analyze data.

Language Arts 5: Writing: RHETORIC
• LA.6.5.1 Select appropriate details, examples, reasons, and/or facts to support an insight, message, or thesis.

NA HONUA MÄULI OLA
• NHMO: ‘Ike Honua Sense of Place Pathway 8-10 Preserve, protect, and sustain a healthy environment. (i.e., environmentally sound legislation, mālama ‘āina)

KEY CONCEPTS
• We can make inferences about our school population and our impact on the ‘āina based on the data we collect about school wastes.
• We need to be more thoughtful and actively participate in recycling programs that will help keep our ‘āina healthy.
• We can reduce management costs and promote better use of our limited natural resources.

ACTIVITY AT A GLANCE
Students form teams and conduct a waste audit of their class and school. They sort and record their results, and make inferences about the school populations based on their data.

ASSESSMENT
Students:
• Develop and test hypotheses.
• Analyze the data they collect from their school audit and graph the results, using the information to make inferences that apply to the school population.
• Write reflections that discuss the process of conducting a waste audit and the potential impact on the ‘āina of the waste that we generate.

TIME
3 class periods
SKILLS
following directions, developing hypotheses, collaborating, analyzing, graphing, making inferences, writing

MATERIALS
Provided:
✓ Student Reading 2
✓ school waste audit form
✓ waste category signs
✓ Learning Log 3

Needed:
✓ secure, well ventilated work area sheltered from sun, wind, and rain
✓ tarp (for displaying items)
✓ garbage dump supplies (see previous lesson)
✓ rubber gloves (at least one pair for each 5 groups)
✓ 5 five-gallon buckets
✓ 5-kilo spring scale
✓ tape
✓ graph paper
✓ broom and disinfectant
✓ safety equipment and first aid kit
✓ 5 barbecue tongs to pick up and sort waste
✓ graph paper

VOCABULARY
audit - a systematic process of objectively obtaining and evaluating evidence inference - a conclusion that is derived from analyzing data or evidence. It is also an assumption about a behavior, an object, a picture, etc.
observation - what a person is actually seeing, hearing, feeling, etc.
four R’s – in this context, reduce, reuse, recycle, rot (to compost)

waste audit – one of the first steps in conducting a recycling project
waste stream - solid waste from homes, businesses, institutions and manufacturing plants that is recycled, burned, or disposed of in landfills, such as the 'residential waste stream' or the 'recyclable waste stream.'

ADVANCE PREPARATION
☐ Make five (5) copies of the school waste audit form.
☐ Make 6 sets of the waste category signs.
☐ Make a copy of Learning Log 3 and Student Reading 2 for each student.
☐ Assemble the “garbage dump” items from the previous lesson onto a tarp.
☐ Prepare the 5-gallon buckets for measuring volume. Place a tape measure against the inside of the bucket and use a permanent marker to mark off a scale divided by one-eighth sections.

TEACHER BACKGROUND INFORMATION
Waste affects many aspects of our lives. No matter who we are or where we live, we create waste. It is a normal consequence of day-to-day life, and it has been that way for as long as people have populated the planet. From medieval Europeans tossing their refuse out a window to modern waste-to-energy plants, people have taken different views of the waste they generate depending on their lifestyle and available technology.

Waste is continually created and discarded in a “waste stream,” as people generate
waste, which is then separated, collected, and either recycled or disposed.

Many people feel they can have no effect on the amount of waste generated by society. Environmental problems such as global warming, hazardous waste, loss of rain forests, endangered species, acid rain, the ozone layer, and the municipal waste crisis can feel out of our control. One thing that each of us can exercise some control over is the amount of waste that we generate. By practicing the ‘four Rs’ – reduce, reuse, recycle, and rot (to compost) – we can all have a positive impact on our environment.

You can make a difference!
A waste audit can be performed to determine composition and quantities of waste being generated. This process leads to a more efficient and effective organization, reduces waste management costs, and promotes better use of limited natural resources. Through recycling newsprint, office paper and mixed paper, millions of trees can be saved. Recycling paper also cuts energy usage in half. Every pound of steel recycled saves enough energy to light a 60-watt bulb for over 26 hours. Recycling a ton of glass saves the equivalent of nine gallons of fuel oil. Recycling used aluminum cans requires only about five percent of the energy needed to produce aluminum from bauxite. Recycling just one aluminum can saves enough electricity to light a 100-watt bulb for \(3\frac{1}{2}\) hours.

In this lesson, students will be conducting a waste audit of various areas in your school. Waste audits should be carefully planned and the safety of people conducting the audit is very important. Sorting should be done in ventilated areas. The confidentiality and privacy of documents or personal information found in the waste stream must be assured. No documents or school papers should be read or removed from the sorting area. Sorters should use protective equipment such as tongs and gloves. Waste is never handled with bare hands.

**Teaching Suggestions**

1. Distribute the student reading to each student, read and discuss.

2. Place garbage dump items from the previous lesson on a tarp and ask students to form a circle around the “dump” site.
   - Ask each student to use tongs to select an item and place it in a pile you have designated as recyclable or non-recyclable materials.
   - Confirm that the materials have been appropriately sorted and make adjustments if necessary.
3. Discuss students’ ideas about the potential of recycling the items.
   
   Discussion Questions
   - Why would clothes end up in a recycling pile? (Clothes can be donated to second-hand stores and resold or given away.)
   - How can jars and other plastic containers be reused? Jars can be used to store items such as ‘inamona (kukui nut relish), mango chutney or coins.
   - Are there any other items that could be recycled that are not represented in our garbage dump? What are they? (Food waste that could be composted; plastics that can be recycled)

4. Explain to students that they will be conducting a waste audit of the school.
   - Introduce the focus question for this lesson:
     What inferences can we make from a waste audit about the impact of our school on the ‘aïna?

5. Help students to distinguish between an “observation” and an “inference.”
   - What is an observation? An observation is what a person is actually seeing, hearing, feeling, etc
   - What is an inference? An inference is a conclusion that is derived from analyzing data or evidence. It is also an assumption about a behavior, object, or picture, etc.

6. Ask students to share their initial ideas about inferences and the kind of inferences they could make related to recycling.
   - Example: “Many people in our school drink bottled water, but they do not recycle their bottles.”
   - Ask students to develop an example of a hypothesis that they can test about the wastes they believe they will find in their waste audit. For example: “There will be more paper waste than plastic waste because we use so much paper at school.” (Note: Lesson 3 will go into more detail about developing testable hypotheses.)

7. Divide the class into five teams and prepare for a waste audit of the school.
   - Distribute the school waste audit form to each team along with gloves and/or tongs and a garbage bag.
   - Tell students that you have already made arrangements for each team to perform a waste audit in a certain location on the school grounds.
   - Assign a specific location to each hui and emphasize that no waste should be collected from the health room or bathrooms.
   - Challenge each team to develop a hypothesis that they will be able to test in the waste audit of their location.
   - Have teams share their hypotheses and refine them as needed before students begin their audit. Discuss what makes a hypothesis “testable.”
• Advise students that they have half an hour to collect as much rubbish as they can from their assigned area.

8. **Have students sort the waste they have collected.**
   • Distribute a set of recycling signs and a 5-gallon bucket to each group.
   • Have each group sort their items.
   • Remind them that only plastics with the 1, 2, and 3 numbers on the bottom can be recycled on Hawai‘i Island.

9. **Record results on the school waste audit form.**
   • Ask each group to weigh their 5-gallon bucket before placing any of the recyclable materials in it. (They can determine the mass of the bucket by weighing it on the classroom spring scale.)
   • Weigh each of the grouped items. Have students record the number of kilograms of each group on their waste audit form.
   • Have each group record the volume of materials in the 5-gallon bucket. Explain how to estimate the volume of each type of waste. Show students the markings you made on the buckets and what these mean.
     * Full bucket – 5 gallons = 19.2 liters
     * Half full – 9.6 liters
     * One-quarter full = 4.8 liters
     * One-eighth = 2.4 liters

10. **Have groups present their hypotheses and their findings.**
    • Have students in each group present their hypotheses and findings. Record their results on the board or on chart paper at the front of the room.
    • Ask students whether their data supports their hypotheses or not and discuss.
    • When all groups have presented, ask students to make some inferences about the school population based on the items found on campus.
    • Discuss the size of this data set and ask if students think it is large enough to represent the school population.

11. **De-brief the waste audit with students.**
    **Discussion Questions**
    • What was the greatest volume of school waste?
    • What were the main components of the school’s waste?
    • What inferences did you make about our school’s population from the data we have collected?
    • Would the results be different if the waste audit was done at a different time of year? Why?
• What were some of the items that could have been reused instead of thrown away?
• How could you reduce the amount of items that were thrown away?
• Which items would have the most impact on the ‘āina? Why?

12. Have students clean up the classroom and sort recyclables.
• Have groups clean up their area.
• Return all non-recyclable items to the garbage.
• Sort recyclables into bins (if your school has a recycling center) or place in garbage bag and label for recycling.
• Recyclables can be delivered to your nearest recycling center.

• Distribute a sheet of graph paper and Learning Log 3 to each student.
• Work with students to graph the results of their waste audit. Have each student graph the results of their school’s waste in mass and volume.
• Have each student complete Learning Log 3 for individual assessment.

ADAPTATIONS / EXTENSIONS

Coordinate an art fair. Have students create art pieces, using recyclable materials. Invite parents and school administrators as guests.

Use the HI5 recycling of plastic bottles and aluminum cans as a school fundraiser.

Recycle Hawaii offers workshops year-round in composting. Workshops are $10 each and include an Earth Machine composter. Workshop dates and locations can be viewed at the Recycle Hawaii website:
http://www.recyclehawaii.org/index.php?option=com_content&task=view&id=67&Itemid=73
To register for workshops, contact Piper Selden at piper_selden@yahoo.com.

RESOURCES

1
PLASTIC BOTTLES
2

ALUMINUM AND OTHER METAL
3

GLASS
4

RECYCLABLE PAPER
FOOD PACKAGING
6

YARD TRIMMINGS
7

FOOD WASTE
8

OTHER
Waste Audit

No matter who we are or where we live, we create waste. It is a normal consequence of day-to-day life, and it has been that way since people populated the planet. From medieval Europeans, tossing their rubbish out a window to modern waste-to-energy plants, people have treated their waste differently depending on their lifestyle and the technology available.

Waste is continually created and thrown away; this is known as the “waste stream.” The waste stream begins with the creation of a product and continues through the separation and collection of the waste to the final disposal. The waste stream begins with each and every one of us.

Many people feel they can have no effect on the amount of waste generated by society. Environmental problems such as global warming, hazardous waste, and the municipal waste crisis can seem out of our control. But each of us can make a difference. It’s easy if we remember the ‘four Rs’ – reduce, reuse, recycle, and rot (to compost).

You can make a difference!

Your challenge is to conduct a waste audit to find out what kind of waste and how much of it is being disposed of at your school. When we know more about the waste we generate, we can take action to reduce the waste. Reducing wastes has many benefits including reducing costs for new materials and promoting better use of limited natural resources.

Did you know?

- When we recycle large amounts of newsprint, office paper, and mixed paper, we can save millions of trees!
- Recycling paper also cuts energy usage in half.
- Every pound of steel recycled saves enough energy to light a 60-watt bulb for over 26 hours.
- Recycling a ton of glass saves the equivalent of nine gallons of fuel oil. Recycling used aluminum cans requires only about five percent of the energy needed to produce aluminum from bauxite.
- Recycling just one aluminum can saves enough electricity to light a 100-watt bulb for 3.5 hours.

Waste audits are carefully planned and the safety of people conducting the audit is very important. When conducting your waste audit remember...

- Sort wastes using tongs or gloves, not your bare hands.
- Sort the wastes in ventilated areas with fresh air circulating.
- Protect the confidentiality and privacy of documents or personal information you find. No documents or school papers can be read or removed from the sorting area.
WASTE AUDIT

SCHOOL NAME: ___________________________  DATE: _______________________

STUDENTS INVOLVED IN AUDIT:

___________________________________________________________________________

We will collect wastes from: [check one]
   Classroom (grade ____)  Office  Cafeteria  Staff Room  School Yard

Our Hypothesis: ____________________________________________________________

<table>
<thead>
<tr>
<th>Recyclables</th>
<th>Mass (kilograms)</th>
<th>Volume (liters)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plastic Bottles</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aluminum Cans and Other Metal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Glass (jars or bottles)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recyclable Paper</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Food Packaging (cereal boxes, cookie packages, candy wrappers, etc.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yard Trimmings</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Food waste</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Additional Observations:

Based on the data we collected, we can infer that (finish this statement)...

Was your hypothesis supported by your data? Explain.
In this lesson we have:
- Developed hypotheses and collected and sorted the school’s trash for one day
- Graphed the waste produced in different parts of the school and the school as a whole
- Made inferences about the school’s population based on the data we collected

To assess your learning, write a two-paragraph reflection.

- First paragraph – discuss the process of conducting a waste audit. What did you learn from it? What was surprising to you about the data that we collected? Did the data your group collected support your hypothesis? Why or why not? What were some inferences we could make from the data we collected?
- Second paragraph – discuss the potential impact on the ‘āina of the waste that we generate. What would happen if we did not responsibly manage our school waste stream? What are some suggestions you could make based on the data we collected to improve our waste management at our school
- Paragraphs should be written below or word processed.

Grading will be as follows:

Mechanics: Spelling, neatness, punctuation and grammar ____/5

Content: Clearly address the topics, include hypothesis, and have supporting details.

Paragraph 1: ____/10
Paragraph 2: ____/10

Total ____/25

- To help organize your thoughts you can refer to your data table and graph and use the inferences we discussed in class. Use the back of this page (or work on a computer) to continue your reflection.

My Reflection
WASTE NOT

Mai hoʿomāunai i ka ʿai o huli mai auaneʻi o Hāloa e nānā.
Do not be wasteful of food lest Hāloa turn around and stare [at you]
(Mary Kawena Pukui, ʻōlelo Noʻeau No. 2052)

How can we use technology to speed up the decomposition of wastes?

HAWAI‘I DOE STANDARD BENCHMARKS

Science 1: The Scientific Process:
SCIENTIFIC INVESTIGATION
• SC.6.1.1 Formulate a testable hypothesis that can be answered through a controlled experiment.

Science 2: The Scientific Process:
NATURE OF SCIENCE
• SC.6.2.1 Explain how technology has an impact on society and science.

Science 3: Life and Environmental Sciences: ORGANISMS AND THE ENVIRONMENT
• SC.6.3.1 Describe how matter and energy are transferred within and among living systems and their physical environment.

NĀ HONUA MAULI OLA
• NHMO: ʻIkeNa‘auao – Intellectual Pathway 6-11 Acquire technological skills and dispositions for improving the quality of life.

KEY CONCEPTS
• In the decomposition process, matter is broken down, nutrients are returned to the physical environment, and heat is released.

• When microorganisms are combined effectively they can accelerate the decomposition process in a healthy, organic way.

ACTIVITY AT A GLANCE
Students conduct an experiment using waste they collect from a class pūpū (snack) party. They record their observations on a data sheet and share their results with classmates.

ASSESSMENT
Students:
• Write a one-page lab report describing their hypothesis, methodology, results and conclusions.
• Diagram how matter and energy are transferred in the decomposition process.
• Explain how Effective Microorganisms (EM) might improve the quality of life in the school community.

TIME
5 class periods (over a 6-week period)

SKILLS
observing, classifying, measuring, collecting and interpreting data, inferring, making and testing a hypothesis
MATERIALS
Provided:
☑ Learning Logs 4 - 7
☑ EM (Effective Microorganisms) Bokashi Recipe
☑ EM Technology “From Waste to Wonderful” DVD

Needed:
☑ hand soap
☑ old newspaper
☑ masking tape and markers (for labels)
☑ 10 small (sandwich size) clear plastic containers with tight lids
☑ measuring cups and spoons
☑ 5 sandwich bags of EM mixture (See sources at the end of this lesson.)
☑ pitcher of water
☑ 1 bottle molasses for EM mix
☑ 4 lbs. wheat bran
☑ 5 sandwich bags of soil
☑ different types of snack foods
☑ or ingredients to make sandwiches (i.e. bread, cold cuts, cheese, lettuce, tomatoes, mayonnaise)

VOCABULARY
Bokashi – a Japanese term for fermented organic matter
decomposition – the breakdown or decay of organic matter
energy – the capacity for work; power
fermentation – a process guided by beneficial microorganisms associated with pickling
microorganism – an organism that can only be seen using a microscope
nutrients – any matter that, taken into a living organism, serves to sustain it, promote growth, replace loss, and provide energy
photosynthesis – a process by which plants produce carbohydrates using sunlight energy to combine carbon dioxide and water in the presence of chlorophyll
putrefaction – decomposition of organic matter that creates an unpleasant odor; the process of rotting solid waste – garbage, rubbish, trash and refuse; items that are no longer useful or items no one wants
variable – something that is likely to change

ADVANCE PREPARATION
☐ Make a copy of Learning Logs 4, 5, 6 and 7 for each student.
☐ Ask students to bring healthy snacks for a class pāpā (snacks) party (especially snacks with peels or shells, e.g., bananas, oranges, peanuts). Alternatively, you can bring ingredients to make sandwiches, which the students can use for the experiment.
☐ Prepare the EM Bokashi mixture unless you opt to have students help prepare it. NOTE: The Bokashi mixture will need two weeks to ferment before students can use it in their decomposition experiments. See the EM Bokashi Recipe provided after the Resources section in this lesson.
**TEACHER BACKGROUND INFORMATION**

To understand the natural decomposition process, students will need to explore how matter and energy are transferred within and among living systems and their physical environment. Energy can be a difficult concept to understand since it is not an object that can be seen or touched. Although energy isn’t visible, it can be detected. Jumping, shooting a basketball, eating, and laughing all require energy. Nonliving things such as a radio clock, toaster oven, and mechanical toys all require energy to operate. Work is involved whenever anything moves, and energy is needed to do work. Therefore, energy is defined as the ability to do work.

