

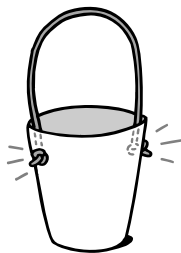
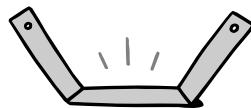
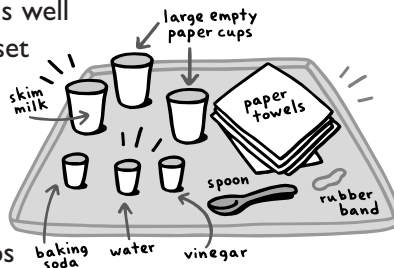
ZOOM Glue



Make glue and test it against other sticky stuff!

Get Ready

- Watch the ZOOM Glue video segment and review the Engineering Scoop to get familiar with the activity. Then cue the tape to the beginning for the meeting.
- This activity requires many materials but is well worth your effort. You'll save time if you set up materials for each team on a tray before the meeting.
- Pre-measure the ingredients into cups for each team. Put the skim milk in one of the large cups. Use the three small cups to hold the vinegar, baking soda, and water.
- Prepare the cardboard strips from old manila folders or paper plates. Cut strips that are about 5" x 1" and use a hole punch to make a hole at each end. Then fold each strip into thirds.



- Prepare the test cups. Use a hole punch or a pencil to make a hole on either side of each large paper cup. Cut 8-inch pieces of yarn and attach as shown.
- You'll need lots of pennies (about 250 per team). Start collecting early and ask kids to bring in spare pennies from home.
- Cover tables with newspaper to absorb any spills.
- For each kid, make copies of the ZOOM Glue activity sheet and the Stay Tuned message (see end of section).
- Post the new ClubZOOM Board activities (see end of section).

What You Need

Design & Build (per team)

- baking soda (1 teaspoon)
- newspaper (to cover tables)
- 3 large paper cups (16 oz.)
- 3 small paper cups (3 oz.)
- 5 paper towels
- plastic spoon
- rubber band
- skim milk (½ cup)
- vinegar (2 tablespoons)
- water (3 tablespoons)
- ZOOM Glue activity sheets

Test (per team)

- 4 cardboard strips (5" x 1")
- glue stick
- large paper clip
- large paper cup (16 oz.)
- peanut butter (Note: If kids have peanut allergies, use honey instead.)
- pennies (about 250)
- 4 small paper plates
- white glue
- yarn (8" piece)
- ZOOM glue

Time

1 ½ hours



Engineering Scoop

Try This First

Quick—grab a pen and list as many glues as you can think of in 60 seconds! Then think about why we have so many different kinds of glue and how they are used.

The Scoop

Engineers have designed all sorts of glues to solve all sorts of problems. Glue helps hold together things like envelopes, sneakers, cars, and airplanes. There are even special glues that surgeons use to close wounds!

You'll be making glue from three household items: skim milk, vinegar, and baking soda. When milk and vinegar are mixed, the vinegar makes the proteins in the milk stick together to form small white lumps. These lumps are called curds. The remaining liquid is called whey.

Next you separate the curds and whey and add baking soda, which reacts with the small amount of vinegar left in the curds. The foaming you can see and hear is carbon dioxide gas, which is made when vinegar and baking soda are mixed. Add a little water and, voilà—you've got sticky glue!

In this activity, you'll compare the strength of your ZOOM glue to other glues: white glue, glue stick glue, and peanut butter (or honey if kids have peanut allergies). You'll test the strength of each glue by sticking together two pieces of cardboard and seeing how much force (measured by the weight of pennies) it takes to break the bond.

What makes a glue "stick"? Cardboard, like many other materials, has lots of very tiny cracks and holes on the surface. (You can't see these with the naked eye.) When you add glue between two pieces of cardboard, the glue seeps into the openings and then hardens. This makes the cardboard stick together.



Find Out More Books

Cool Chemistry: Great Experiments with Simple Stuff

Moje, Steven. New York: Sterling Publishing Company, 1999.

Why does milk curdle? Turn to page 54 to find out. If your kids enjoyed making glue, they might want to try some of these other chemistry experiments.

The Science Chef: 100 Fun Food Experiments and Recipes for Kids

D'Amico, Joan, and Karen Drummond. New York: John Wiley and Sons, 1995.

Make your own cottage cheese and learn about the process of making curds and whey. Then explore the chemistry behind other recipes, like why sauces thicken, why cut apples turn brown, and why bread rises.



