"Dyeing to Find Out - Extracting Nature's Colors." National Gardening Association. kidsgardening.com

California State Standards
History 4th Grade: 4.2.5
History 5th Grade: 5.1.1,2

Dyeing to Find Out
Extracting Nature's Colors

Nature presents an incredible visual rainbow. For centuries, people have tried to capture these natural hues for decorating animal skins, fabrics, crafts, hair, and bodies. They've even been employed to distinguish serf from master and one religious sect from another, and to color banners carried in battle.

Your classroom garden, vacant lot, school grounds, and local grocery store can provide fuel for exploring the ways in which plants have enriched and continue to color our world. Dyeing with plants can provide an intriguing lens for exploring the local environment, learning science concepts, conducting experiments, learning about history and other cultures, and creating compelling crafts.

Investigating plant dyes can be as simple a project as simmering some onion skins, dipping in yarn, and observing to see what colors are revealed. Or it can be a more complicated project involving researching, gathering, and experimenting with different types of plants, recipes, and dyeing techniques. It might tie into a study of different cultures (e.g., Navaho) or periods in history (e.g., Middle Ages).

Although plants exhibit a wide range of colors, not all of these pigments can be used as dyes. Some won't dissolve in water, some can't hang on to fibers; others will fade when washed or exposed to air or sunlight. It's not obvious from looking at plant colors which will reward us with vibrant dyes—a fact that can lend shades of mystery and excitement to your classroom dyeing explorations.

Dyeing to Find Out

Invite your students to consider the following: *Why do plants have so many different colors? What purpose might they serve for the plant?* Ask the class to recall what they've observed and already know about plants. The green in most leaves is surely the most ubiquitous plant color. The green pigment chlorophyll in the leaves helps capture the sun's energy and

convert it to chemical energy, which is then stored and used as food for the plant. Colors in flowers are adaptations that attract insects and other animals who, in turn, pollinate and help plants reproduce. Some plants have colorful fruits that attract animals who eat them, inadvertently spreading the plant's seeds as they do so. Scientists believe that other pigments may help protect plants from disease. Despite what we know about the role of a few of the thousands of plant pigments, the role of most colors in plants remains a mystery to scientists!

Most plant parts have a mixture of pigments, which is why dyes made from plants tend to appear more subtle and muted—less "pure"—than synthetic dyes. These "earth tones" in plant dyes intrigue many hobby and craft dyers, because the rich hues of mother nature all seem to "go together."

Once your students have harvested plant parts and predicted which colors might emerge from which plants, challenge them to brainstorm how they think they could "extract" the colors by considering different approaches and variables. Record their thoughts so they can set up investigations to test some of their ideas, or try out the activities below. The Curriculum Connections suggest other activities and ideas for digging deeper, as well as more background information to help you guide your students in their quest for colors.

Materials

*__Pounded Flower Prints:__ fresh flowers and leaves, rubber mallet, white or light-colored cotton fabric, safety goggles, wax paper, newspaper

*__Sun-Brewed Dye Bath:__ Distilled water or pre-measured tap water that has been allowed to sit uncovered for a day or two to allow chlorine and fluoride to evaporate; various fibers (wool, cotton, silk, linen; fabric or yarn); glass pint jars with lids; alum (aluminum potassium sulfate from a pharmacy or craft store); plastic wrap; paper towels; plastic or wooden spoons

*__Stovetop Dye Bath:__ Various plant materials, large enamel pot, hotplate or stovetop, large wooden spoon or spatula, alum, cream of tartar, fabric or yarn, cheesecloth or nylon stockings

Exploring Pigment: Pounded Flower Prints

A first step in exploring the mystery of plant pigments is to transfer them directly to fabric creating decorative patterns to adorn napkins, pillow cases, or to make prints for framing. Have kids predict what colors their

prints will be, explain their thinking, and then compare and discuss the results.

1. If using new napkins or pillowcases, wash them first to remove sizing. If students are making a print to be framed, cut fabric 1 inch larger than frame size so they can wrap the fabric around a piece of cardboard in the frame.

2. Cut flowers from stems, leaving a little bit of stem attached.

3. Choose a work space that can be safely pounded with a hammer, such as the floor or a sturdy work table. Cover the surface with thick protective layer of newspaper, and place wax paper on top to keep the newsprint from being transferred to the fabric. Lay fabric on top of the wax paper. Have kids practice on scrap fabric first to see the effects of different flowers.

4. Invite students to experiment with designs. They should place flowers and leaves face down on the fabric and place sheet of wax paper over the entire design.

5. With safety goggles on, students can hammer through the wax paper to transfer the flower pigment onto the fabric. Make sure they pound along the margins to define the shape. Thick flowers require more pounding.

6. Remove wax paper and check the fabric. Students may want to add more flowers and continue the process until they are pleased with the results. For a print to be framed, leave the small flower pieces that adhere to the fabric. For napkins and pillowcases, remove the residue.

7. Wash napkins and pillowcases in cold water and iron them. (Flower prints may fade when washed in hot water.) For a framed print, iron the fabric, then wrap the border of the fabric around the thin piece of cardboard that comes with the frame (or provide your own). Tape fabric to cardboard and place it in the frame.

