STEMS2 Unit Plan Template

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# BACKGROUND:

## Lesson Background:

Many loko i’a in the state of Hawai’i were once highly productive and sustainable coastal food systems that relied on a constant supply of freshwater from upland watersheds within an ahupua’a. Currently, the status of loko i’a is shifting from a once productive historical relic to an inspiring model of innovative engineering and a potential clue that can help solve today’s sustainable development needs. Students will learn about sustainability and resourcefulness as foundational values within the Hawaiian culture (Kanaiaupuni, 2004; Keala, Hollyer, & Castro, 2007; Oliviera, 2014).

With the help of modern science and technology, many loko i’a across the state are in the process of being restored and studied. Where loko i’a are present, cultural and scientific research groups are continuing to re-examine the potential of applying traditional food production methods as modern solutions for our growing island and state. Students will have an opportunity to develop their understanding of the connections between ecosystem services of watersheds, freshwater resources, and sustainable food production in Hawai’i and to present their own ideas for how this problem can be solved. Ultimately, students will evaluate these issues as a function of their own sense of place and responsibility to be aware and help protect our shared natural resources. Student will be encouraged to view themselves as “insiders” taking on an important role to serve the Keaukaha community (Lim, 2010; Smith & Sobel, 2010).

Community partners are important for helping to build meaning as part of a rich place-based experience (Smith & Sobel, 2010). As a class, they will have the opportunity to work with Mālama O Honokea, a non-profit education group, to study the loko i’a system and help with restoration efforts at Honokea loko i’a in Keaukaha, Hilo. Honokea and the surrounding recreational areas have been constantly subjected to natural disasters, waste spills, pollution, and varied land-use practices. Efforts to reclaim the loko i’a currently exist through partnerships between volunteers, community educators, and the University of Hawaii at Hilo.

Design thinking is process-driven approach to problem solving that is rooted in developing empathy for the real needs of people. This focus helps to develop meaning and essentialness in the work. The Stanford d.school method is used in this unit as the preferred model for outlining and presenting the design thinking process. Stanford d.school materials are available online at <https://dschool-old.stanford.edu/groups/k12/>.

Student will begin the unit with a set of hands-on classroom lessons introducing them to the structure/functions of, and threats to, Hawaiian watershed systems. Next, students will learn about the cultural significance, history and ecology of loko i’a by visiting Honokea loko i’a in Keaukaha, Hilo. Students will work with the organization Hui Ho’oleimaluo during their learning journeys to Honokea. During this unit, student will learn about the cultural and historical significance of Honokea, the biological diversity and ecological dynamics of the area, and current research happening at the loko i’a. As a mid-unit project, students will create an informal report on their experience at the loko i’a which will contain data from their scientific investigation of the loko and possible recommendations for the pond’s future use by various members of the local community. Students will be encourage to evaluate their experiences in the context of their own sense of place and community connections.

The next part of the unit further explores enduring understandings of place-based resource management and sustainability. Students will learn about Design Thinking, a human-centered, problem-solving methodology that focuses on creativity, collaboration, and innovation in product design. The Stanford Design Thinking model has five parts: Empathize, Define, Ideate, Prototype, and Test. Through their lessons, students are led to consider a water related problem in a place/community that they are all connected to, their school campus. Ultimately, students will engage in a place-based, engineering design challenge to develop an innovative product by applying design thinking. Students will keep a digital notebook through the design process, and as a culminating assessment present their working prototype to key “users” identified earlier in the design process.

## Unit Overview:

This two part integrated multicultural unit is designed for use with 11th-12th graders. Part 1 (4 weeks): students learn about watersheds and aquifer systems via exploration of connections between healthy native ecosystems and clean water in the context of the loko i’a system and their school greenhouse. Part 2 (4 weeks): students will learn the process of design thinking and engage in an engineering design challenge related to sustainable water use on their school campus.

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# STAGE 1:

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## Unit Plan Title:

Design STEMS2 Learning from the Past, Designing our Future: Conservation of Hawai’i’s watersheds and freshwater resources

## Essential Question:

How can scientific, traditional, and community-based approaches be used to protect watersheds, conserve freshwater resources, and help to design innovative solutions for sustainability in Hawai’i?

## Enduring Understanding(s):

* Watersheds and their associated aquifers are complex and dynamic systems that are an important source of clean freshwater which society depends on.
* Water is considered a prized and sacred resource in many cultures, especially in Hawaiian culture. Preserving sources of freshwater, a limited resource, is of high importance for maintaining productive and sustainable food systems (e.g., loko i’a, plant agriculture, greenhouse operations). Freshwater conservation is a critical practice for all people and places.
* Place-specific community management is an important part of restoring and monitoring the health of loko i’a.
* Design thinking can help people to be more creative and to produce innovative and meaningful solutions to meet the needs of real people.