Web Sites

From Moo to Glue
www.ga.k12.pa.us/students/us/clubs/KTK/Glue/Index.htm

Learn more about the science and history behind making glue.

Homemade Glue
www.billybear4kids.com/graduation/summer/recipes/Glue.html

Make glue from cornstarch, corn syrup, and vinegar.

Sticker Glue
www.indoindians.com/tips/homemade_glue.htm

Make your own glue for stickers from vinegar and gelatin.

Run the Meeting

1 Get Started (5 minutes)

Welcome kids and ask for a volunteer to share the Stay Tuned coded message. (*Answer: From moo to glue.*) Then read the Challenge Letter together.

Tell kids that the ZOOM glue they'll make today is made from milk, vinegar, and baking soda. After they make the glue, they'll test it against other sticky things: commercial white glue, glue stick glue, and peanut butter. You can show the ZOOM Glue video segment to introduce the activity directions. Stop the video before the cast tests the glue.



2 Design & Build (10–15 minutes)

Organize teams of 2 to 4 kids and assign them to tables where the activity materials are ready to go. As the kids make the glue, ask:

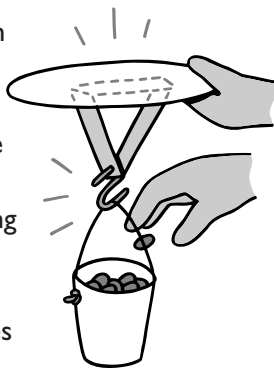
- Take a look at the curds. What do they remind you of?
- What do the curds feel like when you gently touch them?
- Notice the bubbles in the cup. What do you think is causing the bubbles?

Note: At step 4 on the activity sheet, kids will need to wait about 5 minutes as the curds and whey separate. Fill this time by having kids read and try out postings on the bulletin board.

3 Test (15–20 minutes)

Now that the glue is ready, it's time to compare its "stickiness" strength to other sticky things: white glue, glue stick glue, and peanut butter (or honey). Testing is a key engineering skill. Engineers test products all the time to learn how they work and how to improve them.

Show the kids the "stick-o-meter" and explain how it works. First they'll stick each test strip to a plate using one of the glues. Remind them to use the same amount of glue on each strip. After the strips dry for 10 minutes, they'll hold one of the plates and hang a cup from the strip. Then they'll add pennies one at a time to the cup until the strip pulls away from the plate. The more pennies it takes to break the bond, the stronger the glue.



Activity Tips



- All of the materials are safe to work with. However, it's important to set safety rules for the kids: Follow directions exactly. Do not taste anything. Keep hands away from eyes. Throw away glues in the trash, not the sink. Wash your hands when finished.
- Scrape the curd gently from the wet paper towel so that the towel doesn't rip.
- Kids may have lots of ideas for how to make sure equal amounts of glue are used on the test strips. If they get "stuck," suggest that they trace a penny in the center of each test strip, and then fill each circle with one type of glue.
- When the kids add baking soda to the mixture, it reacts with the vinegar and produces carbon dioxide gas (CO₂). They'll see CO₂ bubbles, and can hear the bubbles pop if they hold the cup near their ears.
- To store the ZOOM glue overnight, cover the cup with plastic wrap and secure it with a rubber band.

While kids wait for the glues to dry, remind them to predict on their activity sheets the number of pennies they think it will take to break the bond for each glue.

As kids test, ask:

- *How did you make sure you used the same amount of each glue? Why is this important?*
- *How many pennies do you predict will break the bond of the glue?*
- *Each time the cup of pennies pulls off the strip, hold the cup in your hands. How heavy does it feel? This is the force needed to break the glue's adhesive bond.*
- *Look at each test strip and plate. Which gave way first: the glue, the test strip, or the plate?*

4 Redesign

In an hour and a half meeting, you probably won't have time for retesting. If the kids are interested in exploring this activity further, see ZOOM Links for extension ideas.

5 Share Results (5–10 minutes)

Ask one person from each team to report their results for each glue. Write the name of each glue on the board or chart paper and record each team's number of pennies. (If you have time, you can average the results for each glue.) Then talk about the findings:

- *According to our results, which glue is the strongest and which is the weakest?*
- *Why might some teams' results be different from others?*
- *Do you think this is a fair test? What other methods could you use to test the glues?*

You can also show the ZOOM Glue video segment and compare results with those of the ZOOM cast.



Connect the activity to engineering by asking kids about different kinds of glues and how they are used. You can use the "Engineering the Future" bulletin board posting to launch discussion.

