How to Make Your ZOOMerang

You can print out your ZOOMerang and make it into a little booklet.

Here's how:

- Print all the ZOOMerang pages.
- Cut out each page along the dotted lines.
- Tape pages 1–6 together from end to end so that you have a long row.
- Tape pages A–F together to make a second long row.
- Lay one row face down on a table and put some glue on the back of the pages.
- Place the second row on top of the first row. The printed part of the second row should face you.
- Smooth out the glue with your hand.
- Let it dry and then fold your ZOOMerang where the pages join together.

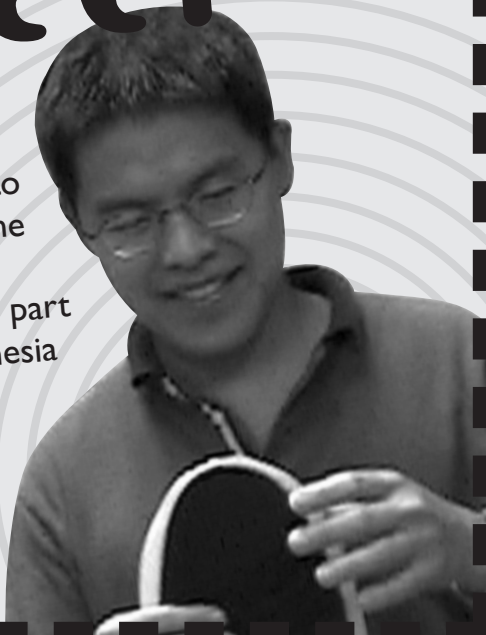
What You Need

- scissors
- tape
- glue

Voila!

Meet an Engineer

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 of your sneaker to the top. **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!



ZOOM Glue

Engineer Challenge:
Design glue that sticks paper together!

What You Need

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

Here's one way to solve the challenge. First, **pour** the skim milk and the vinegar into one of the paper cups. **Stir** for about 30 seconds. **Put** a folded paper towel over another cup and **hold** it in place with a rubber band. Next, **pour** the milk and vinegar mixture into the cup with the paper towel and **wait** about 5 minutes. The liquid will **drip** through the paper towel, leaving white lumps on top.

Use a spoon to **scoop** out the white lumps and **put** them on a clean paper towel. **Press** another paper towel on the lumps to **soak up** the remaining liquid. **Put** the lumps in a

Sent in by Ashley V. of Norwood, MA

clean paper cup. **Add** about 2 teaspoons of water and stir. **Add** the baking soda and stir. Then **add** small amounts of water until your mixture looks like glue.

Now, **try** making your own glue recipe. What would happen if you used **whole milk** instead of skim? Or what would happen if you added **more vinegar**? Test out your new recipe and compare it to your original glue.

Test It!

How sticky is your glue? One way to test it is with a Stick-o-meter. Make a **Stick-o-meter** like the one in the picture. You can find the directions for this ZOOMsci at: **pbskids.org/zoom**. **How many pennies** can you add to the paper cup before it falls? How do you think your homemade glue **compares** to other kinds of glue? Use your Stick-o-meter to **test** other kinds of glue and **record** your results in the chart.

Stick-o-meter Results

Number of pennies needed to break the glue bond

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

If you have an idea for an engineering activity, send it to ZOOM at **pbskids.org/zoom/sendit**.

Science 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 **put** glue between two pieces of paper, the glue **seeps** into tiny **cracks** in the paper. When the glue **hardens**, it holds the paper together. Engineers have designed glues to **hold** things together like envelopes, sneakers, and even airplanes! What can you **stick** together with your glue?

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Try out some engineering activities!
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What Do Engineers Do?

If you said, "**build things**" or "**invent things**," you're on the right track. Engineers use math and science to **solve problems**. They **design** things like safe bridges, strong tennis rackets, and comfortable sneakers.

Are **YOU** ready to solve some engineering challenges? Try the activities inside. You can **design** a roller coaster ride for a marble, **build** a vehicle that glides on air, and **test** your own glue!

Meet an Engineer

Have you ever been on a roller coaster? Roller coasters can be scary when you zoom around corners and hang upside-down. Who makes sure the rides are safe? **Civil engineers**, like **Oksana Wall**. Oksana works with engineers who design rides and roller coasters at Disney World. Oksana's job involves many different skills. Some days she sits at her desk and designs parts of a ride. Other days a problem comes up that Oksana needs to solve. When a giant robot stopped swinging its arms, Oksana crawled inside to see what was wrong.

Photo courtesy of Walt Disney World.

