

Can Soil Be Used as a Natural Dye? How to Make Dirt Shirts

Several variations can be used for this activity.

First have the students make a hypothesis about what will happen when white cotton material is submerged in mud (of various colors). For the scientist, the first hypothesis will state that the treatment will not affect the color of the cloth. This is called the null hypothesis, or hypothesis of no difference. The scientist will then have an alternative hypothesis that says the soil will change the color of the cloth.

Bright red and yellow soils are the most effective dyes due to the type of iron present in those soils. (Red is oxidized, anhydrous, Fe_2O_3 , a hematite mineral; Yellow is oxidized, hydrated, $2\text{Fe}_2\text{O}_3 \cdot 3\text{H}_2\text{O}$, a limonite mineral.) Soils are usually dark because of organic matter, or humus, though there are other minerals that sometimes result in dark soil colors.

The white t-shirt below was dyed in the mud of the Double Mountain Fork of the Brazos River, just off US 70 in Texas. The left photo shows the contrasting original color of the shirt with the Brazos mud. The right photo shows the same shirt, once it was muddied and rinsed in the river. The color fades with washing, but will never again be white. Click on the photos for a larger image.



TEKS:

- Grade 3: 112.5.b2 A-E, 3 A&C
- Grade 4: 112.6.b2 A-E, 3 A&C
- Grade 5: 112.7.b2 A-E, 3 A&C
- Grade 6: 112.22.b2 A-E, 3 A&C
- Grade 7: 112.23.b2 A-E, 3 A&C
- Grade 8: 112.24.b2 A-E, 3 A&C, 4B
- Int Phys Chem: 112.42c2 A-D, 3 A&C

Supplies:

Soils - minimum of one bright or dark red or yellow soil, other soils can be used if desired

In the Texas High Plains, bright red or yellow soils are difficult to find. They are commonly associated with soils formed in, or materials associated with the Permian Redbeds. These formations are exposed on the south, east, and west edges of the High Plains. Look in road cuts or stream/river cut in breaks associated with the various forks or tributaries of the Brazos, Canadian, Pecos, or Red Rivers.

Fixatives or mordants can be used as a variable to see if they influence the way the dye sets into the cloth.

Pretreatments may prepare the fibers

to receive the dye more effectively.

Sodium carbonate, Soda Ash is a pretreatment. Mix the soda ash and soak the cloth before putting the wet cloth into the mud. For information about Soda Ash, see this website:

<http://www.pburch.net/dyeing/FAQ/sodaash.shtml>. Soda ash is the common name for sodium carbonate (but is not the same as baking soda, sodium bicarbonate).

Vinegar is used in the mud mixture, or as a post-treatment rinse, approximately 1 cup of vinegar for each gallon of water. The vinegar alters the pH of the mixture, which causes the iron pigments in the soil to be more soluble, and so more easily transferred to the fibers. The end result is a more colorfast dye.

Water temperature can be used as a variable, hot water generally is more effective than cold water. (Cloth-mud mixtures can be boiled.)

Color Enhancers: Anhydrous iron oxide (Fe_2O_3), will enhance the red color.

Methods:

Wash and dry the shirts first with a standard detergent.

Pretreat cloth, if that is desired.

Make mud, it needs to be thin enough that you can easily work the soil into the cloth. I have never measured the quantities, but use a slurry mixture.

The soil-water mixture needs to be dilute enough to easily flow. I suspect I am using 2 to 4 parts water for every 1 part soil.

Allow the cloth to soak in the mud for 4 hours or more. Agitation allows more mud/fiber contact. Heat can be applied in this step.

Rinse the cloth. Vinegar can be used in this step.

After allowing the cloth to dry, it can be washed in cold water to determine the amount of color set.

Washing will fade the color as some soil particles will be removed from the cloth.

Dry in a hot dryer after rinsing in cold water.

Check the outcome against the original hypothesis.

Comments from personal experience:

Shirts can be tied or knotted, etc., for a tie-dye effect.

I am not sure that I have noticed any real difference using pretreatments with soil dyes, but it is useful with other natural dyes.

Personally, I have had better results with soil when running the shirts through the soil mixture more than once. The first time through the complete cycle to drying sets a light color. The second time through the soil-vinegar solution sets a darker color.

I have not used potters clays, though I have considered it (having recently encountered some potters ...).

