

HYDROLOGIC CYCLE

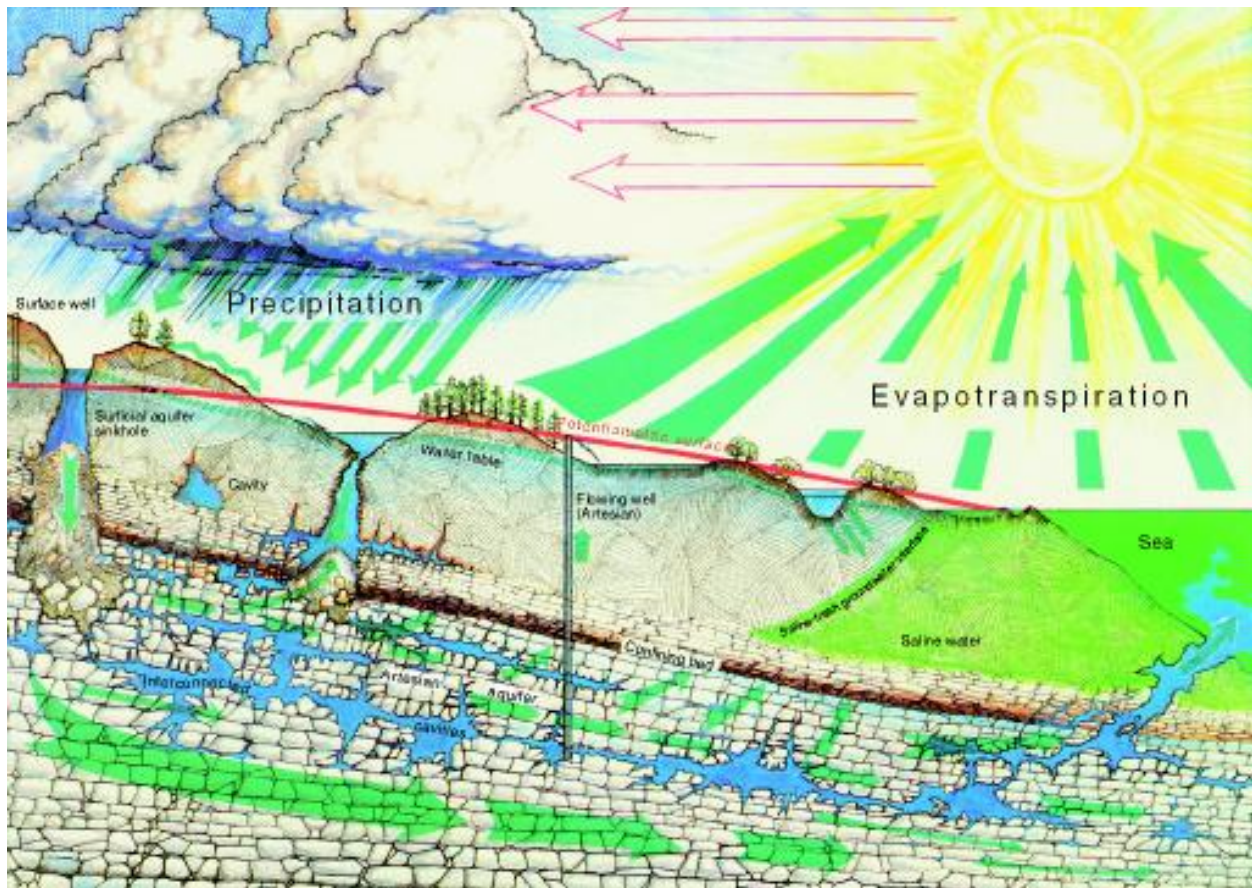
The hydrologic cycle is essentially a closed system with regard to water. The same water circles endlessly through its different phases, moving from sea to atmosphere to the land and back to the sea. Approximately 80,000 cubic miles of water evaporate annually from the world's oceans. The power source for the hydrologic cycle is solar energy, which induces evaporation. Although annual incoming radiant energy from the sun is greatest in the equatorial zone, the solar radiation reaching the earth's surface is reduced by the high cloudiness of that zone, and this reduced solar radiation, in addition to the high humidity, reduces evaporation. Highest evaporation occurs in the zones of highest solar radiation intensity at the earth's surface which are located to the north and south of the equator in the subtropical high pressure and trade-winds belts. King (1962) identified 20½N and 10½S as the latitudes with the highest levels of evaporation.

Once evaporated, water is carried through the atmosphere as clouds and vapor, forming an integral part of the earth's weather. When atmospheric conditions are right, water vapor condenses and falls as precipitation, such as rain, snow, sleet, or hail. Some precipitation bypasses part of the cycle and either evaporates while in the air or falls into the ocean. Other precipitation falls on the land.

Precipitation that falls on the land flows through many different pathways. Some precipitation will flow on the surface as runoff or overland flow. This water eventually makes its way to bodies of surface water, such as lakes, wetlands or rivers, where it will reside temporarily. Eventually, the surface water evaporates back into the atmosphere, makes its way to the ocean by way of a river system, or seeps through the lake, wetlands, or stream bottom into the underlying rocks or sediments.

Some precipitation seeps into the ground on which it falls, a process known as infiltration. As the water percolates downward through the soil, some may be removed by growing plants and recycled back into the atmosphere by transpiration from leaf surfaces. Some soil moisture will remain, clinging to the soil particles. Excess moisture is pulled downward by gravity until it reaches the zone of saturation or water table. Water below the water table is called groundwater. Much, but not all, groundwater flows beneath the land surface through layers of soil and rock until it reaches points of discharge, such as springs, wells, or seeps. Most groundwater discharges to streams and ultimately flows to the ocean, however long or deep the journey. Some of the very old groundwater, however, known as connate water, may stay beneath the land surface for millions of years. Connate water, which is highly mineralized because of its long contact with rock materials, is water that became trapped in sediments when they were deposited and subsequently was buried by younger sediments. Typically, however, the age of groundwater ranges from a few tens of years to tens of thousands of years (Bouwer 1978).

Water is added to the hydrologic cycle in minute amounts each year from deep within the earth by volcanic eruptions. This water is called juvenile water or primary water and is a component of deep rock and magma. This added water is balanced by water removed from the hydrologic cycle each year by combination with newly deposited hydrated minerals, such as gypsum, a mineral whose chemical formula contains water molecules.



References

- King, C.A. 1962. An Introduction to Oceanography. New York, N.Y.: McGraw-Hill.
 Bouwer, H. 1978. Groundwater Hydrology. New York, N.Y.: McGraw Hill.

Study Questions

1. Why are the areas of highest evaporation of water not found at the equator?
2. The subtropical regions of the earth have the highest evaporation rates. They are areas identified as latitudes 20.5 N and 10 S. These areas are characteristically blessed with high pressure and trade winds. Explain why high pressure and wind accelerate evaporation.
3. Using a dictionary, define water-table. Is groundwater found above or below the water-table?
4. What is connate water?
5. What is juvenile water?
6. Connate water and juvenile water are added to the hydrologic cycle every year, but accumulations are balanced through the removal of hydrologic water by what process?
7. Using only your words and arrows, draw the hydrologic cycle.