**Overview & Guiding Questions**

Students will be provided with samples of two soil types and record observations of differences and similarities between them. They will develop an experiment to continue exploring the connection between soil characteristics and plant growth.

* What is soil? What do you see in your soil?
* What do plants get from the soil and how do they get it?
* Do all plants need the same things?
* Why use an experiment?

**Objectives**

***Ecological Understanding***

* Students will be able to describe basic components of soil.
* Students will begin to describe how soil influences plant growth.

***Scientific Process***

* Students will practice making observations with multiple senses.
* Students will practice asking scientific questions.
* Students will be able to formulate a hypothesis making a prediction about their experiment.
* Students will be able to describe basic elements of experimental design.

***Sense of Place***

* Students will examine soil samples taken from their local environment.

**Time Required**

90 minutes

**Supplies**

* Broom and dustpan
* Crushed granite
* Schoolyard soil
* Jeweler’s loupes
* Paper plates
* *Classroom setup:* 1 light apparatus (PVC frame, 1 light bulb, timer and extension cord), 2 trays for holding pots
* *Experiment kits for student pairs:* 2 4-inch pots, 2 coffee filters, 2 bags of soil, 2 packets of seeds, 2 labels
* 1 bag of serpentine soil, 1 bag of loam soil

**Preparatory Activities**

* Make sure each classroom has a complete kit with all supplies.
* Collect soil from the schoolyard the day of the lesson. Soil should be collected so that it includes as much “live” material as possible (e.g. root bits, leaves, soil fauna, etc.). If time allows, collect soil with students prior to the lesson.
* Place soil material on paper plates. Each team should be given a plate with loam soil and a plate with serpentine soil.

**Classroom Activities**

Students will touch, smell, and see different root bits, leaves, soil fauna, and non–living material in two soil types. Then, student pairs will plant seeds in each soil type and begin an experiment. Students will continue to examine the characteristics of the different soils and will connect these characteristics to plant growth. They will create hypotheses and predictions related to plant growth for their experiment.

NOTE: Experiment setup requires many hands. At least 3 volunteers recommended.

**Lesson 2: You Are The Scientist!**

**LESSON PLAN OUTLINE**

1. WHAT IS SOIL, LOOK AT IT! (15 MIN)
2. WHAT IS THIS EXPERIMENT AND WHY ARE WE DOING IT? (15 MIN)
3. EXPERIMENT SET-UP (45 MIN)
4. WRAP-UP (15 MIN)

**LESSON PLAN**

1. **WHAT IS SOIL, LOOK AT IT! (15 MIN)**

**Objective:** To start making observations. Notice that soil is complex and has many components, including rocks and plant materials (bits of leaves, roots). Students may observe living organisms in the soil.

**Prep:** One or more volunteer puts soil on paper plates while the other gives the introduction. Each team gets one small handful of soil and one handful of crushed decomposed granite.

**Adapt This!**

Use local soils gathered near the school for this section.

1. Review Lesson 1, focusing on observation and its role in the scientific process.
2. *What is soil?* Get some ideas from students and list on the board. Guide students to the definition of soil as a mixture of rocks, minerals, and organic material (decaying plants and animals) that forms the upper surface of the earth and where plants grow. Soil also includes air, water, and living plants, animals, fungi, and bacteria.
3. *Before scientists can start asking questions, they make observations.* Hand out the paper plates with soil and jeweler’s loupes or magnifying glasses.
4. *Let’s spend some time exploring the soil on our paper plates. Take a few minutes to look at it, feel it, and smell it.* Have students record their observations on page 5 of the Experimental Log.
5. Give students 5 minutes to observe the soil and then discuss as a group. *What does the soil feel like, what does the rock feel like?*
6. *What do you see in your soil samples?* Create a list or Venn diagram on the SmartBoard; the list might include small rocks, leaf litter, plant roots, and live insects.
7. *Do you see anything in your crushed rock samples? What don’t you see here in the soil that you think you might see in a different sample or at a different time?*
8. *What does your soil smell like? Does it smell differently than the crushed rock? Why do you think it smells differently? Why does garbage smell? Why do feet smell? These things all smell because they have bacteria – little tiny microorganisms – living in or on them. The bacteria take bits of living matter and break it down into smaller bits in a process called decomposition. So, soil smells because there are living things in it that are decomposing organic matter, like the plant roots, for example.*
9. Come back to the definition of soil following observation, and guide students to a working definition of soil (may include: contains rocks, minerals, water, air, decomposed living things, live plants or animals, medium for plants to grow, covers the earth surface, etc.)
10. **WHAT IS THIS EXPERIMENT AND WHY ARE WE DOING IT? (15 MIN)**

**Objective:** Recognize that plants are immobile and therefore very dependent on the conditions in their immediate environment, especially the soil their seed landed on. Begin to learn what plants get from soil.

