WHAT A PLANT WANTS (1 60 MIN PERIOD)

Siemens SCIENCE Day
LEARNING BY DOING

Addresses NGSS
Level of Difficulty: 3
Grade Range: 4-6

OVERVIEW

In this activity, students will analyze different types of soil. They will test several types of soil to determine the best soil in which to grow a school garden.

Topic: Agronomy and Plant Needs

Real-World Science Topics

- An exploration of the types of soils.
- An exploration of the optimal growing conditions for crops.

Objective

Students will gain an understanding of the optimal growth conditions for crops by testing several types of soil to determine the one best suited for growing vegetables.

NGSS Three-Dimensions

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Analyzing and Interpreting Data Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used. Analyze and interpret data to make sense of phenomena using logical reasoning. (3-LS4-1) **Constructing Explanations and Designing Solutions** Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems.	**LS4.C: Adaptation** For any particular environment, some kinds of organisms survive well, some survive less well, and some cannot survive at all. (3-LS4-3)	**Cause and Effect** Cause and effect relationships are routinely identified and used to explain change. (3-LS4-2), (3-LS4-3) **Interdependence of Engineering, Technology, and Science on Society and the Natural World** Knowledge of relevant scientific concepts and research findings is important in engineering. (3-LS4-3)

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Use evidence (e.g., observations, patterns) to construct an explanation. (3-LS4-2)

Engaging in Argument from Evidence

Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s). Construct an argument with evidence. (3-LS4-3)

Make a claim about the merit of a solution to a problem by citing relevant evidence about how it meets the criteria and constraints of the problem. (3-LS4-4)

Background Information

Soil is composed of rocks that have been weathered down as well as broken down organic matter. It comes in many different colors depending on what components are in the soil. All soils differ in their ability to support plant growth. Soil benefits plants in several ways. It provides stability for the plants by giving them a place to anchor themselves. It also is a source of both water and nutrients for the plants. A sandy soil allows water to pass through it too quickly and it doesn't hold its shape very well. The soil holding its shape is what enables the plants to anchor themselves. Clay is a type of soil that holds water well, but it becomes very compacted and holds its water too long for most plants. The compaction also makes it difficult for roots to move through it. The loam soil is made up of mostly organic matter and has holes throughout it that allow plants' roots to move through them as well as water, but the loamy soil holds the water and its shape as well, which makes it the best soil for planting a garden.

Key Vocabulary

Clay – A soil which is composed of very fine particles, usually containing silicates, aluminum, and or iron and magnesium.
Loam – A soil that is rich in nutrients containing equal amounts of sand and silt while also having a small amount of clay in it as well.
Sand – A soil that is the fine debris of rocks and often consists of small loose grains of quartz.
Topsoil – The fertile upper part of the soil on the earth's surface.

WHAT A PLANT WANTS (1 60 MIN PERIOD)

Materials Needed for Activity

Materials Needed for Demonstration:

- 1 picture of the food pyramid

Materials Needed for Each Team of 3-4 Students:

- 4 12oz Styrofoam cups
- Clay soil
- Sandy soil
- Loam soil
- Local soil
- 1000 milliliters of water
- 4 small bowls
- Graduated cylinder

Teacher Preparation

Use a pencil to place a hole in the middle of the bottom of each of the Styrofoam cups to be used in the experiment. Label each cup for one of the four soils: Clay Soil, Sandy Soil, Loam Soil, and Local Soil.

Prepare the four soils. They will need as much soil as it will take to fill the cups needed for each group of 3-4 students. The four soils will be clay, loam, sandy soil, and a local soil.

1) Creating sandy soil: Mix topsoil and sand in equal ratios.
2) Creating loamy soil: Mix topsoil, peat moss, and sand in equal proportions.
3) Clay soil.
4) Sample of local soil from the school grounds

STEPS FOR *WHAT A PLANT WANTS*

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1. Warm-up Activity: Start the lesson by showing the students an example of the food pyramid.

- Have students brainstorm what they would consider to be well-rounded meals for them to eat on a daily basis.
- Discuss with them why they included fruits, vegetables and proteins. Discuss why it is so important to have food from all five food groups in their diets.
- Ask them why they would never have a meal that solely included candy bars and the effect it might have on the body if that is all you ate all the time. Focus in on the fact that his kind of diet would be absent of all the necessary nutrients that a body needs to function and to grow properly.
- Explain to the students that plants are much like the human body in that they need the proper nutrients to grow and to produce the fruits and vegetables that we eat on a daily basis.
- Explain that since the soil is where the plants get their nutrients this is where they will be looking to determine which type of soil is the best in which to grow their vegetables. The best type of soil is one that has air pockets and is not compacted. This allows roots to grow through the soil and enables the plant to get the nutrients they require to thrive. It also allows the water to move down through the soil. However, a soil that retains the water for too long will cause roots to rot and most plants will die.

2. Hand out to each group of students four cups (one of each of the four types of soil) and the recording sheet. Allow the students to pour out each cup of soil onto a paper towel one at a time and to make observations about the soil. Students will make their observations on the Soil Characteristics Chart Handout.

- Encourage students to make observations about the following soil characteristics:
  - color
  - texture
  - size of the particles
  - presence of organic matter
- They may include any other observations they can make using their five senses with the exception of taste. Remind students that in science we don't smell things during experiments but we waft, by moving our hands over the object we wish to smell so that we do not smell it directly.
- When students are done with their observations, have them make a prediction about which of the three soils they believe will be the best for growing plants. Ask them to explain their answers.
- Have students place the soil back into the appropriate cups.