The most basic need of any organism is energy. Through photosynthesis plants or producers convert solar energy into food (chemical energy). The plants are eaten by herbivores, which are in turn, consumed by omnivores or carnivores. At each step in the food chain, energy is lost as heat. This energy loss is due to the cellular respiration, reproduction, movement and other survival needs of every living thing. A plant uses some of the energy it receives to grow and function. The herbivore uses its energy to grow, but also to look for food, escape from predators, and reproduce. A carnivore uses large amounts of energy to obtain food in addition to its regular life processes (e.g., breathing, digesting food, moving). The energy these organisms use eventually leaves their bodies in the form of heat. The amount of energy transferred from one organism to the next in the food chain is generally about 10 percent. For example, herbivores must consume an enormous amount of food to obtain the chemical energy necessary to meet their survival needs.

**Heat Loss in Food Chain**

![Heat Loss in Food Chain Diagram]

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*Project Aloha Āina © 2010 Pacific American Foundation and The Kohala Center*
Decomposition
When plants or animals die, their remains decay through the action of decomposers. Large decomposers help to break up the organic matter into smaller pieces, which are then fed on by microorganisms, including different types of fungi and bacteria. This process is called decomposition. The action of the microorganisms releases nutrients into the environment. These nutrients are taken up by the plants, and the cycle begins all over again.

Effective Microorganisms (EM)
Microorganisms are too small to be seen by the naked eye. These tiny organisms, which can include bacteria, protozoa, and fungi, aid in the decomposition process. Twenty-five years ago, Dr. Teruo Higa, a scientist from Japan, found that by combining beneficial microorganisms, which include lactic acid bacteria (commonly found in yogurt and cheeses), yeast (found in bread and beer), and phototrophic bacteria (“cousins” of blue-green algae), he could accelerate the decomposition process in a healthy, safe, and organic manner. This innovation helped reduce the vast amounts of waste ending up in landfills in Japan.

EM Bokashi
Bokashi is a Japanese term meaning fermented organic matter. EM Bokashi is fermented organic matter made with EM. The organic matter used to make EM Bokashi is typically rice bran or wheat bran. EM Bokashi is commonly used to accelerate the decomposition process of food waste. The general idea is to combine organic matter with a sugar source and inoculate it with beneficial Effective Microorganisms. The organic matter acts as the “EM House” and the sugar is food for the microorganisms.

An ancient practice that has gained recent recognition is the cultivation of indigenous microorganisms. Asian countries have been practicing the collection and culturing of microorganisms for centuries. This natural farming technique allows farmers to use naturally occurring microbes to serve as a soil amendment. There are no chemicals used to cultivate the microorganism. The benefit of collecting and cultivating these microbes is that it improves soil health and is less harmful to the environment. Some of Hawai‘i’s farmers and community groups have embraced the practice and have been successful in growing healthy crops. (For more information on cultivating indigenous microorganisms, see handout.)

Designing an Experiment
Controlling Variables
In this lesson, students will be conducting experiments to find out if EM Bokashi mixed with soil affects the rate of decomposition. They will combine the EM Bokashi with natural food wastes. They will then add soil to the container to see how quickly the wastes break down. When setting up their experiments, they will be manipulating one or more variable (EM and soil) to see how this affects another variable (decomposing food items). The terminology can be confusing since there are two kinds of variables – one that they will manipulate,
which could be called the treatment, and one that will be measured (the amount of decomposition). It is important to control as many variables as possible so that they can be sure that changes they observe are due to the EM, and not other factors. For example, to determine how effective the EM Bokashi is in accelerating the decomposition process, students need to control variables, such as the type of natural food waste, the amount of waste, and physical factors such as light, oxygen, and temperature. If they have identical set-ups and the only variable is the EM Bokashi with the addition of soil, they should be able to conclude that differences in the decomposition rates are due to the EM Bokashi and soil.

**Experiment Set-up** You may want to conduct this lesson as a teacher-led inquiry and guide the experimental set up as follows: Use the same type and amount of food waste in each of two (2) containers. Then add:
- Container 1: add 2 cups of EM Bokashi
- Container 2: add nothing (control)

Seal all containers and store in the same cool, dark environment for two (2) weeks. Alternatively, have student teams design their own experiments using materials on hand and design their own observation sheets (see Learning Log 6).

After two (2) weeks, have student groups open containers and record their observations on Learning Log 6. Students will compare the process of fermentation (a process guided by beneficial microorganisms) versus putrefaction (a process guided by harmful pathogens).

Next have groups add soil to each container. After two (2) weeks, have students open containers and record their observations. The container with the EM Bokashi and soil should have decomposed significantly. The student teams should observe little decomposition of food in the control container.

**Teaching Suggestions**

**Part 1**

1. **Conduct a class discussion about food chains, using an example of an orange as breakfast food for students.**
   - Have students imagine that they had an orange smoothie for breakfast. If they were to illustrate the life cycle of the orange, what would that look like?
   - Ask a student volunteer to illustrate it on the board, using a simple visual diagram. Make adjustments to the diagram if necessary.
   - Use the diagram to trace the path of matter and energy from the sun to the producer to the human and finally to the decomposers who break down our wastes, releasing nutrients back to the orange tree.
2. **Review how matter and energy are transferred within and among living systems and their physical environment.** (Refer also to the diagram in the Teacher Background Information above.)

**PART 2: THE PŪPŪ PARTY**

3. **Divide the class into 5 research teams and assemble groups at tables for the pūpū party.** (You may want to assemble the teams so that students with different skills can work together.)
   - Invite students to share the pūpū (snacks) that students have brought to class.
   - Give each group some old newspapers and ask them to hang onto all of the wastes, including food waste and paper and plastic products.
   - Alternatively, in lieu of a class pūpū party, distribute ingredients to student teams to prepare a sandwich (bread, cheese, lettuce, tomatoes, cold cut, mayonnaise). Have students cut the sandwich in half and place each half in two separate containers.

4. **Ask each group to sort the food waste.**
   - After they finish their snacks, have each group sort all of the waste into two piles – food wastes and other waste.
   - Discuss what happens to the wastes when they are thrown away.
     **Discussion Questions**
     - Can you predict what would happen to the different kinds of waste if it were left alone for two weeks? If it were buried in the soil?
     - Which type of waste would decompose first? Why?
     - Which of these materials could be recycled? Can food be recycled? How could the recycled food materials be utilized?
     - How do natural materials break down in nature?

5. **Distribute Learning Log 4 and show the EM Technology “From Waste to Wonderful” DVD.**
   - Have each student fill out the **Learning Log 4** as they watch the film.
   - Review their responses and discuss the role of microorganisms in the decomposition process.
   - Ask students to create their own diagrams, with captions, to explain how matter and energy are transferred during decomposition.

6. **Distribute Learning Log 5 and work with students to design their experiments.**
   - Challenge each team to develop a hypothesis that they could use to test the effectiveness of the EM Bokashi.
   - Present characteristics of testable hypotheses to answer questions about the effectiveness of EM Bokashi in speeding up decomposition.
Characteristics of a testable hypothesis:
- It is clearly stated.
- The hypothesized relationship between the variable (in this case, EM Bokashi) and the predicted result is based on what we know, observe, or research.
- It can be tested with the materials and conditions available.

7. Discuss the need to control variables to make useful comparisons.
- Show students the materials available for their experiments.
- Ask them what would happen if they had two containers of food and added EM Bokashi to both of them. How would they know if the EM had been effective if they had nothing to compare it to?
- Discuss the need to have a control in their experiment (that would not have EM added to it).
- Define “variables” and ask students to come up with ideas of what they would need to control if they want to be sure any effects they find are due just to EM. (See Teacher Background Information.)

8. Have each group collect materials for their experiment.
- Show them the materials available for their experiments.
- Each team should receive two small clear plastic containers with lids (for their wastes), a bag of the EM Bokashi mixture that was prepared ahead of time (See Advance Preparation) a small bag of soil, a measuring cup, permanent marker, and container labels or masking tape.
- Also distribute Learning Log 6 to students and have everyone record their team’s observations for day 1.

9. Review the following guidelines for the experiment and safety procedures:
- Wash hands thoroughly after handling waste.
- Place the same amount and types of wastes into each small plastic container.
- Completely cover the wastes (or sandwich) with EM Bokashi. Ensure that EM Bokashi is sprinkled liberally and mixed well into food waste.
- Label containers, e.g., EM Bokashi or No EM Bokashi. Include date and team name on each label.
- Store containers in a cool, dark environment.

- On day 14, ask students to record their observations of their experiment on Learning Log 6.
- Have each group retrieve their containers and take them outside to open them and record their observations. (Anticipate some unpleasant smells so plan for outdoors.)
- Be sure students open the container with the EM Bokashi first so they can make observations without being overwhelmed by smells from the control container.
• Students should notice a pickle-like smell when the EM Bokashi container is opened. The control container should have an unpleasant odor. The food waste in the EM Bokashi container will have fermented versus the control container where food putrefied or decayed.

11. **Continue experiment.**

   • Once students have recorded their observations, have each team place two cups of soil into each of their containers and mix thoroughly. Please note that the soil should be sprinkled liberally on the sandwich with the EM Bokashi.
   • Seal container tightly.
   • Store containers in a cool, dark environment.

12. **Twenty-eight (28) Day follow-up: Record observations on Learning Log 6.**

   • On day 28, ask students to record their observations of their experiment on Learning Log 6.
   • Have each group retrieve their containers and take them outside to open them and record their observations.
   • Be sure students open the container with the EM Bokashi first so they can make observations without being overwhelmed by smells from the control container.
   • They should notice a significant difference with the EM Bokashi container. The waste should have decomposed. The control container will have an unpleasant odor and little to no decomposition will have occurred.
   • Have each group record their findings.
   • Prepare an area on your school ground so students can empty their experimental containers into the ground.

13. **Have each group present the students’ findings to their classmates and conduct a class discussion.**

   • Ask students to refer to the chart in Student Reading 1 from Lesson 1 for various decomposition rates of products without EM.

   **Discussion Questions**
   • Why did the materials in the containers smell differently? (fermentation in the EM container vs. putrefaction in the control)
   • Were your hypotheses validated?
   • What can you conclude from your experiment?
   • How effective is EM for speeding up the decomposition process?
   • Did you find that the wastes combined with EM Bokashi decomposed more rapidly than the wastes that did not have the EM Bokashi mixture?
   • If not, what other factors might account for their results?
   • If you conducted this experiment again, what methods might you change? Why?
   • How could we use the EM Bokashi and wastes to fertilize plants at school? (Refer to the DVD).
14. Distribute Learning Log 7 to students.
   - Review the criteria for students’ lab reports and set a due date for completion.

ADAPTATIONS / EXTENSIONS

The current trend in agriculture in Hawai‘i is to work towards using fewer chemicals and pesticides. Some Asian countries have been practicing natural farming techniques for centuries. These techniques include the collection and culturing of soil microorganisms that naturally occur in the environment. These “indigenous microorganisms” are believed to produce healthier plants and eliminate the need for inorganic pest control. A hand-out is included in the pocket of the Teaching Guide offering a summary of natural farming and how to produce your own indigenous microorganisms on your school campus.

RESOURCES


   http://www.emtechnologynetwork.org/~en/_web/library/coverimagese2/P1010802w800.html: A USA-produced video gives the bigger picture and details of the process, including how to use the system in schools. The video comes highly recommended.


## Authorized EM Resellers

<table>
<thead>
<tr>
<th>ISLAND OF KAUA‘I</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Crop Production Services, Inc.</strong></td>
<td><strong>Environmental Waste Management System (EWMS), Inc.</strong></td>
</tr>
<tr>
<td>Lihue Industrial Park</td>
<td>P.O. Box 25577</td>
</tr>
<tr>
<td>3042 Peleke Street</td>
<td>Honolulu, HI 96825</td>
</tr>
<tr>
<td>Lihue, HI 96766</td>
<td>Phone / fax: (808) 396-2378</td>
</tr>
<tr>
<td>Phone: 808-245-3472</td>
<td>e-mail: <a href="mailto:ewms@hawaii.rr.com">ewms@hawaii.rr.com</a></td>
</tr>
<tr>
<td>Fax: 808-245-2838</td>
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<tbody>
<tr>
<td><strong>TIM Lloyd - TNT Products</strong></td>
<td><strong>Crop Production Services, Inc.</strong></td>
</tr>
<tr>
<td>P.O. Box 1384</td>
<td>900 Leilani Street</td>
</tr>
<tr>
<td>Hilo, HI 96721</td>
<td>Hilo, HI 96720</td>
</tr>
<tr>
<td>Phone: 808-937-9874</td>
<td>Phone: 808-935-7191</td>
</tr>
<tr>
<td></td>
<td>Fax: 808-934-8436</td>
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</tbody>
</table>

|  |  |
| **Farm & Garden** | **Environmental Waste Management System (EWMS), Inc.** |
| Kailua-Kona | P.O. Box 25577 |
| Phone: 808-329-4775 | Honolulu, HI 96825 |
|  | Phone / fax: (808) 396-2378 |
| Captain Cook | e-mail: ewms@hawaii.rr.com |
| Phone: 808-323-3017 |  |

<table>
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<tbody>
<tr>
<td><strong>Crop Production Services</strong></td>
<td><strong>Environmental Waste Management System (EWMS), Inc.</strong></td>
</tr>
<tr>
<td>201 Papa Place</td>
<td>P.O. Box 25577</td>
</tr>
<tr>
<td>Kahului, HI 96732</td>
<td>Honolulu, HI 96825</td>
</tr>
<tr>
<td>Phone: 808-871-2622</td>
<td>Phone / fax: (808) 396-2378</td>
</tr>
<tr>
<td>Fax: 808-877-4532</td>
<td>e-mail: <a href="mailto:ewms@hawaii.rr.com">ewms@hawaii.rr.com</a></td>
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<tr>
<td><strong>Fukuda Seed Store</strong></td>
<td><strong>Waimānalo Feed Supply</strong></td>
</tr>
<tr>
<td>1287 Kalani Street, #106</td>
<td>41-1560 Kalanianaole Hwy</td>
</tr>
<tr>
<td>Honolulu, HI 96817</td>
<td>Waimanalo, HI 96795</td>
</tr>
<tr>
<td>Phone: 808-841-6719</td>
<td>Phone: 808-259-5344</td>
</tr>
<tr>
<td>Fax: 808-842-0295</td>
<td>Fax: 808-259-8034</td>
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### Authorized EM Resellers

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<th>Crop Production Services, Inc.</th>
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</tr>
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<tr>
<td>96-1345 Waihona Street</td>
<td>P.O. Box 25577</td>
</tr>
<tr>
<td>Pearl City, HI 96782</td>
<td>Honolulu, HI 96825</td>
</tr>
<tr>
<td>Phone: 808-454-0041</td>
<td>Phone / fax: (808) 396-2378</td>
</tr>
<tr>
<td>Fax: 808-454-0046</td>
<td>e-mail: <a href="mailto:ewms@hawaii.rr.com">ewms@hawaii.rr.com</a></td>
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<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>City Feed</td>
<td>Kahalu’u Country Store</td>
</tr>
<tr>
<td>1827 S. Beretania St.</td>
<td>PO Box 23644</td>
</tr>
<tr>
<td>Honolulu, HI 96826</td>
<td>Honolulu, HI 96826</td>
</tr>
<tr>
<td>Phone / Fax: (808) 949-1457</td>
<td>Phone: (808) 256-5605</td>
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</tr>
<tr>
<td>Asagi Hatchery, Inc.</td>
<td>Koolau Farmers</td>
</tr>
<tr>
<td>1830 Kanakanui Street</td>
<td>Kāne‘ohe Store</td>
</tr>
<tr>
<td>Honolulu, HI 96819</td>
<td>45-5800 Kam Hwy.</td>
</tr>
<tr>
<td>Hilo, HI 96721</td>
<td>Phone: 808-247-3911</td>
</tr>
<tr>
<td>Phone: 808-845-4522</td>
<td>Kailua Store</td>
</tr>
<tr>
<td>Fax: 808-842-6651</td>
<td>1127 Kailua Rd.</td>
</tr>
<tr>
<td></td>
<td>Phone: 808-263-4414</td>
</tr>
<tr>
<td></td>
<td>Honolulu Store</td>
</tr>
<tr>
<td></td>
<td>1199 Dillingham Blvd.</td>
</tr>
<tr>
<td></td>
<td>Phone: 808-843-0436</td>
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<td></td>
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<tr>
<td>EM Hawai’i, LLC</td>
<td></td>
</tr>
<tr>
<td>Gentry Pacific Design Center, Suite 217A</td>
<td></td>
</tr>
<tr>
<td>560 North Nimitz Hwy.</td>
<td></td>
</tr>
<tr>
<td>Honolulu, HI 96817</td>
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<tr>
<td>Phone / Fax: 808-548-0396</td>
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</tr>
<tr>
<td>Email: <a href="mailto:emhawaii001@hawaii.rr.com">emhawaii001@hawaii.rr.com</a></td>
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WASTE NOT

INGREDIENTS

<table>
<thead>
<tr>
<th>Recipe for 1 pound of EM Bokashi</th>
<th>Recipe for 4 pounds of EM Bokashi</th>
<th>Recipe for 50 pounds of EM Bokashi</th>
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</thead>
<tbody>
<tr>
<td>• 1 pound of wheat bran or rice bran</td>
<td>• 4 pounds of wheat bran or rice bran</td>
<td>• 50 pounds of wheat bran or rice bran</td>
</tr>
<tr>
<td>• 1 cup of clean, or tap water</td>
<td>• 1 to 1½ quarts, distilled or tap water</td>
<td>• 1 to 1½ gallons distilled or tap water</td>
</tr>
<tr>
<td>• 1½ teaspoon EM</td>
<td>• 2 tablespoons EM</td>
<td>• ½ cup EM</td>
</tr>
<tr>
<td>• 1½ teaspoon of molasses</td>
<td>• 2 tablespoons of molasses</td>
<td>• ½ cup molasses</td>
</tr>
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</table>

1. Combine molasses and water.

2. Add EM and mix thoroughly.

3. Pour the solution slowly into the wheat bran.

4. Mix the liquid into the wheat bran with your hands. Make sure the ingredients are thoroughly mixed. Once the wheat bran mixture reaches a 35% - 40% moisture content level, STOP! (How is this determined? Grab a handful of the mixture and squeeze it into a ball. No liquid should drip through your fingers. When you open your hand the EM Bokashi ball should keep its shape but crumble slowly to the touch. If excess water drips through your fingers, it indicates too much liquid has been added. To correct this, simply add more wheat bran and mix thoroughly to achieve the desired moisture level.)

