Playing in the Dirt: Discovering Soil

Grades 7-8

Science

Objectives

Through classroom experiences, students will compare different types of soil found around their school and home to identify three basic soil components. Students will also develop an experiment to discover the effect of soil types on seed germination.

Vocabulary

Clay– soil that is sticky when wet, can be rolled into a ball and is used in making bricks
Loam– a rich soil composed of sand, silt, clay, and some organic matter
Organic Material– matter from dead plants and animals
Sand– loose, gritty grains of disintegrated rock found in soils, on beaches and in deserts
Silt– a fine-grained, sandy sediment carried or deposited by water

Background

When you dig into the ground under the grass in your yard, you will find soil. But what happens if you keep on digging? If you dug far enough, would you run out of soil? How far would you have to dig before you ran out? And what would you find there?

If you dug far enough, you would hit solid rock. This is called bedrock. But before you got there you would have to dig through different layers of soil. The layers are known as horizons, and all the layers together make up the soil profile. The first layer would be nothing but dark-colored **organic materials**. That is the layer formed by plants and insects that have died and dead leaves that have fallen. Organic matter is beneficial to soils. It increases water-holding capacity, serves as a reservoir for plant nutrients such as nitrogen, and provides food for the living things in the soil. Just under that is the topsoil. The topsoil is the best place for plants to take root and grow. It is a mixture of air, water, organic material (matter from dead plants and animals) and minerals (**sand, clay, silt**). The subsoil is the layer below the topsoil. It is made mostly of clay or sand and has very little organic material. Plants have a hard time growing in subsoil. Between the subsoil and the bedrock is a layer of small rocks that have started to break off the bedrock. This layer is the parent material of the soil. That's because most of what makes up the soil was once part of the rock. The final layer is the bedrock.

"The nation that destroys its soil destroys itself."
- Franklin D. Roosevelt

There are three basic categories of particles that exist in soils. Clay is the smallest, feels sticky and often stains the fingers. Silt feels smooth and soft and is somewhat slick. Clay and silt particles cannot be seen with the naked eye. Sand particles can be seen with the naked eye. They are the largest and feel gritty.

Soils are distinguished by observing the percentage of each of the three types of particles. These mixtures are called **loams**. If soil has more sand it is a "sandy loam," more silt, a "silty loam," or more clay, a "clay loam." Soils vary Clay loams hold water tightly, but they drain poorly. Clayish soils are sticky. Plants growing in clay may suffer from a lack of air around the roots because the tiny clay particles absorb so much water. Clay soils drain poorly and prevent plants from getting the needed water around their roots. Sandy loams provide enough air to the roots because the particles are large; however, sand does not hold water well, and it drains quickly. The water becomes unavailable to thirsty plants. Plants in sand soils need to be watered frequently. Silty loam can be found around water sources. It is generally the soil that is carried in by flooding and then left in the drying process. This soil can collect organic materials and nutrients and store them in the existing soil.

The best growing soils combine the airiness and drainage of sand with the water-holding capacity of clay. Loam soils that contain approximately 40 percent sand, 40 percent silt and 20 percent clay are considered the best cultivating soils.
in their ability to be cultivated. The combination of particle types dictates how the soil will handle, drain and hold water.

Additional Resources

- Soil and Soil Dynamics video: https://youtu.be/mg7XSjcnZQM
- Soil Texture by Feel video: https://www.youtube.com/watch?v=GWZwbVJCNec

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Teacher Resources

Activity 1: What is Soil, (Science) 1 50 minute class periods

Materials

- Pen or Pencil
- **Activity 1 Worksheet 1"What is Soil?" worksheets**
- Computer access to show "Soil and Soil Dynamics" video

Procedures

Engage:

1. To determine what students already know about soil, have each student develop an answer to the following question… "What is Soil?"
2. Ask the question, then through "Think. Pair. Share." have students work with a partner to answer the question on the **"What is Soil?"** worksheets.

Explore

1. Show video https://youtu.be/mg7XSjcnZQM
2. Have students develop statements/questions about the importance of soil based on the information in the video.
3. Have students develop a model to describe the cycling of Earth's materials and the flow of energy that drives the process.

