WHAT'S GOING ON WITH OUR WATER?

THE HYDROLOGIC CYCLE & THE EVERGLADES

What's Going On With Our Water?
Lesson One: The Hydrologic Cycle

Sunshine State Standards: SC.D.2.4.1
SC.G.1.4.1, SC.G.2.4.5

Objective

Students will understand the hydrologic cycle, discover who the major users of water are in South Florida, and understand how the users intervene in the cycle.

Materials

Picture or diagram of the hydrologic cycle

Procedures

Using the picture as a visual aid, explain the hydrologic cycle to the students. Further talk about human interaction in the cycle.

Activity

1. Give students an oral quiz on terms used in the lecture.

2. Ask students to make lists of water usage in several areas, and call on them to explain their choices.

3. Ask students to draw their own diagrams of the hydrologic cycle, adding the effect of human interaction into their drawings. Students should include many of the following elements in their drawings: surface water, groundwater, canals, the ocean and the atmosphere. Human interference should be indicated by such things as: pumping water out of the ground for residential use, discharges from industrial sites, agricultural irrigation, recreational use, and discharges from sewage treatment plants.

Assessment

Active participation in the discussion; accuracy of students' diagrams.

THE HYDROLOGIC CYCLE

Water in the hydrologic or water cycle begins as surface water. It is warmed by the Sun to the point of evaporation. When it evaporates, it turns to vapor and rises in the atmosphere. Water is also turned into vapor through the process of transpiration. The combination of evaporation and transpiration is called evapo-transpiration. As the water vapor rises, it cools and condenses. Condensation is the process by which the vapor becomes a liquid again or turns directly into a solid (ice, hail or snow). These water particles then collect and form clouds.

The heavier liquid falls to earth as rain or precipitation. Some of the precipitation runs off into creeks and ditches and some percolates downward into the ground until it reaches the water table where it is stored in a natural underground rock formation known as the aquifer. Water that percolates into the aquifer usually stays there until someone pumps it out. Water that does not percolate into the ground warms up and turns back into vapor. The vapor rises, cools, turns back into microscopic water droplets and forms clouds. Next thing you know, it is raining again and the whole cycle repeats itself.

HUMANS AND THE HYDROLOGIC CYCLE

The earth's water supply remains constant, but man is capable of altering the cycle of that fixed supply. Population increases, rising living standards, and industrial and economic growth have placed greater demands on our natural environment. Our activities can create an imbalance in the hydrologic equation and can affect the quantity and quality of natural water resources available to current and future generations.

Water use by households, industries and farms has increased. People demand clean water at reasonable costs, yet the amount of fresh water is limited and the easily accessible sources have been developed. As the population increases, so will our need to withdraw more water from rivers, lakes and aquifers, threatening local resources and future water supplies. A larger population will not only use more water but will discharge more wastewater. Domestic, agricultural and industrial wastes, including the intensive use of pesticides, herbicides and fertilizers, often overload water supplies with hazardous chemicals and bacteria. Also, poor irrigation practices raise soil salinity and evaporation rates. These factors contribute to a reduction in the availability of potable water, putting even greater pressure on existing water resources.

Large cities and urban sprawl particularly affect local climate and hydrology. Urbanization is accompanied by accelerated drainage of water through road drains and city sewer systems, which even increases the magnitude of urban flood events. This alters the rates of infiltration, evaporation, and transpiration that would otherwise occur in a natural setting. The replenishing of ground water aquifers does not occur or occurs at a slower rate.

Together, these various effects determine the amount of water in the system and can result in extremely negative consequences for river watersheds, lake levels, aquifers, and the environment as a whole. Therefore, it is vital to learn about and protect our water resources.

Oral Quiz on the Hydrologic Cycle

(Teacher's Notes)

1. What are the six major components of the hydrologic cycle? Define each component.

Evaporation, Transpiration, Condensation, Precipitation, Percolation, and Runoff

Evaporation is the process of returning moisture to the atmosphere. Water on any surface, especially the surfaces of mudholes, ponds, streams, rivers, lakes, and oceans, is warmed by the sun's heat until it reaches the point at which water turns into the vapor, or gaseous, form. The water vapor then rises into the atmosphere.

Transpiration is the process by which plants return moisture to the air. Plants take up water through their roots and then lose some of the water through pores in their leaves. As hot air passes over the surface of the leaves, the moisture absorbs the heat and evaporates into the air. Evapo-transpiration is the combined net effect of two processes: evaporation and transpiration. Evapo-transpiration uses a larger portion of precipitation than the other processes associated with the hydrologic cycle.

