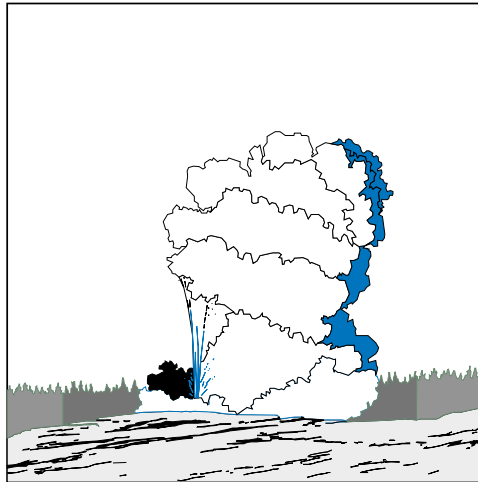
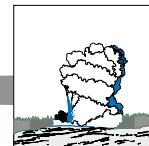


Unit 10: The Water Cycle

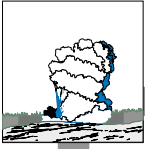




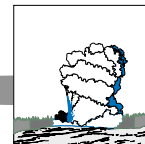
Practice

Study the vocabulary words and definitions below.

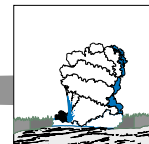
- aquifer** layer of rock found underground that is filled with water
- artesian well** a well in which water naturally rises above the level at which it was initially found
- clouds** condensed water vapor in the atmosphere
- condensation** the changing of a gas into a liquid
- dew point** the temperature at which water vapor condenses
- evaporation** the changing of a liquid into a gas by the escaping of atoms or molecules into the atmosphere
- geyser** a fountain of hot water erupting periodically from the ground
- groundwater** underground water that supplies wells and springs
- hard water** water that contains large amounts of dissolved minerals (magnesium and calcium carbonate)



- hydrologic cycle** the movement of water from the oceans and freshwater sources to the land and air and then back to the oceans; also called the *water cycle*
- hydrosphere** all of Earth's water
- nitrates** pollutants from fertilizers or waste products of animals that seep into the water
- phosphates** pollutants from detergents or fertilizers that seep into water
- pollutant** substance that causes harm to the environment
- pollution** the contamination of the environment with waste
- precipitation** moisture that falls to Earth as rain, hail, sleet, or snow
- runoff** excess rainwater that drains into lakes and other bodies of water
- saltwater intrusion** when salt water moves into the bodies of fresh water
- saturated** a condition in which a substance can hold no more water



- sinkhole** a depression in a region where soluble rock has been removed by groundwater
- soft water** water that does not contain dissolved minerals
- spring** a flow of groundwater that emerges naturally at the ground surface
- transpiration** the process by which water evaporates from the leaves of plants
- water cycle** the movement of water from the oceans and freshwater sources to the land and air and then back to the oceans; also called the *hydrologic cycle*
- water table** the upper level of the saturated zone of groundwater
- water vapor** water in a gaseous state



Introduction

More than 70 percent of planet Earth's surface is covered by water. This 70 percent of the surface includes oceans, lakes, rivers, and other bodies of water. Water circulates among these sources in a cycle powered by the sun. This **water cycle** is essential to all life.

In Florida, water is of extreme importance, with 90 percent of the population living less than one hour away from the coast. The linkage of our freshwater system to our coastal waters by caves, tunnels, lakes, rivers, and swamps makes Florida home to many unique environments.

The Water Cycle

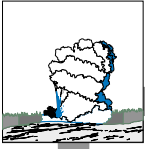
The **hydrosphere** is all of Earth's water. The oceans contain over 95 percent of Earth's water supply; however, its water is salty and cannot be used directly by people on Earth to drink and grow food. Earth's usable freshwater supplies are found in moving water such as rivers, streams, and **springs**, and in standing water in ponds, lakes, and wetlands. Much of our freshwater supply is frozen in polar ice caps and glaciers.



