

BLACKBEARD'S BURIED TREASURE

A Soil Science Mystery for Middle School Students

OVERVIEW

Soils have unique properties that influence our everyday lives. Soil properties determine how plants grow, whether water can be filtered of waste products, or if a house or road can be built. Soil properties consist of texture, color, structure, consistency, pH and contribute to ideas like infiltration rates, fertility, and soil moisture. Soil forensics is a field that utilizes these distinctive characteristics of different soils to solve mysteries.

Purpose

Learn about soil properties and interpret evidence to find buried treasure.

Time:

2, 45 minute sessions or 1.5 hours

NC Essential Standards

Sixth Grade Science Objectives

6.E.2.3: Explain how the formation of soil is related to the parent rock type and the environment in which it develops



This lesson offers a scenario in which the boots of the feared pirate, Blackbeard, have been recovered, stained and crusted with layers of soil. The soil on the boots hold the key to where Blackbeard's treasure is hidden. Students will learn about fundamental soil properties and use that knowledge to discover where Blackbeard buried his treasure so many years ago.

MATERIALS for a class of 30 students

- Pair of old boots with layers of "mystery" soil from each horizon smeared on
- Smeared boot samples from each horizon layer for 5 groups
- 5 "unknown samples" representing possible hiding places for the buried treasure, one should be the same as the soil sample from the boot. Each group will tackle a different soil.
- Water spray bottles
- Munsell color chart (optional, but useful)
- pH paper or pH meter

PROCEDURE: Before you begin:

- Make a copy of the above lesson resources for each student
- Post the focus question at the front of the classroom

FOCUS QUESTION:

What are the different properties of soils and how is this information useful?



GETTING STARTED:

Remind students of the focus question. Explain that in this lesson they will be exploring the different properties of soil and using the information in an applied way, by trying to find Blackbeard's buried treasure. Tell students that the field of soil forensics utilizes a soil's unique characteristics to assist in solving crimes and mysteries.

Hold a brief discussion of Blackbeard's biography and his role in North Carolina history:



BLACKBEARD FACTOIDS

- Blackbeard was a ferocious pirate that terrorized the Atlantic and Caribbean seas in the early 1700's
- Blackbeard was British, his real name was thought to be Edward Teach (or Thatch)
- He had a wild and untamed beard and it was rumored he wove gun-powder laced wicks into it, lighting them on fire during battle.
- His flagship's name was the Queen Anne's Revenge
- Blackbeard and his crew would often use the Outer Banks, particularly around Ocracoke for refuge.
- He was trapped by Lieutenant Robert Maynard of the Royal Navy by Virginia Governor, Alexander Spotswood and killed in the bloody battle that ensued.
- His treasure was never found.

Read the newspaper clipping on the following page to set the stage for the soil exploration. The scenario details how a grounds keeper on Ocracoke Island found a buried chest with Blackbeard's soil encrusted boot inside. Once read, discuss the main ideas of the article. Why would the boot lead to Blackbeard's treasure? What information do student's need to know to solve the mystery? What are the steps they plan to take?

Explain to the students each of the soil properties they will investigate and demonstrate how to measure each characteristic. After each demonstration, allow students calibrate their fingers for each property. Together go through Blackbeard's sample and write the soil properties on the front of the board, using the same format as the Soil Description page. Arrange students in small groups and give them one sample from the each location. Have the students determine the properties and note their results in the Soil Description page.

Bring students together for a discussion. Which group thinks they know where Blackbeard's treasure is hidden? In what ways does their data support this conclusion? Do other groups think they have the location? Why or why not? What soil property enabled students to figure out the mystery? What characteristics did the soils have in common? What properties were different? Why do soils have different properties? What new questions do students have about soils?

Ocracoke Groundskeeper Finds Blackbeard's Boot

Ocracoke, NC. A deluge of storms moved through the area last night, flinging bicycles into trees, cats into flower pots and left out lawn chairs into the ocean. Brighton Early, caretaker of the Ocracoke Lighthouse, awoke dismayed to discover devastating soil erosion throughout the grounds. As he began the arduous task of raking debris, a glint of gold gleamed in the early morning sun. Curious, Mr. Early crept closer and swept away the sand covering the object. A battered trunk trimmed in gold with the initials "BB" engraved into the lid lay lodged before him.



Brighton Early recovers what is believed Blackbeard's boot.

