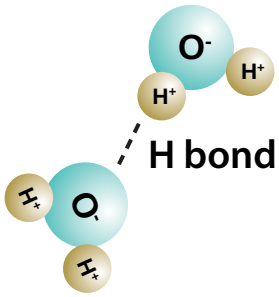
Roll or Slide?
Cohesion and Adhesion of Water

Hydrogen bonding between water molecules



The bonds that connect water molecules are special types of bonds called **hydrogen bonds**. These are weak bonds and connect water molecules in the liquid state.

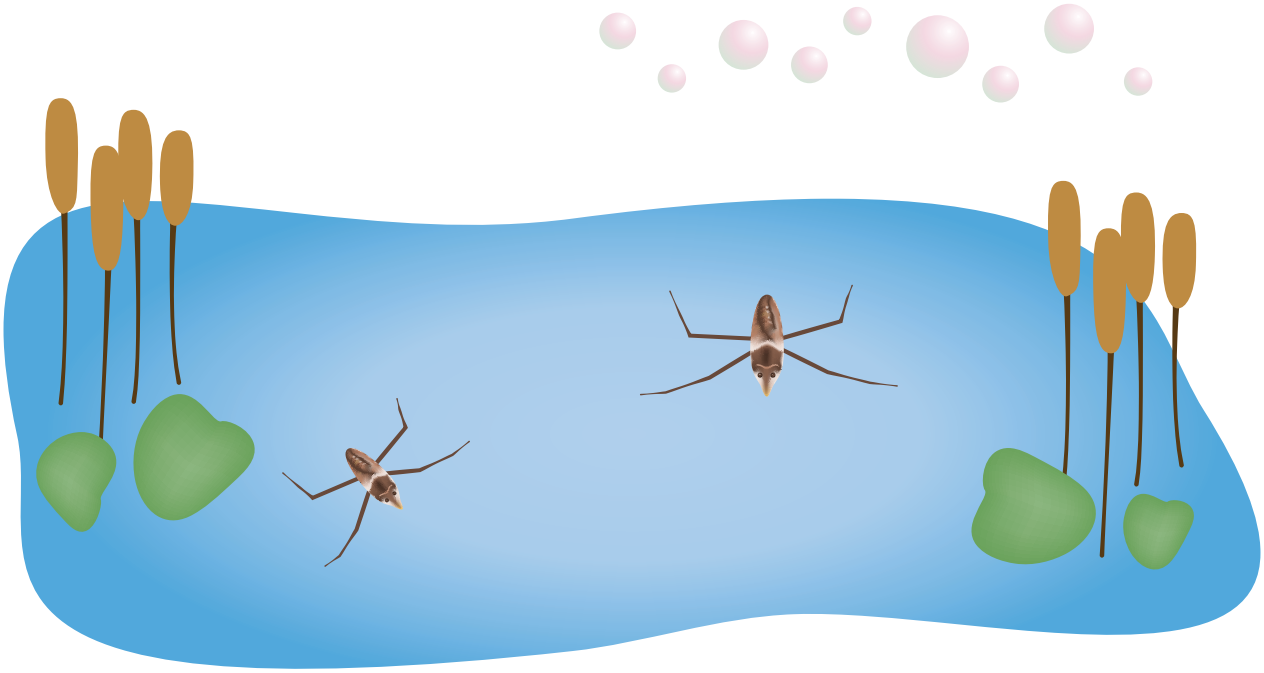
The hydrogen bonds between water molecules are the reason for two of water's unique properties: **cohesion** and **adhesion**. Cohesion refers to water molecules easily sticking to other water molecules. Adhesion refers to water molecules sticking to other things, which is why water forms a thin film and spreads out on surfaces such as glass.

When water comes into contact with surfaces such as glass or wax paper, the adhesive forces are stronger than the cohesive forces. Instead of the droplets sticking together in a ball or sphere, they spread out.

Water molecules in a glass of water are attracted to each other on all sides by cohesion. The molecules at the surface of the water in the glass are not exposed to other water molecules on all sides. They are exposed to air on the top. This causes them to form a stronger attraction to the water molecules on the sides of them and below them. Because of this stronger attraction, the surface of the water acts like a film. This film becomes somewhat visible when you fill a glass with water to the very top. This "film" is called surface tension.

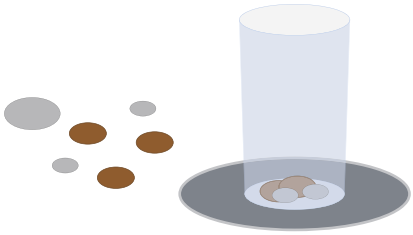
Some examples of surface tension are:

- Small insects whose mass is not great enough to penetrate the water surface will be able to walk on water.
- Soaps and detergents help to lower the surface tension of water while washing clothes, allowing the water to more readily soak into the pores of dirty areas.
- A carefully placed sewing needle can be made to float on the surface of water even though it is several times denser than water.
- The mixture of water and other ingredients in bubbles minimizes the tension between molecules, allowing them to be pulled into a spherical shape.



Try this!

Materials



- Glass of water
- Saucer
- A bunch of coins

1. Place the glass on the saucer.
2. Fill the glass of water all the way to the top. The water will form a slight dome over the top of the glass and not spill over.
3. Now, add one coin at a time to the glass, slowly slipping the coin in on the rim.

Guess how many coins you can add to the glass before the water starts to overflow!

What's the science behind it?

The glass was initially filled to the brim without the water spilling over. This is because the surface tension holds the water molecules together and prevents them from spilling down the side of the glass. As coins are added, the surface begins to bulge. Eventually, the coins push the water level too high for the surface tension to hold it in place and the water spills over.

How Many Drops of Water Can Fit on a Penny?

Now let's try something that interferes with the cohesion of water.

Materials

- A clean penny
- Paper towel
- Dropper
- Water
- Liquid soap
- Tweezers

Directions

1. Place a penny on a piece of paper towel.
2. Use the dropper to place one drop of water at a time on the penny.
3. Count the drops as you go along.
4. Stop adding drops when any water runs over the edge of the penny.
5. Repeat steps 1-4 three more times and fill in the number of drops on the chart.
6. Calculate the average when you are finished.

No Soap	Trial 1	Trial 2	Trial 3	Trial 4	Average

7. Using a pair of tweezers, dip the penny into the liquid soap.
8. Repeat steps 1-4 four times and fill in the number of drops on the chart. Dip the penny in liquid soap before beginning each trial.

Soap	Trial 1	Trial 2	Trial 3	Trial 4	Average

Questions

1. Compare the results from the trials with soap and without soap.

2. Explain your results in terms of cohesion and surface tension.

3. How does adding soap to a penny affect how many drops can fit on it?

Roll or Slide?

From this simple, one-step experiment, we'll see cohesion in action.

Materials

- Dropper
- Water
- Wax paper

Directions

1. Drop 4 drops of water on a piece of wax paper. Try to put one drop directly on top of another.

Questions

1. What happens to the droplets of water?

2. What shape do they take on?

3. Do they move across the wax paper?

4. Is this an example of cohesion or adhesion?

5. If you keep adding more drops of water, the sphere will eventually flatten out. What force causes the sphere to flatten out?