Agriculture in the Classroom
UtahStateUniversity
COOPERATIVE EXTENSION

Color in the Garden

Visual Arts and Science

Purpose
Students will use the art of soil painting to explore science and the natural world.

Time: Activity 1—30 minutes
Activity 2—1 to 1½ hours

Grade Level: 3–4

Materials

Activity 1

- ❑ Paper or reclosable quart bag (1 for each student)
- ❑ Digital camera (1 for each pair of students, optional)
- ❑ Access to an outdoor area with a variety of vegetation (garden, schoolyard, or park)

Activity 2

- ❑ *Diary of a Worm*, by Doreen Cronin
- ❑ Laminated Color Wheels (attached, one for every group of four students)

Activity 3

- ❑ 8.5" x 11" grey construction paper (one per student)
- ❑ Elmer's Glue mixed with 2 parts water
- ❑ Roll of toilet paper
- ❑ Bowl or jar for glue/water mixture for students (students can share)
- ❑ Various soils, prepared for painting (very finely ground and sifted)—these may be found locally, or purchase a "Soil Painting Kit" from Utah Agriculture in the Classroom (see Links section)
- ❑ Soil/glue mixture—8:1 parts glue to water; 4 tablespoons of glue mixture to ½ tablespoon soil
- ❑ Paintbrushes for students (½" brushes work well)
- ❑ Plastic table covers, if desired

Background

This lesson integrates the art concept of color with the science standards concerning living and non-living concepts and soils in a garden setting. In the visual arts, color theory is a body of practical guidance to color mixing and the visual impacts of specific color combinations. Although color theory principles first appear in the writings of Leone Battista Alberti (c.1435) and the notebooks of Leonardo da Vinci (c.1490), a tradition of "colory theory" begins in the 18th century, initially within a partisan controversy around Isaac Newton's theory of color (Opticks, 1704) and the nature of so-called primary colors. From there it developed as an independent artistic tradition with only superficial reference to colorimetry and vision science.

A typical artist's paint or pigment color wheel includes the blue, red, and yellow primary colors. The corresponding secondary colors are green, orange, and violet. The tertiary colors are red–orange, red–violet, yellow–orange, yellow–green, blue–violet, and blue–green.

A color wheel based on RGB (red, green, blue) or RGV (red, green, violet) additive primaries has cyan, magenta, and yellow secondaries (cyan was previously known as cyan blue). Alternatively, the same arrangement of colors around a circle can be described as based on cyan, magenta, and yellow subtractive primaries, with red, green, and blue (or violet) being secondaries.

Most color wheels are based on three primary colors, three secondary colors, and the six intermediate colors formed by mixing a primary with a secondary, known as tertiary colors, for a total of 12 main divisions; some add more intermediates, for 24 named colors. Other color wheels, however, are based on the four opponent colors, and may have four or eight main colors.

A multitude of colors can be found in the garden, from the leaves and flowers, to the insects and seeds, to the soil and rocks. The first activity in this lesson will focus on colors in the garden. Students will use the color wheel to determine if the colors of the items they collect from the garden are primary, secondary or tertiary colors. In addition, the students will determine whether the colors are warm or cool.

The second activity will follow up with soil painting, using soil-based pigments to understand Utah soils. Soils are important for the beauty their many colors add to our landscape. Most of us overlook this natural beauty because we see it every day. Often these colors blend with vegetation, sky, water, and other natural features. Over the centuries, humans have used soil colors to serve as pigments in bricks, pottery, and art work. These artifacts from the past give us an idea of how early people lived and worked.

Utah has over 1,300 different soil types. Each soil has its own unique characteristics. The attached soil map does not depict the true colors of these soils. Rather, it shows a general trend of lighter colored top soils in the driest parts of the east with the darkest top soils in the rich, moister grassland regions. Forested mountainous areas are midway between. The reason for the darkest top soils is that they have more organic matter built up over thousands of years in the high root-density grassland communities. More vegetation with high root densities results in organic matter to build rich topsoil and stain the soil a darker color.

Definitions

- Organic matter consists of plant and animal material that has decomposed to various degrees.
- Parent material is the bedrock or minerals from which soils form.
- Top soil is the top layer of soil that is most affected by vegetation.

