15th St. Farm Nutrition Education Program Curriculum Guide

"Where healthy soil, plants and people meet!"

Grades K-12

Developed by the 15th St. Farm and the Center for the Advancement of Food Security & Healthy Communities

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GARDEN

Welcome to the 15th St. Nutrition Education Program curriculum guide, "where healthy soil, plants, and people meet!"

Located in the heart of downtown St. Petersburg Florida, the 15th St. Farm is as a therapeutic vegetable garden that provides fresh nutrient-dense food to residents. This urban oasis is a place where visitors of all ages can come to reconnect with nature, discover the true taste of ultra-fresh organically grown food, learn and socialize.

Our Nutritional Education Program (NEP) is an initiative of the 15th. St Farm that employs gardening as an educational tool not only for science and math but also in the holistic understanding that humans are **a part** of nature and not separate from it. From planting seeds to harvesting student grown fruits and vegetables, the 15th St. NEP offers opportunities for children to experience the growing cycle and be involved in the production of *"Good Food,"* defined as food that tastes good, is nutrient-dense and environmentally sound. Our program aims to increase student's willingness to try new fruits and vegetables as well as develop an emotional attachment to the food they grow.

This hands-on curriculum will help guide students, teachers and administrators in recognizing the enrichment provided by school gardens and experiential learning. Think of this curriculum as a suggested guide rather than a fixed course of lessons. We invite curiosity, exploration and discovery as the student's taste, smell and feel their way through the garden via the activities and discussion questions outlined. So, feel free to let learning run its course as the lessons unfold!

This interactive and engaging curriculum was developed by local garden educators in collaboration with students of the USF department of anthropology. Our 15th St. NEP collaborators include The University of South Florida Center for the Advancement of Food Security and Healthy Communities, The USF Metropolitan Food Project, Microbiome research Institute, Urban Food Park and supported by a generous grant from the United States Department of Agriculture/National Institute of Food and Agriculture (GRANT135334385).

If you are an educator using this curriculum in Pinellas County, you will need to be at least a level 2 instructor of the Pinellas County volunteer system. Further information can be found at: <u>https://focus.pcsb.org/volunteer/</u>.









Garden Care Tips To Make The Most Beautiful School Garden

Keep the Soil Healthy

As a medium for plants to grow, make sure that the soil that you're going to use for your plants are rich in nutrients and enough water. You may also want to feed your soil with organic matter. This can include shredded leaves, composted materials and aged/dried animal manures

Watering

Plants can be up to 95% water and need water to grow. However too much water can lead to root rot. To determine if your plant needs water, stick your finger about an inch into the soil —if it feels dry, water the plant. Make sure you're watering the soil and base of the plant rather than the plant itself. Water evenly, all the way around the plant ensuring that the soil stays moist.

Maintaining Plant

Plant maintenance can consist of pruning your plant (selectively removing plant parts such as branches, buds, depleted flowers, etc.), controlling pests using naturally occurring pesticides such as eucalyptus oil or neem oil and maintaining adequate light conditions to facilitate growth.

Harvesting

13

When harvesting fruiting crops it is generally best to harvest when fruit are ready to be eaten to ensure they stay flavorful and nutrient-dense. Keep in mind that the goal of the plant is to reproduce. If crops grow to full maturity and are not harvested, the plant will stop reproducing. Because of that, pay attention to the kinds of plants in your garden and their respective harvest dates.



Soil Lesson: Key Concepts, Resources and Activities

Goals		
Determine the characteristics of fertile soil		
□ Identify different components of soil		
Learn about the elements that nurture the soil		
Learn about the elements and conditions that harn	n soil	
Identify different layers in the soil		
Vo	ocabulary	
Living soil: minerals, rocks, Sand, and clay		
□ living organisms need: Air, water, shelter, sunlight		
Nutrients, Fertilizers, Pesticides		
☐ Microorganisms, insects, nematodes, arthropods, gastropods, earthworms		
Foliar spray		
Topsoil		
□ Microorganisms, insects, nematodes, arthropods, g	astropods, earthworms	
Int	roduction	
 Animals and minerals live together in a community infrastructure need to work together for the well-beir 	with different jobs like a city where all the parts of the ng of people	
Soil microorganisms depend on plants and animals		
• Soil is alive, it is hosting trillions and trillions of microorganisms. Like animals and humans, they need water, air, food, and shelter to thrive		
Soil and Plants are the living skin of the earth and lik	e all skins it is thin and fragile	
• Soil is like a city; it is a complex living and bio-diverse organism. It is an organized system with many actors responding to many needs		
• Soil is composed of minerals (sand, rocks, and clay), organic matter, microorganisms, water, and air.		
It is impossible to grow healthy food on soil that is sprayed with toxic chemicals		
Resources		
Observe soil and differentiate components (soil vs sand?)	Soil Arthropods NRCS Soils	
Soil Jar activity Soil is alive example/ microscope Soil is Alive!	A collection of 10 children's stories from around the world https://www.fao.org/3/cb4185en/cb4185en.pdf The secrets of the soil (Beginner)tps://www.fao.org/3/i4768e/i4768e.pdf Soil experiments for children	
	https://www.fao.org/3/i7957e/i7957e.pdf	

Key Concepts (soil food web)

- Soil as a growing medium for plants
- Soil is alive with trillions and trillions of microorganisms that make life possible
- Nurture soil, nurture people. Soil, like people, can heal with nurture
- Most man-made chemicals are dangerous to life.
- Plants, animals, and humans depend on microorganisms to grow and live
- •Healthy soil, Healthy plants, Healthy communities (People, animals, and microorganisms)
- The cycles of life are key to life on earth and allow it to perpetuate
- Biodiversity makes healthy soil. Rich plants and animals biodiversity make a healthy environment

