Theme Two: The Living Soil-The Living Plant

We Are All Interconnected and Related.

Theme Two explores our connections to the living soil and plants that make life possible. Our very survival on Earth depends on our knowledge and care of the soil ecosystem. The Latin words *humus*, soil/earth, and *homo*, human being, have a common derivation, from which we also get our word "humble." The soil is the great connector of our lives, the source of all food, fiber, seed, and oxygen production from the land. As children work in the school garden, they discover the connections and relationships they have with the living world, both seen and unseen. It is through these relationships that they become more engaged with learning and begin to care about preserving and protecting the Earth and themselves. Many of the sciences can be explored and discovered in the garden: soil biology, botany, entomology, hydrology, zoology, earth sciences, climatology, geography, and ecology are found in "gardenology." The naturalist John Muir once said, "When one tugs at a single thing in nature, he finds it attached to the rest of the world." So it is in the school garden.

The Living Soil--The Living Plant: We are all Interconnected and Related
Theme 2: Curriculum Map – Grades K–2

NOTE: *Codes in* ***RED*** *(e.g., K2.2.1) in the Learning Outcomes, Garden Activities, and Classroom Extensions columns refer to curriculum resources found in the Appendix documents.*

Strand	Topic	K–2 Learning Outcomes	Garden Activities	Classroom Extensions	CC ELA Standards	CC Math Standards	NGSS HCPS III-Science Standards	HCPS III NHES Health
Scientific Inquiry	Scientific inquiry & engineering design	Make Observations. Ask questions. Collect data. Interpret data. Make conclusions. Design, build, and test various solutions to simple garden problems in infrastructure.	What is soil made of? Observe garden soil. Ask questions. Explore and classify the parts of soil. Where do these soil parts come from? Can we recombine them to make soil? Design a solution to a problem identified in the garden. Discuss possibilities, create a small model, build the best solution, test.	As challenges arise in the school garden the children share them. Keep a wall chart of problems to be solved. Investigate topics led by student-inquiry using scientific method.	K.W.7 K.SL.2 1.W.7 1.SL.4 2.W.7 2.SL.2	K.MD.2 K.MD.3 1.MD.4 2.MD.10	K-LS1-1 K-ESS3-1 1-LS1-1 1-ESS1-2 2-LS2-1 2-LS4-1	HE.K-2.5.1
Science of Living Soil	Characteristics and components of living soil	Understand how soil is created. Recognize differences among soil samples and be able to identify living and nonliving components of soil.	Explore different types of soil using the 5 senses Observe and compare soil samples collected from different sites. Develop a word bank and draw or write about soil descriptions. K2.2.1 Sort and classify soil components. Recombine to make soil. K2.2.1	Senses exploration exercises. K2.2.2 Use the word bank developed in the garden class to integrate into the daily work. Discuss the different interpretative meanings of the words soil and dirt.	K.W.2 K.SL.4 1.W.7 1.SL.4 2.W.7 2.SL.2	K.MD.2 K.MD.3 1.MD.4	1-LS1-1 2-PS1-1 2-PS1-2 2-PS1-3 SC.K.1.1 SC.K.1.3 SC.K.3.1 SC.K.4.1 SC.K.6.1 SC.1.5.2	

Strand	Topic	K–2 Learning Outcomes	Garden Activities	Classroom Extensions	CC ELA Standards	CC Math Standards	NGSS HCPS III-Science Standards	HCPS III NHES Health
	Soil organisms - their functions and interrelationships	Understand that soil is alive and that organisms and organic matter are responsible for soil health. Recognize the difference between vertebrates and Invertebrates: FBI - Fungus, Bacteria, and Invertebrates	Investigate worms living in soil and compost systems Create and maintain a worm bin to investigate the role worms play in soil fertility K2.2.3 STEM Sift finished compost (or garden soil) and explore, draw, and describe the organisms you see in the soil. K2.2.4, K2.2.5	Keep a small classroom worm box. Use this as a prompt for writing and drawing about the life of a worm.	K.RI.10 K.W.2 1.RI.10 1.SL.4 2.RI.10 2.W.7	K.CC.5 K.CC.6 1.OA.5 1.NBT.1 2.OA.1	K-LS1-1 K-ESS3-1 1-LS1-1 2-PS1-1 2-PS1-2 2-LS4-1 SC.K.1.2 SC.1.5.2 SC.2.3.1	
	The creation and erosion of soils	Identify living and nonliving components of soil and understand their sources.	Sort and classify the components of soil into living and nonliving things and discuss their origins. Experiment with combining individual soil components to create soil. Investigate origins of Hawai‘i’s soils through the story of the ‘Ōhia. K2: 2-6	Grandma’s Seed Box Sort and Classify. K2.2.3 Students retell the ‘Ōhia story from memory. The plight of the ‘Ōhia today and the significance of this Keystone Species tree can be discussed, written about, or drawn.	K.W.7 K.SL.2 1.RI.10 1.W.7 2.RI.3 2.W.7	K.CC.4 K.CC.6 1.MD.4 2.MD.5	2ESS1-1 2ESS2-1 2ESS2-2 SC.K.1.3 SC.1.2.2 SC.2.8.1	
	Soil Mixtures for planting	Understand the differences between potting soil and garden soil for planting seeds and plants.	Observe potting mix and garden soil. Compare and contrast by experimenting with germinating seeds in both mediums and record observations. Create a soil mixture for transplanting (½		K.W.3 K.W.7 1.W.7 1.SL.1 2.W.7 2.SL.1	K.CC.5 K.CC.6 1.NBT.3 1.MD.4 2.OA.1 2.G.3	2-PS1-1 2-PS1-2 SC.2.8.1	

