

Rock Art: Making Paint

Created by Jacob Hamill, SCDNR Heritage Trust Archivist and Kerrigan Sunday, SCDNR Heritage Trust Intern (2018). Adapted from *Making Paint with Minerals Lesson Plan* by the Royal Society of Chemistry.

Grade Level

1st – 8th, High School Chemistry and Earth Science

Estimated Time

1 hour 30 minutes - 2 hours

Goal

Students will learn about the natural materials used by paleolithic people to create rock art, use similar materials to create paint, and use paint to replicate paleolithic rock art.

Objectives

After completion of the activity, students will be able to:

1. *Define* rock art and differentiate between petroglyphs and pictographs.
2. *Observe* examples of paleolithic rock art.
3. *Identify* natural materials used in the creation of paleolithic rock art.
4. *Compare* natural materials used in the creation of rock art to modern, synthetic materials.
5. *Recognize* paint as a mixture of three primary components and *understand* the difference between a pigment, a binder, and an extender.
6. *Create* different colors of paint using different materials.
7. *Demonstrate* safe lab procedures when working with hazardous substances.
8. *Show* correct use of lab equipment.
9. *Replicate* paleolithic rock art using similar materials/pigments.
10. *Hypothesize* how paleolithic utilized their natural environment to create paint and paint tools.
11. *Speculate* the purpose and meaning of rock art.
12. *Relate* their experience making paint and rock art to the experiences of paleolithic people.

Academic Standards

Science

- 1.S.1 The student will use the science and engineering practices, including the processes and skills of scientific inquiry, to develop understandings of science content.
- 1.E.4 The student will demonstrate an understanding of the properties and uses of Earth's natural resources.

- 2.S.1 The student will use the science and engineering practices, including the processes and skills of scientific inquiry, to develop understandings of science content.
- 3.S.1 The student will use the science and engineering practices, including the processes and skills of scientific inquiry, to develop understandings of science content.
- 3.P.2 The student will demonstrate an understanding of the properties used to classify matter and how heat energy can change matter from one state to another.
- 3.E.4 The student will demonstrate an understanding of the composition of Earth and the processes that shape features of Earth's surface.
- 4.S.1 The student will use the science and engineering practices, including the processes and skills of scientific inquiry, to develop understandings of science content.
- 5.S.1 The student will use the science and engineering practices, including the processes and skills of scientific inquiry, to develop understandings of science content.
- 5.P.2 The student will demonstrate an understanding of the physical properties of matter and mixtures.
- 6.S.1 The student will use the science and engineering practices, including the processes and skills of scientific inquiry, to develop understandings of science content.
- 7.S.1 The student will use the science and engineering practices, including the processes and skills of scientific inquiry, to develop understandings of science content.
- 7.P.2 The student will demonstrate an understanding of the structure and properties of matter and that matter is conserved as it undergoes change.
- 8.S.1 The student will use the science and engineering practices, including the processes and skills of scientific inquiry, to develop understandings of science content.
- H.C.1 The student will use the science and engineering practices, including the processes and skills of scientific inquiry, to develop understandings of science content.
- H.C.3 The student will demonstrate an understanding of the structures and classification of chemical compounds.
- H.C.4 The student will demonstrate an understanding of the structure and behavior of the different states of matter.
- H.E.1 The student will use the science and engineering practices, including the processes and skills of scientific inquiry, to develop understandings of science content.
- H.E.3 The student will demonstrate an understanding of the internal and external dynamics of Earth's geosphere.

Social Studies

- 1-1.3 Identify various natural resources (e.g., water, animals, plants, minerals) around the world.
- 1-1.4 Compare the ways that people use land and natural resources in different settings around the world.

2-4.3 Recognize the cultural contributions of Native American tribal groups, African Americans, and immigrant groups.

Visual Art

VA-1 I can use the elements and principles of art to create artwork.

VA-2 I can use different materials, techniques, and processes to make art.

VA-3 I can improve and complete artistic work using elements and principles.

VA-6 I can identify and examine the role of visual arts through history and world cultures.

Activity Type: In-Class

This lesson plan is to be done as an in-class activity. The teacher will provide the required materials.

