Mounts Botanical Garden of Palm Beach County

Teacher Guide

Clean Clear Water

The goal of this program is to introduce middle school students to the Everglades ecosystem and the critical role that water plays in the overall health and well being of all who live here. Through our classroom program and hands on activities, students will see first hand the work that is being done to preserve the health of the Everglades. Through education, we can all do our part to ensure that this unique ecosystem found nowhere else on earth will be here for future generations.

This packet includes activities and information that will be helpful in preparing your students for their time at Mounts Botanical Garden and their classroom experience.

The program and water testing activities were designed to inspire civic responsibility and a sense of stewardship over our natural resources.

In South Florida, when we talk about natural resources it all comes down to

WATER...

Florida's Aquifers

South Florida is one of the wettest areas of the country and typically gets about 53 inches (4.42 feet) of rainfall each year. Sometimes, more than half of that rainfall comes in less than a two-month span in late summer.
With all of that rain, why don't we experience flooding like you see the rest of the country where towns are flooded and rivers overflow taking cars and homes with them?

It has to do with the geology of Florida...the ground beneath us. Florida's underground is made up primarily of multiple layers of porous rock such as limestone or sandstone. Instead of rainwater remaining on the surface of the land, the pores, or holes in the underground rock, enable water to percolate through it, being naturally cleaned of wastes as it moves downward where it is stored in enormous underground basins.
These underground basins are known as aquifers, and they are where 90% of the state's drinking water comes from. Florida's aquifers are among the most productive in the world, supplying more than 8 billion gallons of water each day.

In South Florida, we have three primary aquifer systems which vary in depth, composition and location. They are: The Surficial Aquifer System, the Intermediate Aquifer System, and the Floridan Aquifer System.

Surficial Aquifer System

- Widespread and shallow (100-300 feet underground)
- Recharged primarily by rainfall.
- Water levels can change rapidly in response to draught or rainfall, as well as withdrawals by pumping.

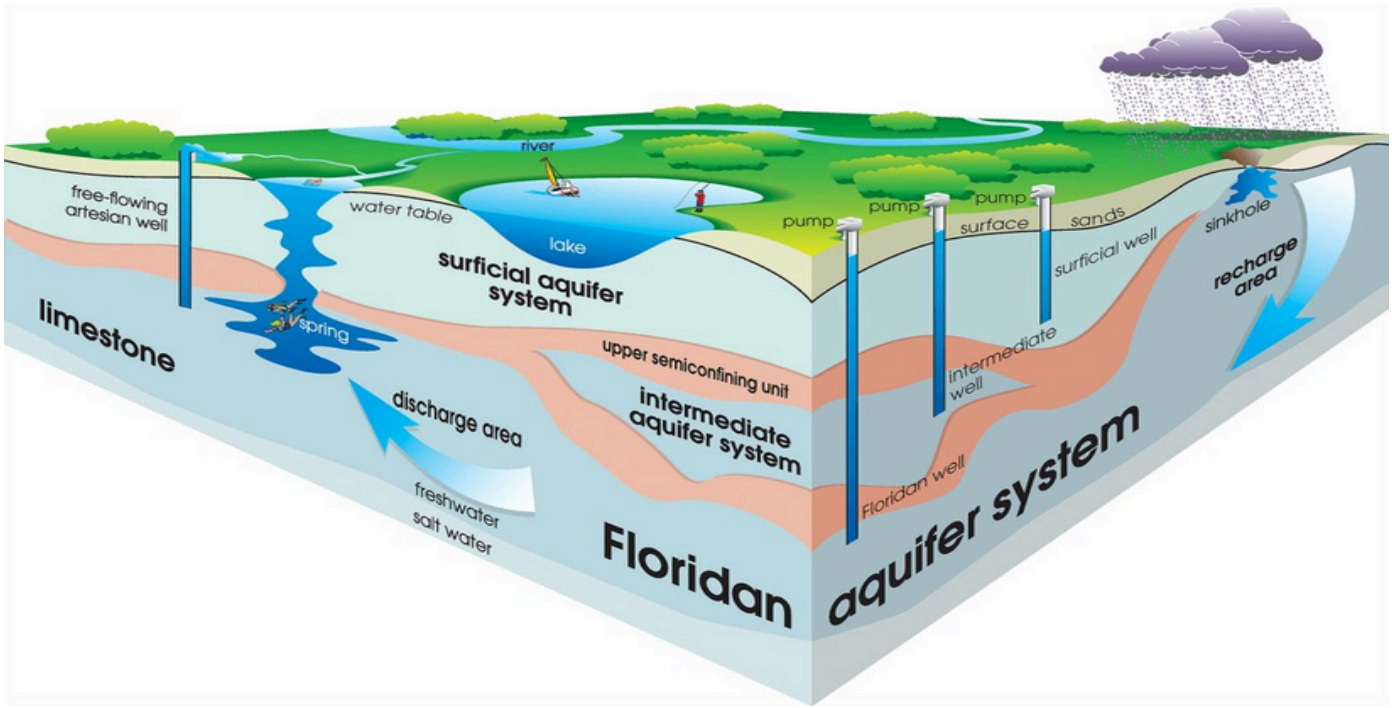
The Biscayne Aquifer is part of the Surficial Aquifer System and is the most intensely used water source in Florida. Covering more than 4000 square miles, the Biscayne Aquifer provides water to Palm Beach, Broward and Miami-Dade counties, some of the most densely populated areas of the state with more than 5 million residents.

