Hydrogen Bonds Make Water Sticky

Water has an amazing ability to adhere (stick) to itself and to other substances.

**Hydrogen Bonds**

Hydrogen bonds form when hydrogen atoms covalently bonded to nitrogen (N), oxygen (O), or fluorine (F) in the form of covalent compounds such as ammonia (NH3), water (H2O) and hydrogen fluoride gas (HF). In these molecules, the hydrogen atoms do not pull as strongly on the shared electrons as the N, O, or F atoms. Therefore, the molecules are polar; the hydrogen atoms become positively charged and are able to form hydrogen bonds to negative ions or negatively charged parts of other molecules (such as the N, O, and F atoms that become negatively charged in these compounds).

Hydrogen bonds are not true bonds like covalent bonds or ionic bonds. Hydrogen bonds are attractions of electrostatic force caused by the difference in charge between slightly positive hydrogen ions and other, slightly negative ions. These attractions are much weaker than true ionic or covalent bonds, but they are strong enough to result in some interesting properties.

In the case of water, hydrogen bonds form between neighboring hydrogen and oxygen atoms of adjacent water molecules. The attraction between individual water molecules creates a bond known as a hydrogen bond.

A molecule of water has two hydrogen atoms. Both of these atoms can form a hydrogen bond with oxygen atoms of different water molecules. Every water molecule can be hydrogen bonded with up to three other water molecules. However, because hydrogen bonds are weaker than covalent bonds, in liquid water they form, break, and reform easily. Thus, the exact number of hydrogen bonds formed per molecule varies.
Cohesion

Molecules of pure substances are attracted to themselves. This sticking together of like substances is called cohesion. Depending on how attracted molecules of the same substance are to one another, the substance will be more or less cohesive. Hydrogen bonds cause water to be exceptionally attracted to each other. Therefore, water is very cohesive.

We see evidence of water’s cohesiveness every day – in water drops and in streams of water. Our experience with water, however usually involves water touching something else or being acted upon by gravity. To really get a sense of water’s cohesiveness, scientists looked at the behavior of water in space. In space, water is able to form perfectly round spheres because the attraction of water to itself pulls the water into the shape with the least amount of surface area compared to the volume – a sphere.

Water drops in space. (A) European Space Agency astronaut Pedro Duque of Spain watches a water bubble float between him and the camera, showing his image refracted, on the International Space Station. (B) A large water sphere made on a 5 cm diameter wire loop by U.S. astronaut Dr. Pettit.