A rusty lock crumbled at his hesitant, fumbling touch and Mr. Early eased open the lid, brimming with nervous anticipation. The smell of the sea wafted out, crusty with salt and bitter with blood and stolen treasure. The black, cavernous depths of the trunk seemed to descend into malevolent and terrifying places, but determinedly Mr. Early reached inside. He slowly eased his hand in and grasped a rough, scaly object.

It was a boot. Swarthy, brown, and blackened with history. He delved into the trunk again, only to find another boot. Disappointment surged through Mr. Early. He hoped and half-expected to find the lost treasure of Blackbeard. The treasure has never been recovered, although rumors place it buried along the shores of Ocracoke. The mystery of the ferocious pirate's heaping bounty surviving as an elusive and wistful dream. Mr. Early reached inside the boot to find an old glass bottle containing a yellowed parchment. With renewed fervor he uncorked the bottle and pulled out what looked like an old map of North Carolina. The entire state was littered with "x" marks.

Mr. Early gazed at his findings; old boots, smelly and soiled, and a moldy piece of paper, not much of a treasure. He grasped a boot and inspected it more closely. Colorful clumps of soil clung to the sole and sides. Having enrolled in a few soil courses in his undergraduate years at NC State he was surprised to find clay hardened onto the boot. Peeling off a few layers, he found clay, a sandy loam and other soil textures and yet the soils around Ocracoke are primarily sandy.

A natural history of Ocracoke and the surrounding environs suggests Blackbeard and his band of marauding pirates occasionally dwelled in the area, raising questions regarding the presence of the clayey soil stained boots. Mr. Early decided to call on an old friend at the local Soil and Water conservation district.

Red McIntyre whistled as he recounted his conversation with Mr. Early. Mr. McIntyre has an inkling about where the treasure could be buried. Back when he was knee-high to a grasshopper, he remembers an old folktale about a wild-haired renegade, with snakes and fire seething from his beard that stalked the untamed areas of the state, stealing food and laundry as he traveled. Mr. McIntyre figures Mr. Early has to match the soil on his boots, to the soil in those suspected areas.

Mr. Early has taken a leave of absence from his position on Ocracoke and nobody has heard from him for two weeks.

With contributions from Clay Johnson and Sandy Smith.

Measuring Soil Color

Soil color is one of the first observations one can make. The color communicates the relationship of the soil to water (wetness or aeration), the mineral and organic matter content. If a soil shows grey colors, it means that it has been wet for a period of time. A red soil common in North Carolina indicates the existence of iron in the soil and that the soil is well aerated. Soils that are dark brown or black points to the presence of a lot of organic matter. The Munsell Color system quantitatively determines color using hue, value and chroma. This method gives scientists a way to communicate soil colors to each other.

If using a Munsell Color Chart:

1. Soil colors should be measured when samples are moist. The easiest way to do this is to take a soil ped and break it apart, the soil inside is usually moist. If it is dry, spray it to slightly moisten it.

2. Using the tabs in the Munsell Color Chart, flip to a page that has colors that seem similar to the sample. Hold the sample behind the page, so the soil shows through the hole by the color chip. Find the best match and note tab (hue), the row (value) and the column (chroma) that the color falls into. For example a reddish soil might be: 2.5YR 5/4. Look to the opposite page and find the name of the color: reddish brown.

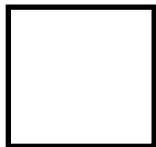


The Munsell Color Chart allows soil color to be quantitatively measured.

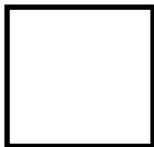
3. Note soil color in the *Soil Description* worksheet.

Using Crayons to Measure Soil Color:

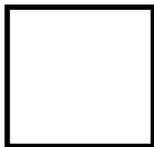
1. Munsell Color Charts are expensive and using crayons is an alternative way to document and communicate soil color. From a box of 48 Crayola Crayons, color in the blank boxes below with the corresponding crayon color. Hold the soil sample next to the box and use to determine soil color. Record observations on the *Soil Description* worksheet.



