Kalo Matters
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Grade Level: 9-12th
Project Time Span: 1 Quarter
To The Teacher:
This unit will:
1) introduce students to the biogeochemical cycles within a given ecosystem.
2) enable students to select kalo species to optimize the best growing conditions within a specific lo’i or mala kalo.
3) provide students the opportunities to calculate area and volume during the planning, drafting, and constructing of the various lo’i or mala kalo.

Goals of the Lesson:
• Develop an understanding of how biogeochemical cycles work within the kalo plant. The chemical reaction involved in photosynthesis, cellular respiration, and the path of energy and matter exchange.
• Determine the optimum match between kalo species and the given environmental conditions for a given lo’i or mala kalo system.
• Area and volume calculations for the needed soil, compost, and water circulation speed for the selected lo’i or mala kalo plots.

Student Learning Objectives (Benchmarks):
This lesson addresses Grade 9 -12th grade benchmarks for HCPS III Science Standards (Life and Environmental Sciences):
• SC.BS.3.1 Describe biogeochemical cycles within ecosystems.
• SC.BS.3.2 Explain the chemical reactions that occur in photosynthesis and cellular respiration that result in cycling of energy.
• SC.BS.3.3 Explain how matter and energy flow through living systems and the physical environment.

This unit addresses Grade 9 – 12th grade benchmarks for HCPS III Mathematics Standards (Geometry):
• G.4.2 Solve problems using the formulas for perimeter, circumference, area, and volume of two-and three-dimensional figures and solids.
• G.4.3 Determine the effect of dimension changes to perimeter, area, and volume for common geometric figures and solids.

Resources and Materials:
Books
• College of Tropical Agriculture and Human Resources, 1997. *Taro Mauka to Makai.* University of Hawai‘i, Honolulu, Hawai‘i.

Websites
- [http://library.thinkquest.org/J0110881/kalo.htm](http://library.thinkquest.org/J0110881/kalo.htm)
- [http://www.canoeplants.com/kalo.html](http://www.canoeplants.com/kalo.html)
- [http://apdl.kcc.hawaii.edu/~ahupuaa/botany/food/taro.htm](http://apdl.kcc.hawaii.edu/~ahupuaa/botany/food/taro.htm)
- [http://www.hawaii.gov/health/oegc/garden/ejoegkal.htm](http://www.hawaii.gov/health/oegc/garden/ejoegkal.htm)

Community Resources
- Amy B.H. Greenwell Ethnobotanical Gardens (Captain Cook, Hawai‘i).
- Kawaloa ancient mala kalo sites (Kealakekua, Hawai‘i).

Materials
- Area phone books
- Tape measure
- Graph Paper
- Kalo plants for display and demonstration
- Kalo corms
- Gardening tools

Instructional Procedures:
1) Explain the significance of the interrelationship of the Kalo plant to the cycles of matter and energy in the environment.
   a. Introduce the concept of biogeochemical compound cycling (e.g., water, carbon, nitrogen, oxygen, potassium) needed for Kalo growth.
   b. Demonstrate cellular respiration and photosynthesis outcomes.
   c. Diagram the cycle of energy and matter between the Kalo plant and the environment (lo‘i or mala kalo).
2) Provide resources for students to research various Kalo species. Have students do a hypothesis of a given Kalo species in relation to the compatibility potential to selected lo‘i or mala kalo environments.
3) Determine available sites within the Konawaena High School Farm to establish lo‘i or mala kalo. Have students measure and calculate the area for both dryland (mala kalo) and wetland (lo‘i) fields. Share possible resources for students to research cost factors for needed construction and upkeep.

Student Learning Activities: W.H.E.R.E. (Understanding By Design)
- **W** – How will students know where they are heading and why?
  - Post essential question on bulletin board during each aspect of the unit.
    1) What makes the Kalo grow?
    2) Which Kalo for which lo‘i or mala kalo?
3) How to build a lo'i or mala kalo?
   o Provide outline guides for each section of the unit. Include key concepts, vocabulary, skills needed, tasks to be completed with timelines.

   1) Biogeochemical Cycles & Photosynthesis
      Key concepts/vocabulary:
      • biogeochemical compounds: water, carbon, nitrogen, oxygen, potassium
      • cellular respiration
      • photosynthesis
      • cycle of energy and matter
      Skills:
      • Making predictions given a set of circumstances
      Tasks:
      • Cause & Effect graphic organizer

   2) Kalo Species & Habitat
      Key concepts/vocabulary:
      • Wetland – lo'i
      • Dryland – mala kalo
      • Types of Kalo
      Skills:
      • Kalo species identification and characteristics
      Tasks:
      • Present brief informational piece (written report, poster, diagram, brochure, booklet, speech, video, photographs, etc.) on recommendation of Kalo species selection for given lo'i or mala kalo.