Materials

- Egg Tempera Materials:
 - Minerals to use as the pigments (for upper level students):
 - Calcium carbonate (for the color white)
 - Iron (III) oxide / unhydrated hematite (for the color red)
 - Iron (III) oxide / hydrated hematite or limonite (for the color yellow)
 - Carbon powder / charcoal (for the color black)
 - Colored chalk or food coloring / liquid watercolors (as an alternative to the minerals)
 - Chicken eggs (four per group plus extras in case of accidents)
 - Distilled water
- Lab Equipment:
 - Mortars and pestles (if necessary)
 - Dust masks (if necessary)
 - Safety goggles (if necessary)
 - Gloves
 - Plastic bags or sheets to cover mortars with (if using hazardous minerals)
 - Yolk separators (optional)
 - Beakers / Plastic cups for egg whites
 - Beakers / Plastic cups for egg yolks
 - Paper towels
 - Sterile pins
 - Teaspoon / Tablespoon or other measuring devices
 - Petri dishes for pigments
 - Mixing / stirring spoons
 - Eye droppers / pipettes

- Paintbrushes
- Cardstock / Paper to paint on
- Cups of clean water to wash brushes in
- Aprons

Background Information

- In archaeology, rock art is a catch-all term for any human-made markings on natural rock. Rock art can be divided between petroglyphs and pictographs. Pictographs are pictorial images, signs or symbols created by drawing or painting. Petroglyphs are images, signs, or symbols that are carved or inscribed on rock.
- Some of the most famous, as well as oldest, pictographs in the world are found in Europe. Examples include the Lascaux and Chauvet cave paintings in France, and the Altamira cave paintings in Spain. However, pictographs are found all over the world, even in South Carolina.
- Paint is a mixture consisting of a pigment, a binder, and an extender. A pigment is what gives the paint its color. Pigments can be synthetic, or they come from natural materials, like minerals and plant matter. A binder is the substance that holds the particles of pigment in place after the paint dries. Some paints use a synthetic binder, while others use natural materials. Oil paint uses linseed oil as its binder. Prehistoric people often used animal fat, plant sap, egg yolks, and even saliva as binders in their paint. An extender is often a liquid mixed into the paint to make the paint flow easier and make it easier to use. Water and alcohol are common extenders.
- The pigments used in prehistoric pictographs was limited to what people could find in the environment. The two dominant pigments found in paleolithic art are red, obtained from red ocher, and black, obtained from charcoal. Other common pigments include yellow, obtained from yellow ocher, and white, obtained from crushed shells or calcium carbonate.
- Green and blue are two pigments noticeably absent from prehistoric rock art in Europe. Blue pigments were difficult to make because of the rarity of blue minerals in Europe, such as lazurite, which was often polished and worn as beads instead of ground into powder to make paint. In America, Native Americans obtained the color blue from indigo dye. However, indigo was not commonly used in paint. Green was easier to make because green pigment could be obtained from abundant sources of malachite. Researchers are not entirely sure why green was not used in Stone Age pictographs in Europe.
- Prehistoric people also manufactured tools to assist them in making rock art. Archaeologists have found shells that were used to hold paint and stones that were used to grind minerals into pigments. Researchers have also identified a prehistoric paintbrush made out of a wolf's leg bone, with one end dipped in ocher.

Vocabulary

- **Anthropology** – The study of humans, past and present. In the United States, the study of Anthropology is divided into four subfields (Sociocultural Anthropology, Biological or Physical Anthropology, Archaeology, and Linguistic Anthropology).
- **Archaeological Site** – A place where human activity occurred and material remains were deposited.
- **Archaeologist** – An Anthropologist (social scientist) who studies the material remains of past human activity.
- **Binder** – A component of paint that holds the particles of pigment in place after the paint dries. Oil paint uses linseed oil as its binder, while acrylic paint uses a synthetic material.
- **Calcite** – A common mineral that is the major component of limestone, marble, and chalk.
- **Charcoal** – A hard, black material consisting of carbon that is often obtained from burning wood, bone, and other organic matter.
- **Cultural Heritage** - A tradition of intangible attributes (i.e., language, origin stories, and rites of passage), artifacts, structures, and places of importance associated with a group of people that are preserved and passed from one generation to the next; defines a group's identity.
- **Cultural Resources** - Evidence of past human activity. They include archaeological sites, historic homes, battlefields, burial grounds, shipwrecks, historic and prehistoric artifacts.
- **Culture** - A set of learned beliefs, values and behaviors or way of life shared by the members of a society.
- **Extender** – A component of paint that is mixed in to make the paint easier to use and flow more easily. Water and alcohol are common extenders.
- **Heritage Tourism** - Traveling to experience the places, artifacts and activities that authentically represent the stories and people of the past.
- **Historic** – The period of time after written records. Dates vary in different geographical areas.
- **Ocher** – A natural earthy material colored with iron oxide. Ocher varies in color from a pale yellow to a deep red and brown.
- **Oil Paint** – A slow-drying style of paint that uses oil, typically linseed oil, as its binder. Oil paint overtook tempera paint in Europe as the preferred style of paint around the sixteenth century.
- **Paleolithic** – The earliest cultural period of the Stone Age, marked by the use of rough or chipped stone tools. Lasted from around 2.5 million years ago until about 10,000 years ago in Europe and the Middle East.
- **Petroglyph** – Any carving or inscription on rock.
- **Pictograph** – A pictorial sign or symbol created by drawing or painting without carving on any kind of surface.

