

The Earth and Water Cycle



One of the characteristics of the planet Earth which makes it unique is that it has liquid water on its surface. How our water continuously moves through the earth and atmosphere is called the **water cycle**.

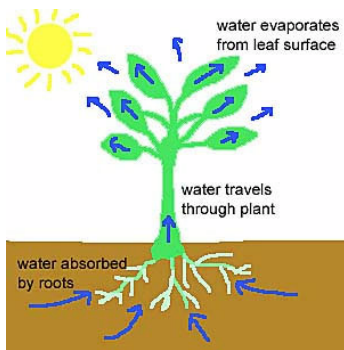
The oceans and seas cover over two thirds of the Earth's surface. More than 97% of the water in the Earth's hydrosphere is found in the oceans, which leaves only about 3% as freshwater. Most of the earth's freshwater (2%) is frozen as ice and snow mostly near the North and South Poles. The rest of the water, less than 1 %, is underground, in lakes and reservoirs, rivers and streams, marshes and swamps' and/or inside the living organisms that make up the biosphere.

Water can be found everywhere in the environment: in the atmosphere, in soil, in plants and animals, and in the human body. Water is essential to daily living and we take for granted the water which comes out of the kitchen tap because it never seems to run out. The planet Earth can be considered a closed system where the water is continuously recycled. That means that the water people drink today is millions of years old and will continue to be recycled over and over again for millions of years.

Processes that Make up the Water Cycle

Water moves in many ways throughout our world. One way water moves is by evaporation. **Evaporation** occurs when liquid water turns into gas water (water vapor). The heat from the sun heating up the surface water in rivers, lakes , and oceans causes water to evaporate. When water turns from a liquid to a gas (evaporates) it is cleaned because all the dissolved substances, called mineral salts, are left behind. This means that evaporated water is purified water. We use this understanding to make products like **distilled water**.

Looking out over lakes, rivers, and/or oceans it is impossible to see drops of water moving upwards into the sky, but it is this water vapor that makes the air humid. Even though it is possible to feel that the air is humid, it is impossible to see the water carried in the air because the particles are so small.



-Another way that water can get into the atmosphere is through transpiration. **Transpiration** is when water is moved from the ground into the air by plants. During transpiration, plant roots absorb water from the ground. This is called **plant uptake**. The water then moves up the plant and some of the water goes out of the leaves. Once the water is exposed to the air on the leaves it can evaporate.

What happens to the water after it evaporates?

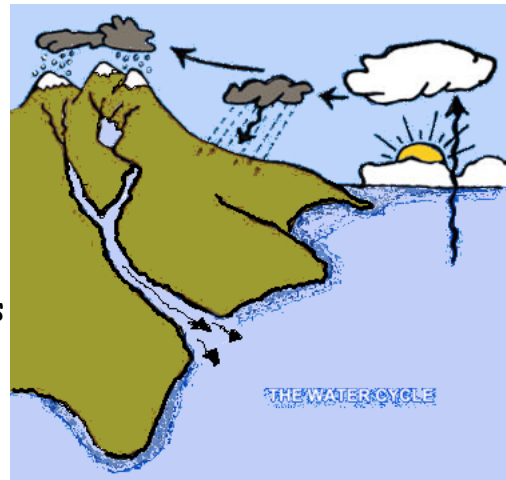
Air carrying the water vapor moves higher and higher, and becomes cooler and cooler. When the temperature of the air drops enough, the water that is a gas starts to **condense** and turn into larger water droplets that increase in number to eventually form clouds. However, water condenses into droplets only when there are small dust particles in the air for water to stick on to and form around. Increased evaporation rates, more dust, and more condensation causes clouds to become bigger and thicker.



Sometimes, conditions in the atmosphere are so cold that the water vapor changes directly into ice. This process, **deposition**, produces snowflakes and frost.

Two other ways that water condenses is as fog and/or dew. **Fog** is basically a cloud at or near the Earth's surface. We say there is a fog when there is so much water in the air that it limits our visibility. **Dew** forms when water droplets condense from the air onto any surface that is cool enough. Dew usually forms in the evening or early morning when air temperatures change.

Wind can move/push the clouds from place to place. This is called **transportation**. For example, the on-shore winds in the diagram are pushing the clouds over the land. Eventually the thickening clouds cannot hold any more water droplets so water moves from the clouds back down to the surface of the Earth as **precipitation**. The water falls because the droplets come together and become so big and heavy that they can't stay floating in the air anymore.



There are many various forms of precipitation. **Rain** forms when the air temperature is above freezing 0°C (32°F). If the air temperature is below freezing or the clouds have been pushed high enough, then the water droplets in the clouds start to freeze and

forms **snow**. If the snow melts as it falls back to the surface and is a mix of frozen, and liquid water we call it **sleet**. If the precipitation is in the form of chunks of ice we call it **hail**. Hail is so heavy that it only forms if upward blowing wind is strong enough to hold the freezing water up till it forms into larger chunks of ice. Eventually the chunk of ice becomes too heavy for the wind to hold up and falls as hail. The size of the hail depends on the strength of the upward wind and other atmospheric conditions.



