

The Living Soil, The Living Plant: We Are All Interconnected and Related  
Theme 2: Grades 3–5

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	Investigate and identify general components of living soil.	<p>Observe a compost pile and identify moisture level, temperature, (brown) carbon to nitrogen (green) ratio.</p> <p>Sort, classify and identify different soils in different garden beds – soil particle size, soil component: clay, silt, loam.</p> <p>Shake jar test – soil column.</p> <p>Form soil into balls, ribbons, snakes, etc. to understand soil components, texture, and properties.</p> <p>Introduce basic soil chemistry – use soil test kit to analyze nitrogen, phosphorus, potassium (K), pH using soil test kit or Vernier probes.</p> <p>Discuss that there are minerals in the soil and how plants show if there is a deficiency (lack) of the mineral, e.g., iron-deficient plants have younger leaves yellowing, calcium deficiency – blossom end rot, etc.</p>		NA	3 NF.A.1	4 ESS1.1	

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	Identify organisms in the soil and observe their functions	Understand the role fungi, bacteria, and invertebrates (FBI) play as decomposers and recyclers of nutrients.	<p>Observe compost pile and identify living (biotic) and non-living (abiotic) factors, observe compost pile over time, identify presence of living organisms throughout the compost cycle.</p> <p>Sift finished compost (or garden soil) and identify shredders, predators, fungi, and make observations using a hand lens.</p> <p>Show videos of Banana Slug String Band.</p> <p>Using visuals such as a field guide or video to analyze the relationship of structure to function in soil organisms, e.g., mandibles – shredding leaves, burrowing in soil opens soils for oxygen, etc.</p> <p>Draw, act, sing, or play a guessing game about the structure and function.</p>		<p>3 SL. 4</p> <p>4 SL. 4</p> <p>5 SL. 4</p>	NA	5-LS2-1	
	Explain how soils are created and erode	<p>Understand that weather, geologic forces, and human activity create different soil types, weathering, and erosion.</p> <p>Analyze and classify various soil types in Hawai'i.</p>	<p>Create a shake jar test (soil column) and identify components of soil (e.g., rocks, clay, sand, silt, humus). Observe and identify signs of erosion caused by water or wind in the garden.</p>		<p>3 SL. 4</p> <p>4 SL. 4</p> <p>5 SL. 4</p>	NA	<p>4-ESS2-1</p> <p>5-LS2-1</p>	

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			<p>Use quadrats to compare and contrast a compost pile in the garden with a decomposing area in a forest, woods, beach, etc.</p> <p>Design a model to demonstrate a solution to erosion.</p> <p>Ahupua'a field trip to identify signs of erosion and weathering; identify composting in nature.</p> <p>Write a legend or story about the origin of Hawai'i's soil</p>					
	Understand how different soil mixtures serve different functions	Understand components of healthy soil for use in plant propagation.	<p>Mix local (using what you have) soil amendments such as crushed coral, worm castings, etc. to compost or potting soil to make nutrient-rich soil.</p> <p>Use the amended soil, the straight compost, and/or the potting mix to start seeds and/or to grow the plant to transplant size.</p> <p>Collect the data. Compare and contrast the data.</p> <p>Transplant seedlings and add necessary amendments.</p> <p>Compare soil needs and practices for planting vegetables</p>		<p>3 RI. 1</p> <p>4 RI. 1</p> <p>5 RI. 1</p>	3.MD.B.4	3-LS-4-2	

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			(annuals) vs. trees (perennials).  Create a soil recipe book of soil mixtures for school and home gardening.					
	Know and describe the roles of oxygen, carbon, and nutrient cycling in the soil	Make observations about oxygen and carbon in healthy soil.  Be able to prove the presence of oxygen and carbon in healthy soil.  Compare carbon and oxygen levels in various soil types.	Students build, maintain, employ aerobic (with oxygen) compost systems and identify browns (carbon) and greens (nitrogen) sources.  Collect data on temperature and moisture level. Use the senses (smell, sight) to observe the changes over time.  Identify humus in a shake jar test (soil column). Identify bubbles in shake jar test (soil column) as evidence of oxygen in soil.		3 RI. 1 4 RI. 1 5 RI. 1	3.MD.B.3	5-LS1-1	
	Explain the relationship between weeds and soil	Identify and employ various soil-building strategies such as mulching and cover cropping.	Conduct a weed identification walk to learn the names of common garden weeds.  Set up a cover crop prior to summer break to restore nutrients and as a method of weed prevention.  Find weeds (volunteer plants) in the garden		3 RF.3.3 4 RF.4.3 5 RF.5.3	NA	3-LS4-3	