Questions & Answers		
What are the physical characteristics of soil?	• Texture: the proportions of the different particles that make up the soil (sand, silt, and clay)	
	 Structure: animals that live in the soil, and plant residues 	
What lives in the soil?	• Soil organisms can generally be divided into six groups: bacteria, fungi, protozoa, nematodes, arthropods, and earthworms. Each group of organisms plays important roles. Even within each group, there is great diversity in form and function. (Fig 1)	
	 Insects, spiders, scorpions, centipedes, millipedes (arthropods) 	
	 Snails and slugs (gastropods) 	
	• Earthworms	
	 Even smaller than these, there are bacteria and fungi! 	
What is an arthropod? Can you see arthropods?	• Arthropods include insects, spiders, scorpions, centipedes, and millipedes! (In the water they include crabs, crayfish, shrimp, lobsters, barnacles	
	 Also distribute nutrients and carry bacteria on their exoskeletons! 	
	 Some also pollinate and produce honey 	
	 Some eat parasites/parasitic insects 	
	 They are food for birds, fish, and mammals 	
All about arthropods/ what are arthropods?	• Even in agricultural soils, more than a thousand arthropod legs support your every step.	
	• Arthropods include insects, spiders, scorpions, centipedes, and millipedes! (In the water they include crabs, crayfish, shrimp, lobsters, and barnacles).	
	 They help feed plants (nutrients) 	
All about worms/how do worms	• Fun fact: earthworms are attracted to one another by scent!	
	 Earthworms eat about ½ to 1 time their body weight every day 	
	• They help break down organic matter by feeding on dead plants and leaves that become nutrients for microorganisms and plants They have been doing it for millions of years before fertilizers were invented. It is the natural way of nature to provide food for every living creature.	

Questions & Answers		
What is a mollusk/gastropod? Do you see any gastropods?	•Gastropods are mollusks, aka snails and slugs. Gastropods contribute up to 33% of the total decomposition activity of organic matter and building of soil structure and are food for larger animals! shrimp, lobsters, barnacles).	
How do snails help the soil? All about snails	• Snails and slugs eat plants and some vegetables Their poop becomes food and nutrients for microorganisms! Their biodiversity makes the soil healthier. It works like a city everybody has a different role. Snails and slugs can multiply rapidly and become a problem if there are not enough birds snakes, raccoons, and possums to eat them	
	• They, like worms, eat old (decaying) plants and transform them into food for new plants.	
How many bacteria are in a handful of good soil?	 Anywhere from 3 million to 50 billion bacteria! more than all humans on earth The weight of all the bacteria in one acre of soil can equal the weight of a cow or two. 	
	• The great majority of bacteria are very useful. Some are neutral and others can be dangerous (pathogens). Like in a city, the great majority of residents are good people, a few may get in trouble given the opportunity, and very few cause trouble.	
	●Plants need them!	
	 Are aerobic= they require air to live They convert nitrogen into ammonium which is useful for plants (to create proteins) 	
Explain bacteria and fungi briefly	• Bacteria and fungi are extremely small and you can only see them through a microscope. (Fig.2)	
	 We can find bacteria everywhere! In the ground, in/on our bodies, and in the air. 	
	 One cup of soil may hold as many bacteria as there are people on Earth. Plants, animals, and humans depend on bacteria and fungi (microorganisms) to grow and live 	
	• Some fungi, such as mycorrhizal fungi, are ancient, and may have arrived before the first plants!	
How many fungal cells are in a	 Anywhere from 3 million to 50 billion bacteria! 	
handful of good soil?	 500,000-100 million individual fungal cells! Some fungi, such as mycorrhizal fungi, are ancient, and may have arrived <i>before</i> the first plants! 	
	•A teaspoon of farm soil may contain tens of yards of fungi. The same amount of soil from a coniferous forest may hold tens of miles of fungi	
	 Releasing nutrients from decaying plants and animals 	
	 Breaking down minerals for plants to use (while nutrients naturally exist in soil, they are not always in a form that plants can use) Plants, animals, and humans, depend on microorganisms to grow and live 	

Do not copy without permission.

Visual Material

Fig 1



https://www.soilfoodweb.com.au/about-our-organisation/benefits-of-a-healthy-soil-foodweb#:~:text=What%20makes%20a%20healthy%20soil%20food%20web%3F



ACTIVITIES	LEVEL 1 A / B / C	DATE	
Time	Soil Jar		
10'	The purpose is to visualize the soil composition 1. Introduce the topic 2. Ask what is the composition of the soil?		
40'	 Hands-on Soil Jar https://cdn.ymaws.com/www.mnla.biz/resource/collection/C9FDA4Es B91E77AF2813/10c SoilTextureJarTest StudentExercise(Collect soil samples from different areas. Put each sample in a separate jar: ½ soil, ¾ water. leaving some room (hea Add a teaspoon of powdered, non-foaming dishwasher detergent as a surf Put on a tight-fitting lid and shake the jar for 10 to 15 minutes to break up separates the soil into its individual mineral particles (sand, silt and clay particles (sand particles) settling out first and the smaller particles (silt and clay particles (sand particles) settling out first and the smaller particles (silt and clay settling out later. One (1) minute after shaking the jar, use the permanent m the height of the settled sand layer on the side of the jar. Be careful not to disediment layer when marking the jar Two (2) hours after shaking the jar, mark the height of the settled silt layer the jar. Again, be careful not to disturb the sediment layers when marking the ide careful not to disturb the sediment layers when marking the ide water to clear, but with some soils it may take weeks. 	5-7F2A-45EI 002).pdf d space) at actant. the soil agg icles) e larger, hea ay particles arker to ma isturb the on the side e jar e of the jar. ly takes 1 to	The top regates and vier) rk of Once again, 3 days for
	2. Observe the soil in the garden, try to find earthworms, arthropods, gastropor under rocks will help you find the most worms and millipedes!)	pods. (Diggi	ng in wet soil
Recap	 What did you learn? repetition of Key concepts 		