5. After the wheat bran has been mixed, place the mixture inside a plastic bag or other airtight container. Remove as much air as possible before sealing.

6. Allow mixture to ferment for about two weeks or longer. Store mixture at room temperature out of direct sunlight.

7. In two weeks, check the mixture. Fermentation is successful if the EM mixture has a sweet fermented smell (similar to a pickle).
8. The moist EM Bokashi can be applied directly to a garden or flower box. It acts like a fertilizer. OR it can be added to kitchen waste to help with the decomposition process.

9. If you would like to store EM Bokashi for future use, spread a thickness of 1-3 inches and allow to dry. Then store in an airtight container.

10. Any questions concerning the EM Bokashi recipe and EM product contact the following distributor: Jo-Anne A. Kaneshiro, Fukuda Seed Store, Inc., phone: 841-6719.
WASTE NOT

“FROM WASTE TO WONDERFUL”

As you watch the film “From Waste to Wonderful”, take notes and write a few answers in response to the questions below. You will find this information very useful when preparing your written summary.

1. Describe what EM Bokashi is.

2. Describe how EM helps to address the food waste problem.

3. Describe the problem we are facing with our landfills.

4. What are some ways that technology has helped us with our waste stream?

5. On the back of this page, create a diagram that shows how matter and energy are transferred during decomposition.
DESIGNING AN EXPERIMENT

Challenge: Work with your team to design an experiment to find out more about how EM affects decomposition. Start by making a list of your observations about EM.

Our Research Question: What do we want to find out?
Develop a question that you want to investigate about EM.

Hypothesis: Develop a hypothesis that you will test with your experiment. If we do [describe your change]…then… [describe what you believe will happen and why].

Procedure: Describe your procedure. Keep in mind that you will need a way to measure the amount of change. You will need a “control” for your experiment where you do not change anything so you will have a comparison.

Results: Record your observations after 14 days and after 28 days.

Conclusion: What actually happened? Did your results validate your hypothesis? Use the back of this page to explain.
## Waste Not

**Observations**

<table>
<thead>
<tr>
<th>Date</th>
<th>Waste with EM Bokashi Observations (Record what you see and smell.)</th>
<th>Control: Waste with nothing added Observations (Record what you see and smell.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Day 1</td>
<td>Open this container first and record what you see and smell below. <strong>NOW</strong> Add 1 cup of soil to the mixture and stir. Seal container and store.</td>
<td>Then open the control container <strong>LAST</strong> and record what you see and smell below. <strong>NOW</strong> Add 1 cup of soil to the mixture and stir. Seal container and store.</td>
</tr>
<tr>
<td>Day 14</td>
<td>Open this container first and record what you see and smell below. How does the EM mixture compare to the control without EM?</td>
<td>Then open the control container <strong>LAST</strong> and record what you see and smell below. How does the control without EM compare to the EM mixture?</td>
</tr>
<tr>
<td>Day 28</td>
<td></td>
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</tbody>
</table>

Use this data sheet, or design your own to record observations of your experiment.
WASTE NOT

LEARNING LOG 7

NAME: _______________________________ CLASS: _________ DATE: __________

LAB REPORT

In this lesson we have:
• Learned about EM Bokashi
• Designed an experiment comparing decomposition of food with EM Bokashi and nothing.

To assess your learning, write a one-page lab report that includes:
1. Research question
2. Hypothesis in an “If…then…” format
   • Describe the variable.
   • Describe the control.
   • Describe how other factors were controlled.
3. Procedure
4. Results: how did the two groups compare? Visually, smell, etc.
5. A well-written scientific conclusion includes the following:
   • The purpose / problem / question of the experiment should be restated.
   • Data obtained in the experiment should be used to support or refute the hypothesis.
   • New concepts learned or demonstrated in the experiment should be stated.
   • No vague words such as ‘it’, ‘they’, or ‘things’
   • Discuss any possible causes for error in the data or any problems you had with the experiment.
   • You should include any new questions or experiments suggested by your experiment.

Grading will be as follows:

Mechanics: Spelling, neatness, punctuation and grammar ______/5
Content: Lab report contains all sections listed ______/20

Total ______/25

Lab reports should be written on folder paper, or typed on a computer and attached to this Learning Log sheet. Use the criteria above to check your report before you turn it in.
Nā Māla O Kona

_Kona po’o ku‘i._

Kona of the added head.

This saying describes farmers as they returned from the fields with bundles of food on their shoulders and a child sitting on top of the bundles.

*(Mary Kawena Pukui, ‘Ōlelo No‘eau No. 1847)*

How did the needs of the people influence the development of the Kona Field System?

---

**HAWAI‘I DOE STANDARD BENCHMARKS**

Science 2: Scientific Process: NATURE OF SCIENCE

- **SC.6.2.2** Explain how the needs of society have influenced the development and use of technologies.

Language Arts 4: Writing: CONVENTIONS AND SKILLS

- **LA.6.4.1** Write in a variety of grade-appropriate formats for a variety of purposes and audiences, such as pieces to reflect on learning and to solve problems

**NĀ HONUA MAULI OLA**

- **NHMO: `Ike Honua 8-1** Be keen observers of their natural environment.

**KEY CONCEPTS**

- *Kanaka* (people) designed the Kona Field System to increase food production.
- *Kanaka* took advantage of the different elevations to maximize crop yield.
- Water was collected from rain, intermittent streams, and the plants themselves to nourish the `āina.
- *Kua‘wi* walls and other agricultural terraces were initially designed for food production and to control soil erosion.

**ACTIVITY AT A GLANCE**

Students learn how the needs of _kanaka_ (people) influenced the development of the Kona Field System. They construct a map that highlights the key cultivation zones and identify crops found in each of the different areas. They learn about traditional Hawaiian planting by the moon and reflect on their own relationship to the ʻāina.

**ASSESSMENT**

Students:

- Create an enlarged map of the Kona Field System, label the different agricultural...
zones, including the terraces and water sources.

- Explain how the needs of the people influenced the development of the Kona Field System.
- Reflect on how kanaka (people) were connected to their environment and followed the phases of the moon to determine the best growing conditions for their crops.

**TIME**

4 class periods

**SKILLS**

analyzing, synthesizing

collaborating, constructing, diagramming,

critical listening, communicating orally,

writing, creativity

**MATERIALS**

Provided:

- Student Readings 1, 2, 3
- Learning Log 8
- Hawaiian Moon Calendar Poster
- Hawaiian Moon Calendar (for students)
- Blank Map

**ADVANCE PREPARATION**

Make 6 copies of each of the Student Readings, Blank Map, and Hawaiian Moon Calendar.

**VOCABULARY**

kuatui – a long, low stone wall marking field boundaries in a dryland cultivation system (literally, “backbone”)

wahi pana - storied, legendary site

**TEACHER BACKGROUND INFORMATION**

Hawaiian mahi‘ai (farmers) were excellent horticulturists. They excelled in their knowledge of the habits of plant growth, requirements for maximum yields, and requirements for cultivating plants under different weather and soil conditions (Krauss, 1974). They were also finely attuned to subtle nuances and could spot slight differences in plants (mutants) that they isolated and cultivated for special qualities (Mitchell, 1992).

In 1200 A.D., the Kona coast was a thriving, fertile land (Bishop Museum, 2010). Dryland agricultural plots extended from Kailua to Hōnaunau. Nā Mala O Kona (The Kona Field System) was the largest of three cultivation sites (Kirch, 1985). It stretched about 20 miles long from north to south, and six miles wide from ma uka (inland) to ma kai (shoreline) (Wolfforth, 2008). The Kona Field System was a systematic cultivation of dryland crops that were cultivated in different vegetation zones, which lacked perennial streams.

Early explorers noted that the Kona Field System was well designed. It took advantage of Kona’s warm climate. The location of the fields maximized the available sunlight and periodic rain showers. Mauna Loa protected the cultivated sites from high trade winds. Onshore winds were generally light. So very little water evaporated from the soil or plants (Kelly, 1983).
Long walls called *kuatwi* (backbone) ran up and down the slope of Mauna Loa. Shorter walls connected to the *kuatwi* walls to form small agricultural plots. Long grasses, *kō* sugar cane stalks, or *läï* (ti stalks) were often planted next to the walls. These crops would trap moisture and were an excellent source of water. Rocks placed near the base of plants would serve as mulch. Dirt would be mounded up around the rocks, which would help retain water. (See teacher answer key)

Today remnants of the *kuatwi* walls and other stone features of the *Nā Māla O Kona* are just a distant reminder of the expansive network of agricultural fields that once existed. However, many landowners are preserving this ancient technological innovation of dryland farming. They offer tours, grow food crops in the ancient beds, and host school and community groups at their sites.

By involving students in *mālama ʻāina* (caring for the land), we can help them experience the *ahupuaʻa* of Keauhou and Kahaluʻu. Caring for and maintaining the ʻāina was part of everyday life for the Hawaiian horticulturist. Offering *haumāna* (students) similar opportunities will deepen their understanding of the need to *aloha ʻāina* and to *pilina ʻāina* (to care for the land and be connected to it).

**TEACHING SUGGESTIONS**

1. **Introduce the standards and the focus question for this lesson.**
   
   How did the needs of the people influence the development of the Kona Field System?

2. **Have a discussion about modern-day and traditional technological devices.**
   
   • Ask students to think about modern-day technological devices that may have been invented for the benefit of the community.
   
   • List student responses on the board. (Examples: computers; health screening devices to perform tests such as EKG, and mammogram; farm equipment, etc.)
   
   • What are more traditional devices that were invented by Hawaiians to address the needs of the people?
   
   • List students’ responses on the board. (Examples: fishponds, *mākāhā*, ‘*auwai* system, *kuatwi* [walls of the Kona terrace fields]).

3. **Display map of Hawai‘i Island.**
   
   • Point out on the map the Kona area from Kailua to Hōnaunau.
   
   • Tell students that this was one of three areas on Hawai‘i Island where intense agricultural cultivation occurred over 800 years ago.
   
   • Identify the name of the area, which was called *Nā Māla O Kona* or The Kona Field System.
4. **Divide the class into teams and distribute the Student Readings and Blank Maps.**
   - Divide students into teams. Approximately six students per hui (group).
   - Distribute Student Readings and Blank Maps to each of the groups. Ask students to pair off, select one of the three readings, and highlight important information they find.
   - Have each pair of students highlight from one of the three readings: the different cultivation zones, technology used for farming, or water sources in the Keauhou and Kahalu’u ahupua’a. They can use the blank map to sketch their findings.
   - Explain that the information they have gathered will be transferred to a large poster map they will construct for their group project.

5. **Project a Blank Map of the Keauhou and Kahalu’u ahupua’a onto chart paper, using an overhead projector.**
   - Tape a large sheet of blank chart paper to the wall.
   - Using an overhead projector, project a transparency of the Keauhou and Kahalu’u ahupua’a map. (Use the same Blank Map that students are using.)
   - Trace the lines of the map onto the chart paper.
   - Have each group create their own enlarged maps using the projector.
   - Ask students to transfer the information they have collected from the Student Readings to the enlarged map.
   - Include wahi pana that are in the area, the different cultivation zones, water sources, and the network of kua‘wai and stone terraces.

6. **Have students present their maps to the rest of their classmates.**
   - Help guide their presentations and summarize what they have learned about Nā Māla O Kona.

7. **Have students complete Learning Log 8 for the individual assessment.**
   - Distribute Learning Log 8 and the Hawaiian Moon Calendar to each student.
   - Using the moon calendar poster that was distributed to you earlier, orient students to it. Point out the current month, what moon phase you are in.
   - Ask students to refer to their own individual moon calendar. What type of crops would be best for planting during the current moon phase?

**Extended Activities**

Play “He Mele No Kāne” on the oli CD. Distribute the Wai a Kāne chant and mo‘olelo (story). Forms teams and assign each hui to different parts of the chant. Distribute large poster paper and ask teams to illustrate what they have read. Place posters at the front of the room to form one long mural. Have each team present their work.
REFERENCES


Wolforth, Thomas. “Historic Properties Assessment for the Kona Forest Unit of the Big Island National Wildlife Refuge Complex: Ho‘okena and Kalahiki Ahupua‘a, South Kona District, Hawai‘i Island TMK: (3) 8–6–001:16.”
Imagine living in early Hawai‘i on the Kona coast. What would you see? Mauna Loa rising in the sky. Kanaka (people) fishing near the shore. ‘Ohana planting and harvesting crops for food, clothing, shelter, and lā‘au lapa‘au (medicines).

In 1200 A.D., the Kona coast was a thriving, fertile land (Bishop Museum, 2010). Dryland agricultural plots extended from Kailua to Hōnaunau. The Kona Field System was the largest of three cultivation sites (Kirch, 1985). It stretched about 20 miles long from north to south, and six miles wide from ma uka (inland) to ma kai (shoreline) (Wolforth, 2008).

Kanaka were keen observers of their environment. They understood the weather patterns and the physical features of the ʻāina (land). This ʻike (knowledge) helped them to determine the best place to plant their crops.

Early explorers noted that the Kona Field System was well designed. It took advantage of Kona’s warm climate. The location of the fields maximized the available sunlight and periodic rain showers. Mauna Loa protected the cultivated sites from high trade winds. Onshore winds were generally light. So very little water evaporated from the soil or plants (Kelly, 1983).

The agricultural areas of the Kona Field System were divided into four zones. These zones defined the best conditions to grow crops (Wolforth, 2008).

The kula zone began at the coast up to about a 500 ft. elevation. The annual rainfall was between 30 and 50 inches. The land was used to cultivate ʻuala (sweet potatoes), gourds, and wauke (paper mulberry). Most of the kanaka lived in this area where crops could be easily harvested.

On the hill of Puʻu O Kaloa, ʻuala grew profusely. ‘Uala was the ideal crop to grow in this area. It could withstand the dry and hot conditions. It was considered a high-yield food, and it didn’t require a lot of watering.
Kanaka believed that when a dumbbell-shaped cloud appeared over the heiau of Pu‘u O Kaloa, it connected to the heiau of Ke‘ekū in Kahalu‘u (Maly, 2007). This was a hō‘ailona (sign) that rain was on its way. It was time to plant ʻuala.

There is a saying “Ua ka ua i Pu‘u O Kaloa. I hea ʻoe? I Kona nei, (ah) ma waho ʻoe.” When it rained at Pu‘u O Kaloa, where were you? This is a response from a sweet potato grower to a kanaka asking for some of his ʻuala. If the person answered I’ve been in Kona, then the grower would assume that the kanaka had not participated in the planting of ʻuala. This would be a sure sign that the person was lazy, and he would be turned away.

The kaluulu (plentiful growth) zone is on the seaward slope of the mountains. It was between the 500 and 1,000 ft. elevation. Rainfall was 40-55 inches a year. ʻUlu (breadfruit) and mountain apple grew profusely. The ʻulu grove stretched across the 20-mile landscape and was about a mile wide. Kanaka planted ʻulu trees far apart from each other so that the ʻulu fruit would grow abundantly. Other vegetable crops were planted between the trees. The low exposed cliffs in the area held in the moisture, which would slowly seep into the soil and nourish the crops below. Fewer kanaka lived in this area.

The ʻāpaʻa zone on the upland slope of Mauna Loa received anywhere from 55 to 80 inches per year. The elevation was approximately 1,000 to 2,500 above sea level. Dryland kalo (taro), läi (ti plant), ʻuala and kō (sugar cane) grew in this zone. This was the most intensely cultivated of the four zones. The Reverend
Ellis wrote about his experience as he “traveled about three or four miles through this delightful region and passed several pools of fresh water…” This is where the most productive māla (gardens) grew. There were few kanaka who lived in this area.

Long walls called kuaīwi (backbone) ran up and down the ‘āpa‘a zone sometimes extending down into the kaluulu area. These walls ran parallel to the gentle slope of Mauna Loa. Shorter walls connected to the kuaīwi walls to form small agricultural plots. Long grasses, kō sugar cane stalks, or lā‘ī were often planted next to the walls. These crops would trap moisture and were an excellent source of water. Rocks placed near the base of a plant would serve as mulch. Dirt would be mounded up around the rocks. This would help retain water.

