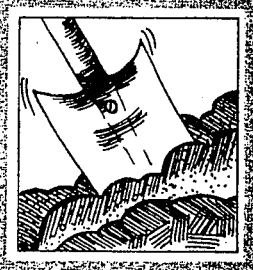
Do You Dig Wetland Soil?



[Soil texture flow chart adapted from Steve Them, 1979. Source unknown.]

Grade Level
K-12, as indicated

Subject Areas
Earth Science

Duration
Part I, 30-40 minutes;
Part II, 60 minutes

Setting
Classroom and wetland

Skills
Gathering, organizing, analyzing, and interpreting information

Charting the Course
Once students have studied soil types and identification procedures, they can investigate the permeability of various soils in "How Thirsty Is the Ground?"

Vocabulary
hydric soil, anaerobic, organic, mineral

Summary

How is wetland soil like a box of crayons?

Students make and use a wetland soils color chart, then dig a hole in a wetland area to study the physical characteristics of the soil.

Objectives

Students will:

- describe physical differences between wetland and upland soils.
- use keys to recognize wetland soils.

Materials

Part I:

- *Crayola® Crayons, 64-color boxes*
- *scissors*
- *paste*
- *posterboard or manila folders*
- *copies of the Color Me Wet! student pages (grades 4-12, p. 237; grades K-3, p. 236).*

Part II:

- *clay cat litter premixed with water to make a paste (see "How Thirsty Is the Ground?" p. 239)*
- *spade or narrow shovel*
- *yard (meter) stick*
- *pencils*
- *hand lenses*
- *copies of the Soils Data Chart, p. 235.*
- *copies of Key to Soil Texture by Feel (for older students), p. 238.*

Making Connections

Students may have dug holes in the ground and noticed variations in soil coloration, but they may not know what causes these colors, or how soil colors are important for keying out soil type. In this activity, students will learn to recognize common wetland soil types and begin to locate wetlands in their communities.

Background

There are many different types of soils, as well as sophisticated classification systems to categorize them. Most soil types are well-drained, nonwetland varieties. Because of the prolonged presence of water, wetland soils are physically different from nonwetland (often called upland) soils.

Wetland (hydric) soils are saturated, flooded, or "ponded" long enough during the growing season to develop anaerobic conditions in upper layers. That is, wetland soil is at times so saturated with water that it cannot hold much, if any, oxygen. The prolonged presence of water, and the resultant lack of oxygen, causes chemical reactions that eventually affect the color of the soil.

The study of a soil sample's color can determine if it is hydric soil even if the sample is not wet at the time of the investigation. By "reading" color characteristics, a soil scientist can tell how long or how frequently an area has been wet. You and your students can learn to recognize some wetland soils in this manner, too.

There are two major types of wetland soils: organic and mineral. Organic wetland soils are those that contain a noticeable amount (more than ten percent) of partially decomposed plants within at least 1.5 feet (0.46 meters) of the ground's surface. In waterlogged spots, organic materials accumulate. The lack of oxygen results in a decrease in

bacterial decomposition, and plants do not decompose as they do in aerated situations. Wet organic soils look like black muck or black to dark brown peat.

Soils that contain little or no organic material are classified as mineral soils. Mineral soils usually consist of a wide range of materials such as sand, silt, and clay. Mineral wetland soils can be gleyed (pronounced "glade") or mottled. Gleyed soils are usually formed when the soils are saturated all of the time (and thus anaerobic). These soils are usually neutral gray, greenish, or bluish gray.

Mottled soils are formed in areas that have wet (anaerobic) conditions, followed by periods of dry (aerobic) conditions. These conditions alternate continuously, possibly seasonally. The basic (matrix) soil color often includes concentrated splotches of brown, orange, red, or yellow. When the soil is very wet, minerals such as iron and manganese collect in spaces in the soil. When air moves into the soil during dry periods, these mineral concentrations oxidize. The iron rusts, leaving a permanent indicator of this process. Oxidized iron concentrations are various shades of red, orange, and yellow, while manganese mottles are black.

When you dig a hole to study wetland soil, you may find horizontal banding of colored materials in the soil profile. The soil types you find will depend on the area studied; you may want to contact your county Natural Resources Conservation Service office for expert help in identifying soil types. Wetland scientists use sophisticated tools such as the Munsell Soil Color Charts to identify wetland soils. Each color chip in the Munsell book represents a combination of hue (color), value (lightness or darkness), and chroma (purity) that reflects the degree of wetness in the soil. The color chart developed in Part I of this activity is a simplified version of the Munsell book.

