Colonial Dyes: Plants & Process

7th Grade Social Studies Curriculum

Home & Careers Classroom

Objective: Students will learn hands-on how early American colonists used natural plant materials to dye fabric by experimenting with premade dyes, using different variables (fabric, mordant, temperature) to assess colors produced.

this lesson was written for indoors/during winter but could be amended for outdoors/in school garden using fresh plant material and 'solar dyeing'
this lesson required 2 instructors given time constraints and set up time prior to lesson/clean up time after
ideally this lesson should be done over 3 class periods: day 1 for overview of process and history, day 2 for actual dye experimentation, day 3 to discuss results and effects of variables

Materials:

Handouts: dye bath worksheets and historical/dye process reading packet
Pre-made dye baths (acorn, onion, madder, walnut, marigold, etc.)
Pre-mordanted and un-mordanted fabric swatches, labeled with sharpie (Fe and Al), presoaked (cotton, linen, wool)
Wooden spoons and/or tongs
Paper towels/extra plastic containers for holding fresh dyed materials to rinse
Plastic gloves
4 to 8 aluminum cookie sheets for group swatch drying
mortar & pestle (acorns for students to grind)
sample plant parts (dependent on season) such as: walnut husks, oak galls, lichen, cotton bolls, calendula & marigold flowers, etc… Also sample fabrics (e.g. wool)
onion skins and whole onions, yellow and/or red (for students to skin)
sample homemade mordants: iron & vinegar
pre-dyed sample fabric swatches showing color variations (e.g. on poster board)
images of plants not available for display (madder, indigo, woad, flax etc.)
optional: drop or hook spindle/wool for students to practice 'spinning' time permitting

Procedure: **40 min class**/14 students

*Break class into 4 smaller groups of students ahead of time – Group A/B/C/D

Intro/Overview – 5-8 min

We're here today to bring an outdoor garden lesson indoors to Home & Careers class! We also know you've been studying Colonial Times in social studies and if early American colonists could see the clothes you are wearing today they'd be amazed! Not only because they had to make their own clothes by hand, but because they even had to make their own dyes to color their clothes – and that process was NOT easy. In fact, to dye fabric colonists had to know their plants, understand the

scientific process, and have an artistic eye for color. So today, you, too, are going to try your hand at dyeing the colonial way using onion skins and acorns! But before we break into groups and dip fabric into dye baths to see what colors we can get – a few important items:

1) everyone's got a handout you can read later about the history of dyeing, but for now, each group just needs worksheets to keep track of your group's trial dyes
2) everyone wears gloves when dyeing so put them on now!
3) each group needs one pen or pencil to record your results
4) 2 groups go with each instructor and then we'll swap
5) one word you will hear us use over and over again is the word **MORDANT** – a mordant is any substance (such as iron or aluminum) that helps dye color bond or 'stick' to fabric so that the color doesn't vanish or fade over time when you wash clothes. Mordants can also affect color intensity or change colors entirely by chemically reacting with the dye bath – you can read more about all the variables involved in dyeing but some of the ones you'll be experimenting with today are using different plants, temperatures, fabric types, and of course, mordants.

Let's get started!

15 min – Groups A&B (7 students) –Onion/Madder baths
Group C&D (7 students) –Acorn/ Walnut baths

Instructors assist students from each group follow the dye bath worksheets, dipping fabrics in various dye baths and jotting down results. While fabric is steeping in baths, students try their hand at peeling off onion skin, grinding acorns, looking at home made mordants and plant samples brought in, etc. Once fabric is removed from dye baths (about 10 min minimum!), students rinse and place swatches on their group's aluminum tray and label accordingly.

15 min – switch groups; process is repeated

END lesson: 1 min – Let your fabric swatches dry overnight on your trays and when you come to class tomorrow see if the colors have changed again – compare group colors to see if there was any variation across groups…

Resources:
See attached comprehensive list of internet resources

Book used when following the dye process for this lesson:
Dean, Jenny. Wild Color. NY: 1999.

