

Exploring Natural Dyes Activity

Program Type: After-school, community center, classroom, museum education activity	Audience Type: Grades 6–8, ages 11–14 (emphasis on Native youth)
Program Length: 1–2 hours	Class Size: Up to 36 students

Description:

Learn traditional* knowledge and environmental science through the craft of creating and using natural dyes. Participants will explore how to create dyes using natural and organic materials, how they behave on different types of fabrics, and how a range of colors can be created with just a few ingredients from the yard or kitchen.

**Traditional knowledge refers to information, skills, and practices that are developed, sustained, and passed on from generation to generation within a community.*

Topics: Dyes, patterns, natural resources, environmental science, traditional knowledge

Process Skills Focus: Observing, predicting, inquiry, critical thinking, controlling variables, experimenting

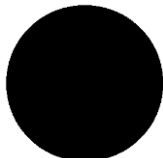
LEARNING OBJECTIVES

For Next Generation Science Standards, see end of outline.

- Indigenous peoples from around the world create dyes from locally available materials.
- Natural dyes can be made from organic materials such as plants, fungi, invertebrates, or minerals.
- Passing down knowledge through generations is a valuable way to gain skills and learn about the environment.

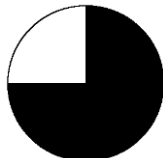
TIME REQUIRED

Advance Prep



60+ minutes

Set Up



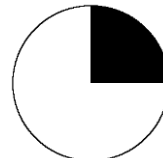
45 minutes

Activity



60+ minutes

Clean Up



15 minutes

PROGRAM FORMAT

Segment

Introduction
Guest Speaker (optional)
Exploring Natural Dyes
Wrap-Up

Format

Facilitator-led/partner discussion
Group Activity
Individual Activity
Guided Discussion

Time

10 min
30–60 min
20–30 min
5 min

SITE REQUIREMENTS

- Classroom or community space large enough for class size
- Tables with chairs grouped into fours (each table shares supplies)
- Access to water source
- 1–2 adults per 20 students

SUPPLIES

Permanent Supplies	Amount
Paintbrushes, fine point	1 per student
Containers for dye (clear cups are preferable)	1 for each dye, per table
Container for rinse water	1 per student
Plastic tablecloths	1 per table
Drying rack	1
Rulers	1 per student
Pencils	1 per student

Major Consumables	Amount
Plant-based fabric (cotton, linen), laundered, cut into 7–10 cm (3–4”) squares	1 square per student
Animal-based fabric (silk, wool), laundered, cut into 7–10 cm (3–4”) squares	1 square per student
Silk fabric, laundered, cut into 7–10 cm (3–4”) squares	1 square per student
Tea, beets, spinach, turmeric, dried black beans	as needed
Alum (potassium aluminum sulfate)	4 oz. per lb fabric
Cream of tartar	1 oz. per lb. fabric
Iron (ferrous sulfate/scrap iron)	½ oz. per lb. fabric
Additional source materials for extracting dye (e.g., vegetables, fruits)	as desired
Paper towels	1 roll per table
Paper cups (option for permanent dye containers)	as needed
Paper (blank, unlined for creating observation chart)	1 per student
Drying rack or drying area	1
Observation chart (see the Resources section)	1 per student

ADVANCE PREPARATION

- Reach out to members of the local Native community and ask if they are willing to share information about what in the local environment was historically used to create natural dyes.
 - Suggestions for where to find a Native community member:
 - Family members of youth
 - Tribal or cultural center
 - Retirement or assisted living center
 - Local Native-owned companies and businesses
- Facilitators are also encouraged to ask for examples of color significance from members of locally based indigenous cultures.
- Cultural sensitivity should be taken into consideration when reaching out to an elder and asking for an interview. The facilitator is encouraged to speak with people in the Native community and learn protocol for asking an elder to present. This protocol may vary among different communities.
- An honorarium is often appropriate to offer in return for someone sharing cultural knowledge.
- **Always** have a gift to present a guest from the Native community. This gift can be flowers, food, a card signed by the students, or even a gift made by the students.
- Create 2–3 dyes from materials in the local environment (see [Native Plant Dyes](#)¹) and 2–3 from products purchased from a grocery store.
 - In general, chop up the source material and simmer in water (1 part source material to 4 parts water) for an extended period of time, allowing it to cool and sit overnight, before straining.
 - The following colors can be made from common grocery store items:
 - Brown: Black tea, brewed strong
 - Red: Beet, fresh (heat slowly and do not boil) or canned
 - Blue: Blueberry, fresh or canned
 - Green: Spinach, fresh or frozen
 - Yellow: Turmeric, powdered
 - Orange: Yellow onion skins, boiled
 - Purple/Black: Black beans, dried
- Optional time savers:
 - Steep materials for less time or use juice from fruits or vegetables. Many vegetable and fruit juices such as carrot, pomegranate, and grape need no special preparation other than pouring into a container. Dried herbs and spices may also be steeped in water for a simple dye preparation. *Caution – the resulting shade of color will be lighter and more prone to fading using either of these methods.*
- Take 1–2 of the dyes and pour a portion of each into a separate container with the alum or cream of tartar, which act as a *mordant* to fix the color onto

