Kalo Keepers

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Castle High School

HCPS Science Standards Addressed: 1.3, 2.5 & 2.9

Grade Level: 9–12

Project Time Span: 1–2 weeks (includes 1 field trip)

To the Teacher:

This lesson is designed for schools in windward O‘ahu; some modifications will be required for use in leeward schools. It is intended to follow P. Chinn and R. Roland’s “Ahupua‘a and Place Names” lesson in this volume, so students have a sense of place of the ahupua‘a in which they live. For further information regarding the Punalu‘u fieldtrip, contact Nalani Mattox, nalanimattox@hawaii.rr.com.

Goals of the Lesson:

• To learn about the historical and cultural significance of kalo
• To examine the physiological and biological characteristics of kalo
• To research the traditional design of the Hawaiian ‘auwai and lo‘i

Student Learning Objectives (Benchmarks):

This lesson addresses Grade 9–12 benchmarks for HCPS Science Standards:

1.3 Using Unifying Concepts and Themes. Students use concepts and themes such as system, change, scale to help them understand and explain the natural world.

• Explain the function of a given system and its relationship to other systems in the natural world.
• Design or create a model to represent a device, a plan, an equation, or a mental image.

2.5 Interdependence. Students describe, analyze, and give examples of how organisms are dependent on one another and their environments.

• Analyze the interdependence within and between terrestrial, aquatic and atmospheric systems.

2.9 Cells, Tissues, and Organs. Students explain the structure, functions, and reproduction of living cells.

• Compare and contrast ways in which selected cells are specialized to carry out particular life functions.

Resources and Materials:

Books and Websites

• White, L.D., 1994, Canoe Plants of Ancient Hawai‘i
  http://www.canoeplants.com/kalo.html
• Planting information

Materials
• Kalo plants
• Appendix 1: Diagram of the Water Cycle
• Appendix 2: Diagram of the Kalo Plant
• Appendix 3: Kalo Life Cycle

Instructional Procedures:
1. Before teaching this lesson (perhaps at the beginning of the school year),
teach “Ahupua’a and Place Names”, a lesson by P. Chinn and R. Roland in
this volume.
2. Introduction to the water cycle (1 day)
   (the lesson should take place outside in view of the nearby mountains)
   • Questions to the class: What direction do the clouds typically travel in
     Hawai’i? What is this side of the island called? Why? What happens to the
     rain as it falls onto the Ko‘olaus? Where does the water go when it hits the
     ground?
   • Discuss what an ahupua’a is and how the water moves through the land
     from the mountain to the sea. Discuss the importance of wai (fresh water)
     and kai (sea water) to the ancient Hawaiians. Provide examples of the
     cities and street names of O‘ahu (i.e., Waikiki, Waimanalo, Wai‘anae,
     Waimea, Wai‘alua, Waipahu, Wai‘alae, Kailua, Hawai‘i Kai, Kaimuki).
   • Show the water cycle diagram (Appendix 1).
   • Questions to the class: What do you notice about the shape of the
     mountains? What do you notice about the plants on the mountains? Do
     you see any patterns? How does the shape and slope of this side of the
     island compare to the other side? Where does the rainwater flow in this
     ahupua’a?
   • Discuss the role of the plants in the water cycle. Describe the role of plant
     roots in the prevention of soil erosion and the uptake of nutrients.
   • Questions to the class: What does sustainability mean? How did the
     ancient Hawaiians simultaneously use and sustain the land’s natural
     resources? What did the Hawaiians use the water for?
   • Discuss the role of the lo‘i in kalo cultivation.
3. Introduction to the kalo plant (1 day)
   • Bring in a few live kalo plants for the class to examine.
   • Questions to the class: What is this plant? What is it used for?
   • Discuss the following story of kalo retrieved from the Canoe Plants of
     Ancient Hawai‘i website:
     o “According to the Kumulipo, the creation chant, kalo grew from the
       first-born son of Wakea (sky father) and Papa (earth mother),
       through Wakea’s relationship with his and Papa’s daughter,
       Ho‘ohokulani. Haloa-naka, as the son was named, was stillborn
       and buried. Out of his body grew the kalo plant, also called Haloa,
       which means everlasting breath.”
   • Hand out the kalo diagram (Appendix 2) and ask the students to identify
     and label the parts of the live kalo plants.
Discuss how the parts of a kalo plant are used by Hawaiians.

4. Kalo life cycle (1 day)
   - Questions to the class: What do plants need to photosynthesize? What do plants produce as a result of photosynthesis? How does a plant use the sugar? What is the function of a kalo's corm?
   - Handout the diagram of the kalo lifecycle (Appendix 3).
   - Discuss the upward movement of water and nutrients to the leaves through the xylem cells and the downward movement of sugar to the corm through the phloem cells.
   - Compare the kalo to other plants with similar structures (i.e., beets, carrots, radishes). Discuss the role these structures have in our lives.