Strand	Topic	K–2 Learning Outcomes	Garden Activities	Classroom Extensions	CC ELA Standards	CC Math Standards	NGSS HCPS III-Science Standards	HCPS III NHES Health
			compost, ½ potting soil) and discuss why transplants need compost. Compare and contrast the soil beneath a tree with soil in a vegetable garden bed.					
	The role of oxygen, carbon and nutrient cycling in the soil	Understand the role of nitrogen and carbon in the soil cycle.	Students build a compost pile and identify that green material (nitrogen) and brown material (carbon), oxygen, and moisture are necessary for compost transformation. K2.2.7 Students apply finished compost to garden beds and observe the results. Sing “Dirt Made My Lunch” by Banana Slug String Band K2.2.8	Practice “Dirt Made My Lunch” Song K2.28 Students bring samples of soil from home, observing and describing the differences and similarities.			2-PS1-1 2-PS1-2	
Science of Living Plants	The relationship between weeds and soil	Recognize the advantages and disadvantages of common weeds and their names. Identify the role weeds play in soil health.	*Conduct a weed identification walk to learn the names of common garden weeds K2.2.9 *Investigate the role of weeds in soil health (ex: identify where weeds grow to cover bare soil) *Sort and classify common weeds by variety, leaf size, etc.	Weeds: Guardians of the Soil. Use this idea for a discussion of weeds and create a poster showing common and useful weeds of your area.	K.SL.2 K.L.4 1.SL.2 1.L.4 2.SL.2 2.L.4	K.MD.3 K.G.1 1.MD.4 2.MD.10	2-PS1-1 2-LS4-1 SC.1.5.1 SC.K.3.1	

Strand	Topic	K–2 Learning Outcomes	Garden Activities	Classroom Extensions	CC ELA Standards	CC Math Standards	NGSS HCPS III-Science Standards	HCPS III NHES Health
			*Chop and drop weeds, add to compost, or make tea from weeds (only use weeds that are not vines and are not seeding). K2.2.10					
	The life cycle of a plant, from seed to seed, structure and function	Identify the structure and function of the 6 plant parts. Identify and describe patterns of what plants and animals need to survive.	Grow a plant from seed to seed; observe, measure, and record/graph growth. Identify the stages of the life cycle and six plant parts as plants grow in the garden. K2.2.11 Learn the Six Plant Part Song. K2.2.12 Grandma's Seed Box: sort and classify. K2.2.3 Grow and prepare a salad using ingredients from all six plant parts. Identify the edible and nonedible parts of plants in the school garden.	Germinate a bean seed on a moist paper towel in the classroom and observe over 1-2 weeks. Draw what you see over time. If your school has the USDA FFVP Program use the weekly snack as another way to talk about the edible parts of fruits and vegetables Practice the Six Plant Part Song. Ask students to draw the six plant parts of one type of plant. Label the parts with words. Share. Read *It's Harvest Time* by Jean McElroy Read *Stems* by Vijaya K. Bodach. Experiment with showing absorption and uptake of water and nutrients by using celery stalks placed in mixture of water and food coloring.	K.W.2 K.SL.2 1.W.2 1.SL.2 2.W.2 2.SL.2	K.MD.1 K.MD.3 1.MD.2 1.MD.4 2.MD.4 2.MD.9	K-LS1-1 1-LS1-1 2-LS2-1 SC.K.1.1 SC.1.4.1 SC.2.4.1	

Strand	Topic	K–2 Learning Outcomes	Garden Activities	Classroom Extensions	CC ELA Standards	CC Math Standards	NGSS HCPS III-Science Standards	HCPS III NHES Health
	Photosynthesis	Understand the role of the sun in the plants' ability to make their own food.	While standing in the garden, observe and identify where plants get energy- Feel the sun Play Photosynthesis Tag K2.2.13 Conduct an experiment comparing plants grown with and without sunlight Introduce the science of photosynthesis.	Read about how the sun provides energy for plants and people.	K.W.8 K.SL.2 1.W.8 1.SL.2 2.W.8 2.SL.2		K-PS3-1 K-PS3-2 2-LS2-1 SC1.3.1 SC.1.4.1	
	Propagation of plants	Propagate plants via seed, transplanting, and vegetative propagation.	Experiment sowing seeds directly into garden soil and into pots. Observe, compare and chart days to germination, flowering and fruiting. K2.2.14 Transplant potted seedlings into garden soil. K2.2.15 Plant via vegetative propagation (kalo, banana, sugar cane, sweet potato, or pineapple). K2.2.16	Explore re-sprouting plants from pieces (celery stalk, green onion bottoms, carrot top, sweet potato). Provide seedlings for distribution to students and growing at home; then compare growth notes. Discuss what and how student families grow for their homes.	K.W.7 1.W.7 2.W.7	K.CC.4 K.MD.2 1.OA.7 1.MD.4 2.MD.9 2.MD.10	K-LS1-1 K-ESS3-1 1-LS1-1 1-LS3-1 2-PS1-2 2-LS4-1 SC.1.5.2 SC.2.4.1	
	Polynesian introduced, endemic, and indigenous plants	Identify and name main forest trees (koa, ʻōhiʻa) and canoe crops (banana, kalo, ʻuala, kō, ʻulu, ʻolena, ti leaf).	Teacher conducts a guided garden walk; identify introduced, endemic, and indigenous plants.	Students identify and share information on what kinds of different plants grow in their own yards.	K.W.8 K.L.4 1.W.8 1.L.4	K.CC.4 K.CC.6 1.NBT.1 1.MD.4	K-LS1-1 1-LS1-1 2-LS2-2 2-LS4-1 SC.K.1.1	

Strand	Topic	K–2 Learning Outcomes	Garden Activities	Classroom Extensions	CC ELA Standards	CC Math Standards	NGSS HCPS III-Science Standards	HCPS III NHES Health
		Recognize that plants have arrived at different times in different ways: waves, wind, and wings.	Conduct a biodiversity scavenger hunt. K2.2.17 Investigate how plants arrived in Hawaii. Seeds are dispersed (wind, water, wings). Harvest and prepare native plants for a craft, cordage, food, medicine, beverage, or lei. K2.2.18		2.W.8 2.L.4	2.OA.1 2.MD.10	SC.K.1.2 SC.1.5.2 SC.2.5.1	
	Inheritance, genetic variation, and diversity in plants	Observe differential traits of varieties of a plant species.	Sort, classify, and count different traits among multiple varieties within a particular plant species (e.g., beans, lettuce). Generate questions about the variations they see in the garden. Have students hypothesize explanations of why variations happen. Observe how a young plant is like but not exactly like the parent plant. Look for plants in the garden that can be divided off the parent plant and harvest keiki. Explore how these plants resemble their parents.	Read stories about the garden and plant types. Identify and compare similarities and differences of genetically inherited traits in animals and humans.	K.SL.2 K.SL.3 1.W.8 1SL.2 2.W.8 2.SL.3	K.CC.4 K.MD.3 1.NBT.3 1.MD.4 2.OA.3 2.MD.10	K-ESS3-1 1-LS3-1 2-PS1-1 SC.K.5.1 SC.K.6.1 SC.1.1.1 SC.1.5.1	