¹ <http://www.fs.fed.us/wildflowers/ethnobotany/dyes.shtml>

the materials. Choose either silk or wool as an animal-based fabric to be saturated with an iron mordant by soaking fabric for an hour in a solution of water that has been boiled with ferrous sulfate, old iron nails, a cast iron pan, or even scrap iron. Cut all fabric into 7–10 cm (3–4”) squares (one square per student).

- Optional (if time allows): Launder all fabric *without using fabric softener* to open up fibers to allow the dye to be more readily absorbed.
- Print the observation charts (see the Resources section), one per student.

CAUTION: Do not use fabric softener when laundering the fabrics.

SET UP

Set out supplies at each table of 4 students with the following items on each table:

- Plastic tablecloth to cover tabletop
- 1 roll of paper towels/clean rags to blot brushes and wipe up spills
- 1 container of each type of prepared dye (2–3 from store-bought materials and 2–3 collected from the local environment)
- 1 container of water to clean brushes when changing colors
- 1 square of each type per student:
 1. plant-based fabric (cotton or linen)
 2. animal-based fabric (silk or wool)
 3. a second piece of the same type of animal-based fabric, treated with an iron mordant
 4. synthetic fabric (examples: polyester, rayon, or spandex)
- 1 paintbrush per student
- 1 ruler, pencil, and sheet of blank, unlined paper per person

INTRODUCTION

30 minutes

Suggested script is **shaded**. Important points or questions are in **bold**. Possible answers are shown in *italics*.

Let students speculate before offering answers to any questions. The answers given are provided primarily for the instructor's benefit.

Recommended Introduction with Guest Speaker

Today we are going to learn about the ancient practice of creating and using natural dyes. People from all over the world have been using materials they find in nature to create dyes for thousands of years. Before we explore different dyes on our own, I've asked a Native Elder from our local community to join us today and talk about the current and historical practices of creating and using dyes amongst our local Native American community.

Refer to the *Voices from our Community* activity guide for information and protocol on interviewing a Native Elder. The guide is also available on the *Roots of Wisdom* website at www.omsf.edu/exhibits/row.

Alternative Introduction with Guided Discussion (if a guest speaker is not available)

Today we are going to learn about the ancient practice of creating and using natural dyes. People from all over the world have been using materials found in local environment to create dyes for thousands of years. Plants, fungi, invertebrates, and minerals are all sources for creating dye.

Today, dye is still a huge part of our culture and daily life.
For example:

- It is really hot outside, so I am wearing white to stay cool.
- I am wearing our school's logo because we have a game tonight.
- I am wearing my favorite color because it makes me happy!

Now partner up with your neighbor and take 30 seconds each to tell each other about why you choose to wear certain articles of clothing today. You can discuss things like colors, patterns, and designs. Ready, set, go!

If time allows, have a few students share what they discussed with their partner.

We all have deeper reasons for choosing our clothes each day than just covering ourselves and staying warm. Our day's activities, personal needs, social identity, and the roles we play (like being a teacher or a student) all contribute to the choices we make. The way we make ourselves look tell us a lot about each

other. Colors, as well as the patterns and designs we make with them, often have deeper, symbolic meanings. Team uniforms are a common example. However, what is true for us today and our culture didn't always hold true in past times and other cultures.

Let's think about some of the deeper, more symbolic meanings of colors and patterns in our society today. For example, *red can mean stop, or signify anger. Yellow can be cheerful or cowardly. White can indicate cleanliness and purity. Black is often associated with grief, formalwear, and even punk rockers!*

If time allows, ask students to come up with more examples of what colors symbolize in our society.

