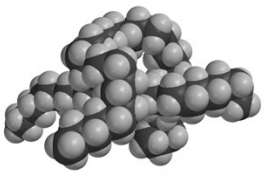
5th Grade - Lesson 2.5
Density of Liquids
Teacher Background

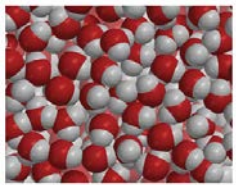
The *density* of a liquid is measured by the *mass* of the liquid divided by its *volume* (D=m/v). Just like solids, liquids have their own characteristic density. Since the molecules that make up a liquid have a certain size, mass, and attraction for each other, it makes sense that each liquid has a certain mass for a given volume, giving it a unique density.

Size, Mass, and Arrangement of Atoms Determine Density

Oil floating on water is a good example. Molecules of oil are made from carbon and hydrogen atoms. Water molecules are made up of oxygen and hydrogen atoms. Oxygen is a little smaller and a little heavier than carbon. This tends to make water heavier than the same volume of oil. Also, water molecules are polar so they attract one another and are very close together. But oil molecules are nonpolar so they don't have strong attractions between molecules. For all these reasons, oil is less dense than water.



Oil Molecules



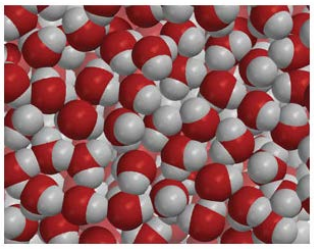
Water Molecules

Another example of the difference in density between liquids is salt water compared to fresh water. When salt is dissolved in water, the mass increases significantly but the volume does not increase very much. This extra mass without a compensating increase in volume makes salt water more dense than fresh water.

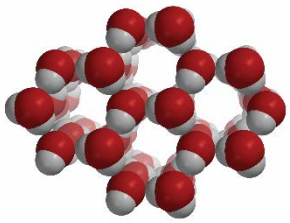
Liquid Water is More Dense than Ice

Temperature also affects the density of solids, liquids, and gases. For almost all substances, heating causes molecules to move faster and get further apart, making them less dense. Cooling a substance causes molecules to move slower and get closer together, making the substance more dense.

Water is an exception to the rule when cooled below 4 °C. Up until that point, water becomes more dense like every other liquid, but at 4 °C water begins to arrange itself into the crystal structure of ice. This requires water molecules to spread apart a bit becoming less dense than it was as a liquid.



Molecules in Liquid Water



Molecules in Ice

Density Influences Deep Ocean Currents

Density based on saltiness and temperature plays an important role in driving the slow movement of water throughout the globe in a pattern called the *ocean conveyor belt*. A very simplified explanation is that cold salty water sinks near the north pole and travels south. Warmer fresher surface water moves north to replace it until it reaches the North Pole. There, this water gets saltier and colder and sinks to begin a new cycle. Estimates are that it takes about 1,000 years for a unit of water to make the full trip.

Density and Deep Ocean Currents