

In the Doldrums



Lesson at a Glance

Students conserve water for one day as if they were in the doldrums on a canoe. They graph human population growth and water consumption for Hawai'i, and then produce an educational presentation about their water future. Students summarize by writing journal entries about applying *mālama* and *ola kino* in their lives.

Focus Question

What can we do to ensure that there will be enough clean fresh water for future generations?

Key Concepts

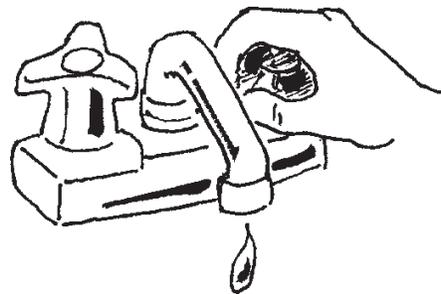
- Clean fresh water is essential for healthy living.
- Conserving water and reusing wastewater will help to sustain our fresh water resources.

Values

mālama
ola kino

Time

three - six class periods



Performance Standards

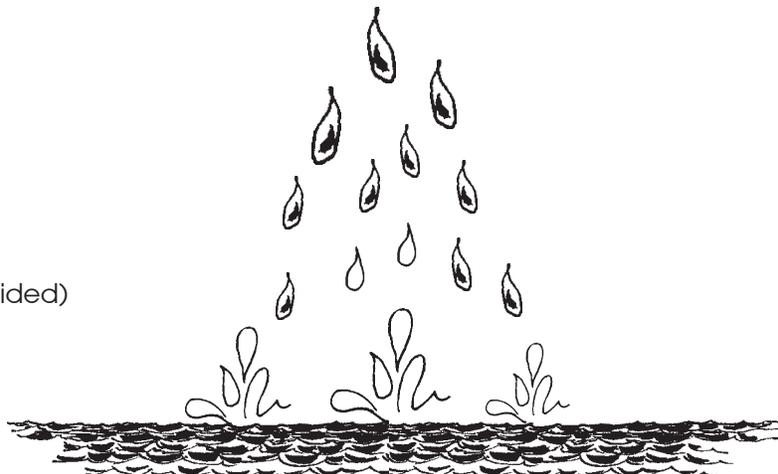
- Depict information and relationships by constructing diagrams, charts and graphs.
- Participate in school and community environmental projects.
- Conclude that humans are dependent upon the Earth's resources and take responsibility toward natural resources.
- Demonstrate comprehension of text by writing about theme/author's message.
- Apply themes to own life experiences.

Subject Areas

science, language arts, art

Materials

Values illustrations (provided)
Momi's journal (provided)
1 liter plastic bottle for each student
student data and activity sheets (provided)
graph paper





Preparation

- Ask students to each bring an empty, clean 1 liter plastic bottle from home. (Alternatively, provide each student with an 8 ounce cup, which they may fill twice with water to use during this activity. This would equal the amount of water Momi had in one-half day on the canoe.)
- Duplicate the student data sheets for distribution to each student.

Optional: Record a television newscast to analyze with students. See Extended Activities.

Teacher Background

Fresh water is one of the most precious resources on Earth. Early Polynesians identified it as *wai*. Since water was considered “the source of life,” it was most fitting for them to conceive the word *waiwai* — referring to wealth or prosperity. For Polynesian voyagers, *wai* was a necessity. The long, grueling journeys would frequently require them to limit the amount of water they drank, testing even the hardest voyager’s endurance.

Today, fresh water is still a precious resource. As we look toward a sustainable future, we need to examine our uses of water and the various impacts our activities have on groundwater and surface water resources.

Are we using our supply of fresh water faster than it can be replaced naturally by rainwater? Since 1900, Hawai‘i’s population has increased from 154,000 to more than 1.2 million. This is an eight-fold increase. With projected development on O‘ahu, the island’s aquifers will reach maximum sustainable yield before the year 2020, so there will not be enough fresh water available to sustain a growing human population.