Now let's compare how some of our views to those of one particular Native American community. Red, yellow, black and white are four sacred colors to the Cheyenne people, a plains tribe from the Upper Midwest on the United States. To the Cheyenne people, red traditionally symbolized life, yellow the sun's power, black victory, and white dawn.

Native American cultures used dye for making patterns and designs with color for many reasons such as to identify different groups of people, indicate a family's status, and portray tribal values. Traditional knowledge was handed down for generations on how to collect natural materials and create dyes for making particular colors and designs. Archeologists can sometimes learn a lot about past cultures and how they changed over time by studying the colors and designs of objects found in a particular place.

While natural dyes have been around for thousands of years, industrially made dyes have only been around for a few hundred years. Since then, the synthetic textile and dye industry has become a huge part of modern society and also one of the largest sources of industrial water pollution on earth.

Natural dyes are better for the environment because they don't create toxic chemicals like formaldehyde, chlorine, lead, and mercury. Natural dyes are less toxic to the environment and the people who work with them and wear them.

INDIVIDUAL
ACTIVITY

Exploring Natural Dyes

20–30 minutes

Now that we have a little background information about dyes, let's talk about how we are going to explore the ones on our tables.

Can anybody guess why some stains are easy to wash out and others aren't? *Some plants stick better than others. Some colors are brighter than others. Chemicals in some plants stick to fabric better than others.*

Those are good guesses. Different types of materials are made up of different types of threads, called fibers. These fibers play an important role in determining how dyes and fabrics respond to one another. Animal fibers are considered easier to dye because they are mainly composed of proteins. Plant fibers can be more difficult because they have a thicker and smoother surface, making it difficult for dyes to bond.

Who can name an example of a fabric made from plants? *Cotton from the cotton plant, linen from flax*

Who can name an example of a material made from animals? *Leather from cows, silk from silk worms, wool from sheep*

Natural dyes can often fade less and last longer if a substance to fix the color onto a material – a mordant – is applied to the material before or after the dye. For example, fabric dyed with berries will fade quickly and wash out, if not treated with a mordant. Mordants work by binding with the dye to create an insoluble compound. They create more of an affinity between the dye and the fabric. The metal ions in the mordants form strong bonds between the dye and the fiber. Mordants like salt, vinegar, and baking soda are good for plant-based fabrics. Metallic mordants like alum, iron, and copper are better for animal-based fabrics, such as wool and silk. Some mordants have been used for centuries, such as wood ash and even stale urine! Urine is most effective when “aged” at least 2 weeks before using. Whew! What an odor!

Some dyes don't need any type of added mordant to work well. These dyes often contain tannin, which is a naturally occurring mordant in black walnut, safflower, and lichen.

Over time, Native communities learned which dyes affixed well to which materials. This knowledge was passed down through generations, becoming traditional knowledge. Careful observations of the natural world result in learned knowledge, which is also how scientists conduct their studies. Traditional knowledge and science both try to explain the world we live in.

Divide the class into groups of 2–4 students so they can share supplies and have conversations around the activity.

1. Provide each student with an observation chart (see the Resources section) and instruct the students to fill out their charts as they use different fabrics and dyes.
2. Have students use a paintbrush to apply the dyes to the fabric and create a pattern. Ensure that the students record their observations.

Instruct the students to rinse their brushes in the rinse water when changing to a different dye color.

3. Tell the students that they can take home their fabric samples and observation chart.

WRAP-UP

5 minutes

Lead a discussion with the students, prompted by the following questions.

Which dye on which fabric was your favorite color?

How did the colors vary using fabrics or dyes that had been treated with mordants? Were the colors brighter or dimmer when mordants were used?

Why do you think dyes react differently on different fabrics?

What kind of pattern did you create?

Why did you choose it?

Does it have any personal or social meaning for you or for your culture?

CLEAN UP

- Place the dyed fabric squares onto the drying rack or drying area and instruct students to clean up their tables by discarding trash and wiping up spills.
- Students should place all unused materials into center of tables for reuse.
- **Remind students to take home their observation charts and continue to observe the effects of mordants on dyes.**
- Save leftover dyes in a refrigerator to extend their shelf life for another class.
- Clean all the paintbrushes and containers.