   3) Building of Lo'i or Mala Koa
      Key concepts/vocabulary:
      • Area
      • Perimeter
      • Volume
      Skills:
      • Use of appropriate measurement tools
      • Calculations for building site preparation (land clearing and layout), building costs (soil, compost, water cycling, etc.), maintenance costs (fertilizer, weeding, etc.)
      Tasks:
      • Drawing of plan and design of lo'i or mala kalo
      • Construction of lo'i or mala kalo
      o Develop with students specific criteria for given performances or products.

   H – How to hook students through engaging and thought-provoking experiences (e.g., issues, oddities, problems, and challenges) that point toward big ideas, essential questions, and performance tasks.
      • Share Hawaiian legend of the Kalo
• Provide samples of Kalo in various conditions (depravation or surplus of chemical compounds or sunlight).
• Guest speaker or field trip

• E – What events, real or simulated, can students experience to make the ideas and issues real? What learning activities will help students to explore the big ideas and essential questions? What instruction is needed to equip students for the final performance?

   Experience:
   ▪ Personal connection to the Hawaiian legend of the Kalo

   Explore:
   ▪ Researching the Kalo species, lo'i or mala kalo sites
   ▪ Field trips—Amy B.H. Greenwell Ethnobotanical Garden and/or ancient mala kalo sites at Kawaloa

   Equip:
   ▪ Hands-on application of putting learning to practice—building of a lo'i or mala kalo and student selection of Kalo species to plant

• R – How will students reflect and rethink, to dig deeper into the core ideas? How will students rehearse, revise, and refine their work based on feedback and self-assessment?

   Reflect:
   ▪ Students will be asked to do an “exit pass” after each class session to determine what they learned and what questions they may still have.

   Rethink:
   ▪ K-W-L (What I Know, What I Want to Know, & What I Learned) charting of students learning will be used for each section of the unit of study.

   Rehearse/Revise/Refine:
   ▪ Self-assessments based on General Learner Outcomes rubric (GLOs) will be used during key points of the unit.
   ▪ Small group sharing of progress with peer feedback and questions will be encouraged throughout the unit of study.
   ▪ Ongoing conferencing with teachers & mentors will be made available throughout the building process.

• E – How will students exhibit their understanding about their final performances and products? How will students self-evaluate to identify their strengths and weaknesses in their work and set future goals?

   Exhibit:
   ▪ Presentation of Kalo species recommendations
   ▪ Design & construction of lo'i or mala kalo
   ▪ Lo'i or mala kalo field site preparation

   Evaluate:
   ▪ “Exit Passes,” K-W-L charts, & GLO rubric self-assessments will provide students with identified areas of strengths/needs for personalized goal-setting.
Assessments:
Formative (Ongoing) Assessments:
- Peers: small group discussions with verbal feedback


- **Goal:** to plan, design, and construct a working lo‘i or mala kalo and research the best match Kalo species for the given system selected.
- **Role:** You are a new kalo farmer interested in becoming a member of a lo‘i or mala kalo cooperative farming enterprise. You are in need of space within a community planned kalo patch. You must be able to provide evidence that you are knowledgeable of your crop selection and have a plan to help build and maintain the lo‘i or mala kalo.
- **Audience:** The targeted audience are the land use committee for the Konawaena High School Farm (peers, parents, teachers/mentors, & community resource people).
- **Situation:** You are to provide research on the productive estimates of the various kalo species you wish to grow. You are vying for a small parcel within a larger planned community lo‘i or mala kalo. The committee is looking for the most viable kalo patch to build. Your plans, designs, and construction cost information will be considered for final selection of a site.
- **Presentation/Performance (Evidence of Learning):** Presentation of kalo species selected for planned lo‘i or mala kalo. Research to include: species scientific name and common name, distinguishing features/characteristic of kalo, estimated time of production from planting to harvest, optimum growing conditions and maintenance plans, and product use/marketability. Choice of format: written report, brochure, pamphlet, video, poster/diagram, photographs, etc.
- **Product (Evidence of Learning):** Your lo‘i or mala kalo design must include the following:
  - scale drawing of lo‘i or mala kalo with appropriate labels (directions, legend, measurement conversions, etc.)
  - listing of needed construction materials and supplies with cost estimates included (information on price breakdown and contact of suppliers).
- **Standards of Success (Criteria):** Product and performance rubric to be developed with students prior to research.

Extension: (optional section)
- Partnership with community resources