

The Water Cycle and Conservation of Matter: Learning Goals for Students and Teachers

Overarching goal: The movement of water, in its various phases, provides an example of the conservation of matter.	
Student and Teacher Learning Goals	Additional Teacher Learning Goals
<ol style="list-style-type: none"> 1. When liquid water is heated, it changes into the gas state (water vapor) that isn't visible. This process is called <i>evaporation</i>. 2. Water changes from the gas state (water vapor) to liquid when water vapor cools. This process is called <i>condensation</i>. 3. Water is made up of molecules that are arranged differently and move differently in solid, liquid, and gas states. 4. Changes in the energy (motion) of molecules help explain how water changes from one state to another during evaporation and condensation. 5. As water changes forms (solid, liquid, or gas), its mass is always conserved, which can be demonstrated mathematically. 6. Energy from the Sun drives the water cycle and includes the processes of evaporation, condensation, and precipitation that allow water to move around the world while being conserved (i.e., water changes state but doesn't disappear). 	<ol style="list-style-type: none"> 1Ta. Evaporation of liquid water happens all the time, not just when it's heated. Some water molecules at the surface (exposed to air) with higher energy than the rest can break free and become water vapor. 2Ta. Condensation happens all the time, even when water vapor isn't cooled. This occurs when molecules of water vapor collide with liquid-water molecules and join with other water molecules to become liquid water. 1Tb and 2Tb. Evaporation and condensation are dynamic in that they occur continuously. In humid environments, evaporation seems to occur more slowly because the air already has more water molecules in it (i.e., closer to saturation). 3Ta. Atoms are the smallest particles of a substance that can exist by itself. Atoms combine to form molecules. 3Tb. Water is made up of two atoms of hydrogen and one atom of oxygen (H₂O). Water has the same chemical composition (H₂O) whether it's in a solid, liquid, or gaseous form. 3Tc. The state of water (solid, liquid, or gas) is determined by the motion (kinetic energy) and arrangement (spacing) of water molecules. 3Td. Temperature is a measure of the average kinetic energy of a substance. 3Te. When water molecules gain energy, they move farther apart and become less dense. 4T. Differences in the density of water in solid, liquid, and gas states are caused by different arrangement (spacing) of molecules. 5Ta. Matter is any substance that has mass and occupies space. 5Tb. Matter can undergo physical changes in which the molecules that comprise it don't change (such as water changing from a liquid to a gas state), or chemical changes in which molecules break apart and rearrange to form new substances. 5Tc. Within a closed system, matter is conserved. 6Ta. Earth is a closed system for water. All water on Earth today is the same water that has been on Earth since the planet was formed. 6Tb. Water on Earth is conserved. Water molecules change states, but they never disappear or lose mass. 6Tc. Plants and soil also play important roles in the water cycle.