Keep in mind that the soils on many properties have been altered by human activities. Tilling for agriculture, filling for development, and stripping for mining are a few examples of activities that change soils. Try to find a relatively undisturbed site, if possible. If you are looking at soil in a city, a suburban housing community, or near farmland, you may have to dig deeper to find undisturbed soils, including the original hydric soil. (Remember to ask for permission to dig, and be sure you fill up holes when you're done.)

Part I of this book contains other information on soils (p. 12) and helpful hints about finding wetland study sites (see chapter 6).

Procedure

Warm Up

Do students have a garden or flower box at home? Have they ever noticed the color of soil? Explain that chemical reactions in water-bearing soils cause color changes, and that soil color can therefore be used as an indicator of the frequency and duration of wetness. You might have your more advanced students study these reactions. Younger students should understand that the presence of water causes chemical changes that make wetland soils look different from other soils.

The Activity

Part I: ***Make Your Own Soil Color Chart***

Hand out copies of the appropriate color chart student page for your grade level and review the directions. Explain that this is a very simplified version of the Munsell book. Have students color the chart using the Crayola® Crayon color names given. (It is important to use the indicated colors in order to identify the soils correctly.) Have students complete the other steps to prepare the charts. They will use them for Part II.

Part II: ***Dig In!***

1. **Before going outside, show students the premixed cat litter. Have each student feel the mixture's texture. Give each student a copy of the Soils Data Chart student page.**

2. **At the wetland, use the spade to dig a hole about two feet deep to find and study wetland soils.** *Note:* If you do not find indications of wetland soils, try another spot.

3. **Avoiding the topmost layer of surface material, pick at the inside surfaces of the hole with the end of a yardstick to reveal the true structure of the soil. Remove golfball-sized pieces of soil from a side of the hole at the indicated depths (see data chart). Ask students to examine both the outside and the inside of these samples (break the soil balls into two or three pieces).**

4. **Have students record soil characteristics and observations in the Soils Data Chart, using the color chart from Part I and the word lists that accompanies the data chart. Older students can use the Key to Soil Texture by Feel on p. 238 to identify soil types.**

Wrap Up and Action

After the data charts have been

completed, use the Dig In! questions below for group discussion.

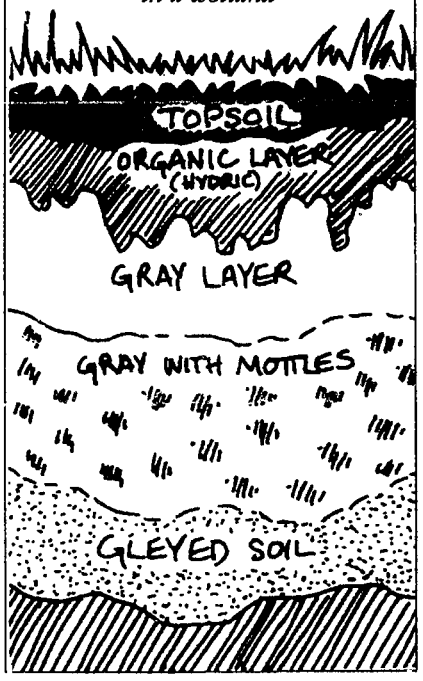
DIG IN!

1. *What soil characteristics did you observe?* Share data and observations from students' completed charts. Wetland soils may have any of the characteristics listed below. If you were able to dig down to wetland soil, the students' charts should in one way or another match these descriptions.

- some shade of dark brown or black (see color chart)
- feels like sticky clay and is some shade of gray, green, or darker color (see color chart)
- made up of peat or organic material, sand and/or other minerals, clay, silt, loam, or some combination of these materials in layers or mixtures
- when squeezed, sticks together or oozes out of fingers in a ribbonlike strand
- broken surfaces of the samples reveal mottles or splotches of color throughout the sample in some shade of red, orange, or yellow (see color chart)
- shades of red or orange "rusty" soil surrounding roots and root channels (the oxygen that wetland plants send to their roots often "leaks" out, oxidizing the iron in the soil)
- no earthworms in very wet, saturated soil (they would drown or suffocate!)
- sulfur gas from anaerobic activity; smells like rotten eggs

2. *How did soil at the bottom of the hole differ from soil near the surface in color and texture?* This depends on the type of wetland you were in and the level of the water table in your sample area. You may have observed layering of soils similar to the diagram shown here. Most wetland soils have a dark layer of (aerobic) organic soil at the top, where oxygen is exchanged with the atmosphere, and (anaerobic) mineral or organic soils below.

