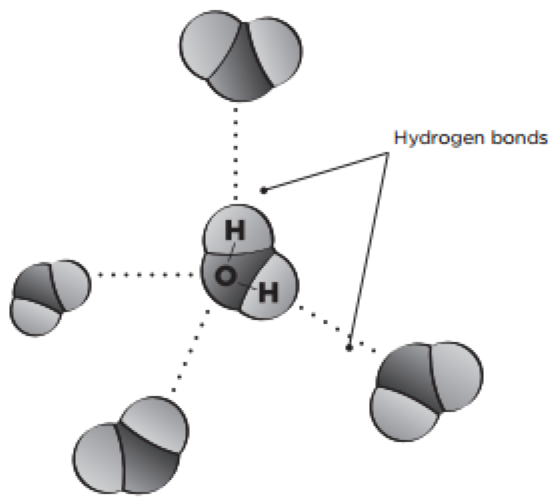
Drops on a Coin

All Resources

In this demonstration, students' assumptions are challenged as they observe the power of **surface tension** in water droplets.

Although a water molecule has an overall neutral charge, the actual structure of a water molecule makes it a **polar molecule** (it has a positive end and a negative end). The two hydrogen atoms are slightly positive, and the oxygen atom is slightly negative. A weak link occurs between the negatively charged oxygen atom of one water molecule and the positively charged hydrogen atoms of a neighbouring water molecule. This weak link is called a **hydrogen bond**. The polarity of the water molecule can also cause it to be attracted to molecules of other polar substances.



There are two types of "stickiness" in this demonstration: cohesion and adhesion.

The attraction between water molecules is called **cohesion**. The cohesive force that occurs between water molecules is so strong that, at the water's surface, it creates a "skin", which is known as **surface tension**. Surface tension is strong enough to support insects that crawl across the water's surface, like water striders (Gerridae).

The attraction of water molecules to other substances, like soil or glass, is called **adhesion**. As drops of water are added onto a penny, the adhesive force between the water and the penny keeps the water from falling off.

Cohesive forces are strong, but not unbreakable. As a water drop builds up and out, usually bulging over the sides of the penny, the cohesive forces will eventually be overcome by the force of gravity on the water molecules. The "skin" will burst, and all of the water will spill off.

The cohesive forces between polar molecules are stronger than those between non-polar molecules, such as those in oil or syrup. That's why you can make a bigger "pile" of water than of oil or syrup.

Objectives

Describe the cohesive and adhesive properties of water.

Materials

Per Student or Pair:
5 cent coin or penny
an eyedropper
water
mineral/baby/olive oil
corn syrup

Key Questions

- How many drops of water they think a coin can hold? Were your predictions correct?
- Does it matter if the coin is heads or tails?
- Will syrup/oil hold more or less drops than water? Why?
- How is it possible to get so many water drops on a coin?
- What causes the ‘skin’ on the surface of the big droplet?
- Would a 10 cent coin hold more or less drops? Why?
- **Teacher Tip:** Younger students may believe a 10 cent coin holds more because it is worth more despite being smaller.

What To Do

1. Place a coin on a table or desk.
2. Holding the eyedropper close to the surface of the coin, carefully squeeze water droplets onto the coin, one at a time. The droplets should pool up on the coin, creating a big droplet of water. Get the students to count the drops.
3. Stop squeezing when the droplet on the coin breaks up and overflows. The count is the number of drops that the coin could hold before the one that caused the coin to overflow.
4. Wipe off the coin or use a new one.
5. As before, gradually add drops of oil or syrup to the surface of the coin using the eyedropper. Get the students to count the drops.

Teacher Tip: To make sure your count is accurate, hold the eyedropper far enough above the coin so that the drop has to fall a short distance before fusing with the droplet on the coin.

Extensions

- Perform this as a student activity, rather than just a demo.
- Add a drop of soap/detergent to the water you use. It reduces the surface tension causing a dramatic reduction in the number of drops that will fit on the coin.
- Start with a full glass of plain water (with a dry rim to prevent the water from dripping down the side of the glass). How many coins can we add to the water without the glass overflowing?
- Gently add coins one by one. Because of surface tension, the water will rise above the rim of the glass before it spills (just like the initial experiment). Compare your original prediction with the number of coins you were able to add.