Dyeing Fabrics in Colonial Times

Ancient History Humans have been dyeing with natural substances since the very beginning - prehistoric cave paintings were made using natural pigments. The Egyptians were master dyers, as were ancient cultures in China and India. The Maya, Aztec and Inca of South America discovered reds and purples not from plants but from the cochineal scale insect (*Dactylopius coccus*), which is still used today as an ingredient for natural food coloring. The ancient Phoenicians of the Mediterranean established an entire dye industry from the crushed shells of a species of shellfish, becoming famous for their "Tyrian purple", while along the Ivory Coast of Africa, a black dye was made from iron-rich mud and plant tannin for religious designs.

In Europe, people also foraged for color in nature, using lichens, mosses, berries, tree bark, etc. to dye their clothes shades of brown, yellow, green and grey. It was difficult for them to produce colors like red, blue, and purple, which is why these colors are still historically associated with royalty. Only the very rich in Europe could afford to pay for bright color! Blue was especially hard to come by. The only native plant in Europe that produced a reliable blue dye was woad (*Isatis tinctoria*), which involved a lengthy process of drying and fermenting 'woad balls' valuable enough for trade. Later, a new blue-producing plant called indigo (*Indigofera tinctoria*), native to India, became available. Indigo produced a more solid, reliable blue than woad. With indigo, stale urine was used to remove oxygen from the dye bath, allowing the blue dye to turn "white" and fix to the fabric, but the moment the indigo-fixed fabric was pulled out and hit the air (oxygen), the color blue magically appeared again!

Colonial America Early American Colonists did not find life easy in the new world, and although they initially relied on ships from England to import pre-dyed fabric needed for making clothes, sheets, and blankets they later had to rely more on themselves, learning sometimes from Native Americans, but also experimenting on their own with whatever they discovered growing nearby. Most colonists were not "master dyers" themselves and did not bring the secrets of dyeing with them – they had to be resourceful. More often than not, this fell to Colonial Women, who were already growing their own herb and kitchen gardens. They would have chosen to grow plants not just for food and medicine, but also for dyeing. One such plant commonly used to color fresh churned butter yellow was Pot Marigold or Calendula, (*Calendula officinalis*) which could also be made into a nice salve for dry hands.

Over time, as Colonists grew to resent the tariffs and restrictions placed upon them by British rule they also began to reject British imports on principle, seeking independence wherever they could, producing as much of their own food and textiles as possible. During the revolutionary war, for instance, true patriots refused to drink the imported British tea their loyalist sympathizers still enjoyed, instead finding native plants with which to brew tea substitutes (such as New Jersey Tea or *Ceanothus americanus*). They also rejected 'India Ink', another British import,

instead using the crushed berries of the native Pokeweed plant (*Phytolacca americana*). They rejected British textiles too, and began to spin and dye their own.

Textiles most common to the Colonial era were those made from flax (used to weave linen), hemp, and wool, with cotton becoming more common only after it was found to grow well in the southern colonies. As for the elusive blue, some Colonists brought woad seed with them from Europe, but later an entire industry evolved in the South around growing indigo. One Colonial woman named Eliza Pinckney (1722–1793) completely changed colonial South Carolina's agriculture. She oversaw three indigo plantations there, producing one third the total value of the Carolina Colony's exports before the Revolutionary War.

Some Common Colonial Dye Plants…

(*Many of these plants you can find growing in the school garden or around Haldane!)*

Calendula - yellow – also used to color cheese and butter
Acorns/Oak – browns or greys/black depending on mordant
Black Walnut – browns, greys
Onion skin – yellows, greens, oranges
Pokeweed – used for ink and for dyeing pink hues
Marigold – yellow orange
Madder (*Rubia tinctorum*)- red and orange from root
Bloodroot (*Sanguinaria canadensis*) – red, plant native to N. America
Goldenrod – yellowish tan/rich gold color
Queen Anne's Lace – bright yellow
Yarrow – medium green
Dandelion – soft yellow
Dock – dark yellow
Fiddlehead ferns and Lichens – yellowish-greens/greys
Blackberry – light gray
Lilly of the Valley – pale greenish yellow (spring leaves) or gold (fall leaves)
Marjoram – purple for wool, reddish-brown for linen
Meadow Rue – root dyes wool yellow

Selections from: Colonial Gardens by Favretti & DeWolf: Massachusetts, 1972.

