what lies beneath
part 2: analysis of local soil profiles

△ FRAMEWORKS

SCIENCE
NS 1.6.5 Communicate results and conclusions from scientific inquiry.
NS 1.7.5 Communicate results and conclusions from scientific inquiry.
NS 1.8.2 Justify conclusions based on appropriate and unbiased observations.
ESS 8.8.14 Apply knowledge of soil profiles to local soil samples.
ESS 8.8.15 Investigate the formation of soil types.
ESS 8.8.19 Investigate and analyze the composition of a variety of soils.

LANGUAGE ARTS
OV 2.6.3 Listen attentively for main ideas and detail.
OV 2.7.3 Listen attentively for main ideas, details and organization.
OV 2.8.2 Establish purpose for listening.

△ OBJECTIVES

The students will learn:

OBJECTIVE #1 To identify soil particles as sand, silt and clay.
OBJECTIVE #2 To describe classes of soil according to their texture, structure, color and profile.
OBJECTIVE #3 To compare the suitability of different soils for plant growth.
OBJECTIVE #4 To appropriately use verbal speaking skills in class discussion with the teacher and garden program specialist.
The ideal garden soil is composed of loam: soil that contains approximately equal parts of sand, silt and clay.

OVERVIEW

Soil is classified according to texture, structure, profile and color to determine its suitability for different uses.

GARDEN ACTIVITIES

▲ Analyze soil for texture, structure and color
▲ Compare soil from soil pit to garden soil
▲ Plant, harvest and work in the garden following the Garden Guide
▲ Recipes and Taste tests as time permits (refer to Delta Garden Study Recipe Book)
**TIPS FOR THE CLASSROOM**

*Pre-lesson preparation:*

▲ Check with the Garden Program Specialist to determine which activity will be conducted in the garden.

**LESSON OUTLINE**

<table>
<thead>
<tr>
<th>activities</th>
<th>estimated duration</th>
<th>actual duration</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>in the classroom</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>▲ Offer the icebreaker</td>
<td>5 minutes</td>
<td></td>
</tr>
<tr>
<td>▲ Explain soil profile, including texture, structure and color</td>
<td>10 minutes</td>
<td></td>
</tr>
<tr>
<td><strong>in the garden</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>▲ Implement one of the activities in the Supporting Information for Teachers</td>
<td>10 minutes</td>
<td></td>
</tr>
<tr>
<td>▲ Plant, harvest and work in the garden following the Garden Guide, paying special attention to soil profiles while planting</td>
<td>15 minutes</td>
<td></td>
</tr>
<tr>
<td><strong>back in the classroom</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>▲ Hand out Student Workbooks, review and assign “Take it Home Activity” as homework</td>
<td>5 minutes</td>
<td></td>
</tr>
</tbody>
</table>

**TIPS FOR THE GARDEN**

*Pre-lesson preparation:*

1. Set up one of the activities in the Supporting Information for Teachers.
2. Prepare to discuss the differences between soil structure, aggregates, color and texture, as well as what each of these might indicate about soil and plants in the garden.
3. Prepare a brief garden work activity for students in the garden.

**Materials needed:**

▲ Student Workbooks

▲ Materials and/or Garden tools for chosen activity (see Supporting Information for Teachers)

▲ Garden tools
# LESSON PLAN

## I. Start in the classroom

### A. Icebreaker
Does Arkansas have an official soil of Arkansas?

**ANSWER:** Yes, the official soil of Arkansas is the “Stuttgart Silt Loam.” It is found mainly in eastern Arkansas and is great for growing rice and soybeans.

### A. Present Main Topic

▲ Explain the soil profile including soil texture, structure and color. Discuss visual in student Workbook and the various soil areas of Arkansas.

## II. Take class to the garden

▲ Define and examine sand, silt and clay, using one of the activities in the Supporting Information for Teachers.

▲ Describing the characteristics of loam, discuss which soil is the best suited for growth of plants and why.

▲ Instruct students to pick and taste available vegetables. Explain that loam, a soil rich in nutrients and of good structure, yields better crops than a nutrient-poor environment.