OPTIONAL EXTENSIONS

- Involve students in collecting materials to create the dyes and ask the students to make predictions about what colors the materials will create.
- Create sample pieces of fabric dyed naturally with and without the use of mordants. Expose some of them to sunlight for an extended time, creating a visual aid that would show how the effects of light contribute to colors fading over time, and how mordants and fixatives prevent color loss.
- Locate local Native items that have been made with natural dyes to show students. If these items not readily available, a slideshow or some other kind of visual aid can be created.
- At-Home Extension: Test the fabric samples for colorfastness by rinsing the samples with clean, cold water. If the dyes rinse out easily, you can always make a new design on the same fabric with dyes you create at home for yourself.

RESOURCES

Colors from Nature: Growing, Collecting, and Using Natural Dyes. Bobbi A. McRae. Timber Press, 1993.

A good beginner's guide to dyeing.

Dyes from American Native Plants: A Practical Guide. Lynne Richards and Ronald J. Tyrl. Timber Press, 2005.

An excellent guide to North American dye plants and their effects.

[Resource and dye plant guide](#)² from the USDA Forest Service. Provides a useful "color guide" to Native North American plants.

[Database](#)³ of Native plants and their known uses by Native American communities.

[Resource](#)⁴ with very detailed information on culturally significant plants.

[Listing](#)⁵ of regional dyeing organizations and dyeing resources.

² <http://www.fs.fed.us/wildflowers/ethnobotany/dyes.shtml>

³ <http://herb.umd.umich.edu/>

⁴ <http://plants.usda.gov/java/factSheet?cultural=yes>

⁵ <http://www.naturaldyes.org/organizations.htm>

Observation chart

Name: _____

Example:
Light pink in color, really pretty.

Fabric: *Silk* Mordant: *No*
Dye: *Beet juice*

Fabric: Mordant:
Dye:

Fabric: Mordant:
Dye:

Fabric: Mordant:
Dye:

Fabric: Mordant:
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Fabric: Mordant:
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GLOSSARY

Vocabulary	Definition
Dye	Substance (natural or synthetic) that changes the color of something. <u>Adjective dye</u> : A dye that requires a mordant to bond the dye to the fabric. <u>Substantive dye</u> : A dye that readily bonds to fabric without the use of added mordants.
Dyebath	Mixture of water and dye that the object is soaked in.
Fiber	A thread that forms a material. <u>Synthetic fiber</u> : Manmade fiber. <u>Plant-based fiber</u> : Fiber derived from plant sources, like cotton and linen. <u>Animal-based fiber</u> : Fiber derived from animal sources, like silk and wool.
Mordant	A fixative, typically a metallic salt solution, which helps to permanently bond the dye to the fiber.
Elder	A person who has gathered knowledge and wisdom about his or her culture; not all elderly people are elders
Indigenous/Native	An individual who has an ancestral claim to a particular environment or region
Traditional knowledge	Wisdom held by elders that is passed down to younger generations
Ways of knowing	Information gained by patient observations, life wisdom, and accumulated knowledge
Western science	A system of knowledge which relies on certain laws that have been established through the application of the scientific method to phenomena in the world around us

**NEXT GENERATION
 SCIENCE STANDARDS**

Practices

- Asking questions and defining problems
- Planning and carrying out investigations
- Analyzing and interpreting data
- Engaging in argument from evidence
- Obtaining, evaluating, and communicating information

Crosscutting Concepts

- Patterns
- Cause and effect
- Energy and matter
- Structure and function
- Stability and change

	Disciplinary Core Idea	K	1	2	3	4	5	MS	HS
Physical Science									
PS1	Matter and Its Interaction	n/a	n/a		n/a	n/a		✓	
PS2	Motion and Stability: Forces and Interactions		n/a	n/a		n/a			
PS3	Energy		n/a	n/a	n/a				
PS4	Waves and Their Applications in Technologies for Information Transfer	n/a		n/a	n/a		n/a		
Life Science									
LS1	From molecules to organisms: Structures and processes			n/a					
LS2	Ecosystems: Interactions, Energy, and Dynamics	n/a	n/a			n/a		✓	
LS3	Heredity: Inheritance and Variation of Traits	n/a		n/a		n/a	n/a		
LS4	Biological Evolution: Unity and Diversity	n/a	n/a			n/a	n/a		
Earth & Space Science									
ESS1	Earth's Place in the Universe	n/a			n/a				
ESS2	Earth's Systems		n/a						
ESS3	Earth and Human Activity		n/a	n/a				✓	
Engineering, Technology, and Applications of Science									
ETS1	Engineering Design							✓	