

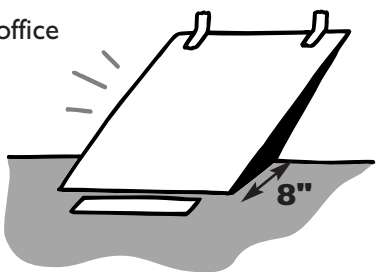
Marble Ride



Make a roller coaster ride for a marble that lasts a l-o-o-o-n-g time!

Get Ready

- Prepare a workspace on the floor near a wall for each team. Put strips of masking tape on the floor 8 inches from the wall. Teams can put the bottom of their cardboard or foam core on a tape strip and lean it against the wall. This way all the boards will be at the same angle. Have teams use masking tape to attach the cardboard or foam core to the wall so it doesn't move.
- You can purchase foam core from an office supply store.
- You will need a stopwatch to time each group's project.
- Collect activity materials. For each kid, make a copy of the Marble Ride activity sheet and the Stay Tuned message (see end of section).
- Post the new ClubZOOM Board activities (see end of section).
- **Note:** There is no ClubZOOM video segment for this activity.



What You Need Design & Build (per team)

- cardboard or foam core (about 20" x 30")
- marble
- masking tape
- materials to build ramps (construction paper, oak tag, empty toilet paper tubes, paper towel tubes, etc.)
- materials to increase friction (sandpaper, yarn, cloth, cotton balls, sponge, corrugated liners from cookie packages, etc.)
- ruler
- Marble Ride activity sheets

Redesign (for the group)

- more masking tape
- more materials to build ramps
- more materials to increase friction

Time
 2 hours



(Note: This activity can be spread over 2 meetings.)

Engineering Scoop

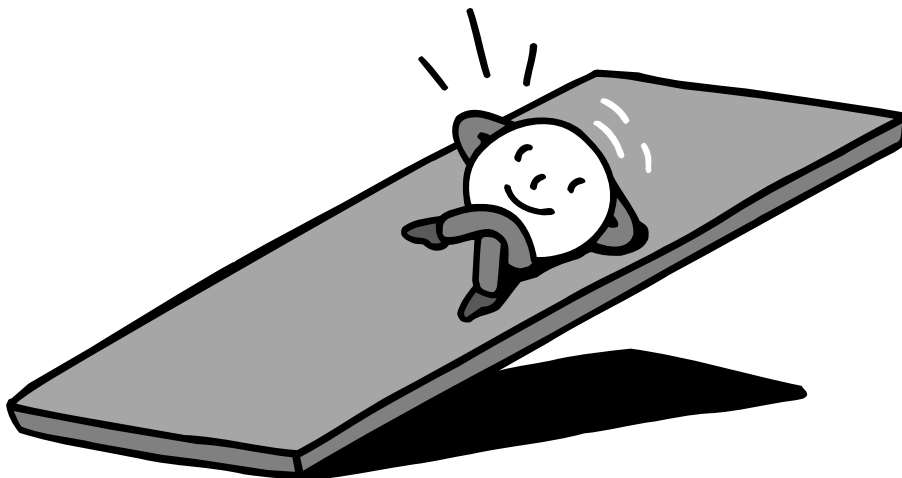
Try This First

Take a look at the materials you've collected. Brainstorm some ways you can use the materials to build the longest-lasting marble ride. How can you use the materials to build different types of ramps? How can you build jumps, bumps, twists, and turns? Which materials can you use to increase friction?

The Scoop

The most basic marble ride is made up of a series of ramps. (Go a little wild and you can have loops, jumps, twists, and chutes.) Two of the things that affect the speed of a marble are the angle of the ramps and friction. By changing the angle of the ramps, you can change the marble's speed. The steeper the angle of the downward ramps, the more the marble will speed up; the less steep the downward ramps, the less the marble will speed up.

As the marble moves down a ramp, there is friction between the surface of the marble and the surface of the ramp. Friction is a dragging force that happens when objects roll or slide against each other. The strength of the force of friction depends in part on the types of surfaces involved. Rough surfaces produce more friction than smooth surfaces. So if you roll a marble across a smooth surface, like a ramp covered in aluminum foil, there is little friction to slow it down. If you roll a marble across a rough surface, like a ramp covered in sandpaper, there is more friction to slow it down.



Find Out More Books



The Fantastical Engineer: A Thrillseeker's Guide to Careers in Theme Park Engineering

Baines, Celeste. Ruston, LA: Bonamy Publishing, 2000. Meet the engineers who design amusement parks, aquariums, theme parks, and other fun places.

