

Science Building a Perfect Soil Recipe



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Overview:

In this lesson, students will engage in the scientific process to create different combinations of clay, sand, and compost to determine what type of soil will grow the longest kale leaf. Students will make observations about the soil that plants grow in around the school and form a hypothesis of what combination of clay, sand, and compost would make the best soil for their plant. They will measure their combination by assigning a certain number of the ten parts to each of the three types of soil. When their soil is created, they will conduct the experiment by planting their seed in the soil and providing for the plant's needs of air, water, nutrients, and sunlight. After a few weeks of caring for their plants, students will estimate the length of the longest leaf, measure the length using standard tools, and compare their leaves to other students' leaves. Based on their observations, students will draw conclusions about which type of soil is best for kale growth and share their results by describing their soil combination in the form of a fraction, writing the ratios in decimal notation, comparing the amounts of each using less than, equal to, and greater than, and by writing an equation and creating a visual model showing how the parts add up to the full recipe.

Time Needed: 40 minutes on first day, 15 minutes on day a few weeks later

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Georgia Performance Science Standards:

- Habits of Mind (3-5):
 - S3CS1/S4CS1/S5CS1. Students will be aware of the importance of curiosity, honesty, openness, and skepticism in science and will exhibit these traits in their own efforts to understand how the world works.
 - S3CS8/S4CS8/S5CS8. Students will understand important features of the process of scientific inquiry.
 - S3CS3/S4CS3/S5CS3. Students will use tools and instruments for observing, measuring, and manipulating objects in scientific activities.
 - S3CS5/S4CS5/S5CS5. Students will communicate scientific ideas and activities clearly.
- Earth Science / Life Science:
 - 3rd Grade
 - S3E1c. Students will use observation to compare similarities and differences of texture, particle size, and color in top soils (such as clay, compost, and sand).
 - S3L1. Students will investigate the habitats of different organisms and the dependence of organisms on their habitat.

Common Core Math Standards:

- Fractions
 - 3rd Grade
 - CCSS.MATH.CONTENT.3.NF.A.1 Understand a fraction $1/b$ as the quantity formed by 1 part when a whole is partitioned into b equal parts; understand a fraction a/b as the quantity formed by a parts of size $1/b$.
 - CCSS.MATH.CONTENT.3.NF.A.3.D. Compare two fractions with the same numerator or the same denominator by reasoning about their size. Recognize that comparisons are valid only when the two fractions refer to the same whole. Record the results of the comparisons with the symbols $>$, $=$, or $<$, and justify the conclusions by using a visual fraction model.

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- 4th Grade
 - CCSS.MATH.CONTENT.4.NF.B.3.A. Understand addition and subtraction of fractions as joining and separating parts referring to the same whole.
 - CCSS.MATH.CONTENT.4.NF.B.3.D. Solve word problems involving addition and subtraction of fractions referring to the same whole and having like denominators, e.g., by using visual fraction models and equations to represent the problem.
 - CCSS.MATH.CONTENT.4.NF.C.5. Express a fraction with denominator 10 as an equivalent fraction with denominator 100, and use this technique to add two fractions with respective denominators 10 and 100. *For example, express $3/10$ as $30/100$, and add $3/10 + 4/100 = 34/100$.*
 - CCSS.MATH.CONTENT.4.NF.C.6. Use decimal notation for fractions with denominators 10 or 100. *For example, rewrite 0.62 as $62/100$; describe a length as 0.62 meters; locate 0.62 on a number line diagram.*
 - CCSS.MATH.CONTENT.4.NF.C.7. Compare two decimals to hundredths by reasoning about their size. Recognize that comparisons are valid only when the two decimals refer to the same whole. Record the results of comparisons with the symbols $>$, $=$, or $<$, and justify the conclusions, e.g., by using a visual model.
- 5th Grade
 - CCSS.MATH.CONTENT.5.NF.A.1
 - Add and subtract fractions with unlike denominators (including mixed numbers) by replacing given fractions with equivalent fractions in such a way as to produce an equivalent sum or difference of fractions with like denominators. *For example, $2/3 + 5/4 = 8/12 + 15/12 = 23/12$. (In general, $a/b + c/d = (ad + bc)/bd$.)*
 - CCSS.MATH.CONTENT.5.NF.A.2
 - Solve word problems involving addition and subtraction of fractions referring to the same whole, including cases of unlike denominators, e.g., by using visual fraction models or equations to represent the problem. Use benchmark fractions and number sense of fractions to estimate mentally and assess the reasonableness of answers. *For example, recognize an incorrect result $2/5 + 1/2 = 3/7$, by observing that $3/7 < 1/2$.*

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Objectives:

- Students express curiosity about how the world works and will understand the process of scientific inquiry.
- Students investigate different soil types and discuss the dependence of organisms on their habitat.
- Students observe and compare the similarities and differences between clay, sand, and compost including smell, texture (smooth, rough), color (dark, light), particle size (large, small), and weight (heavy, light). Students will discuss how these characteristics can be a benefit or disadvantage for their plants.
- Students identify the fraction of their soil mixture that is comprised of each soil type and express their fractions with a denominator of 10 as an equivalent fraction with a denominator of 100 and use decimal notation to represent the numbers.
- Students will compare the amount of each type of soil in their mixture, recording the results of comparisons using the symbols $>$, $+$, $<$ and justifying the conclusion using a visual model.
- Students create a word problem involving the addition of fractions by using both a visual fraction model and an equation to represent the problem.
- Students estimate, measure, and compare the difference in the height of the plants and communicate scientific ideas clearly.

