Alaskan Soils

Alaska FFA Association and USDA Northwest Climate Hub

Grade Levels 6-12

USDA NRCS

DESCRIPTION

Students will begin by using the US Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) Guide to Texture by Feel to classify soil samples.

Students will test soils from the land around them and from soil samples given to them. Using their results, students will compare and analyze differences in soil acidity and nutrient levels to determine suitable and unsuitable crops for their region.

OBJECTIVES

Students will:

1. Apply prior knowledge to make a prediction
2. Analyze the results of an experiment
3. Evaluate graphic and tabular information
4. Apply understanding of experimental results to predict how agricultural producers choose which crops to grow based on soil restrictions.

MATERIALS NEEDED

- Soil Testing Kits
- USDA NRCS Guide to Texture by Feel
- Local soil samples in plastic baggies
- Ordered soil samples
- Soil Testing Video and Soil pH Testing Video
- Alaskan Soils Worksheet
- Water
- Paper towels
- Plastic gloves & safety glasses

BACKGROUND

1. If possible, watch How Dirt Works for a clear explanation of soil significance and use.

Soil is the foundation of healthy plants and animals. Soil supports water and nutrient absorption in plants, aggregate stability, root aeration, and root health—all of which are necessary for plant growth. As farmers, we must learn to understand soil composition and assist in increasing soil health under changing climatic conditions.

ACTIVITY 1

What kind of soils are in your backyard?

In this activity, we are going to learn about the types of soil where we are (if available) by completing a soil type test using our hands and eyes, following the NRCS Guide to Texture by Feel.

1. Split students into groups of 3-4.

2. Have students collect a sample of soil from somewhere in the yard, garden, or farm. They don't need much—half of a small zip-closing plastic baggie will do.

3. Have students record in their notebook where they found the soil and what kinds of plants were growing in it.

4. Follow directions on the guide to complete a soil type test. This can be done for your local soil sample and the soil samples provided in your kits.

5. Have students conduct a little research. What type of plants grow well in their local soil sample? Have them write their answers on the Worksheet.

PREP FOR ACTIVITY 2

What is changing about soil in Alaska?
In Alaska, where the climate is changing faster than anywhere else in the United States, there are several threats to continued soil health:

1. In much of Alaska, **permafrost** is present. Soils with permafrost drain poorly because of the frozen subsoil layer that keeps water higher in the soil (a perched water table). **As temperatures increase, permafrost thaws**, resulting in improved drainage and increased production of organic matter. Decreases in permafrost could benefit soils by increasing the potential for crop cultivation across larger areas of the state over the long term (mid-century or beyond). At the same time, loss of permafrost can lead to **land caving or sinking**, particularly where there are significant amounts of ice present closer to the surface. Thawing permafrost is a leading cause of erosion on rivers and coastlines. Loss of permafrost also contributes to greenhouse gas emissions, which cause climate change.

2. **Expected increases in the frequency and intensity of large rain events** may lead to more erosion, particularly on cropland that lacks vegetative cover during winter and spring months. Large rain events also affect recently logged land and can result in landslides on slopes. Erosion due to wind or rain decreases organic matter and degrades soil function. Erosion weakens soil aggregates, which reduces the ability of soil to hold water and nutrients and reduces beneficial microbial habitat. Soil erosion reduces water quality, which impacts downstream users, fish, and wildlife.

3. **Increases in fire frequency and extremes** will also affect soil resources. The extent, intensity, and frequency of fire and extreme fires are projected to increase due to climate change and will affect soil by increasing exposure. The consequences of extreme fire include more **severely burned areas that are vulnerable to soil erosion, landslides, and flooding**. Wildland fires also destroy the insulating layer of organic matter at the soil surface, resulting in permafrost degradation. It is important to keep in mind that climate impacts on soil will vary widely due to complex interactions between location and plant and root productivity, along with soil type, management decisions, and other soil processes.

Alaskan Soils and this Activity

With the climate changing in Alaska at a much faster rate than the rest of the United States, it is critically important for students to understand how to maintain soil health under shifting conditions. As such, the students will be completing an activity in which they test local soil for nitrogen, phosphorus, potassium, and pH levels.

Plants use **nitrogen** to make molecules for necessary functions, such as chlorophyll for photosynthesis (powerhouse) and proteins that make up enzymes to affect the rate of reactions. Different crops have different needs for nitrogen. Some crops, such as soybeans, are considered low need because bacteria live in their roots and produce nitrogen for the plant to use (a symbiosis). Some plants, such as potatoes, need a relatively large amount of nitrogen.

Phosphorus tends to be a high-need nutrient for most crops. It is an essential component of adenosine triphosphate (ATP), which provides energy and is involved in many plant processes.

Potassium is essential for plant growth, and it is involved in water, nutrient, and carbohydrate movement through plant tissue, enzyme activation, and the production of adenosine triphosphate, ATP.

In this activity, students also measure **soil pH** (how acidic or basic soil is) because of its importance for crops. When soil becomes too acidic, vital nutrients, such as phosphorus, become less available to plants. Most field crops need slightly acidic to neutral soil pH for optimal growth. For example, the recommended pH range for corn is 5.8 to 6.2, and the recommended pH for soybeans is 6.6 to 7.0

ACTIVITY 2

Soil Testing
You walk over soil all the time, but how often do you think about what makes soil, soil? You've probably noticed that soil is made up of various types of particles and materials (rocks, twigs, water, air, worms, insects, and much more). These are some of the components of soil that you can see.

But soil also contains things that we can't see and can only measure with chemical tests. These things—acids, bases, nitrates, phosphates, and potassium—are chemicals that affect what types of plants will grow well in the soil.

Because soil is such a critical component to plant growth and livestock production, discovering the chemicals in our soil is important to determining appropriate actions as Alaskan producers!

Procedure:

1. It is an option to introduce the activity with a video, show students the Soil Testing Video to familiarize them with how to test for nitrogen, phosphate, and potassium levels. To

demonstrate pH testing, show the Soil pH testing video. Otherwise, the instructor can use these videos to familiarize themselves with the process.

2. Split students into groups of 3-4.

3. Using your local and provided soil samples, follow the directions on the soil test kit to test your soil. Measure the soil's pH, as well as nitrate, phosphate, and potassium content.

4. Have students record the results of the tests on their worksheets. Then ask the following questions. Have them write their responses on their worksheets:

    - Did all the soil samples have the same results for each test? If not, how could you explain that?

    - Ask the people responsible for caring for the places where you got your soil if they are adding anything to the soil. How could what they were adding affect the soil?

5. If your soil test kit has a list of plants that grow best in various soil types, compare this to the types of plants you found growing in your soil. Are these plants likely to do well in this soil? If not, how can you change the soil so that the plants would do well? What would you need to add to it?

6. How might some of the crops that grow well on your land change if soil conditions change due to climate impacts like wildfire, extreme precipitation events, and erosion?

Compare Results.

More Resources:

1. How Dirt Works Video—An excellent explanation of the myriad ways in which soil is host to an entire organismic community, host to all life on earth, and crucial to the growth of our food and livestock.
2. USDA Web Soil Survey—A tool that allows users to deep dive into soil quality in a specific area.
3. The Twelve Orders of Soil Taxonomy
4. Land Capability Classification typifies soil based on agricultural uses.
5. Importance of Soil pH—an extension opportunity for students to learn about soil pH.