Objects in Motion

Fleisher, Paul. Minneapolis, MN: Lerner Publications Co., 2002. Turn to page 24 to learn some of the science behind Marble Ride, including why a ball speeds up as it rolls down a ramp.



Web Sites

Amusement Park Physics:
Roller Coaster
www.learner.org/exhibits/parkphysics/coaster.html

Test out your abilities as a roller coaster designer in this activity, and learn the physics behind the fun.

Roller Coaster
www.discoverengineering.org/eweek/cool_things/roller_coaster/splash.htm

Hold on tight! Check out the video footage of roller coasters in action and read about the different types of engineers who design them.

Run the Meeting

1 Get Started (5–10 minutes)

Welcome kids and ask for a volunteer to share the Stay Tuned coded message. (*Answer: How slow can you go?*) Then read the Challenge Letter together.

Ask kids if they have ever been on a roller coaster. Tell kids that they are going to make an amusement park ride for a marble. The goal is to have the ride last as long as possible. To do this, they have to make the marble go as slowly as possible. Hold up a sample ramp (a construction-paper tube). Ask kids at what angle you should hold the ramp so that the marble rolls slowly.

Now talk with kids about another way to slow down the marble—by increasing friction. Ask them if they have ever tried to ride a bike over a rough surface, like grass or gravel. How does this compare to riding over a smooth surface, like pavement? Suggest that they slow their marble in a similar way—by adding rough, textured materials, such as sandpaper, to increase friction. Brainstorm other ways to slow the marble as it moves on the ride (such as speed bumps or making the marble travel up hill).

2 Design (20–30 minutes)

Organize teams of 2 to 3 kids and distribute the activity materials. Let the building begin! As the kids build, ask:

- *How will you angle the ramp so the marble moves slowly but doesn't stop?*
- *What materials can you add to the ramp to make the marble travel more slowly?*
- *What other parts can you build to slow down the marble?*

Activity Tips

- Distribute materials to each team but also keep some extras in reserve in case teams run out.
- Encourage kids to test the track often to make sure the marble doesn't get stuck in certain places.
- Make sure the adult leader uses the stopwatch and drops the marble for consistent results.
- Some teams might race through the project and finish in one meeting. Have them lean their board at a higher angle against the wall and then redesign their marble ride.
- Marble rides can be fragile, so store the projects carefully between meetings to avoid bending or crushing them.

3 Test (15 minutes)

Have the teams stop working to time their marble rides. Let kids know that it's okay if they are not finished. They will have more time to continue building. Have the whole group watch each marble ride. It is best if you, the leader, both release the marble and run the stopwatch so the timing will be more accurate. Time three trials for each ride. Have each team record their times on the back of their handouts and find their average time. Talk about the designs by asking:

- Are there any places where your marble gets stuck or falls off? How could you fix these areas?
- What could you add to slow down the marble?
- What's similar about some of the rides that last the longest?
- Why is it important to test each ride three times and find the average?



Stop here if you are dividing this activity into two meetings. Ask kids to write their names on their marble rides. Then store the projects in a safe place.

4 Redesign (25–30 minutes)

Challenge the teams to make changes to their rides so that it takes a longer amount of time for the marble to complete the ride. Remind kids that the goal is for each team to improve the time of their own ride, not to beat the times of other teams!

5 Share Results (10–15 minutes)

Have the group visit each marble ride again for a final test. Use a stopwatch to time the designs. Run three trials and find the average time for each ride. Then talk about the final marble ride designs by asking:

- What changes did you make to your final design? Why?
- How does your final time compare to your first time?
- If you could start over, how would you design your ride differently?

Connect the activity to engineering by talking about the design of real roller coasters and racetracks. You can use the “Engineering the Future” bulletin board posting to talk about designing safety features.

6 Wrap Up (5 minutes)

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



ZOOM Links

Try these related activities on the ZOOM Web site.

Balls and Ramp

pbskids.org/zoom/sci/ballsandramp.html

Use the law of gravity to tell time.

Roller Coaster

pbskids.org/zoom/sci/rollercoaster.html

Make a marble loop-the-loop on a track that you design.



Challenge

Dear ClubZOOM Engineers,

How's your afternoon going? I'm R. U. Havinfun, president and founder of Loads of Laughs Amusement Parks.

Let me get right to the point. Ticket sales are down. People say our rides are fun but they are over too quickly. We need a new ride...one that lasts a l-o-o-o-o-n-g time, so people feel that they are getting their money's worth.