Water moves from the oceans and freshwater sources to the land and air and then back to the oceans in a continuous cycle called the *water cycle* or **hydrologic cycle**. The water cycle provides fresh, usable water to lands all over the world—even to areas where there are no bodies of fresh water nearby. The water cycle changes salty, unusable ocean water into fresh, usable water.

The water cycle has three main steps. However, the cycle is continuous—there is no beginning or end.

The first step involves the **evaporation** of water into the air. Evaporation is a process in which water changes from its liquid state to a gaseous state



called **water vapor**. Most of this occurs when the sun heats the water in oceans, lakes, and other bodies of water, causing evaporation. Plants also give off water vapor from their leaves in a process called **transpiration**. Animals, too, give off water vapor as part of respiration.

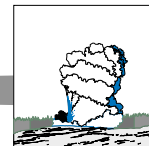
In the second step of the water cycle, the water changes back into a liquid during a process called **condensation**. This occurs because water vapor cools as it rises in the atmosphere. The temperature at which water condenses is called the **dew point**. At the dew point, water condenses into tiny droplets that may form dew or **clouds**. The water that evaporates from the ocean condenses as fresh water because the salts do not evaporate.

The third and last step of the water cycle is **precipitation**. This is when the fresh water returns to Earth as rain, snow, sleet, hail, fog, or dew. Some of the water that returns to Earth will wash into the oceans, lakes, and rivers. This water is called **runoff**. The rest of the water soaks into the ground and becomes **groundwater**. Eventually, the groundwater will return to the ocean through underground channels, where it will continue in the water cycle.

water cycle

Seawater

Seawater is not pure water. It contains salts and other chemical compounds. All of the salts in ocean water were carried from the land to the sea by rivers or runoff. The salinity is the amount of dissolved



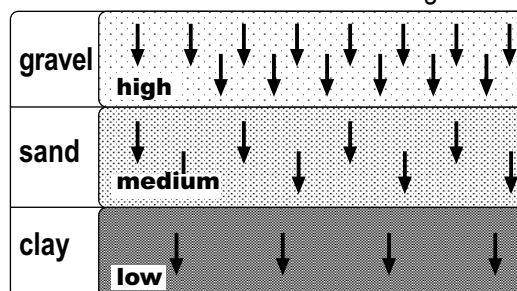
substances in seawater. Most seawater has a salinity of about 3.5 percent or 35 parts per thousand. Salinity of seawater increases as water is evaporated by the sun because the salts are left behind. As ice forms, salinity also increases as only the water freezes leaving the salts in the water below. Salinity of seawater decreases when the amount of water is increased by precipitation or runoff.

Groundwater

Water that soaks into the ground is called *groundwater*. Different types of rocks and soil hold different amounts of groundwater. Ground that has many pores or spaces between the soil particles can hold a lot of groundwater. When all of the pores and spaces are filled with water and the ground has all the water that it can hold, it is said to be **saturated**. The upper level of the saturated zone of groundwater is called the **water table**. When you dig a well to get water, you must dig below the level of the water table to get water to flow up through the well.

Permeability

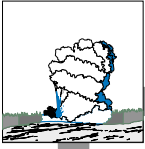
rate at which water can move through soils



Porosity

amount of pore space for water

Underground water moves from high ground to lower ground. It moves more slowly underground because of friction between the rocks and the water. The larger the spaces between the rocks, the faster the water can move. **Aquifers** are layers of rock found underground that have large pores and through which water can easily move. Most aquifers are made of sand, gravel, sandstone, or limestone. Most of the time you must use a pump to get the water from an aquifer. However, sometimes when a well is dug, there is enough pressure to cause the water to flow to the surface on its own. This natural upward flow of water forms an **artesian well**.



a geyser

When water reaches the surface under pressure and flows out of natural openings in the rock, a *spring* is formed. **Geysers** are springs in which the water that flows out is hot. Usually, it takes time for the pressure and steam to build. That is why geysers flow in spurts rather than continuously. Old Faithful in Yellowstone National Park is a geyser that erupts about every hour.