Groundwater supplies more than 90 percent of the state’s total daily residential water use. That’s approximately 690 million liters of water being used per day.

Surface water (water from streams and springs) accounts for only a small portion of residential water use, although tapping groundwater indirectly affects streams by lowering the water table. Agriculture is the biggest user of surface water. Farmers use it to irrigate crops and provide water for livestock. People on O‘ahu rely primarily

on groundwater sources; people on the other islands are more dependent on surface water and rain catchments. Refer to the water use figures on the student data sheet for more information.

Every day, millions of gallons of reusable water is pumped into our ocean as wastewater. A small amount of this wastewater is treated and reused to meet some of our agricultural water needs for irrigation. But much more could be reused. Brackish water can be piped to homes for flushing toilets and watering plants. This will allow our groundwater aquifers to recharge. By carefully planning our community development, conserving water, protecting watersheds, and minimizing the removal of vegetation, we can minimize the depletion of our fresh water supply and plan for a more sustainable future.

Taking Action!

Grade 5 students at Ma‘ema‘e School teamed up with the Honolulu Board of Water Supply to save water in their community. The Board of Water Supply provided Water Saver Kits that students distributed to families. People compared their water use before and after installing water-saving devices and realized that they could make water conservation an everyday household habit in Hawai‘i.





Supplemental Resources

Coffman, Tom. *Rediscovering Water*. Board of Water Supply, City and County of Honolulu, 1979. (Presents the history of water use and control in Hawai'i.)

(Contact David Nagamine for information on wastewater re-use. There is a new educational video and a pamphlet available to schools. The video is aimed at 6th grade level and is approximately 17 minutes in length.

O'Connor, Maura, ed., *'Ōhi'a Project, "Water Watchers,"* (grade 4). Bishop Museum and Moanalua Gardens Foundation, 1992. This activity provides background information and a game that illustrate how water consumption needs have changed over time in the Islands. *'Ōhi'a Project* guidebooks are available in main public libraries and in many school libraries.



Resource Agency

Hawai'i Water Environment Association, Public Education Committee, c/o City Environmental Services Department, 650 S. King St. 3rd Floor, Honolulu, HI 96813



Benchmarks

Every day millions of gallons of potentially useful fresh water are pumped out into the ocean as wastewater. At the same time, our island groundwater aquifers are being depleted at an ever increasing rate. Recent estimates predict that fresh water usage on the island of O`ahu will exceed groundwater supplies by the year 2020. One solution to this situation is to reuse wastewater to meet fresh water needs and to recharge our aquifers.

The table below is from the Ke Ala Hōkū Critical Indicators Report 1997-1998 showing benchmarks for wastewater use in Hawai'i.

INDICATORS	1990	1991	1992	1993	1994	1995	1996	BENCHMARKS	
								2000	2010
Wastewater Reuse									
Amount of wastewater reused (in mgd*)					12.6	13.3		35.0	
Percentage of total wastewater treated					9.0	9.5		25.0	

Source: Department of Health, Wastewater Branch

* million gallons per day



Teaching Suggestions

1. Have students read week four of Aunty Momi's journal.
2. Using the Pacific map grids and the voyaging line created in the first activity, *The Remarkable Journey*, ask students to mark the area near the equator known as the doldrums. Use tape or have students cut out some paper dolphin shapes to mark this area on the large blue tarp grid. Move the canoe cut-out to the doldrums (just north of the equator) along the voyaging line. Have student groups discuss the journal.
3. Have students each fill an empty liter bottle with water. (This is just slightly less than what Aunty Momi had to drink.) Place a sign over the classroom faucet to indicate that water is off limits for the day for all uses from your sink. Tell students to use the water from their bottles as their source for the day. They should drink normally and note the time of day when their water runs out. At this point, they can replenish from a drinking fountain.
4. The following day, discuss students' reactions to this challenge. Distribute the water use data sheets, ask students to graph the data and summarize it.
5. Challenge students to produce a "Water Watch" presentation to share this data with other classes in the school. Divide the class into teams. Ask teams to decide on the focus for their presentations:
 - fresh water for our future
 - conserving water at home and school
 - wastewater: how do we reuse it?
6. Distribute the student investigation sheet and review it with student teams. Discuss ways to obtain additional information for their presentations. Brainstorm different ways that students can communicate their message to

others such as skits, songs, guidebooks, games or newscasts (see Extended Activity).

