Understanding By Design – Backwards Design Process
(Developed by Grant Wiggins and Jay McTighe, 2002)

Stage 1 – Desired Results

Established Goal(s)/Content Standard(s):

Middle School	High School
MS-LS1-6: Construct a scientific explanation based on evidence for the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms.	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.
MS-LS2-1: Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.	HS-LS2-5: Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.
MS-LS2-3: Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.	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.
MS-LS2-4: Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.	HS-LS2-7: Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.
	HS-LS2-8: Evaluate evidence for the role of group behavior on individual and species' chances to survive and reproduce

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Understanding(s)	**Essential Question(s):**
Students will understand: ● Big Ideas/Concepts ○ Photosynthesis ○ Cellular Respiration ○ Biosphere, Atmosphere, Hydrosphere, Geosphere ○ Carbon Cycle ○ Biodiversity ○ Ahupuaʻa ● Specific Understandings ○ Inputs and outputs of photosynthesis ○ Inputs and outputs of cellular respiration ○ Exchange of carbon between organisms and environment ○ Factors that affect biodiversity ○ Relationships between species and the physical environment in an ecosystem ○ Structure, function, and purpose of ahupuaʻa land division ● Misunderstanding: ○ Environmental conditions on land do not have impacts on aquatic environments ○ Ahupuaʻa is an archaic land division system without practical applications today ○ Ahupuaʻa MUST run from mountain to ocean ○ All invasive species are bad	● What is an ahupuaʻa? ● What significant/functional features make up an ahupuaʻa? ● What is Kalaepōhaku's ahupuaʻa? ● What is your ahupuaʻa? ● What is the prominence of native species compared to invasive species in your/our ahupuaʻa? ● How has your/our ahupuaʻa changed as a result of changes in population and human development over time? ● What factors affect the quality of the water and inhabitants of an ahupuaʻa? ● Is your/our ahupuaʻa still capable of sustainability? ● What actions must we take to preserve ahupuaʻa ecosystems? ● Can ahupuaʻa ecosystems contribute to sustainable ways of living?

Student objectives (outcomes):
Students will be able to:

- Understand the importance of Native Hawaiian streams
- Identify common native and invasive animal and plant species
- Analyze the health of a stream ecosystem through kilo, data collection, and analysis
- Exhibit behavior that displays mindfulness of the conservation and protection of natural and cultural resources
- Conduct fish surveys by using traditional herding methods in conjunction with data collection tools
- Implement multiple gardening skills to contribute to a sustainable community

- Maintain ongoing data collection and make informed conclusions from data analysis
- Recognize the processes of photosynthesis, cellular respiration, the carbon cycle, and the water cycle as they occur within an ahupua‘a

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Stage 2 – Assessment Evidence

Performance Task(s):

- Performance Tasks
  - Labeled map of Oʻahu designating land divisions that are pertinent to where students live and learn
  - Develop a model of an ahupuaʻa that depicts the processes of photosynthesis, cellular respiration, carbon cycle, and water cycle as relevant throughout different sections of the ecosystem
  - Publish a digital portfolio to serve as a scientific field journal, personal biography, and distributable compilation of lab findings and reports

Other Evidence:

- Formative Assessment
  - Part 1
    - "No Hea Mai ʻOe?" Worksheet
    - Hawaiian Land Divisions Quiz (online)(print)
    - Digital Portfolio: My Ahupuaʻa
  - Part 2
    - Ahupuaʻa Diagrams
    - Digital Portfolio: Sustainable Land Division Reflection
  - Part 3
    - Household Acids and Bases Lab Activity
    - Digital Portfolio: Ocean Acidification NOAA Article Reflection
    - NOAA Understanding Ocean and Coastal Acidification Digital Lab Activity
    - NOAA Investigating Coral Bleaching Using Data in the Classroom Digital Activity
  - Part 4
    - Digital Portfolio: Garden Work, Data, and Reflections
    - Digital Portfolio: Pālolo Stream Fish Surveys, Native Organisms Field Guide, Data Analysis, and Reflections
  - Part 5
    - Digital Portfolio: Waiheʻe Tunnel Work, Data, and Reflections
    - Digital Portfolio: Heʻeia/Waikalua Work, Data, and Reflections
    - Digital Portfolio: Maunalua Work, Data, and Reflections
- Summative Assessment
  - Part 6
    - Ahupuaʻa Model
    - Digital Portfolio

Stage 3 – Learning Plan

Learning Activities:

- Part 1: No Hea Mai ʻOe? ~ Where Are You From?
  - Students learn the ahupuaʻa to which Kalaepōhaku (Saint Louis School) belongs
  - Students identify hometown
  - Students reference modern and historical maps/diagrams to determine the ahupuaʻa in which they reside (Map 1)
  - Students label mokupuni (island), moku (district), ahupuaʻa (watershed), and ʻili (town) on a map to recognize where they geographically reside and learn (Map 2)
  - Students complete Hawaiian Land Divisions Quiz (online)(print) to assess their understanding of the four levels of traditional land division
  - Students explore the Hawaiian knowledge (traditional names, winds, rains, stories, etc.) associated with their region of Oʻahu and compile this information in a digital portfolio (Place Names of Hawaiʻi) (Hānau ka Ua)
- Part 2: He Aha Ka Ahupuaʻa? ~ What is an Ahupuaʻa?
  - What is an Ahupuaʻa? (Additional Lesson Plan)
    - Students learn about the cultural, societal, and environmental importance of the ahupuaʻa system
    - Students develop informed opinions about land division criteria and what makes a community sustainable
    - Land Management
  - Students recognize the sections that make up an ahupuaʻa and the importance/contributions of each area to the function and stability of the entire ecosystem (Map 3)(Map 4)(Map 5)
  - Students document their thought processes about meaningful land divisions, the effectiveness of the ahupuaʻa as a sustainable ecosystem, and the current access to natural and manmade resources within boundaries of modern land divisions in their digital portfolio
- Part 3: E Hoʻokolohua ~ Experiment
  - Complete Household Acids and Bases Lab Activity to provide a soft introduction to the concepts of acidic and basic
  - NOAA Topic: Ocean Acidification
    - Respond to NOAA Ocean Acidification article
    - Complete Understanding Ocean and Coastal Acidification digital lab activity (Abbreviated Activity Worksheet)
  - NOAA Activity: Investigating Coral Bleaching Using Data in the Classroom
    - Complete digital lab activity to practice reading and interpreting data to develop informed conclusions about environmental conditions
  - Activity reflections posted to digital portfolio
- Part 4: E Aʻo I Waho ~ Learn Outside (On-Campus)
  - Students will explore and contribute to our on-campus garden and understand

the sustainability that comes from kula/mala sections of an ahupuaʻa
        - Plant new crops
        - Maintain existing crops
        - Harvest and distribute ripe crops
        - Compost campus-generated food waste
        - Log and monitor quantities of composted food waste
        - Identify native plants and their uses
        - Identify invasive and introduced plants and recognize their impact, whether positive or negative
    - Students will explore the stretch of Pālolo Stream that runs through our campus to understand the importance of the kahawai section of an ahupuaʻa (Native Hawaiian Stream Health and Biodiversity Survey)
        - Clear natural and manmade debris to maintain a clean and accessible stream
        - Log and monitor quantities of removed trash and debris
        - Conduct fish surveys and catalog identified species (ʻOʻopu Study)(FishBase)(DLNR Aquatic Invasive Species)(MarineBio)
        - Remove invasive species (Hawaii Invasive Species Council)
        - Document important/historical/cultural features at the stream
        - Collect field data for water pH, turbidity, dissolved oxygen, and temperature (Project Wet)
        - Interpret data to analyze aquatic conditions and determine impact on stream creatures
        - Compare water quality to upland and ocean samples
    - Activity reflections posted to digital portfolio
- Part 5: E Aʻo I Waho ~ Outdoor Learning (Off-Campus)
    - Students will explore an initial water source of an ahupuaʻa by journeying to Waiheʻe Valley, understanding the lewa section and beginning of the water cycle
        - Identify native plants and their uses (National Tropical Botanical Garden)(Bishop Museum)(Pacific Island Ecosystems at Risk)
        - Collect water samples to perform relevant water tests (pH, temperature, etc.) (Earth Force Low-Cost Estuary Kit)
        - Compare water quality to stream and ocean samples
    - Students will explore a functioning fishpond, such as Heʻeia or Waikalua, to learn about the role of loko iʻa in the ahupuaʻa, especially as it pertains to the water cycle and food security
        - Clear natural and manmade debris to maintain a clean fishpond
        - Conduct fish surveys and catalog identified species (ʻO'opu Study)(FishBase)(MarineBio)
        - Remove invasive species (DLNR Aquatic Invasive Species)
        - Collect field data for water pH, turbidity, dissolved oxygen, and temperature (Earth Force Low-Cost Estuary Kit)

        - Interpret data to analyze aquatic conditions and determine impact on sea creatures
        - Compare water quality to upland and stream samples
    - Students will explore a beach area, such as Maunalua Bay, to observe how kahakai is impacted by the environmental conditions of the upper sections of the ahupuaʻa
        - Conduct fish surveys and catalog identified species
        - Collect field data for water pH, turbidity, dissolved oxygen, and temperature
        - Interpret data to analyze aquatic conditions and determine impact on sea creatures
        - Compare water quality to upland and stream samples
    - Activity reflections posted to digital portfolio
- Part 6: E Hōʻike ~ Report
    - Students will develop a model which demonstrates the structures and functions of each region of an ahupuaʻa as well as depicting the processes of photosynthesis, cellular respiration, carbon cycle, and water cycle as they relate to the presence of relevant organisms and conditions at different sections of the ahupuaʻa
    - Students will publish a completed digital portfolio which showcases their personalized learning, work progress over time, compiled data, and determined conclusions (Digital Portfolio Example Template)