Intermediate Aquifer System

- Lies between the Surficial and the Floridian Aquifers.
- The main source of water for the western counties in central Florida.

Floridan Aquifer System

- The largest, oldest, and deepest aquifer in the southeastern U.S. It



Everglades Wetlands

The wetlands of the Florida Everglades cover most of southern Florida, starting near Lake Okeechobee reaching all the way to the Florida Bay on the southernmost coast. Also known as the "River of Grass," the wetlands of the Florida Everglades are a very slow moving shallow river dominated by sawgrass marsh. In its southward course, the water passes through diverse habitats including cypress swamps, wet prairie and mangroves.

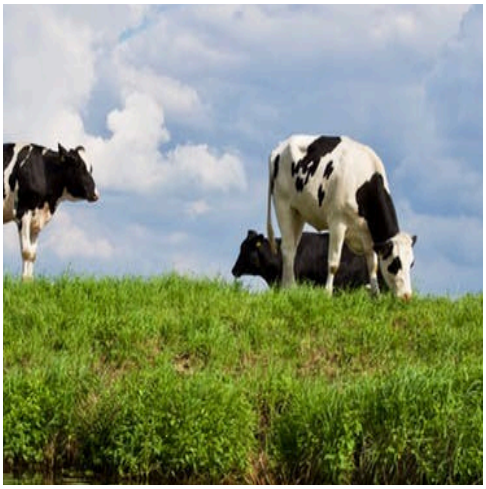
The water that flows through the Everglades ecosystem provides critical resources to people. It improves water quality by filtering out pollutants and absorbing excess nutrients, replenishes our aquifers, and reduces flooding.

In order to be classified as a wetland, an area will have two main characteristics:

1. Poorly drained soils, also known as hydric soils.
2. Home to a unique diversity of wildlife and vegetation specifically adapted to thrive in wet environments. Plants that can be found in these wetland environments have many interesting alternative strategies to obtain and transfer oxygen. Some of these adaptations might appear as: "knees" in a tree's root system that jut out of the ground and extend above the high water mark. They are thought to help absorb oxygen as well as help stabilize the trees in saturated soil.

Shallow or exposed roots that pick up oxygen from the surface, aerobic soil layers, and hollow tubes or air spaces that transport oxygen to the roots.

Swollen tree trunks that are usually thickened to the height of deepest water inundation. This is thought to decrease the chance of trees being uprooted.



The introduction of humans to the Florida Everglades has created serious effects to the natural ecosystem. Pollution from agricultural and cattle farms has caused a change in the delicate balance of the water quality. Roads and levees originally built to keep human developments from flooding have obstructed the natural flow of water.

In turn, many of the plants and animals living in the wetlands have been unable to adapt to the change in the water flow and quality and have seen a drastic reduction in populations.

According to the U.S. Geological Survey...

