The Living Soil, The Living Plant: We Are All Interconnected and Related
Theme 2: Curriculum Map—Grades 6-8

Strand	Topic	Learning Outcome	Garden Activities	Classroom Extensions	Common Core- ELA	Common Core-Math	NGSS	NHES
Science of Living Soil	Describe characteristics and components of living soil	Compare and contrast the abiotic and biotic factors of the soil and how they relate to other systems. Recognize and classify sand, silt, clay, and loam. Understand proportional relationships between soil components.	Using a quadrat, hand lens, and/or magiscope describe and draw soils from different areas. Make qualitative and quantitative observations. Soil percolation and absorption test to analyze porosity and components of soil. Use a soil test kit to analyze basic soil chemistry- nitrogen, phosphorus, potassium, pH and determine what amendments to put in the area to create optimal soil health. Analyze soils using the clump test. Construct loamy soil necessary for optimum plant growth. *See Appendix: http://www.sde.ct.gov/sde/lib/sde/pdf/curriculum/science/Gr6_Task_Student.pdf http://nosprayhawaii.com/education/how-to/soil-structure-test/	Percolation and absorption tests. Use technology to research soil maps of the island. Create a pie graph to represent soil components. Research soil components: clay, silt, sand, humus.	CCSS SL.1 SL.4 L.3 L.4 L.5.c L.6,	6.RP.A.1 6.RP.A.3.C 7.RP.A.2.A 7.RP.A.2.B 7.RP.A.2.C 7.RP.A.2.D 7.RP.A.3	MS-LS2-3 MS-ESS2-1	

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	Identify organisms in the soil and observe their functions	Cite specific evidence for how microbes affect plant growth and overall soil health.	Design an experiment to compare plants grown in sterilized soil and compost enriched soil. Apply media rich in microorganisms such as worm castings or EM Bokashi to garden beds and observe plants' response. Collect and culture microbe samples using an agar petri dish. Using a microscope, analyze growth to distinguish between "threads" (mycelium) of fungus and the circular "clumps" (colonies) of bacteria. Construct a Berlese funnel to identify macroorganisms in the soil. See Appendix: *NRCS Soil Biology Primer* Agar plate prep: http://www.sciencestuff.com/nav/instructions/agar1.htm Berlese funnel: http://www.carolina.com/teacher-resources/Interactive/constructing-berlese-funnels-study-invertebrate-density-biodiversity/tr19101.tr	Culture compost samples on agar plates and view underneath microscopes. Distinguish between bacterial and fungal populations.	CCSS: SL.1, SL.4, L.3, L.4, L.5.c, L.6	6.EE.C.9 6.SP.A.1 6.SP.B.5.A 7.SP.A.1 8.SP.A.1 8.SP.A.2 8.SP.A.3 8.SP.A.4	MS-LS2-4	

Strand	Topic	Learning Outcome	Garden Activities	Classroom Extensions	Common Core- ELA	Common Core-Math	NGSS	NHES
	Explain how soils are created and erode	Summarize how parent material of soil (rock) is transformed through the process of weathering. Categorize the organic components of soil.	Compare and contrast the layers in soil horizons in different areas of the garden. Measure the layers. Use quadrats to carefully observe the topsoil and identify its components, record data. Identify an area of erosion. Measure the length, width, and depth of the area and calculate the volume of topsoil lost. Design, implement and test a solution to prevent erosion. Monitor intervention over time to evaluate efficacy	Using actual soil components (organic matter, rock, etc.) design a visual representation of a soil horizon, with particular attention to color and scaled particle size. Using the data from the quadrat activity above, create a graph using a computer program and analyze the results. Using actual soil components (organic matter, rock, etc.) create a visual representation of a soil horizon, with particular attention to color and scaled particle size.		6.G.A.2 7.G.B.6 8.G.C.9	MS-ESS2-1 MS-LS2-3	
	Understand how different soil mixtures serve different functions	Synthesize nursery medium using proportional relationships of materials.	Mix local soil amendments (using what you have) such as crushed coral, worm castings, etc. to compost or potting soil to make nutrient rich soil. Use the amended soil, the straight compost and/or the potting mix to start seeds and/or to grow the plant to transplant size. Collect the data. Compare and contrast the data. Transplant seedlings and add necessary amendments.			6.RP.A.1 6.RP.A.2 6.RP.A.3.A 6.RP.A.3.C 6.RP.A.3.D 7.RP.A.1 7.RP.A.2.A 7.RP.A.2.B 7.RP.A.2.C 7.RP.A.2.D 7.RP.A.3		