Materials:

- Trowels (one per small group)
- Magnifying Glasses (one per small group)
- Kale seeds (one per small group)
- Identical cups with drainage holes (one per small group)
- Different soils: clay, sand, compost

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Optional Materials:

- Mixing bowls and/or wooden spoons
- Chef hats and/or aprons

Outline:

- Engage: Make an observation and conduct research
- Explore: Ask a question and form a hypothesis
- Explain: Conduct an experiment
- Extend: Draw conclusions and share results

Lesson Plan:

- Engage (small groups / in the garden) - 10 minutes:
Scientific Method: Make an observation and conduct research
 - Observe plants growing in the garden and various outdoor spaces around the school noting the dependence of those plants on their unique habitat.
 - Small groups can use a trowel to pull up some of the soil in each location. Students touch and look closely with a magnifying glass before articulating what they observe about the soil using the words that describe:
 - Smell
 - Texture (smooth, rough)
 - Color (dark, light)
 - Particle Size (small, large)
 - Weight (light, heavy)
- Explore (small groups / in the classroom) - 10 minutes:
Scientific Method: Ask a question
 - Ask students if making those observations and describing the types of soils brought up any questions in their mind - particularly as they plan to plant their kale seeds.
 - Guide students to asking "What type of soil will our kale leaves grow the longest in?" (Note that if the students ask "What type of soil will kale like the best?" or a question similar, to reframe it to address a measurable attribute like the plant's height or the leaves length).

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Scientific Method: Form a hypothesis

- Review with students the three main types of soil:
 - Clay: soil with the smallest particles; water does not pass through easily
 - Sand: soil with the largest particles; water passes through easily
 - Humus / Compost: organic material; provides nutrients
- Allow them the opportunity to touch, smell, and look closely at each.
- Ask students in small groups to come up with a hypothesis to write on a sentence frame: "I think the kale leaves will grow the longest in a soil that is made up of x/10 clay, y/10 sand, and z/10 humus because..."
- Explain (small groups / in centers) - 20 minutes:

Scientific Method: Conduct an experiment

 - Explain that we are going to conduct an experiment to figure out which group came up with the best soil recipe.
 - Each small group will measure out the parts of their soil recipe (with a total of 10 parts total). The parts can be measured with standard or non-standard measurement units.
 - Students can plant their kale seed in their mixture then, ask students to recall what plants need to grow and create a plan to account for each:
 - Nutrients: seeds are planted in soil
 - Air and Light: pick a location with plenty of light
 - Water: develop a plan for watering each the same amount each day
- Extend (small groups / in the classroom on a day a few weeks later) - 15 minutes:

Scientific Method: Draw Conclusions

 - A few weeks later, students in their small groups can estimate the length of their longest leaf, measure its length using standards tools, and compare the difference in their leaf's length to other plants in the class.
 - Based on their comparison, small groups can discuss which type of soil grew the longest kale leaf for their group and brainstorm why that may be true.

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Scientific Method: Share Results

- Each of the groups can share their results, conclusion, and explanation of why they think the experiment may have turned out as it did.
- Results should include a detailed description of the soil mixtures that was created by the group.
 - Showing the ratio of clay to soil to compost in fractions with a denominator of 10, as well as a denominator of 100, and written in decimal notation.
 - Comparing the amount of clay to soil to compost that they chose to use, conveying comparisons using the symbols $>$, $+$, $<$.
 - Displaying both an equation and a visual model showing how the parts add up to the full recipe.

- Evaluate:

Example Evaluation

Engage		
S3CS1/S4CS1/S5CS1. S3L1.	Student exhibited curiosity in an effort to understand how the natural world works and investigated plants' dependence on their habitat.	
S3CS8/S4CS8/S5CS8. S3E1c.	Student participated in making an observation comparing the similarities and differences between clay, sand, and compost.	
S3CS3/S4CS3/S5CS3.	Student used tools (trowels, magnifying glasses) to observe).	
Explore		
S3CS8/S4CS8/S5CS8.	Student participated asking a question and forming a hypothesis.	
CCSS.MATH.CONTENT.3.NF.A.1	Student understood the use of fractions to describe the proportion of each type of soil out of ten parts.	
Explain		
S3CS8/S4CS8/S5CS8.	Student participated in conducting the experiment.	
Extend		
S3CS8/S4CS8/S5CS8.	Student participated in drawing conclusions.	

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- Evaluate:

Example Evaluation

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S3CS8/S4CS8/S5CS8.	Student participated asking a question and forming a hypothesis.	
CCSS.MATH.CONTENT.3.NF.A.1	Student understood the use of fractions to describe the proportion of each type of soil out of ten parts.	
Explain		
S3CS8/S4CS8/S5CS8.	Student participated in conducting the experiment.	
Extend		
S3CS8/S4CS8/S5CS8.	Student participated in drawing conclusions.	
S3CS5/S4CS5/S5CS5.	Student communicated scientific ideas clearly in results.	
CCSS.MATH.CONTENT.4.NF.C.5. CCSS.MATH.CONTENT.4.NF.C.6.	Student expressed their fractions with a denominator of 10 and 100 and wrote the fractions in decimal notation.	
CCSS.MATH.CONTENT.3.NF.A.3.D. CCSS.MATH.CONTENT.4.NF.C.7.	Student compared the ratio of each type of soil that they used in their recipe.	
CCSS.MATH.CONTENT.5.NF.A.2	Student explained the combination of the types of soil by adding the fractions or decimals to equal one whole - representing with an equation and a visual representation.	
TOTAL:		/100