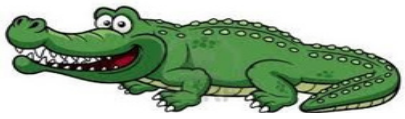
as Everglades wetland areas deteriorated:

- 68 plant and animal species quickly became threatened or endangered.
- The number of breeding wading birds dropped by 90%.
- Recreationally important fish species began to decline.
- Seagrasses in Florida Bay died off.

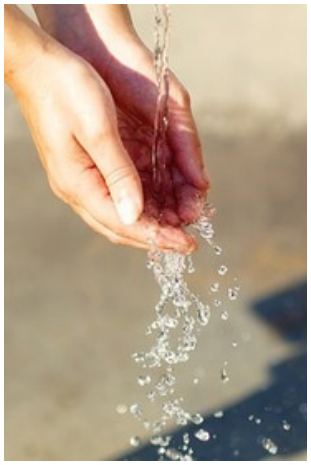
Humans also use an abundance of water in their everyday lives; for cooking, bathing, lawn maintenance, recreation, and countless other activities. Every drop of water we touch will eventually go back into the ecosystem changed. It may contain oil washed from roads during rain storms, detergents from cleaning and bathing, fertilizer from our lawns, and chlorine and other chemicals from pools and recreational swimming areas.

Currently, the largest environmental restoration project ever in the U.S. is underway in the Everglades, the goal is bring the River of Grass back to a healthy ecosystem.

See What Everglades Restoration is about: Watch this short video at:
https://www.evergladesrestoration.gov/about/



C.E.R.P.



What is being done to restore the Everglades to a healthy, thriving ecosystem?

By the 1980s scientists, environmentalists and the National Park Service realized the health of the Everglades was declining rapidly and that something needed to be done to correct the problems.

Historically, over 450 billion gallons of water per year flowed southward into Everglades National Park across what is now the Tamiami Trail. By the year 2000, the amount of water flowing southward had been cut nearly in half, and only 260 billion gallons were now flowing along this path.

THE SOLUTION?

C.E.R.P.: The Comprehensive Everglades Restoration Plan. It was enacted by the U.S. Congress in 2000 for the restoration of the Everglades Ecosystem in southern Florida. It was the result of 10 years of planning by scientists, policy makers, and public stakeholders and uses the best possible science to restore the flow of freshwater to the natural system.

THE GOAL?

Not just supplying more water to the ecosystem, but getting thewater right!

Q Q T D

The solutions to Everglades Restoration can be framed by four interrelated factors: **QUANTITY, QUALITY, TIMING, and DISTRIBUTION (QQTD).**

The principal goal of restoration is to deliver the right amount of water, of the right quality, to the right places, and at the right time. The comprehensive plan consists of over 60 components that work together to accomplish these hydrologic improvements.

QUANTITY

According to US Geological Survey; on average, 1.7 BILLION gallons of water that once flowed through the ecosystem are wasted each day through discharges to the ocean or gulf. C.E.R.P. plans are to capture this water and store it in new reservoirs and treatment areas to be released when needed. Of the water captured by the plan, 80% will go to the environment and 20% will be used to enhance urban and agricultural water supplies.

QUALITY

Excess phosphorous, mercury, and other contaminants harm the region's surface and ground water. The Plan will greatly improve the quality of water being released into the Everglades by first directing the water to storage reservoirs and Stormwater Treatment Areas (STAs). STAs are also called constructed wetlands and over 45,000 acres of them are removing excess nutrients and cleaning the water through green technology; using plants that absorb excess nutrients in the water and store them in their leaves or in the soil.

TIMING

Alternating periods of flooding and drying, called hydroperiods, are natural and vital to the historical functioning of the Everglades Ecosystem. The timing of water held in reservoirs and released into the ecosystem now more closely matches natural patterns to mimic natural rainfall patterns and is reducing damage done by too much or too little fresh water in areas where the proper water levels are vital to the health and well being of nesting birds, plants animals and shoreline erosion.

DISTRIBUTION

The movement of water is the final factor in the Plan's equation. Over 50% of the original Everglades have been lost to urban and agricultural development. The remainder has been separated by roads, canals, and levees. The Plan will remove more than 240 miles of levees and canals to improve the connectivity of natural areas and to enhance sheetflow.