Groundwater dissolves certain types of minerals, such as limestone, and carries them away, leaving hollow chambers or underground caves and caverns. Occasionally, during dry periods when the level of the

groundwater is very low, the roofs of these caves may collapse, forming **sinkholes**. When the water table returns to its normal level, the sinkholes fill with water and become lakes or ponds.

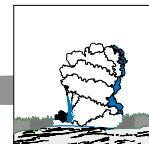
Rainwater that does not contain any dissolved minerals is called **soft water**. When the rainwater filters through the ground, it dissolves calcium carbonate from limestone and becomes **hard water**.

Florida's Freshwater Systems

Florida has over 30,000 bodies of fresh water, which makes the state an excellent area for fishing and outdoor recreation. These bodies of water include lakes, rivers, ponds, canals, and swamps, the navigation of which is controlled by the United States Army Corps of Engineers.

Florida has thousands of lakes, including Lake Okeechobee—its largest and most famous. Lake Okeechobee is a large, natural lake in the heart of south-central Florida. The Okeechobee Waterway is a navigation channel which connects the Atlantic Ocean and the Gulf of Mexico.

Florida has many swamps, marshes, and other wetlands due to its humid climate and low elevation. The Everglades (also known as the River of Grass), which lies directly south of Lake Okeechobee, is the largest marsh. It is a combination of sawgrass and water. A well-known swamp is the Okefenokee swamp found along the Suwannee River in northern Florida. Because of the unstable nature of the swamp's soil, Native Americans gave it a name meaning *Land of the Trembling Earth*.



Florida has a number of rivers in its freshwater system. The St. Johns River begins in a swampy area just west of Ft. Pierce and flows in a northerly direction about 300 miles to Mayport, north of Jacksonville. It is the largest river system located entirely in the state. The St. Johns River receives part of its water flow from underground water seepage, including a large number of perennial springs. The southwest region of Florida has a system of four major rivers that all have their origin in the Green Swamp. These include the Hillsborough, Withlacoochee,

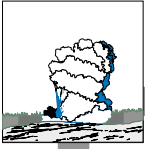
Oklawaha, and Peace rivers. The Suwannee River, which flows out of the Okefenokee Swamp in northern Florida, was made famous by Stephen Foster's song "Old Folks at Home."

A major river system in northern Florida is the Apalachicola-Chattahoochee-Flint. It drains areas in Alabama, Tennessee, and Georgia, and adds their runoff to the Florida system. The Apalachicola river system is important economically because its estuary (the place where river and the Gulf of Mexico meet) is a major source of shellfish, oysters, shrimp, and crabs.

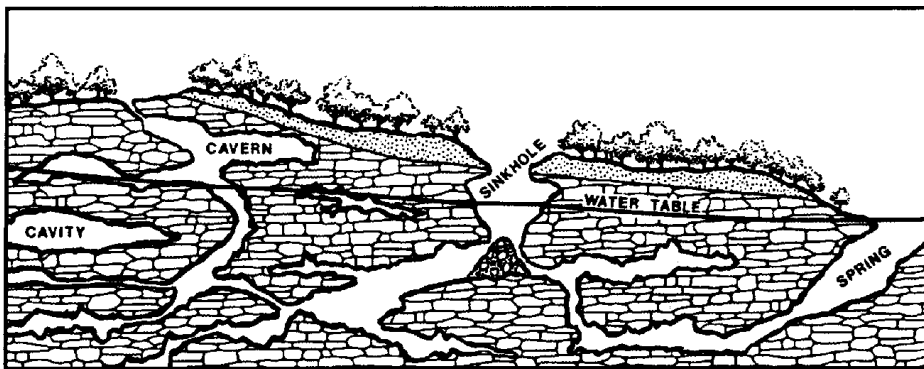
Because of Florida's low elevation, there exists a very delicate environment. Its freshwater systems are constantly monitored by the United States Army Corp of Engineers, and many of its lakes and canals are controlled by its five water management districts. The level of Lake Okeechobee is of extreme importance. In flood conditions, water is released from the lake to flow through canals and out to the ocean.