	Goals	
☐ Identify what we can and cannot compost		
Explain the process of composting and its benefits		
Explain how to take care of compost		
Define 4 key elements organisms need to thrive		
Compare and contrast anaerobic to aerobic composting		
Differentiate mulch, compost, and humus		
V	'ocabulary	
Brown paper bags, Eggshells, Fruits, Dairy, Meat,	Plastic	
□ Dead plants, Organic matter, Decomposition		
□ Soil health, Erosion, Water, Personal food waste		
□ Temperature, Aeration, Moisture		
Nitrogen, Carbon, Oxygen, Water		
□ Mulches		
Biostimulant		
Oxygen level, Efficiency, Odor, Phases		
□ Aerobic		
□ Anaerobic		
□ Manure		
vermicompost		
\Box Compost tea and compost extract		
Humu		
In	troduction	
 The key to a good garden is good soil and making c 	compost helps us achieve that	
 Compost improves soil health and lessens erosion 		
 Compost conserves water, reduces personal food v 	waste, and reduces the need for chemical fertilizers	
Resources		
Lesson Plan Compost: A Scientific Investigation	Compost How to create easy "black gold"	
Compost Your Way	https://kidsgardening.org/wp-	
Fun Facts	content/uploads/2023/05/Decomposition-Scavenger-Hunt.pdf	

Fun Facts	content/uploads/2023/05/Decomposition-Scavenger-Hun
Make a Worm Composting Bin	<u>Composting Process</u>
Decomposition Garden Activity Pack Weigh the Waste	What Can I Compost?
Brew compost tea	What Can and Cannot be composted

Key Concepts

Compost is organic matter that has been broken down by decomposers and microorganisms and is full of available nutrients and microorganisms that will further feed plants by decomposing mulch and organic matter

• Compost is also called "The gardener's black gold"

• Composting improves soil health, lessens erosion, conserves water, and reduces personal food waste helps reduce food waste

• Compost microorganisms like all living creatures need air, moisture, food, and adequate temperature. Different microorganisms like different temperatures as they digest their food they will generate heat

• The final product of compost should look crumbly and smooth, dark and rich in color, with no bad odor, and ¹/₃ the original size of the communities (People, animals, and microorganisms)

• Compost can be added to potting soil, garden beds, potted plants, and fruits trees

• Anaerobic composting happens in low-oxygen environments. It releases a strong and unpleasant odor and is favorable to pathogens

• Aerobic composting requires oxygen. Has a pleasant odor, and includes multiple phases: Mesophilic phase, Thermophilic phase, Maturation, Curing, and Cooling. It happens faster in warm weather than in cold weather.

Questions & Answers		
Does the soil get sunburnt ?	• Like your skin too much sun is bad and will dry and hurt Even within each group, there is great diversity in form and function.	
How do you protect soil from sunburns?	•Keep it covered by living and dead plants they will act as the clothing	
What do you call dead plants on the ground?	• Mulch	
What else does mulch do?	• It feeds all the microorganisms. In turn, the microorganisms will feed the plants. Everybody's poop becomes someone else's lunch	
	 Mulch also helps retain moisture in the soil and cools the soil making it comfortable for the plant roots 	
When do we mulch?	• Before planting, seedlings will be easier. Open a space in the mulch, dig a hole, and plant the seedling. After planting the seedling make sure not to cover the small plant	
Is compost mulch?	• No compost is full of microorganisms and exposing it to the sun would kill them quickly which would be bad	

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Questions & Answers		
What is compost?	• It is organic matter that is being broken down by decomposers and microorganisms and is full of available nutrients and microorganisms that will further feed the plants	
	 The natural process of recycling organic matter into available nutrients 	
	• The key to a good garden is good soil and making compost helps us achieve that	
	• Composting speeds up the process when something decomposes by providing the ideal environment for bacteria, fungi, and other decomposing organisms	
	Compost also called "black gold"	
	 At the end of the process, the decomposed material should look like garden soil. That final product is what we call compost 	
What can we compost? What Can I Compost?	 Brown paper bags, Coffee ground, and filters, Eggshells (break down easily and are a good source of calcium), Fruit and vegetables, Leaves, Teabags, Yard trimmings, Nutshells, Hair and fur 	
What can't be composted?	• Dairy products and eggs (creates odor problems and can attract pests),	
	• Diseased plants (disease might transfer to other plants)	
	 Yard trimmings treated with chemical pesticides (might kill beneficial composting organisms) 	
	 Fats, grease, or oils (creates odor problems and can attract pests), 	
	 Pet waste (might contain parasites, bacteria, germs, pathogens, and viruses that are harmful to humans) Plastic 	
Why does compost get hot? Touch your belly. Is it hot?	 The same thing that happens in your stomach is happening in the compost pile. Microorganisms digest the organic material to release the nutrients microorganisms need different temperatures, The temperature is an indication of which one is working/ a compost pile can go up to 160F The same thing that happens in your stomach is happening in the compost pile. Microorganisms digest the organic material to release the nutrients microorganisms need different temperatures, The temperature is an indication of which one is working/ a compost pile can go up to 160F 	

Questions & Answers		
Benefits of Composting		
 Improves Soil Health and 	 Compost contains three primary nutrients needed for garden crops 	
Lessens Erosion	• Nitrogen	
	• Phosphorus	
	• Potassium	
	 Compost also increases the soil's water retention 	
 Conserves water 	• The water-retaining capabilities of soil increase with the addition of	
	organic matter	
	• Compost acts like a natural sponge, storing water and holding moisture	
	 Using compost to improve the soil always allows you to water less 	
 Reduces Personal Food 	 The average household of 4 throws out \$150 of food per month 	
Waste	 Composting is a great way to save those scraps from researching the 	
	landfill	
	 28% of the organic waste that we throw away can be composted instead 	
	of thrown into the trash	
 Reduces the need for 		
chemical fertilizers		
Organisms need four key		
elements to thrive	4 Key Elements for Compost	
• Nitrogen	 Is one of the basic building blocks of life and is essential for growth and 	
	reproduction in plants and animals]	
	"Greens"	
	 Having lots of greens in your compost will make sure the decomposers 	
	grow and reproduce quickly	
	Examples – coffee grounds, food scraps, weeds	
 Carbon is another 	 Is one of the basic building blocks of life and is essential for growth and 	
necessary compound for all	reproduction in plants and animals] "Browns"	
life forms	 Acts as a food source for decomposers, helps keep them alive while they 	
	break down waste	
	 Examples – dead leaves, twigs, branches, paper 	
	 Want to have 2-3 times more brown materials than greens 	
 Oxygen and Water 	 Decomposers need oxygen and water to survive 	
	Compost should be kept constantly moist	
	• To ensure a faster composting process, you need the right amount of air	
	and water	
	• You can get a better airflow going through it by lavering the different	
	materials in there and making sure the material you put is in smaller pieces	
	- , , , , ,	

