



Classroom Activity | Grades K–2

Fun with Adhesives

GUIDING QUESTION

- What causes adhesives to be sticky?

LEARNING OBJECTIVES

Students will be able to:

- observe and record the properties observed when two substances are mixed together.
- measure and record capacity using appropriate science tools and measurement units.
- work in teams to develop a solution to a technology problem.

OVERVIEW

Adhesives are all around us. They cause bandages to stick to our skin, enable us to wrap gifts, and help us post reminder notes. Adhesives vary in stickiness depending on the purpose of their use. In this lesson, students encounter a real-world problem that requires an inventive solution. When an art teacher runs out of glue for her classes, students work together as engineering teams to create a formula for homemade glue. Then students test their glue concoctions using various materials (e.g. paper, cardboard).

NEXT GENERATION SCIENCE STANDARDS

- PS1.A: Structure and Properties of Matter
 - 2-PS1-1: Different kinds of matter exist and many of them can be either solid or liquid, depending on temperature. Matter can be described and classified by its observable properties.
 - 2-PS1-2: Different properties are suited to different purposes. (2-PS1-3)
 - 2-PS1-3: A great variety of objects can be built from a small set of pieces.
- PS1.B: Chemical Reactions
 - 2-PS1-4: Heating or cooling a substance may cause changes that can be observed. Sometimes these changes are reversible, and sometimes they are not.

- ETS1.A: Defining and Delimiting an Engineering Problem
 - K-2-ETS1-1:
 - A situation that people want to change or create can be approached as a problem to be solved through engineering. Such problems may have acceptable solutions. (secondary to KPS2-2)
 - Asking questions, making observations, and gathering information are helpful in thinking about problems. (secondary to K-ESS3-2)
 - Before beginning to design a solution, it is important to clearly understand the problem.
- ETS1.C: Optimizing the Design Solution
 - K-2-ETS1-1: Because there is always more than one possible solution to a problem, it is useful to compare and test designs. (secondary to 2-ESS2-1)

LESSON TIME FRAME

Two 45-minute lessons

Teacher note: This lesson may take 2–3 sessions depending on the pace of your students. To maximize your use of time, limit the supplies and time given for students to complete the collage on the first day or allow them to complete this prior to the lesson with the art teacher.

BACKGROUND INFORMATION

In this lesson, students observe what happens when flour gets wet. A major component in flour is starch, which exists as tiny granules. When these granules come in contact with enough water, they swell and break, releasing tiny starch molecules that stick together. This gluey substance is good for adhering paper materials such as construction paper and cardboard. Heat also helps the starch molecules to be released and this is why you will find that many recipes for paper mache paste use boiled water. For safety reasons, the primary students in this lesson use warm water, but should still be able to observe and create sticky glue. Glue is an adhesive or substance that sticks surfaces together. As an adhesive or glue sets, it either reacts with oxygen in the air or loses a solvent by evaporation. Bonds form between surfaces when an adhesive hardens.

While students in the primary grades will not discuss what is going on in the reaction at a molecular level, teachers should emphasize the problem solving and inquiry skills required in this lesson such as measuring, observing, and describing. Helping students develop a positive science disposition and motivation for invention and innovation are equally important goals in this lesson.

While focusing on measuring, observing, and describing, students will explore various ways to create adhesive using flour.

MATERIALS

Teacher Materials/Prep

- Sample student data table for explanation
- Sample student testing chart for explanation
- Covers for tables (newspaper or waterproof tablecloths) for easy cleanup
- Print/cut Stoplight Exit tickets for students (1 per student)
- Print Student Resources (1 per student):
 - Student Capture Sheet: Flour Observations
 - Student Capture Sheet: Investigation Table
- Print Home Connection Resource: Fun with Adhesives (1 per student)

Student Materials

- Construction paper for collage
- Glue stick for collage
- Cardboard for collage
- Markers or paint for collage
- Student Capture Sheet: Flour Observations
- Student Capture Sheet: Investigation Table
- Home Connection Resource: Fun with Adhesives
- Pencil
- Science journal
- Magnifiers for examining flour
- 10 by 10 cm of wax paper
- Dropper