Even if an area is light in color overall, darker soils can be found. A darker color means more organic matter is present as a result of additional moisture and plant growth. Similarly, light soils can be found in areas that are generally darker. In this case, a light soil often shows where soil development is thinner due to slope or as a result of erosion. Also, lighter soil colors can be found in subsoil. The colors of subsoil and, to a lesser degree, topsoil, are based on parent material.

Soils are grouped as red, pale red, black, brown, yellow, yellowish-red, and grayish-brown. However, describing soils in these terms is not very exact! So, just like paint stores, there is a book of soil colors used worldwide called the Munsell Soil Color Charts. The color information is based on the soil classification system used by soil scientists for describing soils. Soil samples are compared to the colors in the charts and given a specific value. Agronomists, biologists, archeologists, geologists, zoologists, and other scientists also use these charts to document colors.

Soils in Utah have been put into general groups with dominant soil characteristics. Iron provides the greatest variety of pigments—colors range from yellow to brown to red. Soils with high amounts of organic matter decompose into black humus—in grasslands the dark colors permeate the layers of soil. Soils with high amounts of lime are almost white. Soils with a green tinge have higher amounts of copper.

General rules about soil color:

- Black, Black/Brown: Soil that has high organic matter content and nutrients for plants. These are deep soils formed mainly of materials transported by water, ice, or gravity. This includes glacial deposits and soil deposited by rivers.
- Gold/Yellow: Soil from certain sandstones.
- Taupe: Clayey soils with lower organic matter content. Soils formed mainly in residual materials from ancient sea beds.
- Red: Soil with a high iron content.
- Cream: Soil with high amounts of lime or formed with wind-blown silty material.

Activity Procedures

Activity 1: Garden Color Match

Provide each student with a paper or reclosable bag and ask them to go into the garden (or a park or schoolyard) and collect, observe, or take a photograph of at least 5-10 items that are different colors.

Activity 2: Living and Nonliving

Read the book *Diary of a Worm*, by Doreen Cronin (optional) and then ask students if they think all soil a worm might travel through is the same color. Hypothesize with the students why soils are different colors. (The minerals in the parent/rock material contribute the color; organic matter in the topsoil makes the soil look darker.) Show soil profile images from Google images for additional visuals.

1. After presenting the background information, ask students to match the items to the closest color on the color wheel. Ask students to classify the colors as either primary colors: red, yellow and blue; secondary colors: mixing two primary colors together (orange, green, and violet); or as tertiary intermediate: mixing a primary and a secondary color together (e.g. yellow/green).
2. After the color of the items has been classified, ask students to identify whether the items collected are warm or cool colors.

3. Sort and categorize the items one more time into living and non-living things. Ask the students if there is any relationship between the living and non-living items they have collected (i.e., rocks that become soil by freezing and thawing; sun, wind, and water soil that anchors and nurtures plants, insects, and water that help or hinder plant growth, etc.)

Activity 2: Soil Painting a Book/Journal Cover

In this activity, students create a Utah-specific journal or book cover with Utah soils. The finished product has the look and feel of finely layered tree bark.

1. Prepare a mixture of watered down glue of about two parts water to one part glue. It does not take much and the mixture can be sealed in a jar to use again. Place some of the mixture in separate bowls to be used for adding soil to do the painting. Experiment with the amount of soil to achieve color, but not grit! Discuss with students why soils are different colors.
2. Provide each student with a single piece of 8.5" x 11" construction paper; light grey works best.
3. Ask students to initial or write their name on the backside of the paper.
4. Each student needs to tear their three, three-square lengths of toilet paper into horizontal thirds (it is easiest to do this if the three squares are folded and then torn). The horizontal pieces should be laid across the book cover paper so it is covered. Then they use their brushes and watered down glue to wet/texture the toilet paper to the page, one strip at a time. When all strips have been placed allow the page dry.
5. Using the previously mixed soil paints (four tablespoons of glue solution to ½ a tablespoon of ground soil), students should begin painting their book covers. This can be done in a variety of patterns.
6. If possible, the painted pages should just be left to dry without moving. The following day the pages are folded in half and hole-punched at the top and bottom of the fold. A piece of twine can be used to string through the holes and attach any pages that are placed inside.
7. Place inside the journal a Utah soils map and a soil profile (attached), and other soil science visuals used to cover the soils part of the core curriculum.