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			and observe their impact, role, and function (e.g., how weeds are impacting plants next to them or preventing erosion).					
Science of Living Plants	<p>Describe the life cycle of a plant from seed to seed</p> <p>Understand structure and function of plant parts</p>	Predict and perform seed germination, seed collection, and seed saving.	<p>Grow a plant from seed to seed, observe, measure, and record/graph growth.</p> <p>Design and conduct an experiment about seed germination in different conditions.</p> <p>Identify the six plant parts (roots, stems, leaves, flowers, fruits, and seeds) and the role they play in plant growth and reproduction.</p> <p>Harvest a variety of seeds and compare structure and function.</p> <p>Conduct a seed exchange.</p> <p>Journal the life cycle of a plant, identifying plant parts and structures.</p> <p>Grow ipu (gourd) or pumpkin. Identify male and female aspects of reproductive parts.</p> <p>Plan and plant a Three Sisters Garden.</p> <p>Dissect a bean seed. Identify various parts</p>		<p>3.SL.3.4</p> <p>3.SL.3.6</p> <p>4.SL.4.4</p> <p>5.SL.5.4</p>	3.MD.B.3	<p>4LS1-1</p> <p>3LS1-1</p>	

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			of the seed.					
	Understand and explain photosynthesis	Describe and summarize photosynthesis.	<p>Cover up part of a leaf (or plant part) to prevent sunlight; observe what happens.</p> <p>Conduct a seed-germination experiment in light vs. dark; make predictions about the needs of sunlight during germination.</p> <p>Draw a picture or create a model to explain photosynthesis.</p> <p>Conduct a play about photosynthesis.</p> <p>Introduce chlorophyll.</p>		<p>3.SL.3.4</p> <p>4.SL.4.4</p> <p>5.SL.5.4</p>	NA	5-LS1-1	
	Understand how to propagate and grow plants	Classify plants based on their propagation strategies and apply propagation strategies to a variety of plants.	<p>Read a seed packet and apply information to practices.</p> <p>Propagate a variety of plants using different methods, such as: seeds, vegetative (asexual) propagation, grafting, air layering.</p> <p>Observe how different plants in the garden or nature reproduce.</p> <p>Identify and discuss how plants have adapted to conditions by utilizing appropriate propagation strategies. Identify propagation</p>		<p>3 RI.3.1</p> <p>4 RI.4.1</p> <p>5 RI.5.1</p>	NA	<p>3-LS1-1</p> <p>3-LS4-3</p> <p>3-LS4-4</p> <p>4-LS1-1</p>	

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			<p>structures exhibited by plants under various conditions (e.g., stress induces flower/seed production; ‘uala stem in contact with soil and water will produce roots).</p> <p>Prepare cuttings to share with community members.</p>					
	Recognize and distinguish between Polynesian-introduced, endemic, and indigenous plants	Identify and classify endemic, indigenous, and Polynesian-introduced plants. Articulate that various plants have different practical uses and applications.	<p>Observe and identify how plants got to Hawai‘i (wind, water, wings), which is an isolated place. Hawai‘i is the endemic species capital of the world.</p> <p>Conduct a guided garden walk; identify introduced, endemic, and indigenous plants on campus; discuss how the plants got to Hawai‘i (wind, water, wings).</p> <p>Create signage to distinguish native plants on campus.</p> <p>Create a map of native plants on campus.</p> <p>Define terms: endemic, indigenous, and Polynesian-introduced.</p> <p>Create a meal with Polynesian-introduced food crops.</p>		<p>3 RI.3.1 3 RI.3.7</p> <p>4 RI.4.1 4 RI.4.7</p> <p>5 RI.5.1 5 RI.5.7</p>	NA	<p>3-LS4-2 3-LS3-3</p> <p>4-LS1-1</p>	