6 Wrap Up (5 minutes)

Hand out club card stickers and the Stay Tuned coded message for the next meeting.

ZOOM Links



To extend this activity, kids can:

- Bring in new glues and other sticky materials to test with their stick-o-meters.
- Invent new ways to test the glues. For example, they could let the glues dry for different amounts of time (like 24 hours) or use test strips made from different materials (like copier paper, wood, aluminum foil, or styrofoam).
- Make new glues or invent their own. For glue recipes and ideas, see the Web sites listed in Find Out More.



Challenge

Dear ClubZOOM Engineers,

Good afternoon! My name is Bond, Jay Bond, and I am the advertising director for the Stuck-On-You Adhesive Company.

My company has invented a new kind of glue, and it's my job to advertise it. But the ideas aren't flowing, and I'm really stuck.

That's where you come in. I need to know how sticky this glue is and how it compares to the competition. We know that you are excellent test engineers and that we can trust you with our secret recipe. It's up to you to make a batch of our glue and then test its stickiness against other glues.

Make sure it's a fair test and your results are accurate. If I get caught for false advertising, then I'll really be in a "sticky" situation!

Stick with me,

Jay
BOND

Jay Bond
Advertising Director
Stuck-On-You Adhesive Company



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ZOOM GLUE

What You Need

- ½ cup skim milk
- 2 tablespoons vinegar
- 2 large paper cups
- 5 paper towels
- rubber band
- plastic spoon
- 1 teaspoon baking soda
- 3 tablespoons water

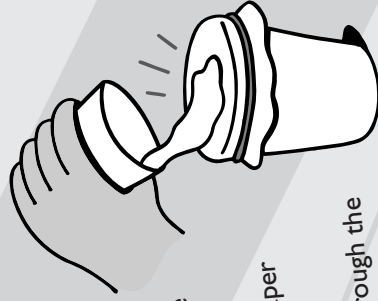


Engineering Scoop

When you mix milk and vinegar together, the vinegar makes the **protein** in the milk stick together to form small white lumps. These are called **curds**. When you add **baking soda**, it **reacts** with the small amount of vinegar left in the curds. Add a little **water** and, voilà—you've got sticky **glue**! When you **add** glue between two pieces of cardboard, the glue **seeps** into tiny **cracks** in the cardboard. When the glue **hardens**, it holds the cardboard together. Engineers have designed glues to **hold together** things like envelopes, sneakers, and even airplanes! What can you **stick** together with your glue?

Redesign It!

Invent new ways to test the glues. What happens if you let the glues dry for a longer amount of **time**, like 24 hours? What happens if you use test strips made from **different materials**, like aluminum foil or styrofoam? You can also **invent your own glue** and test it with your stick-o-meter. Choose **one thing** to test and **send** your results to ZOOM.



1 Put the vinegar into the cup holding the skim milk. **Stir** for about 30 seconds. The lumps that form are called **curds**, and the liquid is called **whey**.

2 Make a strainer to separate the curds from the whey. **Put** a folded paper towel over one of the large paper cups. **Push** down in the center so it forms a **bowl** shape. Put a rubber band around the top of the cup to **hold** the paper towel.

3 Pour the curds and whey into the cup with the paper towel.

4 Wait about 5 minutes for all the whey to drip through the paper towel.

5 Use a spoon to carefully **scoop** out the curds and **put** them on a clean paper towel.

6 Put another paper towel on top of the curds and **gently press** down. **Soak up** the remaining liquid until the curds feel **firm**, not squishy.

7 Put the curds in a clean paper cup. **Add** about 2 teaspoons of water to the curds and **stir**.

8 Add the baking soda and stir. Do you see any **bubbles**? This is the carbon dioxide **gas** that's made when baking soda and vinegar **react**.

9 Add small amounts of water until your mixture looks like glue.

Sent in by Ashley V. of Norwood, MA



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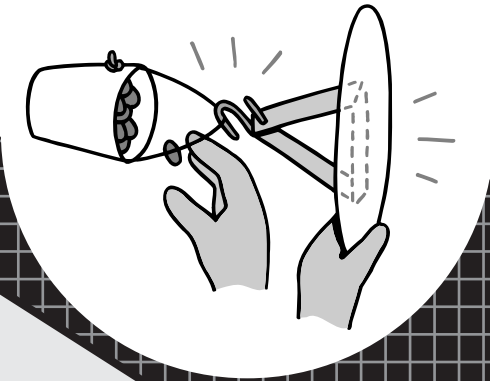
KIDS

ZOOM Glue

Engineer's Notebook

Test Glue with the Stick-o-meter!