***Acer rubrum* or Red Maple** "In Pennsylvania with the bark the natives dye a dark blue, and make a good black ink." pg102, from Miller, Philip *The Gardener's Dictionary* 1759 London.

***Centaurea cyanis* or Bachelor's Buttons** "the expressed juice of the neutral florets makes a good ink; it also stains linen of a beautiful blue, but the color is not permanent in any mode hitherto used. Mr. Boyle says the juice of the central florets, with the addition of a very small quantity of alum, makes a lasting transparent blue, not inferior to ultramarine." pg48, Miller

***Cotinus coggyria* or Smoke Tree** "The wood serveth to give a yellow dye; but the laves and young branches doe dye a blacke colour; and the barke they tanne leather." pg105, from Parkinson, John *Theatrum Botanicum* 1640 London

The Art and Science of Natural Dyeing

Natural dyeing is part botany, part chemistry, and part artistry (not to mention luck!). It involves understanding the scientific process (keeping controls, manipulating variables) to figure out how to reliably reproduce the same dye color more than once. Here is an overview of what a "Master Dyer" would need to know!

These Variables can all affect the color you get when dyeing with natural materials:

Type of Fibers Different fibers will absorb colors differently!
-protein fibers come from animals/insects: wool and silk (mohair, angora, alpaca, camel!)
-cellulose fibers come from plants: cotton, linen (from flax plant), hemp, jute/burlap etc.

Water quality and pH
Alkaline (sweet), or acidic (sour) water affects color; mineral impurities can also affect.

Temperature of Dye Bath
Cold or heated dye baths can affect color; specific heat temperatures too.

Time in Dye Bath Sometimes the longer fibers soak, the darker the color. Sometimes not!

Insects, Animals, Plants and their parts all produce different colors
Beetles, shellfish, different plant parts like leaves, roots, bark, flowers, seeds. The season in which plant parts are collected (leaves!) and region/conditions in which plants are grown (soil type!) also affect color, including using fresh vs. dried plants.

Type of Pot Iron, aluminum or copper pots used for making dye baths can affect color.

Mordants affect how well a dye 'sets' or how well the color permanently attaches so it does not wash away. *A mordant is any substance that acts as a bond to permanently fix dye to fiber.* Without mordants, most natural dyes fade or disappear after repeated washing.

-Chemical mordants are metallic salts of aluminum, iron and copper. Alum tends to make colors brighter and lighter, while iron tends to darken and subdue colors.
-Natural mordants are natural acids found in plants such as rhubarb leaves (oxalic acid) and oak galls and tree bark (tannin). Oak galls are caused by gall wasps.
-Some mordants are used in combination with other substances (known as modifiers) to improve effect. Alum combined with cream of tartar helps it adhere better to fibers, as does Copper combined with vinegar (or in the past, urine!).

Here is a **recipe for "Turkey Red", the most complex dye known**, originally developed in India and brought to Europe in the 18th century by way of Turkey: *"Turkey Red required as many as 20 different processes over a period of several months, and included not only madder but ingredients such as animal dung, rancid oils, soda ash, tannin, alum, and ox blood."*pg 16, Dean, Jenny. Wild Color. NY: 1999.

Test Dyes: ACORN GROUP_____

*****_Always use gloves and use care when handling dye baths!_
*Always add wet (presoaked) fabric to dye bath - helps color absorb!
*Usually, the longer you leave fabric in dye bath, the better the color.
*Always rinse dyed fabric in cold water after removing from bath.
*Mordants affect how color "sticks" to fabric. Iron mordant darkens colors, Alum mordant brightens colors. (Fe = symbol for iron, Al = alum or Aluminum)
*Color will look different again once fabric is completely dry!

COOL dip/plain uncooked acorn bath

Dip #1Ac – ***plain*** **cotton fabric**

Soak Time:	Color?

Dip #2Ac – ***iron*****-mordanted cotton fabric**

Soak Time:	Color?

