

Drops on a Penny

Overview

Science Concept	Try It Out	ZOOMon: Change One Variable	Share Results
Surface tension	Test how many drops of water fit on a penny.	<ul style="list-style-type: none"> • Type of coin • Whether or not you add soap 	<ul style="list-style-type: none"> • How many drops fit on the penny? Did your results change when you repeated the test? • What makes the drops stick together? • Why did different numbers of drops fit on different coins?

Science Scoop

When you put water drops on a penny, the drops pile up into a dome because of **surface tension**. Surface tension is produced by the force of attraction between water molecules. Within the liquid, each water molecule is attracted to its neighboring molecules, making them “stick” together. The water molecules at the top, however, “stick” only to the water molecules next to and below them. That’s because there are none above them. This unbalanced attractive force causes the water to act as if it had a thin “skin” on the surface. (Have you ever seen a bug sitting on top of a puddle? It is this skin-like quality produced by surface tension that allows small insects to rest on the water’s surface.) As you add more drops, the force of gravity becomes stronger than the force of attraction among the water molecules at the surface. This causes the water to spill over the edge of the coin.



The **type of coin** affects the number of water drops it can hold. Because a large coin has more surface area than a small coin, the large coin holds more drops. A coin with lots of detail also has more surface area and holds more drops than a smoother coin.

When you **add soap** to the water, you reduce the surface tension. As a result, a smaller number of soapy water drops will fit on a coin before the water spills over.

Set Up

- Watch the Drops on a Penny video segment, and try the activity yourself before the meeting.
- Post the new ClubZOOM Board activities (see end of section).
- Set up a VCR and monitor to show the Drops on a Penny video segment (optional).
- Collect materials for the ClubZOOM Box. For each kid, make copies of the Drops on a Penny handout and the Stay Tuned (see end of section).



Materials		
<p>For Each ClubZOOMer</p> <ul style="list-style-type: none"> • penny • eyedropper • cup of water • Drops on a Penny handout (see end of section) • Stay Tuned (see end of section) 	<p>To Share</p> <ul style="list-style-type: none"> • newspaper • other coins, like nickels, dimes, and quarters • liquid dish soap • ZOOM Challenge (see end of section) 	<p>For Water Dome and Pepper Demonstrations</p> <ul style="list-style-type: none"> • 2 paper cups filled with water • plate or bowl • pepper • liquid dish soap
<p>Have extra materials available so the kids can test different variables.</p>		



Find Out More

A Drop of Water: A Book of Science and Wonder

Wick, Walter. New York: Scholastic Press, 1997.

Full-page photographs capture a drop of water as it forms, falls, and splashes. The text and experiments introduce eight- to twelve-year-olds to surface tension and other properties of water.

Lee Marek's Weird Science: Soakin' Science

Marek, Lee and Lynn Brunelle. Toronto, Ontario, Canada: Somerville House, 1999.

This book and kit combination teaches water science through a series of experiments.

Ask a Scientist

newton.dep.anl.gov/askasci/gen99/gen99414.htm

In response to a question from a ten-year-old girl, a scientist offers an explanation of surface tension.

Water Properties

uni.edu/~iowawet/H2OProperties.html

Watch a virtual experiment with a floating paper clip, read about how surface tension works, and explore other properties of water.



Run the Meeting

1 Kick Off the Meeting (5 minutes)

Welcome the kids and ask for a volunteer to decipher the Stay Tuned. (Answer: Stick water to a penny.) Then have another volunteer read the ZOOM Challenge.

2 Try It Out (25 minutes)

◆ Introduce surface tension with these quick demonstrations:

Water Dome

Fill a cup to the rim with water. Then ask kids to predict how many drops of water you can add before the water spills over. Place the cup on a plate or in a bowl to catch the water. Start adding drops one at a time. (It takes about a minute before the water spills over, but this helps build suspense.) Ask the kids for their ideas about why the water doesn't spill over immediately. Then introduce surface tension and explain how it helps the drops form a dome.

Pepper Demonstration

Now demonstrate what happens when you reduce surface tension. Fill a bowl or cup with water and sprinkle pepper on the surface. Ask a volunteer with clean hands to touch the water lightly with a fingertip. (The pepper stays in place.) Put a small drop of liquid soap on the volunteer's fingertip and ask him or her to touch the surface again. (Pepper shoots out to the sides.)

Ask kids why they think the pepper moves. Remind them that water molecules "stick" together. Explain that when you touch the water's surface with soap, you reduce the surface tension at that spot. Since the surface tension in the rest of the water is stronger than at the soapy spot, water molecules elsewhere in the cup or bowl pull water molecules away from the soapy spot. And, if there's something resting on the water molecules like pepper, it goes along for the ride, too!