5. Kalo planting (1 day)
   - Prior to planting, the teacher needs to select a location that is approved by the school administration and groundskeepers.
   - Explain to the students that they will be planting one kalo plant near the classroom to have an opportunity to watch a kalo plant grow over time.
   - Discuss the proper soil preparation and planting techniques for dryland kalo cultivation (see the website in the materials section).
   - Prepare the selected area for planting.
   - Plant the kalo top or keiki in the ground and water thoroughly.
   - Establish a weekly schedule for the students to water and monitor the kalo.

6. Lo`i research project (4–5 days)
   - Explain the expectations for the research project
     - The students may work individually or in groups of two to research the traditional use and design of the `auwai and lo`i by ancient Hawaiians (Abbott, 1992).
     - The groups will also have to design and construct their own three-dimensional model of a lo`i based upon what they learned through their research.
     - The model should include a complete ahupua`a with a mountain, a valley, a stream, an `auwai, a terraced lo`i, and an ocean.
     - The students can use whatever resources or materials they can find, including but not limited to:
       - Recycled materials (e.g., wood, plastic bottles or containers, aluminum foil, newspaper, fabric, popsicle sticks, plants, soil)
       - Art Supplies (e.g., paint, pens, colored pencils, construction paper)
     - Since the model will be sprayed with water on the final day of the project, the model should be functional and be able to efficiently direct water through the entire ahupua`a.

7. Punalu`u fieldtrip (1 day)
   - The students will spend the day in an ahupua`a in windward O`ahu. They will participate in service learning by removing invasive plants from an established `auwai and the surrounding area. Students will also have the opportunity to compare and contrast their lo`i models to an existing lo`i in the Punalu`u valley.

Student Learning Activities:
   - Students will examine the life cycle and the physiology of a kalo plant.
• Students will plant kalo and monitor its growth over time.
• Students will conduct a research project into the traditional use and design of the 'auwai and the lo'ī by ancient Hawaiians.
• Students will design and create their own three-dimensional model of a lo'ī.
• Students will participate in a service learning fieldtrip to the Punaluʻu Valley on the windward side of Oʻahu to help maintain an existing 'auwai, lo'ī, and native plant garden.

Assessment:
• Discussion, in-class worksheets, class notes
• Research report on the traditional use and design of the 'auwai and terraced lo'ī patches.
• Lo'ī model

Extension:
• The teacher could lead a class wide project that involves restoring a lo'ī. During the restoration process the students would be able to use the knowledge that they gained while researching and designing their own lo'ī model. The project could be ongoing throughout the school year so that the students would be able to see progress over time. Establishing a monthly water sampling routine to monitor the stream over time would help students become familiar with the physical processes that occur year round in the ahupuaʻa. My hope is that the students would learn how to restore the land, promote sustainability, and ultimately learn how to restore the Hawaiian culture.
• The class could also create a dryland kalo garden on the school grounds. The students would be responsible for preparing the soil, planting kalo, and watering the plants each day. To follow the growth of their own kalo plants, the students could regularly count the leaves, measure the width and length of the leaves, measure the plant's height, and record any other observations. The garden could ultimately serve as a cooperative group project that could span the entire school year.
• The Kalo Keepers Lesson could also lead into a lesson on the design and use of traditional Hawaiian fishponds. Students could investigate the structure and function of the fishponds in relation to sustainability. The fishponds could also introduce the students to many ecological processes (i.e., predation, competition, population growth).

Evaluation of Lesson:
• The following questions could be used to evaluate the effectiveness and success of the lesson:
  o What happened during the lesson?
  o How was the students' participation?
  o Did the students meet the learning objectives?
  o What did you like or dislike about the lesson?
  o What worked or didn’t work?
  o How would you improve this lesson in the future?
Appendix 1: Diagram of the Water Cycle
Appendix 2: Diagram of the *Kalo* Plant

a. fleshy corm (*kalo*)
b. base of the corm
c. bud on the side of the corm
d. bud growing into a cormlet
e. sucker growing up from a cormlet (*keiki*)
f. runner growing from a bud near the top of the corm
g. shoot growing from a runner
h. un-opened flower head
i. opened flower head
j. female flowers
k. male flowers
l. sterile appendage
m. base of a leaf stalk or petiole
n. petiole or leaf stalk (*ha*)
o. top of the petiole
p. leaf spot, only in some varieties
q. dark streaks on leaf, only in some varieties
r. midribs of upper leaf lobes
s. rounded tips of upper leaf lobes
t. pointed lower leaf tip
u. leaf (*lau*)
v. parent plant (*makua*)
Appendix 3: Kalo Life Cycle


- establishment stage
- vegetative stage (leaf and root growth stage)
- maturity stage (corn growth stage)

weeks after planting