Sample soil layers in a wetland



3. *Can you find evidence around your sample area that shows where the soil particles came from?* Most organic topsoil is the result of the breakdown of fallen leaves and dead plants, as described in "Nature's Recyclers." Organic wetland soil is the accumulation of organic material that has not decayed because of the anaerobic soil condition. Mineral soils are formed over time from weathering of rocks. Wetland soils on the banks of streams and rivers may have been formed through the gradual deposition of soil particles that were carried in (and eroded) by water.

4. *Can you tell where the water and soils in this area are coming from? What watershed drains to this spot?* Have the students look at factors that bring water into the area, since it is the degree of wetness and how it affects the condition of the soil that we are most interested in here. Look at topographic features of the area and weather conditions. For example, if the wetland lies in a depression at the bottom of a slope, runoff from the slope will end up in the wetland, eventually seeping into the soil to make or keep it wet.

5. *Did you find anything that was not natural (i.e., human-made) in the soil? How do you think it got there?* In many cases, human products (e.g., litter, chemical pollutants) enter a wetland just as deposited soil and other natural materials do—with the inflow of water. These materials are introduced to the environment at some point, whether intentionally or unintentionally. Discuss these possibilities with the class. Have students speculate on the source of any human-made materials they have found.

6. *Compare wetland soil to soil you have observed at home and around school. How do the soils differ, and what makes them different?* The primary difference is that wetland soil is wet or saturated for an extended period, and upland soil is not saturated. The colors of the two soils are different because chemical reactions that occur in anaerobic (saturated) soils differ from those that occur in aerobic soils. The differences that students may observe in wetland and upland soils depend on the areas sampled—there are many possibilities. Organic soils are wetland soils, if the overall matrix of the soil throughout the hole is organic.

Assessment

Have students:

- observe soil samples and record their observations.
- classify soil types through color analysis.
- identify environmental and human-made factors that influence soil conditions.

Extensions

If you find clay or sticky soil while outside, have students make small wetland sculptures to take home!

Invite an extension agent or soil scientist to visit the class to discuss the results of the field work. Ask this visitor to share aspects of his or her career with students.

Nature in Your Neighborhood: Be a Wetland Watchdog!

Are there wetlands in your neighborhood that need protecting? Find a stream or other body of water—or even a puddle that stays wet for a week or more. Dig a small hole in the ground and use your color chart to see if it may be a wetland. How are people using the land in and around this spot? Check areas where the ground has been plowed to build a road, house, or other building. If the soil is gray or very dark, it could be a wetland. Ask officials if the construction there is legal. Devise a neighborhood plan to make the area even better. You might clean up the area, or plant wetland plants to prevent erosion and attract more wildlife. See chapter 6 for more ideas.

Notes:

Soils Data Chart

Record the words or phrases that apply to each soil sample in the chart below.

Texture/moisture: Rub the soil between your fingers. Choose words that describe how it feels.

- *dry, moist, wet, very wet,* or *drippy*
- *falls apart, sticks together, sticky* (sticks to fingers)
- *feels like clay* (easily molded into shapes)
- *slippery, oozes* (extrudes between fingers when you squeeze it)

Soil particles: Draw the size and shape of the particles. What is the sample made of?

- *sand* (feels gritty)
- *minerals* (tiny bits of rock)
- *clay* (like the cat litter sample)
- *silt* (like flour or powder; slippery when wet)
- *pebbles*
- *organic matter* (bits of leaves, twigs, bark, etc.)

Color: Use color chart

Other features or creatures: What does the soil smell like? List or describe any rocks, dead plants, or other nonliving materials in the soil. List or describe any living things such as worms, roots, or insects. Do you see any roots with "rusty" red or orange soil around them?

Depth From Soil Surface	**Texture/ Moisture** (describe how it feels)	**Soil Particles** (describe or identify them)	**Color #** (use color chart)	**Other Features or Creatures**
2 inches (5 cm)				
4 inches (10 cm)				
6 inches (15 cm)				
12 inches (30 cm)				
18 inches (45 cm)				