## Standard Benchmarks and Values

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| --- | --- | --- | --- | --- |
| Science | Technology | Engineering | Mathematics | Social Science |
| Standards Addressed  **NGSS - Performance Expectations**  **HS-LS2-2.** Use mathematical representations to support and revise explanations based on evidence  about factors affecting biodiversity and populations in ecosystems of different scales.  **HS-LS2-6.** Evaluate claims, evidence, and reasoning that the complex interactions in ecosystems  maintain relatively consistent numbers and types of organisms in stable conditions, but  changing conditions may result in a new ecosystem.  **HS-LS2-7.** Design, evaluate, and refine a solution for reducing the impacts of human activities on the  environment and biodiversity.  **HS-ETS1-3**. Evaluate a solution to a complex real-world problem based on prioritized criteria and  trade-offs that account for a range of constraints, including cost, safety, reliability, and  aesthetics as well as possible social, cultural, and environmental impacts.  **HS-ESS3-1.** Construct an explanation based on evidence for how the availability of natural resources,  occurrence of natural hazards, and changes in climate have influenced human activity.  **HS-ESS3-4.** Evaluate or refine a technological solution that reduces impacts of human activities on  natural systems.  **HS-ESS3-6.** Use a computational representation to illustrate the relationships among Earth systems  and how those relationships are being modified due to human activity.      **Common Core – Math**  **MP.2** Reason abstractly and quantitatively.  **HSN.Q.A.1** Use units as a way to understand problems and to guide the solution of multi-step  problems; choose and interpret units consistently in formulas; choose and interpret the  scale and the origin in graphs and data displays.  **HSN.Q.A.2** Define appropriate quantities for descriptive modeling.  **Common Core – Language Arts**  **WHST.9-10.2** Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.  **WHST.9-10.6** Use technology, including the Internet, to produce, publish, and update individual or shared writing products, taking advantage of technology's capacity to link to other information and to display information flexibly and dynamically.  **RST.11-12.2** Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.  **RST.11-12.7** Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) to address a question or solve a problem.  **RST.11-12.8** Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.  **C3 Social Studies**  **D1.5.9-12.** Determine the kinds of sources that will be helpful in answering compelling and supporting questions, taking into consideration multiple points of view represented in the sources, the types of sources available, and the potential uses of the sources.  **D2.Geo.4.9-12.** Analyze relationships and interactions within and between human and physical systems to explain reciprocal influences that occur among them.  **D2.Geo.6.9-12** . Evaluate the impact of human settlement activities on the environmental and cultural characteristics of specific places and regions.  **D2.Geo.10.9-12** . Evaluate how changes in the environmental and cultural characteristics of a place or region influence spatial patterns of trade and land use.  **D2.Eco.2.9-12.** Use marginal benefits and marginal costs to construct an argument for or against an approach or solution to an economic issue.  Standards Assessed  **C3 Social Studies**  **D4.6.9-12** . Use disciplinary and interdisciplinary lenses to understand the characteristics and causes of local, regional, and global problems; instances of such problems in multiple contexts; and challenges and opportunities faced by those trying to address these problems over time and place.  **D2.Geo.3.9-12.** Use geographic data to analyze variations in the spatial patterns of cultural and environmental characteristics at multiple scales.  **Common Core – Language Arts**  **WHST.9-10.4** Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.  **NGSS - Performance Expectations**  **HS-ETS1-1.** Analyze a major global challenge to specify qualitative and quantitative criteria and  constraints for solutions that account for societal needs and wants.  **HS-ETS1-2.** Design a solution to a complex real-world problem by breaking it down into smaller, more  manageable problems that can be solved through engineering.  **HS-ESS2-5**. Plan and investigate the properties of water and its effects on Earth materials and surface  Processes. | | | | |
| Sense of Place (Nā Hopena Aʻo and beyond) | | | | |
| **Standard #1. Strengthened Sense of Belonging**  (A) Know who I am and where I am from (E ) Am open to new ideas and different ways of doing things (H) Actively participate in school and communities    **Standard #2. Strengthened Sense of Responsibility**  (F) Set goals and complete tasks fully (G) Reflect on the quality and relevancy of the learning (H) Honor and make family, school, and communities proud    **Standard #3. Strengthened Sense of Excellence**  (C ) Prioritize and manage time and energy well (F) Utilize creativity and imagination to problem-solve and innovate (G) See failure as an opportunity to learn well    **Standard #4. Strengthened Sense of Aloha**  (E ) Respond mindfully to what is needed (G) Share the responsibility for collective work (H) Spread happiness    **Standard #5.** **Strengthening Sense of Total Well-Being**  (E ) Utilize the resources available for wellness in everything and everywhere (F) Have enough energy to get things done daily    **Standard #6** . **Strengthening Sense of Hawai’i**  (B) Use Hawaiian words appropriate to their task (C ) Learn the names, stories, special characteristics and the importance of places in Hawai‘i (F) Compare and contrast different points of views, cultures and their contributions (G) Treat Hawai‘i with pride and respect | | | | |

## Critical Skills and Concepts:

* Structure and function of watersheds in Hawai’i
* Structure and function of loko i’a (biogeophysical, ecological, cultural)
* Science research in coastal systems in Hawai’i
* Hui Ho’oleimaluo/ cultural protocol/ mo’olelo
* Hawaiian aquaculture (engineering innovation)
* Design thinking (Stanford model) process and mindsets
* Place-specific design/ engineering design challenge

# STAGE 2:

## Authentic Performance Tasks:

Phase 1

* Watershed model and topographical map
* Restoration of Honokea loko i’a
* Map of Honokea loko i’a
* Species ID Guide (Google Slides)
* Honokea project class report

Phase 2

* Design Challenge hack
* User interview
* Irrigation system for school greenhouse
* Prototype testing with user
* Essay

## Authentic Audience:

* 12th grade environmental science class
* Hui Ho’oleimaluo & CLA greenhouse managers (i.e., community partner & school facilities manager)

## Other Evidence:

Phase 1

* Lesson worksheets
* Pre-Post quiz (water resources)
* Water resources Cornell notes (Withgott & Laposata Ch. 15) and concept map (Bozeman)
* Loko i’a map for water quality sample locations
* Field notes
* Learning journey reflections (x3)
* Learning journey participation (x3)

Phase 2

* Lesson worksheets
* Group discussions
* 5-min brainstorm
* Looks Like/ Works Like models
* Design Thinking student notebook

# STAGE 3:

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## Lesson Sequence