Questions & Answers		
How do we make a good Compost?		
• Temperature	 Hot compost breaks down quicker. Warm weather will speed up compost. Cold weather will slow compost. For a compost pile to kill weeds and seeds, it will require to be a minimum of 1 cubic yard to reach a minimum of 130 degrees for 3 days. This high temperature will kill pathogens and will be adequate to make compost tea Ideally, 130-140 degrees E 	
 Aeration and turning 	Speeds up the process and ensure an even decomposition of the pile	
	• Turn it once a week during the summer, once every three weeks during colder	
Aeration in Compost	months	
• Water	•, but not soggy (50-65% moisture is optimal for microbes)	
	A good portion of the water will come from rain, moisture from the green	
	If the pile is too wet it will become anaerobic and smell. To remedy the issue turn/aerate it to dry, and add more "brown"	
Final product	Should look crumbly and smooth without recognizable craps	
	Dark and rich in color (humus) Should not have a bad odor. if it does that is indicative of moisture levels being off or not enough aeration 	
	• 1/3 of the original size	
How can we use it?	Add It to potting soll Mix into garden beds	
	• Feed it to potted plants	
	Add it to the soil around fruit trees	
What is humus?	• Humus is dark, organic material that forms in soil when plant/animal matter decays, it is the result of the decomposition process (compost is a slightly more flexible term, while humus is a specific component, also known as "finished compost")	
	Humus has better water retention than compost, but both benefit the soil	
	 Humus has a 'shelf life' of a hundred years or more! 	
	 Soil will have a crumbling texture if humus is incorporated 	
Composting types: Anaerobic	Anaerobic composting happens in low-oxygen environments it releases a strong	
	and unpleasant odor, and is favorable to pathogens	
	It releases a strong and unpleasant odor and is favorable to pathogens	
Composting types: Aerobic	Aerobic composting requires oxygen. Has a pleasant odor	
-Includes multiple Phases	1 Mesonhilic phase : temps between 35-37 *C: lasts a few days	
	2: Thermophilic phase temps between 55-60*C: days to months	
	3: Maturation, curing, and cooling phase; lasts a few months	
	It happens faster in warm weather than in cold weather.	

Questions & Answers		
Heat production depends on the elements discussed previously (nitrogen, carbon, oxygen, water; specifically, C/N ratio) as well as the ambient temperature (environment; outdoor/indoor)	 As the compost heats, more oxygen is consumed by the microbes If the temperature rises above 160 degrees F, compost becomes anaerobic, and the beneficial microorganisms/microbes will die On the other hand, if the pile is too cold, harmful pathogens and weeds will destroy the quality of the compost, and possibly spread through the pile A hot pile of compost can maintain its heat for a few days, as you notice the temperature dropping down to around 100 degrees F, turn the pile again 	
What will happen if the C: N ratio is too high? Too low?	 Too high= compost process is slowed Too low= nitrogen loss in the form of ammonia gas, leachate 	

Visual Material

Mulch



https://www.homedepot.com/c/ab/best-mulch-foryour-yard/9ba683603be9fa5395fab90378c2bc5





https://www.thespruce.com/compost-blackgold-for-your-garden-soil-1403130



4 Key Elements for Compost





https://www.morelandcommunitygardening.org/education/

Aeration in Compost

Figure 1. Air flow in a compost pile



LEVEL	A/B/C	DATE		
Time	Composting Activities			
10'	1. Introduce the topic			
	2. What is trash composed of?			
	3. Ask what are decomposers? What are fungi, microorganisms, and insect	ts? What is	s their	
	job?			
	4. What is organic and inorganic waste			
	3. Record what the students know before the lesson			
40'	Hands-on			
	Lesson Plan Compost: A Scientific Investigation			
	Materials:			
	• 6 clear jars			
	• At least one "set" of trash:			
	an apple core			
	• a piece of plastic			
	o two leaves from outside			
	o a piece of bread			
	 Soil enough to fill six jars (from outside, not store-bought to ensure that it contains) 			
	the bacteria and microorganisms necessary for decomposition)			
	Procedure			
	1. Fill each iar to within 1 inch from the top with soil			
	2. Explain that you will be leaving the objects in the soil for seven weeks, a	nd ask the	auestion	
	again: "How do you think these objects will change over time?"			
	3. Add a few tablespoons of water to the jar and keep the lid off. Continue	adding wa	ater to	
	each jar as necessary to keep the soil moist but not soaked over the next s	even weel	ks	
	4. Each week have students record observations for each trash item			
	5. At the end of seven weeks record final observations. They should observ	/e a treme	ndous	
D	difference in some jars between the first and last week	<u> </u>		
Кесар	• Observe each jar and compare their objects and whether they were dec	omposed o	or not.	
	Discuss what is decomposed and what isn't			
	• What did you learn? repetition of Key concepts			

Works Cited

Individual credit to Damien for composting notes, Emmanuel for questions, and Alex for a supplementation of synthesis and lesson plans.

"Air Flow in a Compost Pile." *BioCycle*, https://www.biocycle.net/aeration-floor-fundamentals/. "Bacteria." *Global Garden*, https://www.globalgarden.co/knowledge/how-do-bacteria-get-nutrition/.