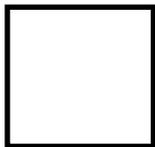
Raw Sienna



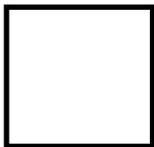
Tumbleweed



Tumbleweed
+ Olive Green



Burnt Sienna



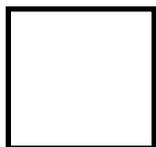
Goldenrod
+ Tan



Tan



Goldenrod



Sepia



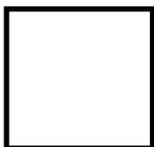
Brown



Chestnut



Mahogany



Timberwolf



Cadet Blue



Black

Determining Soil Structure

Soil structure is the aggregation of soil particles into groups or clumps called peds. These soil clumps or peds form shapes that impacts water infiltration and runoff from the soil surface and the ability of water to move through the soil. Soil structure is arranged into six primary shapes; granular, blocky, columnar or prismatic, platy, massive, and single grained.

1. Hold the sample and closely examine the shape of the ped
2. Using the guide below, determine the type of soil structure. Record your notes on the Soil Profile Description page

Granular

Granular soil looks like cookie crumbs. It is very loose and has many pores.



Blocky

Blocky soil has rounded or angular edges. They range from the size of a pea to a walnut.



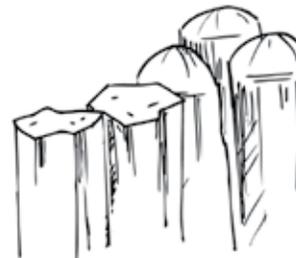
Platy

Thin, flat pieces of soil that lie flat on top of each other. Usually found in compacted soil.



Columnar or Prismatic

Vertical columns of soil and fewer pores than blocky soil. Columnar soils have rounded salt “caps” and are generally found in arid climates.



Single-Grained

Soil is in individual particles that do not stick together. Very common in sandy soils.