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			Construct a healthy growing environment for seedlings and plants. Prepare and amend garden beds for planting crops. Prepare and amend areas for planting perennials such as fruit trees. Compare and contrast practices for preparing soils for annuals vs. perennials.					
	Know and describe the roles of oxygen, carbon, and nutrient cycling in the soil	Understand that aerating the soil and incorporating organic material impacts plant growth.	Students build anaerobic (without oxygen) and aerobic (with oxygen) compost systems, collect temperature data, and observe change over time, using visual and olfactory cues. Compare and contrast compost piles using different ratios of carbon and nitrogen, moisture, etc. Gently aerate garden beds to add oxygen for the health of fungus, bacteria and insects. Add water, carbon, and nitrogen (stable organic material) to improve plant health and support micro and macroorganisms.			6.EE.C.9 8.SP.A.1 8.SP.A.2 8.SP.A.3http://www.corestandards.org/Math/Content/8/SP/ - CCSS.Math.Content.8.SP.A.4 8.SP.A.4	MS-LS2-3 MS-LS2-4	

Strand	Topic	Learning Outcome	Garden Activities	Classroom Extensions	Common Core- ELA	Common Core-Math	NGSS	NHES
Science of Living Plants	Explain the relationship between weeds and soil	Classify weed versus non-weed in specific environments and how weeds can be a garden resource.	Conduct a weed identification walk to learn the names of common garden weeds. Use weeds as resources for compost nitrogen enrichment. Recognize and identify noxious weeds in the garden that would contaminate compost (weed seeds). Design and test strategies for managing noxious weeds in your garden.				MS-LS2-2 MS-LS4-2	
	Describe the life cycle of a plant from seed to seed; understand structure and function of plant parts	Identify and name plants based on their characteristics. Recognize and identify which life cycle stage the plant is in based on its structures, and save seed.	Categorize seeds and plants into monocots and dicots. Participate in seed saving by selecting parent plant, and stating specific argument for selection. Compare and contrast plant adaptations and methods of seed dispersal. Identify the 6 plant parts (roots, stems leaves, flowers, fruits and seeds) and the role they play in plant growth and reproduction. Identify reproductive parts of plants. Explain the reproductive cycle of plants.	Conduct a seed exchange	CCSS SL.4 L.1.a L.3, L.4, L.5.c, L.6		MS-LS1-4 MS-LS1-5	