Strand	Topic	K–2 Learning Outcomes	Garden Activities	Classroom Extensions	CC ELA Standards	CC Math Standards	NGSS HCPS III-Science Standards	HCPS III NHES Health
Science of Soil Fertility	Creating compost systems	Describe the components of composting (green and brown, decomposers, air, water, time).	Identify and collect green (nitrogen) and brown (carbon) materials for compost pile. Build, tend, and record observations of a compost pile over time. K2.2.7 Observe nature's composting (i.e. a rotting apple, leaves decomposing under a tree). Build and tend a garden worm bin. K2.2.3 Make and use compost tea.	Build and tend a classroom worm bin. K2.2.3 Read *Compost Stew - An A to Z Recipe for the Earth* by Mary M. Siddals	K.W.3 K.W.7 1.W.7 1.W.8 2.W.7 2.W.8	K.G.1 K.G.3 1.G.3 2.G.3	K-ESS3-3 1-LS1-1 2-LS4-1 SC.2.6.1 SC.2.8.1	
	Natural soil fertility systems	Understand that compost feeds the soil and plants. Mulch protects, cools, and retains moisture in the soil.	Apply finished compost and/or vermicompost to the garden. Investigate and gather different materials from the nearby environment and use to mulch around garden plants. Grow plants that make good mulch sources. K2.2.19 Observe and record temperature of mulched and un-mulched soil. K2.2.20	Use the temperature collection log as a prompt for graphing data and thinking about temperature differences. K2.2.20	K.W.7 K.SL.2 1.W.7 1.SL.2 2.W.7 2.SL.3	K.G.1 K.G.4 1.MD.4 2.MD.9	K-ESS3-3 K-PS3-2 2-PS1-2 2-PS1-4 SC.K.1.2 SC.2.6.1 SC.2.8.2 SC.1.2.2	

Strand	Topic	K–2 Learning Outcomes	Garden Activities	Classroom Extensions	CC ELA Standards	CC Math Standards	NGSS HCPS III-Science Standards	HCPS III NHES Health
			Grow a plant in amended (with compost) and non-amended soils; record observations and formulate questions based on observations.					
	Decomposition	Understand that decomposition includes organic materials, air, water, organisms, and time.	Build, turn, and sift a compost pile and observe decomposition. K2.2.7 Conduct a visual investigation of fungi, bacteria, and invertebrates (FBI) in compost using our eyes and a magnifying glass. Tell the story of the compost pile as the ultimate resort getaway (ideal habitat) for the FBI, a place with all their favorite food, enough air, water, etc. K2.2.21 FBI & Decomposition songs K2.2.4 Observe decomposition of mulch on the soil over time (compost in place). Experiment with the decomposition of organic and inorganic materials. Bury and dig up to observe over time. Rank them.	Students create a visual report of decomposition of organic & inorganic materials over time. Can utilize digital photos to create a slideshow or Powerpoint for presentation.	K.W.2 K.W.7 1.W.2 1.W.7 2.W.2 2.W.7	K.MD.2 K.MD.3 1.MD.4 2.MD.5	K-LS1-1 K-ESS3-1 2-PS1-1 K-2-ETS1-1 K-2-ETS1-2 K-2-ETS1-3 SC.2.6.1	

Strand	Topic	K–2 Learning Outcomes	Garden Activities	Classroom Extensions	CC ELA Standards	CC Math Standards	NGSS HCPS III-Science Standards	HCPS III NHES Health
Biodiversity and interdependent relationships	The effects of weather on the earth, soil, and plants	Understand how sun, rain, and clouds affect soil and plants.	Observe changes in the garden after a weather event (rainfall, heavy wind, cloudy day). Investigate how temperature changes with clouds and rainfall. Observe and discuss how plants are affected by rain, sun, drought, and temperature. STEM	Get a classroom thermometer, observe temperature and record at 3 points or more during the day. Students can record data to compare and analyze results.	K.W.7 K.SL.1 1.W.7 1.SL.1 2.W.7 2.SL.1	K.MD.2 K.G.1 1.NBT.3 1.MD.4 2.MD.4 2.MD.9	K-ESS2-1 K-ESS3-2 1-ESS1-2 2-ESS2-1 2-ESS2-3 SC.1.1.2 SC.1.8.1 SC.2.1.2	
	Biodiversity within the garden environment	Diversity creates strength and health in a living system, plant and animal interdependence.	Conduct a nature walk to identify trees and plants on the school campus. What is biodiversity? Observe and/or draw different types of seeds or leaves and describe their differences; have students sort them based on their observations. Count and name the different types of trees students can see from the garden. Biodiversity Survey: Who lives in our garden, what are their names? How many of each can you count? K2.2.22 Compare biodiversity of the campus to the	Ask students to share what they saw on the campus nature walk. Can they remember the names of any of the trees or plants? Where is there the most biodiversity, campus or garden? Why? Read *On One Flower - Butterflies, Ticks and a Few More Icks* by Anthony D. Fredericks Offer for reference non-fiction texts such as *What Lives in the Garden?* by John Woodward	K.W.8 K.SL.3 1.W.8 1.SL.2 2.W.8 2.SL.2	K.CC.5 K.CC.6 1.MD.4 2.MD.10	K-LS1-1 K-ESS3-1 1-LS1-1 1-LS3-1 2-PS1-1 2-LS2-2 SC.K.1.1 SC.1.4.1 SC.2.3.1	