3. Hand out to each group four small bowls to go with the four cups of soil.

- The students will then pour 240 milliliters of water into each cup.
- One student will hold the cup over the pie tin, while another student will pour the water.
- Water that makes it through the soil will flow through the hole in the cup and into the bowl.
- Students should pour the water into the graduated cylinder and measure how much water made it through the soil.
- Students will repeat this process for each of the four soils. Each time the amount of water that makes its way through the soil should be measured and recorded. Each group should create a bar graph that reflects their results.

4. Students will then dump the cups of soil back into the bowls and make observations about the soil. Their observations should include any changes that have been made in the soil as a result of the water.

- Is the soil still somewhat loose (good for roots to go through) ?
- Has the soil become compacted?

Plants need soil that is somewhat loose, but it must also still hold together well because the roots of a plant need to be firm and secure to anchor the plant.

5. Students will now review the observations they have made and look at the water retention qualities of the different soils and determine which soil would be the best for gardening. In doing so, they should answer these questions:

   - What type of soil held the most water?
   - What type of soil held the least water?
   - Was there a type of soil that became compacted by the water?
   - Was there a soil that kept its shape even with the water?
   - What soil would be the best to have as garden soil at the school?

6. **Wrap-up Activity:** Collect all of the bar graphs that have been made and display them on the board. Have a discussion about the results and discuss the soils that each group has chosen as the best for growing plants in a garden. Students should have chosen the loamy soil as the best soil for gardening. Discuss any reasons for choices other than this soil.

Extension Activity

Based on their results, students can test their theories on the best type of soil for growing vegetables. They can grow peppers and tomatoes in container gardens. Students can plant tomato and pepper plants in each of the types of soil used in this experiment and then record the results of growing the plants until the vegetables mature on the plants. Conclusions can then be made as to whether or not their theories from the soil activity were correct.

Sources

http://agverra.com/blog/soil-types/
http://www.ehow.com/
http://www.brighthubeducation.com

WHAT A PLANT WANTS
STUDENT HANDOUT

Name:

Date:

Soil Characteristics		
Type of Soil	**Draw a Picture**	**Observations of the Soil**
Clay		
Loam		
Sandy		
Local Soil		

WHAT A PLANT WANTS

STUDENT HANDOUT

Siemens SCIENCE Day
LEARNING BY DOING

Create a Bar Graph Below to reflect your results from the water and soil experiment.

mL water	Clay Soil		Loam Soil		Sandy Soil		Local Soil	
240								
235								
230								
225								
220								
210								
205								
200								
195								
190								
185								
180								
175								
170								
165								
160								
155								
150								
145								
140								
135								

WHAT A PLANT WANTS

STUDENT HANDOUT

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mL water	Clay Soil		Loam Soil		Sandy Soil		Local Soil	
130								
125								
120								
115								
110								
105								
100								
95								
90								
85								
80								
75								
70								
65								
60								
55								
50								
45								
40								
30								
20								
10								

WHAT A PLANT WANTS
STUDENT HANDOUT

AFTER POURING THE WATER INTO THE SOIL		
Type of Soil	**Draw a Picture**	**Observations of the Soil**
Clay		
Loam		
Sandy		
Local Soil		

After the water has been poured through the soils, answer the following questions:

1. Which soil type held the most water?_____

2. Which soil type allowed the most water to pass through?_____

3. Was there a soil that became compacted by the water?_____

4. Was there a soil that kept its shape even with the water?_____

5. After comparing your observations of the soil prior to the water and after the water which soils changed the most? In what ways?

6. Based on your observations, which soil would be the most appropriate to use for garden soil and what did you observe that would lead you to believe it to be the best soil?

WHAT A PLANT WANTS
TEACHER HANDOUT

Soil Characteristics		
Type of Soil	**Draw a Picture**	**Observations of the Soil**
Clay		Sticks together when you squeeze it Smooth Slimy when wet
Loam		Soft Dark in color Sticks together when squeezed but there are still spaces in the soil.
Sandy		Very small grains Does not stick together Easily pours Does not hold its shape
Local Soil		

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AFTER POURING THE WATER INTO THE SOIL		
Type of Soil	**Draw a Picture**	**Observations of the Soil**
Clay		
Loam		
Sandy		
Local Soil		

After the water has been poured through the soils, answer the following questions:

1. Which soil type held the most water? Clay

2. Which soil type allowed the most water to pass through? Sand

3. Was there a soil that became compacted by the water? Clay

4. Was there a soil that kept its shape even with the water? Loam

5. After comparing your observations of the soil prior to the water and after the water which soils changed the most? In what ways?

   The sand became wet, but fell apart easily.
   The clay became harder and compacted and would not be easy for water to pass through or for roots to grow through.
   The loam sticks together and holds it shape, but is still soft enough to allow roots to pass through it.

6. Based on your observations, which soil would be the most appropriate to use for garden soil and what did you observe that would lead you to believe it to be the best soil?

   The Loam would be the best soil, because it did hold a good deal of water, but did not become compacted like the clay. It also holds together enough to give the roots a good place to anchor themselves. The sand on the other hand falls apart very easily and the plants would not be able to anchor themselves well. The water will also run right through sand.