Condensation is the cooling of water vapor until it becomes a liquid. As the dew point is reached, water vapor forms tiny visible water droplets. When these droplets form in the sky and other atmospheric conditions are present, clouds will form. As the droplets collide, they merge and form larger droplets and eventually, precipitation will occur.

Precipitation is moisture that falls from the atmosphere as rain, snow, sleet or hail. Precipitation varies in amount, intensity and form by season and geographic location. These factors impact whether water will flow into streams or infiltrate into the ground.

Percolation is the downward movement of water through soil and rock. Percolation occurs beneath the root zone. Ground water percolates through the soil much as water fills a sponge, and moves from space to space along fractures in rock, through sand and gravel, or through channels in formations such as cavernous limestone.

Runoff is the movement of excessive rain that flows across the earth's surface towards streams, lakes, creeks, ditches, canals, oceans, or depressions in the earth's surface. The characteristics that affect the rate of runoff include rainfall duration and intensity as well as the ground's slope, soil type and ground cover.

Oral Quiz on the Hydrologic Cycle, cont.

2. Is water is a finite or infinite source?

Water is a finite source.

3. Where does our drinking water come from?

Drinking water in South Florida comes from the aquifer.

4. Which two processes in the hydrologic cycle are important for increasing our drinking water supply?

Percolation and precipitation. Make sure students understand the connection between rainfall and drinking water – what comes down as rain, comes out our tap later.

Written Exercise: Ask students to list answers to the following questions:

1. How is water used for agriculture?

Irrigation of sugar cane, vegetables and citrus groves; processing fruit

2. How is water used in homes?

Cooking, flushing toilets, lawn irrigation, washing cars, swimming pools, bathing and showering, brushing teeth, washing hands

3. How is water used by industry?

Manufacturing processes, sewage treatment, car washes, restaurants

4. How is water used in the Everglades?

Root uptake by plants, drinking and bathing for animals, evapo-transpiration

What's Going On With Our Water?
Lesson Two: The Everglades Watershed

Objectives

Students will understand the natural historical flow of water through the Everglades ecosystem and be able to discuss how the water flows today as a result of the changes made by the U.S. Army Corps of Engineers in the 1940's as part of the Central and Southern Florida (C&SF) Flood Control drainage project.

Materials

The Challenge of Water Management Poster (poster of South Florida's present day drainage system - available at the South Florida Water Management District)

Canals of the South Florida Water Management District (map available at the South Florida Water Management District)

Student handouts: Everglades Fact Sheet, the Natural Water System of South Florida, and South Florida's People-made Water System

Procedures

Distribute student handouts in advance and ask students to read the material before class.

Lead a discussion of how the Everglades area appeared before it was drained. If possible, obtain pictures of the historic Everglades. Refer to the handout of the pre-dredged condition as well as to the attached description.

Activity

After the discussion, ask students to answer an oral quiz. List their answers on the board.

Assessment

Participation in discussion and quiz.

The Everglades Watershed/Ecosystem

The Everglades ecosystem has been called the River of Grass because the Everglades is actually a river system with sawgrass that grows throughout. In some places the sawgrass is so thick, you cannot see the water.

The Everglades region is actually one part of a vast ecosystem encompassing the Kissimmee River watershed, Lake Okeechobee, the Everglades and Florida Bay. The system starts close to Disney World in Orlando. The water flows down through the Kissimmee River southward toward Lake Okeechobee, then into the wide flatlands and on into the Gulf of Mexico. Lake Okeechobee is the "heart" of the system with the Kissimmee River (C-38 canal) to the north, and the sawgrass Everglades to the south of the lake, eventually connecting to Florida Bay.

The historical river of grass was a few inches deep, up to 50 miles wide and 100 miles long. Historically, during the rainy season when the level of Lake Okeechobee rose and spilled naturally over its southern banks, the waters crept through the marshlands of the Everglades in one broad sheet of water. The water was brackish, rich with shrimp, lobster, crab, fish, turtles, alligators and birds.

(Continue discussion using a schematic of the current water flow through the Everglades and a map showing the canals and structures that resulted from the dredging project.)

The Everglades originally covered 4,000 square miles between Lake Okeechobee and Florida Bay. From the 1880's through the 1970's, a series of drainage and flood control projects resulted in a complex system of water retention areas, gates and pumping stations to accommodate agriculture and development. The canal system provided bat access, drainage, flood control, irrigation and water supply. Unfortunately, the canal system also interrupted the natural flow of water through the ecosystem. Populations of many native plants and animals are now reduced. Exotic plants now replace the native vegetation.