Assessment

1. Gather 30 living and non-living items. Divide the class into two relay race teams. Provide each team with 15 items and then ask students to race a short distance sorting the items into a living or non-living box. Check the boxes after the race to re-teach incorrectly placed items.
2. Using the same items and strategy as used above, ask students to sort the items by color classification.
3. Ask students to match the soil samples used for painting with the counties from which the samples came.

Curriculum Extensions/Adaptations/Integrations

1. Using the soil painting images of Jan Lang, ask students to use the soil paints to paint a teepee, a tree, or a mountain. Be sure to ask them to draw the shape first.
2. Create a soil profile in a jar or cup using local soils to demarcate the horizons. Once the profiles are complete, use a stick to poke the soil on the edges to create a type of soil jar or cup art.
3. Texture soil samples students collect locally. View YouTube videos to help with your understanding of soil texturing.

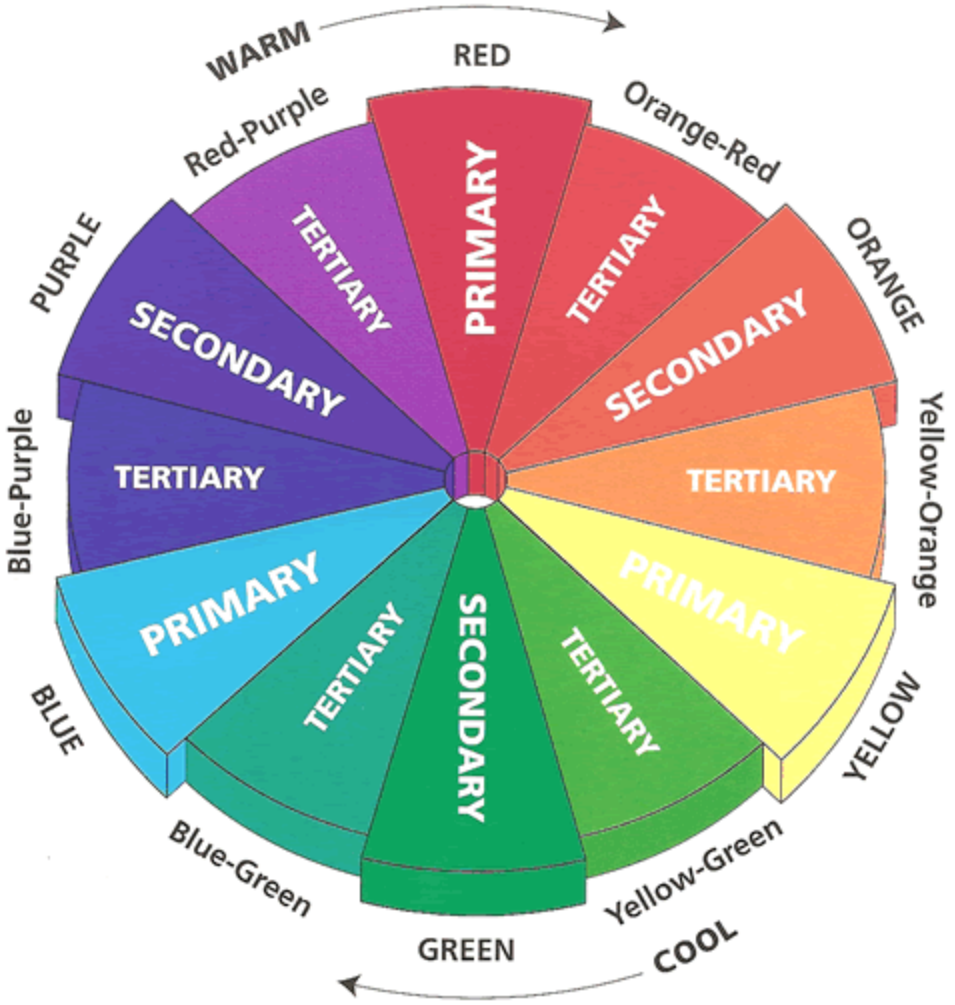
Family Connections

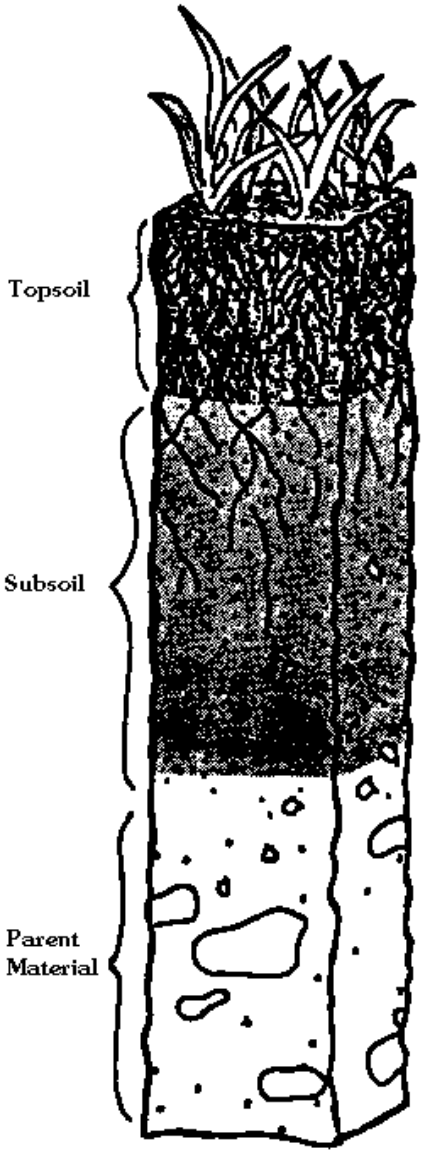
1. Asks students with their families to look in their own backyard or neighborhood for colors not found in the schoolyard. Ask them to share the items and the color observations with the class.
2. Provide the students with the soil paint recipe and then using the soils from home, ask family members to submit their art for display in the classroom.
3. Ask students to share a book they have on gardening or plants from home or from the library and discuss the colors in the book.

Resources/Links

- Utah Agriculture in the Classroom (search "dirt" or "painting"): http://www.agclassroom.org/ut