Activity Tips



- Remind the kids to keep the coins flat and to avoid bumping the table as they add water drops.
- Younger kids might have difficulty using the eyedroppers and may need assistance.
- Have kids cover their work surface with newspaper to soak up any spilled water.
- Create a large data chart for the kids to record and compare their data. Write down the number of drops for each kid and find the group average. See sample chart below.

Sample Data Chart

Student Name	Average Number of Drops on a Penny
Group Total	
Group Average	

Drops on a Penny

- ◆ Now have the kids explore surface tension for themselves. Distribute the activity materials and assist the kids as they add water drops onto their pennies.
- ◆ Since each test will produce slightly different results, have the kids repeat the experiment three times. Then have them find an average by adding each test result and dividing by three.

3 ZOOMon (10 minutes)

Have the kids experiment by finding out how many drops of water fit on different coins, like nickels, dimes, or quarters. Ask them to make predictions based on what they learned from the number of drops that fit on a penny.

4 Share Results (10 minutes)

Have the kids draw conclusions about their Drops on a Penny results.

- **How many drops fit on a penny before the water spilled over?**
- **Did your results change when you repeated the test? Why?**
(Possible reasons: the table moved, there were air bubbles in the drops, the size of the drops varied.)
- **How many drops fit on other coins? How did you use what you knew about pennies to make predictions for different coins?**
- **Why might some coins hold more water drops than others?**

Have the kids write or draw their results on the back of their activity handouts. If they have difficulty, use the questions above to guide them. Then have kids post their results on the ClubZOOM Board.

Send It to ZOOM!

Remind the kids to send their results and ideas about **Drops on a Penny** to ZOOM. They can do this by mailing their activity handouts to ZOOM or by visiting the ZOOM Web site at pbskids.org/zoom/sendit/sci-exp.html

**5 Wrap Up** (5 minutes)

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

**ZOOM Links**

Visit the ZOOMWeb site and continue exploring **surface tension**:

Drops on a Penny

pbskids.org/zoom/sci/dropsonpennies.html

Visit the online version of Drops on a Penny to see the results posted by other kids.

Pepper

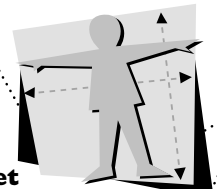
pbskids.org/zoom/phenom/saltnpepper.html

Scatter floating pepper with a drop of soap.

Soap Powered Boat

pbskids.org/zoom/phenom/soapboat.html

Make a paper boat move by reducing the surface tension.

**Don't Forget Square or Rectangle!**

Remind the kids to keep collecting data to add to the Data Chart. Have they measured their **friends from school or from their neighborhood?**



Challenge

Dear ClubZOOMers,

Dan H. of Boston, Massachusetts, wants to know
your answer to this question:

“How many **drops** of water can you fit on top
of a **penny?**” Ten? One hundred? One million?

Make a **guess** and give it a **try!**

pbskids.org/zoom



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Drops on a Penny

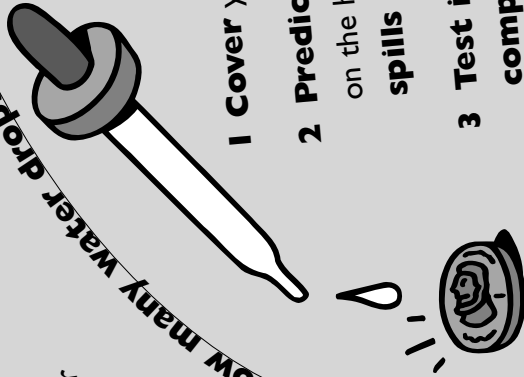
- What You Need:**
- penny
 - eyedropper
 - cup of water
 - newspaper



Science Scoop

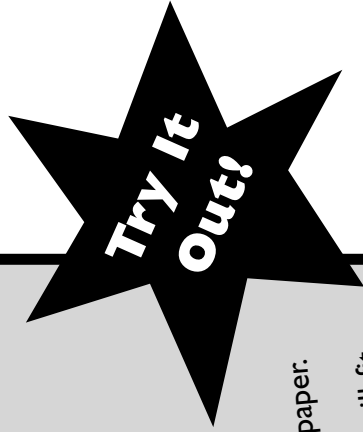
When you place water drops on a penny, the drops pile up into a small **dome**. Why? Water molecules are **attracted** to each other in all directions, making them “**stick**” together. However, the molecules at the surface “stick” only to molecules **next to** and **below** them. That’s because there are none above them. This makes the surface act as if it had a thin “**skin**.” This is called **surface tension**. As you add more drops, the force of gravity becomes stronger than the force of attraction among the water molecules at the surface. This causes the water to **spill** over the edge of the coin.

How many water drops can you fit on a penny?