## III. Take class back to classroom

▲ Hand out the Student Workbook as reference material and class assignment. Review take it home activities and encourage students to do them.
**SUPPORTING INFORMATION FOR TEACHERS**

**BACKGROUND**

Soil consists of broken-down rock fragments, organic matter, living organisms, moisture and air. Desirable topsoil for plant growth contains approximately 50 percent solid material and 50 percent air.

Arkansas is divided into eight major soil areas: Ozark Highlands, Boston Mountains, Arkansas Valley Uplands, Ouachita Mountains, Bottomlands and Terraces, Coastal Plain, and Loessial Plains and Hills. The soils in these areas vary widely. Consider the following characteristics during the class discussion of soil in your area:

<table>
<thead>
<tr>
<th>Soil Area</th>
<th>Texture</th>
<th>Content &amp; Structure</th>
<th>Drainage</th>
</tr>
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<tr>
<td>Ozark Highlands</td>
<td>fine to medium</td>
<td>limestone; mixed minerals</td>
<td>good</td>
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<td>medium</td>
<td>shale (clay rock); mixed minerals</td>
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Although areas of Arkansas vary in soil quality, most areas contain one or a combination of the following soil types:

1. **Loam**, the optimal soil class for plant growth. It contains approximately 7-27% clay, 28-50% silt and about 50% sand.
2. **Sandy Loam**. It contains mostly sand, but enough silt and clay to hold the soil together when moist.
3. **Silt Loam**. It contains mostly silt and feels smooth and when rubbed between fingers and thumb.
4. **Silty Clay Loam**. Silt dominates, but the soil contains enough clay to make it feel somewhat slick and sticky when moist.
5. **Clay Loam**. Clay dominates. Contains lesser amounts of sand and silt. The soil feels smooth when dry and sticky when wet.
6. **Clay**. This soil has a very fine texture with no sand or silt. It holds form when wet and ribbons when wet with fingers; hard when dry.

**ACTIVITIES**

**Compare and mix soil types**

**MATERIALS NEEDED**

▲ Clear bowls or jars (keep some empty)
▲ 3 or more various types of soil or soil amendments. These could include: soil from the garden, sand, silt, clay, compost, perlite, gravel, etc.

*note: these materials may also be used for activities for the next lesson

**PROCEDURE**

Set each soil type out in a jar or bowl and allow students to touch and make observations about the soil/amendment types. Consider the following questions:

1. What are some differences and similarities between the types?
2. Which ones might make better or worse soils for plants? Why?
3. Which of the soil types are most like soils in your area of the state?
Ask students to predict which mixtures of the soil types would be best for plants to grow in. Using empty jars or bowls, allow students to explore and mix the different soils/amendments. Allow time for students to share their observations, predictions, and rationale.

**Excavate Soil**

**MATERIALS NEEDED**
- Soil pit
- Excavated soil

**PROCEDURE**
Instruct the students to dig up a small amount of soil from an unplanted vegetable bed and dump next to a small amount of soil that was dug from non-gardening space. Instruct students to analyze the soils from the pit and the garden bed. Distinguish the soil in terms of sand, silt and clay.

▲ How do you differentiate sand, silt and clay? How does the soil feel (coarse, fine, smooth, sticky,)? In general, sand is quite coarse and rough and the individual particles can be seen without a magnifying glass. Silt particles are smooth and fine. Clay particles can only be seen with a microscope and feel extremely smooth when dry and sticky or slick when wet.

▲ Does the soil leave an imprint or hold its form when pressed? Dry silt will show an imprint when pressed between thumb and finger. Clay will hold its form when molded.

▲ What’s the structure? How are the sand, silt and clay particles grouped? In surface soil, the structure is usually granular, with rounded aggregates that are held together by organic material and some clay.

▲ What do the colors indicate about nutrient content and drainage? Dark colors indicate high levels of organic matter. Light colors indicate low organic matter. Gray is often a sign of poor drainage.

Be sure to backfill the soil pit before you leave. Time and circumstances permitting, instruct students to plant vegetable seedlings as appropriate.

