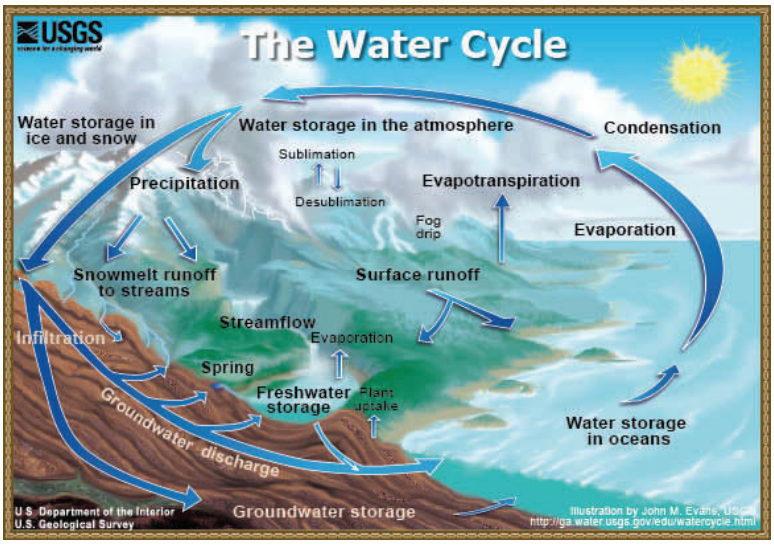
A Content Secondary Science Newsletter from the
Southern Nevada Regional Professional Development Program

Science Dissected

Earth Science Atmospheric Processes and the Water Cycle

The water cycle is probably the best known of the geologic processes. Heat energy from the sun evaporates surface water, sending water vapor into the atmosphere. Less dense, the water vapor will rise. Temperatures fall as altitude is gained until the water vapor condenses into clouds. Some students think that clouds are water vapor. Actually clouds are extremely small droplets of water. These cloud droplets stay suspended because they are less dense than the surrounding air. As cloud droplet come together they get bigger and the white, fluffy clouds start to get darker. Precipitation (rainfall) will happen when the cloud droplets are so large that they can no longer stay suspended. Falling to the ground, this rainfall can either accumulate in low places, i.e. rivers, lakes, oceans; or flow across the surface into rivers and streams. This surface water can then be evaporated, starting the process all over again. Some water will infiltrate into the ground where is can be taken up by the roots of plants. Plants are able to release water back into the atmosphere via a process called transpiration. Small pores on the surface of the plant's leaves will open and release water vapor.



The water cycle, or hydrologic cycle, is nature's way of providing a constant supply of fresh water. It is important that students understand that water is not being created anywhere on the planet through natural processes. With energy from the sun, water is moved from the liquid state to the gas state (evaporation). During this process only pure water molecules are put into the atmosphere. Many students have a difficult time believing this. A simple experiment can be done in the classroom to illustrate the 'purifying power' of evaporation. Take a 100 mL beaker and fill it with ordinary tap water. You can then add anything you want, such as salt, food coloring, and/or vinegar. Place the beaker on a hot plate and heat the mixture to boil. As the steam rises, hold an aluminum pie plate filled with ice over the steam. The steam will hit the cold plate and start to condense. Using a clean cup, capture some of the water as it falls from the pie plate. Students will be able to see

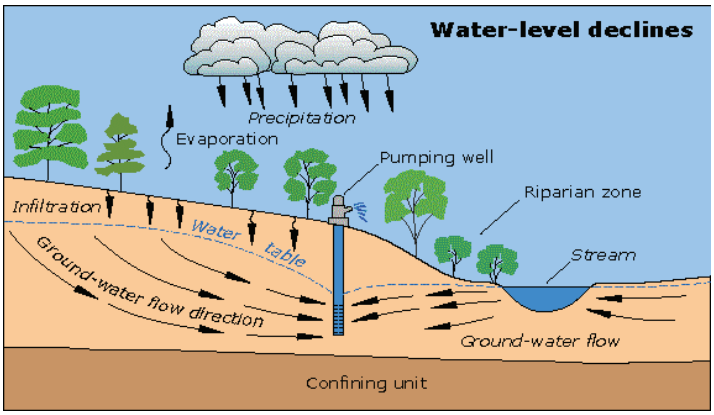
The Solarball purifies water for drinking. This unit uses solar energy to drive a mini water cycle generating drinkable condensation

Written by: Jenelle Hopkins

and taste this water as being pure water; none of the material that had been added to the beaker is condensing on the pie pan. You can even have the students make a diagram of this set up and compare it to the real components of the water cycle: the beaker is any surface water, the steam is water vapor entering the atmosphere, the water condensing on the pie plate is what happens when water vapor rises up in the atmosphere, cools and condenses in clouds, and the water dripping off of the pie plate represents precipitation.

What part of the water cycle does the hot plate represent? The sun! The water cycle is powered by the heat energy from the sun. In our model we are using electrical energy to produce the heat that is needed to boil the water. So in this sense the model is not perfect. This is a good opportunity to talk about models; both their benefits and limitations.

Now that we have fresh water falling from the skies, what happens next? This depends on where the rain is falling. The surface reservoirs (oceans, rivers, lakes and streams) capture some of the rainfall. This is a ready source of water for a variety of human activities. Additionally, some of the water sinks into the ground. This infiltration is another way that nature captures, purifies, and stores water. As water percolates down through various layers of sand and silt, bacteria and other impurities are pulled out. Water continues downward under the influence of gravity until it reaches an impermeable level where it accumulates. This storage is called groundwater. In many places around the world, groundwater is the primary water supply for homes, businesses, and growing crops. Pumps pull this accumulated water back up to the surface. Many students erroneously believe that groundwater is just an underground river. Students can't understand how open spaces within rocks, called pore spaces, can hold enough water to be of any consequence. Challenge the students to consider what happens when they use a straw to drink a slushy drink such as a 7-11 Slurpee®. They should be familiar with pulling out all of the sugar-flavored water, leaving behind only small ice particles. These ice particles represent the rock and soil particles that hold ground water, in this instance the sugar-flavored water, and the straw represents the way groundwater can be pulled out via pumps. No underground 'river' is necessary.



Groundwater flow and effects of pumping

Figure Reference http://ga.water.usgs.gov/edu/earthgwdecline.html

Key Points

- The water cycle is powered by energy from the sun.
- Evaporation, condensation, precipitation, transpiration, and infiltration are the important processes of the water cycle.
- Evaporation and infiltration are processes in the water cycle that provide a continuous supply of fresh water.

Related Links

Interactive Water Cycle Animation from the EPA, www.epa.gov/safewater/kids/flash/flash_watercycle.html
Water Cycle from Earthguide, earthguide.ucsd.edu/earthguide/diagrams/watercycle,
USGS Nevada Science Center, http://nevada.usgs.gov/water/