Sun-Brewed Dye Bath

Color Chameleons

When students experiment with these activities they'll discover that plant pigments often won't produce an obvious dye color. For instance, fabric dyed with something as vivid as red beet juice usually turns out a shade of brown or tan. And even on those occasions when they do achieve a nice red fabric, it soon fades under the effects of washing and sunlight. Experimenting with mordants (e.g., alum) and the pH of the dye solution can affect the resulting hues and fastness (See Getting Pigments to Hang On).

This is a simple dyeing method used by Native Americans that takes advantage of the sun as a heat source. It offers lots of variables for experimentation. Consider the following to get your juices flowing: Vary amounts of fabric or yarn. Use different kinds of fabric or yarn. Vary how long you "steep" plant parts and/or fabric.

1. Collect plant parts noted in the chart below or those that you have identified via your research. (Recommended books on natural dye sources are listed in the Resources section.) Crush berries and chop other plant parts, place them in the jars, and add water to within an inch of the brim. Cap the jars. (Note: If jar lids contain metal, cover the mouth first with plastic wrap to prevent the metal from reacting with the dye.)

2. Place the jar in a warm, sunny place for several days and then strain the liquid through cheesecloth or a strainer. Place the plant material in the compost pile or worm bin.

3. To each pint jar, add 1/4 teaspoon of alum and stir with a wooden or plastic spoon. Place moistened material or yarn in each jar, distribute them evenly, and replace the lids. Return jars to a sunny spot for 1 to 4 days.

4. Remove material and rinse it gently in cool, clear water, and place it on paper towels to dry.

Stovetop Dye Bath

Prepared to take your dyeing project to the next step? This activity requires more equipment, time, and materials, and will reward students with more color fabric for their efforts. Use it to challenge math and inquiry skills and explore what hues the plants in your schoolyard will yield.

Students may want to experiment by leaving the fabric in the dye bath for different amounts of time, even overnight. Or they might want to do some

"tie dyeing" to see what patterns emerge when they tie knots, rubber bands, or otherwise prevent the dye from penetrating throughout the fabric.

1. Getting the Color Out. Prepare plant materials as in the Sun-Brewed Dye Bath activity (above). In an enamel pot, cover the plant materials with water and then simmer them for about an hour until the water is colored and the plant tissues look bleached.

Strain the dye bath through cheesecloth or an old stocking to get rid of plant material. (Some dyers do simultaneous dyeing in which the plant materials are left in when the fabric is dyed. If you decide to do this, place the plants or the fabric in an old stocking or net bag to protect the material from direct contact.)

2. Treat the material. Wash your material with soap to remove dirt and oils that could prevent the dye from binding to the fabric. If you're using a skein of yarn, tie it loosely so the mordant and dye can penetrate well.

3. Treat with Mordant. If you're just getting started, you may choose not to use a mordant to "fix" the dye. Some plants will yield colorfast dyes without a mordant (e.g., turmeric and black walnut hulls), and others may yield color without a mordant, but it may wear out with washing and sunlight (e.g., purple cabbage).

If you're using the mordant alum to help the dye bind better to the fabric, you can either pretreat the yarn or fabric (as is typically done) or try adding the mordant directly to the dye bath.

To pretreat the yarn or fabric, measure 3/4 teaspoon alum plus 1/4 teaspoon cream of tartar per each quart of water in your dye bath. Dissolve this in a cup of hot water, then add it to a pot of water (1 quart of water per each ounce of fabric). Wet the fabric to ensure penetration, then add it to the mordant solution.

Heat slowly at a simmer for one hour. (Wool, in particular, doesn't respond well to rapid temperature changes.) Remove the pot from the heat; cool and rinse the fabric before adding it to the dye bath.

4. The Dyeing Begins. Simmer for 30 to 60 minutes, turning the material gently. Stir and check the color every 10 minutes or so. Rinse dyed materials with progressively cooler water and hang them to dry.

Plants to Grow and Collect* for Dyeing
Plants are listed to correspond with certain colors, but your results may vary with the amount of plant used, stage of maturity, soil fertility, and other environmental and procedural factors.

Color
Plant

Blue
Leaves: red cabbage

Fruit: elderberries

Leaves & stems: tomato plants

Yellow
Leaves: alder, mint, parsley, birch

Flowers: aster, calendula, chamomile, dandelion, golden marguerite, marigolds, zinnias

Leaves & stems: bindweed, mullein, wild mustard

Green
Leaves: carrots, golden marguerite

Flowers: black-eyed Susan

Leaves & stems: spinach

Orange

Flowers: dyer's coreopsis

Other: turmeric

Gold/Brass
Flowers: sunflower

Leaves & stems: cocklebur, dock, goldenrod, redroot pigweed

Seeds: sunflower

Tan/Brown
Leaves: birch

Fruit: hawthorne

Other: Coffee grounds

Magenta Roots: dandelion
Pink Leaves: red cabbage
Purple Fruit: wild grapes, mulberries
Red Roots: madder
Black Black walnut hulls

**(Never pick a flower that seems to be in short supply in an area or that you know to be endangered.)*

Calendula

Mulberries

Red Cabbage