7. When teams have completed their tasks, have them work together to organize a group Water Watch presentation to other classes in the school.

8. Ask students to reflect in their journals on their experience with water in this exercise. How does it compare to Aunty Momi's experience on board the canoe? How are they incorporating the values of *mālama* and *ola kino* into their lives.

Extended Activity:

- Challenge students to develop a Water Watch newscast. Record a newscast and have students observe format, style, and roles of people involved, i.e. news anchor, investigative reporters, videographers, editors, etc. If your school does not have access to video equipment, have students produce a computer presentation or a newspaper report.

Sample Briefing for Water Watch newscast:

We have just received a report that projected demand for fresh water in Hawai'i will exceed our supply by the year 2020. We need to send out investigative reporting teams to find out what is being done to ensure that we don't run out of water. We need to find out how people in the community are conserving water and how we are re-using treated wastewater. Our newscast will air on _____ (date). To meet our deadline, we need teams of investigative reporters (researchers), writers, videographers or photographers, and editors to produce reports on: water conservation at school, water conservation in homes, and wastewater re-use.

Students could feature reporters in the field, public service announcements with music, sports announcements related to water, and advertisements for products or services such as water-saving devices, "unthirsty" landscaping plants, or free leak-detection home visits.



Focus Question: What can we do to ensure that there will be enough clean fresh water for future generations?

Standard	Student Tasks	Assessment: Meet Criteria	Assessment: Exceed Criteria
<p>✓ 2 Demonstrate comprehension of text by writing about theme/ author's message.</p>	<p>In small groups, students will discuss the following questions after reading Auntie Momi's journal:</p> <ul style="list-style-type: none"> • Why was it so important for Auntie Momi and the crew to conserve water? • How is water use on the canoe similar or different from the way you use water in your own home? • How is our island's water supply similar to the canoe's? • How would you feel if you were limited to a specific amount of drinking water? • Which two values were most important in Auntie Momi's journal? 	<p>During their discussion:</p> <ul style="list-style-type: none"> • student groups write out the answer to each question; • each group shares its answers to at least two questions with the whole class. 	<p>Student will write a short paper or poem comparing water use on a canoe with water use on their island.</p>
<p>✓ 4 Depict information and relationships by constructing diagrams, charts and graphs. Conclude that humans are dependent upon the Earth's resources and take responsibility toward natural resources.</p>	<p>Students graph the human population and water use figures for Hawai'i and summarize the data.</p> <p>Students discuss their conclusions from the data they have graphed.</p> <ul style="list-style-type: none"> • Will there be enough water in the future? • Are we using water faster than rainfall replenishes it? • Is this a sustainable use of water? <p>What can we do to conserve water?</p>	<p>Each student will:</p> <ul style="list-style-type: none"> • construct a graph that depicts human population growth and water use in Hawai'i; • write conclusions from the data that is graphed. <p>Groups of students will:</p> <ul style="list-style-type: none"> • discuss their conclusions from the data; <p>share at least one of their conclusions from the data with the whole class.</p>	<p>Students create a display of water data to share with others in the school.</p>