We will be visiting the Arthur R. Marshall Loxahatchee National Wild Refuge on our field trip. There is a special area you will see that is an integral part of the future of Everglades Conservation. LILA stands for Loxahatchee Impoundment Landscape Assessment. It is a working, 80-acre model of the Everglades ecosystem. This living laboratory gives scientists opportunities to apply restoration techniques on a small, controlled scale before implementation in the 1.7 million acre Everglades ecosystem.

Things to check out!

- Video about water flow and Scientists working at LILA: http://www.smithsonianmag.com/ videos/category/science/florida-everglades-restoring-the-wetlands/
- South Florida Water Management District's website: https://www.sfwmd.gov/. Find real time readings including rainfall, the depth of Lake Okeechobee and current water conditions

Fun Facts

The Everglades is:

- Home to wildlife and habitats found nowhere else on Earth!
- 2X the size of the state of New Jersey!
- The largest designated wilderness in the eastern U.S.!
- Home to 13 endangered and 10 threatened species!
- The only place in the world where alligators and crocodiles co-exist! Sawgrass is not actually grass, but a large sedge plant.

Scientist consider it to be one of the oldest plant species on Earth today! Scientists and technicians make approximately 27,000 visits per year to water quality monitoring systems!

In 2013, Stormwater Treatment Areas treated enough water to cover the island of Manhattan with 54 feet of water!

Program Objectives

At the end of the Program, students will be able to:

1.) Define the following vocabulary words:

- Benthic
- C.E.R.P.
- Detritus
- Humous Soil
- Hydric Soils
- Hydrophytic Plants
- Pneumatophores
- Q.Q.T.D.
- STA's
- Xeriscape

2.) Analyze the contents of water collected from the wetlands.

3.) Compare and contrast contents of water samples collected from Mounts Wetlands and the Everglades.

4.) Identify causes of pollution in the Everglades.

5.) Explain Q.Q.T.D and how it relates to restoration in the Everglades.

6.) Explain the importance of fresh water aquifers and the threat of salt water intrusion.

7.) Differentiate between vegetation that can live in a wetland and those that cannot.

8.) Plan how to conserve water in and around your home and school.

Definitions

Algae – a diverse group of photosynthetic organisms that lack roots, stems, leaves, and vascular tissues.

Alligator holes – located in marshes and characterized by three components: a depression in the muck; water to fill the resulting basin; and alligators to create and maintain the hole. Important because they remain filled with water during the dry season.

Amorphous – without a clearly defined shape or form. Anaerobic – living in the absence of oxygen.

Aquifer – the underground formation of rock or sand that stores water: people with wells pump water from aquifers for home use.

Benthic – pertaining to organisms that live on rock or sediment beneath a body of water.

Biodiversity – a variety of life in the world or in a particular habitat or ecosystem.

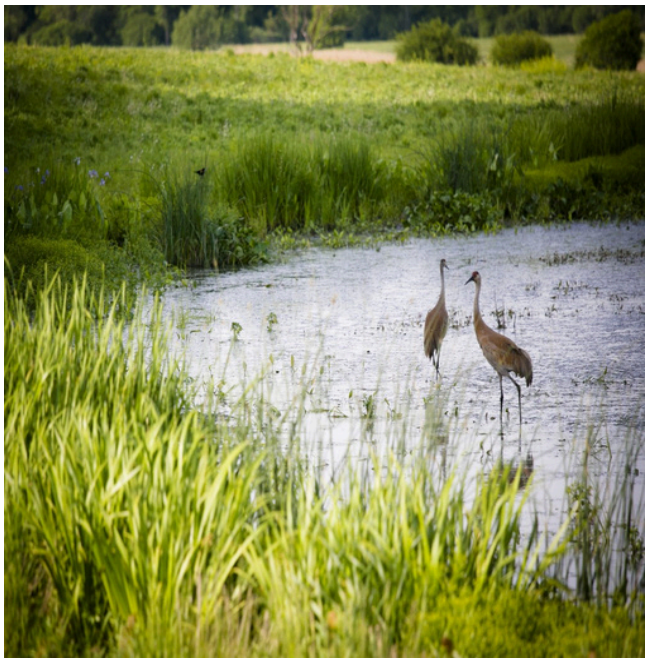
Biome – A large naturally occurring community of flora and fauna occupying a major habitat.