Today, the Everglades is no longer a free-flowing river. A dam now holds water back from Lake Okeechobee. Three huge reservoirs called "Water Conservation Areas" trap most of the water, creating three lakes. The flooding of these areas has resulted in a loss of wet prairie habitats. Some of the water is allowed to flow into Everglades National Park by opening flood gates along Tamiami Trail. Primary canals carry the rest to sea.

Because the water "isn't right" throughout the River of Grass, many birds are not able to feed and nest, so they leave the area. Also, without fresh water flows from the Everglades, Florida Bay becomes more salty. If it gets too salty, shrimp, lobster, crab and fish populations decline.

Oral Quiz on the Everglades

(Teacher's Notes)

1. What were the objectives of the engineers who altered the Everglades from its original natural and historical state?

To provide access from Lake Okeechobee to the Atlantic Ocean and the Gulf of Mexico (navigation/transportation)

To make land suitable for development (this and navigation were the original reasons the Everglades were altered)

To carry water away from populated areas and farms during major storms and hurricanes (flood control)

To contain water within Lake Okeechobee for water supply and to release it from the lake during times of high water such as hurricanes. (The great hurricane of 1928 caused 1836 deaths, 1870 injuries, and $287 million worth of damage)

To provide for the water needs of a growing population.

2. Draw a diagram of the primary features of the historical Everglades. Identify each feature and describe its function.

Lake Okeechobee, eastern Atlantic Ridge, Everglades area, Florida Bay and the Biscayne Aquifer.

3. Draw a diagram of the primary features of present day Everglades. Identify each feature and describe its function.

Dyke around Lake Okeechobee, development along the eastern Atlantic Ridge, Water Conservation Areas, Everglades agricultural area, the natural Everglades area, primary canals to the east through Palm Beach, Broward and Miami-Dade counties, the St. Lucie Canal, Florida Bay and the Biscayne Aquifer.

Oral Quiz on the Everglades, cont.

4. What are the effects of these changes?

A lot less water is flowing through the Everglades because it is being diverted by the canals to the ocean and stored in Lake Okeechobee by the dyke. As a result, the vegetation in the Everglades is dying, and the animals that depend on the plants are also dying.

Fertilizers from the agricultural area are polluting the Everglades with phosphorus, causing the vegetation to die even faster and polluting the water.

The water sent out the canals is dumping fresh water in the coastal areas (estuaries), and the resulting change in salinity is killing local animals such as shrimp, crabs and lobsters.

Lake Okeechobee is being kept at levels that are artificially high which ruins the natural ecology. Historically, Lake levels rose and dropped seasonally. Now the Lake is kept high all the time.

Everglades Fact Sheet

(Student Handout)

- The Everglades ecosystem has been called the River of Grass because the Everglades is actually a river system with sawgrass that grows throughout. In some places, the sawgrass is so thick, you cannot see the water.

- The Everglades region is actually one part of a vast ecosystem encompassing the Kissimmee River watershed, Lake Okeechobee, the Everglades and Florida Bay. The system starts close to Disney World in Orlando. The water flows down through the Kissimmee River southward toward Lake Okeechobee, then into the wide flatlands and on into the Gulf of Mexico. Lake Okeechobee is the "heart" of the system with the Kissimmee River (C-38 canal) to the north, and the sawgrass Everglades to the south of the lake, eventually connecting to Florida Bay.

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- The Seminole and Miccosukee Indians who lived in the Everglades used the wildlife for food. Because their populations were small, what they took from the Everglades was not harmful.

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Everglades Fact Sheet, cont.

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- Some of the water is allowed to flow into Everglades National Park by opening flood gates along Tamiami Trail. Primary canals carry the rest to sea.

- Water flowing through the Everglades today is polluted by high levels of mercury, nitrogen and phosphorus.

- Because the water “isn’t right” throughout the River of Grass, many birds are not able to feed and nest so they leave the area. Also, without fresh water flows from the Everglades, Florida Bay becomes more salty. If it gets too salty, shrimp, lobster, crab and fish populations decline.

- Today, the population of South Florida is approaching 5 million. Water flowing from your faucet at home would have been part of the Everglades system years ago.

- For more information on the Everglades check out these two web sites:
  www.evergladesplan.org
  www.sfwmd.gov

NOTE: See Diagrams of:

The Hydrologic Cycle

Natural Water System of South Florida (Old Florida)

People-Made Water System of South Florida (New Florida)

Infrared Photo of the State of Florida showing manmade canals

Order posters and maps from the South Florida Water Management District, or use examples of water systems in your geographic area.