Times of drought are equally dangerous. When there is not enough rainfall, the aquifer beneath the land becomes dangerously low, allowing for **saltwater intrusion**. This is when salt water moves into the freshwater aquifer. This can contaminate our water supply reducing the amount of fresh water available.





Sinkholes are formed when the rock layers are dissolved by groundwater or the water table drops abruptly. In both cases, the underlying rock cannot support the surface rock and soil. The underground layers collapse, forming a sinkhole. They can occur unexpectedly and *swallow* houses, roads, and other buildings. Sinkholes, such as Big Dismal Sink in Leon County and Riverview Sink in Hillsborough County, are common in parts of Florida. Recent sinkholes have occurred in central Florida in Winter Park, Gainesville, and Chiefland. In January 1999 a sinkhole occurred in the northbound lane of I-95 in Palm Beach County.

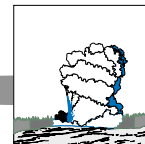


sinkhole

Other factors that affect Florida's freshwater systems are **pollutants**. **Phosphates**, found in detergents and fertilizers, and **nitrates** from animal wastes and fertilizers, are two major causes of water **pollution** in Florida. These pollutants kill fish and plant life and make water unsafe for drinking. Current environmental safeguards are helping to protect our limited water supply.

Summary

Earth's water moves in a continuous hydrologic cycle through evaporation, condensation, and precipitation. Seawater makes up over 95 percent of the hydrosphere. Through evaporation in the water cycle, salt water is changed to fresh water. Groundwater is held in rocks, soil, and aquifers. The action of water may form springs, geysers, caves, and sinkholes. Florida has many freshwater bodies that provide recreation and food. We must protect our delicately balanced water resources.



Lab Activity 1: Part 1—The Hydrologic Cycle

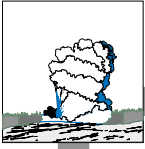
Purpose

Demonstrate evaporation, a part of the hydrologic cycle.

Materials

- beaker, jar, or aluminum can
- crushed ice
- food coloring
- salt

1. Fill a container (beaker, jar, or aluminum can) with crushed ice.
2. Add a little salt. (Salt will make the temperature very low.)
3. Put some food coloring on the ice and mix it.
4. Let stand.
5. What do you see on the outside of the container? _____
6. Where did this come from? _____
7. Did it come from the water inside the container? _____
8. How can you tell? _____



Lab Activity 1: Part 2—The Hydrologic Cycle

Purpose

Demonstrate condensation, a part of the hydrologic cycle.

Materials

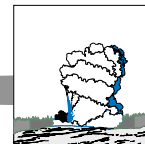
- large, flat dish
- medium heat-resistant container
- boiling water
- crushed ice
- hot plate

1. Fill a heat-resistant container half full of boiling water.
2. Place crushed ice in a flat dish larger than the container used in step one.
3. Put the dish with crushed ice on top of the container filled with boiling water.
4. What happens to some of the boiling water? _____

5. What do you see on the bottom of the dish that contains crushed ice?

6. Where do you think this came from? _____

7. Why do you think the water droplets form on the bottom of the dish?

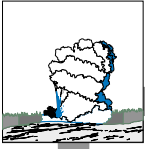


Practice

Use the list below to complete the following statements. One or more terms will be used more than once.

air	hydrosphere	polar ice caps	springs
condensation	lakes	ponds	streams
evaporation	land	precipitation	water cycle
hydrologic cycle	oceans	rivers	wetlands

1. The movement of water in a cycle from the ocean and the land to the air and back again is called the _____ .
2. All of Earth's water is called the _____ .
3. Over 95 percent of Earth's water supply is found in the _____ .
4. Earth's usable freshwater water supplies are found in _____ , _____ , _____ , _____ , and _____ .
5. Much of our freshwater supply is unavailable to us because it is frozen in _____ .
6. In the water cycle, water moves from the _____ and the _____ to the _____ and back to the _____ .



7. The _____ changes salty ocean water into fresh water.

8. Three steps of the water cycle are _____ ,
_____, and _____ .