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Integrated learning solutions

UNIT: THE ART OF CHANGE–
A CHEMICAL AND PHYSICAL ADVENTURE
EXPLORING PHYSICAL AND CHEMICAL CHANGES THROUGH INDIGO DYEING

Grade Band: 5, 7
Content Focus: Visual Arts & Science



LEARNING DESCRIPTION

Students will explore both physical and chemical changes by using the visual arts process of indigo dyeing to help students apply their understanding of chemical and physical changes as they go through the various steps of dyeing fabric.

LEARNING TARGETS

Essential Questions	"I Can" Statements
How can visual arts be used to demonstrate understanding of what constitutes a physical change versus a chemical change? How can the artistic process of indigo dyeing be used to model and classify both physical and chemical changes?	I can use art materials to engage in the artistic process of indigo dyeing. I can differentiate between which steps in the visual arts process were physical changes and which were chemical changes.

	I can justify my artistic choices using my knowledge of both physical and chemical changes.

GEORGIA STANDARDS

Curriculum Standards	Arts Standards
Grade 5: S5P1. Obtain, evaluate, and communicate information to explain the differences between a physical change and a chemical change. a. Plan and carry out investigations of physical changes by manipulating, separating, and mixing dry and liquid materials. b. Construct an argument based on observations to support a claim that the physical changes in the state of water are due to temperature changes, which cause small particles that cannot be seen to move differently. c. Plan and carry out an investigation to determine if a chemical change occurred based on observable evidence (color, gas, temperature change, odor, new substance produced).	**Grade 5:** VA5.CR.1 Engage in the creative process to generate and visualize ideas by using subject matter and symbols to communicate meaning. VA5.CR.2 Create works of art based on selected themes. VA5.CR.3 Understand and apply media, techniques, processes, and concepts of two-dimensional art. VA5.CN.2 Integrate information from other disciplines to enhance the understanding and production of works of art.

SOUTH CAROLINA STANDARDS

Curriculum Standards	Arts Standards
Grade 7: 7-PS1-2. Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.	**Anchor Standard 1:** I can use the elements and principles of art to create artwork. **Anchor Standard 2:** I can use different materials, techniques, and processes to make art. **Anchor Standard 7:** I can relate visual arts ideas to other arts disciplines, content areas, and careers.

KEY VOCABULARY

Content Vocabulary	Arts Vocabulary
• State of matter - The distinct forms that different phases of matter take on: solid, liquid, gas and plasma • Physical change - A change from one state of matter to another without a change in chemical composition • Chemical change - A change that produces one or more new substances and may release energy • Substance - A type of matter that has a unique set of properties • Material - Relating to, derived from, or consisting of matter • Heat - The movement of thermal energy from one place to another • Reversible change - A change that can be undone; often called a physical or temporary change • Irreversible change - A process that is not reversible • Mixtures - A combination of two or more substances that can be separated by physical means • Compound - A substance made up of two or more elements that are chemically combined. For example, carbon dioxide is a compound that is chemically combined • Oxidize - To undergo a chemical reaction in which a substance combines with oxygen, resulting in a change in its chemical composition	• Indigo dye - An organic compound with a distinctive blue color; historically, indigo was a natural dye extracted from plants, and this process was important economically because blue dyes were once rare • Indican - The compound that yields indigo blue, is a glycoside: a sugar (in this case a form of glucose) bound to another molecule, indoxyl; when the glycosidic bond is broken, the indoxyl is freed; then the indoxyl compound is oxidized, it becomes blue: indigo blue • Shibori - A Japanese manual resist dyeing technique, which produces patterns on fabric • Resist - A technique where a substance or material is applied to a surface to prevent certain areas from absorbing paint, dye, or ink; it creates patterns, designs, or textures by "resisting" the medium in specific areas