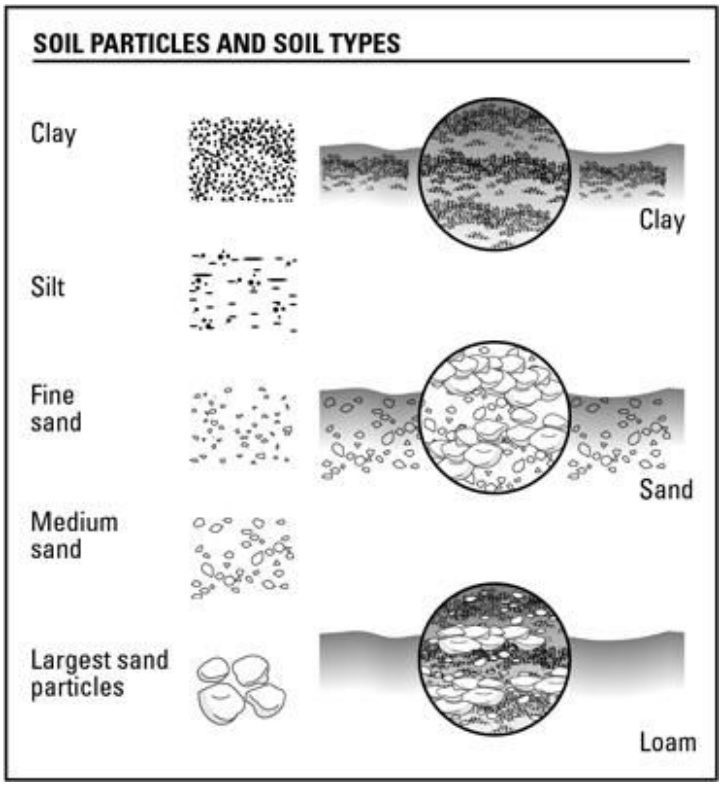
Explain

1. Discuss the three basic soil components and the qualities that each add to the soil.

   SAND - Sand particles are the largest of the three types. They can be angular or rounded.

   SILT - Silt particles are more angular and larger than clay but still microscopic.

   CLAY - Clay particles are microscopic and flat.



Activity 2: Ribbon Test to Determine Soil Type (Science) 1 50 minute class period

EXPERT TIP: Test each of the soil samples beforehand to make sure they work for this activity!

Materials

- Soil samples from three different areas, as follows:
    1. topsoil from a flower bed.
    2. soil from a building excavation site.
    3. subsoil from an eroded road bank.
- Small tray or plate for students to work over
- Spray Bottle
- Large bucket or container for students to dump materials
- Large bucket or container filled with water for students to wash large particles off (you don't want all that soil to go into your sink)
- "Soil Texture by Feel" video: **https://www.youtube.com/watch?v=GWZwbVJCNec**
- **Activity 2 Worksheet 1 "Ribbon Test to Determine Soil Type"** worksheets

Procedures

THIS ACTIVITY IS MESSY.

Extend or Elaborate

1. Provide each student with a small handful of soil. *Note: Distribute samples of different soil types to students at random so that not everyone has the same soil type.*
2. Students will determine soil type by feel.
3. Students will gradually add water to their soil samples using spray bottles until they can make balls of moist soil.
4. Students will gently stretch the soil between their thumbs and forefingers and try to make a ribbon. (Some samples will not form into a ribbon, depending on the soil texture).
5. Students will note the feel of the soil as they are working it.
6. Students will use the descriptions below to assign soils to different textural classes.

SAND	Loose and single-grained with a gritty feeling when moistened. Not sticky and will not form a ribbon when pressed between thumb and index finger.
SANDY LOAM	Contains sufficient silt and clay to give coherence to the moistened soil. Feels gritty and also slightly sticky. Will not form a ribbon.
CLAY LOAM	Forms short ribbons of less than 3 cm long.
CLAY	Extremely sticky and plastic when moist. Easily forms a ribbon longer than 3 cm.

Activity 3: Soil Make-Up (Science) 1-3 50 minute class periods

EXPERT TIP: Test each of the soil samples beforehand to make sure they work for this activity!

