Building a Perfect Soil Recipe

Science

Overview:
In this lesson, students will engage in the scientific process to determine what type of soil will grow the tallest spinach plant--creating combinations of clay, sand, and compost. Students will make observations about the soil that plants grow in around the school, they'll 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, then 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 height of each plant, measure the heights using standard tools, and compare the difference in height of each. Based on their observations, students will draw conclusions about which type of soil is best for spinach to grow in and will then share their results describing their soil combination in the form of a fraction with a denominator of 10 and of 100, writing the ratios in decimal notation, comparing the amounts of each using symbols >, =, <, 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 a day a few weeks later)

Objectives:

- Students will express curiosity about how the world works and will understand the process of scientific inquiry.
- Students will investigate the soils that different plants grow in and discuss the dependence of organisms on their habitat.
- Students will observe to compare the similarities and differences between clay, sand, and compost including smell, texture (smooth, rough), color (dark, light), and particle size (large, small), weight (heavy, light). Students will discuss the how these characteristics can be a benefit or disadvantage for their plants.
- Students will 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 will create a word problem involving the addition of all of the fractions referring to the same whole by using both a visual fraction model and an equation to represent the problem.
- Students will estimate, measure (with standard tools), and compare the difference in the height of the plants and will communicate scientific ideas clearly.

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Materials:

- Trowels (1 per small group)
- Magnifying Glasses (1 per small group)
- Spinach seeds (1 per small group)
- Identical cups with drainage holes (1 per small group)
- Different soils: clay, sand, compost

Optional Materials:

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

Outline:

- Engage: Make an Observation / Conduct Research
- Explore: Ask a Question / Form a Hypothesis
- Explain: Conduct an Experiment
- Extend: Draw Conclusions / Share Results

Lesson Plan:

- Engage (small groups/in the garden) - 10 minutes
  - Scientific Method: Make an Observation/Conduct Research:
    - Observe the plants growing in the garden and various outdoor spaces around the school to investigate 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 then touch and look closely with a magnifying class 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 doing some research into describing the types of soils brought up any questions in their mind - particularly as they plan to plant their spinach seeds.
    - Guide students to asking “What type of soil will our spinach seeds grow the tallest in?” (Note that if the students ask “What type the spinach will like the best?” or a question similar, to reframe it to address a measureable attribute like the plant’s height).

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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 spinach will grow the tallest 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) with standard or non-standard measurement units.
  - Students can plant their spinach 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 height of their plants, measure the height of their plants using standards tools, and compare the difference in the height of the other plants in the class.
  - Based on their comparison, small groups can discuss which type of soil grew the tallest spinach plant for their group and brainstorm why that may be true.

- Scientific Method: Share Results
  - Each of the groups can share their results, conclusion, and explain their ideas of why the experiment may have turned out as it did.
  - Results should include a detailed description of the soil mixtures that were 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.

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Evaluate

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.	
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