

5th Grade - Lesson 1.4

The Water Cycle

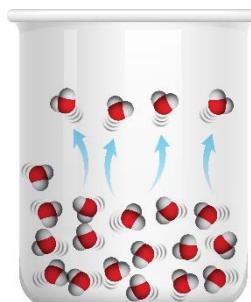
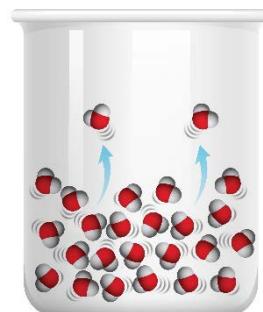
Teacher Background

The water cycle relies on the processes of evaporation and condensation.

Evaporation

The evaporation of water happens over a wide range of temperatures. At any temperature, the molecules of a substance are moving at a variety of speeds (kinetic energies). Evaporation happens when the molecules at the surface of a liquid move fast enough to break away from other molecules in the liquid and become a gas.

Evaporation happens in room-temperature water and even in cold water because at those temperatures, a portion of water molecules have enough energy to break away from other water molecules (evaporate). When a faster-moving molecule is at the surface, it can break away from other molecules even though most of the other molecules are moving more slowly. On cold days, water evaporates, but it evaporates more slowly than it would on a warmer day.



Increased Rate of Evaporation

Adding energy (heating) increases the rate of evaporation

Although water can evaporate at low temperatures, the *rate* of evaporation increases as the temperature increases. This makes sense because at higher temperatures, more molecules are moving faster; therefore, it is more likely for a molecule to have enough energy to break away from the liquid to become a gas.



Condensation

Condensation

The flip side of evaporation is condensation. For condensation to occur, molecules of water vapor in the air need to be moving slow enough so that when they collide with other molecules of water vapor, they attract to become liquid water.



Increased Rate of Condensation

Removing energy (cooling) increases the rate of condensation

As the temperature decreases, the rate of condensation increases. This is because a lower temperature means that more molecules are moving more slowly. If molecules move slower, they are more likely to attract and change their state from a gas to a liquid.

Evaporation and Condensation Happen at the Same Time

At any temperature, evaporation and condensation are actually occurring at the same time. Faster molecules from the liquid evaporate while slower molecules from the gas condense. Depending on the conditions, one process will happen at a faster rate than the other resulting in *net* evaporation or *net* condensation.

Other factors affect evaporation and condensation

There's more that influences evaporation and condensation than just temperature. The amount of water vapor in the air is also a big factor. When the air is dry, water evaporates faster than it condenses so there is a net high rate of evaporation. But if the air is very humid, the rate of condensation would be high so even if water evaporated, the *net* rate of evaporation would not be as high as on a dry day.

Relative humidity

Since water vapor in air condenses to liquid water as the air cools, cooler air tends to contain less water vapor than warmer air. This is the basis for the measurement of *relative humidity* which measures the amount of water vapor in the air *relative* to the maximum amount of water vapor the air can hold at that temperature. Since warm air can hold more water vapor than colder air, a given amount of water vapor in warm air will have a *lower* relative humidity than the same amount of water vapor in cool air. Since cold air can't hold as much water vapor as warmer, a given amount of water vapor in cold air will have a *higher* relative humidity than the same amount of water vapor in warm air.

Fog

Depending on the amount of water vapor and the temperature of the air and ground, condensation causes a lot of the different types of moisture that we see. With the right combination of water vapor and temperature, condensed water vapor can form a mist that is visible and close to the ground, called *fog*.



Dew

Condensation is also the cause of *dew*. Dew is liquid water that has condensed from water vapor and is often found on grass and your car on a cold morning.

Frost

When it is really cold outside, frost can form on surfaces such as glass and on plants. Some frost forms when water vapor in the air condenses to liquid water and then freezes to form ice.

Frost can also form in a different way when the humidity and temperature are just right. In these cases, the water vapor in the air changes directly to ice crystals on a cold surface without passing through a liquid phase.

