



# WASTE WATER & THE HYDROLOGIC CYCLE

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**We take you on a tour of our planet's water cycle—which may or may not include alien motherships.**

If you're serious about your hydroponic garden, you probably use a reverse osmosis filter (RO) to ensure your plants have the purest water. RO systems create waste water during the purification process. Have you ever looked down at your waste water stream and wondered where all that water is going to end up? Does it go in a landfill? Does it go into the ocean? Does it get transported off the planet by an alien mothership? Although the process by which water moves around the Earth may seem like deep and complex science, it's actually a fairly simple process—

let's take a look at some basic water terminology as it relates to the processes of water transformation.

Precipitation happens when condensed water vapor falls to the Earth's surface, mostly as rain and snow. Seventy-eight percent of global precipitation occurs over the ocean. Evaporation is the transformation of water from a liquid to a gas as it moves from the ground or bodies of water into the atmosphere. Oceans evaporate the largest part of our water budget. Dogs pant, people sweat but plants transpire, as moisture is

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carried from roots to small pores called stoma located on the leaves, where it evaporates into a vapor and is released into the atmosphere. During a growing season, a leaf will transpire many times more water than its own weight—a large oak tree can transpire 40,000 gallons a year! If you enjoy a cold beer on a hot day, you've probably noticed the droplets of moisture that collect on the can or bottle. Condensation is the cause of your wet can, as vapor in the air transforms into water droplets and clings to the outside of your beer. Other forms of condensation—slightly more pertinent to our topic—are clouds and fog.

Water is always in motion. Although the number of water molecules on Earth remains constant, the number of individual water molecules in any one place can rise and fall as they move in and out of the atmosphere as part of a never-ending process of water circulation. The movement and endless recycling of water between the atmosphere, the surface of the Earth and underground is called the hydrologic cycle.

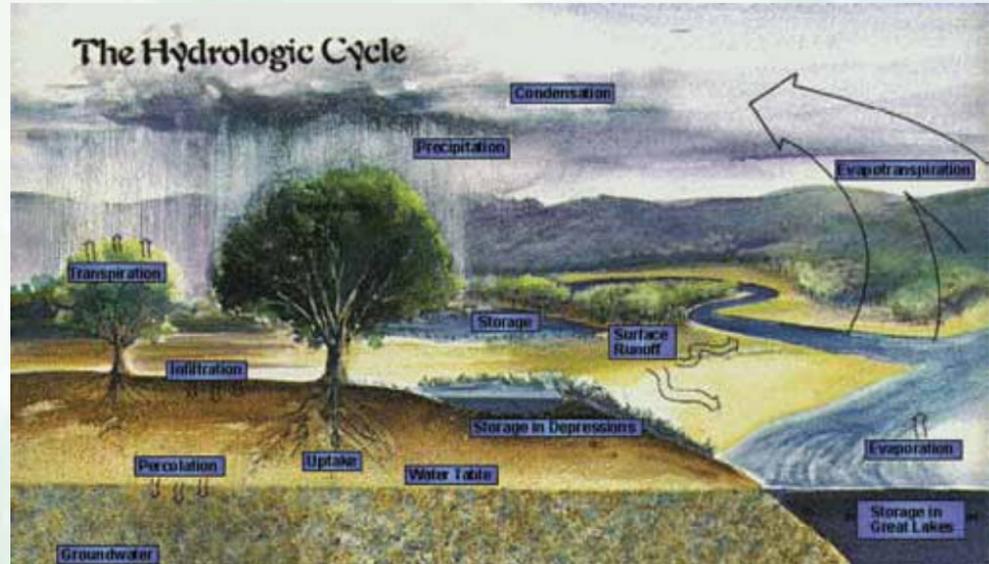


Figure one

cle. The water moves from one source to another—such as from the river to the ocean or from the ocean to the atmosphere—by physical processes driven by the transfer of energy from the sun. This water cycle supports the maintenance of life and all the ecosystems on Earth. Through these transformations the water cycle purifies water, replenishes the land with fresh precipitation

and transports minerals to different areas. This cycling of water is linked with energy exchanges that help to determine the Earth's climate and cause much of its natural climate variability. The hydrologic cycle of water (shown in figure one) illustrates how the movement of water through the hydrosphere is constantly being replenished.

Water transformation is one portion of this cycle, but the processes of water storage within the land is the other. Water seeping into the ground after falling from the air (by means of precipitation) is called infiltration. Once the ground is saturated, the excess water moves across the land in rivers and streams collectively called runoff. When this happens underground in aquifers it is known as subsurface flow—and this water may return to the surface by forming a spring, being pumped by people or eventually seeping into the ocean.

These processes are in constant ebb and flow, changing with the seasons, geographic location and increased climate variability. Human activities that alter the water cycle include agriculture, industry, deforestation, urbanization, construction of dams and aquifer over-drafting. These deficits are constantly being replenished, however, as part of the Earth's overall water

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budget is in constant circulation. For example, water covers 70 per cent of the Earth's surface and of that, 97.5 per cent is in the oceans, 2.4 per cent is fresh water on land and the atmosphere holds less than 0.001 per cent. The annual precipitation figure for the Earth actually totals more than 30 times the atmosphere's total capacity to hold water. Under the surface, groundwater infiltrates the soil, flows downward until it encounters impermeable rock and then travels laterally in underground bodies of water called aquifers. Groundwater then returns to the surface through these aquifers, which empty into lakes, rivers and the oceans. As the amount of groundwater water increases or decreases, the water table rises or falls accordingly. Plants access this water through their roots and use it for photosynthesis and then it is evaporated through the stoma on the undersides of leaves. As much as 10 per cent of the moisture found in the atmosphere is released by plants through this process called transpiration.

Now that we understand the hydrologic cycle of water on Earth, let's look at one of the most common misconceptions in regards to waste water and reverse osmosis systems. As many of you know, the process of reverse osmosis requires a waste water stream in order to separate hardness and contaminants from pure water molecules. These pure water molecules are small enough to pass through the thin film material in your system's tightly wound membrane, while the unwanted substances that are rejected by the membrane as waste simply flow back into the hydrologic cycle, often through subsurface flow back into the groundwater and aquifers. If you are still concerned with waste water, many water purification systems offer a solution that reduces the amount of waste. It should be noted that reducing waste water could negatively affect the life of the membrane you're using if your source water TDS count (total dissolved solids) is high. As you can now see, 'waste' water is kind of a relative term, since it is impossible to destroy a water molecule and everything ends up back in the hydrologic cycle of the Earth—which at this time does not include any alien motherhips! **MY**

### Sources:

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