- 1 Cover** your work surface with newspaper.
- 2 Predict** how many drops of water will fit on the head of a penny before the water **spills** over.
- 3 Test it!** Count the number of drops and **compare** it to your prediction.
- 4 Try it again!** Repeat the test **three times**. Do you get about the same number of drops each time?
- 5** If you get a different number for each test, find the **average** number of drops. Here’s how: **Add** your results from each test. Then **divide** by **three**.

Sent in by Dan H. of Boston, MA



Now it’s time for you to **experiment**. What happens if you use a **different coin**, like a nickel, a dime, or a quarter? Use what you know about a penny to predict how many drops will fit on a different coin. What happens if you mix **soap** with the water and then add the drops? Choose **one thing** to change (that’s the variable) and make a **prediction**. Then **test** it and send your results to ZOOM.

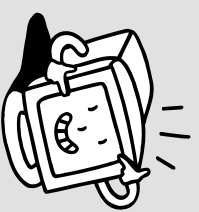


Send your ideas to ZOOM!

Dear ZOOM,

Here's what happened when I put drops of water on a coin:

	My Prediction	Test 1 Number of Drops	Test 2 Number of Drops	Test 3 Number of Drops	Total Number of Drops	Average Number of Drops
Penny						
Nickel						
Dime						
Quarter						



Send an e-mail:

pbskids.org/zoom/sendit

Then instantly print out a copy of ZOOMerang—a newsletter filled with cast trivia and lots of fun ZOOM activities.



Or, send a letter:

ZOOM
Box 350
Boston, MA 02134

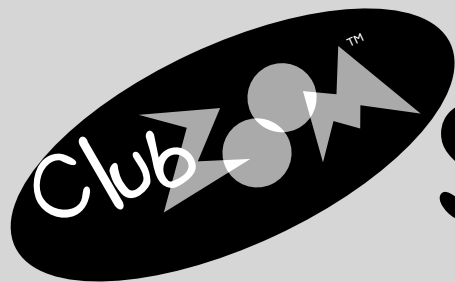
Don't forget to include your name and return address so we can send you a copy of ZOOMerang.

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Stay Tuned

At the next meeting,
you'll be challenged to:

12-51-24-32-14 11 45-35-53-15-43 21-43-35-33 41-11-41-15-43



Crack the Code

Read the message by learning the **Checkerboard Code**.

Here's how it works:

The letters of the alphabet are written in a grid that has five rows and five columns. Each letter in the message is replaced with a pair of numbers. The first number stands for the row number. The second number stands for the column number. So, an "A" is represented by 11, and a "B" is represented by 12. Here's how "SEND IT TO ZOOM" looks in Checkerboard Code:

44-15-34-14 24-45 45-35 55-35-35-33

To read the message in Checkerboard Code, find the letter in the checkerboard that matches each pair of numbers in the message.

	1	2	3	4	5	
1	A	B	C	D	E	44=S
2	F	G	H	I	J	15=E
3	K	L	M	N	O	34=N
4	P	Q	R	S	T	14=D
5	U	V	W	X	Y/Z	

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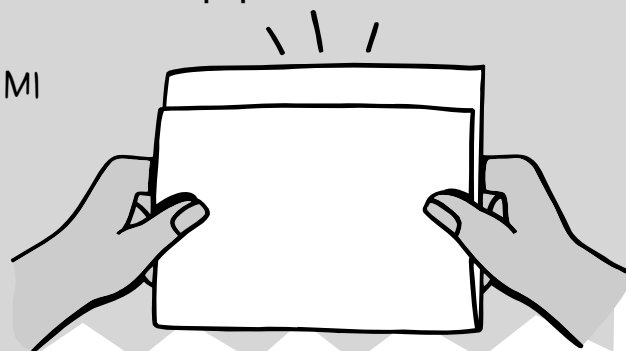
Folding Paper

Try to **fold** a sheet of paper in half **more than 8 times**.

Fold it in the **same direction** each time.

You can use any **size** and **kind** of paper.

Sent in by Paul M. of Albion, MI



Eight Finger Shoe Tie

Try **tying** your shoes without using your **thumbs**.



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Chris O. of Jacksonville, Florida, is a member of the ZOOMteam. He volunteered with Habitat for Humanity, an organization that **builds houses for families in need.** Chris gave drinks to other volunteers, helped out in a landscaping project, and built a bench. Thanks to Chris and other volunteers like him, a family got a home of its own.



pbskids.org/zoom



Join the ZOOMteam!



Visit the ZOOM Web site for ideas on how you can volunteer. Then tell us what you did, and we'll send you a **free** ZOOM Into Action wristband and iron-on T-shirt decal.

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funny™



What did the tie say to the hat?

Ha-Ha-Ha-Ha-Ha!

You go on ahead and I'll hang around!



Hee-Hee-Hee-Hee

Sent in by David A. of New York

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