Lesson Title: Grade Four Integrated Science Curriculum – Loko ʻia (Fishponds)

Standards and Benchmarks:

CCSS

- **CCSS.ELA-Literacy.RI.4.3** Explain events, procedures, ideas, or concepts in a historical, scientific, or technical text, including what happened and why, based on specific information in the text.

- **CCSS.ELA-Literacy.RI.4.4** Determine the meaning of general academic and domain-specific words or phrases in a text relevant to a grade 4 topic or subject area.

- **CCSS.ELA-Literacy.RI.4.7** Interpret information presented visually, orally, or quantitatively (e.g., in charts, graphs, diagrams, time lines, animations, or interactive elements on Web pages) and explain how the information contributes to an understanding of the text in which it appears.

- **CCSS.Math.Content.4.MD.A.1** Know relative sizes of measurement units within one system of units including km, m, cm; kg, g; lb, oz.; l, ml; hr, min, sec. Within a single system of measurement, express measurements in a larger unit in terms of a smaller unit. Record measurement equivalents in a two-column table. For example, know that 1 ft is 12 times as long as 1 in. Express the length of a 4 ft snake as 48 in. Generate a conversion table for feet and inches listing the number pairs (1, 12), (2, 24), (3, 36), ...

- **CCSS.Math.Content.4.MD.B.4** Make a line plot to display a data set of measurements in fractions of a unit (1/2, 1/4, 1/8). Solve problems involving addition and subtraction of fractions by using information presented in line plots. For example, from a line plot find and interpret the difference in length between the longest and shortest specimens in an insect collection.

NGSS

- **4-ESS2-2.** Analyze and interpret data from maps to describe patterns of Earth's features. [Clarification Statement: Maps can include topographic maps of Earth's land and ocean floor, as well as maps of the locations of mountains, continental boundaries, volcanoes, and earthquakes.]
- **4-ESS3-2.** Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.* [Clarification Statement: Examples of solutions could include designing an earthquake resistant building and improving monitoring of volcanic activity.] [Assessment Boundary: Assessment is limited to earthquakes, floods, tsunamis, and volcanic eruptions.]

HCPSIII

Social Studies 7: Geography: WORLD IN SPATIAL TERMS

- **SS.4.7.2** Collect, organize, and analyze data to interpret and construct geographic representations.
- **SS.4.7.3** Analyze the consequences of human modification of the physical environment in Hawai'i using geographic representations (including *lo'i kalo* and *loko i'a*).

Science 1: The Scientific Process: SCIENTIFIC INVESTIGATION

- **SC.4.1.2** Differentiate between an observation and an inference.

Language Arts 3: Reading: LITERARY RESPONSE AND ANALYSIS
- **LA 4.3.1** Explain the problem or conflict in a story and how it is resolved.

Language Arts 4: Writing: CONVENTIONS AND SKILLS
- **LA.4.4.1** Write in a variety of grade-appropriate formats for a variety of purposes and audiences.

Essential Question: How can the ancient Hawaiian fishpond (Loko ʻia) model be used to create a modern solution to the problem of food security?

Big Ideas / Enduring Understandings:
- We can learn lessons from history and apply them to make better choices today
- Hawaiian fishponds naturally circulate water through engineering and changes in tide
- Development in Hawaii has not prioritized food security, which puts Hawaii at risk
- Working collaboratively and through iteration, we can come up with innovative solutions to complicated problems

Final Assessment:

Mini-assessment: Students create a scale-model ancient fishpond (loko ʻia) using a toddler toy wading pool and illustrate how ancient Hawaiian engineering and changing tides allow water to circulate.

Students, in groups of 3-6, use various materials to recreate a fishpond wall in a toddler toy wading pool. Following the directions in the Pacific American Foundation Grade 4 Aloha ʻAina curriculum, use a hose and food coloring to illustrate the ebb and flow of tides.

Final Assessment: Students create a conceptual engineer's schematic of a "modern fishpond", applying modern technology (aquaponics) and the ancient technology of water flow (from a mountain stream through a taro patch / lo'i kalo to the fishpond / loko i'a) to solve the problem of food sustainability in Hawaii.

> **Problem:** With only three days of food reserves in Hawaii, we need a way to produce and hold fresh more of our food. While it would be great to go back to the ancient Hawaiian methods of farming and aquaculture (fishponds) using flowing water, development has put a strain on our water resources and available space for agriculture and aquaculture land (farmland and shoreline space for fishponds).

How would you recreate the idea of the ancient Hawaiian fishpond today in your neighborhood? Apply ancient technologies of loko i'a and modern technologies of aquaponics to create your group's plan.

Students create a schematic that meets the criteria above in groups of four.
Step 1: Each student creates his or her own schematic
Step 2: Teacher runs a peer review process that has group members find a positive element of each team member's schematic and an element of the schematic that would need changing
Step 3: The team of 4 blends each of the individual schematic into one design integrating at least one element of each individual's design and showing how they have avoided or solved challenges identified in the individual schematics.
Step 4: Teacher gives feedback on draft 2 and group makes changes accordingly. Group attempts to take the schematic to scale and create an accurate key.
Step 5: Draft 3 is evaluated by a visiting expert (fishpond, aquaponics, or engineer) ideally from one of the field trips explained below. Feedback is given based on feasibility of solution, effective circulation and filtration of water, and ability to implement in their neighborhood's existing open area.
Step 6: Group creates draft 4 which is presented in the final ho'ike / symposium to an authentic audience (ideally experts from the community)

Lesson Plans:

Stage 1: Execute the Pacific American Foundation Grade 4 Aloha 'Aina curriculum (Ahupua'a) lessons 3 and 4 available on Ulukau.org (http://ulukau.org/gsdl2.81/cgi-bin/cbalohaaina4?l=en)
4-6 40 minute class periods.
Culminate in the mini assessment as described above.
Stage 2: Visit a Hawaiian fishpond and / or an aquaponics facility.
Fishpond suggestions:
Waikalua Loko (http://waikalualokofishpond.org)
Paepae o Hei'eia (http://paepaeoheeia.org)
Aquaponics facilities:
Mari's Garden: (http://www.marisgardens.com)
Discussion: What did we see that we already learned about? What new questions do we have after this field trip? Where can we look and whom can we ask to answer these questions? How can lessons from this field trip help us answer our Essential Question and solve our challenge?

Stage 3: What is the purpose of water circulation in the fishpond and the aquaponics? How can we test for this?

Examine dissolved oxygen, ph, and nitrate/nitrite in a fish tank. Test one tank with two fish and no filter/pump and one tank with two fish and a filter/pump. Test daily for 5 days and chart data on large paper in the room. Feed each tank the same, measured amount of food. Why is there a difference in these tests?

Stage 4: Examine the final assessment challenge. Take a real or virtual (Google Earth) tour of the neighborhood and look for areas where agriculture could take place. Is there undeveloped shoreline where a fishpond could be placed? Is there a freshwater source and is the water quality safe? How would we test this? Is there undeveloped land that could be farmed?
Address the final assessment challenge.