Strand	Topic	K–2 Learning Outcomes	Garden Activities	Classroom Extensions	CC ELA Standards	CC Math Standards	NGSS HCPS III-Science Standards	HCPS III NHES Health
			garden.					
	Interrelationships between soil, plants, animals, humans, and environment	Describe how living things are interconnected with each other and with the environments they live in.	Explore plant relationships with companion planting (ex: 3 sisters-corn, beans, squash). K2.2.23 Investigate, observe and identify plant/animal relationships in the garden. Draw a picture or describe one relationship. Observe and discuss the activity and interaction of birds, mammals, and invertebrates in the garden. Use the garden as a model to observe and identify how soil, plants, animals, insects, and humans interact; draw or describe one of these relationships	Tell or read the story of The Three Sisters. Students write or draw a story about an interrelationship they have observed in the garden. Share. Read *Jo MacDonald Had a Garden* by Mary Quattlebaum; *Molly's Organic Farm* by Carol L. Malnor & Tina L. Hunner Read *Pulelehua and Māmaki* by Janice Crowl; show native plant and native Kamehameha butterfly (including life cycle phases).	K.RI.10 K.SL.2 1.RI.3 1.SL.2 2.RI.3 2.SL.2	K.CC.5 K.CC.6 1.MD.4 2.MD.10	K-ESS3-1 K-LS1-1 1-LS1-1 2-LS4-1 SC.K.1.1 SC.1.5.2 SC.2.3.1	
	Beneficial organisms and pests (IPM, pollination)	Understand the role of the 3 P's of a garden system: Pests, Pollinators, and Predators.	Identify and draw common garden insects. K2.2.24 Identify evidence of pests in the garden. (Example: holes in leaves, aphids on leaves) Identify garden pollinators and	Ask the students to share what they know or remember about pests, pollinators, and predators. Read short stories about the insects that are important to our food system like bees and butterflies, etc. Design an enclosed habitat for an insect to	K.W.8 K.SL.2 1.W.8 1.SL.2 2.W.8 2.SL.2	K.G.1 K.G.4 1.MD.4 1.G.1 2.MD.3 2.MD.9	K-LS1-1 K-ESS2-2 1-LS3-1 2-LS4-1 2-LS2-2 SC.K.1.2 SC.1.5.2 SC.2.3.1	

Strand	Topic	K–2 Learning Outcomes	Garden Activities	Classroom Extensions	CC ELA Standards	CC Math Standards	NGSS HCPS III-Science Standards	HCPS III NHES Health
			beneficial insects and the plants that attract them. K2.2.25 Grow a butterfly garden. Observe and ask questions about the roles of pests, pollinators, and predators in the garden system. Play the Pests, Pollinators, & Predators Tag Game. K2.2.13	observe closely and study. Create a scarecrow out of recycled materials to help scare away some garden pests.				
Science of Best Garden Practices	Preparation for planting	Know how to prepare a garden bed or a pot for planting a seed or plant.	Prepare a bed for planting. Remove weeds, add amendments, and smooth the soil with a rake. Fill pots with potting mix and plant seeds.	Children can describe, write, or draw the steps to make a bed. Design a visual plan to create garden beds; teach about shapes, how to measure length/width, perimeter, or how to partition into fractional parts. Read *Jack's Garden* by Henry Cole; *Water, Weed, and Wait* by Edith H. Fine	K.RI.1 K.SL.2 1.RI.1 1.SL.2 2.RI.3 2.SL.2	K.G.1 K.G.6 1.MD.2 2.G.3 2.MD.1 2.G.3	K-LS1-1 1-LS1-1 2-LS1-1 K-2-ETS1-1 K-2-ETS1-2 K-2-ETS1-3	
	Safely use, maintain, store, and repair garden tools	Demonstrate proper use, safety, and maintenance of garden tools.	Learn the names of the tools, how to use them safely and when to use them, how to clean them and put them away. K2.2.26		K.SL.4 K.L.4 1.SL.4 1.L.4 2.W.8 2.SL.2		K-2-ETS1-1	7.2.2 HE.K-2.1.4

Strand	Topic	K–2 Learning Outcomes	Garden Activities	Classroom Extensions	CC ELA Standards	CC Math Standards	NGSS HCPS III-Science Standards	HCPS III NHES Health
			Some tools are not appropriate for K-2.					

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.	Observe a compost pile and identify moisture level, temperature, (brown) carbon to nitrogen (green) ratio. Sort, classify and identify different soils in different garden beds – soil particle size, soil component: clay, silt, loam. Shake jar test – soil column. Form soil into balls, ribbons, snakes, etc. to understand soil components, texture, and properties. Introduce basic soil chemistry – use soil test kit to analyze nitrogen, phosphorus, potassium (K), pH using soil test kit or Vernier probes. 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.		NA	3 NF.A.1	4 ESS1.1	

Strand	Topic	Learning Outcome	Garden Activities	Classroom Extensions	Common Core- ELA	Common Core-Math	NGSS	NHES
	Identify organisms in the soil and observe their functions	Understand the role fungi, bacteria, and invertebrates (FBI) play as decomposers and recyclers of nutrients.	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. Sift finished compost (or garden soil) and identify shredders, predators, fungi, and make observations using a hand lens. Show videos of Banana Slug String Band. 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. Draw, act, sing, or play a guessing game about the structure and function.		3 SL. 4 4 SL. 4 5 SL. 4	NA	5-LS2-1	
	Explain how soils are created and erode	Understand that weather, geologic forces, and human activity create different soil types, weathering, and erosion. Analyze and classify various soil types in Hawai‘i.	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.		3 SL. 4 4 SL. 4 5 SL. 4	NA	4-ESS2-1 5-LS2-1	

Strand	Topic	Learning Outcome	Garden Activities	Classroom Extensions	Common Core- ELA	Common Core-Math	NGSS	NHES
			Use quadrats to compare and contrast a compost pile in the garden with a decomposing area in a forest, woods, beach, etc. Design a model to demonstrate a solution to erosion. Ahupua‘a field trip to identify signs of erosion and weathering; identify composting in nature. Write a legend or story about the origin of Hawai‘i’s soil					
	Understand how different soil mixtures serve different functions	Understand components of healthy soil for use in plant propagation.	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. 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. Compare soil needs and practices for planting vegetables		3 RI. 1 4 RI. 1 5 RI. 1	3.MD.B.4	3-LS-4-2	

Strand	Topic	Learning Outcome	Garden Activities	Classroom Extensions	Common Core- ELA	Common Core-Math	NGSS	NHES
			(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	