Materials

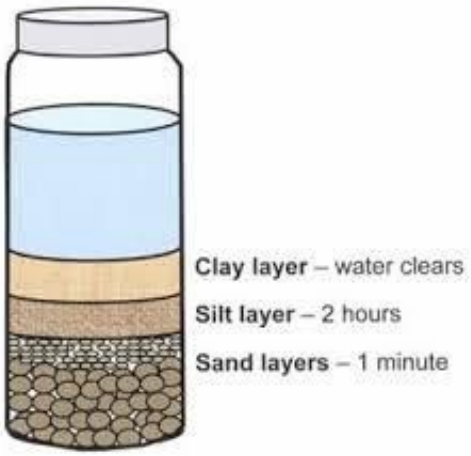
- Soil samples from three different areas, as follows:
    1. topsoil from a flower bed.
    2. soil from a building excavation site.
    3. subsoil from an eroded road bank.
- Masking tape
- Marker
- 3 straight-sided jars and lids, equal in size and shape (Large glass pickle jars work well.)
- Rulers
- **Activity 3 Worksheet 1 "Soil Make-Up"** worksheets

Procedures

1. Using masking tape, label each jar with the soil type (A, B, C) and your group name.
2. Fill each jar about 1/3 with soil samples (A, B, C) provided to you by your teacher.
3. Fill each jar with water to about 5 cm from the top and tightly secure your lid.
4. Take turns shaking the jar until all of the soil is "dissolved" and the particles are suspended in the water (about 2 minutes).
5. Find a spot in the classroom to place your jar where it won't be disturbed.
6. Allow the jar to settle for the next 24-48 hours.

After the "settling period" you should be able to see distinct layers.

1. Observe the layers of sediment. (floating material is organic matter)
2. Using your ruler, measure in cm the total depth of sediment in the jar and record your findings in the table.
3. Next, measure the depth of each layer and record it on the table.
4. Calculate the percentage of each soil component using the calculations page and then record the percentages on the "Soil Layers Chart" worksheet.
5. After recording the percentages on the "Soil Layers Chart," classify the soil sample by comparing the percentages to those on the "Soil Texture Chart."
6. Record your results on the last line of the "Soil Layers Chart."
7. Complete the discussion questions and turn in your assignment.



Activity 4: Effect of Soil Types on Seed Germination (Science)

1 50 minute class period to plant; 3-4 weeks to observe

Materials

- Clear plastic cups (9 to 12 oz)
- Seeds (wheat, corn, soybeans, alfalfa)
- Spray bottles for watering
- Calculators
- Rulers
- **Activity 4 Worksheet 1 "Developing a Soil Experiment"** worksheets
- **Activity 4 Worksheet 2 "Scientific Method"** worksheet

Procedures

1. Divide the class into groups. There should be an equal number of groups planting the same kind of seed.
2. Each group will fill three cups with soil (one cup with soil from each of the three samples).
3. Students will record group name, soil sample used (A,B, or C), and kind of seed on the outside of each cup.
   —Students will use the spray bottles to water as needed.
4. Students will set cups near a window or in a plant center for germination.
5. Students will design charts and use a separate chart for each sample to record observations.
6. Students will continue their observations for 3 – 4 weeks, making observation of different growth rates due to water, drought, or seed variety.
7. At the end of the study, set all cups together by seed and soil sample.
8. Students will make final observations and discuss possible conclusions to the study.
9. Students will use the "Scientific Method Format" worksheet to make a formal lab report on the study.

Evaluate

Use the discussion questions, along with the scientific experiment to evaluate student learning. One way to evaluate Activity 3 is to have students create a blog or storybook documenting the experiment. They can take pictures of the plants each day and describe what they see in a blog, or google document that can be made into a book.

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Standards

Oklahoma Academic Standards

Activity 1: What is Soil (Science)

MS-ESS2-1 Develop a model to describe the cycling of Earth's materials and the flow of energy that drives the process.

Activity 2: Ribbon Test to Determine Soil Type (Science)

MS-ESS2-1 Develop a model to describe the cycling of Earth's materials and the flow of energy that drives the process.

Activity 3: Soil Make-Up (Science)

MS-ESS2-1 Develop a model to describe the cycling of Earth's materials and the flow of energy that drives the process.

Activity 4: Effect of Soil Types on Seed Germination (Science)

MS-LS1-5 Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms.

Playing in the Dirt: Discovering Soil

Activity 1 Worksheet 1: What is Soil?

Name: _____Date: _____

Class/Hour/Teacher: _____

Work together to come up with a definition and description of soil.

