Be a Scientist!

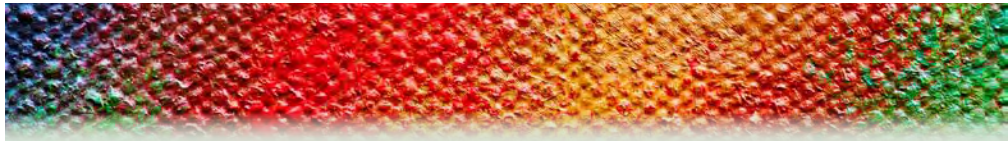
Test different types of paint and different surfaces to paint on. Gather several types of paint, such as watercolor, egg tempera, oil-based, or finger paint. Experiment with each paint on different surfaces such as cardboard, paper, wood, and canvas.

To which surface does each type of paint stick best? Why do you think certain paint sticks to some surfaces better than others?

Beyond the Book

Visit an art museum and observe the many different forms of artwork. Think about the role of chemistry in creating each piece.

Notes



The Chemistry of Art

FOCUS Question

How do the properties of matter help people create different forms of art?

Cause and Effect

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The Chemistry of Art

Written by Karen de Seve

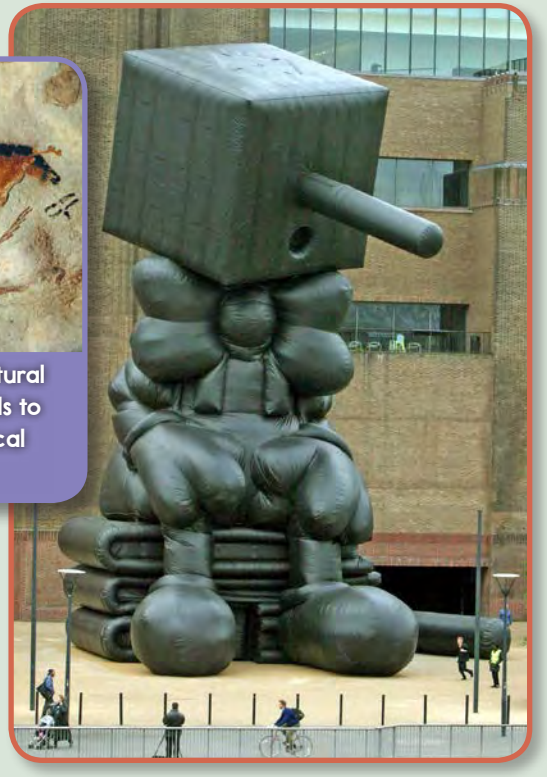
www.sciencea-z.com

There's Chemistry in Art

From flat cave paintings to huge modern sculptures, visual art comes in many different forms. How do artists make art? The answer is chemistry.

Early artists used the physical properties of rocks and minerals to paint on cave walls. Modern artists often use *chemical reactions* to create art. A chemical reaction changes a substance into something different. Let's look at some of the ways artists use chemistry to create art.

Early humans used the natural color of rocks and minerals to make art. These are physical changes.



Modern artists use physical and chemical changes to make art.

Notes

Read-Think-Write

Write your answers on separate paper. Use details from the text as evidence.

1. What did early humans use to make color for their cave paintings?
2. How could you get paint to stick to a smooth plastic surface? Use information from the book.
3. Look back at the text and diagram on page 5. What would happen to the air-dried clay object if it got wet before it was fired in a kiln, and why?
4. According to the author, why is glass considered a *super-cooled liquid* instead of a solid?
5. Suppose an artist wanted to make a sculpture of a green wave and a red boat entirely out of metal, without any paint. Using what you learned on page 9, tell how the artist could make the metal change color.

FOCUS Question

How do the properties of matter help people create different forms of art? Choose one of the forms of art in this book. Explain in your own words why the chemistry of the materials is important to artists.

Earliest Colors

By grinding soft rocks into colored powder, early humans made *pigments*. The colors of the pigments depended on the minerals in the rocks and the elements in the minerals.

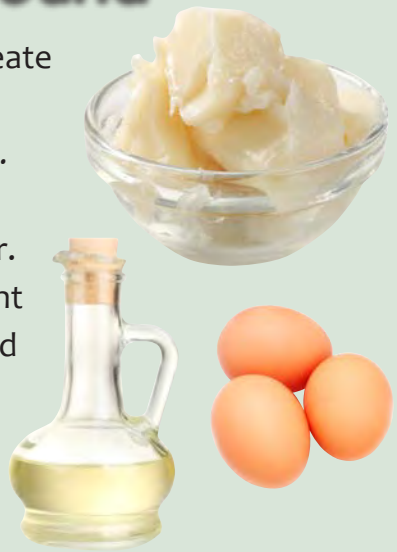
Ochre (OH-kur) was the first natural material people used as a pigment. Iron gives ochre a red or yellow color. White came from calcium in gypsum. Black came from animal bones, wood, or plants that were charred in a fire. The number of colors grew as people found new minerals.

Hematite is a form of iron that makes ochre red.