The ‘āpa‘a zone is where dryland kalo was intensely cultivated. Archibald Menzies, a naturalist for Captain Vancouver, described his observation of kalo cultivation. “The whole field is generally covered with a thick layer of hay, made from long, coarse grass or the tops of sugar cane, which continually preserves a certain degree of moisture in the soil that would otherwise be parched up by the scorching heat of the solar rays.” ‘Auwai (irrigation ditches) were engineered to pull water from intermittent streams to feed the dryland terraces.

The ‘ama‘u or upland forest zone was further up the slopes of Mauna Loa. The elevation climbed 2,500 to 4,000 ft. Annual rainfall was about 80 inches per year. This area was used to grow mai‘a (bananas). There were many benefits in planting mai‘a besides using it as a food crop. The banana stalk trapped and held water. It also protected the soil and increased moisture in pit planting.

Other resources in the ‘ama‘u zone such as koa woods were harvested to build canoes. Bird feathers were collected to make capes and helmets. Temporary hale
(shelters) were scattered throughout this zone. These shelters supported kanaka when they visited the area to harvest crops.

References

Honolulu: Mutual Publishing.

“Final Environmental Assessment Amy Greenwell Ethnobotanical Garden Visitor Education Center and Parking Lot.”


Wolfforth, Thomas. “Historic Properties Assessment for the Kona Forest Unit of the Big Island National Wildlife Refuge Complex: Hoʻokena and Kalahiki Ahupuaʻa, South Kona District, Hawaiʻi Island TMK: (3) 8–6–001:16.”
Nā Māla O Kona

What made Nā Māla O Kona (Kona Field System) so unique? It was the kuaīwi, rock wall terraces, and mounds that made it so distinct from other field systems.

Kuaīwi were long, broad stone walls. The walls were a result of land being cleared. Rocks were piled up into areas to develop planting sections. The kuaīwi ran parallel to the slope of Mauna Loa and Hualalai in a ma uka (inland) to ma kai (shoreline) direction. Shorter retaining walls called “cross walls” ran perpendicular to the kuaīwi.

The agricultural fields were a network of rectangular stonewalls intersecting one another. This network extended from Kailua to Hōnaunau and was 20 miles long and six miles wide.
Technological Innovation

Many studies show that the dryland field system of Kona developed over time. Kanaka (people) did not bring this technological innovation with them. It developed as the political structure changed and the population began to grow.

One study shows that the field systems were developed in five phases.

Phase I was considered the “slash and burn” period. This technology required farmers to clear small areas to plant their crops. The area of study shows that the period was from approximately 1400 to 1600 A.D.

Phase II quickly followed. Farmers used their semi-permanent māla (garden) plots to build cross-slope terraces. This invention helped control erosion and maintain the soil.

Phase III occurred in the mid-1500s to 1600s. Growers built kuaīwi, which served as field boundaries, clearing piles and planting features. The kuaīwi were later used as a way to prevent animals from entering the māla area.

Phase IV included stone mounds. These mounds were used for gardening. The mounds represented planting or clearing features. Some experts believe that this period showed a shift in agriculture. Hawaiian technologies were now being used to grow newly introduced plants such as oranges, cucumbers, Irish potatoes, and watermelons.

Phase V involved the introduction of coffee. This occurred in the late 1800s. This period is when Hawai‘i turned from subsistence to a market economy.

Much of the prime agricultural lands became the prime residence for many of the ali‘i in the 19 century. The fields produced food crops such as kalo (taro), ʻulu (breadfruit), kō (sugar cane), ʻuala (sweet potato), and wauke (paper mulberry). It was an ideal place to live.

The Hawaiian planter developed the kuaīwi, rock wall terraces, and mounds to increase food production as result of a growing population. These walled
enclosures also helped to prevent soil erosion and later protect māla plants from animals. This innovative practice supported the needs of the community.

How can we apply this practice of mālama ‘āina to our own community?

References

“Final Environmental Assessment Amy Greenwell Ethnobotanical Garden Visitor Education Center and Parking Lot.”

Kelly, Marion. 1989. “Dynamics of production intensification in pre-contact Hawai‘i.”

Nā Māla O Kona

STUDENT MAP
NA MĀLA O KONA

NAME: ___________________________ DATE: ___________________

Directions: Answer the questions below. Give examples where appropriate.

How did the needs of the people influence the development of the Kona Field System?

Why were the kūaiwi and other stone terraces important to food production?

Identify two elements of wai (water) found in the oli - Wai A Kāne. How would kanaka (people) irrigate their crops?
Many Hawai‘i planters still use the moon cycle for planting. Identify one crop in each of the agricultural zones of the Kona Field System. Identify the best moon cycle to plant your crop. (Refer to the moon calendar that was distributed earlier or the moon calendar on your classroom wall.)

If you were a farmer living in Kona long ago, how would you determine the best place to grow your crops? What would you look for in your environment that would help you decide?
# Hawaiian Moon Calendar

<table>
<thead>
<tr>
<th>Moon Phases</th>
<th>Name and Translation</th>
<th>Daily Planting Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Moon Phases" /></td>
<td><strong>1. Hilo</strong> (faint, slender, wispy)</td>
<td>Night 1: Foods maturing underground will &quot;hide&quot; so they may be small like the moon. The is the first night of the moon phase called “growing large” and began with the first night of the new month with a “glimpse of the new moon.”</td>
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<tr>
<td><img src="image" alt="Moon Phases" /></td>
<td><strong>2. Hoaka</strong> (faint light)</td>
<td>Night 2: Some Hawaiians believed this was a good day for planting, especially ‘uala (sweet potato), <em>kalo</em> (taro), but they will be small at harvest since the new moon is small.</td>
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<tr>
<td><img src="image" alt="Moon Phases" /></td>
<td><strong>3. Kū Kahi</strong></td>
<td>Night 3: The Kū days are believed to be good for planting ‘uala (sweet potato), <em>kalo</em> (taro) and <em>mai’a</em> (banana) because the plants will grow &quot;upright&quot; or &quot;erect&quot; (kū).</td>
</tr>
<tr>
<td><img src="image" alt="Moon Phases" /></td>
<td><strong>4. Kū Lua</strong></td>
<td>Night 4: Plants grow ‘upright’ or ‘erect’ (kū) at this time.</td>
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<tr>
<td><strong>5. Kū Kolu</strong></td>
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<td>Night 5: Days 3, 4, 5 and 6 are the Kū days, which are good for planting.</td>
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<td>This is the third night of Kū.</td>
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<td></td>
<td>The last night of Kū.</td>
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<tr>
<td><strong>7. ‘Ole Kū Kahi</strong></td>
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<td>Night 7: ‘Ole means &quot;nothing,&quot; &quot;without.&quot; According to Hawaiian traditions, this is an unproductive time for planting. The ‘Ole Kū days are 7, 8, 9 and 10 and these are the bad days for planting. ‘Ole is also the name of the wind, which was said to blow during the phases of the moon we call the first quarter and the third quarter.</td>
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<td></td>
<td>The first of four nights of the ascending moon. This is an unproductive time, for ‘ole means nothing. The ‘ole winds of the “ascending” moon prevailed four nights.</td>
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<td><strong>8. ‘Ole Kū Lua</strong></td>
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<td>Night 8: Farmers generally don’t like this day for planting, but it’s good for weeding.</td>
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<td></td>
<td>Nothing will be had from the sea.</td>
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<td><strong>9. ‘Ole Kū Kolu</strong></td>
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<td>Night 9: This is also not a good day for planting according to tradition, but weeding is recommended.</td>
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<td></td>
<td>This is an unproductive time for ‘ole means nothing.</td>
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<tr>
<td>Night 10: `Ole Kū Pau</td>
<td>The last of four unproductive days.</td>
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<tr>
<td>Night 10: Pau means &quot;end.&quot; This is the last of the four `ole or unproductive days.</td>
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<tr>
<th>Night 11: Huna (Hoʻao)</th>
<th>Huna means to conceal. The moon is concealing its horns.</th>
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<tbody>
<tr>
<td>Night 11: Farmers favor root plants now because the plants will grow well hidden (huna) under dense foliage. An example is the ipu (bottle gourd) that hides under its leaves. This is the first night of the second phase called the “roundness” of the moon. During this rounding phase, the moon “scattered to Akua and descends to Hoku and Māhealani.”</td>
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<tr>
<th>Night 12: Mohalu (Mōhaluhalu)</th>
<th>Mohalu means clearness, the clearness of the moon. The night is sacred to Kāne.</th>
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<tbody>
<tr>
<td>Night 12: This is the night that farmers favor flowering plants, especially the ipu, mai'a and kalo. Kāne was worshipped on the 12th and 13th nights.</td>
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<tr>
<th>Night 13: Hua</th>
<th>The moon is rounded like an egg. The night brings fruitfulness.</th>
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<tbody>
<tr>
<td>Night 13: Hua means &quot;fruit&quot; or &quot;seed&quot; and it was believed that this night when the moon was rounded like an egg would be fruitful.</td>
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<td>Night 14: On this night all things reproduce abundantly (ho'ookua). Farmers make offerings to increase the growth of plants and food (me'ai).</td>
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| **14. Akua**  
The moon has become a god (akua). It is on this night that the great round moon becomes separated from Earth. |
| **15. Hoku**  
The moon is as bright as a star. Hoku is the fullest moon of the month. |
| **16. Mahealani**  
This additional night of full moon symbolizes good luck and fertility. |
| **17. Ku Lua or Kulu**  
This is the second night after the full moon. The moon sets after sunrise. Kulu means to drop. Water drips and the blossoms of the plant drop off. |
<p>| Night 15: This is a prolific time for trees, root plants and mai'a. |
| Night 16: This night of the &quot;calendar&quot; full moon is a good time for planting. Farmers believe that plants will grow large and flourish if they are planted now. |
| Night 17: This is a good time for potatoes and melons. It is also a time when the mai'a (banana) sheath drops off, exposing its new bunch of fruits. |</p>
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<tr>
<td><strong>18. Lāʻau Kūkahi</strong></td>
<td>The first of three lāʻau days. Lāʻau means medicine for the sick.</td>
<td>Night 18: This is a good time for planting maiʻa. Lāʻau days favor growth in plants and trees; also a good time to gather and use plants for medicine. In this third phase, the moon “sinks” thorough the lāʻau nights and “moves on to smallness” until the last night of the month when it is out of sight.</td>
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<td><strong>19. Lāʻau Kūlua</strong></td>
<td>The second lāʻau night. The moon has waned, and its sharp points (the ends of the moon) can be seen once more.</td>
<td>Night 19: This is a good day for planting.</td>
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<td><strong>20. Lāʻau Pau</strong></td>
<td>Lāʻau nights are finished.</td>
<td>Night 20: This is the end of the lāʻau nights and is a good time for planting.</td>
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<tr>
<td><strong>21. ‘Ole Kū Kahi</strong></td>
<td>This is the first of three nights of the descending moon.</td>
<td>Night 21: Farmers use this time for weeding.</td>
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<tr>
<td><strong>22. ‘Ole Kū Lua</strong></td>
<td>The second night of the descending moon.</td>
<td>Night 22: ‘Ole days are not believed to be good for planting or fishing.</td>
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<tr>
<td><strong>23. 'Ole Pau</strong></td>
<td>'Ole nights of the descending moon are finished.</td>
<td>Night 23: The last of the 'ole nights is not believed to be a good time for planting.</td>
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<td><img src="image1.png" alt="Image" /></td>
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<tr>
<td><strong>24. Kāloa Kūkahi</strong></td>
<td>First night of Kāloa Kapu for the deity Kanaloa.</td>
<td>Night 24: Hawaiian farmers planted long-stemmed or long-leaved plants, such as mai'a, kō (sugar cane), wauke (paper mulberry) and 'ohe (bamboo) at this time. Hala (pandanus) was believed to develop long leaves, very suitable for weaving, if planted on this night.</td>
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<td><img src="image2.png" alt="Image" /></td>
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<td><img src="image3.png" alt="Image" /></td>
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<td><img src="image4.png" alt="Image" /></td>
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<tr>
<td><strong>27. Kāne</strong></td>
<td>Deity of all living things. The night is kapu to Kāne. No fires can be made. Sound is forbidden.</td>
<td>Night 27: On this time, people offered prayers devoted to health and food.</td>
</tr>
</tbody>
</table>
28. Lono
Deity of fertility. The night is kapu to Lono. No noises can be made at all.

Night 28: Farmers planted melons and ipu (bottle gourd), since these plants are kino lau (the embodiment) of the god Lono.

29. Mauli
The last breath. The feeble moon rises a little before sunrise and is seen for the last time.

Night 29: Uli means a dark color; implies plants would have a dark-green, rich growth. If there were only twenty-nine days in the month, the priest omitted Mauli, as each month had to end with Muku, which means “out of sight” or fainting.

30. Muku
Finished or dying, cut short. This is the end of the lunar cycle. The utterly dark night has no moon at all. The moon cannot be seen, as it is traveling with the sun.

Night 30: At this time, mai‘a will fruit bunches one muku long (a measurement from the finger tips of one hand to the opposite elbow,). Trees and kō will prosper, but this time is not recommended for ‘uala.

Sources


Seasonal Planting Notes

In ancient times, the months were marked by the appearance of different stars and constellations in the eastern sky at sunset.

Ho’olio (Cooler, Wetter Season)

Weluhu (Oct.-Nov.) Makalii (Pleiades) appears in the ENE sky after sunset. Rainy season. Makahiki, a four-month long harvest festival, dedicated to Lono, a god of rain and agriculture began toward the end of Kau (mid-October) and continued into the new year.

Makali’i (Nov.-Dec.) Sun rises and sets at its southern limit (winter solstice). Land prepared for planting.

Kaelo (Dec.-Jan.) ‘A‘a (Sirius) and Orion in the eastern evening sky. ‘Uala (sweet potato) planting in dry areas to take advantage of winter rains.

Kaulua (Jan.-Feb.) Ke Ali‘i o Kona I ka Lewa (Canopus) in the ESE evening sky. Planting for all crops - kalo, ‘uala, ipu (gourds), wauke (bark cloth), olona (for cordage), bananas, yams, and arrowroot.

Nana (Feb.-Mar.) Sun rises due east and sets due west (Spring Equinox). Mulch and weed garden; vigorous plant growth begins.

Welo (Mar.-Apr.) Leo in the eastern evening sky. All things grow, crops maturing.

Kau Wela (Hotter, Drier Season)

Ikiki (April-May) Makalii in the WNW evening sky; Hokule‘a (Arcturus in the ENE evening sky. ‘Uala planting with summer rains.

Kaaaona (May-June) Sun rises and sets at its northern limit (summer solstice). ‘Ulu (breadfruit) ripens.

Hinaia‘ele‘ele (June-July) Manaiakalani (Maui’s Fish Hook, or Scorpio) in the SE evening sky. Humid weather and sudden storms. ‘Ohi’a ‘ai (mountain apple) ripens; gourds and melons ripen.

Hilina Ehu (July-Aug.) Leo in the western evening sky. ‘Ohi’a ‘ai abundant.

Hilina Ma (Aug.-Sept.) Sun rises due east and sets due west (Fall Equinox). Tubers ripen for harvest, sugar cane blossoms; vines dying off.
'Ikuwa (Sept.-Oct.) Iwakeli'i (Cassiopeia) in the NNE evening sky. Thunder and rain. Plant growth slows; kalo and 'uala harvest. Preparation for the Makahiki Harvest Festival.

Reprinted from:
Prince Kūhio Hawaiian Civic Club. 2002. *Ancient Hawaiian Moon Calendar Related to Fishing and Farming*. P.O. Box 4728, Honolulu, Hi 96812

**ADDITIONAL RESOURCE**

ʻŌPALA OUTING

How has technology changed the way we consume and dispose of products, and what can we do to promote zero waste to hoʻola (heal) our ahupua‘a?

HAWAIʻI DOE STANDARD BENCHMARKS

Science 2: The Scientific Process: NATURE OF SCIENCE
• SC.6.2.2 Explain how the needs of society have influenced the development and use of technologies.

Language Arts 5: Writing: RHETORIC
• LA.6.5.2 Use an organizational structure (e.g., chronological, comparison and contrast, spatial order, climactic order, order of importance) to support meaning.

Language Arts 6: Oral Communication: CONVENTIONS AND SKILLS
• LA.6.6.1 Explain how appropriate participation affects the productivity of group activities.
• LA.6.6.3 Give short prepared oral presentations to inform and persuade.
• LA.6.6.4 Use appropriate listening strategies (e.g. listening attentively, taking notes, asking questions) to learn from an oral presentation.

GENERAL LEARNER OUTCOME

GLO 5: Effective Communicator
• Communicate effectively and clearly through speaking, using appropriate forms, conventions, and styles to convey ideas and information for a variety of audiences and purposes.

NĀ HONUA MAULI OLA
• NHMO: ʻIke Honua - Sense of Place Pathway 8-2 Maintain a clean and healthy environment (i.e. waste management).
• NHMO: ʻIke Honua - Sense of Place Pathway 8-13 Teach others about the concept of malama through example.
• NHMO: ʻIke Honua - Sense of Place Pathway 8-14 Participate in conservation and recycling practices and activities.

KEY CONCEPTS
• Technology has changed the way we consume by allowing us to purchase many new products that are shipped over long distances and often manufactured from new human-made materials.
• Technology impacts the way we dispose of and recycle products.
• We can make consumer choices that will reduce waste, and we can take action to recycle and compost more of the materials we use.

ACTIVITY AT A GLANCE
Students visit the Recycling and Reuse Center at the Keauhou transfer station. They then write a letter to explain how technology has changed the way they consume and dispose of products and how their school community can help promote zero waste to hoʻola their ahupuaʻa. Students
groups take action to reduce waste in their school community and then present their projects to `ohana and the school community.

