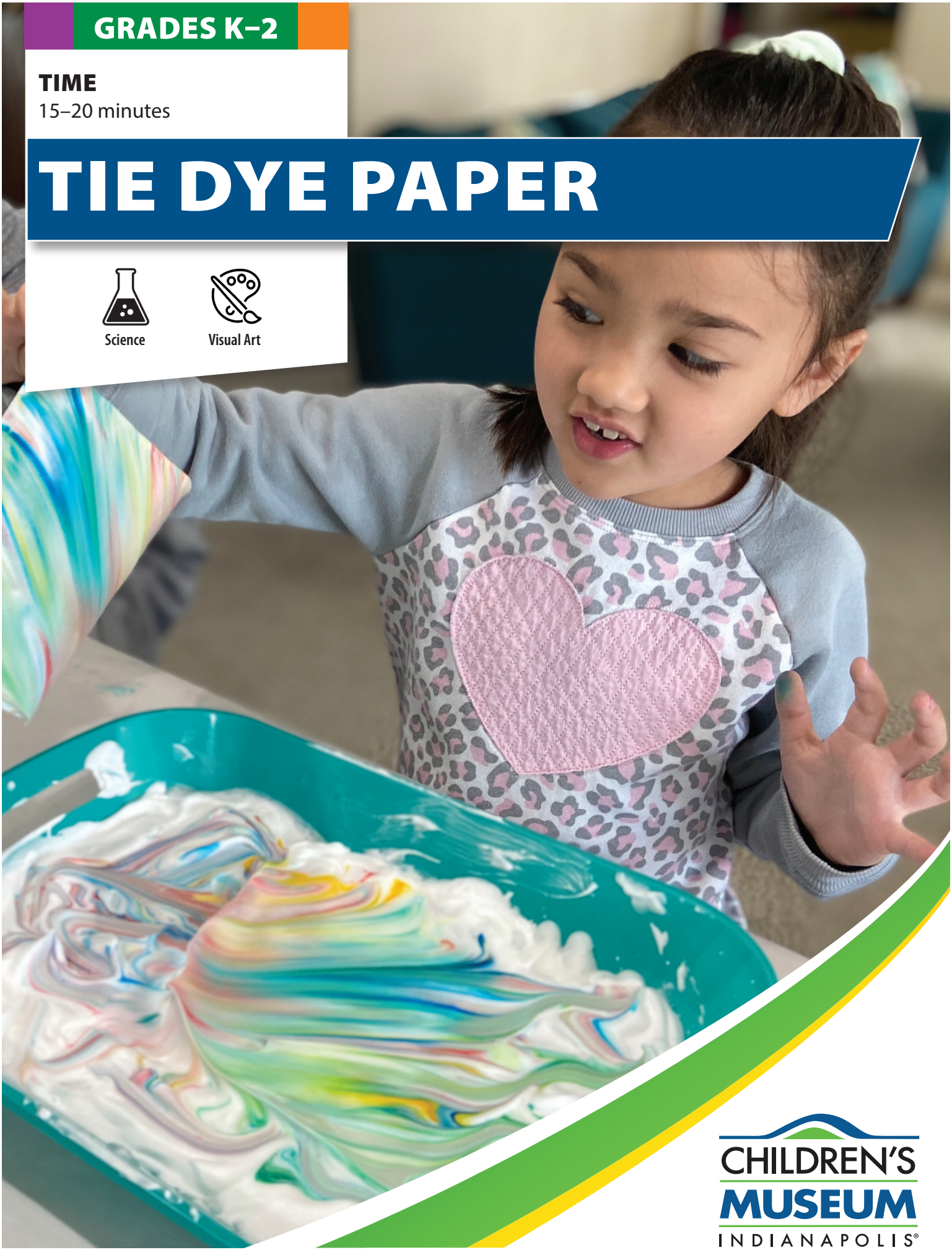
GRADES K–2

TIME
15–20 minutes

TIE DYE PAPER

Science

Visual Art



CHILDREN'S MUSEUM INDIANAPOLIS®

TIE DYE PAPER

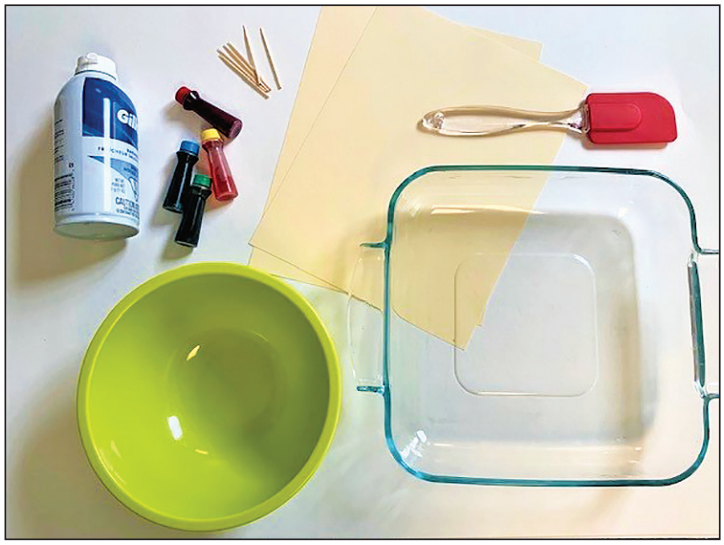
The Children's Museum's lessons are designed to weave classroom experiences and museum education together. All lessons are interdisciplinary and can be used as individual classroom experiences or in combination to create a cohesive unit. Lessons are optimized when used in connection with museum field trips.

Just like characters in a book, materials in the world around us have different combinations of traits that make them unique. Scientists take all of these traits into account when conducting investigations. In this lesson, students will characterize materials first by their state of matter and then by how they respond to water. Students will discover that some materials **repel** water while other materials **attract** water. By combining materials with various properties, students will create a piece of colorful, tie dye-esque paper. A little science plus a little art equals a lot of fun!

***After trying this lesson, further explore this topic with the lesson Color-Changing Milk.*

FOCUS QUESTIONS

- What are the properties of solids, liquids, and gasses?
- How do different materials respond to water?
- How does the paper-dyeing process work?



INDIANA ACADEMIC STANDARDS

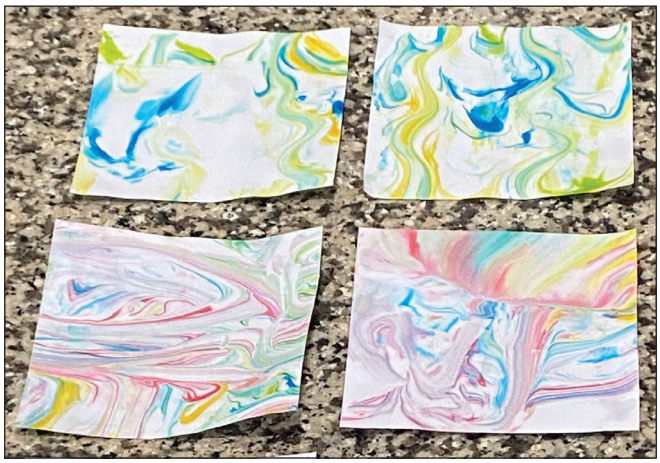
Science: 1.PS.1, 2.PS.1

Visual Arts: VA:Cr2.1.Ka, VA:Cr2.1.1a, VA:Cr2.1.2a

OBJECTIVES

Students will:

- Discover that some materials attract water and some materials repel water
- Make and test predictions about how various materials will respond to water
- Create a piece of colorful paper using hydrophobic and hydrophilic materials



MATERIALS

- Newspaper, trash bag, or drop cloth (optional)
- Large pan or plate (a cookie sheet works well)
- Shaving cream
- Spatula
- Food coloring
- Fork or toothpick
- Paper (cardstock works best, but any paper will work)
- Large bowl or trash can

