

Nature’s Design: Systems, Cycles, Patterns, Relationships, and Adaptations in the Garden System  
Theme 4: Grades 3–5

Strand	Topic	Learning Outcome	Garden Activities	Classroom Extensions	Common Core-ELA	Common Core-Math	NGSS	NHES
Food	The plant nutrient cycle (carbon cycle, nitrogen cycle, N-P-K, and minerals in plant growth)	Identify and understand which nutrients are important for plant growth (e.g., nitrogen for leafy growth, phosphorus for flowers and roots, etc.).  Recognize that composting recycles nature’s nutrients (greens are nitrogen and browns are carbon).  Identify nitrogen-fixing plants, observe physical characteristics and their role in the nitrogen cycle, bringing nitrogen from the air into the ground.  Provide examples of how healthy soil grows healthy plants which, when eaten, can lead to healthy people.	Discuss and draw a model of nutrient cycling.  Create signs and labels to place in the garden to mark carbon and nitrogen sources.  Disease detective: learn to identify nutrient deficiencies on plants by reading clues (e.g., yellowing leaves, spots on leaves, etc.).		3.RI.1 3.RI.2 3.RI.3  4.RI.1 4.RI.2 4.RI.3  5.RI.2 5.RI.3		3-LS1-1  4-LS1-1	
	The Soil Food Web: A complex living system of organisms in the soil and their interactions with each other, the environment, plants, and animals	Understand and explain that the Soil Food Web includes fungi, bacteria, and invertebrates (FBI).  Provide examples that FBI and the soil food web contribute to healthy soil and more nutritious food.	Explore FBI in soil: categorize, draw, look under microscope or magnifying lenses.		3-RI.1 3-RI.2 3-RI.3  4-RI.1 4-RI.2 4-RI.3  5-RI.2 5-RI.3		3-LS1-1	

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	Growing systems in Hawai'i: Indigenous, conventional, aquaponics, hydroponics, agroforestry, permaculture, organic gardening	<p>Compare and contrast properties and qualities of various food growing systems (e.g., yield, size, inputs, ecological impact, nutrition profile, etc.).</p> <p>Identify canoe-crop growing systems and experiment with growing those crops in other systems (e.g., aquaponics).</p>	Grow food crop in two to four different systems; compare and contrast properties and qualities (e.g., yield, size, inputs, ecological impact, nutrition profile, etc.).		<p>3-RI.1 3-RI.2 3-RI.3</p> <p>4-RI.1 4-RI.2 4-RI.3</p> <p>5-RI.2 5-RI.3</p>		<p>3-LS1-1 3-SR-3</p>	
Energy and Matter	Energy cycles in the garden system	<p>Understand and explain the transfer of energy from sun to plants to animals.</p> <p>Identify in the garden examples of energy transfer and flow.</p>	Make observations of plants and animals in the garden; compare survival needs and relationships.	Create a model to illustrate and be able to explain photosynthesis and compare and contrast to animal respiration.	<p>3-RI.1 3-RI.2 3-RI.3</p> <p>4-RI.1 4-RI.2 4-RI.3</p> <p>5-RI.2 5-RI.3</p>		<p>3-LS1-1</p> <p>4-PS3-2 4-PS3-4 4-ESSE-1</p>	
	<p>The Food Web: Trophic levels and proportional relationships of producers to consumers, carrying capacity, and population equilibrium</p> <p>Relationship between producers and consumers and effect on habitat</p>	<p>Identify producers and consumers in the garden, including humans.</p> <p>Investigate the relationship between producers and consumers: which population has more, how do they affect the garden systems, when are the populations out of balance and in balance.</p> <p>Provide examples from the garden,</p>	Make observations of plants and animals and their role as producer and consumer.		<p>3-RI.1 3-RI.2 3-RI.3</p> <p>4-RI.1 4-RI.2 4-RI.3</p> <p>5-RI.2 5-RI.3</p>		<p>3-LS1-1</p> <p>4-PS3-2 4-ESSE-1</p>	