**ASSESSMENT**

Students:
- Create a diagram to represent how landfills are designed to minimize impact on the environment.
- Write a one-page letter to someone at the Recycling and Reuse Center at the Keauhou transfer station to summarize learning and address the unit essential question.
- Work with a hui (group) to complete a project that reduces waste and reflects caring for and healing our ahupua’a.
- Present projects (e.g., computer presentation, video, model, story, or song) to peers and `ohana and explain ways in which technology has changed our society.
- Complete a self-assessment of contributions to group work and personal commitment to care for the `āina.

**TIME**

4 class periods

**SKILLS**

collaborating, constructing, diagramming, critical listening, communicating orally, writing, creativity

**MATERIALS**

Provided:

- Learning Logs 9-13
- Landfill diagram
- Project Ideas (optional – one per group)
- Student Assessment Overview and rubrics (Provided in Unit Introduction)

**ADVANCE PREPARATION**

- Make copies of the rubrics provided in the Unit Introduction (or plan to project them for students to review).
- Make arrangements for a classroom visitation by a Recycling Specialist with the County of Hawaii Environmental Management
  - Phone: 895-6776
  - Email: topson@hawaii.rr.com
- Make arrangements for students to visit the Recycling and Reuse Center at the Keauhou transfer station.
  - Contact: Travis Olson
  - Phone: 895-6776
  - Email: topson@hawaii.rr.com
☐ Review the Field Sites Appendix for materials needed for the field trip and management suggestions.
☐ Review the Field Sites Appendix for materials needed for the field trip and management suggestions.
☐ Make a copy of Learning Logs 9-12 for each student

Optional: Make arrangements for students to visit other sites that are involved in “green” conservation practices.

1. Innovations Public Charter School
   Contact: Krista Donaldson
   E-mail: kristajoan@gmail.com
   Ph: 557-9085 or 327-6205
   Fee: none
   Innovations Public Charter School offers school tours on their property. They are practicing sustainability by involving their students and families in conservation practices. The school recycles, uses gray water to irrigate their gardens, mulch and compost using compostable products.

2. Kona Brewing Company
   Contact: Mattson Davis
   E-mail: smattson@konabrewingco.com
   Ph: 937-0466
   Fee: none
   Kona Brewing Co. is committed to “best green” practices. The company recycles, uses compostable take-out trays, and catches 90 gallons of condensation per day from air conditioning and uses it for landscape irrigation.

3. Amy B.H. Greenwell Ethnobotanical Garden
   Contact: Peter Van Dyke
   E-mail: agg@bishopmuseum.org
   Ph: 323-3318
   Fee: $3 for Hawai‘i Island Schools
   The Garden has a five-acre intact ancient ku‘aiwi wall system and other agricultural plots. Tours are provided and students can also be involved in an in-service mālama ‘āina experience.

4. Ku‘aiwi Farm
   Contact: Una Greenaway
   E-mail: una@hawaii.rr.com
   Ph: 328-8888
   Fee: $5 for students
   Ku‘aiwi Farm is practicing sustainability and has installed photovoltaic panels, a water catchment system, and solar water heaters. Ancient ku‘aiwi walls and terraces are still being used as vegetable gardens. The Farm blends ancient growing techniques with modern-day farming practices.

   Vehicles no larger than a 15-passenger van.
**TEACHER BACKGROUND INFORMATION**

**How has technology changed the way we consume and dispose of products?**
Technology has enabled us to purchase materials that have traveled a long distance to reach us. We consume more products, many of which are made from new human-made materials that take a long time to decompose. The average consumption of goods and services by American households has doubled since 1957 when televisions became common in private homes (Kingsolver, 2004). We also have the advantage of using disposable products that are often convenient, but there is a trade-off when the impact of disposing these materials is considered.

**What can we do to promote zero waste to hoʻola (heal) our ahupuaʻa?**
There are many ways that we can reduce waste, from the choices we make as consumers to the actions we take to reduce what we throw away. As we consider purchasing products, it’s useful to consider how the product impacts the environment, for example, does it have an excessive amount of packaging? Is it recyclable? Will it last a long time? Does it contain toxic material that might be released into the environment? When these things are taken into consideration, we might decide to pass up some products, to consume less, and to select more “green” items that have less of an impact and contribute less to the stream of waste.

When we have finished with a product, we can reduce waste by composting natural or compostable materials, recycling or re-using containers, or donating outgrown items to others.

**TEACHING SUGGESTIONS**

1. **If you have not already done so, distribute the student assessment overview and discuss students’ culminating projects that address the unit essential question:**
   How has technology changed the way we consume and dispose of products, and what can we do to promote zero waste to hoʻola (heal) our ahupuaʻa?
   • Ask students to generate some initial responses to the essential question.
   • Review the tasks on the Student Assessment Overview. Explain that students will be visiting the Recycling and Reuse Center at the Keauhou transfer station to learn what they are doing to reduce waste.
   • Students will then write individual letters to one of the sites and conduct a group project to take action to promote zero waste in their school community.
   • Ask students to generate some initial ideas about what those projects could be.

2. **Review the concepts from the previous lessons and have a class discussion.**
   **Discussion Questions**
   • Why was it easier for people in early Hawaiʻi to dispose of their waste? *(Their waste was made from natural materials, which decompose quickly.)*
• What are some ways we currently eliminate, reuse, or dispose of waste? (Recycling centers, composting green waste, waste-to-energy combustion facilities, and landfills.)
• Why do items such as glass bottles, fishing line, plastic bottles, and diapers have such a great impact on our ‘āina (land)? (It takes longer for these items to decompose – some up to 1 million years) Refer to the chart in Student Reading 1 for decomposition rates.
• How do we become more responsible citizens to help reduce waste in our ahupua’a? (By developing a plan to reduce waste in our school community, implementing it, and educating others about it.)

3. Discuss the class field trips to the different recycling facilities.
• Distribute Learning Log 9 and describe the learning activities that will take place at the Recycling and Reuse Center at the Keauhou transfer station.
• Discuss ways to focus attention and listen carefully to presentations and how to take notes effectively.
• Review what students need to bring on the field trip and your expectations for good behavior while visiting sites.

5. Review agenda and conduct the ‘Ōpala Outing field trip with students.

AFTER THE FIELD TRIP

6. De-brief with students and discuss what they learned at each site.
• Ask students to share responses from their Learning Logs.
• Review some of the potential impacts of landfills on the environment (emit foul odors, release harmful methane gas into the atmosphere, noise of trucks for nearby neighbors, potential for leaching toxic liquid into groundwater, take up valuable land)

7. Discuss students’ individual unit projects. Distribute and review Learning Log 10.
• Review the rubrics for students’ culminating projects to write a letter to one of the sites that are involved in conservation practices.
• Discuss expectations, due date and criteria for grading.
• Introduce or review the format for writing a formal letter.
• Ask student to turn in drafts of their letters and work with them to edit their work and produce final letters free of grammatical, spelling and punctuation errors.

8. Distribute and review Learning Log 11.
• Have students form hui (groups) to work on projects that will promote zero waste in the school community.
• Review the rubric and criteria for grading.
• Brainstorm various project ideas such as putting on an educational puppet show about recycling, conducting a used clothing drive, or starting a recycling center at school. If desired, hand out or discuss the Project Ideas sheet provided at the end of the lesson.
9. Discuss ways to work cooperatively and be an effective group member.
   • Distribute Learning Log 12 and review it with students.
   • Explain that students will be responsible for assessing their contribution to the group at the end of this project.

10. Plan the presentations and set a date for students to present their projects.
    • Invite other grade levels, administrators and/or families to attend.
    • Students can have a pāpū party celebration with invited guests after sharing their projects.
    • If desired, ask each student to bring a healthy snack that uses little or no disposable packaging to share.
    • Ask all guests to dispose of their waste in appropriate recycling or composting bins.

11. Have students complete all assessments and congratulate them on their accomplishments.

REFERENCE

RESOURCES
Advanced Disposal. Landfill Diagram.
http://www.advanceddisposal.com/ads_gar/101_education_zone/101_kids_corner/101_landfill_diagram.aspx (Simplified diagram, designed for students to understand how a landfill works)


Michigan Environmental Education Curriculum. Where Does Our Garbage Go?
http://techalive.mtu.edu/meec/module15/Landfills.htm (Interactive diagram of a landfill – move cursor over parts of the landfill to see how it works)


LEARNING LOG 9
RECYCLING AND LANDFILL SITES

NAME: __________________________  DATE: __________

1. What kinds of products are accepted for recycling here?

2. What is the difference between Plastic #1 and Plastic #2? What kinds of products can these plastics become after they have been recycled?

3. Why are recycled aluminum and glass considered a closed loop product and plastic is not?

4. What kinds of materials does the scrap metal center receive? Where are the end markets? What are these items remanufactured into?

5. Diagram how a modern landfill is constructed. Identify the differences between a modern landfill and the Pu‘uanahulu landfill.
6. Describe what is happening between matter and energy in the landfill process.

7. What are some dangers that the landfill may cause to the environment? How are these challenges being addressed?

8. How does the way we use and discard products make you feel?
**Typical Anatomy of a Landfill**

1. **Protective Cover**
   - Geosynthetic Liner
   - A liner at the bottom of a landfill to prevent leachate from leaching to the ground. It is made of a synthetic polymer and is buried below the landfill to prevent leachate from accumulating.

2. **Geosynthetic Clay Liner (GCL)**
   - A synthetic material that is used to replace the traditional clay liner. It is made of a synthetic polymer with a high clay content and is used to prevent permeation of water and leachate.

3. **Drainage Layer**
   - A layer of rocks or gravel placed above the geosynthetic liner to allow leachate to drain away from the landfill.

4. **Composite Cap System**
   - A system of layers that are designed to prevent leachate from leaching to the ground. It includes a geosynthetic liner, a geosynthetic clay liner, and a drainage layer.

5. **Leachate Collection System**
   - A system of pipes and tubes that are used to collect leachate from the landfill and transport it to a treatment facility.

6. **Filter Geotextile**
   - A textile material that is used to filter water and leachate from the landfill.

7. **Geosynthetic Clay Liner (GCL)**
   - A synthetic material that is used to replace the traditional clay liner. It is made of a synthetic polymer with a high clay content and is used to prevent permeation of water and leachate.

8. **Geosynthetic Liner**
   - A synthetic liner that is used to prevent leachate from leaching to the ground. It is made of a synthetic polymer and is buried below the landfill to prevent leachate from accumulating.

9. **Compacted Clay**
   - A layer of clay that is compacted to prevent leachate from leaching to the ground.

10. **Working Landfill**
    - The area where waste is deposited and compacted to allow for the safe disposal of waste.

**How does the landfill work?**

Graphic and text reprinted from [www.wm.com](http://www.wm.com), WM Waste Management. © 2003, Waste Management Inc.)

To see this document in full size, visit the Waste Management Web site and select Community / Educational Resources.
In this lesson, you had a chance to visit local companies who are helping to reduce waste in our communities by recycling products. You also had an opportunity to learn about how technology has changed the way we use and dispose of products. Now it’s time for you to extend a warm mahalo to those who provided you with a tour of their recycling facility. To assess your learning, write a one-page thank-you letter to someone at the site we toured:

Recycle Hawai’i
P.O. Box 4847
Hilo, HI 96720

Attn: Travis Olson

Your letter should include:
- Your thanks and appreciation for the opportunity to visit the site.
- What you learned to answer the unit essential question.
- What you found most interesting.
- Things you told your friends or family about the place.
- How you will change your habits to help promote zero waste and make recycling easier.

Your letter should:
- Be hand-written on folder paper or on stationary in cursive.
- Follow the format for a formal letter. (We will review this in class.)

Your letter will be graded as follows:
Mechanics: Spelling, neatness, punctuation, and grammar ______/5

Poor quality work will be redone until it is acceptable.

Content/Design:
- Include concrete examples and express true appreciation
- Use an organizational structure that supports the meaning of the letter.

_____/20

Total ______/25
In this unit, you learned about how technology has changed the way we use and dispose of products. You may also have had a chance to visit a local recycling center that is helping to reduce waste in our communities by recycling products. You may have also visited sites where ancient agricultural terraces are being restored or used to grow food. You may have seen a company that is involved in “best green” practices. Now it’s time for you and your group to take action and develop a plan to support zero waste in our school community.

UNIT ESSENTIAL QUESTION:
How has technology changed the way we consume and dispose of products, and what can we do to promote zero waste to hoʻola (heal) our ahupua’a?

PROJECT
As a group, choose a service project you would like to do for our school. Some ideas to think about: create recycling sites around campus for recycling bottles and cans, make a compost pile using some of our school’s kitchen waste as fertilizer for a garden, set up worm recycling project, conduct a used clothing drive and donate useful items to the homeless, build an aquaponic system, create a puppet show about recycling, create a PSA (public service announcement) for broadcast on radio or television. Remember, whatever project your group decides to do, each of you will contribute.

PRESENTATION
Make a short 3-5 minute presentation of your group’s project. Your project should answer the unit essential question. Your group may choose to present your project as a computer presentation, video, story, song or poster board.

OUR IDEA:

OUR PLAN:
**GROUP MEMBERS AND THEIR RESPONSIBILITIES:**

<table>
<thead>
<tr>
<th>Name of Group Member</th>
<th>Kuleana (Responsibility)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tr>
</tbody>
</table>

**HOW WE WILL PRESENT OUR PROJECT:**
Place a check in the box that matches your performance as a group member. Add up your points and answer the questions below.

<table>
<thead>
<tr>
<th>Maika‘i loa! Excellent 4 points</th>
<th>Maika‘i Good 3 points</th>
<th>Ano Maika‘i Okay 2 points</th>
<th>Auē! Not so good 1 point</th>
</tr>
</thead>
<tbody>
<tr>
<td>I did my best work for the team. It was in-depth, organized, neat and creative!</td>
<td>4 points</td>
<td>3 points</td>
<td>2 points</td>
</tr>
<tr>
<td>I helped others when they needed my ʻökua.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I finished my work on time.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I listened to others’ ideas without being critical.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I gave positive feedback to my team members.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I asked for and used feedback from others.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I think we did an awesome job as a team.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Total Score _______________

Explain what your contribution was to the team.

What was difficult for you in working with your team? Why?

How could you improve and help your team to be more effective? (If you need more room, use the other side of this sheet.)

What action can YOU take to ʻmālama (care for) the area where you live?
Use your finished EM compost to plant a garden. You learned about EM and performed an experiment using EM Bokashi. Now it’s time to use the EM fermented waste from the pūpū party to plant a garden or fertilize a tree. (See directions http://www.emhawaii.com/index.php/em-teachers-manual.html a teacher’s manual to using EM for compost.)

Design a recycling or waste reduction program at your school. You have already conducted a waste audit of your school. Think of ways your group can reduce waste at its source. Target materials to collect for recycling. For example, you noticed a great deal of aluminum cans being tossed into regular waste bins in the teacher’s lounge. Set up a recycling bin for teachers to dispose of their waste. Create campus posters to educate students and teachers about your efforts.

Implement a school composting project. Schools generate large amounts of green waste. Work with the grounds staff and custodians to organize a school compost pile. Inform everyone through school announcements that yard trimmings will be disposed of in the designated compost pile. The compost can later be used to fertilize plants around your school campus.

Produce a recycling play and perform it for younger students. Use your talent to write and produce a play for younger children in your school. Teach them about recycling, reducing and reusing products. Write a song or rap that will enhance your play.

Trash to Treasure. Work with your teacher to implement a school-wide yard sale or clothing drive for the homeless. Ask students and school administrators to donate new or gently used items. Collect and store items for giving to the homeless or for your sale.

Waste Not! Work with your cafeteria manager to recycle food waste. This project is challenging so make sure you fully discuss your project idea with your teacher. Experiment by recycling food waste from one lunch period. Once you have allowed the food waste to ferment with EM, use the EM waste as compost for your school garden. (Go to: http://www.emhawaii.com/index.php/em-teachers-manual.html for a teacher’s manual with directions on how to recycle food waste using EM.)
Aloha ‘Āina

Appendices

E lawe I kea a’o a mālama, a e ‘oi mau ka na‘auao.
He who takes his teachings and applies them increases his knowledge.
(Mary Kawena Pukui - ‘Ōlelo No’eau No. 328)
KE OLI

Early Hawaiians recorded their literature in memory, not writing. They composed and maintained an extensive oral tradition, a body of literature covering every facet of Hawaiian life. Chants, called mele, recorded thousands of years of ancient Polynesian and Hawaiian history.

Chants also recorded the daily life of the Hawaiian people, their love of the land, humor or tragedy, and the heroic character of their leaders. A mele chant is a poetic form of song that tells a story. They can be classified into two general categories, mele oli and mele hula.

Mele oli

Unaccompanied chants, usually performed by one person at ritual occasions such as a birth, a death, or the departure of a ranking chief. Mele oli also recount historical events and tell stories and legends.