Limonite is a form of iron that makes ochre yellow.

Paint Sticks Around

Paint is another way artists create art. Early artists experimented with substances called *binders.* The atoms in a binder hold the atoms in the pigment together. They also help glue the pigment to a surface. Animal fat, oil, and eggs are types of binders.



Binders such as animal fat, oil, and eggs hold pigment to a surface, even after the liquid evaporates.

The type of surface also affects how well paint sticks. When paint touches a surface, atoms in the paint bind to atoms in the material. Wood is rough, so it has a lot of surface area. Paint binds well to it. Canvas is not quite as rough, but paints bind to it, too. Plastic is smooth, so paint does not easily stick to it.

wood

canvas

Artists created the Statue of Liberty by pounding huge sheets of copper (Cu) to shape her body, torch, and crown. Over time, the copper atoms interacted with oxygen atoms in the air, and the shiny brown copper turned green. This natural process is called *oxidation.* The green coating on the copper is called a *patina.*

Metal artwork can be colored in other ways as well. Titanium (Ti) and aluminum (Al) change color when put into a liquid with an electric current. The electricity creates a chemical reaction on the surface of the metal. The metal becomes *anodized.*

Understanding the chemistry of materials allows artists to make new creations. How do you use chemistry to make beautiful art?

About thirty tons of copper sheet were used to shape the Statue of Liberty's body.

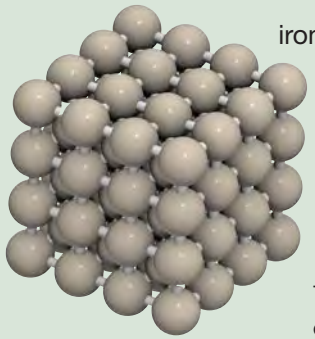
These colorful flowers were made from steel and anodized aluminum.

Metal

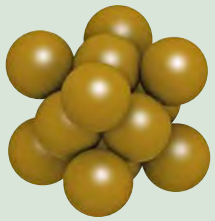
Artists use metal to make everything from delicate gold jewelry to huge steel statues. Some types of metal are easy to bend, while others are not. Like all materials, metals are made of atoms. The strength of a metal, and how easily it can bend, depend on how the atoms are stacked together. Atoms packed tightly together in a grid form a *crystal* structure. The tighter the packing, the stronger the crystal. Iron (Fe) has a strong grid structure. It can support huge objects like the Eiffel Tower. Gold (Au) is a soft metal because its atoms are not as tightly bound together. Artistic jewelry is often made of gold.

wowser!

Workers used about 8,000 tons of iron to build the Eiffel Tower.



iron (Fe)



gold (Au)

The crystal structure of iron (Fe) and gold (Au) affect the properties of each metal.

Clay

Clay is a special type of natural material made up of minerals with atoms that are stacked in layers. Between the layers of clay are water molecules.

Clay can be air-dried. Some water molecules escape during drying. The layers of mineral atoms move closer together, and the clay shrinks a little. This is a physical change. But if it gets wet, the clay will break apart.

Firing the clay in a hot *kiln* creates a chemical reaction and prevents breaking. At 1,000 degrees Celsius (1,832°F), nearly all the water molecules are removed from the clay. At 1,200°C (2192°F) and higher, all the water is gone. What's left is a strong grid of tightly packed mineral atoms. If it gets wet, the clay will not break apart.

CREATING CLAY POTTERY

Step 1: The clay pottery is shaped on a pottery wheel and allowed to air-dry.

Step 2: The clay pottery is fired in a kiln at very high temperatures.

Step 3: The clay pottery is done. Water will not damage it now.

Glass

Have you ever walked through a garden of colorful glass creations? These beautiful objects of art started out as a type of sand called *silica.* The elements silicon (Si) and oxygen (O) join together in a grid to form silica sand.

Do You Know?

Adding different elements to melted silica can change its color. Copper makes it green, cobalt makes it blue, and sulfur makes it yellow.

Turning sand into glass requires an extremely hot furnace. Silica sand melts at about 1,600°C (2,912°F). At this high temperature, the silicon and oxygen atoms move apart in a chemical reaction. The solid sand transforms into a thick, gooey (or *viscous*) liquid. Inside, the atoms are no longer in an orderly grid, so the molten glass can flow. Once the silica sand is liquid, a glassblower can form it into any shape.

Glassblowers are artists who use *molten*, or liquid, glass to make sculptures.

A glassblower starts with a blob of melted silica on a long metal tube. The artist blows into the tube to create an air bubble in the liquid. The surface of the gooey glass expands, but the silica atoms still cling to one another.

This glassblower is creating a large sculpture for an outdoor display.

The artist shapes the molten glass. As it cools, the atoms can't form the grid shape they were in before. Instead, they stay in a new, random position. The material is now glass. A chemical reaction has occurred. Since the atoms inside never return to their orderly grid structure, glass is considered a *super-cooled liquid* instead of a solid. But it sure seems like a fragile solid if you drop and break it!

Glass can be made into beautiful works of art!