Whenever we create a new ride, we start by making a model. Building a model allows us to make sure that the ride is safe before we put people on it. We would like you to design a model of the new ride. Instead of passengers, you'll use a marble!

Cheers,

R. U. Havinfun

R. U. Havinfun
President and Founder
Loads of Laughs Amusement Parks



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Marble Ride

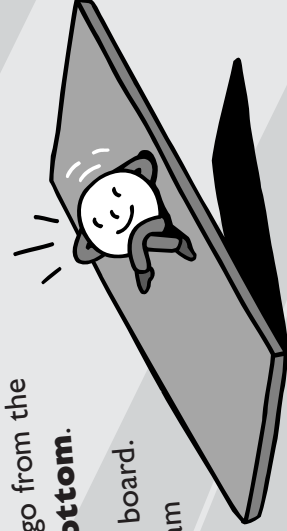
What You Need

- large piece of cardboard or foam core (about 20" x 30" inches)
- ruler
- masking tape
- building materials (things like construction paper, paper towel tubes, sandpaper, yarn, cloth, cotton balls, sponge, clay)
- marble



Engineering 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 ramps, the **more** the marble will speed up. The **less steep** the ramps, the **less** the marble will speed up. As the marble moves down a ramp, there is **friction** between the marble and the ramp. Friction is a **dragging force** that happens when objects **roll or slide** against each other. **Rough** surfaces produce more friction than **smooth** surfaces. 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. How did **you** design your marble ride so it was as **slow** as possible?



1 Design a **roller coaster ride** for a marble.

The goal is to have your marble go **slow**, so it takes as long as possible to go from the **top** of the board to the **bottom**.

2 First **set up** a marble ride board.

Lean the cardboard or foam core against a wall.

Make sure the bottom is **8 inches** from the wall.

3 **Plan** your design. What can you do to **slow** down the marble?

4 Start **building!**

5 Each time you **add** a new part to your Marble Ride,

test it with your marble.

6 When you're ready, **time** how long it takes your marble to go from start to finish.

Redesign It!

Make **changes** to your Marble Ride so it lasts longer. What other materials can you add to

slow down the marble? What changes can you make to **increase friction**? Choose **one thing** to change (that's the variable) and make a **prediction**. Then

test it and **send** your results to ZOOM.

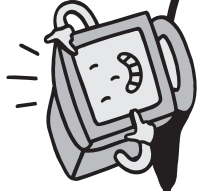
Sent in by Jenny, Anna, Erin, Becky, Jessica, and Jackie of Page, AZ



Marble Ride

Here's my marble ride.

(Draw your design and label the parts.)



Send It to ZOOM™!

Tell us about your design at
pbskids.org/zoom/sendit

1st Design

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

.....> (Add each time together. Then divide the sum by 3.)

2nd Design

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

.....> (Add each time together. Then divide the sum by 3.)

Meet an Engineer



Sean Stang-Osborne

Imagine this. You're about to brush your teeth, you turn on the faucet . . . no water. What's going on? That's a question to ask environmental engineer Sean Stang-Osborne. Sean's job is to make sure towns and cities get the water they need for drinking, cleaning, and even fighting fires. If water doesn't flow, he figures out why. Sometimes it's because the main water pipe is clogged. Sean opens fire hydrants and tests the water flow. If it's too slow, there's a clog. Sean loves his work because he gets to spend a lot of time outdoors.



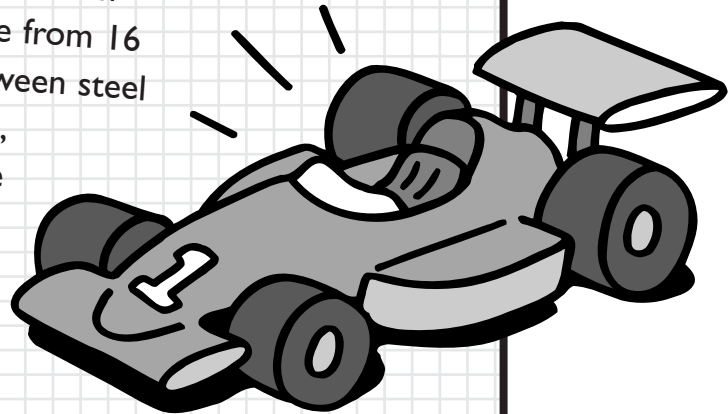
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Engineering the Future

The Indianapolis 500 Race is the exact opposite of your marble ride. Instead of moving slowly, drivers race their cars as fast as they can. But if a car crashes at a high speed, you can have a real problem. So a team of engineers designed special walls for the racetrack. Near each turn they built **“soft” walls** made from 16 inches of foam sandwiched between steel beams. If cars run into the walls, the foam cushions them and the drivers are less likely to hurt themselves. Keeping people safe is a real engineering challenge. **Become an engineer** and design safety systems of the future!