- Painting with Soil—South Dakota soil painting instructions with clear acrylic paint and local soil: http://www.sdagclassroom.org/teachers/resourcespdfs/soilpaintinstruct.pdf
- Painting with Soil—Jan Lang's Images of the Lewis and Clark Expedition (see attached sample): http://www.nrcs.usda.gov/feature/lewisandclark/paintingwithsoil.html
- Dirt Secrets in the Soil—Instructional Unit and DVD: https://extension.usu.edu/aitc/cart/Results.cfm?keywords=dirt:
- K-12 Teaching Resources and Activities by Dr. Dirt: http://www.wtamu.edu/~crobinson/DrDirt.htm
- The Answer Worm Tells All About Soil: http://www.nrcs.usda.gov/feature/education/squirm/skworm.html
- Soil texturing on YouTube: http://www.youtube.com/watch?v=knrmCbctGEA

Color Wheel


WARM
RED
Orange-Red
ORANGE
Yellow-Orange
YELLOW
Yellow-Green
GREEN
COOL
Blue-Green
BLUE
Blue-Purple
PURPLE
Red-Purple
PRIMARY
TERTIARY
SECONDARY
TERTIARY
SECONDARY
TERTIARY
PRIMARY
TERTIARY
SECONDARY
TERTIARY
PRIMARY
TERTIARY
SECONDARY
TERTIARY



Utah Soil Painting Sample Legend

Cache County, Utah, Soil: Millville Silt Loam, Color: dark grayish brown (Hue: 10YR – Value: 4 – Chroma: 3) - Mollisol

Millard County, Utah, Soil: BRD Loam, Color: black (10YR 2/1) (Hue: 7.5YR – Value: 6 – Chroma: 4) - Entisol

Grand County, Utah, Soil: Nakai Fine Sandy Loam, Color: reddish yellow (Hue: 7.5YR – Value: 6 – Chorma: 6) - Entisol

Sevier County, Utah, Soil: Aurora Clay, Color: grey (Hue: Gley 2 – Value: 8 – Chroma: 1) - Alfisol

Piute County, Utah, Soil: BRCM Silt, Color: yellow (Hue: 5Y – Value: 8 – Chroma: 3) - Entisol

Note: The **Hue** notation of a color indicates its relation to Red, Yellow, Green, Blue, and Purple; the **Value** notation indicates its lightness; and the **Chroma** notation indicates its strength (or departure from a neutral of the same lightness). Reference: Muncell Soil Color Charts – 2000 Revised Washable Edition.