"Colored Mulch." *HomeDepot*, https://www.homedepot.com/c/ab/best-mulch-for-youryard/9ba683603be9fa5395fab90378c2bc5.

"Compost: A Scientific Investigation." California Academy of Sciences,

https://www.calacademy.org/educators/lesson-plans/compost-a-scientific-investigation. "Composting." *KidsGardening*, https://kidsgardening.org/resources/gardening-basics-composting/.

Folds, Evan. "The Ultimate Guide to Brewing Compost Tea." *Medium*, Medium, 10 Mar. 2018,

https://evanfolds.medium.com/the-ultimate-guide-to-brewing-compost-tea-8ddeb4622b9e. "Fungi." *Kids Discover*, https://kidsdiscover.com/teacherresources/fungi/.

"Humus Compost." Help Me Compost, https://helpmecompost.com/compost/basics/humus-compost/.

"Humus." National Geographic, https://education.nationalgeographic.org/resource/humus/.

- "Ingredients Needed to Make Compost." Grow It Build It, https://growitbuildit.com/how-to-make-acompost-pile/.
- "Keep Compost Moist." Kitchen Garden, https://kitchen-garden.be/gardening-why-garden/compostgrowing-soil.

Leon County Office of Sustainability. "What Can I Compost?" *Growing Green*, https://cms.leoncountyfl.gov/growinggreen/Green-Topics/Composting-Initiatives.

- LoveYourKids. "Composting." Easy Science For Kids, https://easyscienceforkids.com/composting/.
- Merkel, Steven. "Black Gold' Compost." *The Spruce*, https://www.thespruce.com/compost-black-gold-for-your-garden-soil-1403130.
- "Phases during Composting." *Climate Policy Watcher*, https://www.climate-policywatcher.org/wastewater-sludge/composting-process.html.

Schulzie, and Getty Images. "A Granular Fertilizer Sprinkled near the Base of a Plant Will Slowly Release Nutrients to the Roots Below." *Better Homes & Gardens*,

https://www.bhg.com/gardening/yard/garden-care/why-you-should-fertilize-plants/.

"Thermophilic Phase." Untamed Science, https://untamedscience.com/biology/ecology/ecologyarticles/the-science-of-compost/.

"Types of Composting and Understanding the Process." *EPA*, Environmental Protection Agency, https://www.epa.gov/sustainable-management-food/types-composting-and-understanding-process.

"What Can and Cannot Be Composted." *Moreland Community Gardening*, https://www.morelandcommunitygardening.org/education/.

Goals
Identify seeds and their parts
□ Identify the stages of seeds
Learn how to sow and plant seeds
\Box Identify some seeds that we eat
Understand how seeds are produced
\Box Understand that plants, soil, animals, and humans depend on each other like systems in a city
□ Understand transplanting as the process of moving a fully germinated seedling or mature plant and replanting it
in a permanent location
Determine benefits and disadvantages of transplanting
Vocabulary
Embryonic stage of plant life
Embryo, Endosperm, Seed Coat
Seed dormancy
□ Sowing seeds
Crops
Germinated seedling
□ Transplanting
Introduction to Key Concepts
 A plant will produce a flower with male and female parts or in some instances male and female flowers or a male or female plant
 The male flower produces pollen which must be carried to the female flower (via wind birds bees and
other insects)
Pollen makes its way into the female plant where it pollinates the ovaries and produces seeds
Online Resources
Visit for more lesson plans:
 Florida Agriculture in the classroom): <u>faitc.org/wp-content/uploads/2018/03/2017_GFG-</u> <u>Book.compressed.pdf</u>
 kidsgardening.org/resource-lesson-plans/
 www.leafforlife.org/index.html

Key Concepts

• The embryonic stage of plant life consists of an embryo (a tiny plant that has a root system and one or more leaves), endosperm (nutritive tissue or the seed), seed coat (protective covering to preserve the internal parts of the seed)

- A nut is technically a fruit, but we usually eat the shell and toss the fruit
- Seed dormancy is the state where the seed is unable to germinate
- Germination is the process of sprouting a new plant and involves Imbibition, Latent phase, and Growth in adulthood
- Sowing seeds requires proper depth, spacing, and organizing

Questions & Answers				
What is a seed?	 A seed is a plant's unit of reproduction. Seeds are produced by adult plants, and if planted, they can grow into another adult plant 			
Where can seeds be found?	 Seeds are found on the inside or outside of existing plants 			
Do all seeds look the same?	• No! Seeds come in different shapes, colors, and sizes.			
What do seeds need to grow?	 Seeds need water, food (soil), and sunlight to grow 			
Why are seeds important?	 Seeds are needed to make new plants. Plants produce the air we breathe. We need plants to breathe fresh air, play outside, and go to school every day. Plants help to keep our air clean. Plants can also produce fruits and vegetables such as strawberries, apples, potatoes, and green beans. 			
What are the parts of a seed?	 Embryo: a tiny plant that has a root system and one or more leaves Endosperm – nutritive tissue or the seed Seed Coat – protective covering that helps the seed to work properly for a long period of time (Fig. 1,2,3) 			
What are some seeds that we eat?	 Wheat Peanuts Lentils Beans Peas 			
What is the largest seed in the world?	• Coconut! Coco-de-Mer, also known as "the double coconut", is the seed of the Lodoicea maldvica plant, a large fan palm that reaches 25 m (82 ft) in height! The palm is only found on two islands Praslin & Curieuse in the Seychelles.			