Photo Credits: Girl creating tie dye paper (Cover), The Children's Museum of Indianapolis; Materials (above), The Children's Museum of Indianapolis; Tie dye papers (above), The Children's Museum of Indianapolis; Procedure Steps (page 3), The Children's Museum of Indianapolis; Shaving cream (page 4), Coprid / Adobe Stock; Food color bottles (page 4), Michelle / Shutterstock

Create a Tie Dye Paper

PROCEDURES

1. Show students the materials for the lesson and explain that they will use these materials to create a piece of artwork. Ask students to characterize each material as a **solid**, a **liquid**, or a **gas** and to explain their reasoning.
2. Explain that, in addition to characterizing materials by their states of matter, we can characterize them by other properties. For example, some materials repel water, and others attract water.
3. Explain that food coloring is made mostly of water. Ask students to make predictions in response to some of the following questions:
   a. What do you think will happen if you add food coloring to shaving cream? Will the shaving cream attract or repel the food coloring?
   b. What do you think will happen if you add food coloring to paper? Will the paper attract or repel the food coloring?
4. Guide students through the process of making colorful paper below. Encourage students to observe the reactions between the food coloring and shaving cream.
5. Discuss students' observations about how the shaving cream and paper responded to the food coloring and how these observations compare to their predictions.
6. Explain that shaving cream is only partially attracted to water, as it's a mixture of soap and water. When students added the food coloring, the food coloring stayed on top of the shaving cream rather than fully mixing with it. Paper, on the other hand, attracts water. When students placed the paper on top of the shaving cream, the food coloring transferred to the paper.
7. Encourage students to experiment with different techniques during the paper-making process and compare the results.

