Environmental Science — The Color of Soil

W 331-E

Project Area: Environmental Science

Skill Level: Beginner—Intermediate

Learner Outcomes:

-Understand what makes soils different colors

-Classify soil color using a modified Munsell Color Chart

TN Science Curriculum Standards:

GLE0407.Inq.2, .Inq.3
GLE0507.Inq2, .Inq.3
GLE0607.Inq2, .Inq.3
GLE0607.2.3
GLE0707.Inq2, .Inq.3
GLE0807.Inq2, .Inq.3
GLE0807.9.3

Materials Needed:

-4+ soil samples of a variety of colors

-Water for moistening soils

-Munsell color book OR student handout with simplified color chart

Time Needed:

30 minutes (optional soil art projects will take an additional 30-60 minutes)

Success Indicator:

Students can classify soil colors

Life Skills: Observing, Reasoning, Communicating

Tags: Soil color

Related Lessons:
"A Recipe for Soil"
"Dig In"
"Life Beneath Your Feet"
"The Soil Web"
"What's Soil Worth?"

Students will learn about what makes soils different colors and will practice classifying soils with a color chart. Soil art project suggestions are included at the end.

Set Up

Collect a variety of soil samples that represent a range of colors. Try to get some that are oxidized (red and orange colors), high in humics (dark brown) (e.g., from a garden) and poorly drained soils (black or grey) (e.g., from a wetland). Soil samples should be moist and can be stored in a zip bag to seal in moisture.

Tip: Due to the nature of this activity, student handouts should be printed in color. To save on printing, the soil color charts can be laminated and reused with multiple classes.

Introduce the Activity

Ask: What color is soil? (Encourage a variety of answers; they'll likely all be right. If students are stuck on "brown," show them some reddish or grey soils you've collected.)

Ask: Why are soils different colors?

Explain that color is determined by two main factors:

1. **Contents of the soil:** Minerals and organic matter from dead plants and animals
2. **Environmental conditions, particularly oxygen exposure**. In soils that are well-drained, water moves through quickly, and there is a lot of oxygen in the soil. This means oxides will form. Iron oxide is bright red (think rust!) and will color the soil red. In poorly drained or saturated soils, water sits and oxygen can't get in. This means the iron minerals will reduce. Reduced iron componds are grey.

On the handout: Students must match the component or condition to the color it contributes. **Answers:**

Iron oxide minerals —> red

Iron sulfide minerals —> black

Calcium minerals —> white

Low oxygen —> grey

Organic matter —> dark brown

Activity I: The Color of Soil

Note: Soil samples should be moist (not soaking wet). If starting with dry soils, have students moisten with some water first. Explain that dried soil is a different color, so we always compare soils while moist.

1. Hand out soil samples for the students to examine. Have them describe the soils in terms of colors (e.g., reddish-brown, yellow brown). They can fill in the first column of the observation sheet.

2. Explain that terms like "reddish-brown" can mean very different things to different people. Scientists need a way to quantify color so they can make sure they are describing the same thing. Soil scientists use the Munsell color charts to describe soils.

3. Explain the **Munsell Color Chart**. Use a soil color book or the simplified version in the student handout. Colors are described in terms of:

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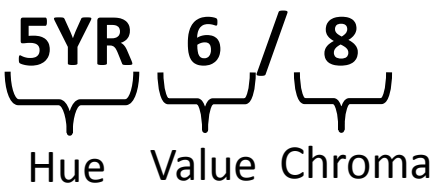
Adapted by: Jennifer DeBruyn and Andrea Ludwig

Hue: color, for soils typically red (R) and/or yellow (Y)

Value: lightness or darkness

Chroma: saturation of color (Think about it as if you were mixing paint, and chroma is how much of the color you add.)



Student Handout: Answer This! Answers:

Is a 5R 6/6 more yellow or red? **RED ("R" stands for red)**

What is the chroma of 5YR 2/4? **4**

Which one of these is darker: 5YR 2/4 or 5YR 8/4?

5YR 2/4 (value is "2," which is darker than "8")

Next, have your students classify the soil samples using the simplified Munsell Color Chart. (*Tip:* Laminate the color page to reuse with multiple groups.) Record the Munsell colors in the chart. Finally, have them speculate on the aeration and contents of the soil based on the color. Have the students guess where you collected each soil sample based on their observations (e.g., from a wetland, a well-drained field, a forest, garden, etc.)

Generalize and Apply

Some questions for discussion:

Do we all see color the same way?