- **Pigment** – The component of paint that gives the paint its color. Can be synthetic or can come from natural materials, such as plant matter or minerals.
- **Prehistoric** – The period of time before written records. Dates vary in different geographical areas.
- **Preservation** - Protection; keeping from damage or destruction.
- **Rock Art** – A popular catch-all term used to refer to both petroglyphs and pictographs.
- **Symbol** – A character or design used to represent an object or idea. A thing which represents something else.
- **Tempera Paint** – A fast-drying paint that uses a water-soluble material, historically egg yolk, as its binder.
- **Vandalism** - Treasure hunting or nonscientific excavation; destruction or damage of property.

Lesson

1. Have a brief discussion on the background of rock art. Explain how it was created and where it can be found in South Carolina. Use images to show different types of rock art, such as petroglyphs and pictographs. Tell your students that this lesson plan will be focusing on pictographs.
2. Have your students brainstorm what types of materials may have been used to make pictographs. How do these compare to modern day materials?
3. Discuss with your students what natural elements / materials could be used to create different colors of paint as seen in pictographs.
4. Instruct your students that they will be making paint using natural materials similar to materials used by prehistoric people to create rock art.
5. Explain that paint is a mixture of three components: a pigment, binder, and extender. Explain that the paint they will be creating today is called “egg tempera” because it uses egg yolk as the binder. This type of paint was used for centuries until the Renaissance when it was replaced by oil-based paint.
6. Divide your class into groups of four. Each group will have their own work station where they will make their own paint. This lesson plan will differ depending on the age of your class and the resources available.
7. Begin the lesson by having your students prepare their pigments.
 - a. If available, older students (middle – high school) can create their pigments by grinding the listed minerals with a mortar and pestle. Students will need to wear dust masks, safety goggles, and gloves to avoid coming in contact with harmful substances. The mortar should also be covered with a plastic sheet or placed in a plastic bag to avoid raising dust while grinding the minerals. Alternatively, these minerals can be acquired in powder form.

- b. Younger students can have a similar experience by grinding colored chalk. Otherwise, it is recommended to simply use food coloring or liquid watercolors for younger classes. To replicate the pigments available to early humans, use only red, yellow, black (or brown), and white.
8. Once the students are finished preparing their pigments, instruct them to separate the yolk of an egg from the egg white. Each student will do this so there will be a total of four egg yolks per group.
 - a. Students may use an egg yolk separator to do this. Alternatively, students can break the egg and roll the egg back and forth between the two halves, letting the egg white fall into a beaker or plastic cup and leaving the egg yolk in one half of the egg shell. Students may need assistance with this. For younger classes you can prepare the egg yolks before class.
 - b. Discard the egg shell and egg white. Carefully transfer the egg yolk to a paper towel to absorb any remaining egg white. Prick the dried yolk with a pin and drain the egg yolk into a clean beaker or plastic cup. Discard the yolk membrane.
9. Add about $\frac{1}{2}$ - 1 teaspoon (or 5 milliliters) of distilled water to the container with the egg yolk and mix to uniformly spread out the yolk.
10. Take about 20 grams of the pigment from the mortar (or approximately 1 $\frac{1}{2}$ tablespoons) and place it in a petri dish. Exact measurements are not necessary.
11. Add water to the dry pigment and mix to form a paste. Different minerals will require different amounts of water. Using an eyedropper or pipette, add roughly an equal amount of the yolk and water mixture to the pigment paste in the petri dish and mix. Thin the paint with more water if needed. The paint should have a slightly glossy appearance.
 - a. If using liquid water colors or food color, have your students add their coloring to yolk and water mixture instead.
12. Using a paintbrush, your students can create their own pictographs on cardstock or other thick forms of paper. Each group should have four colors to work with (ideally red, yellow, black, and white).
13. Discuss with your students how creating art with handmade paint was harder than simply using normal paint in a bottle. Make note that even though they made their own paint, they still used modern tools, like petri dishes, beakers, and paintbrushes, to create their art. Brainstorm what prehistoric people made their tools out of.
14. Explain to your students how the colors they used reflects the pigments that were commonly used by prehistoric people in the creation of rock art. Also explain that while they used egg yolks as binders, prehistoric people used saliva, plant sap, and animal fat as binders for their pigments.
15. Discuss that while this lesson was reflective of the rock art created by stone age people in Europe, humans continued to create rock art in other parts of the world. In parts of North America, some of the rock art created by indigenous people is considered fairly

recent because it depicts things imported by European settlers to North America, such as guns and horses.

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