STATES OF MATTER

Matter is anything that has mass and takes up space. Matter is made of tiny particles called atoms, which can combine to form other particles called molecules. Matter can take a variety of forms, or states. Below are three common states of matter.

Solid: In a solid, the molecules are very close together and do not move very much. A solid keeps its shape. The pan, spatula, fork, paper, and bowl in this lesson are solids.

Liquid: In a liquid, molecules are close together (but not as close as molecules in solid) and move around a little bit. A liquid takes the shape of its container. The food coloring in this lesson is a liquid.

Gas: In a gas, the molecules are far apart and move around a lot. The air you are breathing is a gas.

1. Cover workstation with newspaper, trash bag, or drop cloth (optional).
2. Squirt shaving cream onto the pan and use the spatula to spread out the shaving cream.

3. Add a few drops of food coloring to the shaving cream.

4. Swirl the food coloring with the fork to create a marbling effect.

5. Place a piece of paper onto the pan of shaving cream and press down gently.

6. Remove the paper from the pan.

7. Use the spatula to scrape the shaving cream off the paper and into the bowl.

8. Set the dyed paper on a flat surface to dry.

Move Like A Molecule

Use this kinesthetic activity to deepen understanding of states of matter.

Instruct students to make two fists. Explain that each fist represents a molecule. Use the directions below to model how molecules behave in different states of matter.

1. Ask students to press their fists together so that their knuckles are touching, then keep their fists still. This is how molecules behave in a solid.
2. Ask students to keep their fists touching and slide them up and down against each other. This is how molecules behave in a liquid.
3. Ask students to move their fists far apart and move them around quickly. This is how molecules behave in a gas.

Say "solid," "liquid," or "gas" at random and ask students to model each state of matter with their fists.

WHAT ABOUT THE SHAVING CREAM?

It is not always easy to characterize a substance as a solid, liquid, or gas. Shaving cream, for example, seems to hold its shape like solid. However, shaving cream is a mixture of liquid soap (which contains water) and a lot of gas. The gas makes the liquid thick enough to hold its shape.

Try this!

Instruct students to do the following:

1. Squirt some shaving cream onto a paper towel.
2. Place a penny on top of the shaving cream and observe what happens. Does the shaving cream support the penny's weight?
3. Let the shaving cream and penny sit out overnight.
4. Observe how the shaving cream has changed. What state of matter is it now? Is it still supporting the penny's weight?
5. Let the shaving cream and penny sit out for several days. Make additional observations. As the liquid in the shaving cream evaporates, the dollop of shaving cream will become a thin, solid soap.

VOCABULARY

- **Matter**
- **Solid**
- **Liquid**
- **Gas**
- **Repel**
- **Attract**

IT'S GREEK TO ME

Materials that repel (push away from) or do not mix well with water are called hydrophobic. Materials that attract (stick to) and mix well with water are called hydrophilic. Many scientific terms have Greek roots. For example, the prefix *hydro-* stems from the Greek word for "water." The suffix *–phobic* stems from the Greek word for "fear," and *–philic* stems from the Greek word for "love." Therefore, hydrophobic means "water-fearing," and hydrophilic means "water-loving."

HOW SOAP WORKS

Shaving cream contains soap. Soap molecules have two parts: a hydrophilic (water-loving) head and a hydrophobic (water-fearing) tail. The head bonds with (sticks to) water. The tail avoids water and bonds with dirt and germs. When you wash your hands, the water washes the soap away—and pulls the dirt and germs away with it.

CHANGE IT UP

Encourage students to experiment with these techniques to create new designs:

- Use different combinations of colors.
- Change the spacing of the food coloring drops (far apart verses close together).
- Swirl the food coloring in a different pattern.
- Use a different tool to swirl the food coloring.
- Use different types of paper.

Discuss how different techniques affect the design, which techniques students prefer, and what other techniques students could try.