

Water Drops on a Penny



Introduction

Why do water droplets bead when dropped on a waxy surface? Why can some insects walk on water? These observations can be attributed to the high surface tension of water. Surface tension is the result of attractive forces between molecules. Water's large contribution to life on Earth depends on its unique properties. Without it, life on Earth would be impossible.

Concepts

- Cohesion
- Surface tension
- Polarity
- Surfactants

Materials

Beaker, 50-mL	Pipets, disposable, 2
Dish soap, liquid	Water, tap
Paper towels	
Pennies, 2	

Safety Precautions

Although this activity is considered nonhazardous, please follow all laboratory safety guidelines. Wash hands thoroughly with soap and water before leaving the laboratory.

Procedure

Part A.

1. Rinse a penny in tap water. Dry thoroughly with a paper towel.
2. Place the penny on a fresh paper towel.
3. Fill a beaker with 25 mL of tap water.
4. Using a pipet, slowly drop individual droplets of water onto the surface of the penny.
5. Count each drop until the water begins to spill over the sides of the penny. Record your observations in a data table.
Note: Watch the penny from above rather than from the side while making observations.
6. Repeat steps 1–5 for a total of 3 trials. Thoroughly dry the penny between each trial.

Part B.

1. Rinse a new penny in tap water. Dry thoroughly with a paper towel.
2. Place the penny on a fresh paper towel.
3. Fill a beaker with 25 mL of tap water. Add 2 drops of liquid dish soap to the beaker and stir.
4. Using a fresh pipet, slowly drop individual droplets of soapy water onto the surface of the penny, as done in Part A.
5. Count each drop until the water begins to spill over the sides of the penny. Record your observations in the data table.
Note: Watch the penny from above rather than from the side while making observations. Stir soap solution between each trial.
6. Repeat steps 1–5 for a total of 3 trials. Rinse the penny in water and dry thoroughly between each trial.
7. Average the number of drops the penny holds for Part A and Part B.

Disposal

Please consult your current *Flinn Scientific Catalog/Reference Manual* for general guidelines and specific procedures, and review all federal, state and local regulations that may apply, before proceeding. Rinse pennies with water and dry completely. Used pipets can be thrown into the regular trash according to Flinn Suggestion Disposal Method #26a.

NGSS Alignment

This laboratory activity relates to the following Next Generation Science Standards (2013):

Disciplinary Core Ideas: Middle School

MS-PS1 Matter and Its Interactions

PS1.A: Structure and Properties of Matter

Disciplinary Core Ideas: High School

HS-PS1 Matter and Its Interactions

PS1.A: Structure and Properties of Matter

Science and Engineering Practices

Developing and using models

Asking questions and defining problems

Constructing explanations and designing solutions

Crosscutting

Concepts

Cause and effect

Stability and change

Structure and function

Tips

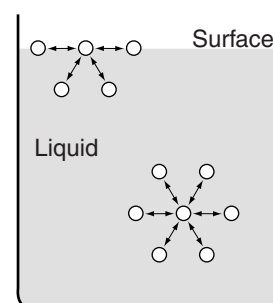
- This activity can be completed as a teacher demonstration or a student lab experiment. Before performing it as a demonstration, ask students how many droplets they think the penny will hold. Will adding soap to the water allow more or fewer drops to be added to the penny?
- As an extension, students can also experiment with additional liquids. Some possibilities are vegetable oil, weak alcohol solutions and milk. Students can also experiment with various brands of dish soaps, as some will affect surface tension more readily than others.
- For an exciting way to introduce the concept of surface tension, use the *Surface Tension Jar—Demonstration Kit* available from Flinn Scientific (Catalog No. [AP6648](#)).

Discussion

Water has many unique properties. These various properties—such as freezing and boiling point, cohesion and surface tension—are a product of the high polarity of water molecules. Because water is polar, having a negative oxygen end and a positive hydrogen end, water molecules are very cohesive. *Cohesion* is the intermolecular forces felt between similar molecules. The boiling point of various liquids reflect the ability of molecules to break these cohesive forces between them and change to a vaporous state. Many liquids have low boiling points and are considered to be volatile, meaning they evaporate readily from an open container. Water's high boiling point is due to the strong cohesive forces, which are more difficult to break.

Surface tension is due to uneven cohesive forces of the molecules at the surface of the liquid compared to those in the rest of the liquid (see Figure 1). The molecules below the surface of the liquid exert balanced forces on one another in all directions. However, the molecules at the surface do not have any attractive forces above them. This leads to the molecules drawing inward toward the liquid below. The result of this is *surface tension*—a net attractive force that tends to pull adjacent surface molecules inward, thus decreasing the surface area to the smallest possible size. The high surface tension of water results in a layer or film that is difficult for objects to pass through or break.

Soaps or detergents are known as surfactants. A *surfactant* is a compound that reduces the surface tension of the liquid in which it is dissolved. Soap works by disrupting the cohesive forces between molecules. When plain water is dropped on a penny, water molecules strongly attract one another and the resulting surface tension is high. This is observed by the bubble-like shape formed by the water as more drops are added to the penny's surface. On the other hand, adding soap to the water interrupts the attraction between water molecules and greatly decreases the surface tension.



Sample Data Table

Liquid	Trial 1	Trial 2	Trial 3	Average
Water	32	25	39	32
Soapy water	13	17	16	15

References

Spangler, S. Drops on a Penny. www.stevespanglerscience.com/lab/experiments/penny-drops/ (accessed January 2016).

Materials for *Water Drops on a Penny* are available from Flinn Scientific, Inc.

Catalog No.	Description
AP6648	Surface Tension Jar—Demonstration Kit
AP1720	Beral Pipets, Extra-Large Bulb, 20/pkg
GP1005	Beakers, Borosilicate Glass, 50-mL

Consult the [Flinn Scientific website](http://www.flinnscientific.com) for current prices.