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

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

Strand	Topic	Learning Outcome	Garden Activities	Classroom Extensions	Common Core- ELA	Common Core-Math	NGSS	NHES
			structures exhibited by plants under various conditions (e.g.,, stress induces flower/seed production; ʻuala stem in contact with soil and water will produce roots). Prepare cuttings to share with community members.					
	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.	Observe and identify how plants got to Hawaiʻi (wind, water, wings), which is an isolated place. Hawaiʻi is the endemic species capital of the world. Conduct a guided garden walk; identify introduced, endemic, and indigenous plants on campus; discuss how the plants got to Hawaiʻi (wind, water, wings). Create signage to distinguish native plants on campus. Create a map of native plants on campus. Define terms: endemic, indigenous, and Polynesian-introduced. Create a meal with Polynesian-introduced food crops.		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-LS3-3 4-LS1-1	

Strand	Topic	Learning Outcome	Garden Activities	Classroom Extensions	Common Core- ELA	Common Core-Math	NGSS	NHES
			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	

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

Strand	Topic	Learning Outcome	Garden Activities	Classroom Extensions	Common Core- ELA	Common Core-Math	NGSS	NHES
			Compare and contrast the condition of trees with and without mulch. Mulch on and between beds to conserve water and prevent weeds. Use ratios to make correct dilutions of worm/compost teas, ash, etc. as a soil amendment.					
	Understand decomposition	Understand that decomposition is one of the ways that nature cycles matter and energy.	Compare and contrast the volume of a compost pile that is turned and a pile that is not turned. Compare and contrast the temperature of a compost pile that is watered and a pile that is dry. 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. FBI/decomposition song *(see Appendix) Observe decomposition of mulch on the soil over time. Record data.		NA	3 MD.B.3 4 MD.B.4 5 MD.B.2	5-PS1-2 5-LS1-1 5-LS2-1	

Strand	Topic	Learning Outcome	Garden Activities	Classroom Extensions	Common Core- ELA	Common Core-Math	NGSS	NHES
			Research decomposition rates. Create a decomposition timeline (e.g., slippers, apple, styrofoam, glass, etc.). * Watch: http://techalive.mtu.edu/meec/module10/EnergyFlow.htm					
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.	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). Classify organisms as pests or beneficial insects. Name beneficial insects based on their function (e.g., decomposers, pollinators, predators, shredders). Cultivate plants that attract beneficial insects. Research plant types that attract beneficial insects or deter pests.		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	

Strand	Topic	Learning Outcome	Garden Activities	Classroom Extensions	Common Core- ELA	Common Core-Math	NGSS	NHES
	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.	Experiment with companion planting and identify the benefits (e.g.,, maximizing space, providing habitats, increasing fertility, etc.). Observe the activity of birds, mammals, and invertebrates in the garden. Create food web illustrations to show some of the relationships. Research companion plants and how they function. Identify the producers, consumers, and decomposers in your garden. Play the web of life game: * See Appendix: http://www.amnh.org/ology/features/stufftodo_bio/weboflife.php		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.	Conduct nature walk to identify and survey biodiversity on campus and in the garden; compare and contrast two sites. Make a list of the plants in the garden by which part is eaten (e.g., leaf, fruit, root). If there were an invasion of pests or a natural disaster, would		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	

Strand	Topic	Learning Outcome	Garden Activities	Classroom Extensions	Common Core- ELA	Common Core-Math	NGSS	NHES
			there still be choices of foods? - List which plants would be resilient enough to withstand each? Compare a monocrop (e.g., a lawn or playing field) to the diverse environment in a garden through observations of the surrounding ecosystem. Use quadrats to survey abundance and diversity of organisms.					
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.	Prepare a planting bed: cultivate, amend, aerate, and shape. Prepare a hole for tree planting: amend, aerate and shape. Transplant crops into a prepared garden bed using best practices (e.g.,, depth, root handling, time of day, and appropriate amounts of water). Read and follow directions on a seed packet. Demonstrate knowledge of vocabulary by planting seeds into a prepared garden bed at correct depth and spacing.		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	3-5-ETS1-1 3-5-ETS1-2	

Strand	Topic	Learning Outcome	Garden Activities	Classroom Extensions	Common Core- ELA	Common Core-Math	NGSS	NHES
	Demonstrate garden safety with tools, equipment, water systems, and protocol	Able to employ shovels, hand trowels, clippers, and picks safely. Able to describe shovel, hand trowel, clipper, and pick maintenance.	Teacher or students model and demonstrate proper and improper use of garden tools. Know names of common garden tools. Handle tools correctly and safely. Use tools for the job intended. 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 drill).		3.SL.3.1 4.SL.4.1 5.SL.5.1	NA	3-5-ETS1-1 3-5-ETS1-2	

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	

Strand	Topic	Learning Outcome	Garden Activities	Classroom Extensions	Common Core- ELA	Common Core-Math	NGSS	NHES
	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		

Strand	Topic	Learning Outcome	Garden Activities	Classroom Extensions	Common Core- ELA	Common Core-Math	NGSS	NHES
			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	

Strand	Topic	Learning Outcome	Garden Activities	Classroom Extensions	Common Core- ELA	Common Core-Math	NGSS	NHES
	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	

Strand	Topic	Learning Outcome	Garden Activities	Classroom Extensions	Common Core- ELA	Common Core-Math	NGSS	NHES
			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	

Strand	Topic	Learning Outcome	Garden Activities	Classroom Extensions	Common Core- ELA	Common Core-Math	NGSS	NHES
			* 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	

Strand	Topic	Learning Outcome	Garden Activities	Classroom Extensions	Common Core- ELA	Common Core-Math	NGSS	NHES
			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	

Strand	Topic	Learning Outcome	Garden Activities	Classroom Extensions	Common Core- ELA	Common Core-Math	NGSS	NHES
			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	

Strand	Topic	Learning Outcome	Garden Activities	Classroom Extensions	Common Core- ELA	Common Core-Math	NGSS	NHES
			“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	

Strand	Topic	Learning Outcome	Garden Activities	Classroom Extensions	Common Core- ELA	Common Core-Math	NGSS	NHES
			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	

Strand	Topic	Learning Outcome	Garden Activities	Classroom Extensions	Common Core- ELA	Common Core-Math	NGSS	NHES
				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	

Strand	Topic	Learning Outcome	Garden Activities	Classroom Extensions	Common Core- ELA	Common Core-Math	NGSS	NHES
		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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Tuesday, June 10, 2016

WHAT IS SOIL MADE OF?