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	Understand and explain photosynthesis	Categorize the inputs and outputs of photosynthesis.	Recognize seasonality in the garden and how it affects the plant's ability to photosynthesize. Design an experiment to demonstrate the effect different quantities of light have on the growth and development of seedlings. Set up and observe transpiration bags. Measure the volume of water collected from different plants and correlate to surface area of a leaf. * See Appendix: Chlorophyll Extraction http://www.scienceprojectlab.com/easy-science-project-chlorophyll.html Chromatography: http://www.nsta.org/publications/news/story.aspx?id=49085	View the leaf of a plant through a microscope and identify cell organelles and structures that contribute to photosynthesis, such as chloroplasts, stomata. Chlorophyll extraction and chromatography. Write the molecular formula for photosynthesis and demonstrate the conservation of matter. Design an experiment to demonstrate the effect different quantities of light have on the growth and development of seedlings.		6.EE.C.9 6.G.A.1 6.G.A.2 6.G.A.3 6.G.A.4 7.G.B.6 8.SP.A.1 8.SP.A.2 8.SP.A.3http://www.corestandards.org/Math/Content/8/SP/ - CCSS.Math.Content.8.SP.A.4 8.SP.A.4	MS-PS1-5 MS-LS1-6	
	Understand how to propagate and grow plants	Design optimal conditions for germinating and growing plants.	Read a seed packet and apply information to practices. Design and conduct an experiment about resource availability (water, sun, nutrients, etc.) and its effect on the germination rate of seeds (sexual reproduction). Design and conduct an experiment about	Create a graph of your data. Put together a scientific paper to communicate your findings. .	CCSS RI.4	6.EE.C.9 7.SP.A.1 7.SP.A.2 7.SP.B.3 7.SP.B.4 8.SP.A.1 8.SP.A.2 8.SP.A.3http://www.corestandards.org/Math/Content/8/SP/ - CCSS.Math.Content.8.SP.A.4 8.SP.A.4	MS-LS2-1	

Strand	Topic	Learning Outcome	Garden Activities	Classroom Extensions	Common Core- ELA	Common Core-Math	NGSS	NHES
			resource availability (water, sun, nutrients, etc.) and its effect on the growth rate of cuttings (asexual propagation). Propagate a variety of plants using different methods, such as: seeds, vegetative (asexual) propagation, grafting, and air layering.					
	Recognize and distinguish between Polynesian-introduced, endemic, and indigenous plants	Identify a minimum of five of each: Polynesian introduced, indigenous, and endemic plants	Conduct a guided garden walk; identify introduced, endemic and indigenous plants. Plant and propagate Polynesian introduced, indigenous and endemic plants in the garden. Harvest and prepare native plants for a craft, cordage, food, medicine or beverage (e.g.,, kapa, lei, etc.).		CCSS L.1.a, L.3, L.4, L.5.c, L.6		MS-LS4-2 MS-LS4-4	
	Understand inheritance, genetic variation, and diversity in plants	Investigate the different methods of plant propagation (seeds, cuttings, air layering, etc.).	Sort, classify, and count different traits among multiple varieties within a particular plant species (e.g.,, beans, or lettuce, or tomatoes). Discuss how and why the variation happens. Develop testable questions from these observations?			6.SP.A.1	MS-LS3-2	

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			Compare color, leaf shape, and taste of different kalo (taro) and/or ‘ulua (sweet potato) varieties. Identify examples of genetic variation in the garden (e.g., pigeon pea, corn). Propagate plants asexually and sexually.					
Science of Soil Fertility	Understand, build, maintain, and use compost systems	Construct and maintain healthy compost systems and apply to the garden (e.g., vermiculture, aerobic, anaerobic).	Using proper ratios of nitrogen to carbon and water to air, build an aerobic compost pile. Observe a compost pile. Turn and record moisture, temperature and pH changes over time. Use a compost log to record data. Determine when a compost pile is finished and ready for use (i.e., temperature is stable, abundance of macro-and microorganisms) Use compost in the garden. Estimate, using buckets, the volume of compost and/or mulch added to soil. Build and tend a classroom or garden worm bin.	Create a graph of your data. Put together a scientific paper to communicate your findings.	CCSS W.10	6.RP.A.1 6.RP.A.2 6.RP.A.3.A 6.RP.A.3.C 6.RP.A.3.D 7.RP.A.1 6.G.A.1 6.G.A.2 7.G.B.4 7.G.B.6 8.G.C.9	MS-LS2-3 MS-LS2-5	

