GRADE 9

SCIENCE • MEDIA ART

Oxidation of Art

Essential Question

What variables exist within the process of creating art using oxidation?

VOCABULARY

oxidation
species
acid
base
abstractions
chemical reaction

Materials List

- copper paint and brushes
- eye droppers
- petri dished labeled A-J
- variety of liquid acids and bases (lemon juice, vinegar, soda (carbonic acid), rainwater, milk, egg whites, drain cleaner, etc.)
- 6"x6" canvases

Access all digital resources here

Pacing	1-2 sessions

Assessment

SUMMATIVE	Students will write a textual analysis, with text being comprised of both dance and literature.

Elements of MEDIA ART	• Motion • Space

CONTENT Standard

NGSS HS-PS1-7

Use mathematical representations to support the claim that atoms, and therefor mass, are conserved during a chemical reaction.

ARTS Standard

MA:Cr1.1.III

Integrate aesthetic principles with a variety of generative methods to fluently form original ideas. solutions, and innovations in media arts creation processes.

21st Century Skills

- Creative Thinking
- Communicating
- Informational Literacy
- Initiative
- Productivity

Lesson Objective

Students will examine oxidation as a chemical reaction and how it was utilized in the sculpting of the Statue of Liberty.

Lesson Overview

Students will explore the oxidation of the Statue of Liberty and discuss the resulting effects its color and texture. They will learn about the process of oxidation and discuss how sculptor Bartholdi created and used oxidation in his paintings. Students will then experiment with using various liquids on copper based paints to create abstract artworks and analyze the variables used in their artistic process.

Artful Thinking Routine

Parts / Purposes / Complexities routine

Have students **watch this video** that explains the color change behind the Statue of Liberty.

- What are the parts of this sculpture?
- What might be the purpose of this sculpture, or what is the artist trying to communicate through this work?
- What are the complexities or pieces that make up this sculpture?

Your notes:

STEP 1

Introduction

Begin by building background knowledge about texture in art. **Ask:** What is texture? Allow students to share responses out loud. Share the wiki definition which is "perceived surface quality of a work of art. It is an element of two-dimensional and three-dimensional designs and is distinguished by its perceived visual and physical properties."

Explain that today students will be learning about how art's texture may change over time due to environmental elements, depending where the artwork is installed.

STEP 2

Chemistry

Explain to students that there are two main types of chemical reactions: oxidation and reduction. Have students watch this **apple video** which illustrates the concept of oxidation at a basic level. Remind students that oxidation occurs when a molecule, atom, or ion loses electrons, while reduction occurs when there is a gain of electrons. From an observational standpoint, it means that the surface of any object is affected as time passes and that affect may be in the coloring or sheen of the surface being affected. Any type of vehicle (cars, motorcycles, etc.) will oxidize over time because they are in contact with oxygen. The surface of the paintwork will change slightly in its molecular structure from surface oxidation (which causes the paint surface to look matte).

Use the resource page included below to share with students how to find the oxidation of an element or compound. Explain that atoms in their elemental state have an oxidation number of 0 and that atoms in monatomic ions have an oxidation number equal to their charge. However in compounds, all other atoms are assigned an oxidation number so that the sum of the oxidation numbers on all the atoms in the species equals the charge of the species.

Your notes:

An example of a reaction utilizing oxidation and reduction occurs between hydrogen and fluorine gas to form hydrofluoric acid: $H_2 + F_2 \rightarrow 2\ HF$. In this reaction, hydrogen is being oxidized and fluorine is being reduced. Ask students to practice identifying oxidation states by using the Oxidation and Reduction Reactions paper included in the resource pages. Explain to students that almost any object can oxidize but that today students will be examining oxidation as it relates to copper based paint.

Discuss: In which chemical family would you expect to find the most readily oxidized elements? (Alkali Metals- group IA- relatively low effective nuclear charge and large radii makes these elements less likely to attract additional electrons). The most readily reduced elements? (Halogens- group 7a relatively large effective nuclear charge and small radii makes these elements more likely to attract additional electrons).

Elements of Art

Review the elements of art with students with a special focus on the element of color. **Ask:** Is color change usually the result of a chemical reaction or of a physical reaction? It is not a good indicator as color change may result in either a physical or chemical change. Explain that in visual art color can portray light, tone, patterns, forms, symbols, movement, harmony (and dissonance), contrast, and mood. Share with students that when oxidation occurs in metals, they usually start to lose their luster (or shininess).

The surface of the metal will show imperfections and metal based paint will change slightly in molecular structure. If the oxidation were to be removed, then the glossy metallic finish of the paint would still be evident (as it is covered by the oxidation). Explain to students the different basic sheens of paints (glossy, satin or eggshell, and matte). Inform students that while oxidation usually affects artwork in a negative (or unintentional way), Frederic Auguste Bartholdi sculpted the Statue of Liberty in a way that purposefully utilized oxidation in the creation of the art.