**Adapt This!**

* Modify the experiment to fit your local environment by choosing local soil types to compare and contrast.
* Set up your experiment with other types of treatments, such as different watering protocols.
* Design your own experiment from scratch that reflects the unique features of your students’ local environment. Your experiments can involve plants, animals, or something else. Plant and soil science experiments work well with all of the lessons, including Lesson 3 (emergence), Lesson 4 (how plants grow), and Lesson 6 (seeds). Experiments that track growth over time or another measureable feature over time can work well with parts of Lesson 5 (comparison), Lesson 7 (graphing) and Lesson 8 (calculating averages).
1. *Okay, so I mentioned earlier that we are going to be doing an experiment on plants. We just had you explore soil because it’s an important part of the plant’s environment. Based on what you have learned today and in Lesson One, what kinds of differences could you see in the different soils that you looked at in photos and in person?* Have the students look at the photos from Lesson One.
2. *How might the soils be different? How might they be different in a way that matters to plants?* Possible answers: may have things that plants need (water, nutrients) or things that hurt them (toxic substances, animals), some soils may be easier to grow in (less rocky).
3. *What do plants get from the soil? What kinds of things do they need? How do they get things from the soil?*

Answers: plants need sunlight, water, nutrients, and carbon dioxide. Plants take in water and nutrients from the soil through their roots and plants use these to make their food (we’ll come back to this in more depth in Lesson 4, but introduce the idea that soil provides some but not all of what a plant needs).

1. *Do you think all plants need exactly the same things in the same amounts? Why or why not?*

Answers: Most plants need the same main ingredients, but they differ in how much and where they get these things from.

1. *We’re going to explore these questions in our experiment, which will be to look at the effects of two different soils on plant growth. Beans will be planted in a loamy soil and a serpentine soil. We’ll watch them grow over the next few weeks and take measurements so that we can compare their growth later.*
2. *Scientists use experiments to answer questions about their environment. What do you think we are asking with this experiment?* (Ans: how do different soils affect plant growth?). Which soil do you think plants will like more? Less?
3. *We can restate our question as a hypothesis, which is simply a question that can be answered by doing experiments and collecting data. How would you state the hypothesis?*
4. Work with students to come up with possible hypotheses (e.g. Soil A will have taller plants, soil B will have taller plants, they will be the same). Emphasize that hypotheses are specific (“grow taller” not “grow better”) and include explanation (“I think X will happen because Y”). *We’ll use our experiment to test our hypothesis. Please write your hypothesis on the first page of your experimental log so that we can think about it throughout the experiment. If we have additional hypotheses as the experiment progresses we can add them to this page.*
5. As we start getting experimental results we’ll go back and check our hypothesis and see what we have learned about it.
6. **EXPERIMENT SET-UP (45 MIN)**

**Prep:** Hand out one student kit unit to each team. Have one volunteer demonstrate the potting procedure so the students can follow along.

1. As a class, go though all the articles of the kit.
2. Have students place the coffee filter at the bottom of the pot.
3. Pour the bag of soil into the pot, being careful not to lose any. The paper plates from the soil observation could be placed under the pots to catch any loose soil. This may make for easier clean up after potting is finished.
4. Slowly pour the vial of water over the pot, giving the soil time to soak it up (this may need to be done outside – or, have one KiDS volunteer go around to each pair and pour water into the pots)
5. Place all ten seeds in the pot and gently press them into the soil. Leave an inch or so of distance between each seed.
6. Place the label in the pot (write down the soil type on the label. In previous years, the white labels were for loam soil.)
7. Put the pot anywhere in the tray under the light fixture located on a table somewhere in the classroom.
8. Repeat for second pot.
9. Clean up stations and wash hands
10. Observe as one KiDS volunteer sets up the lighting system and adds water to the tray.
11. **WRAP-UP (10 MIN)**

**Objective**: Have Students speculate on what might happen in the experiment. Recall that soils are different from each other and have different components, many of which are important for plant growth. Give a hint of what we’ll do next time.

1. *Do you have any predictions for what might happen? Will some plants grow bigger than others? Which ones?*
2. *When do you think these seeds will start to emerge?* *Do you think that beans in different soils might emerge at different times? Will they all emerge? Or will some just die or stay in the soil?* Pairs discuss, then document predictions about that in the experimental log in the binder.
3. *When the seeds start emerging you will start collecting data on how many plants emerge in each soil. Any predictions? What kind of data do you think you need to collect?*

**Assessment for Lesson 2**

**Team/Student Name(s): \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

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| --- | --- | --- | --- | --- |
| **Level of Understanding****Indicator** | **Engaged**1 points | **Emerging**3 points | **Proficient**6 points | **Total Points** |
| *Scientific Skill Development:* (Questions 1-3) Student’s power of observation and hypothesis building is growing.  | Student predicts that plants will grow differently in different soil types. | Student specifically states how plants will differ in each soil type (e.g. taller/shorter, faster/slower, etc.) | Student offers an explanation of how or why the differences in plant growth might occur. |  |
| *Ecological Understanding:*(Questions 2, 3)Student can identify soil as being made up of many living and non-living things and relate it to testing plant growth. | Student accurately predicts which soil type will better support plant growth. | Student explains why plant growth is different in different soil types. (e.g. more/less water or nutrients in one soil type). | Student correctly relates differences in plant growth to differences in soil characteristics. |  |