Humans impact our environment in a number of ways in positive and negative ways. Factories, cars, and homes can cause pollution that mixes with clouds in the air. This combination can change the pH of the atmospheric water. We call this acid rain because it is more acidic than normal rain. Acid rain impacts our world in a number of ways such as; decreasing plant growth and health, decreasing fish populations, chemically eroding buildings and statues, and can even cause people and animals to get sick.

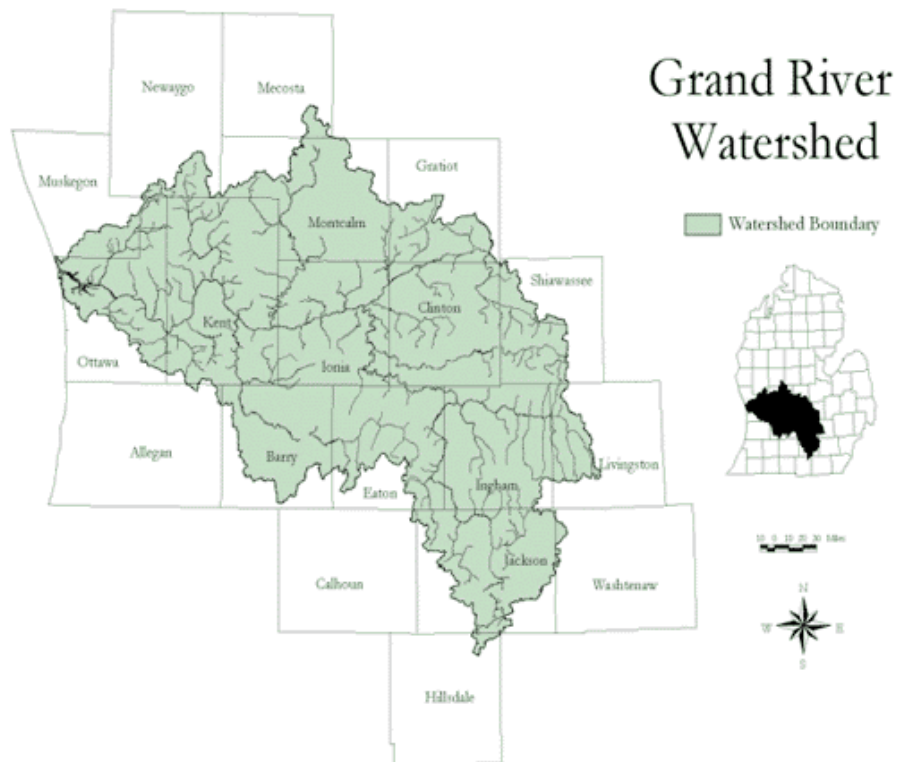
What happens to water after it reaches the surface again?

Various things may now happen to the water as it reaches the Earth's surface in the form of either rain, sleet, hail, or snow. If it falls as snow high up on a mountaintop, the water may stay stored there throughout the winter, or until it warms enough to melt. Liquid water running off the surface of the land downhill flows into streams, rivers, ponds, and lakes/oceans. This process is called **surface runoff**.



What is a Watershed?

Water that does not evaporate or soak into the soil usually flows as small streams into larger streams, then into rivers, and eventually the ocean. The land area from which the water drains to a given point is called a **watershed** or drainage basin. You can think of a watershed as a drainboard that carries rinse water into your kitchen sink. The excess water of the drainboard makes its way down into the drain of the sink. The watershed can be thought of as the total land area that directs excess water into a waterway (the drain).



- Think of a small stream in your community. Water



from a few acres drained into that little stream. Those few acres are its watershed. Small streams will drain into larger streams. The land areas drained by the small streams make up the watershed of the larger stream into which they flowed...small watersheds make up the larger watersheds.

A good example of small creeks or rivers flowing into larger waterways is

the Mississippi River. The Mississippi River drains a watershed of about 1,243,000 square miles. Thousands of smaller watersheds compose this massive watershed.

Anywhere you stand on the earth's land, you are standing in a watershed. All water on land drains to somewhere, and any type of land can compose a watershed from mountainous land, land that is nearly flat, marshy land, or to rocky/rough land. The land could have trees, wildlife, but also be urbanized and covered with towns, suburban developments, and industrial plants.

The inhabitants of the watershed are also part of the watershed, because we influence what happens within the watershed for good or bad. We have a tremendous responsibility to ensure that we do not disrupt the watershed in any way. It is important to realize that if we contaminate the water running into the waterway, we also contaminate the waterway itself. Furthermore, by contaminating the waterway, we also affect our neighbors who are downstream from us.

Not all water runs off the surface.

Some of the liquid water may filter into the soil and drain downwards. Water moves (soaks) into the ground through the process of **infiltration**. This happens because there are spaces and holes between the particles of soil where water can seep through. This process is called infiltration. As the water infiltrates through the soil and rock impurities are filtered out and the water is cleaned.

Once the water is in the ground it doesn't always stop moving. Water that remains under the surface of the Earth is called **groundwater**. Some of this groundwater may continue to travel slowly through the soil and rock, moving downhill and might reach the surface

again as springs. Some of the water may also be stored in an underground layer of water known as an **aquifer**. Aquifers naturally store groundwater within permeable rock, gravel, silt, clay, and/or sand for long periods of time.