Questions & Answers				
What is a nut?	• A nut is technically a seed. Example. Cashews, walnuts and pecans			
How are seeds produced?	 A plant will produce a flower with male and female parts or in some instances male and female flowers or a male or female plant The male flower produces pollen which has to be carried to the female flower (It is carried by the wind, birds, bees, and other insects) 			
	• The pollen makes its' way into the female plant where it pollinates the ovaries and produces seeds			
What is seed dormancy?	• The state where the environmental conditions make a seed unable to germinate and is in a dormant state where all activity and metabolism is suspended. Seeds can remain dormant for hundreds and sometimes thousands of years! (Fig 7)			
How can you plant seeds?	 Direct seeding/sowing – planting seeds directly in the soil It starts with the soil also known as the seed starting medium. This is when the proportions of temperature, moisture, and light help regulate the retention of moisture that seeds need to germinate and survive the early stage of plant development. Perlite: Is a volcanic glass that provides aeration and optimum moisture retention (Fig. 6) 			
	 Vermiculite: Is a mineral used for moisture retention and provides nutrients for seedlings. (Fig. 5) Coir is an organic material (from spent coconut husks) that resist compaction and holds moisture. Typically seed packets contain seeding instructions. Follow them for successful germination. Plant at a proper depth Pay attention to spacing. Think of the size of the adult plant. 			
Seed sowing tips	 It is okay to sow multiple seeds because not all will germinate, and you will be able to eliminate the extras to maintain the recommended spacing Sow carrots and radishes close and then thin them out Plant seeds in rows to stay organized Press down gently on the soil with the back of a rake to mark the rows and direct the water to where the seeds are Water seeds gently and every day until the plants are a few inches tall (don't blast with water that will uncover and disturb the seeds) 			

Questions & Answers				
What is seed germination	 Is the process a seed goes through when it "wakes up" from its dormant state and starts to grow Germination of seed requires the seed to feel that the conditions are correct to "wake up from dormancy" Moisture, temperature, and sunlight are required for the seed to germinate and start growing A seed will first grow a root to access nutrients and moisture then it will grow a stem, leaves, and then flowers and seeds 			
What are the phases of germination?	Imbibition – the seed rapidly takes up water, the seed swells and softens Latent phase – seed breaks down and uses the food stored inside the seed One of the most important parts of this process is the breakdown of proteins, which feeds the roots and stem growth Growth: Roots and leaves multiply and strengthen into a mature plant			
How long do you think the whole life cycle takes?	That will produce flowers and seeds to complete a full cycle This depends on which plant you are growing. For example, a sunflower's life cycle can be 2-3 months while a banana's life cycle can be 9-12 months and a banana tree can live for 6 years			
What is Harvest	Seeds packets will indicate "Days to harvest" this indicates how many days a seed will become a plant ready to harvest			

Visual Material

Fig 1



https://www.toppr.com/guides/evs/seeds-and-seeds/seed/

Fig 2



https://hortpeople.com/monocots-vs-dicots-with-diagrams/

Fig 3



Parts of a seed

d Root Vascular

Fig 4

	Seed	Root	vascular	Lear	Flower
Monocot		TRACT			
	One cotyledon	Fibrous roots	Scattered	Parallel veins	Multiples of 3
Dicot		Station of the state		Ree	
	Two cotyledon	Tap roots	Ringed	Net-like veins	4 or 5

https://ib.bioninja.com.au/higher-level/topic-9-plant-biology/untitled-3/monocots-versus-αιcots.ntmi

Fig 5

Vermiculite



Fig 6

Perlite



Fig 7



Activities					
LEVEL	A - Beginner Activity 1	DATE			
Time	Types of Seeds				
10′	1. Introduce the topic				
	2. Hand each child three different looking seeds				
	3. Ask them to guess which seed belongs to which plant of three plant options.4. Tell the children to talk amongst themselves about their guesses and why they think they are right				
	5. After each child makes a guess, explain which seeds belong to wh	ich plants	5		

LEVEL	A - Beginner Activity 2	DATE		
Time	Seed Needs			
10'	1. Introduce the topic			
	 Revisit ideal conditions that seeds require for germination Introduce ingredients that will be used to create the seed starting medium (the earlier described ideal conditions of soil to plant the seeds) and explain the purpose each serves in promoting the ideal conditions required 			
40'	Hands–on			
	Creating a Seed starting medium			
	Materials:			
	• starting medium			
	• measuring cups			
	• pots			
	Procedure			
	1. Give each kid the supplies and demonstrate how to properly plant the seed. Including how much soil			
	2. Fill the cup ¾ with soil			
	3. Ensure the seed depth is equivalent to 2 times the size of the seed			
	4. Make sure the amount of water is enough to make the soil			
	moist, but not super saturated.			
4.01	4. Let them write their names on the cups so they don't get switche	d		
10.	Discussion			
	How does this seed starting medium provide the ideal conditions for germination and plant growth?			
	How does it allow for drainage and yet still retain moisture?			
	How could the temperature be controlled?			

LEVEL	2A What's Inside? (Beginner) Date:
Time	Activities
10′	 Introduction How many parts does a seed have? Let the students answer, then introduce the five primary parts with the rendering of the anatomy of the seed Differentiate between monocot and dicot seeds as you review the function of each part of the seed Explain that seeds contain everything they need internally to sprout with the exception of heat, oxygen, and moisture
20'	 Hands-on Plant part identification 1. Prepare for this lesson a few days to a week in advance by sprouting seeds in jars 2. Present the students with a sample of various seeds that have sprouted in small jars 3. Have them touch the sprouts and examine each variety with their magnifying glasses 4. Name each seed and have them try to identify the five parts
	Materials Needed per Group 1. Small samples of various seeds that have been sprouted, Magnifying glasses, Anatomy of a Seed - Printed or displayed
10'	 Discussion Seeds look different from each plant so what role does the "size" of the seed play? Will bigger seeds produce bigger plants? How long do you think dormant seeds can remain viable? Could we grow something from seeds that are 800 years old?
5'	 Assessment 1. By a show of hands, how many of you know what's inside a seed? 2. Now that you know the five parts of a seed and the function they serve, raise your hand if you think you could explain it to someone else?