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			Harvest and prepare native plants for a craft, cordage, food, medicine, or beverage (e.g., kapa, lei, etc.)					
	Understand inheritance, genetic variation, and diversity in plants	Distinguish genetic and inherited differences in plants.  Define biodiversity.	Identify examples of genetic variation in the garden (e.g.,, pigeon pea, corn, lettuce, beans, kalo).  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.  Compare and contrast color, leaf shape, and taste of several kalo and/or sweet potato varieties.		3 RI.3.1 3 RI.3.7  4 RI.4.1 4 RI.4.7  5 RI.5.1 5 RI.5.7	NA	3-LS3-1 3-LS3-2 3-LS4-2	
Science of Soil Fertility	Understand, build, maintain, and use compost systems	Able to construct, retrieve, and layer green (nitrogen) and brown (carbon) in composting systems.  Understand that green and brown provide various nutritional elements for optimal FBI activity.  Connect vermiculture, soil amendments, and healthy layering to soil creation and plant nutrition uptake.	Build a compost pile with green (nitrogen) and brown (carbon) layers in the proper ratios.  Build and maintain several different compost systems: aerobic, anaerobic, compost bins, compost pallets.  Observe a compost pile. Turn and record moisture, temperature, and pH changes over time. Use a compost log to record data.		3 RI.3.1 3 RI.3.7  4 RI.4.1 4 RI.4.7  5 RI.5.1 5 RI.5.7	3 MD.B.3  4 MD.B.4  5 MD.B.2	5-LS2-1  3-5-ETS1-1 3-5-ETS1-2	

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			<p>Determine when a compost pile is finished and ready for use (i.e., temperature is stable, abundance of macro- and microorganisms).</p> <p>Discuss the importance of compost and create a poem, play, and/or song about it.</p> <p><i>*See Appendix:</i>  <a href="http://www3.epa.gov/climatechange/wycd/waste/downloads/composting-chapter10-28-10.pdf">http://www3.epa.gov/climatechange/wycd/waste/downloads/composting-chapter10-28-10.pdf</a></p>					
	Investigate, analyze and apply natural soil fertility systems	<p>Create an argument for how soil amendments improve soil fertility.</p> <p>Able to amend garden soil with sifted compost.</p>	<p>Sift compost and make observations.</p> <p>Sort vermicast from red wigglers and/or Indian blue worms.</p> <p>Apply compost created from the different compost systems to garden beds, grow the same crop in the beds, compare and contrast the plants' growth.</p> <p>Identify mulch (brown/carbon) sources on campus.</p> <p>Identify human discards appropriate for mulch, weed cover, and/or brown (carbon) layer in compost (newspaper, cardboard, shredded paper).</p>		NA	<p>3 MD.B.3</p> <p>4 MD.B.4</p> <p>5 MD.B.2</p>	3-5 -ETS1-3	

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			<p>Compare and contrast the condition of trees with and without mulch.</p> <p>Mulch on and between beds to conserve water and prevent weeds.</p> <p>Use ratios to make correct dilutions of worm/compost teas, ash, etc. as a soil amendment.</p>					
	Understand decomposition	Understand that decomposition is one of the ways that nature cycles matter and energy.	<p>Compare and contrast the volume of a compost pile that is turned and a pile that is not turned.</p> <p>Compare and contrast the temperature of a compost pile that is watered and a pile that is dry.</p> <p>Conduct a visual investigation of fungi, bacteria, and invertebrates (FBI) in the wet/dry or turned/unturned compost using our eyes and a magnifying glass.</p> <p>FBI/decomposition song *(see Appendix)</p> <p>Observe decomposition of mulch on the soil over time. Record data.</p>		NA	3 MD.B.3 4 MD.B.4 5 MD.B.2	5-PS1-2 5-LS1-1 5-LS2-1	

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			<p>Research decomposition rates. Create a decomposition timeline (e.g., slippers, apple, styrofoam, glass, etc.).</p> <p>* Watch: <a href="http://techalive.mtu.edu/meec/module10/EnergyFlow.htm">http://techalive.mtu.edu/meec/module10/EnergyFlow.htm</a></p>					
Biodiversity and interdependent relationships	Understand and describe how weather shapes the Earth and affects soil and plants	Examine and summarize how weather affects soil creation and shapes land formations.	Observe geographical features at school. Create a model to replicate geographical features.		NA	NA	4-ESS2-1 4-ESS2-2	
	Identify the roles that beneficial insects and pests play in the garden	Identify beneficial insects and pests. Identify invasive species.	<p>Identify evidence of pests in the garden (e.g., holes in leaves, egg, etc.) and determine which organisms are responsible using a field guide (see Appendix for field guide).</p> <p>Classify organisms as pests or beneficial insects.</p> <p>Name beneficial insects based on their function (e.g., decomposers, pollinators, predators, shredders).</p> <p>Cultivate plants that attract beneficial insects.</p> <p>Research plant types that attract beneficial insects or deter pests.</p>		<p>3 RI.3.1 3 RI.3.7</p> <p>4 RI.4.1 4 RI.4.7</p> <p>5 RI.5.1 5 RI.5.7</p>	NA	3-LS4-2 3-LS4-3 3-LS4-4	