- 1 Put a small amount of ZOOMTM glue in the center of a test strip.
- 2 Stick the test strip to the **bottom** of a paper plate.
- 3 Repeat the first two steps for the white glue, glue stick, and peanut butter. Make sure you use the **same amount** of each one so it's a **fair test**.
- 4 Let all the strips **dry** for 10 minutes. While you're waiting, **predict** how many pennies it will take to **pull** each strip from each plate. **Record** your predictions in the chart below.
- 5 **Test it out!** Hang the cup from the strip using a paper clip. One person can **hold** the plate. The other person **puts** pennies **one at a time** into the cup.
- 6 Keep **adding** pennies until the strip **pulls away** from the plate.
- 7 **Count** the number of pennies in the cup. **Record** your results on the chart.
- 8 **Repeat** the test for each glue. Which is the **strongest**? Which is the **weakest**?



Stick-o-meter Results

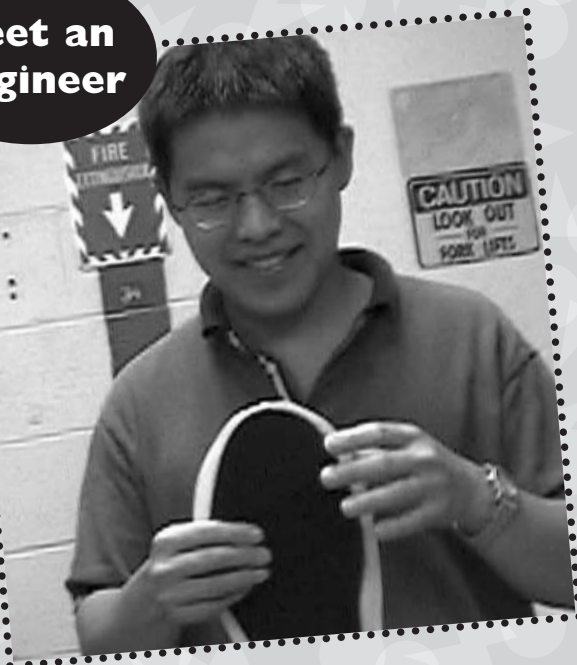
(Number of pennies needed to break the glue bond)

Prediction	ZOOM Glue	White Glue	Glue Stick	Peanut Butter
Actual number of pennies				



Send it to ZOOMTM!
Tell us about your results at
pbskids.org/zoom/sendit

Meet an Engineer



Sun Sasongko

Glue is everywhere: in furniture, in airplanes, in clothes. It's even in your sneakers. A special kind of glue is used to attach the bottom, rubber part of your sneaker to the top of your sneaker. Even if you run for miles or walk in the rain, this glue lasts. Sun Sasongko, a chemical engineer, designs this kind of glue. As part of his job, he travels to China and Indonesia to test his glue in the factories where sneakers are made. Sometimes the factory owners give him free samples, so now he owns lots of sneakers!



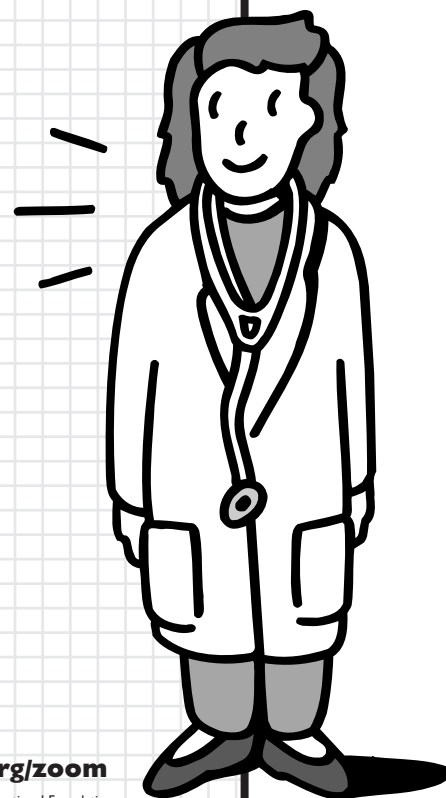
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Engineering the Future

Have you ever been to the doctor to get stitches? Not much fun, huh? Now closing a wound can be a lot less painful thanks to a new kind of glue. This **special glue** is less painful than stitches and wears off by itself so you don't have to go back to the doctor to have it removed. Do **you** have ideas for new types of glue? Become an engineer and design the glues of the future!