LEVEL	3A Will These Grow? (Beginner)	Date:
Time	Activities	
	Introduction	
10'	1. Describe germination process	
	2. Seeds need perfect conditions to leave their dormancy an	d begin to germinate
	3. The germination test aims to provide those conditions so	that seeds will germinate and
	viability can be determined	

	Materials I	Materials Needed per Group			
		1. Seeds, Paper towels, Water, Resealable bags, Labels, Permanent marker			
	Hands–on	Starting Seed Germination 1. Position students at tables where they can have small workspace to themselves and provide them with a small bowl of water, a paper towel, a resealable bag, marker, and some seeds			
20'		 Have them create their tests as describe in "<u>Testing Your Old Seed</u>" Each student should mark their bags with their name, the date, and the type of seed being tested 			
10'	Discussion	 How long do you think it will take for these seeds to germinate? How many seeds do you think will germinate out of the 10 that you are testing? 			
5′	Assessmer	 a show of hands, how many of you know how seeds germinate? by a show of hands, how many of you know how seeds germinate? Now that you know how the germination process works, how many of you think you could explain the process to someone else? 			

Works Cited

Individual credit to Damien for composting notes, Emmanuel for questions, and Alex for a supplementation of synthesis and lesson plans.

"Air Flow in a Compost Pile." *BioCycle*, https://www.biocycle.net/aeration-floor-fundamentals/. "Bacteria." *Global Garden*, https://www.globalgarden.co/knowledge/how-do-bacteria-get-nutrition/.

"Colored Mulch." *HomeDepot*, https://www.homedepot.com/c/ab/best-mulch-for-youryard/9ba683603be9fa5395fab90378c2bc5.

"Compost: A Scientific Investigation." California Academy of Sciences,

https://www.calacademy.org/educators/lesson-plans/compost-a-scientific-investigation. "Composting." *KidsGardening*, https://kidsgardening.org/resources/gardening-basics-composting/.

Folds, Evan. "The Ultimate Guide to Brewing Compost Tea." Medium, Medium, 10 Mar. 2018,

https://evanfolds.medium.com/the-ultimate-guide-to-brewing-compost-tea-8ddeb4622b9e. "Fungi." *Kids Discover*, https://kidsdiscover.com/teacherresources/fungi/.

"Humus Compost." Help Me Compost, https://helpmecompost.com/compost/basics/humus-compost/.

"Humus." National Geographic, https://education.nationalgeographic.org/resource/humus/.

- "Ingredients Needed to Make Compost." Grow It Build It, https://growitbuildit.com/how-to-make-acompost-pile/.
- "Keep Compost Moist." Kitchen Garden, https://kitchen-garden.be/gardening-why-garden/compostgrowing-soil.

Leon County Office of Sustainability. "What Can I Compost?" *Growing Green*, https://cms.leoncountyfl.gov/growinggreen/Green-Topics/Composting-Initiatives.

- LoveYourKids. "Composting." Easy Science For Kids, https://easyscienceforkids.com/composting/.
- Merkel, Steven. "Black Gold' Compost." *The Spruce*, https://www.thespruce.com/compost-black-gold-for-your-garden-soil-1403130.
- "Phases during Composting." *Climate Policy Watcher*, https://www.climate-policywatcher.org/wastewater-sludge/composting-process.html.

Schulzie, and Getty Images. "A Granular Fertilizer Sprinkled near the Base of a Plant Will Slowly Release Nutrients to the Roots Below." *Better Homes & Gardens*,

https://www.bhg.com/gardening/yard/garden-care/why-you-should-fertilize-plants/.

"Thermophilic Phase." Untamed Science, https://untamedscience.com/biology/ecology/ecologyarticles/the-science-of-compost/.

"Types of Composting and Understanding the Process." *EPA*, Environmental Protection Agency, https://www.epa.gov/sustainable-management-food/types-composting-and-understanding-process.

"What Can and Cannot Be Composted." *Moreland Community Gardening*, https://www.morelandcommunitygardening.org/education/.

LEVEL	A/B/C	DATE

Objectives	Vocabulary	
Identify the parts of a plant	Roots, Leaves, Seeds, Flowers, Fruit, and Stems	
Explain the different functions each part contributes	Absorption, Food sources, Sunlight collection, Proliferation of more plants, Soil water uptake, Pollination	
Explain the process of photosynthesis	Carbon dioxide, Oxygen, Chlorophyll, Stomata	
Explain the process of pollination	Bees, Butterflies, Plant growth, Flowers, Anther, Stigma	
Identify the parts of a seed and their importance	Embryo, Endosperm, Seed Coat	
Compare and contrast evapotranspiration and transpiration	 Evaporation = Loss of water from water bodies, Transpiration = Loss of water from plants, Evapotranspiration = Evaporation + Transpiration 	

Key Concepts			
•	The parts of a plant are: Roots, Leaves, Seeds, Flowers, Fruit, and Stems		
•	Roots absorb water through evapotranspiration and transpiration		
•	Fruits hold the seeds and provide a food source		
•	Seeds create more plants and consist of three parts: Embryo, endosperm, and seed coat		
•	Leaves collect sunlight through photosynthesis using chlorophyll and stomata		
•	Stems take water up from the soil and consist of three parts: Phloem, Xylem, Cambium		
•	*Fun fact bonus: Potatoes are actually stems, not roots!!!		
•	Flowers undergo pollination by bees or butterflies to increase plant growth, with the main components being the		
	Anther and the Stigma		

Suggested Activities	Resources - <u>Anatomy of a Flower</u>	
A. A Level - Root Observation & Comparison	- Supplementation by Damien	
B. B Level - Root Observation & Comparison	- Supplementation by Damien	
C. C Level - Root Observation & Comparison + Food and parts lists	- Supplementation by Damien	





Fun Facts

- 1. Root: Roots act like straws absorbing water and minerals from the soil. Tiny roots hairs stick out of the root.
- 2. They help in the absorption process. Roots provide foundation to the plant in the soil so it does not collapse. Roots are also used to store extra food for future use.
- 3. Stems: Stems do many things. They support the plant. They act like a system that supplies water for different actions. It carries out water and nutrients from the roots and food, which is in the form of glucose from the leaves to other plant parts. There are two types of stems, the bendable stem woody.
- 4. Leaves: Most plants' food is made in their leaves. Leaves are designed to capture sunlight. It is used by the plant to make food through a process called photosynthesis.
- Flowers: A flower is the part in a plant which is used for reproduction. Flowers contain dust particles which are used as a fertilizing element and tiny eggs. These tiny eggs are called ovules. After completion of the process of transferring pollen grains of the flower and fertilization process, the ovule becomes a fruit.