What is Soil: _____

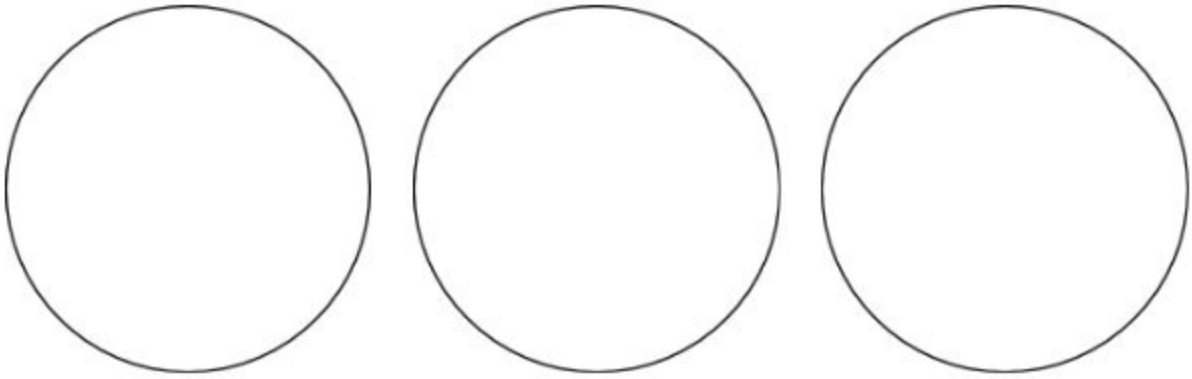
THINK	PAIR

SHARE

Watch this video, then complete the worksheet: https://youtu.be/mg7XSjcnZQM

Three Statements/Questions about Importance of Soil

In each circle write a statement or question about the importance of soil.



Draw a model to describe the cycling of Earth's materials and the flow of energy that drives the process. Explain how the rock cycle produces soil and what other factors contribute to the development of soil.

Use the chart and information from the video to discuss the basic soil components and the qualities that each add to the soil.

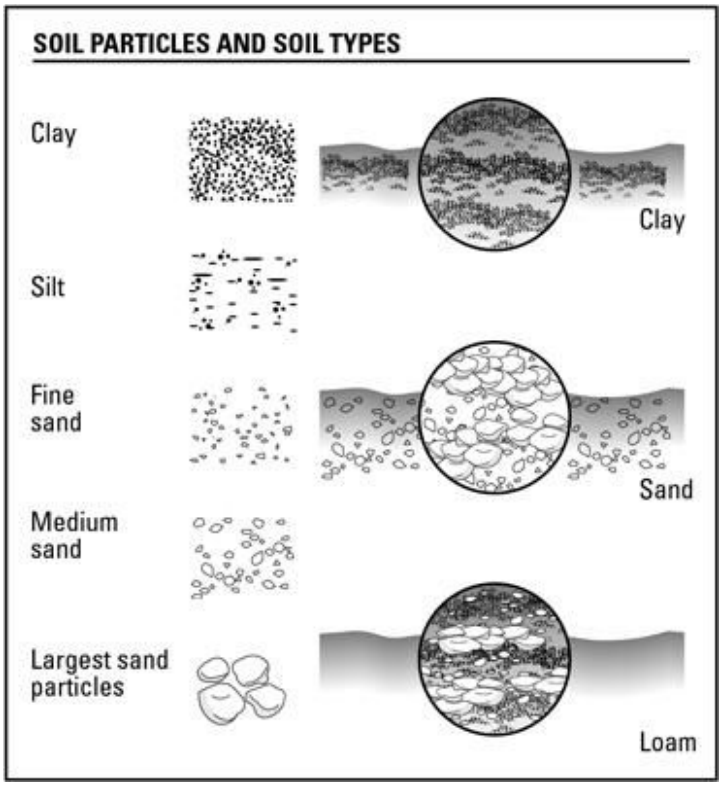
CLAY

SILT

FINE SAND

MEDIUM SAND

LARGEST SAND PARTICLES



Playing in the Dirt: Discovering Soil

Activity 2 Worksheet 1: Ribbon Test to Determine Soil Type

Name: _____Date: _____

Class/Hour/Teacher: _____

RIBBON TEST

You are going to conduct a RIBBON TEST for the soil provided to you by your teacher. First, with a small amount of soil in your hand, *slowly* add water to your sample until you are able to form a moist ball of soil. Gently stretch the stretch the soil between your thumbs and forefingers and try to make a ribbon. To see this in action, go to the link:
https://www.youtube.com/watch?v=GWZwbVJCNec