Was there more agreement between people when we used the chart?

Why do soil scientists need to use a color chart?

Extension I: Get Outside

Go outside! Take the color chart and a trowel and find different soils around the schoolyard. Have your students practice classification in the field.

Extension II: Soil Art Projects

Soil Paints:

Materials needed:

4+ soils of various colors (dried)	Coffee bean grinder	Pantyhose
Small containers for paint	Art paper	Paintbrushes
Clear glue OR Mod Podge OR clear acrylic	Water	Stir sticks

Instructions:

1. Prepare the soils: Grind dry soils in a coffee bean grinder. Pour soils into a cup, stretch pantyhose over top, turn upside down and shake into a second cup. This will leave you with a fine-sieved soil. (*Note:* Students can help with this step or to reduce the mess [and time], you can do this step ahead of time.)
2. Put fine-sieved soil into small cups. Add clear artist acrylic OR Mod Podge OR clear glue. Thin with a few drops of water, if necessary. Stir well.
3. Have students draw a design with felt-tip markers. If you want to provide some direction, suggest a picture of why soil is important to you.
4. Let them paint their pictures with the soil paint.

Other soil art projects:

Soil crayons: Prepare the soils as above, then mix into melted paraffin wax, pour into molds, and let harden. Instructions here: doctordirt.org/soil-crayons

Dirt shirts: Make tie-dye dirt shirts using soil. Instructions here: doctordirt.org/teachingresources/dirtshirts

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Words to Explore

Hue

Value

Chroma

Well-drained

Poorly drained

Did You Know?

Near the ocean, green sands sometime form due to a mineral called **glauconite**.

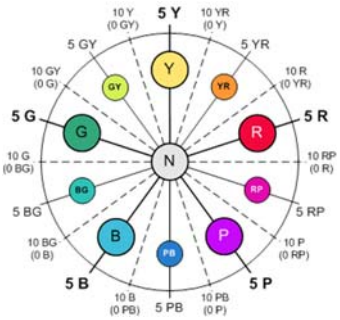
What's coloring my soil?

Draw a line between the soil component and the color that it adds to soils:

Iron oxide minerals	**Black**
Iron sulfide minerals	**Red**
Calcium minerals	**Dark Brown**
Low oxygen	**Gray**
Organic matter	**White**

Munsell Soil Color

Soil scientists use a Munsell Color Chart to describe soil colors. The Munsell colors use three parts:



Hue is the color: red, yellow, green, etc. On the chart, hue is listed as red (R) or yellow-red (YR) or yellow (Y).

Value is the lightness and darkness of the color. It ranges from 0 (black) to 10 (white).

0	1	2	3	4	5	6	7	8	9

Chroma is the saturation of the color. Brighter colors have higher numbers.

2	4	6	8	10	12

Now put it together!

Soil color is written like this:

5YR 6 / 8

Hue Value Chroma

Answer this!

Is a 5R 6/6 more yellow or red? _____

What is the chroma of 5YR 2/4? _____

Which one of these is darker: 5YR 2/4 or 5YR 8/4? _____

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Credits: Jennifer DeBruyn

Soil Color Observation Sheet

Soil	Describe the color in your own words	Munsell color (use the chart!)	Was this soil well-drained (lots of oxygen) or poorly drained (low oxygen)?	What types of minerals or substances are in this soil?
1			❑ Well-drained (colors) ❑ Poorly drained (grey)	❑ Iron oxides (red) ❑ Iron sulfides (black specks) ❑ Calcium minerals (white) ❑ Organic matter (black)
2			❑ Well-drained (colors) ❑ Poorly drained (grey)	❑ Iron oxides (red) ❑ Iron sulfides (black specks) ❑ Calcium minerals (white) ❑ Organic matter (black)
3			❑ Well-drained (colors) ❑ Poorly drained (grey)	❑ Iron oxides (red) ❑ Iron sulfides (black specks) ❑ Calcium minerals (white) ❑ Organic matter (black)
4			❑ Well-drained (colors) ❑ Poorly drained (grey)	❑ Iron oxides (red) ❑ Iron sulfides (black specks) ❑ Calcium minerals (white) ❑ Organic matter (black)
5			❑ Well-drained (colors) ❑ Poorly drained (grey)	❑ Iron oxides (red) ❑ Iron sulfides (black specks) ❑ Calcium minerals (white) ❑ Organic matter (black)

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Munsell Soil Colors