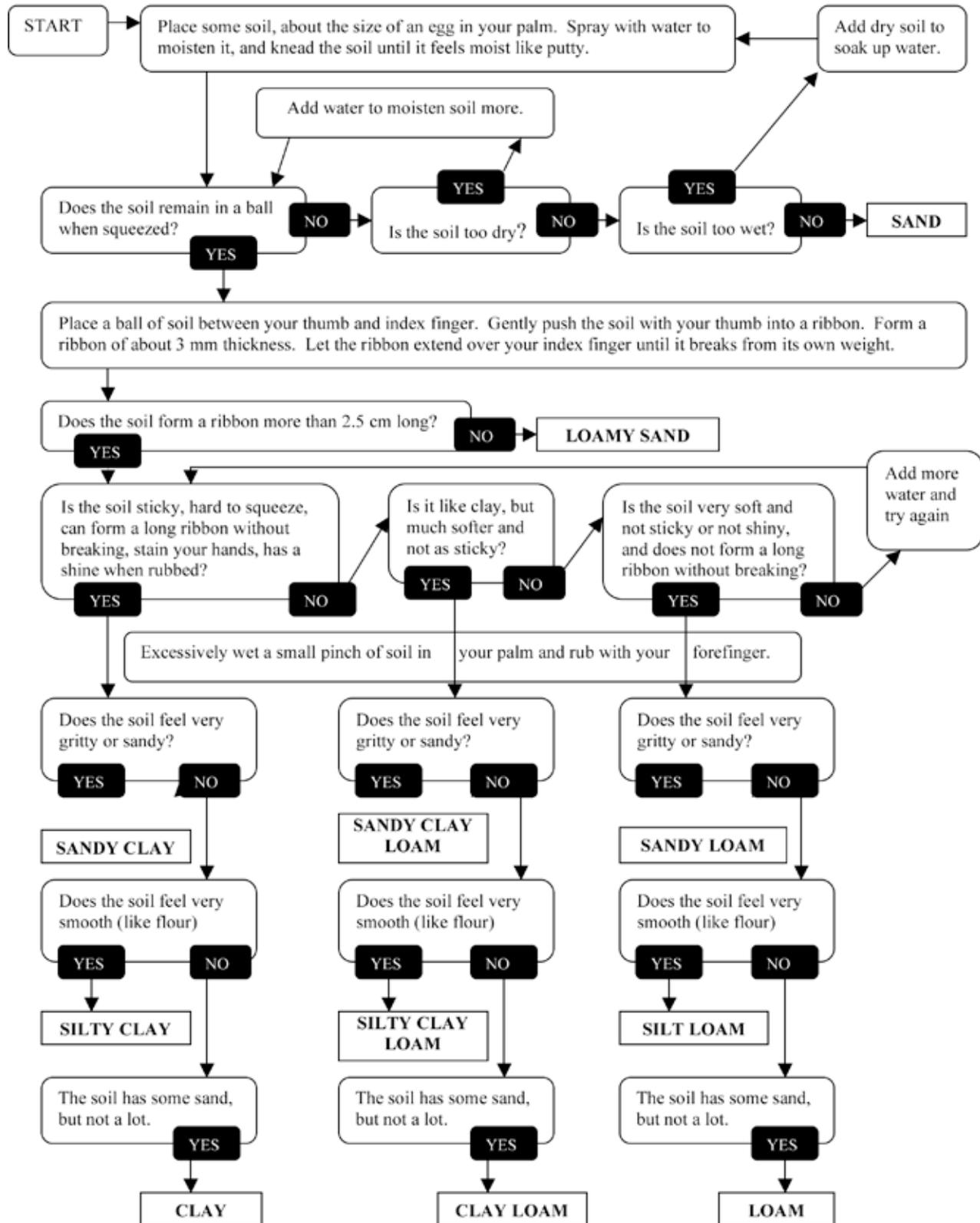
Massive

Massive soil has no structure and no pores. Soil is hard to break apart and appears in large clods.



Figuring Soil Texture

Soil is made up of mineral particles that are categorized into three sizes, sand, silt and clay. Sand is the largest, followed by silt, with clay being the smallest particle size. Soil texture refers to the proportion of sand, silt and clay particles present in a soil. Most soils are combinations of these different soil particles. Use the guide below to help determine your soil's texture.



Discovering Soil Consistence

Soil consistence measures the degree to which soil particles are resistant to breaking apart. Soil consistence is important in determining how a soil can be used, whether it is suitable for a garden, a septic system or a building. We will evaluate consistence in three ways; Stickiness, Plasticity and Rupture Resistance.

Stickiness

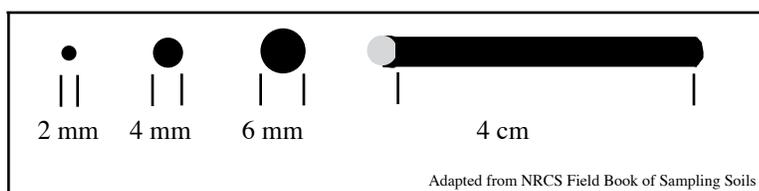
Stickiness refers to the capacity of soil to adhere to objects. Work moistened soil between thumb and forefinger. Squeeze fingers together and then release. Find the class that your soil fits best:

Stickiness Class	Criteria
Non-Sticky	Little or no soil sticks to fingers, after release of pressure
Slightly Sticky	Soil sticks to both fingers after release of pressure. Soil stretches a little on separation of fingers
Moderately Sticky	Soil sticks to both fingers, soil stretches some on separation of fingers
Very Sticky	Soil sticks firmly to both fingers and stretches greatly upon separation of fingers

Plasticity

Plasticity is the degree to which worked soil can be made into a “worm” without breaking. Take a soil sample about the size of a walnut. Moisten it and begin working it like modeling clay. Try to form a worm at least 4 centimeters long. Continue to make the worm skinnier and skinnier and follow the table below to determine which plasticity class your soil falls into.

Plasticity Class	Criteria: Make a roll of soil 4 cm long
Non-Plastic	Will not form a 6mm diameter roll, or if formed, can't support itself if held on end
Slightly Plastic	6mm diameter roll supports itself, 4mm diameter roll does not
Moderately Plastic	4mm diameter roll supports itself, 2mm diameter roll does not
Very Plastic	2mm diameter roll support roll supports it weight.



Rupture Resistance

Take a moist soil ped and hold it between your thumb and forefinger. Gently squeeze until it falls apart. Use the descriptions below to determine which consistence category your soil falls into. Record your observation on the *Soil Description* worksheet.

Loose - Soil material falls apart when handled. Hard to pick out a single ped. Sand is a soil that usually has a single-grained structure.

Friable - Soil material crushes easily under gentle pressure between the thumb and forefinger.

Firm - Soil crushed under moderate pressure but resistant to crumbling.

Very Firm - Soil has to be crushed under strong pressure, hurts when smushed between thumb and forefinger.

Name: _____

Soil Description Worksheet

Record your soil property data in the spaces below.

Sample	Color	Structure	Texture	Consistence		
				Stickiness	Plasticity	Rupture Resistance
Blackbeard's Boot						
Sample Location: _____						

Additional Observations