Mele hula

Chants accompanied by dance movements alone, or by dance movements with musical instruments such as the drum, pahu, and gourd rattle, ‘uli’uli.
# Aloha ‘Āina Oli

## CD Play List

<table>
<thead>
<tr>
<th>Track</th>
<th>Oli</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1</td>
<td>E  Ho Mai</td>
</tr>
<tr>
<td>#2</td>
<td>E  Ulu</td>
</tr>
<tr>
<td>#3</td>
<td>Hiki Mai ka Lā</td>
</tr>
<tr>
<td>#4</td>
<td>Ola i ka Hā</td>
</tr>
<tr>
<td>#5</td>
<td>Oli Iā Laka</td>
</tr>
<tr>
<td>#6</td>
<td>Oli Komo No Kawai Nui</td>
</tr>
<tr>
<td>#7</td>
<td>Oli Mahalo</td>
</tr>
<tr>
<td>#8</td>
<td>He Mele No Kāne</td>
</tr>
</tbody>
</table>
E Hō Mai

Composed by: Edith Kekuhikihipu‘uone‘naa‘ili‘iohala Kanāka‘ole

| E hō mai ka ‘ike mai luna mai e | Grant us the knowledge from above |
| O nā mea huna no‘eau no nā mele e | Concerning the hidden wisdom of songs, |
| E hō mai | Grant, |
| E hō mai | Grant, |
| E hō mai | Grant us these things |

BACKGROUND

Kumu hula master and Hawaiian cultural and language expert, Edith K. Kanāka‘ole (affectionately known as Aunty Edith), composed this oli (chant) for her hula troupe, Hālau O Kekuhi. The chant was originally performed by students at the beginning of class to request knowledge and wisdom from the ancestral deities to accomplish the task at hand.

Today, this oli is commonly used at the start of an event or small gathering to focus a group’s energies and ultimately carry out the kuleana (responsibility) they have undertaken. It is recommended that haumāna (students) use this chant to help them seek knowledge and clear their minds of any negativity.
E Ulu

From Nathaniel B. Emerson Unwritten Literature of Hawai‘i: The Sacred Songs of the Hula (1999)

<table>
<thead>
<tr>
<th>E ulu, e ulu</th>
<th>Grow, grow</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kini o ke Akua</td>
<td>In the multitude of God</td>
</tr>
<tr>
<td>Ulu Kāne me Kanaloa</td>
<td>Grow with respect to the forest and sea</td>
</tr>
<tr>
<td>Ulu ʻōhiʻa lau koa me ka ʻieʻie</td>
<td>Grow with ʻōhiʻa, koa and ʻieʻie</td>
</tr>
<tr>
<td>Aʻe mai i noho i kou kuahu</td>
<td>Inhabit your place O God</td>
</tr>
<tr>
<td>Eia ka wai, he wai e ola</td>
<td>Here is the water, the water of life</td>
</tr>
<tr>
<td>E ola nō e!</td>
<td>Life forever!</td>
</tr>
</tbody>
</table>

BACKGROUND
Kumu hula master and Hawaiian cultural and language expert, John Keola Lake, taught this oli to Kumu Hula Kaʻanohi Aipa. In her hālau it is often used as a gathering chant when haumāna enter the forest to collect greeneries for costumes or hoʻokupu (offerings). It may also be used when entering the forest for inspiration or guidance.


Hiki Mai Ka Lā

From Pele and Hiiaka - A Myth from Hawaii by Nathaniel B. Emerson (1915)

<table>
<thead>
<tr>
<th>Hiki mai, hiki mai ka lā</th>
<th>Here it comes, here comes the Sun</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aloha wale, ka lā e kau nei</td>
<td>How I love the Sun in the sky</td>
</tr>
<tr>
<td>Aia malalo o Kawaihoa</td>
<td>There below is Kawaihoa</td>
</tr>
<tr>
<td>A ka lalo o Kaua’i</td>
<td>On the incline of Kaua’i</td>
</tr>
<tr>
<td>O Lehua</td>
<td>is Lehua</td>
</tr>
</tbody>
</table>

BACKGROUND

Pele’s sister Kapoulakinau danced this hula on the island of Ni‘ihau. It is considered one of the earliest of hula; a hula ki‘i.

This oli was shared with the Windward Ahupua‘a Kūpuna by Anakala Kimo Awai of Hilo along with the Hilo district’s kūpuna. He also taught its motions. It is both a chant of welcome to the morning Sun in the sky as well as a request for inspiration from ke akua, the creation, or our ancestors.
Ola i ka Hä

Composed by: Frank Kawaikapuokalani Hewett

<table>
<thead>
<tr>
<th>Ola i ka hä</th>
<th>There is life in the breath (hä – Háloa/kalo)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ola i ka wai</td>
<td>There is life in the waters (Käneikawaiola – god of creation)</td>
</tr>
<tr>
<td>Ola i ka ‘i</td>
<td>There is life in the supreme (Kumulipo chant of Kalaninui‘amamao)</td>
</tr>
<tr>
<td>Häwai‘i, Häwai‘i, Häwai‘i</td>
<td>Hä – wai – ‘i (reflecting the genealogies of creation of Häwai‘i, God, the environment and humankind)</td>
</tr>
<tr>
<td>Wäkea ka lani</td>
<td>Wäkea of the heavens</td>
</tr>
<tr>
<td>Papa ka hönua</td>
<td>Papa of the earth</td>
</tr>
<tr>
<td>No ka lunā, ko lunā</td>
<td>For up belonging up</td>
</tr>
<tr>
<td>No ka lalo, ko lalo</td>
<td>For down belonging down</td>
</tr>
<tr>
<td>O ka pono no ia e</td>
<td>It is the “Natural Order”</td>
</tr>
<tr>
<td>E ola kākou a mau loa e</td>
<td>May we live forever</td>
</tr>
</tbody>
</table>

BACKGROUND

Ola i ka hä
The first line is a reflection of the legend of the origin of the kalo, the child of Wäkea and Ho‘ohōkūkalani who soon after birth expired. This child was buried near their home and from his body grew forth the kalo plant. A second son was born to Wäkea and Ho‘ohōkūkalani and he became the father of the human race. Like his elder brother, he was also named Háloa with the epithet nakalaukapalili added to his name. The first birth of the first Háloa established the tradition of the senior line in the Hawaiian tradition, and the birth of the second Háloa established the tradition of the junior line subservient to the senior line, humankind as custodians to the gods who manifest in nature/environment. The word hä used in the first line is a reflection of the names Háloa and Hāloanakalaukapalili.

Ola i ka wai
The second line is a reflection of the god, Kāne, the god of creation. Kāne has many forms, which include the water, the sunlight, and the rainbow. Kāne is the giver of life and not the taker of life, therefore no human sacrifices were offered to him. He is at the zenith in the pantheon of gods and the other gods are said to be lesser manifestations of
him. Kāne worship incorporated shrines with sacred upright stones where prayers and offerings were left.

In order for the kalo to grow tall and strong it needs both water and sunlight, both manifestations as mentioned earlier of the god, Kāne. An ancient proverb states, “Pāʻaliʻali kalo i ka wai ʻole,” without water the kalo grows misshapen or crooked. Kāne in the form of water not only provides sustenance for good healthy growth of the kalo but also provides sustenance – the same for mankind.

The word “wai,” in the second line, is a reflection of the god, Kāneikawaiola – the god of the living or healing waters.

Ola i ka ‘i
The third line is a reflection of the Kumulipo chant that was used as a prayer for the dedication of the chief Lonoikamakahiki to the gods soon after his birth. It is at that time that the honors of Kapu, Wela, Hoano and Moe were conferred to him by his father, Keawekekahialiʻiomakoku, King of Hawaiʻi. After the ceremony his name was changed to Kaʻīʻi-mamao. The third line also reflects the name of ‘Io, the tradition of one supreme deity connected to the worship of the ‘io (hawk) and the pueo (owl).

Hāwaiʻi, Hāwaiʻi, Hāwaiʻi
The fourth line connects the three components, the ha, the wai and the ʻi in the name Hāwaiʻi; the breath or the air that we breathe, the water that we drink and god/goddess most superior. Air and water sustains the life created through the god. As explained to me by Aunty Emma deFries in our study of the supreme one god ʻIo, the island names that end with (ʻi) such as Hāwaiʻi, Mauʻi, Molokaʻi, Lānaʻi and Kauaʻi became so in our ancient past due to the ruling chiefs who collectively worshipped the supreme god, ʻIo. In my study with Aunty Emma, ʻIo was referred to as ʻI-o-na-lani-nui-a-mamao (the Supreme most god of the great heavens and beyond.). Aunty Emma asked me to always keep this tradition close to me.

Wakea ka lani
Papa ka hōnua
No ka luna ko luna
No kalalo ko lalo
ʻO ka pono no ia e

The fifth, sixth, seventh, eighth and ninth lines reflect the “natural order” of our gods, environment and people. To everything there is a natural or proper order. There is a beginning and an end, a top and a bottom, a male god and a female counterpart. There is harmony, balance and unity. The gods are at the top of the triad followed by the
environment and then humankind. The same order is reflected in the social structure as established in the kapu system, ali‘i, kahuna, maka‘aina, and kauvwā along with terms and roles within the ‘ohana such as kāpuna, mākua, ʻopio, keiki and kamaiki. From the top to the bottom, all is in its proper place. This is truly our pono. Not as translated as the word, "righteousness," but the natural order as allotted like mana by the god/goddess.

The tenth line reflects the life, health and healing, which we attribute to our gods. The kalo and the human race were born from Wākea and Hoʻohōkūkalani. The life force is in the manifestations of the god Kāne, the sun, the air and the rainbow. All of this is perpetuated by the pono, the natural order, the balance and the unity.

(Mana‘o from Frank Kawaikapuokalani Hewett)
**Oli Iʻa Laka**

Chant to Laka

<table>
<thead>
<tr>
<th>Hawaiian</th>
<th>English</th>
</tr>
</thead>
<tbody>
<tr>
<td>Noho ana ke akua</td>
<td>The god resides</td>
</tr>
<tr>
<td>i ka nāhelehele</td>
<td>in the thick forest</td>
</tr>
<tr>
<td>iʻalaiʻia e ke kīʻohuʻohu</td>
<td>that was hidden by the clinging mist</td>
</tr>
<tr>
<td>e ka ua koko</td>
<td>by the low-lying rainbow</td>
</tr>
<tr>
<td>E nā kino malu i ka lani</td>
<td>O beings sheltered in the heavens</td>
</tr>
<tr>
<td>malu e hoe</td>
<td>sheltered continually</td>
</tr>
<tr>
<td>E hoʻoulu mai ana ʻo Laka</td>
<td>Laka will confer growth on</td>
</tr>
<tr>
<td>i kona mau kahu</td>
<td>her caretakers</td>
</tr>
<tr>
<td>ʻO wau [mākou,</td>
<td>Tis I [we]</td>
</tr>
<tr>
<td>ʻo wau [mākou] nō, a!</td>
<td>ʻtis I [we] indeed, ah!</td>
</tr>
</tbody>
</table>

(Performed by: Brenda Lehua Huliheʻe in the Bishop Museum, 1949)
Oli Komo No Kawai Nui

Entrance Chant for Kawai Nui

<table>
<thead>
<tr>
<th>Kāhea</th>
<th>(Greeting)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ha‘ale‘ale ka leo (o) ka ‘alae</td>
<td>Full is the voice of the ‘alae</td>
</tr>
<tr>
<td>He māpuna leo polo ‘ai i ka la‘i</td>
<td>A voice of invitation in the calm</td>
</tr>
<tr>
<td>He pule kānaenaē i Ulupō</td>
<td>A chant of request to Ulupō</td>
</tr>
<tr>
<td>I ulu pono la i Ulumāwao</td>
<td>That true inspiration reaches Ulumāwao</td>
</tr>
<tr>
<td>Kakali ka neke i ka nihi (i)</td>
<td>The neke ferns await at the border</td>
</tr>
<tr>
<td>ka ni‘o o ka wahinewai</td>
<td>At the entrance of the woman-water</td>
</tr>
<tr>
<td>Ke nihi ka hele nei, e!</td>
<td>(We) proceed with due care now!</td>
</tr>
<tr>
<td>Ke nihi ka hele nei, e!</td>
<td>(We) proceed with due care now!</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Pane</th>
<th>(Reply)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Māwehe ‘ia ka neki i ka wai</td>
<td>The neki rushes part at the water</td>
</tr>
<tr>
<td>E ho‘ike i ka wai ‘anapanapa</td>
<td>Reveal the shimmering waters</td>
</tr>
<tr>
<td>Ho‘ike pū nō ka mana‘o pono</td>
<td>Revealed along with your righteous intent</td>
</tr>
<tr>
<td>E mai, hele mai, i [Nā Pōhaku]</td>
<td>Approach, enter, at [Nā Pōhaku]</td>
</tr>
<tr>
<td>E mai, hele mai, eia nō makou nei</td>
<td>Approach, enter, here we are</td>
</tr>
</tbody>
</table>

(Composed by S.M. Gon III, December 2000 for ‘Ahahui Mālama I Ka Lōkahi)

Notes:
Other famous places along Kawai Nui can be used in place of [Nā Pōhaku] as appropriate, for example, Holomakani. There is quite a bit of kaona (hidden meaning) and symbolism in this oli that bears explanation:

- ‘alae: the ‘alae is an endangered endemic waterbird of Kawai Nui and in ancient times, the ‘alae symbolized the voice of the chief whose opinion swayed the chiefly council. Some consider the voice of the ‘alae an ill omen, but as a kino lau (forms taken by a supernatural body) of Hauwahine, the voice of the ‘alae is an auspicious thing at Kawai Nui!
- māpuna leo: literally translated, it means wafted voice of few words; an apt description of the voice of the ‘alae! But “māpuna” also alludes to the life-giving freshwater springs that arise in Kawai Nui.
• **polo ʻai**: literally means to summon, to invite. It is also a veiled allusion to the famous *lepo ʻai ʻia* (edible dirt) of Kawai Nui, one of the *ʻai kamahaʻo* (surprising foods) of the land.

• **Ulupō and Ulumawao** lie before and behind you as you chant at Nā Pōhaku, and the play on *ulu* (growth, inspiration) is quite obvious here.

• **neke**: an ambiguous reference to two plants of Kawai Nui: a fern, and also a bulrush of the same name. A variant of the name is “neki.”

• **niʻo**: doorway or sacred threshold, but also highest point, pinnacle, as the stone of Nā Pōhaku are perched on high, overlooking the wetlands

• **wahinewai**: a veiled reference to Hauwahine, the moʻo-wahine at Kawai Nui

• **nihi ka hele**: to proceed with careful observance of *kapu*. Proceeding with care is part of the protocol of respect.

• **ʻānapanapa**: the ʻānapanapa (soap plant) is an indigenous plant that grows around Nā Pōhaku but also describes the shimmering waters of Kawai Nui.
Oli Mahalo

Composed by: Kehau Camara

<table>
<thead>
<tr>
<th>Linlinea</th>
<th>Translation</th>
</tr>
</thead>
<tbody>
<tr>
<td>‘U hola ‘ia ka maka loa la</td>
<td>To spread forth, open up the most fine quality mat</td>
</tr>
<tr>
<td>Pū’ai ke aloha la</td>
<td>Exchange/share as potluck or aloha</td>
</tr>
<tr>
<td>Kūka’i ‘ia ka Hāloa la</td>
<td>Exchange as greetings (between man and wife and descendants)</td>
</tr>
<tr>
<td>Pā wehi mai nā lehua</td>
<td>To adorn with the lehua flower</td>
</tr>
<tr>
<td>Mai ka ho’oku’i a ka hālāwai la</td>
<td>From East to West; sunrise to sunset, we are discoverers, navigators, take care of our ʻāina</td>
</tr>
<tr>
<td>Mahalo, e nā akua</td>
<td>We thank our creators</td>
</tr>
<tr>
<td>Mahalo, e nā kāpuna la ea</td>
<td>We thank our ancestors</td>
</tr>
<tr>
<td>Mahalo, me ke aloha la</td>
<td>We thank you with love</td>
</tr>
<tr>
<td>Mahalo, me ke aloha la</td>
<td>We thank you with love</td>
</tr>
</tbody>
</table>

**BACKGROUND**

This oli was composed as a greeting of thanks for hospitality, love, generosity and knowledge that is given to us. It also gives thanks to the beauty of the islands and our people. Hāloa is ever-lasting breath. The kalo plant is considered our ancestor that is cherished and preserved. Makaloa is the finest mat woven. It is considered higher quality than lau hala. The message is that it’s important for us to practice being “thankful” every day.
He Mele No Kāne

Traditional Chant

<table>
<thead>
<tr>
<th>He ui, he ninau</th>
<th>A query, a question</th>
</tr>
</thead>
<tbody>
<tr>
<td>E ui ana aku au ia `oe: Aia i hea ka wai a Kāne?</td>
<td>I ask you: Where is the water of Kāne?</td>
</tr>
<tr>
<td>Aia i ka hikina a ka la,</td>
<td>There where the sun rises,</td>
</tr>
<tr>
<td>Puka i ha’eha’e,</td>
<td>Emerging at Ha’eha’e</td>
</tr>
<tr>
<td>Aia i laila ka wai a Kāne!</td>
<td>There is the water of Kāne!</td>
</tr>
<tr>
<td>He ui, he ninau</td>
<td>A query, a question</td>
</tr>
<tr>
<td>E ui ana aku au ia `oe: Aia i hea ka wai a Kāne?</td>
<td>I ask you: Where is the water of Kāne?</td>
</tr>
<tr>
<td>Aia i kaulana a ka la,</td>
<td>There where the sun rests,</td>
</tr>
<tr>
<td>I ka pae `opua i ke kai,</td>
<td>In the cloud banks lined up at sea,</td>
</tr>
<tr>
<td>Eia mai ana ma Nihoa ma ka mole mai o Lehua,</td>
<td>Approaching from Nihoa from the base of Lehua</td>
</tr>
<tr>
<td>Aia i laila ka wai a Kāne!</td>
<td>There is the water of Kāne!</td>
</tr>
<tr>
<td>He ui, he ninau</td>
<td>A query, a question</td>
</tr>
<tr>
<td>E ui ana aku au ia `oe: Aia i hea ka wai a Kāne?</td>
<td>I ask you: Where is the water of Kāne?</td>
</tr>
<tr>
<td>Aia i ke kuahiwi, i ke kualono,</td>
<td>There on the mountain, on the ridge,</td>
</tr>
<tr>
<td>I ke awawa, I ke kahawai</td>
<td>In the gulch, in the stream,</td>
</tr>
<tr>
<td>Aia i laila ka wai a Kāne!</td>
<td>There is the water of Kāne!</td>
</tr>
<tr>
<td>He ui, he ninau</td>
<td>A query, a question</td>
</tr>
<tr>
<td>E ui ana aku au ia `oe: Aia i hea ka wai a Kāne?</td>
<td>I ask you: Where is the water of Kāne?</td>
</tr>
<tr>
<td>Aia i ke kai, I ka moana,</td>
<td>Over the near-shore sea, over the far sea,</td>
</tr>
<tr>
<td>I ke kualau, I ke anuenue,</td>
<td>In the wind-blown rain at sea, in the rainbow</td>
</tr>
<tr>
<td>I ka punohu, I ka uakoko,</td>
<td>In the red billowing cloud, in the low red rainbow</td>
</tr>
<tr>
<td>I ka `alewalewa,</td>
<td>In the low hanging clouds,</td>
</tr>
<tr>
<td>Aia i laila ka wai a Kāne!</td>
<td>There is the water of Kāne!</td>
</tr>
</tbody>
</table>
He ui, he ninau
E ui ana aku au ia ‘oe: Aia i hea ka wai a Kāne?
Aia i luna ka wai a Kāne!