Fig 1

Anatomy of a Flower



LEVEL	A/B/C	Activity Options	Date:			
	Activities					
A	 Have a few plants available Have them take labels (rooparts of the plant Depending on what is in the potato (eat the root), for expendence 	a few plants available to look at, a few with roots out, on a piece of paper them take labels (roots, leaves, stems, flowers, fruits, seeds, etc) and place them near of the plant ending on what is in the garden, could walk around and compare lettuce (eat the leaves) to o (eat the root), for example				
В	 Have a few plants available to look at, a few with roots out, on a piece of paper Have them take labels (roots, leaves, stems, flowers, fruits, seeds, etc) and place them near parts of the plant Depending on what is in the garden, could walk around and compare lettuce (eat the leaves) to potato (eat the root), for example 					
C	 Have a few plants availabl Have a diagram of a plant leaves, stems, flowers, fru Ask them to list (out loud food is Depending on what is in th potato (eat the root), for ex 	e to look at, a few with roots out, o available, and ask the students to c its, seeds, etc) or on paper) various foods they eat ne garden, could walk around and c cample	on a piece of paper reate labels/label the plant (roots, and what part of the plant(s) the compare lettuce (eat the leaves) to			

Works Cited

"Anatomy of a Flower." *Education*, https://www.education.com/worksheet/article/anatomy-of-flower/.

- Azure-Dragon. "Broccoli." *Harvard Health Publishing Harvard Medical School*, Getty Images, https://www.health.harvard.edu/heart-health/vegetable-of-the-month-broccoli.
- Bauer, Elise. "Artichoke." *Simply Recipes*, https://www.simplyrecipes.com/recipes/how_to_cook_and_eat_an_artichoke/.
- "Beets." Healthline, https://www.healthline.com/nutrition/benefits-of-beets.

"Boiled Asparagus." The Plant Based School, https://theplantbasedschool.com/boiled-asparagus/.

"Cabbage." Cleveland Clinic, https://health.clevelandclinic.org/benefits-of-cabbage/.

"Carrots." Live Eat Learn, https://www.liveeatlearn.com/carrots/.

"Corn." Britannica, https://www.britannica.com/plant/corn-plant.

- Getty Images. "Onions." *Southern Living*, https://www.southernliving.com/food/veggies/onions/how-to-store-onions.
- "Grains." Let's Eat Healthy, https://www.healthyeating.org/nutrition-topics/general/food-groups/grains.

"Green Beans." Alpha Foodie, https://www.alphafoodie.com/how-to-boil-green-beans/.

"Green Peas." Healthline, https://www.healthline.com/nutrition/green-peas-are-healthy.

- Joe_Potato. "Cauliflower." *Harvard Health Publishing Harvard Medical School*, Getty Images, https://www.health.harvard.edu/heart-health/vegetable-of-the-month-cauliflower.
- LabXchange. "Evapotranspiration = Evaporation + Transpiration." *Labxchange*, The President and Fellows of Harvard College, https://www.labxchange.org/library/items/lb:LabXchange:c91a9fb1:lx_image:1?source=%2Fclas ses%2F15428e3e-2a46-4d40-8ce7-4ee36247dbba%3Fsource%3D%2Flibrary%2Fclusters%2Flx-cluster%3Aabe-italiano.

"Lettuce Iceberg Large." *Fresh Midwest*, https://www.freshmidwest.com/shop/produce/vegetables/lettuce_spinach_and_greens/lettuce_ice berg_large/p/78517/.

Lommel, Claudia. "Spinach." *Healthline*, https://www.healthline.com/nutrition/foods/spinach.

Parts of Plan Lesson: Key Concepts, Resources and Activities

- MaskaRad. "Radishes." *Gardening Know How*, https://www.gardeningknowhow.com/edible/vegetables/radish/tips-how-plant-radish.htm.
- "Oranges." Britannica, https://www.britannica.com/plant/orange-fruit.
- Peters-Fabelfroh, Kristian. "Chlorophyll." *National Geographic*, CC. Unported, https://education.nationalgeographic.org/resource/chlorophyll/.
- "Plant Parts." Easy Science For Kids, https://easyscienceforkids.com/plant-parts-facts-for-kids-video/.
- "Pollination." Ypsilanti District Library, https://www.ypsilibrary.org/2020/06/bees/.
- "Primary Growth vs. Secondary Growth." *Lumen*, https://courses.lumenlearning.com/wm-biology2/chapter/stem-growth/.
- Russ, Karen. "Collards (Brassica Oleracea) That Are Bolting after a Prolonged Cold Period." *Home & Garden Information Center*, HGIC, 2009, https://hgic.clemson.edu/factsheet/collards/.
- Shutterstock. "Photosynthesis." Smithsonian Science Education Center, https://ssec.si.edu/stemvisionsblog/what-photosynthesis.
- Staroseltsev, Alex. "Apple." *Collins*, Shutterstock, https://www.collinsdictionary.com/us/dictionary/english/apple.
- "Stomata Diagram." Science Facts, https://www.sciencefacts.net/stomata.html.
- "Tomatoes." Healthline, https://www.healthline.com/nutrition/foods/tomatoes.
- VVMICH. "Celery." *EatingWell*, Getty Images, https://www.eatingwell.com/article/7935325/is-celery-good-for-you/.