Equipment:
Hand lenses
Mason jars with lids (2)
Water

Using the equipment and your senses, look for evidence of the components below. Describe and/or draw what you observed.

	GARDEN	FIELD	FOREST
LIVING COMPONENTS Worms, insects, spiders, fungi, etc.			
ORGANIC MATTER Plant or animal material			
PARENT MATERIAL as MINERAL PARTICLES Rocks, sand, clay, silt Note SIZE of particles			
WATER			
AIR			
TEXTURE (gritty, slippery, sticky, etc.)			
COLOR (dark brown, gray, yellow, red, etc.)			
SMELL (earthy, sweet, sour, etc.)			

Soil Sleuths Lab Worksheet

Name/s: _____ Date: _____

Part One – If it feels good.

Sample name	Texture (gritty, slippery, sticky, etc.)	Color (dark brown, gray, yellow, red, etc.)	Smell (earthy, sweet, sour, etc.)	What signs of life and organic matter (worms, leaves, bugs, etc.)

a. How did the soil samples differ?

b. How were they the same?

c. Which soil would you want to grow a plant in and why?

Part Two (switch roles)

Sample name	Ball: Did it form a ball? Did it hold together when pushed?	Ribbon: Length of ribbon in inches	What soil type is this sample (can be a combination)?

a. Which sample made the strongest ball? Why?

b. Which sample made the longest ribbon? Why?

Part Three – Shake it up

Sample name	Layers description

a. *Are the mud shake layers consistent with the Part One touch test?*

Discuss the following and then choose someone on your group to share with the whole class.

a. *Where did the soil sample come from?*

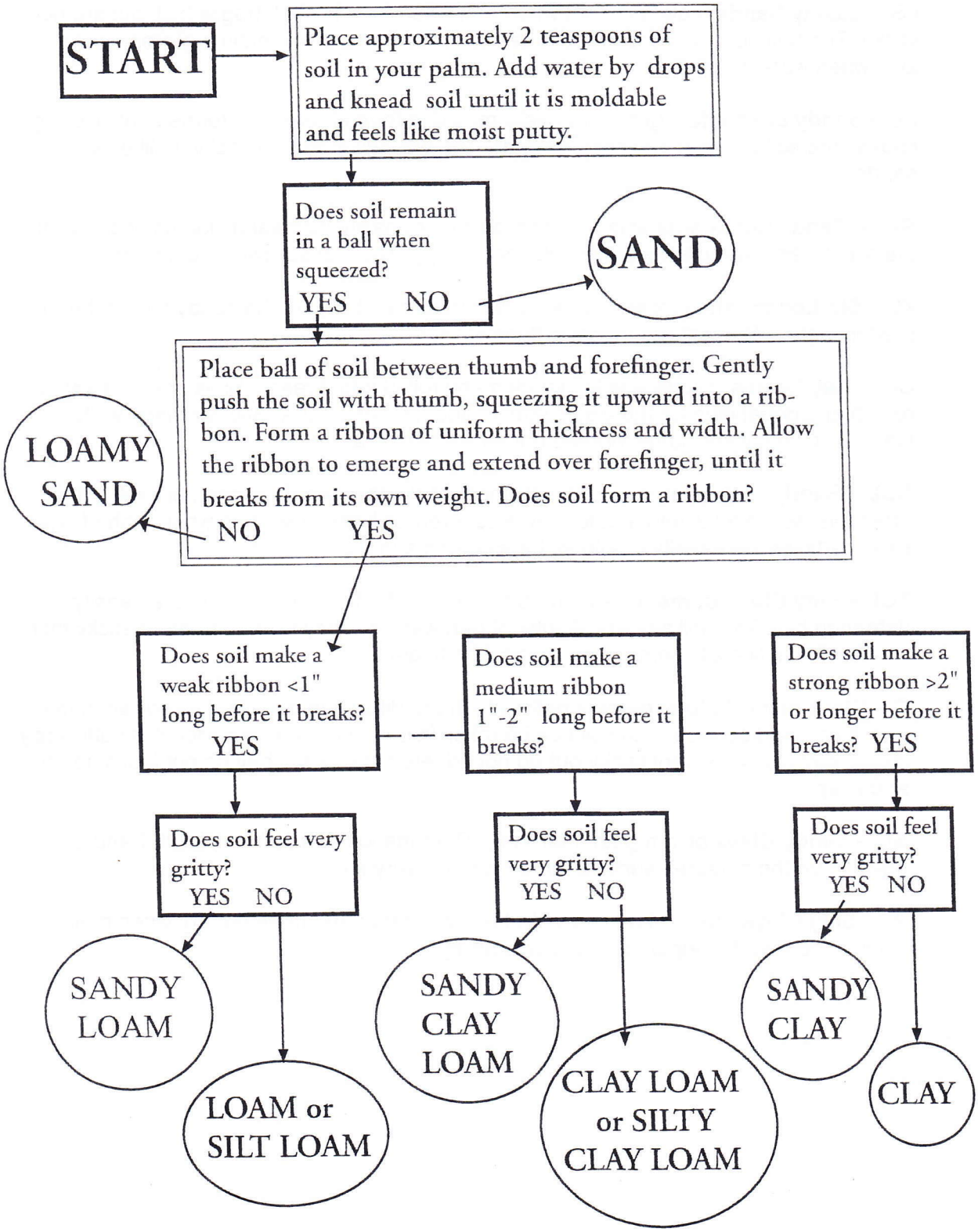
b. *Which sample has the most organic matter?*

c. *Does there seem to be a connection between the proportions of different-sized particles and where soils originated?*

d. *How can you test your inferences?*

Soil Texture Feel Test Key

Begin at the place marked "start" and follow the flow chart by answering the questions, until you identify the soil sample. Please note that soils having a high organic matter content may feel smoother (siltier) than they actually are.



Source: Adapted from WOW!: The Wonders of Wetlands, Environmental Concern Inc.

COMPOST

Organic matter decomposed to a state where it has become humus.

Organic matter: the water remains or waste products of any living thing
Humus: A fragrant spongy nutrient rich material resulting from the decomposition of organic matter.