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		including the soil food web, energy transfer through the trophic levels.						
	Forms and transformation of energy  Conservation of energy (potential, kinetic-thermal, and chemical)	In the garden, identify examples of energy types: kinetic, potential (e.g., water-storage tank), thermal (, sun), chemical (, sugar in fruits).  Observe in the garden to provide evidence that energy can be transferred by light and heat (e.g., sun - corn - cooking - human).	Conduct a garden energy identification walk.  Experiment with moving water in the garden using pipes, bamboo, buckets. Identify how energy is transformed as the water moves.  Discuss energy transfer after eating lunch or a garden snack.	Design and develop a device or tool that converts energy from one form to another (e.g., solar oven, wind turbine, water turbine).	3.RI.1 3.RI.2 3.RI.3  4.RI.1 4.RI.2 4.RI.3  5.RI.2 5.RI.3		3-LS1-1  4-PS3-2 4-PS3-4 4-ESSE-1	
	Chemical and physical changes in the garden system and classroom kitchen	Observe and identify that some changes caused by heating and cooling can be reversed and some cannot.  Identify the physical changes (e.g., texture, color) that occur with varying cooking times.  Identify the chemical changes (e.g., taste of the same ingredient), during different stages of fermentation.	Observe and discuss changes in the food before and after processing. Compare and contrast texture, color, taste, smell.		3-RI.1 3-RI.2 3-RI.3  4-RI.1 4-RI.2 4-RI.3  5-RI.2 5-RI.3		3-LS1-1  4-PS3-2 4-ESSE-1	
	Fossil fuels and renewable energy: Inputs, outputs, and the transformation of energy	Identify renewable energy resources in the garden, school, home, or community.		Discussion topic examples: Compare a tractor, a rototiller, and a garden fork to cultivate a garden bed; use of a solar pump				

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		Compare and contrast one renewable energy resource with fossils fuels. Evaluate impact on environment and human labor to build and maintain.		vs. an electric pump for a hydroponic system.				
Water	<p>The water cycle and its interrelationship with weather and climate</p> <p>The properties of water</p>	<p>Understand and explain the water cycle know the terms precipitation, condensation, and evaporation.</p> <p>Understand that all the water we have now is the same water since the Earth was formed.</p>	<p>Label all parts of the water cycle.</p> <p>Illustrate how weather cycles impact the water cycle.</p> <p>Identify on a map a local watershed, including drinking water source and wastewater treatment systems. Have a class discussion.</p>		<p>3-RI.1 3-RI.2 3-RI.3</p> <p>4-RI.1 4-RI.2 4-RI.3</p> <p>5-RI.2 5-RI.3</p>		<p>3-LS1-1</p> <p>4-ESS2-1</p> <p>5-ESS2-2</p>	
	Recognize the action of water in living systems	<p>Provide examples for water as diluter, solvent, transporter, insulator, diffuser (water in any of its forms).</p> <p>Make observations and measurement to provide evidence of the rate of erosion by water.</p>	<p>Make compost tea. Students observe how the color shade of the tea gets lighter and lighter the more water you add (diluter, transporter).</p> <p>Experiment with putting worm castings directly into the soil versus making tea (transporter, diffuser).</p>		<p>3-RI.1 3-RI.2 3-RI.3</p> <p>4-RI.1 4-RI.2 4-RI.3</p> <p>5-RI.2 5-RI.3</p>		<p>3-LS1-1</p> <p>5-ESS2-2</p> <p>5-ESS3-1</p>	
	<p>The hydrology of Hawai'i Island</p> <p>Drinking water for Hawai'i Island</p>	<p>Recognize the unique features of the hydrology of Hawai'i as presented in place-based stories.</p> <p>Identify drinking water sources for school and home.</p>	<p>Identify on a map a local watershed, including drinking water source and wastewater treatment systems. Have a class discussion.</p> <p>Conduct tests on irrigation water or</p>		<p>3-RI.1 3-RI.2 3-RI.3</p> <p>4-RI.1 4-RI.2 4-RI.3</p> <p>5-RI.2 5-RI.3</p>		<p>3-LS1-1</p> <p>3-ESS2-1</p> <p>4-ESS2-1</p> <p>5-ESS2-2</p>	