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			* See Appendix: Composting: http://www3.epa.gov/climatechange/wycd/waste/downloads/composting-chapter10-28-10.pdf					
	Investigate, analyze and apply natural soil fertility systems	Recognize and integrate soil fertility systems for optimal plant growth. Know how to apply amendments in growing cycles.	Sift finished compost and make observations. Sort vermicast from red wigglers and/or Indian blue worms Use ratios to make correct dilutions of worm/compost teas, ash, etc. as a soil amendment. Use compost and amendments as a part of bed prep. Mulch on and between beds to conserve water and prevent weeds.	Create and share recipes and dilutions for natural fertilizers.		6.RP.A.1 6.RP.A.2 6.RP.A.3.A 6.RP.A.3.C 6.RP.A.3.D 7.RP.A.1	MS-LS2-5	
	Understand decomposition	Observe decaying organic matter and explain its role within the garden ecosystem.	Build and maintain a compost system to demonstrate the cycling of matter and apply to the garden. Measure the change in volume of a compost pile over time. Measure the temperature changes in a compost pile over time.	Graph the changes in volume and temperature of a compost pile and determine if there is a relationship. Create a decomposition timeline using organic and inorganic items found in the garden and on school campus. Display in the garden		7.G.B.6 8.F.B.5 8.G.C.9	MS-LS2-3	

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			Collect and culture microbe samples using an agar petri dish. Using a microscope, analyze growth to distinguish between “threads” (mycelium) of fungus and the circular “clumps” (colonies) of bacteria. Construct a Berlese funnel to identify macroorganisms in the soil. * See Appendix: NRCS Soil Biology Primer, Decomposition Timeline Agar plate prep: http://www.sciencestuff.com/nav/instructions/agar1.htm Berlese funnel: http://www.carolina.com/teacher-resources/Interactive/constructing-berlese-funnels-study-invertebrate-density-biodiversity/tr19101.tr					
Biodiversity and interdependent relationships	Understand and describe how weather shapes the earth and affects soil and plants	Understand the importance of topsoil and its necessity to life on the planet. Understand the adverse affect soil erosion has on biodiversity. Appreciate the effects of plants and weather on soil erosion.	Earth as an Apple topsoil model * See Appendix http://www.iupui.edu/~ghw/lessons/materials/EarthAppleFarmlandNov02.pdf Create a decomposition timeline using organic and inorganic items found	Using primary and secondary sources, investigate what happened to soils during the rise of sugar cane plantations in Hawai‘i.		CCSS 6.NS.1	MS-ESS2-1	

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			in the garden and on school campus. Display in the garden Identify areas in the garden that model the effects of water and wind on areas of soil with and without plants. Compare and contrast.					
	Identify the roles that beneficial insects and pests play in the garden	Know the basic tenets of Integrated Pest Management and the importance of pollinators. Recognize the role fungus, bacteria, and insects play in the decomposition process.	Practice Integrated Pest Management to maintain maximum biodiversity in the garden ecosystem. Identify evidence of pests in the garden (ex: holes in leaves, egg, etc.), and determine which organisms are responsible. Using a field guide, investigate the life cycle of the pest, and use this information to experiment with methods of control (e.g., cabbage moth, little fire ant). * See Appendix for *Field Guide* Identify garden pollinators and beneficial insects and their host plants. Propagate, plant and maintain these “host” plants in the garden. Use a quadrat, measure and record abundance and diversity of insects on				MS-LS2-2	

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			“host” plants vs. grass or path. Build and apply healthy compost to garden beds.					
	Demonstrate understanding of the interrelationships among soil, plants, animals, and humans	Know the role insects play as pollinators for food crops. Recognize the interrelationship between insects, plants and other factors in the garden. Appraise the impacts of pesticide, herbicide, and commercial fertilizer use.	Practice Integrated Pest Management to maintain maximum biodiversity in the garden ecosystem. Use techniques such as companion planting, and planting for beneficial insects to increase the biodiversity of the garden. Recognize plant stages and link to diversity of living organisms in the garden. Identify trophic levels within the garden ecosystem. (sun/soil/water/air - producers(plant) - primary consumers (herbivore) - secondary consumers/ tertiary consumer (omnivore/carnivore) Play Web of Life game. *See Appendix: http://www.amnh.org/ology/features/stufftodo_bio/weboflife.php				MS-LS2-2	