1. As you work the soil, use the diagram to determine which type of soil you have:
    (1) When wet, does the soil form a ball?
        (a) Yes; go to #2
        (b) No: the soil you have is considered SAND
    (2) Does the soil Ribbon or does it crumble?
        (a) Yes the soil forms a ribbon; go to #3
        (b) No, it crumbles: the soil you have is considered LOAMY SAND
    (3) How long is your soil ribbon in cm?
        (a) The ribbon is less than 2.5 cm in length; Type of LOAM – go to #4 then 5
        (b) The ribbon is between 2.5 and 5 cm; Type of CLAY LOAM – go to #4 then 6
        (c) The ribbon is more than 5 cm; Type of CLAY – go to #4 then 7
    (4) Next, you will test if the soil is smooth or gritty. To do this, place a small amount of the soil in your hand and add water to excess (think soupy mud). Rub the soil with your finger to see if it is Gritty like sugar or smooth like flour?
    (5) For types of LOAM (ribbon less than 2.5 cm in length):
        (a) It feels VERY gritty – SANDY LOAM
        (b) It feels VERY smooth – SILT LOAM
        (c) It feels neither gritty nor smooth - LOAM
    (6) For types of CLAY LOAM (ribbon between 2.5 and 5 cm in length):
        (a) It feels VERY gritty – SANDY CLAY LOAM
        (b) It feels VERY smooth – SILTY CLAY LOAM
        (c) It feels neither gritty nor smooth – CLAY LOAM
    (7) For types of CLAY LOAM (ribbon more than 5 cm in length):
        (a) It feels VERY gritty – SANDY CLAY
        (b) It feels VERY smooth – SILTY CLAY
        (c) It feels neither gritty nor smooth – CLAY
    (8) Next, place the soil you used for the ribbon test into the container designated by your teacher. Wash your hands and return to your work station.

Use the descriptions below to assign soils to different textural classes.

SAND	**Loose and single-grained with a gritty feeling when moistened. Not sticky and will not form a ribbon when pressed between thumb and index finger.**
SANDY LOAM	**Contains sufficient silt and clay to give coherence to the moistened soil. Feels gritty and also slightly sticky. Will not form a ribbon.**
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What type of soil do you think you have? Why?

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Activity 3 Worksheet 1: Soil Make-up

Name: _____Date: _____

Class/Hour/Teacher: _____

1. **Use masking tape, to label each jar with the soil type (A, B, C) and your group name.**
2. **Fill each jar about 1/3 with soil samples (A, B, C) provided to you by your teacher.**
3. **Fill each jar with water to about 5 cm from the top and tightly secure your lid.**
4. **Take turns shaking the jar until all of the soil is "dissolved" and the particles are suspended in the water (about 2 minutes).**
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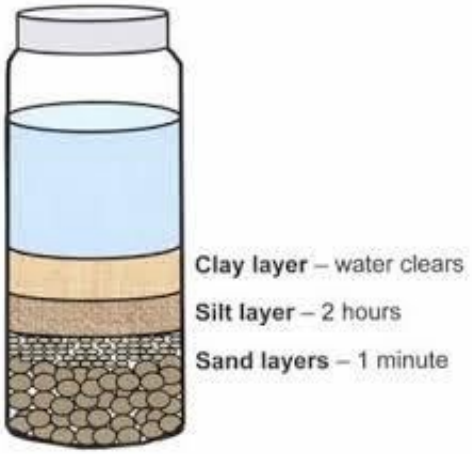
6. **Allow the jar to settle for the next 24-48 hours.**



After the "settling period" you should be able to see distinct layers.

1. **Observe the layers of sediment. (floating material is organic matter)**
2. **Using your ruler, measure in cm the total depth of sediment in the jar and record your findings in the table.**
3. **Next, measure the depth of each layer and record it in the table below.**
4. **Calculate the percentage of each soil component using the calculations page and then record the percentages in the "Soil Layers Chart".**
5. **After recording the percentages on the "Soil Layers Chart," classify the soil sample by comparing the percentages to those on the "Soil Texture Chart."**
6. **Record your results on the last line of the "Soil Layers Chart."**
7. **Complete the discussion questions and turn in your assignment.**

Soil Layers Chart

	SOIL A		SOIL B		SOIL C	
Measurements and percentages	**Depth (cm)**	**Percent (%)**	**Depth (cm)**	**Percent (%)**	**Depth (cm)**	**Percent (%)**
ALL soil particles						
SAND particles						
SILT particles						
CLAY particles						
Type of Soil						