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			stream water for pH, nitrogen, phosphate, and salinity.					
	Water storage, sources, and management	<p>Identify water systems in the garden.</p> <p>Understand school garden water systems as identified with public water systems.</p> <p>Eliminate standing water as vector for disease.</p>	<p>Create a water usage or best practices plan for the garden.</p> <p>Design an irrigation system.</p>		<p>3-LS1-1 3-RI.1 3-RI.2 3-RI.3</p> <p>4-RI.1 4-RI.2 4-RI.3</p> <p>5-RI.2 5-RI.3</p>		<p>3-ESS2-1</p> <p>5-ESS3-1</p>	
Natural Resource Management and Conservation	Water conservation and management	<p>Make observations and measurement of water use to support the argument for water conservation.</p>	<p>Explore various types of wastewater on campus, including garden greywater.</p> <p>Design as system to use garden greywater.</p>		<p>3-RI.1 3-RI.2 3-RI.3</p> <p>4-RI.1 4-RI.2 4-RI.3</p> <p>5-RI.2 5-RI.3</p>		<p>3-LS1-1</p> <p>5-ESS3-1</p>	
	Local sources of organic nutrients for soil fertility	<p>Understand organic materials as an output and input for other organisms.</p> <p>Identify discarded materials from human systems and sort into organic and inorganic materials. Sort organic materials into green and brown layers. Integrate into compost systems.</p> <p>Identify that healthy disposal of discarded materials from human systems depends on</p>	<p>Create a compost pile using paper and prunings (layering brown and green waste).</p>		<p>3-LS1-1 3-RI.1 3-RI.2 3-RI.3</p> <p>4-RI.1 4-RI.2 4-RI.3</p> <p>5-RI.2 5-RI.3</p>		<p>5-LS2-1</p> <p>5-PS1-4</p>	

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		worms and other organisms that recycle matter and natural materials.  Identify byproducts from food growing, production, transportation, and consumption.						
	Recycling, upcycling, and downcycling of inorganic materials	Identify uses of discarded materials from human systems. Identify human discards that could be composted, recycled, or reused.  Understand that “waste” is made of natural resources. Identify how “waste” can be a useful material.  Understand and incorporate 4R’s into daily life.	Explore using a composting toilet on campus.  Audit of discarded materials in the classroom trash.  Make recycling signs for campus recycling center. Set-up recycling center for garden area.  Read Hawai’i Recycling Guide. Take copy home and discuss.		3-RI.1 3-RI.2 3-RI.3  4-RI.1 4-RI.2 4-RI.3  5-RI.2 5-RI.3		3-LS1-1  5-LS2-1 5-PS1-4	
	Components of air quality	Identify human activities that produce air pollution.  Describe natural systems that increase air quality.	Talk about cigarette smoking as air pollution, and potential for water and soil pollution.  Identify photosynthesis as nature’s air-quality filter.					
	Carbon footprint and carbon sequestration	Obtain and combine information about the carbon footprint of personal and family activities.  Identify how to offset the footprint through	Identify carbon sources in the garden. Compare and contrast with carbon sources in the classroom and/or home.  Discuss how to recycle					

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Comment [1]: Complete standards?

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Comment [2]: Standards?

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		garden activities (e.g., composting, planting trees/carbon sequestration).	these carbon sources (e.g., composting, artwork, etc.).					
	Sources and impacts (air water and soil) of clean energy in the community	Identify systems that produce clean energy.  Identify that human energy consumption impacts air, water, and soil quality.	Describe solar, wind, and methane gas collection as clean energy sources. Identify and describe how petroleum gas causes air pollution.					
Best Conservation Practices	The individual's role in the conservation of natural resources	Identify human activities that consume or pollute natural resources. Identify human activities that restore, preserve, and/or protect natural resources.	Identify plastic-bag pollution and its effect on birds, ecosystems, and marine life. Discuss Hawai'i as the first state to ban plastic bags. Pick up litter on campus.					
	Conservation is a set of practices that preserve, restore, and protect natural resources and ecosystems	Identify and participate in local historical, cultural, and/or archaeological conservation practices.  Identify and participate in non-regional historical, cultural, and/or environmental conservation practices.	Examine ahupua'a map. Discuss the use of ahupua'a names in everyday language. Connect use of ahupua'a names to conservation practice.					

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Comment [4]: Standards

Resources: Groundwater - USGS Ground Water in Hawai'i