Marble Ride

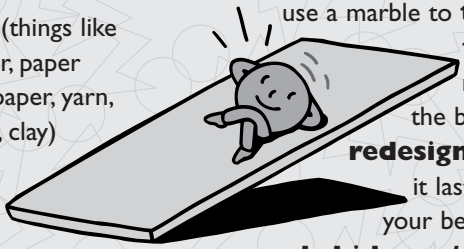
Engineer Challenge:
Design a slow roller coaster ride!

Roller coaster rides are usually fast, but not this time. The goal is to make your marble roll **as slowly as possible**!

First **set up** a Marble Ride board. **Lean** the cardboard against a wall. Put the bottom about **8 inches** from the wall. Then **design** your Marble Ride. Use building materials to create a track for the marble. What can you do to **slow** down the marble? Each time you add something to your ride, use a marble to **test** it out. When you're ready, **time** how long it takes your marble to go from the top of the board to the bottom. Keep **redesigning** and **testing** your ride until it lasts as long as possible. Then send your best times to ZOOM at **pbskids.org/zoom**.

What You Need

- large piece of cardboard
- ruler
- masking tape
- building materials (things like construction paper, paper towel tubes, sandpaper, yarn, cloth, cotton balls, clay)
- marble
- watch or clock



Sent in by Jenny, Anna, Erin, Becky, Jessica, and Jackie of Page, AZ

Marble Ride Trials

Test your Marble Ride three times and **record** the times below. Then figure out your average time.

	Trial 1	Trial 2	Trial 3	Average Time
Time (in seconds)				

(Add the trial times together. Then divide the sum by 3.)

Science Scoop

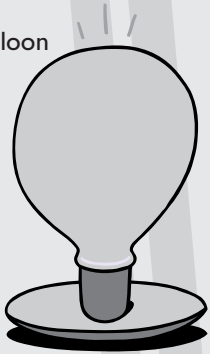
To slow the speed of the marble, you need to think about two things: the **angle** of the ramps and **friction**. The **steeper** the angle of the ramps, the **more** the marble will speed up. The more friction, the more a marble will slow down. Friction causes a **dragging force** between the marble and the ramp. That happens either when the marble **slides** along the ramp or when something on the ramp gets **squashed** as the marble passes over. **Rough** surfaces and **soft** surfaces produce the most friction. So if you roll a marble across a **rough** surface, like a ramp covered in sandpaper, there will be **more friction** to slow it down. If you roll a marble down a **soft** surface, like a ramp covered with a soft cloth, the marble will also slow down. How can **you** design your marble ride so it is as **slow** as possible?

Engineer Challenge: Make a vehicle that travels on air!

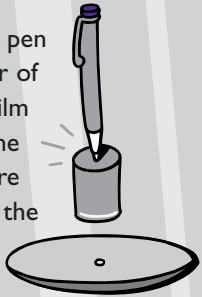
Hovercraft

What You Need

- ballpoint pen
- large plastic plate
- film canister
- large round balloon
- poster putty (sold in office supply stores)



This is one way to design it. Use the pen to **poke** a small **hole** in the center of the plate and the **bottom** of the film canister. **Put** poster putty around the **bottom** of the film canister. Be sure you don't cover the hole! **Line up** the **holes** and **stick** the film canister to the **middle** of the plate.



Blow up the balloon, **twist** the end, and **pinch** it shut. Have a friend **hold** the neck of the balloon while you **stretch** the end over the film canister. **Place** your hovercraft on a smooth surface. **Let go** of the balloon and gently **tap** the side of the plate. **What happens?**

Sent in by Dene D. of Woodbridge, VA

Photo courtesy of amphibioussmarine.com

Now try to **improve** this hovercraft design. How does the size of the balloon affect how far your hovercraft can travel? How can you **steer** the hovercraft with a piece of string? Choose **one thing** to change, like the size of the plate or the hole in the film canister. Then **make changes** and **test** your new design. **Draw** a picture of your design and **send** it to ZOOM at **pbskids.org/zoom**.

ZOOM sci™

Build more things that move, like **Balloon Car** or **Spool Racer**, at **pbskids.org/zoom**.

Science Scoop

Put a **plate** on a table and **gently tap** the side of the plate. It doesn't move very far, does it? That's because of **friction** between the plate and the table. Friction is a **dragging force** that happens when objects slide against each other. Why does your hovercraft **glide** more easily? Because it's **resting** on a cushion of air! When you let go of the balloon, the air flows under the plate. The **layer of air** under the plate keeps the plate and table from rubbing together. That's why there is **less friction** than when a plain plate slides on the table.