Compost recycles **all** organic matter on the planet, stabilizing nitrogen

Benefits to the Soil
Increases water retention
Increases aeration
Nutrients released over time
Provides balanced nutrients
Improves soil structure
Balances pH
Adds micronutrients
Full of beneficial microbes
Compost is ALIVE, it a buffer and reacts with the life in the soil.

Chemical fertilizer is designed to be directly released to the plant—a one-time shot

Feed the soil to feed the plant
Four key elements to compost:

1. **Nitrogen (green leafy material)**
2. **Carbon (brown and woody material)**
3. **Moisture (from water)**
4. **Oxygen (from air)**

Aerobic Composting (with air)
Carbon (browns)/ Nitrogen (greens) balance (Ideally 25 to 1, by volume approx 1 to 1)
Water/Air balance
3'x3' minimum size for pile to heat up.

Primary decomposers (FBI)
Bacteria (heat up the pile); the pile gets hot because of microbial respiration ("party in the pile").
Fungus (begin their work as the pile begins to cool down).
Insects/Invertebrates and worms (work in the completely cooled parts of the pile).

When building a pile, use what you have.
The smaller the particles are when you begin, the faster they break down.
Keep your layers even and flat when building.
When the pile cools down, turn it.
Compost is "finished," or stable, when it no longer heats up.

Kū ʻĀina Pā
Summer Intensive 2016

Garden Bed Preparation and Compost Application

"Take care of the edges and the corners; the rest will take care of itself." – Orin Martin

Considerations for a garden bed

Size
Access to water
Access for people and tools
Sun exposure
Slope
Wind
Soil quality

Before digging, check soil moisture. Do not dig if it is too wet or too dry.

- **Corner posts**
- **Check paths, rake clear and add ½-2" of soil on to your bed**
- **Edge the bed**
- **Deep dig the bed with a garden fork from center out**
- **Add sifted (finished) compost and amendments, evenly**
- **Lightly till compost and amendments into top 4" of soil**
- **Smooth bed with a rake, and string if you want to**
- **Mulch the path if appropriate**

Add Organic Material by:
Adding compost into soil
Adding soil amendments
Topdressing
Mulching

There are many methods to bed preparation; as you work in your garden, you will tailor a method that best suits you.

Kū ʻĀina Pā
Summer Intensive 2016

Seed Saving and Seeds

At Mālaʻai: The Culinary Garden of Waimea Middle School

Seeds

Seeds have an intelligence; they know when to germinate, or break dormancy, when triggered by moisture, temperature, and sometimes light. They also carry the essence of the plant that they will become.

Seed Bank

Monocots (corn)

Dicots (bean)

Dormancy

Germination

Storing Seeds- Cool, Dark, and Dry, the lower humidity, the better.
Most seeds remain viable for between 1 and 5 years.

Reading a Seed Packet

Season
Sun exposure
Soil temperature
Days to germination
Planting depth
Spacing (Planting in triangulation)
Thinning
Days to Harvest

Record Keeping- reference

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Summer Intensive 2016

Water and Watering

What is the nature of your water?

- Where does it come from?
- How much do you have?

Factors for watering:

- **How much water do your plants need?**
  - Put plants with similar watering needs near to one and other.
  - What kind of soil do you have?
  - Do you have mulch?

- **When to water?**
  Evaporation, and evapotranspiration
  Time of day
  Season
  Plant specific needs

- **Methods**
  - overhead
  - drip
  - hand watering

Tips:

- Water heavily, less frequently
- Let soil surface dry between watering
- **Check moisture level before watering**
- Use mulch to protect your soil from sun and wind

TOOL USE

"The right tool for the right job, honey!" – Glen Dandenau,
Head of Grounds, Berea College.

Soil preparation & cultivation	Fertility – composting, mulching	Crop care – weeding, harvesting
Spading fork	Hands and fingers	Hoe
Shovel	Pitch fork	Pruner
Spade	Rake	Sickle
Rake		Bucket for tools
		Basket for harvest

TOOL CARE

BLADE CARE: Rags - Cotton t shirt Paper towels Putty knife or wire brush Mill file
HANDLE CARE: Oil – linseed/cooking Rags Water Brush

KEEP TOOLS OUT OF SUN AND RAIN

Soil Types

S - Sands do not stain the fingers when wet. They feel gritty, lacking cohesion when wet and are loose when dry. Any water squirted onto the surface quickly disappears and the surface returns to matt.

LS - Loamy Sands feels gritty but when moist can form a weak fragile ball, but are not sticky. The ball quickly collapses. Unlike sands the surface will retain a glistening wet look when water is applied.

SL - Sandy Loams feel gritty, but easily mold to form a deformed ball. Rolling causes the soil to break into short threads. The wet soil is slightly sticky, unlike loamy sands.

SZL - Sandy Silt Loams when moist mold more easily than sandy loams because of the silt content. They feel equally gritty and soapy. The wet soil clings to fingers.

ZL - Silt Loams when moist form an easily deformed ball, but the soapy feel of the silt predominates. The wet soil clings to fingers.

CL - Clay Loams are usually easily molded and rolled into threads. Balls are moderately robust and depending on the clay content either smear or ruck. Stickier than sandy loams and sandy silt loams, but are not as sticky as clays.