I ke ‘ouli, il ke ao ‘ele‘ele
I ke ao panopano
I ke ao popolo hua mea a Kāne, la e,
Aia i laila ka wai a Kāne!

He ui, he ninau
E ui ana aku au ia ‘oe: Aia I hea ka wai a Kāne?
Aia I lalo, i ka honua, i ka wai hu,

I ka wai kau a Kāne me Kanaloa
He waipuna, he wai e inu,
He wai e mana, he wai e ola,

E ola no ea!
E ola!

A query, a question
I ask you: Where is the water of Kāne?

There in the sky above is the water of Kāne!
In the portents of the sky, in the black clouds
In the thickening clouds,
In the dark purple cloud of Kāne,
There is the water of Kāne!

A query, a question
I ask you: Where is the water of Kāne?

There in the ground below, in the water gushing up,
In the water placed by Kāne and Kanaloa,
A freshwater spring, water to drink,
Water to give spiritual power, water that heals,
Bless us with life, indeed!
Health and life!
PROJECT ALOHA ‘ĀINA FIELD SITES

Project Aloha ‘Āina is working in partnership with other organizations to offer field site experiences for students. These field site experiences are an integral part of the units in this guide. Details about the field site investigations are provided in the final lesson of each unit. The information in this Appendix is provided to help teachers in preparing for the field trips.
FIELD SITES: GRADE 6

‘ŌPALA OUTING

Mālama Our ‘Āina

*Ku i ka welo.*
Fits into the family behavior.
Whether good or bad, one’s behavior is judged by the family he belongs to.
(Mary Kawena Pukui, ‘Ōlelo No‘eau No. 1879)

Please review the following guidelines to help prepare students for the field trip:

- It is important to show  hōʻihi (respect) for this  wahi (place) and for one another by treating all volunteers and fellow students with respect.

- Give your full attention to your group leaders so everyone benefits from the experience.

- Stay with your group and do not wander off.

- Place all of your belongings, including bottled water in a backpack so that your hands will be free.
### Field Sites: Grade 6

**ʻŌpala Outing**

**Ukana**

What to bring...

_E hume i ka malo, e hoʻokala i ka ihe._

Gird the loincloth, sharpen the spear.

A call to prepare for the project at hand.

*(Mary Kawena Pukui, ʻŌlelo Noʻeau No. 299)*

<table>
<thead>
<tr>
<th>Teacher’s Ukana (Supplies)</th>
<th>Students’ Ukana</th>
</tr>
</thead>
<tbody>
<tr>
<td>• name tags</td>
<td>• backpack</td>
</tr>
<tr>
<td>• day’s agenda</td>
<td>• water in small unbreakable container</td>
</tr>
<tr>
<td>• first aid kit</td>
<td>• lunch with as little disposable packaging as possible</td>
</tr>
<tr>
<td>• trash bag</td>
<td>• athletic shoes</td>
</tr>
<tr>
<td>• athletic shoes</td>
<td>• comfortable clothing</td>
</tr>
<tr>
<td>• hat</td>
<td>• hat</td>
</tr>
<tr>
<td>• sunscreen</td>
<td>• sunscreen</td>
</tr>
<tr>
<td>• lunch and water in backpack</td>
<td>• nametag</td>
</tr>
<tr>
<td>• cellular phone (optional)</td>
<td>• towel</td>
</tr>
<tr>
<td>• liquid soap or sani-wipes</td>
<td>• mosquito repellant</td>
</tr>
<tr>
<td>• paper towels</td>
<td></td>
</tr>
<tr>
<td>• distribute Learning Log Sheet 8 to each student</td>
<td></td>
</tr>
<tr>
<td>• ensure students each have a pencil</td>
<td></td>
</tr>
<tr>
<td>• digital camera (for taking pictures during the field trip)</td>
<td></td>
</tr>
</tbody>
</table>
**Field Sites: Grade 6**

**ʻŌpala Outing**

**Field Site:**

**Recycling and Reuse Center at the Keauhou transfer station**

Operated by:
Recycle Hawai‘i
P.O. Box 4847
Hilo, HI 96720
Contact: Travis Olson
Phone: 895-6776
Email: tolsen@hawaii.rr.com

*Contact Travis Olson to schedule a tour.*

**Directions:**

On Highway 11, make turnoff onto Mamalahoa Hwy. just before the Shell Station and Teshima’s restaurant. Drive ¼ mile. Green sign on left-hand side.

**Optional:**

Arrangements can be made for students to tour “green” businesses that are practicing sustainable conservation methods.

1. **Innovations Public Charter School**
   Contact: Krista Donaldson
   E-mail: kristajoan@gmail.com
   Ph: 557-9085 or 327-6205
   Fee: none

*Innovations Public Charter School offers school tours on their property. They are practicing sustainability by involving their students and families in conservation practices. The school recycles, uses gray water to irrigate their gardens, mulch and compost using compostable products.*

2. **Kona Brewing Company**
   Contact: Mattson Davis
   E-mail: smattson@konabrewingco.com
   Ph: 937-0466

*Kona Brewing Co. is committed to “best green” practices. The company recycles most of their consumable products, uses compostable take-out trays, and catches 90 gallons of condensation per day from their air conditioning and uses it for landscape irrigation.*
3. **Amy B.H. Greenwell Ethnobotanical Garden**
   Contact: Peter Van Dyke  
   E-mail: agg@bishopmuseum.org  
   Ph: 323-3318  
   Fee: $3 for Hawai‘i Island Schools

*The Garden has a five-acre intact ancient kua‘wi wall system and other agricultural plots. Tours are provided and students can also be involved in an in-service mālama ʻāina experience.*

4. **Kua‘wi Farm**
   Contact: Una Greenaway  
   E-mail: una@hawaii.rr.com  
   Ph: 328-8888  
   Fee: $5 for students

*Kua‘wi Organic Farm is practicing sustainability and has installed photovoltaic panels, a water catchment system, and solar water heaters on their property. Ancient kua‘wi walls and terraces are still being used as vegetable gardens. The Farm blends ancient growing techniques with modern-day farming practices.*

Vehicles no larger than a 15-passenger van.
Wai a Kāne

A Short Story about Knowing the Water Sources

Written by Kalei Tsuha
© 2009 Kalei Tsuha

Wai a Kāne is a famous chant that asks the rhetorical question, *where are the waters of Kāne located?* Utilizing a short story and the traditional chant, we can quickly see where the waters of Kāne are located.

The mother was Kapapaiākea, the father was Holomoana. To them was born a son, ‘Aukele. They resided in Kahalu‘u, Kona near a spring named Waihua‘a‘a‘ala. After some time, ‘Aukele went to live with his grand mother, Mo‘o‘inanea, at Keōlonahihi just north of Kahalu‘u Bay. Mo‘o‘inanea taught ‘Aukele all about the waters of Kāne. One day ‘Aukele asked Mo‘o‘inanea:

*He uī, he nīnau,*
*E uī aku ana au iā ‘oe,*
*Aia i hea ka wai a Kāne?*

Mo‘o‘inanea responded:
*Aia i ka hikina a ka lā,*
Puka i Ha‘eha‘e,
*Aia i laila ka wai a Kāne.*

*A query, a question,*
*I am requesting from you*
*Where is the water of Kāne?*

It is in the eastern gate of the sun
Rising in Ha‘eha‘e
That is where the water of Kāne is located

‘Aukele asked his grandmother, *why in the east?* Mo‘o‘inanea answered, *because the prevailing Mo‘a‘e trade winds bring the daily rains and moisture to the Northeastern end of our islands.* ‘Aukele wondered if there were more water sources so he asked his grandmother:

*E uī aku ana au iā ‘oe,*
*Aia i hea ka wai a Kāne?*

Mo‘o‘inanea responded:
*Aia i Kaulanaakalā,*
*I ka pae ‘ōpua i ke kai*
*Ea mai ana ma Nihoa,*
*Ma ka mole mai o Lehua,*
*Aia i laila ka wai a Kāne*

*I am beseeching you,*
*Where is the water of Kāne?*

It is where the sunsets
In the cloud banks over the ocean
Being suspended over Nihoa
At the taproot of Lehua
That is where the water of Kāne is located

Kaulanaakalā is a poetic reference to the west.

Community Training – Permission to use as a teaching resource is granted to PAF. For further use or distribution, contact damartin@ksbe.edu"
'Aukele pondered a bit and then replied, *why in the west?* Mo‘o‘īnanea responded, *because transpiration occurs in the afternoon when the sun begins it’s descent towards the west.* The sun heats the mountain tops which then pulls the ocean clouds & moisture up towards its peaks. ʻŌhi‘a lehua captures & collects the water which then trickles down into earth. ʻAukele knew that there were more sources for water and asked Mo‘o‘īnanea again:

_E ui aku ana au ia ʻoe,_  
_Aia i hea ka wai a Kâne?_  
_I am pleading you,_  
_Where is the water of Kâne?_

Mo‘o‘īnanea replied:  
_Aia i kuahiwi, i ke kualono,_  
_I ke awātea, i ke kahawai,_  
_Aia i laila ka wai a Kâne._  
_It is in the mountain tops, the ridges,_  
_The valleys, the streams,_  
_That is where the water of Kâne is located._

ʻAukele asked, *how do our mountains provide water in our streams?* Mo‘o‘īnanea replied, _hāhāi ka ua i ka ʻululāʻau._ Rain follows the forest. The forests on our mountains transpire and gathers the water. The forests are our head waters, the water source. The earth cools and the heated ocean draws the moisture down from the mountains. That is where the Kēhau winds come from and the dew we find collected on the liko lehua or leaf buds and blades of pili grass.

ʻAukele knew that there were more water sources and asked his grand mother again:

_E ui aku ana au ia ʻoe,_  
_Aia i hea ka wai a Kâne?_  
_I am begging you,_  
_Where is the water of Kâne?_

Mo‘o‘īnanea smiled and explained:  
_Aia i kai, i ka moana,_  
_I ke kualau, i ke ānuenue,_  
_I ka pūnohu, i ka ua koko,_  
_I ka ‘ālewalewa,_  
_Aia i laila ka wai a Kâne._  
_It is in the ocean, in the sea,_  
_In squalls, rainbows,_  
_Red rainbows, low hanging rainbows,_  
_High suspended rainbows,_  
_That is the location of the water of Kâne._

ʻAukele asked, *how can the deep ocean be a source of water?* Mo‘o‘īnanea replied, _sea squalls happen due to storm systems out in the ocean._ Rainbows indicate moisture in the sky. _Red pūnohu rainbows and suspended ʻālewalewa rainbows are immediate indicators that rain is soon to arrive._ Rainbows generally mean that rain is occurring.

ʻAukele asked his grandmother:  
_E ui aku ana au ia ʻoe,_  
_Aia i hea ka wai a Kâne?_  
_I am imploring you,_  
_Where is the water of Kâne?_
Mo‘o‘inanea responded:
Aia i luna ka wai a Kāne,
I ke aouli, ike ao ‘ele’ele,
I ke ao panopano,
I ke ao popolohua mea a Kāne lā ē!
Aia i laila ka wai a Kāne.

‘Aukele said, Tūtū, why these clouds? Mo‘o‘inanea replied, because these clouds are all dark colored clouds. Clouds communicate to us through their colors, shapes, and location. White clouds mean calm weather, yellow tinged ones mean vog or smoke activity, orange and red ones mean that light is refracting off of them at sunrise or sunset, and the thick dark colored gray, purple or black ones indicate that they are heavy with moisture and will surely rain.

‘Aukele was almost satisfied with all of the answers but knew that water can be found elsewhere too and asked:

E ui aku ana au iā ‘oe,
Aia i hea ka wai a Kāne?

Mo‘o‘inanea responded:
Aia i lalo, i ka honua,
I ka wai h!,
I ka wai kau a Kāne me Kanaloa

‘Aukele remembered the spring near his home in Kahalu‘u and asked, where does the spring water come from? Mo‘o‘inanea replied, you can find springs in the ocean, percolating up in little ponds, and oozing out of cave or mountain walls. Springs come from our cloud forests in our mountains. We are dependent on our healthy forests in the mountains. If they don’t exist, our water is not captured and funneled down to our subterranean reservoirs. These reservoirs well up and are found along our coastlines. We need our forests so that our oceans are healthy. The ocean in turn provides the nutrients that are recaptured every day in the clouds that are pulled up into our mountains. This ma uka to ma kai, or mountain to sea, relationship is pertinent to our survival. This process is essential to the health of our environment and our health as well. Water is life.

‘Aukele exclaimed:
He waipuna, he wai e inu,
He wai e mana, he wai e ola

Mo‘o‘inanea exclaimed:
E ola nō, eā!
How to Cultivate Indigenous Microorganisms

Hoon Park¹ and Michael W. DuPonte²
¹Ocean Star Hawaii Natural Farms, LLC
²CTAHR Department of Human Nutrition, Food and Animal Sciences, Komohana Extension Office

Past trends in conventional western agriculture, including monoculture without crop rotation, overuse of inorganic fertilizers, and wide-scale applications of broad-spectrum organophosphate pesticides, have hindered the role of naturally occurring microorganisms in promoting biological nitrogen fixation and decomposition of organic matter, microbiologically enhanced plant nutrient uptake, and other natural soil processes that depend on active soil microbe populations.

The current trend in U.S. agriculture, including Hawai‘i agriculture, is toward less chemically intensive, more biologically based practices, in the hope that they may improve soil health and agricultural production and be less harmful to the environment than conventional agricultural production methods. In Asian countries, including Korea, deliberate collection and culturing of naturally occurring soil microorganisms has been a common agricultural practice for centuries, and application of these cultures to crop soils is believed to minimize the need for applications of inorganic soil amendments. However, little scientific documentation of the benefits of these practices exists. This publication outlines the principal steps in culturing naturally occurring microorganisms in a process similar to one used on farms in Korea. Those wishing to culture and utilize microorganisms in this way should be aware that the value of the techniques and applications described has not been verified in Hawai‘i by controlled experiments. Therefore, the practices described in this publication should be considered as suggested, rather than recommended.

Although the people shown in the following photos are not wearing protective equipment, anyone following the procedures outlined should carefully consider their personal health situation and wear appropriate protective apparel; see suggestions for safe handling on page 7.

Collecting microorganisms from the environment

When is the best time to collect microorganisms?
Microorganisms (microbes) may be cultured at any time of the year; however, avoid wet, rainy seasons. Excessive moisture in the environment promotes growth of fungi that are less desirable for the intended uses.

How time-consuming is it to collect these microbes?
The collection process takes approximately 4–5 days in cooler weather (about 68°F, 20°C) and 3–4 days under warmer conditions (> 68°F, 20°C).

Where are the best places to collect microorganisms?
Beneficial microbes are highly concentrated under undisturbed forests or other vegetated areas. Combining microbes collected from multiple sites will likely result in a more robust culture.

What collection supplies will I need?
Collection materials are relatively inexpensive and readily obtainable.
- a small wooden box, 12 x 12 x 4 inches deep, preferably made of cedar (photo 1)
- steamed white rice
- white paper towels, enough to cover the wooden box
- two to four large rubber bands
- a sheet of clear plastic, large enough to completely cover the wooden box
- ¼-inch mesh wire screen large enough to completely cover the wooden box.
How are collection supplies assembled?
Fill the wooden box with 3 inches of steamed rice (photo 2). Cover the box with white paper towel, being careful not to let the towel touch the rice (photo 3). There should be an inch or so of air space between the rice and the paper towel. Use rubber bands around the top of the box to secure the paper towel in place.

Cover the top of the box with wire screen (photo 4) to prevent animals from tampering with the rice. Top the wire with a sheet of clear plastic to protect the box from rain, and place it under trees or in another secluded area. The box should not be in direct sunlight.

Partially bury the box in the soil (photo 5). It should be buried at least 2 inches deep for best results.

Cover the box with fallen leaves from the harvest location (photo 6). Anchor the plastic sheet on all sides with small rocks to prevent it from being dislodged by wind.

Leave the box undisturbed for a minimum of 4–5 days. After that time, check to see whether the moist rice is covered with white mold. If mold growth is sparse, re-cover the box and wait an additional 2–3 days before re-checking. If the mold is a color other than white (other colors indicate growth of less effective fungi) or if rain has entered the box, the contents should be discarded and the process repeated.