Comments from others' experience:

I want to thank you for your dirt shirt web page. I'm a PhD student in ecology, and I just made a very successful batch of dirt shirts with some soil samples I brought back from my field site in Costa Rica. In order to dispose of my soil samples in accordance with USDA regulations, I had to sterilize them either by autoclaving or boiling. Not wanting to bring down the wrath of everyone in the department by filling the autoclave with fine red dust, I elected to boil them-- and what better use for a big pot of boiling mud than to make dirt shirts? I invited a bunch of friends over for a dirt shirt party. Your recipe worked really well. My only suggestion would be to add the vinegar during the soaking step--this is what I've done while dyeing fabric with other reagents in the past, and it seemed to work really well in this case, too. We simmered the shirts in mud and vinegar (c. 1 cup per gallon) for about four hours, and rinsed in plain water. The color is great, and has lasted through one washing so far with no perceptible fading.

Thanks for your advice, and keep up the good work!

Susan G. Letcher, Graduate Program in Ecology and Evolutionary Biology University of Connecticut

75 North Eagleville Rd., Storrs, CT 06269-3043

860-486-0805

Ready-made Texas Dirt Shirts are available from Planet Earth Trading Company, <http://www.dirtshirts.com/>.

For other states and places, visit: <http://www.wtamu.edu/~crobinson/DrDirt/dirtshirts.html> .

I would be interested in your results or comments. Are there changes you would suggest?

Clay Robinson, Ph.D., Alias Dr. Dirt [email Dr. Dirt](mailto:clay@wtamu.edu)

First presented September 25, 2004

Updated November 1, 2006



Search

MLRA #14

GO

Features

- ▶ Soil Facts
- ▶ Soil Education
- ▶ Experiments for the Classroom
- ▶ State Websites
- ▶ Soils Gallery

▶ Find a Service Center

▶ States and Regions

▶ MLRA Offices

Painting With Soil



Teaching Objective

"To gain a deeper appreciation of soils -- one of our most important natural resources."

Introduction

Soils are one of our most important natural resources. They also are important for the beauty their many colors add to our landscapes. Most of us overlook this natural beauty because we see it every day. Often these colors blend with vegetation, sky, water, etc. Soil colors serve as pigments in bricks and pottery.

If you look at the works of many of the great artists, you will notice that "earth colors" are dominant. The color and texture of soil painting is fascinating and a creative opportunity for all ages of students.

Materials

soil (dried in air)
 hammer or mallet
 mortar and pestle (rubber-tipped)
 paper cups (4 oz.)
 pencils
 ink pens (black, different tip sizes)
 paint brushes (different kinds and sizes)
 artist acrylic (clear gloss medium)
 sponges and rags
 water color paper
 masking tape

Procedure

Soils

1. Gather soils of various colors.

2. Place each dried soil sample on a piece of paper and crush into pieces with hammer or mallet.
[Figure, Step 1a](#)
3. Place some of the crushed soil into a mortar. Use a rubber-tipped pestle to crush the soil into a fine powder. Repeat to crush all of the different colored soils.
[Figure, Step 1b](#)
4. Place the different soils in paper cups -- notice the colors and textures.

Artwork

1. Lightly sketch art work on water color paper with a pencil. When satisfied with composition, use ink for permanent lines.
2. With masking tape, carefully tape paper edges to table or board. This is done so that the art work will dry flat.
[Figure, Step 1c](#)
3. Pour small amounts of artist acrylic in small paper cups. Add small amounts of soil. Experiment with depth of color and mixing the different soils.
4. Use different sizes and kinds of paint brushes, sponges, and rags. Experiment and have fun.
5. Layering colors. When your art work is dry, you may apply another layer of soil paint.
6. You may want to use a black ink pen to make finishing touches on your artwork.

Activity Time

The estimated time is about 1 hour.

[< Back to Lesson Plans](#)

National Association of Conservation Districts

NACD's mission is to serve conservation districts by providing national leadership and a unified voice for natural resource conservation.


[NACD Home](#)
[News & Events](#)
[District Resources](#)
[Stewardship & Education](#)
[Conservation Policy](#)
[Stewardship Program](#) • [Education Resources](#) • [Canon Envirothon](#) • [Contests](#) • [Marketplace](#)

Soil Education Resources

Is soil an important ingredient in your every day life?

The answer is yes, and here are a few reasons why:

- Last night you slept in a building built on soil.
- You drink water that flows through soil and is cleaned by the soil.
- You breathe air that comes partly from plants growing in the soil.
- You even wear clothes made from plants that grow in the soil.



Soils make our lives possible. We build on them, play on them, drive on them, eat food grown in or raised on them, take medicines from them, wear clothes we wouldn't have without soils, drink water that wouldn't be clean without soils, breathe air we wouldn't have without the plants and trees growing in soils. The entire earth—every ecosystem, every living organism—is dependent upon soils.