Materials per Student Group

- “Testing Board” (Large piece of cardboard divided into three columns labeled “paper to paper,” “paper to cardboard,” and “cardboard to cardboard.” Tape an 8 ½ by 11 piece of construction paper to the paper to paper column.)
- Triangles cut from construction paper (at least 12, depending on number of tests)
- Triangles cut from cardboard (at least 6 depending on number of tests)
- Paper or plastic cups (approximately 6 per group)
- Sticky back labels or a permanent marker for labeling cups
- Spoon for scooping flour

- Metric measuring cups or graduated cylinders as appropriate for your students
- Flour (approximately 500 ml)
- Pitcher of warm water
- Craft sticks for stirring (6)
- Paper towels or rags for spills

CLASSROOM ACTIVITY

1. Provide students with glue, construction paper, cardboard, markers and/or paint to make a collage using various shapes.

Teacher Note: See suggestions for time management stated earlier in the Time Frame section of this lesson.

2. Allow time for students to build their shape collage.
3. Discuss how an adhesive/glue was used to create the artwork. Locate other examples around the classroom of products that have sticky properties (e.g. tape, notepads, labels, etc.).
4. Present students with the following problem:
 - An art teacher at a different school wants students to make collages, but the school has run out of glue. She has heard that a combination of flour and water can be used as a substitute, but what is the best combination?
5. Tell students that in this lesson, they will explore different combinations of flour and water to invent a glue that can stick together paper to paper, paper to cardboard, and cardboard to cardboard—just like they used when making the collage. Discuss how teams of scientists can work together to solve problems and invent new products.
6. Distribute Fun with Adhesives: Student Resource Page 1. Provide students the opportunity to use their senses of touch and sight to observe and describe the physical properties of a small amount of flour (about one spoonful placed on wax paper). If available, allow students to explore with magnifiers. Next, students should observe and record observations of the flour when 5, 10, and 20 drops of water are added to the flour. As necessary, provide instruction for the use of droppers. Allow students to predict which combination of flour and water will make the best glue. Remind them to explain their reasoning.
7. Provide instruction on how to use science tools. For instance, model how to use graduated cylinders or metric measuring cups to measure. Discuss measurement symbols/abbreviations and how to label each metric measurement when students are recording their work. Model how to scoop the flour into the measuring cup and how to hold the cup when pouring water to avoid a big mess.
8. Divide students into small groups. Distribute Fun with Adhesives: Student Resource Page 2. Discuss and model how to complete the table. Provide each group with about

500 ml of flour, a small pitcher of warm water, scissors, cardboard, construction paper, 6 plastic cups, craft sticks for stirring, and paper towels to complete the investigation.

Trial #	Amount of Flour	Amount of Water	Description of Mixture	Paper to Paper	Paper to Cardboard	Cardboard to Cardboard
1	10 ml	100 ml	Very watery	No	No	No

Distribute “Testing Boards” to each group. Students will attempt to use the invented glue samples to adhere shapes to the “Testing Board.” Model how students should label the samples.

- After student groups have completed the table and the Testing Board, bring the whole class together to share their findings. Which combinations appeared to work best? Did some combinations work well with only certain materials? How did the properties of flour change when it was mixed with different amounts of water? What were the benefits of working together as a team?
- Remind students of the art teacher’s problem discussed at the beginning of the lesson. What combinations of flour and water would students recommend to the art teacher? Students should write their recommendations and explain their reasoning in a science journal. Bring closure to the lesson by allowing students to share their journal responses.

REFLECTION

Distribute one Stoplight Exit Ticket to each student. Students will complete the Stoplight Exit Ticket to show their understanding of the lesson. On their Stoplight Exit Ticket handout, students will color in the section of the stoplight that explains their understanding of the lesson.

Refer back to the Guiding Question for the lesson: What causes adhesives to be sticky? Tell the students they should keep this question in mind while filling out their exit ticket.



Stoplight Exit Ticket

- **Red:** I do not understand today’s lesson.
- **Yellow:** I almost understand today’s lesson.
- **Green:** I get it! I understand today’s lesson.