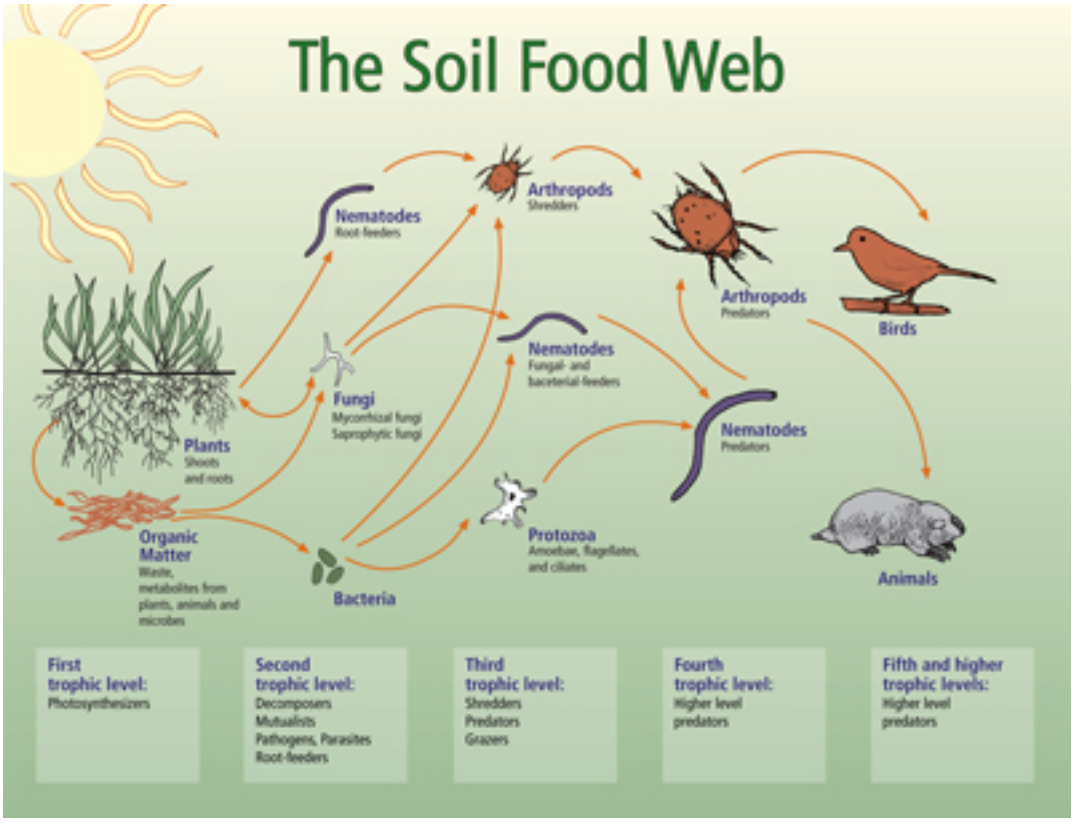
SCL - Sandy Clay Loams are distinctly more sticky than a sandy loam, but still gritty. The moist soil molds into a deformable, coherent ball, which smears when rubbed. The sand particles are usually visible in the smeared surface.

ZCL - Silty Clay Loams have a smooth soapy feel. The moist soil forms an easily deformed ball. The soil smears slightly. When wet, silty clay loams are stickier than silt loams, but like silt loams, they cling to the fingers.

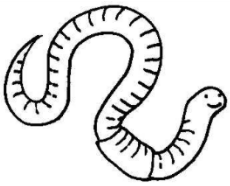
C - Clays mold to form durable balls, which are difficult to deform. The soil smears to give a polished surface. The soil can be rolled into long threads provided it is sufficiently moist. Wet clays are very sticky but do not adhere to fingers. They do not feel smooth and soapy.

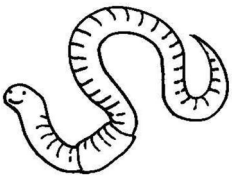
SC - Sandy Clays bind together strongly. Deformation of a ball is difficult. Sand is obvious on the smeared surface. When wet it is very sticky.

ZC - Silty Clays are similar to clays but feel smoother and butterier when moist. They adhere to the fingers and are very sticky.


The Soil Food Web
Nematodes
Root-feeders
Arthropods
Shredders
Arthropods
Predators
Birds
Nematodes
Fungal- and
bacterial-feeders
Fungi
Mycorrhizal fungi
Saprophytic fungi
Nematodes
Predators
Plants
Shoots
and roots
Protozoa
Amoebae, flagellates,
and ciliates
Organic
Matter
Waste,
metabolites from
plants, animals and
microbes
Bacteria
Animals
First
trophic level:
Photosynthesizers
Second
trophic level:
Decomposers
Mutualists
Pathogens, Parasites
Root-feeders
Third
trophic level:
Shredders
Predators
Grazers
Fourth
trophic level:
Higher level
predators
Fifth and higher
trophic levels:
Higher level
predators

Vermiculture Resources





General Information
http://www.biologyjunction.com/earthworm%20facts.htm#hatch

Easy Worm Bin Instructions
Two bin system
http://whatcom.wsu.edu/ag/compost/Easywormbin.htm

Harvesting Vermicast
http://www.youtube.com/watch?v=p1vhDsprLNM (tarp method)
https://www.youtube.com/watch?v=uLQ2UeyzAV0 (screen method)
http://www.youtube.com/watch?v=BhyTzhPtJcg (overhead light method)

Online Vermiculture Newsletter
http://www.redwormcomposting.com

Interactive Resource (Highly Recommended!)
3rd Grade - http://www.calrecycle.ca.gov/Vermi/

Curriculum
5th grade - http://carteret.ces.ncsu.edu/files/library/16/Vermicomposting%20Curriculum.pdf
http://urbanext.illinois.edu/worms/teachersbin/index.cfm

Worm Bin Bingo
Free downloadable bingo cards
http://www.lifelab.org/2010/05/worm-bingo/

Vermicast Tea
http://www.wikihow.com/Make-Worm-Castings-Tea
http://www.youtube.com/watch?v=xCcgPeS4pFg
https://www.youtube.com/watch?v=HqC9vyr6coY
http://www.amazon.com/Portable-Solar-Oxygenator-Aerator-Aquarium/dp/B00B14VEXQ
(solar powered aerator for brewing compost tea, no electricity required)

Hawaii Island School Garden Network
http://www.kohalacenter.org/HISGN/home.html
https://www.facebook.com/HISGN
dmitts@kohalacenter.org
Revised 03/16/16

School Learning Gardens MAP Training
Daily Questionnaire
Tuesday, June 7, 2016

1. Please share how you will use the following activities and/or knowledge gained in your class (if there's nothing – leave blank):
   - Morning story telling practice
   - What is soil made of?
   - Engineering Design Process
   - Compost making
   - Garden Bed preparation

2. What is your formative assessment of the MAP today?
   - Theme TWO: alignment with other standards – Core, NGSS, HCPS, etc.?
   - Cluster documents – what was useful? How to improve?

3. How did our activities help to teach **Living Soils, Living Plants** and meet the Learning Outcomes?

4. What did you like best about the day?

5. What can we do to improve the day?