MATERIALS

- Chemistry of Indigo
- Indigo Dying Chart
- 10x2 Artful Thinking Routine
- Colors/Shapes/Lines Artful Thinking Routine
- Video of shibori folding techniques
- Rubber gloves
- Buckets
- Water
- Plastic table cloth liner
- Paint stirrer
- Cotton fabric cut into squares for dyeing (a sheet works well)
- Indigo Dye kit: http://www.dharmatrading.com/kits/starter/sets/indigo-dye-kit.html
- Rubber bands
- Various size clothes pins

INSTRUCTIONAL DESIGN

Opening/Activating Strategy

- Review physical and chemical changes.
- Introduce students to the art of Shibori with images.
    - Have students observe the images using a visual thinking strategy, such as the artful thinking routine of 10x2 or the artful thinking routine of Colors/Shapes/Lines.
        - 10x2 Artful Thinking Routine:
            - Look at the image quietly for at least 30 seconds. Let your eyes wander.
            - List 10 words or phrases about any aspect of the picture.
            - Repeat Steps 1 and 2: Look at the image again and try to add 10 more words or phrases to your list.
        - Colors/Shapes/Lines Artful Thinking Routine:
            - Look at the artwork or object for a moment.
                - What **colors** do you see?
                - What **shapes** do you see?
                - What **lines** do you see?
- Tell students that Shibori is a technique that results in both physical and chemical changes.

Work Session

Teacher note: This activity can be done in small groups or as a whole class.
Hand out the physical and chemical changes checklist. Students may complete this individually or in pairs/groups. Students will complete the checklist during the process.

- Pass out the Indigo Dying Chart to students. Spend a few minutes going over the document.
- Follow these steps for preparing the indigo:
    - Fill a bucket with four gallons of water.
    - Add the thiox and soda ash to the water while stirring.
    - Add the reduced indigo.

    - Stir in a clockwise motion until indigo is dissolved, reverse the direction and place the lid on the bucket.
    - Let indigo sit for twenty minutes.
- While the indigo is sitting, demonstrate or show students a video of shibori folding techniques. Students should fold their cloth and bind to create a resist.
- Remove the lid from the indigo vat and remove the frothy bloom. The bloom is the result of oxygen leaving the vat. Now the vat is ready for dyeing.
- Put on rubber gloves.
- Dip the fabric bundle into clean water and wring out.
- Hold your bundle under the surface of the indigo vat, massaging the dye into the fabric for one minute.
- Remove the bundle; notice the physical characteristics of the bundle.
- It should be a yellow color that changes from green to blue as it oxidizes.
    - Ask students to make observations about what is happening to the color and why they think it's changing.
    - Discuss what it means for something to "oxidize".
- The bundle may be dipped multiple times to obtain a deep blue color.
- Allow the bundle to sit for ten minutes.
- Rinse the bundle under water.
- Unbind your bundle and admire your design.
- Hang to dry.

Closing/Reflection

- Have students reflect on the following questions either in small groups or in a written format:
    - How did engaging in the arts support and build upon your understanding of chemical and physical changes?
    - How did this STEAM activity help you understand chemical and physical changes in the world around you?
    - If you were to go through this artistic process again, what would you do differently? Why?

ASSESSMENTS

Formative

- Observations of students in the artistic process
- Question and answer

Summative

- Indigo Dying Chart

DIFFERENTIATION

Accelerated: Ask students to predict their shibori pattern based on their folding technique. Compare the predictions and final product.

Remedial:

- Chunk the lesson by periodically stopping to review the Indigo Dying Chart with students and discuss the physical and chemical changes that are taking place.
- Allow students to work with a small group or in partners on the Indigo Dying Chart.

ADDITIONAL RESOURCES

- Shibori: https://www.seamwork.com/issues/2015/08/shibori-dyeing

CREDITS

U.S. Department of Education- STEM + the Art of Integrated Learning

**This integrated lesson provides differentiated ideas and activities for educators that are aligned to a sampling of standards. Standards referenced at the time of publishing may differ based on each state's adoption of new standards.*

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