**SOURCES**

- United States Department of Agriculture, Natural Resources Conservation Service
- The Encyclopedia of Arkansas History and Culture
- Arkansas Conservation Center
You’ve already learned that weathering results in soil, which is layered in horizons. The composition of soil differs across the earth, depending on climate and some other factors. Soil is classified into different groups based on texture, structure, soil profile and color. In the United States, the US Department of Agriculture has developed a system to classify soil. While soil kits or tests reveal the exact composition of soil, simply observing and handling the soil can tell you much about its characteristics.

**Soil Texture:** Soil texture refers to the size of particles in the soil. It ranges from large to small. Large particles are sand, medium-size particles are called silt, and the smallest particles are clay. When rubbed between fingers and thumb, sand feels rough. Silt particles are so small they are best seen with a microscope. Silt feels smooth when dry and leaves a mark if pressed between your thumb and fingers. When wet, it feels smooth. Clay particles can only be seen with the aid of a powerful microscope. They feel extremely smooth when dry and become sticky and slick when wet. You can form clay into molds. You may have seen clay pottery or bricks.

The size of the particles determines the soil’s ability to absorb and hold water. Sandy soils will lose water fast whereas clay soils are tight and won’t allow for air and water to get through. The best texture of soil for garden crops is called loam. It is made up of equal parts of sand, silt and clay. This allows the passage of air, prevents packing down and retains water.

**Soil Structure and Aggregates:** Aggregates are groups of soil particles that bind or stick to each other. Aggregates are often just lumps of soil. Some soil types, like sand, rarely form aggregates because the particles do not bind together. Clay, on the other hand, is a type of soil that often forms aggregates when it becomes wet and then heated. Clay particles bind so well that people form bricks by adding water to clay, then baking them in the sun or in an oven.

Soil structure refers to how soil particles are arranged into aggregates. There are millions of organisms living in the soil, such as bacteria and earth worms, that help keep soil rich in organic matter (great nutrients for plants). These organisms need water and air, just as we do. Soil structure affects how well water and air can flow thorough the soil. If aggregates are arranged to closely, then the soil structure will keep soil-living organisms from getting the water and air they need. But when aggregates are spaced out too far apart, they can become loose and blown or washed away. Good soil structure for gardening will have aggregates spaced out just enough to let water and air through. Adding more organic matter, like composted leaves or manure, will improve the soil structure.
Soil Color: Different colors in the soil can have many causes, but color usually depends upon the amount of:

1. Minerals and organic matter in the soil
2. How well the soil drains water
3. Exposure to the air and weather

By observing the colors in soil, one can usually determine whether soil contains minerals, organic matter and/or water. For example, most soil minerals are gray. Gray soil can also be a sign of poor drainage. Red soil usually means that the soil is heavy in iron oxide minerals. White soil suggests that the soil is very low in nutrients (minerals and organic matter). If soil is dark brown or black, usually the soil is rich in organic matter.

Soil texture, structure and drainage heavily depend upon the location of the soil. The state of Arkansas has eight major soil areas based on the landscape and geography of each area.

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soil texture refers to the size of the particles in the soil
soil profile layers of soil in an area
soil aggregates groups of soil particles that bind to each other
soil structure the arrangement of soil aggregates

major soil areas of Arkansas

- **Ozark Highlands**
- **Boston Mountains**
- **Arkansas Valley & Ridges**
- **Ouachita Mountains**
- **Bottomlands & Terraces**
- **Loessial Plains & Hills**
- **Coastal Plain**
ESS 8.8.19 Investigate and analyze the composition of a variety of soils.

1. List at least three factors that affect soil color.

2. The texture of soil refers to the ____________.
   a. mineral content of the soil
   b. the way particles feel
   c. how different particles are grouped together
   d. size of the particles in the soil

3. Describe the relationship between soil structure and soil aggregates.

Take it Home
Take a walk outside today. Look around you and try to find a few different types of soil.
1. List at least three factors that affect soil color.
   
   Answer: minerals, organic matter, soil drainage, exposure to air and/or weather

2. The texture of soil refers to the ___________.
   
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   ▲ aggregates are groups of soil particles bound together
   ▲ structure is the arrangement of soil aggregates
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