

Surface Tension

Cohesion and Surface Tension

Have you ever filled a glass of water to the very top and then slowly added a few more drops? Before it overflows, the water forms a dome-like shape above the rim of the glass. This dome-like shape forms due to the water molecules' cohesive properties, or their tendency to stick to one another. **Cohesion refers to the attraction of molecules for other molecules of the same kind**, and water molecules have strong cohesive forces thanks to their ability to form hydrogen bonds with one another.

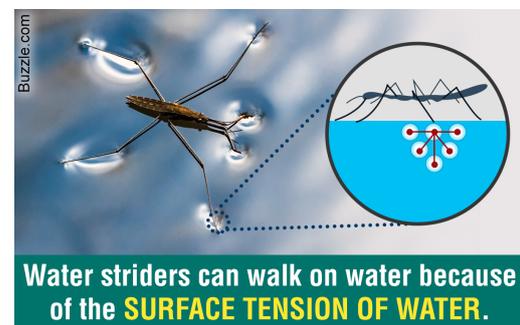
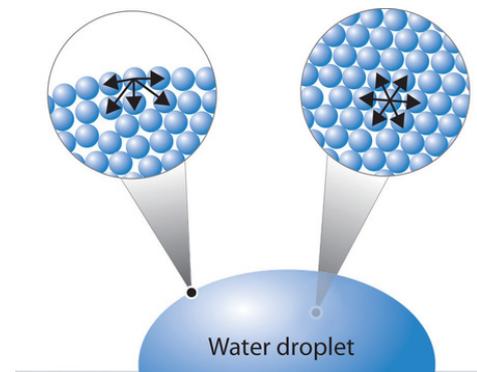
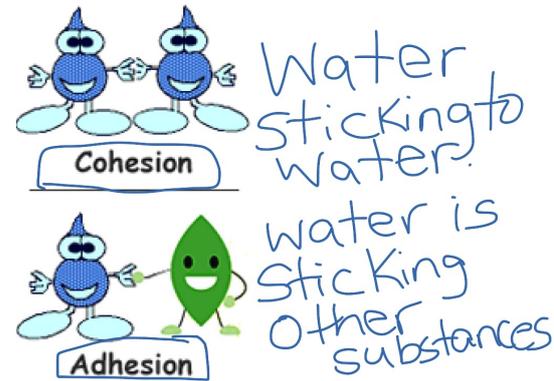
Cohesive forces are responsible for surface tension, the tendency of a liquid's surface to behave like an elastic sheet. Water molecules at the surface will form bonds with their neighbors, just like water molecules deeper within the liquid. However, because they are exposed to air on one side, they will have fewer neighboring water molecules to bond with, and will form stronger bonds with the neighbors they do have. Surface tension causes water to form spherical droplets and allows it to support small objects, like a scrap of paper or a needle, if they are placed carefully on its surface.

Adhesive forces

Water likes to stick to itself, but under certain circumstances, it actually prefers to stick to other types of molecules. **Adhesion is the attraction of molecules of one kind for molecules of a different kind**, and it can be quite strong for water. When pouring tea or water out of a container (especially when you do it slowly), the attraction between the surface of the container and the water molecules is stronger than that of the water molecules among themselves. That's why the liquid dribbles over and down the sides.

Why are cohesive and adhesive forces important for life?

They play a role in many water-based processes in biology, including the movement of water to the tops of trees and the drainage of tears from tear ducts in the corners of your eyes. A simple example of cohesion and surface tension in action comes from the water strider, an insect that relies on surface tension to stay afloat on the surface of water.

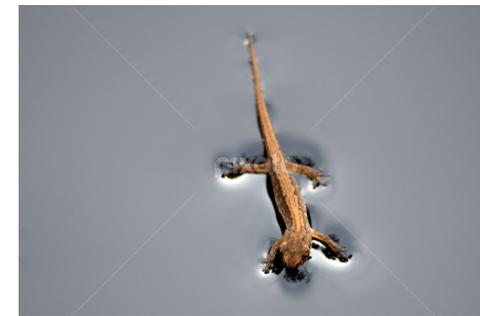


How do some Animals Walk on Water?

More than 1,200 animal species have evolved the ability to walk on water. Tiny creatures such as insects and spiders can do it, and larger ones such as some reptiles, birds and even mammals have also developed this talent.

The tiniest animals are gliders. Insects, such as water striders, and spiders, such as fisher spiders, can glide or scamper across the surface of water. These critters are small enough that their weight can be supported almost entirely by surface tension, the relatively weak forces that hold water molecules together. For these animals, gliding across the water is actually similar to how you might bounce on a trampoline. When tiny water-walking insects or spiders press against the water, their feet bend or deform the surface, but don't break through it. The surface then bounces back, propelling the tiny water-walker forward. Water striders are among of the very few species that spend nearly their entire lifecycle at the water's surface.

Larger animals are slappers. Surface tension forces are too weak to support the weight of a larger body. The basilisk lizard, water birds including the Western Grebe, and even some tail-walking dolphins must strike the surface with enough force and speed to keep their heavier bodies from going under. The basilisk lizard (shown on right), for instance, can dash at speeds of more than five feet per second by slapping the water with its hind feet.



Surface tension in everyday life

Soaps and detergents: These help the cleaning of clothes by lowering the surface tension of the water so that it more readily soaks into pores and soiled areas.

Washing with cold water: The major reason for using hot water for washing is that its surface tension is lower and it is a better wetting agent. But if the detergent lowers the surface tension, the heating may be unnecessary.

Why bubbles are round: The surface tension of water provides the necessary wall tension for the formation of bubbles with water. The tendency to minimize that wall tension pulls the bubbles into spherical shapes.

Surface Tension and Droplets: Surface tension is responsible for the shape of liquid droplets. Although easily deformed, droplets of water tend to be pulled into a spherical shape by the cohesive forces of the surface layer.



Fun fact

In his PhD project, Rahil studies oil droplets walking on oil's surface (look at the picture on the right). It turns out that these droplets behave very similar to atoms and electrons which make up everything that you can see around you!