Calculations:

Soil A

Percentage of **SAND** particles = $\frac{\text{Total height of SAND particles}}{\text{Total height ALL soil particles}}$ = _____ X100 = _____%

Percentage of **SILT** particles = $\frac{\text{Total height SILT particles}}{\text{Total height ALL soil particles}}$ = _____ X100 = _____%

Percentage of **CLAY** particles = $\frac{\text{Total height CLAY particles}}{\text{Total height ALL soil particles}}$ = _____ X100 = _____%

Soil B

Percentage of **SAND** particles = $\frac{\text{Total height of SAND particles}}{\text{Total height ALL soil particles}}$ = _____ X100 = _____%

Percentage of **SILT** particles = $\frac{\text{Total height SILT particles}}{\text{Total height ALL soil particles}}$ = _____ X100 = _____%

Percentage of **CLAY** particles = $\frac{\text{Total height CLAY particles}}{\text{Total height ALL soil particles}}$ = _____ X100 = _____%

Soil C

Percentage of **SAND** particles = $\frac{\text{Total height of SAND particles}}{\text{Total height ALL soil particles}}$ = _____ X100 = _____%

Percentage of **SILT** particles = $\frac{\text{Total height SILT particles}}{\text{Total height ALL soil particles}}$ = _____ X100 = _____%

Percentage of **CLAY** particles = $\frac{\text{Total height CLAY particles}}{\text{Total height ALL soil particles}}$ = _____ X100 = _____%

Soil Texture Chart

	% clay	% silt	% sand
loam	20	40	40
silt loam	15	60	25
silt	5	85	10
sandy loam	10	20	70
loamy sand	5	10	85
sand	2	3	95
clay loam	35	35	30
clay	60	20	20

NOTE: A more detailed description of soil textures can be found on the internet by using a search engine and typing in "Soil Texture Triangle."

Draw a picture of each jar in the spaces below. Include percentages of the soil levels and the soil textures you have identified for each sample.

Sample A **Sample B** **Sample C**

Soil texture _____ **Soil texture** _____ **Soil texture** _____

Discussion Questions:

1. **Does the soil from each sample have better, worse, or the same drainage as loam?**

2. **How would the samples compare to loam for water capacity, airiness and ease of handling?**

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Activity 4 Worksheet 1: Developing a Soil Experiment

Name: _____Date: _____

Class/Hour/Teacher: _____

This is an opportunity for you to develop an experiment to test different soil types and their ability to germinate seeds. In your group, you will receive three seeds, along with three cups that you will fill with the different types of soil. Make sure to label the cups with (1) your group name/number, (2) the type of soil used (A, B, or C) and (3) the type of seed you are using.

- Fill each cup about ¾ of the way with the different types of soil and then plant the seed 2x the depth of the seed size. (ie. is the seed is 0.5 cm in length, plant it at a depth of 1.0 cm.) Gently cover the seed with soil.
- Dampen the soil with the spray bottle, paying close attention to how many "sprays" you do per cup (the number of sprays should always be the same)
- Place your cups near a window or in a plant center for germination.
- With your group, determine the times for recording growth of the plants and design charts or tables for your observations. Note: Use a separate chart for each sample to record observations.
- Throughout the next 3-4 weeks, you will record your observations in your tables and charts.
- At the end of the study, set all cups together by seed and soil sample.
- Working with other students in your class, make final observations of the growth of the plants and discuss possible conclusions to the study.
- Use the "Scientific Method Format" to make a formal lab report on the study.

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Activity 4 Worksheet 2: Scientific Method Format

Name: _____Date: _____

Class/Hour/Teacher: _____

Title of Experiment or Study: _____

I. State the Problem: ***What do you want to learn or find out?***

II. Form the hypothesis: ***What is known about the subject or problem, and what is a prediction for what will happen?***

III. Experiment: ***(Set up procedures) This should include: materials used; dates of the experimental study; variables, both dependent and independent (constant and experimental); how and what was done to set up the experiment; fair testing procedures.***

IV. Observations: ***Include the records, graphs, data collected during the study.***

V. Interpret the Data: ***Does the data support/defend the hypothesis?***

VI. Draw Conclusions: ***Justify the data collected with concluding statements about what has been learned. Discuss any problems or concerns. Use other studies to support the conclusion. Give alternative ideas for testing the hypothesis.***