HOME CONNECTION

Send home the Home Connection Resource: Fun with Adhesives with the students. They may choose one or complete both of the activities provided:

- Students may work with their parents to complete a paper mache project at home using flour and water as glue.
- Students and their parents may explore how melting can change the physical properties of an object and change it into a sticky adhesive. With parent supervision, students can make marshmallow cereal treats.

Name: _____

Date: _____

1. Observe the flour. Record your observations on the chart below. Use pictures and words to describe your observations.

<p style="text-align: center;">Dry Flour</p>	<p style="text-align: center;">Flour + 5 Drops of Water</p>
<p style="text-align: center;">Flour + 10 Drops of Water</p>	<p style="text-align: center;">Flour + 25 Drops of Water</p>

2. How much flour and water should be put together to make glue for an art collage using paper and cardboard? Write your prediction below and explain your reasoning.

Name: _____

Date: _____

Problem: A Sticky Situation

An art teacher at a different school promised her class they would make a collage, but the school has run out of glue. She has heard that a combination of flour and water can be used as a substitute, but what is the best combination?

Directions: Complete the table below with your group. Which combinations of flour and water will make the best glue for the materials in the table?

Trial #	Amount of Flour	Amount of Water	Description of Mixture	Paper to Paper	Paper to Cardboard	Cardboard to Cardboard

STOPLIGHT EXIT TICKET



Color in the stoplight to show your understanding of today's lesson.

- **RED:** I do not understand today's lesson.
- **YELLOW:** I almost understand today's lesson.
- **GREEN:** I get it! I understand today's lesson.



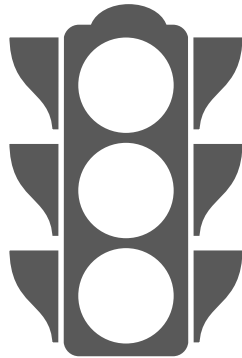
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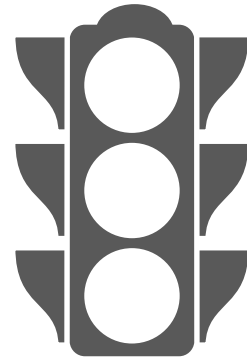
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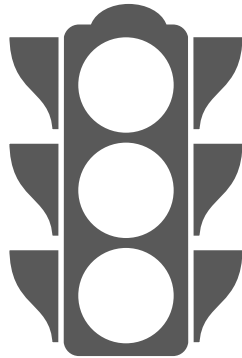
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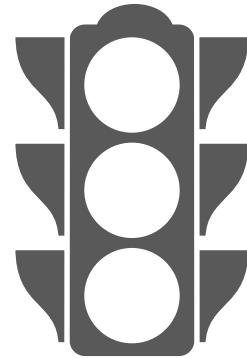
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Color in the stoplight to show your understanding of today's lesson.

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HOME CONNECTION RESOURCE: FUN WITH ADHESIVES

Dear Parent or Guardian,

Your young scientist has been learning about properties of materials and how they change. Today your young scientist worked on an engineering team to develop a formula for homemade glue. Select one of the following tasks to complete together with your young scientist to help reinforce and apply their understanding of science concepts:

- Combine melted butter and marshmallows in a saucepan to make a sticky edible adhesive. Add cereal to create tasty marshmallow cereal treats! (Be sure to take the appropriate safety precautions when cooking together to avoid burns or other injuries when using heated materials.)
- Explore ways to use flour and water to make a paste suitable for paper mache. First, cut newspaper strips. Next, blow up a balloon. Third, dip a newspaper strip into the paper mache paste and wring out excess liquid. Finally, spread the newspaper strip onto the balloon. Repeat until the balloon is fully covered. Let the paper mache dry. Decorate and fill with candy to create a colorful piñata.

For more detailed directions, please see the *Fun with Adhesives Family Activity*, and more activities found at: <https://www.youngscientistlab.com/parents/family-activities>.

We hope you continue learning together with us about the power of science.

See you in science class!