<p>✓ 5 - 7 Participate in school and community environmental projects.</p> 	<p>Investigative student teams will produce an environmental "Water Watch" presentation to share with others in the school. Presentations will address the need for clean fresh water for healthy living and explore ways to conserve water.</p> <p>Sample conservation questions to address:</p> <ul style="list-style-type: none"> • Water conservation at school/home: What is being done and could be done to conserve water? Are there leaky faucets, running toilets, or people using too much water? Are people landscaping with plants that don't need too much water? Are there water-saving devices on showers? • Wastewater re-use: How is wastewater being reused? What can we do to increase our use of wastewater? How can we reuse wastewater in our homes? 	<p>Each group of students will:</p> <ul style="list-style-type: none"> • develop a "Water Watch" presentation (skit, "newscast", posters, public service announcement, guidebook or games) to share with other classes in the school. 	<p>Students will:</p> <ul style="list-style-type: none"> • develop and implement a water conservation campaign for their school; • compare water consumption figures for the school before and after their campaign. 
<p>✓ 8 Apply themes to own life experiences.</p>	<p>Students will reflect on the values learned in this activity and in Aunty Momi's journal.</p>	<p>Student's journal will have:</p> <ul style="list-style-type: none"> • a daily entry for one week reflecting on the values of <i>mālama</i> and <i>ola kīno</i>; • at least two entries showing how a particular value is applied to student's life. 	<p>Student's journal will have a daily entry for two weeks showing how different values are applied to student's life.</p>

Student Data Sheet



Will there be enough fresh water in the future?

Plot the following figures for human population growth in the Hawaiian Islands on a graph:

Year	Population
1778	250,000 - 800,000 *
1831	130,313
1850	84,165
1876	53,900
1884	80,578
1900	154,001
1920	255,881
1940	422,770
1944	859,000
1954	622,000
1971	788,000
1980	964,691
1990	1,108,229
1997	1,186,602
2020 (projected)	1,200,000 +



Source: Atlas of Hawaii and Federal-State Cooperative Program for Population Estimates (provided by Hawai'i Dept. of Business Economic Development and Tourism)

* Captain James King on Cook's voyage estimated a population of 400,000; (Schmitt, R.C. *Journal of Polynesian Society* 80:237-243, 1971.) David Stannard, (*Before the Horror* 1989) estimates a population of 800,000 to 1,000,000.

Plot the following water use figures for the Hawaiian Islands on a graph.

Year	Fresh Water Use (in gallons per day)
1965	1,597,000
1980	2,658,000
2000 (projected)	4,698,000

Source: Atlas of Hawaii

Student Investigation Sheet



Water Conservation

Water Wasters Checklist: Investigate ways that water is wasted at school or home and make a checklist. (Look for leaks, water left running and any other uses that look wasteful to you.)

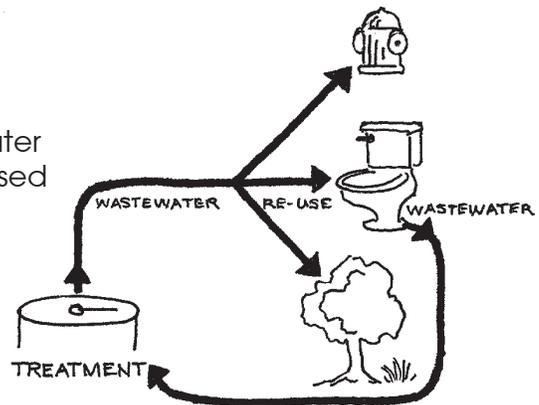
Conserve It! List your team's ideas for conserving water at school or home and think of a creative way to communicate your ideas to others in your school.



Wastewater Re-use

Wastewater from most homes and schools goes to water treatment plants. There the water is treated and released to the ocean. A small amount of this wastewater is treated and reused on some crops and golf courses.

In what other ways could wastewater be reused in your community?



Interview some people in your school or neighborhood and find out what they think about wastewater re-use in your community.

To find out more about how wastewater is being re-used in Hawai'i, call or write to the Water Quality Division of Wastewater Management; O`ahu phone number (808) 527-5368.