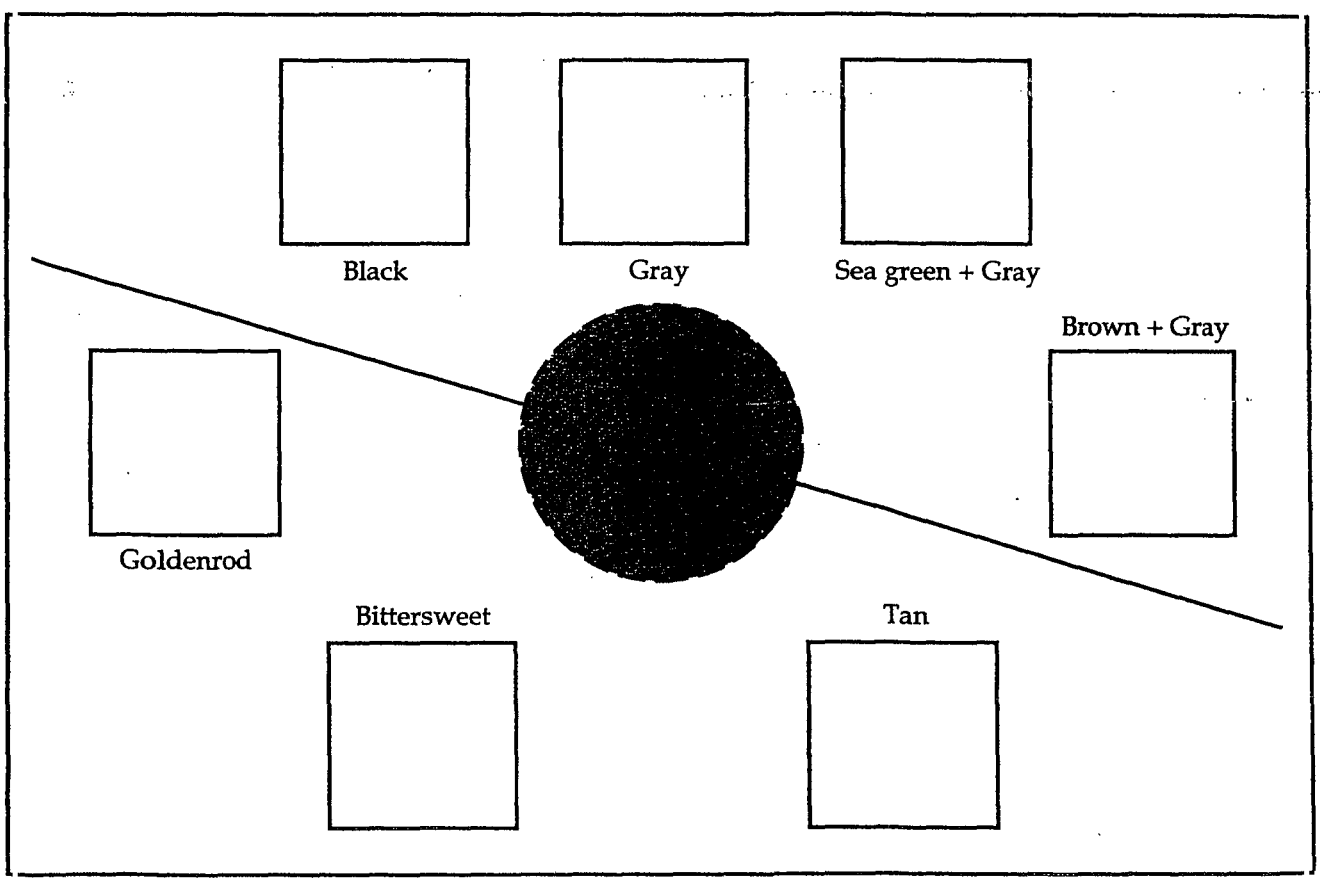
Color Me Wet!

1. Use Crayola® Crayons (a box of 64) to color in the squares on the chart below. It is very important to use the right colors!

2. Fold the rectangle in half and cut out the dark circle.

3. Use your chart when studying soil. Your chart is similar to the complicated color charts wetland scientists use to identify wetland soils.

Hold the chart in one hand and hold a sample of soil behind the hole with your other hand. Try to match the color of the soil to one of the squares. If it nearly matches a box above the diagonal line, it may be wetland soil.



Color Me Wet!