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	Demonstrate understanding of the interrelationships among soil, plants, animals, and humans	Develop a model to describe the movement of matter and energy between compost, healthy soils, and optimal human health.	<p>Experiment with companion planting and identify the benefits (e.g., maximizing space, providing habitats, increasing fertility, etc.).</p> <p>Observe the activity of birds, mammals, and invertebrates in the garden. Create food web illustrations to show some of the relationships.</p> <p>Research companion plants and how they function.</p> <p>Identify the producers, consumers, and decomposers in your garden.</p> <p>Play the web of life game:  * See Appendix:  <a href="http://www.amnh.org/ology/features/stufftodo_bio/weboflife.php">http://www.amnh.org/ology/features/stufftodo_bio/weboflife.php</a></p>		3 RI.3.1 3 RI.3.7  4 RI.4.1 4 RI.4.7  5 RI.5.1 5 RI.5.7	NA	5-LS2-1 5-PS1-4	
	Explain the importance of biodiversity to create resilience in the garden environment	Identify and distinguish biodiversity in a variety of natural contexts.	<p>Conduct nature walk to identify and survey biodiversity on campus and in the garden; compare and contrast two sites.</p> <p>Make a list of the plants in the garden by which part is eaten (e.g., leaf, fruit, root).</p> <p>If there were an invasion of pests or a natural disaster, would</p>		3 RI.3.1 3 RI.3.7  4 RI.4.1 4 RI.4.7  5 RI.5.1 5 RI.5.7	NA	3-LS4-2 3-LS4-3 3-LS4-4	

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			<p>there still be choices of foods? - List which plants would be resilient enough to withstand each?</p> <p>Compare a monocrop (e.g., a lawn or playing field) to the diverse environment in a garden through observations of the surrounding ecosystem.</p> <p>Use quadrats to survey abundance and diversity of organisms.</p>					
Science of Best Garden Practices	Know how to prepare different planting areas for a variety of plant types	Ability to transplant and direct-seed with optimal soil amendments and conditions.	<p>Prepare a planting bed: cultivate, amend, aerate, and shape.</p> <p>Prepare a hole for tree planting: amend, aerate and shape.</p> <p>Transplant crops into a prepared garden bed using best practices (e.g.,, depth, root handling, time of day, and appropriate amounts of water).</p> <p>Read and follow directions on a seed packet.</p> <p>Demonstrate knowledge of vocabulary by planting seeds into a prepared garden bed at correct depth and spacing.</p>		<p>3 RI.3.1 3 RI.3.7</p> <p>4 RI.4.1 4 RI.4.7</p> <p>5 RI.5.1 5 RI.5.7</p>	<p>3.MD.B.3</p> <p>4.MD.B.4</p> <p>5.MD.B.2</p>	<p>3-5-ETS1-1 3-5-ETS1-2</p>	

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	Demonstrate garden safety with tools, equipment, water systems, and protocol	<p>Able to employ shovels, hand trowels, clippers, and picks safely.</p> <p>Able to describe shovel, hand trowel, clipper, and pick maintenance.</p>	<p>Teacher or students model and demonstrate proper and improper use of garden tools.</p> <p>Know names of common garden tools.</p> <p>Handle tools correctly and safely.</p> <p>Use tools for the job intended.</p> <p>Practice cleaning and putting tools away properly.</p> <p>Sand all wooden handles at least once a year.</p> <p>Ensure that there is no standing water in containers or plants to reduce mosquito larvae.</p> <p>Develop and practice safety protocol (e.g., tsunami drills, fire drills, containment drill).</p>		<p>3.SL.3.1</p> <p>4.SL.4.1</p> <p>5.SL.5.1</p>	NA	<p>3-5-ETS1-1</p> <p>3-5-ETS1-2</p>	