Teacher to Teacher

Teacher Tip

There is always a fascination around the Statue of Liberty. Build on that! There are so many resources available for further research, including many wonderful high level "picture books". Another resource for students is **this article from wonderopolis.com**

STEP 4

Main Activity

Before the Main Activity: Set up stations around the classroom or lab with various petri dishes containing acids and bases (vinegar, water, patinas, etc.). Each petri dish should also include an eye dropper. Do not label the petri dishes, but for your own personal knowledge be sure to keep track of which petri dish contains which liquid.

Discuss acids and bases with students using the Acids and Bases handout included in the resource pages below. Review the concept of oxidation once more.

Distribute 6"x6" (or 10"x10" if it is within your budget) stretched canvases, and copper paint to students. Have students place their names on the backs of their canvases.

Instruct students to apply two coats of copper paint to their canvas, inform them that they are to cover the entire canvas. Next, have students rotate between stations dropping liquid from the petri dishes onto their copper canvases. Students should complete the appropriate hand out below, taking notes on the oxidation of their work.

As their paintings dry be sure to have students observe how their work changes over time. **Ask:** How is time an integral part of this art making process? What does it have to do with oxidation?

Estimated Time: 45-60 minutes

Your notes:

CLOSURE

Ask students to each place each of their canvases side by side to form a large collective artwork displayed on the floor. Ask students to stand in a circle around the artworks. Reflect on the works as a group.

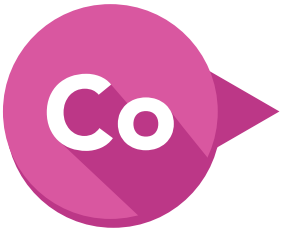
The Elements of Visual Art

LINE

A continuous mark on a surface by a moving point. Open from the beginning to the ending. ***Outline, contour, silhouette.***

SHAPE

A visual element that has two dimensions: length and width. Closed. ***Square, triangle, circle, free-form.***



COLOR

Properties of hue (red, blue, etc.), intensity (purity and strength of a color), and value (lightness or darkness).

FORM

Three-dimensional (having height, width and depth) and which encloses volume. ***Cubes, spheres, pyramids, and cylinders.***

TEXTURE

Surface Qualities. The look or feel of objects. ***Rough, smooth, glassy, blurry, silky, wooly.***

VALUE

Describes the lightness or darkness of a color. Gradual changes in drawings, woodcuts, photographs, etc. even when color is absent.

SPACE

Two or three-dimensional in reference to the distance or area between, around, above, below or within objects.

pH	Examples of solutions
0	Battery acid
1	Stomach acid
2	Vinegar, lemon juice
3	Orange juice, soda
4	Tomato juice
5	Black coffee
6	Milk
7	Water
8	Sea water
9	Baking soda
10	Handsoap
11	Ammonia
12	Soapy water
13	Bleach
14	Drain cleaner

Common Acids	pH
lemons	2.3
vinegar	2.9
apples	3.1
oranges	3.5
grapes	4
sour milk	4.4
white bread	5.5
fresh milk	6.6

Common Bases	pH
human saliva	6-8
distilled water	7
eggs	7.8
milk of magnesia	10.5
ammonia water	11.6
limewater	12.4
baking soda	14

Source: wikihow

Name: _____

Finding the Oxidation Number:

Oxidation numbers are usually written with the sign (+ or –) first, then the magnitude, which is the opposite of charges on ions. Chemists use the following guidelines to determine oxidation numbers:

Step 1: Atoms in their elemental state have an oxidation number of 0.
Step 2: The oxidation number of a monatomic ion equals the charge of the ion.
Step 3: For metallic ions, know that multiple oxidation numbers are possible. Many metal elements can have more than one charge.
Step 4: Assign an oxidation number of -2 to oxygen (with exceptions)

Exceptions:

- when oxygen is in its elemental state (O2), its oxidation number is 0, as is the case for all elemental atoms
- when oxygen is part of a peroxide, its oxidation number is -1
- when oxygen is bound to fluorine, its oxidation number is +2

Provide the oxidation state for the underlined element in each of the following species:

a) $\underline{Ca}I_2$

b) $\underline{O}F_2$

c) $\underline{C}_6H_{12}O_6$

d) $Rb_2\underline{O}_2$

e) $S_2O_3^{2-}$

f). $Be\underline{H}_2$

g). $\underline{Cl}O^-$

h) $\underline{S}_8$

Source: wikihow

Name: _____

Using Oxidation Numbers:

Keeping track of electrons is an important to chemists who need to know when electors are being transferred from one atom to another.