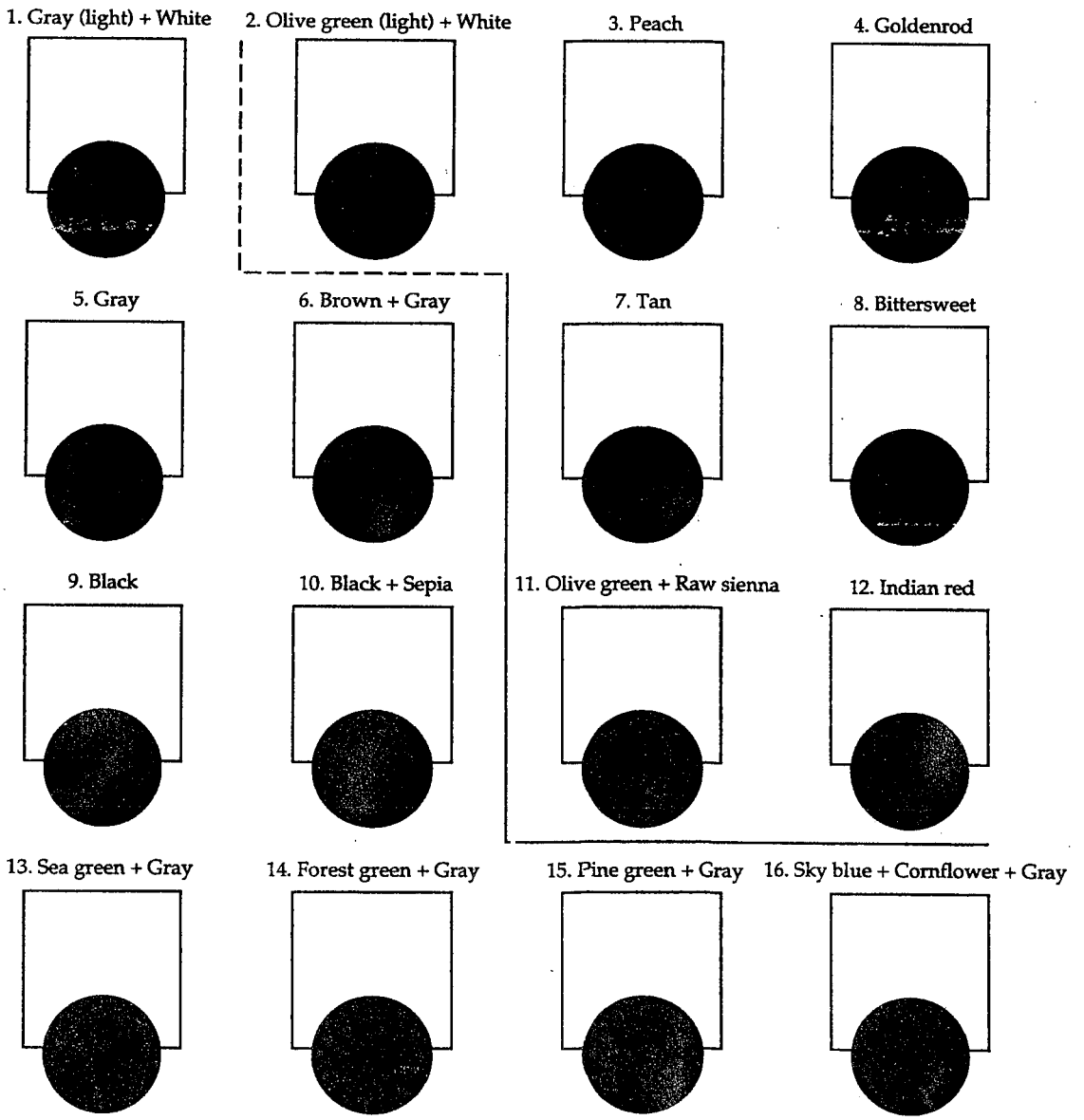
Use Crayola® Crayons to color in the squares on the chart below. It is very important to use the right colors! Press firmly when coloring, unless the name says "light." Cut out the whole chart and paste it to a piece of posterboard or half of a manila folder. Carefully cut out the black circles, through all thicknesses.

Use this color chart when studying soil in the field. Wetland scientists use similar but much more complicated color charts to identify wetland soils. Hold the chart in one hand; in the other hand hold a sample of soil behind the chart, so that it is visible through one of the holes. Your soil sample may contain bits of rock, organic material, and mineral concentrations. You must key out only the dominant soil color and ignore all other materials. Move the sample around until you find one or two colors that nearly match or approximate the dominant color.

Numbers 1, 5, 6, 9, 10, 13, 14, 15, 16, and sometimes 2 are probably wetland soils; the others are probably not wetland soils. Any soil with a basic (matrix) color that is a shade of dark brown, black, or gray may be a wetland soil. You will probably see other colors and materials within the matrix soil color. These colorful streaks may be the result of certain minerals. They appear as shades of red, orange, and yellow (associated with iron in the soil), or black (associated with manganese, not to be confused with dark organic material). These areas are good indicators of seasonal wetlands and other wetlands that are not always wet. Do not use these color mottles to key out the soil, but recognize that they are an additional indicator of wetland conditions.

WETLAND SOILS COLOR CHART

WET ← → DRY



Key to Soil Texture by Feel

Begin at the place marked "Start" and follow the flow chart by answering the questions, until you identify the soil sample.