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Fannee Doolee

Sent in by Allyson K. of Seattle, WA

Fannee Doolee likes **fiddles** but doesn't like **violins**.
Fannee Doolee likes **ladders** but doesn't like **heights**.
Fannee Doolee likes **brooms** but doesn't like **cleaning**.
Fannee Doolee is one funny lady. Can you figure out why
Fannee Doolee likes some things but not others?

Ready to check
your answer?
Look inside!

Make up your own
Fannee Dooles and send
them to ZOOM at
pbskids.org/zoom/sendit/

Fannee Dooles are a ZOOM secret. We can't
tell you the answer, but we can give you a clue.
Fannee Dooles likes her name a lot. Why do
you think that is?

ANSWER

All submissions become the property of
ZOOM and will be eligible for inclusion in all
ZOOMmedia. This means that we can share
your ideas with other ZOOMers on TV, the
Web, in print materials, and in other media.



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Patterns to the Rescue



Can you figure out each pattern?
Fill in the number and shape that come next!

1. (16) (14) [12] (10) (8) [6] _ _

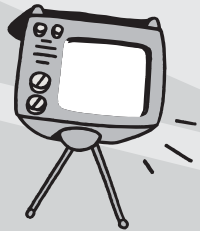
2. [10] (12) [11] (13) [12] (14) _ _

3. (30) [29] (27) (24) [20] (15) _ _

4. (2) (3) (5) (9) (17) (33) _ _

Ready to check
your answer?
Look inside!

CYBERCHASE is an animated adventure series that takes kids on a wild ride through cyberspace where they are challenged to use the power of math. Visit the CYBERCHASE Web site at pbskids.org/cyberchase to play more math games and find out when CYBERCHASE is on in your area.



ANSWER

1 (subtract 2)



2 (subtract 1, then add 2)



3 (subtract consecutive numbers)



4 (multiply by 2 and subtract 1)

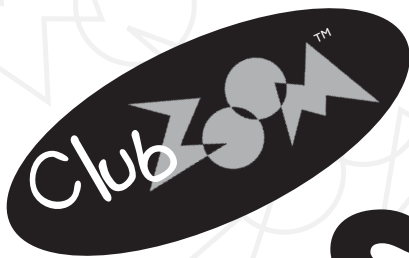


www.pbskids.org

www.thirteen.org



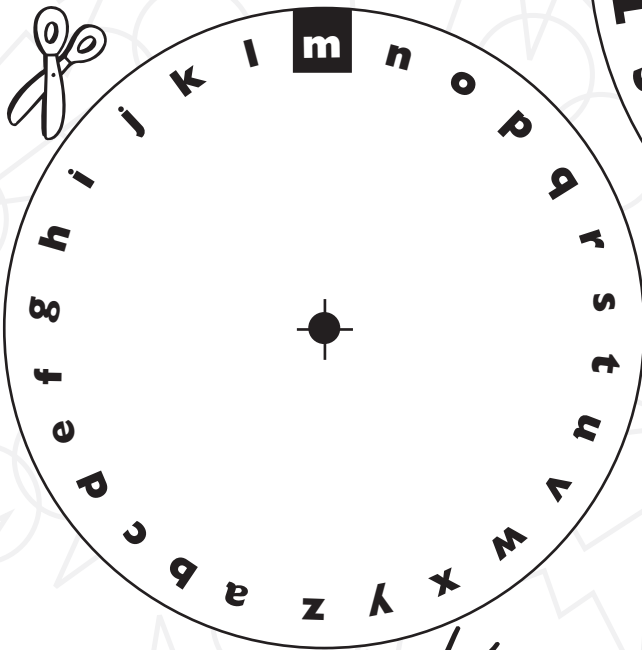
CYBERCHASE is produced by Thirteen/WNET New York and Nelvana. Funding for CYBERCHASE is provided by the National Science Foundation, PBS, and the Corporation for Public Broadcasting. Additional funding is provided by The Arthur Vining Davis Foundations, The Kettering Family Foundation, and the Volkhausen Family. Any opinions, findings, and conclusions expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.



Stay Tuned

Wondering what you'll be doing next time in ClubZOOM? Solve the secret message, and you'll get a clue!

To read this message, you need to learn the **Circle Code**. Here's how it works. Cut out the two circles below. Place the smaller circle on top of the larger one. Line up the "A" on the large circle with the "m" on the small circle. Find each of the letters in the secret message on the small circle and write down the letters they line up with on the large circle. Good luck!



Secret Message

tai exai omz kag sa?



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