Brackish – somewhat salty, containing salt. Where fresh water mixes with salt water.

CERP – Comprehensive Everglades Restoration Plan: a 30 year, $10.9 billion series of water-system and environmental improvements to restore the Everglades. It is the most ambitious restoration project ever undertaken in North America. Approved by congress in 1999.

Conservation – a careful preservation of something; especially: planned management of a natural resource to prevent exploitation, destruction, or neglect.

Consumers – an organism that feeds on plants or other animals for energy. There are 4 types: herbivores, carnivores, omnivores and detritivores (decomposers).



Detritus – dead or decaying organic matter.

Drought – a prolonged period with no rain.

Ecology – a branch of science focused on the interrelationships between organisms and their environment.

Ecosystem – a biological community of interacting organisms and their physical environment.

Evaporation – the process of turning from liquid into vapor. It is fundamental part of the water cycle and is constantly occurring throughout nature.

Flora – plant life of a particular region.

Extinct – no longer in existence.

Fauna – animal life of a particular region .

Habitat – the place or environment where a plant or animal lives and grows.

Irrigation – the watering of land by artificial means to foster plant growth.

Ridges and sloughs – a linear pattern of higher sawgrass ridges, separated by deeper water lily sloughs.

Humus soil – amorphous, dark colored soil formed from the decomposition of organic matter.

Hydrated – supplied with water.

Hydric soils – a soil that formed under conditions of saturation, flooding or ponding long enough during the growing season to develop anaerobic conditions in the upper part.

Hydrophytic plants – plants that grow wholly or partly submerged in water. They can be rooted in the mud or floating without anchorage.

Hydroperiod – alternating periods of flooding and drying.

Invertebrate – an animal without a spinal column.

Larvae – immature form of an adult that undergoes metamorphosis prior to changing into the adult form.

Microfauna – animals too small to see with the naked eye, includes protozoa and nematodes.

Micro irrigation – also called drip irrigation, delivers water directly to the root zone of the plant through a network of valves, pipes, tubing and emitters.

Native species – a species that normally lives and thrives in a particular ecosystem.

Non-native Species – AKA Exotic Species – a species living outside its native distributional range, which has arrived there by human activity, either deliberate or accidental.

Organic – natural matter or compounds with a carbon base relating to or derived from living matter.

Peat – partially decayed plant matter formed on the surface of water-logged soils.

Percolation – the downward movement of water through rock and soil toward the water table.

Pneumatophores – roots on wetland plants that function in respiration.

QQTD – Quality, Quantity Timing and Distribution of water. The main factors in the Comprehensive Everglades Restoration Project (CERP).

Recharge – when water is added to an aquifer.

Sawgrass marsh – A large expanse of sawgrass containing standing water for much of the year .

Sediment – particulate organic and inorganic matter which lies on the bottom of an aquatic habitat.

Sloughs – main routes of moving water through the Everglades.

Species of Special Concern – any native species (plant or animal) documented by research or inventory to be at a low population level and likely to become threatened in the near future.

STA – Stormwater Treatment Areas: constructed wetlands that remove and store nutrients through plant growth and the accumulation of dead plant material that is slowly converted to a layer of peat soil.

Substrate – a substance or layer on which an organism lives, grows or obtains its nourishment.

Sustainability – continued indefinitely.

Swamps – Wetlands dominated by woody plants. Characterized by saturated soils during the growing season and standing water during certain times of the year.

System – a group of interacting natural bodies that, together, perform one or more vital functions.

Threatened species – plants or animals likely to become endangered in the near future.

Transpiration – a process in which water absorbed by plant roots is lost from pores in the leaves.

Vertebrates – any group of animals that has an internal skeletal system including a backbone.

Watershed – a region drained by surface and groundwater flow in rivers, streams or other surface waterways.

Water table - the level below which the ground is saturated with water.

Wet prairie – dominated by emergent plants including grasses and other low growing plants in large areas of open water.

Wetlands – areas where the water table is at, near, or above the land surface for a significant part of most years.

Wetland – land consisting of marshes or swamps; saturated land.

Xeriscape – the conservation of water and energy through creative landscaping.