Culturing the microorganisms
Once the desired microbes have been collected, the next step is to increase their numbers.

How are the materials assembled to cultivate microbes?
1) Weigh and record the weight of the large bowl.
2) Use the wooden spoon to move the molded rice from the wooden box into the bowl (photos 7, 8). Weigh the filled bowl and calculate the weight of the rice mass by subtracting the weight of the empty bowl from the filled bowl.
3) Gradually add an amount of granulated brown sugar equal to the weight of the rice mass (photo 9). Hand-knead the sugar and rice until the material has the consistency of gooey molasses (photo 10). Protective gloves are suggested.
4) Fill the clean clay pot two-thirds full with the rice/sugar mixture (photos 11, 12). Cover it with paper towel secured in place with rubber bands (photo 13).
5) Store the pot in a cool area away from direct sunlight for 7 days. This will allow the mixture to ferment.
6) Working in a shaded area (photo 14), add a small amount of water to the fermented rice mixture in a 1:500 ratio. Then, slowly blend in wheat mill run (or used mushroom medium) until mixture is of semi-moist but not wet consistency (roughly 65–70% moisture) (photos 15–17).
7) Place a mound of the mixture on a soil surface and cover it with the straw mat or leaves, protecting it from sunlight (photo 18). Allow the microbes to propagate for 7 days. Periodically examine the external surface of the pile for white mold growth, monitor internal temperature of the pile with a composting thermometer so as not to exceed 122°F (50°C), and turn the pile with a shovel (a minimum of three to four times during the week) to keep fermentation temperatures from getting too high.
8) When the fermentation process is finished, internal temperature will stabilize, indicating cultivation is complete.
finished. Your culture of naturally occurring microorganisms is now ready for use (photos 19, 20).

**Application**

**What do I do with the fermented mixture?**

Dilute the final product (1 to 1 by volume) with soil and incorporate this mixture into the surface soil as a top-dressing for crop production, or add it to your compost pile. This biological soil amendment is expected to enhance soil microorganism activity. For more information, please contact the author (mduponte@hawaii.edu).

**Acknowledgments**

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**References**


Best safety practices for handling fungi

While culturing indigenous fungi may often be safe, it can be important to take precautions when handling these organisms, because humans can be adversely affected by contact with fungal spores and the mycotoxins that fungi can produce. This is especially important for children, the elderly, immunologically compromised individuals, and people who have allergies, asthma, sinusitis, and similar respiratory problems. Take the following precautions when gathering spores, mixing ingredients, and applying a fungi-based soil amendment.

Wash your hands thoroughly with soap and water before and after handling fungal materials. Do not touch your mouth, nose, or eyes when handling fungi; do not use your hands to smoke or eat.

Work with fungi in an open-air environment, never in small, enclosed rooms.

Wear disposable gloves when handling fungi, and throw them out when done. Do not use your bare hands to handle fungal materials if you have a cut or open wound.

Wear eye protection and a disposable N95 respirator mask when handling fungi.

Do not move tools and other supplies that have been in contact with fungi to other areas of the farm or home unless they have been washed with soap and water.
1. How does recycling help to prevent landfills from overflowing?
   A. Manufacturing companies create new products from discarded plastics, metals, glass and paper.
   B. Manufacturing companies produce ash and exhaust gas that can be recycled.
   C. Recycled plastics are being used by local utility companies to generate electricity.
   D. The technology of recycling does not help solve the problem of overflowing landfills.

2. How does composting help to prevent landfills from overflowing?
   A. Local companies are planting gardens around their facilities to conserve water and reduce green waste.
   B. Composting does not address the problem of overflowing landfills.
   C. Local companies are recycling yard waste to produce composted green waste for people to use.
   D. Local companies are recycling cans, papers, plastics and glass to reduce the amount of waste going to the landfill.

3. Why is source reduction the best way to malama our ‘aina (take care of our environment)?
   A. Buying fewer products produces less waste.
   B. Producing less waste decreases the amount of ‘opala (rubbish) that ends up in our landfills and waste-to-energy plants.
   C. Buying food items in bulk reduces the amount of packaging material that ends up as waste.
   D. All of the above

4. Which is true about our wastes today?
   A. We use many modern tools and products that decay easily, or biodegrade in a short time.
   B. The ‘opala (rubbish) that we recycle is taken to our landfills or to the H-Power plant.
   C. Many products we use are disposable or come heavily wrapped in packaging.
   D. The ‘opala is mostly old carpets, furniture, mattresses, sewage sludge and dead animals.

5. How does the H-Power waste-to-energy plant transform ‘opala to energy?
   A. Reused, recycled and composted materials are burned to produce smoke that drives a turbine to make electricity.
   B. Waste materials are burned in a furnace to boil water, which produces steam (heat energy) that drives a turbine, using mechanical energy to make electrical energy.
   C. Green waste is blended into a liquid that drives a turbine to make electricity.
   D. Waste materials are burned using mechanical energy to make heat energy that drives a turbine and makes electrical energy.
   A. Electrical energy, mechanical energy, ash
   B. Electrical energy, heat energy, garbage
   C. Electrical energy, ash, exhaust gas
   D. Electrical energy, exhaust gas, water

7. How does the H-Power waste-to-energy plant have a negative impact on society?
   A. H-Power may release pollutants into the air.
   B. H-Power causes water pollution.
   C. H-Power causes warming of ocean waters.
   D. H-Power causes global warming.

8. What is one way that early Hawaiian technology differs from modern technology?
   A. Early Hawaiians buried their metals in deep pits so that the metals would break down.
   B. In early Hawai’i, trash was burned to produce steam for energy.
   C. In early Hawai’i, tools were made of materials that broke down naturally (decomposed) in the soil.
   D. All of the above

9. How does the H-Power waste-to-energy plant have a positive impact on society?
   A. The steam from H-Power may be used by restaurants, homes and other businesses.
   B. H-Power reduces the amount of waste in Hawai’i landfills and it produces energy.
   C. The turbines used at H-Power are made from recycled metals.
   D. The electricity generated by H-Power is used to power homes across the entire State of Hawai’i.
6th grade students conducted a “School Waste Audit” on their campus in teams. One team was instructed to collect recyclable material from a 6th grade classroom. Then they sorted the items into different categories and counted them. A record of their results is shown below. Use this information to answer the next two questions.

10. What inferences can we make about the 6th graders from this data?
   A. Students buy more drinks in plastic bottles than in aluminum cans.
   B. Drinks sold in aluminum cans are available through a vending machine on campus.
   C. Students are saving glass jars for an art project.
   D. None of the inferences above are correct from the data provided.

11. If students recorded recyclables from all of the classrooms in the school it would more accurately represent the school population because:
   A. We can only make inferences about the 6th grade class from this data.
   B. We cannot make inferences about other grade levels from this data.
   C. The total number of items could increase if we include all classrooms.
   D. All of the above

12. A Japanese scientist invented a method to use a powerful group of beneficial microorganisms that he named Effective Microorganisms (EM) to help ferment food wastes. This method helps to speed up the decomposition process, which can provide a natural fertilizer for plants. Which of the experiments described below would test the role of EM in the decomposition of food wastes?
   A. Place similar food wastes into two different containers. Cover the wastes in both containers with EM and record observations for two weeks.
   B. Place similar food wastes in two different containers. Cover the wastes in one container with EM and label it “EM”. Don’t add anything to the other container and label it “control”. Record observations for two weeks.
   C. Place food wastes in one container, and other recyclables in a different container. Cover the wastes in both containers with EM and record observations for two weeks.
   D. Place vegetable foods in one container, and meat scraps in a different container. Cover the wastes in both containers with EM and record observations for two weeks.
Sixth grade students designed an experiment to compare decomposition rates of cafeteria waste (vegetable waste) and classroom waste (paper, plastic). Students placed five gallons of waste from each source in separate containers. Then they mixed the waste in each container with one gallon of soil. The students measured the volume of contents in each container every four weeks for three months. The following table and graph represent their findings. Use this table and graph to help answer the next three questions.

**Change in Waste Volume Over Time**

<table>
<thead>
<tr>
<th>Time</th>
<th>Cafeteria Waste (gallons)</th>
<th>Classroom Waste (gallons)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 weeks</td>
<td>12.0</td>
<td>6.0</td>
</tr>
<tr>
<td>4 weeks</td>
<td>11.8</td>
<td>5.9</td>
</tr>
<tr>
<td>8 weeks</td>
<td>10.5</td>
<td>5.0</td>
</tr>
<tr>
<td>12 weeks</td>
<td>8.2</td>
<td>3.0</td>
</tr>
</tbody>
</table>

13. Which is the hypothesis that was most likely tested in this experiment?
   A. If waste from the cafeteria is placed in a container with soil, then the volume will decrease because microorganisms will break down the vegetables.
   B. If waste from the classroom is placed in a container with soil and vegetables, then the volume will decrease faster.
   C. If waste from the cafeteria and classroom are placed in containers with soil, then the volume of classroom waste will be less than the cafeteria waste after 12 weeks because the classroom waste breaks down faster.
   D. If waste from the cafeteria and classroom are placed in containers with soil, then the volume of cafeteria waste will be less than the classroom waste after 12 weeks because the cafeteria waste breaks down faster.

14. Students created a graph to help them display and analyze their data. Which of the following statements is supported by this data?
   A. At 12 weeks, the volume of cafeteria waste was 2.5 gallons less than the volume of classroom waste.
   B. At 8 weeks, the volume of classroom waste was less than the volume of cafeteria waste.
   C. The volume of cafeteria waste did not change over 12 weeks.
   D. The volume of the cafeteria waste was reduced by one third.
15. Which of the following is an appropriate inference from this data set?
   A. Over time, plastics will decompose faster if you add more soil.
   B. Over time, food waste decomposes more slowly than paper waste.
   C. Over time, paper will decompose faster if you add more soil.
   D. Over time, paper and plastics will fill more of a landfill than vegetable wastes.

16. Which is true about how matter and energy are transferred in living systems and their environment?
   A. Plants use nutrients that decomposers release into the soil.
   B. Plants convert energy from the sun into food in the process of photosynthesis.
   C. Decomposers break up organic matter and microorganisms help to release nutrients into the soil.
   D. All of the above.

17. Beneficial microorganisms are important to bring *lokahi* (harmony or balance) to the environment because:
   A. They provide energy to plants in the same way that the sun does.
   B. They slow down decomposition of food waste.
   C. They break down our wastes in the process of decomposition.
   D. They produce disease, decay and pollution.

18. Which is true about wastes in early Hawai‘i?
   A. Materials such as glass bottles or disposable diapers were manufactured using natural materials that broke down naturally in the soil.
   B. Disposal of garbage and human wastes was not regulated.
   C. It was uncommon for early Hawaiians to dispose items that could be fixed or reused.
   D. Technology in early Hawai‘i made waste disposal very convenient.

19. What can we do to reduce waste to *ho‘ola* (to heal) our *ahupua‘a* (land division)?
   A. We could develop a plan to reduce waste in our school, implement it and educate others about it.
   B. We could create a food waste recycling program and use effective microorganisms to turn the organic waste into plant fertilizer.
   C. We could practice Hawaiian values such as *kuleana* (responsibility) and *malama* (caring).
   D. All of the above
20. Some companies on Oahu use recycling technologies that turn waste into reusable products. Which of the following are examples of these technologies?
   A. Green wastes such as yard trimmings and wood chips are composted to make park benches.
   B. Old tires are recycled and used on playground surfaces, and recycled plastics are used to build picnic tables and park benches.
   C. Scrap metal is recycled into green waste and used as fertilizer on baseball and football fields and in parks.
   D. Garbage is dumped into a large hole, packed down firmly and covered every day with a fresh layer of soil or plastic foam.
Aloha ‘Āina Grade 6 Pre-Post Assessment

Answer Sheet

Use pencil to completely darken the appropriate circle for each question.

1. ○ A ○ B ○ C ○ D
2. ○ A ○ B ○ C ○ D
3. ○ A ○ B ○ C ○ D
4. ○ A ○ B ○ C ○ D
5. ○ A ○ B ○ C ○ D
6. ○ A ○ B ○ C ○ D
7. ○ A ○ B ○ C ○ D
8. ○ A ○ B ○ C ○ D
9. ○ A ○ B ○ C ○ D
10. ○ A ○ B ○ C ○ D
11. ○ A ○ B ○ C ○ D
12. ○ A ○ B ○ C ○ D
13. ○ A ○ B ○ C ○ D
14. ○ A ○ B ○ C ○ D
15. ○ A ○ B ○ C ○ D
16. ○ A ○ B ○ C ○ D
17. ○ A ○ B ○ C ○ D
18. ○ A ○ B ○ C ○ D
19. ○ A ○ B ○ C ○ D
20. ○ A ○ B ○ C ○ D
Aloha ‘Aina Teacher Instructions
Pre & Post Unit Tests and Answer Sheet
Grade 6 – Conservation

| Aloha & Introduction | Mahalo teachers for using this Aloha ‘Aina curriculum!
Your efforts with the pre & post unit tests provide valuable information to student learning and our overall project evaluation. |
|----------------------|-------------------------------------------------------------------------------------------------------------|
| Test Versions        | There are two versions (the order of test items for pre & post-test may vary):
1. Paper versions are provided within the curriculum units.
2. Online versions are also available through Lotus Notes. If you want your students to take the online version, please contact Colleen Murakami at: Colleen_Murakami@notes.k12.hi.us.
For either the paper or online test version, please make sure that students have scratch paper and pencils to use if necessary. |
| Reporting of Test Outcomes | Paper Version – Within 2 weeks of taking the pre & post-tests, send completed tests to Pacific American Foundation, 146 Hekili St. #203, Kailua, HI 96734, Attention: Brenda Colburn along with your roster of student alias names and date of pre-, post-tests. (Alias names will be used to match pre & post scores; confidentiality will be maintained.)
Online Version – All necessary information is contained within. |
| Explanations to Students | Before taking both tests, please let your students know that:
1. Answering each question honestly and as best as they can, will give them and you, their teacher, a sampling of what they already know, what they can expect to learn in this unit, and what they have learned.
   • The pre-test is a quick snap-shot of what we know before beginning the unit.
   • The post-test is a quick snap-shot of what we learned after finishing the unit.
2. In the pre-test, it’s okay if there are many questions that are unfamiliar to them; just try their best in answering. Because the purpose of the pre & post-tests is to inform us about the learning that occur/occurred, they will not be graded.
3. Instead the value to them in doing the pre & post-test will help them to:
   • Use what they already know to learn new things
   • Give them an idea of what the new things are that they will learn and at the taking of the post-test,
   • Assurance about what they learned well.
4. Some of the questions have graphs, pictures or maps that are used for more than one question.
5. The online tools that are available to them when taking the HSA, are not available with the online Aloha ‘Aina test. |
### Test Answers Grade 6 Conservation

Test answers, listed numerically below, are provided here for your convenience. Test answers are also found in the curriculum units. Pre & post-tests are designed to assess one or more of the standard benchmarks. The benchmarks appear in boldface before each test item.

**SC.6.2.2** Explain how the needs of society have influenced the development and use of technologies.

1. A
2. C
3. D
4. C

**SC.6.6.2** Describe the different types of energy transformation.

5. B
6. C

**SC.6.2.1** Explain how technology has an impact on society and science.

7. A
8. C
9. B

**MA.6.13.1** Make inferences about a population based on the interpretation of a sample data set.

10. D
11. D

**SC.6.1.1** Formulate a testable hypothesis that can be answered through a controlled experiment.

12. B
13. D

**SC.6.1.2** Use appropriate tools, equipment, and techniques safely to collect, display, and analyze data.

14. A
15. B (Also MA.6.13.1)

**SC.6.3.1** Describe how matter and energy are transferred within and among living systems and their physical environment.

16. D
17. C

*Na Honua Mauli Ola* (NHMO) – Hawaii Guidelines for Culturally Healthy and Responsive Learning Environments

18. C
19. D

**SC.6.2.2**

20. B
Do remember to emphasize with your students, in the way that works best for you, the value of assessing learning through the pre & post-tests. Especially allow time for student discussions after each assessment. Some suggested prompts are:

<table>
<thead>
<tr>
<th>Assessment Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pre-test</strong></td>
</tr>
<tr>
<td>• What ideas, facts are we certain about? What do we already know individually and as a group?</td>
</tr>
<tr>
<td>• How helpful were our guesses about those items we were unsure about? What was our thinking behind the answers we guessed at?</td>
</tr>
<tr>
<td>• In what ways do our answers help us to prepare for new learning? What new vocabulary or learning step should we focus on?</td>
</tr>
<tr>
<td>• Were there any patterns that appeared from our class performance? As a student and as the teacher, what do these patterns tell you?</td>
</tr>
<tr>
<td>• What are you looking forward to learning in this unit?</td>
</tr>
<tr>
<td>• What should we remain cautious about in taking this pre-test? That is, the items are just a sampling. What kinds of things might influence our pre-test performance? How does knowing what these are help us to become better learners as we progress through the unit?</td>
</tr>
</tbody>
</table>

| **Post-test**     |
| • Compare and contrast the pre & post-test performances. |
| o What are the general statements or observations made? |
| o In what ways did your test-taking approaches differ? |
| o What was easy? What was still difficult? What needs clarifying? What needs to be learned in a different way? |
| o How does the post-test performance align with other unit assessment activities completed? With students’ own assessment of how well they learned overall? With teacher’s assessment? |
| • Were there any patterns that appeared from our class performance? As a student and as the teacher, what do these patterns tell you? |
| • How well do the pre & post-test represent what was learned in the unit? What recommendations do we have to the test developers? |