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Hinky Pinky

Sent in by Reb ekah S. of Hagerstown, MD

To play Hinky Pinky, you think of a pair of rhyming words to answer a question. Your answer must have the right number of syllables. A hink pink is a pair of one-syllable words that rhyme. A hinky pinky is a pair of two-syllable words that rhyme.

EXAMPLE

What is a hink pink for unusual cub?
A rare bear!

The words "rare" and "bear" rhyme, and each word has one syllable.

Can you solve these?

- 1 What is a hink pink for **kind rodents**?
- 2 What is a hink pink for a **bashful insect**?
- 3 What is a hink pink for a **phony reptile**?
- 4 What is a hinky pinky for a **happy fruit**?
- 5 What is a hinky pinky for a **small violin**?
- 6 What is a hinky pinky for a **reptile snowstorm**?

Ready to check your answer?
Look inside!

The Ultimate Challenge

Can you come up with a hinky pinkety?
(That's a pair of three-syllable words that rhyme.)
Send your best one to ZOOM at
pbskids.org/zoom/sendit

- 1 kind rodents = nice mice
- 2 bashful insect = shy fly
- 3 phony reptile = fake snake
- 4 happy fruit = merry cherry
- 5 small violin = little fiddle
- 6 reptile snowstorm = lizard bizzard

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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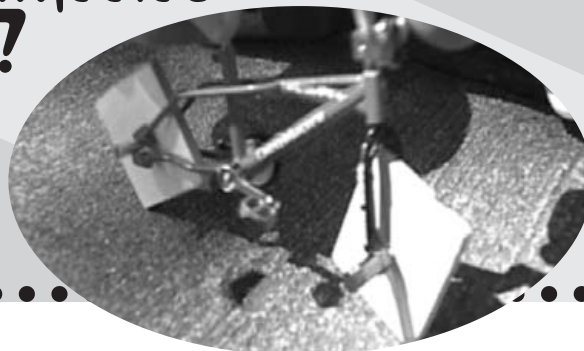
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How

do you ride
a square-wheeled
bike?



Mind Blaster

...brought to you by



- a) Put it on a steep hill. Gravity will help.
- b) Build a bumpy road to ride it on.
- c) Pedal as fast as you can to get momentum.

Ready to check
your answer?
Look inside!

DragonflyTV is a show about real kids doing real science. Visit the DragonflyTV Web site at pbskids.org/dragonflytv to find out when the show is on in your area and explore more science.



Major funding for DragonflyTV is provided by Best Buy Children's Foundation and the National Science Foundation. 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.



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ANSWER

Gravity will not help the square to roll forward, and no matter how **fast you peddle** you won't be able to build momentum if you can't move forward.

So the answer is B—you build a bumpy road to ride a square-wheeled bike!






The secret isn't in the wheels, it's in the ROAD! Professors at Macalester College in St. Paul, Minnesota, actually built a road featuring "bumps" that were an exact fit for the square wheels. As the rider pedals forward, the wheels pass smoothly over the bumps, so the rider doesn't bounce up and down. Call him a square if you will, but this rider will eventually get to where he wants to go!





Stay Tuned

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

To read the message, you'll need to learn the **Pattern Code**. Here's how it works. Match each symbol with the box that looks like it. The first symbol looks like this:  It looks the same as the box the "U" is sitting in, so the first letter is "U". Here are some more examples: A= B= L= W= See if you can solve the rest of the code.

A	B	C
D	E	F
G	H	I

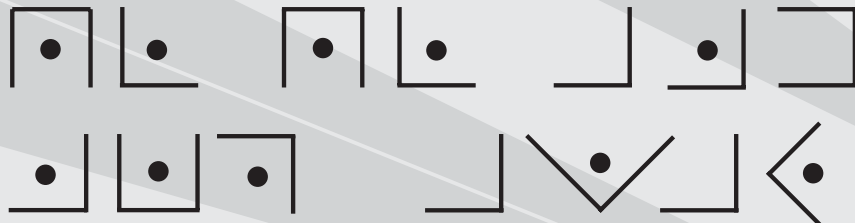
	J	
K		L
	M	

•N	•O	•P
•Q	•R	•S
•T	•U	•V

	•W	
•X		•Y
	•Z	



Secret Message



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