Here is the reaction of combining hydrogen gas and oxygen gas to make water:

$$2H_2(g)+O_2(g)=2H_2O(l)$$

The reaction breaks chemical bonds and forms new ones. It also involves a loss of electrons from H2. Terms used to describe the loss or gain of electrons include: Oxidation (the loss of one or more electrons) and Reduction (the gain of one or more electrons by an atom).

In the reaction above H_2 is being oxidized because it is losing _____.
O_2 is being _____ because the oxidation number of each oxygen atom decreased from - to -2 from the gain of 2 negatively charged electrons.

A helpful tip for remembering Oxidation and Reduction: **OILRIG: O**xidation **I**s **L**oss, **R**eduction **I**s **G**ain

Reducing Agent (reductant): Loses electrons and is therefor oxidized in a chemical reaction (in the above example H_2 is the reducing agent)

Oxidizing Agent (oxidant): Gains electrons and gets reduced in a chemical reaction. In the above reaction O_2 is the oxidizing agent.

Redox Reactions: Chemical reactions that involve the transfer of electrons. Oxidation state changes are a sign that electron transfer is occurring. All redox reactions involve both a reduction and an oxidation.

For the following reactions, indicate the species being oxidized and reduced, and show the oxidation states above their symbols:

a. $2\ KBrO_{3(s)} \rightarrow KBr_{(s)} + 3\ O_{2(g)}$ Oxidized Reduced

b. $Sr_{(s)} + 2\ CuNO_{3(aq)} \rightarrow Sr(NO_3)_{2(aq)} + 2\ Cu_{(s)}$ Oxidized Reduced

c. $2\ F_{2(g)} + 0_{2(g)} \rightarrow 2\ 0F_{2(g)}$ Oxidized Reduced

d. $NH_4NO_{3(s)} \rightarrow N_20_{(g)} + 2\ H_20_{(1)}$ Oxidized Reduced

Finding the Oxidation Number

a. +2
b.+2
c. 0
d. -1
e. +2
f. -1
g. +1
h. 0

Using the Oxidation Number

A. K= +1, Br=+5, O=2 ; K=+1, Br= -1; O=0 Oxidized: $KBrO_3$ (Br) Reduced: $KBrO_3$ (O)

B. Sr=0 ; Cu= +1, N= +5, O=-2 ; Sr= +2, N=+5, O= -2 ; Cu= 0 Oxidized: Sr Reduced: Cu^+

C. F=0 ; O=0, O=2+, F=-1 Oxidized: O_2 Reduced= F_2

D. N=-3, H=+1, N=+5, O=-2 ; N=+1, O=-2; H=+1, O=-2 Oxidized: NH_4NO_3 (N in No_{3^-})

Name: _____

Record observations on the oxidation of the copper paint caused by acids and bases:

Liquid	Notes:	Do you think this liquid is an acid or a base?	What do you think the liquid is?
A			
B			
C			
D			
E			

Name: _____

Liquid	Notes:	Do you think this liquid is an acid or a base?	What do you think the liquid is?
F			
G			
H			
I			
J			

TEACHER
ASSESSMENT
SCIENCE • MEDIA ART

Oxidation of Art

Student: _____

Total Score: ____ / 8

CRITERIA	Distinguished (4 Points)	Excelled (3 Points)	Adequate (2 Points)	Basic (1 Point)
The student is able to use mathematical representations to support the claim that atoms, and therefor mass, are conserved during a chemical reaction.	☐ The student is able to use mathematical representations to effectively support the claim that atoms, and therefor mass, are conserved during a chemical reaction.	☐ The student is able to use mathematical representations to support the claim that atoms, and therefor mass, are conserved during a chemical reaction.	☐ With support, the student is able to use mathematical representations to support the claim that atoms, and therefor mass, are conserved during a chemical reaction.	☐ The student is unable to use mathematical representations to support the claim that atoms, and therefor mass, are conserved during a chemical reaction.
The student is able to integrate aesthetic principles with a variety of generative methods to fluently form original ideas. solutions, and innovations in media arts creation processes.	☐ The student is able to integrate aesthetic principles with a variety of generative methods to efficiently, fluently form insightful original ideas. solutions, and innovations in media arts creation processes.	☐ The student is able to integrate aesthetic principles with a variety of generative methods to fluently form original ideas. solutions, and innovations in media arts creation processes.	☐ With support, the student is able to integrate aesthetic principles with a variety of generative methods to fluently form original ideas. solutions, and innovations in media arts creation processes.	☐ The student is unable to integrate aesthetic principles with a variety of generative methods to fluently form original ideas. solutions, and innovations in media arts creation processes.
NOTES:				