A Few Facts about Soil

- Soil makes up the outermost layer of our planet.
- Topsoil is the most productive soil layer.
- Soil has varying amounts of organic matter (living and dead organisms), minerals and nutrients.
- Five tons of topsoil spread over an acre is only as thick as a dime.
- Natural processes can take more than 500 years to form one inch of topsoil.
- Soil scientists have identified over 70,000 kinds of soil in the United States.
- Soil is formed from rocks and decaying plants and animals.
- An average soil sample is 45 percent minerals, 25 percent water, 25 percent air and five percent organic matter.
- Different-sized mineral particles, such as sand, silt, and clay, give soil its texture.
- Fungi and bacteria help break down organic matter in the soil.
- Plant roots and lichens break up rocks which become part of new soil.
- Roots loosen the soil, allowing oxygen to penetrate. This benefits animals living in the soil.
- Roots hold soil together and help prevent erosion.

Information provided by U.S. Dept. of Agriculture, Natural Resources Conservation Service and listed on the Environmental Protection Agency website at <http://epa.gov/gmpo/edresources/soil.html>.

Soils Education Materials

NACD worked with the Smithsonian and Soil Science Society of America in the development of soils materials to compliment the "Dig It! The Secrets of Soils" exhibit at the Smithsonian National Museum of Natural History (<http://www.forces.si.edu/soils/>). The soils education materials were designed to teach students (K-8) as well as adults about the importance of soils in their everyday lives. The exhibit will be in Washington, D.C. until January 2010 and then is scheduled to travel to ten cities around the United States through 2013.

[Soil Education Material Flyer](#) - Download a flyer of all "Dig It! The Secrets of Soil" materials.

[NACD Marketplace](#) - The "Dig It! The Secrets of Soil" education materials are available for to purchase at the NACD Marketplace.

Soils Activities

[Soils Educators Guide](#) (1.2 MB, PDF) - This online interactive guide is full of great resource to use in a classroom or other educational programs. It contains activities, science standards that complement the [Dig It! student booklets](#), literature connections, links to additional soils outreach materials and more. The printed educators guide is also available in quantities of ten from the [NACD Marketplace](#).

[Soil Activity Worksheets](#) (linked below) - The K-7 soils education worksheets listed below complement the Dig It! student booklets or are great for use with soils outreach programs.

- [Kindergarten](#) (PDF)
- [Grade 1](#) (PDF)
- [Grade 2](#) (PDF)
- [Grade 3](#) (PDF)
- [Grade 4](#) (PDF)
- [Grade 5](#) (PDF)
- [Grade 6](#) (PDF)
- [Grade 7](#) (PDF)

[Soils Topic Book List](#) (PDF) - Looking for books to read to students or add to your library collection? Download this list of books that will give students a better understanding of soils in their everyday life.

[Fun Facts about Soil and Worms](#) (PDF) - Use these fun and informative facts as part of an exhibit or question and answers with student or adults. This activity covers the importance of worms and our soil.

[2009 NACD "Dig It! The Secrets of Soil" Poster Contest](#) - Check with your local conservation district to see if they are sponsoring a local, area or state contest utilizing the DIG IT! The Secrets of Soil theme for a poster contest. Additional information can be found on our poster contest site.

Additional Soils Resources

[Dig It! Logo and Soils Images](#) - Several images that go along with the 2009 Stewardship theme, "Dig It! The Secrets of Soil," use on your website, promotions or publications.

[Smithsonian DIG IT! The Secrets of Soil Exhibit](#)

[News Article: "DIG IT! Soils Takes Center Stage at Smithsonian"](#) (PDF)

[Soil Science Society of America](#) - This site contains soil lesson plans and more.

Scoop on Soil

This site has a variety of soil education information from USDA-NRCS and University of IL Extension including fundamental soil concepts, soil biology printer, soil quotes, a help stop soil erosion activity and more.

[Dr. Dirt!](#) - Great selection of hands on soil activities to share with students.

[Soil Paint Recipe](#) | [PDF](#) |

[Soil Presentations](#) - Keep the attention of the students and community members you are educating through these catchy presentations on soils!

[Soil Texture Lesson](#) - A soil texture lesson, a soil texture analysis experiment and an accompanying PowerPoint presentation are available from the Soil Science Society of America at <http://www.nacdn.net/resources/presentations/education/>.

[Soil Color Lesson](#) - A soil color lesson, a soil crayons experiment and an accompanying PowerPoint presentation are available from the Soil Science Society of America at <http://www.nacdn.net/resources/presentations/education/>.

*Materials developed for soils education outreach and
NACD Stewardship in partnership with:*



Partners: [NCDEA](#) | [NRCS](#) | [NASCA](#) | [RC&Ds](#) | [CTIC](#) | [NWC](#) | [Envirothon](#) | [USDA](#) | [FSA](#) | [FS](#) | [BLM](#) | [BR](#) | [FWS](#)

NACD • 509 Capitol Ct. NE • Washington, D.C. 20002 • P: 202.547.6223 • F: 202.547.6450 • Contact Us