Dip #3Ac – ***alum*****-mordanted cotton fabric**

Soak Time:	Color?

WARM dip/plain simmered acorn bath

Dip #1WAc – ***plain*** **cotton fabric**

Soak Time:	Color?

Dip #2WAc – ***iron*****-mordanted cotton fabric**

Soak Time:	Color?

Dip #3WAc – ***alum*****-mordanted cotton fabric**

Soak Time:	Color?

Test Dyes: WALNUT **GROUP_____**

*****_Always use gloves and use care when handling dye baths!_
* Always add wet (presoaked) fabric to dye bath - helps color absorb!
*Usually, the longer you leave fabric in dye bath, the better the color.
*Always rinse dyed fabric in cold water after removing from bath.
*Mordants affect how color "sticks" to fabric. Iron mordant darkens colors, Alum mordant brightens colors. (Fe = symbol for iron, Al = alum or Aluminum)
*Color will look different again once fabric is completely dry!

COOL dip/plain Black Walnut bath

Dip #1B – ***plain*** **linen fabric**

Soak Time:	Color?

Dip #2B – ***iron*****-mordanted linen fabric**

Soak Time:	Color?

Dip #3B – ***YOUR CHOICE! Write-in*** **fabric:**

Soak Time:	Color?

***Let your test dyes dry overnight. When you return to class the next day, look closely at your group's color results and discuss these questions…**

1. Which variable made the greatest difference in color for the **acorn** dye bath - temperature or mordant? What effect did each variable have?
2. Which variable made the greatest difference in color for the **onion** dye bath – mordant or fabric? What effect did each variable have?
3. Did temperature affect **madder root** color?
4. Did mordant affect **black walnut** color?
5. Did all four class groups get the same color results or were there variations even between groups? If so, why do you think this happened? What was the variable?
6. If you had to make and dye your own clothes, which colonial fabrics/colors would you choose? (cotton, linen, wool) (onion, madder, acorn, walnut)

Test Dyes: ONION GROUP_____

*****_Always use gloves and use care when handling dye baths!_
*Wet fabric in water before putting in dye bath – helps color absorb!
*Usually, the longer you leave fabric in dye bath, the better the color.
*Always rinse dyed fabric in cold water after removing from bath.
*Mordants affect how color "sticks" to fabric. Iron mordant darkens colors, Alum mordant brightens colors. (Fe = symbol for iron, Al = alum or Aluminum)
*Color will look different again once fabric is completely dry!

Warm dip/plain simmered Onion bath

Dip #1On – ***plain*** **cotton fabric**

Soak Time: In: Out:	Color?

Dip #2On– ***alum*****-mordanted cotton**

Soak Time: In: Out:	Color?

Dip #3On – **alum-mordanted wool**

Soak Time: In: Out:	Color?

Warm dip/iron-mordanted Onion Bath

Dip #1FeOn – ***plain*** **cotton fabric**

Soak Time: In: Out:	Color?

Dip #2FeOn – ***alum*****-mordanted cotton fabric**

Soak Time: In: Out:	Color?

Dip #3FeOn – ***alum*****-mordanted wool**

Soak Time: In: Out:	Color?

Test Dyes: MADDER ROOT GROUP_____

*****Always use gloves and use care when handling dye baths!*
**Wet fabric in water before putting in dye bath – helps color absorb!*
**Usually, the longer you leave fabric in dye bath, the better the color.*
**Always rinse dyed fabric in cold water after removing from bath.*
**Mordants affect how color "sticks" to fabric. Iron mordant darkens colors, Alum mordant brightens colors. (Fe = symbol for iron, Al = alum or Aluminum)*
**Color will look different again once fabric is completely dry!*

Warm Dip – Madder Root

Dip #1M – **plain linen fabric**

Soak Time: In: Out:	Color?

Dip #2MAl– ***alum*-mordanted wool**

Soak Time: In: Out:	Color?

Cool Dip – Madder Root

Dip#M3 – **plain linen fabric**

Soak Time: In: Out:	Color?

Dip#M4 – **plain wool**

Soak Time: In: Out:	Color?