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			Food Web: http://scienceclassyr10.wikispaces.com/file/view/Garden_Food_Web.jpg/216568952/798x564/Garden_Food_Web.jpg					
	Explain the importance of biodiversity to create resilience in the garden environment	Identify the components of a biodiverse system and recognize that a diverse gene pool is critical to survival and resilience.	Compare and contrast transgenic, hybrid, and open pollinated crops. Apply principles of seed saving to maintain biodiversity in your garden. Compare a monocrop to the diverse environment in a garden. * See Appendix: http://docs.rwu.edu/cgi/viewcontent.cgi?article=1080&context=fcas_fp	Adapt the web of life game: Play 2 times: #1 Use very limited garden population (5-7 kinds of players 1 tree, 1 leaf crop, 1 insect, 1 bird, 1 mammal, 1 soil microbe etc.) and play game. Be sure each player has played at least two times. End game by eliminating one of the kinds of players (they drop their string). Look at how it impacts the web between you. #2 Play again using a much more diverse garden population (use real examples from your garden). Be sure each player has played at least two times. End game by eliminating one of the kinds of players (they drop their string). Look at how it impacts the web between you. Compare and contrast resilience of the two systems. Analyze arguments for and against GMO (transgenic) crops.	CCSLA: L.3 L.4 L.5 L.6 RI.1 RI.2 RI.4		MS-LS2-4	

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				Use scientific evidence to support your claim for how GMO crops affect biodiversity. Research the Great Famine of Ireland and consider implications for your community. Research the effects of invasive species (Christmas Berry, Kahili Ginger) on the native Hawaiian ecosystem.				
Science of Best Garden Practices	Know how to prepare different planting areas for a variety of plant types	Prepare a hole for tree planting. Use the soil profile to model positive and negative integers when planting a tree on a vertical axis with ground level being zero. Know how to prepare a planting bed: cultivate, amend, aerate and shape . Transplant crops into a prepared garden bed using best practices (depth, root handling, time of day, and appropriate amounts of water.) Read and follow directions on a seed packet. Demonstrate knowledge of vocabulary and	Prepare a hole for tree planting: amend, aerate and shape (correct size, kinds and proportions of amendments to be added). Plant a tree using the correct methodology. Prepare a planting bed: cultivate, amend, aerate and shape. Transplant crops into a prepared garden bed using best practices (depth, root handling, time of day, and appropriate amounts of water.) Read and follow directions on a seed packet. Demonstrate knowledge of vocabulary and concepts by planting seeds into a prepared		CCSS 6.NS.5 7.NS.1		MS-LS2-5	

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		concepts by planting seeds into a prepared garden bed at correct depth and spacing. Design an experiment to compare and contrast till/no till and or monocrop/diversified crop planting and evaluate the results.	garden bed at correct depth and spacing. Design and conduct an experiment to compare and contrast till/no till and or monocrop/diversified crop planting and evaluate the results.					
	Demonstrate garden safety with tools, equipment, water systems, and protocol	Students demonstrate proper use of garden tools. Students know names and uses for common garden tools. Students use tools safely and correctly. Students maintain tools correctly.	Teacher and students model and demonstrate proper and improper use of garden tools. Clean tools before storing. Match tool to storage space. Handle tools correctly and safely. Practice cleaning and putting tools away properly. Sand all wooden handles at least once a year. Ensure that there is no standing water in containers, or plants, to reduce mosquito larvae. Develop and practice safety protocol (e.g., tsunami drills, fire drills, containment drills.	Design a rubric and conduct peer evaluation for care and storage of tools.				

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