

A Question of Quality

Grade Level: 9th - 12th

Objective:

Students will be able to:

- Explain how a Stormwater Treatment Area reduces phosphorus levels in the Everglades.
- Describe the effects of excess phosphorus on the Everglades ecosystems.
- Analyze Stormwater Treatment Area sample data and infer the effectiveness of the station
- Determine the effects of human activity on water quality.

Standards:

- SC.912.L.17.17 - Assess the effectiveness of innovative methods of protecting the environment.
- SC.912.L.17.16 - Discuss the large-scale environmental impacts resulting from human activity, including waste spills, oil spills, runoff, greenhouse gases, ozone depletion, and surface and groundwater pollution.
- MAFS.912.S-IC.2.6- Evaluate reports based on data

Everglades Literacy Conceptual Framework Connections:

- Fundamental Concept 1
- Fundamental Concept 2
- Fundamental Concept 6
- Fundamental Concept 7

At A Glance:

Students will learn about water quality management for the Everglades and will analyze sample data from a Stormwater Treatment Area.

Background:

Water quality is defined as the physical, chemical, and biological condition of water as applied to a specific use.

To assess water quality within 16 South Florida counties, the South Florida Water Management District monitors surface water in a variety of locations, including canals, pumping stations, agricultural discharges, and many other types of aquatic environments.

Southern Florida's primary source of fresh water is from rainfall. Excess rainwater, or stormwater, drains away in the canal system that protects southern Florida from flooding. This excess water is called **stormwater runoff**.

Stormwater runoff also carries nutrients off the landscape, especially fertilizers used in suburban, agricultural and urban settings. These nutrients flow mainly from farms, but also from lawns, roadways and other developed areas into the Everglades. Scientists have determined that a common ingredient in fertilizer, phosphorus, has put the fragile Everglades environment at risk.

Phosphorus, chemical symbol P, atomic number 15, is one of the 94 naturally occurring elements. It is used in a broad variety of industries and is an essential nutrient to almost every life form on Earth. High concentrations of phosphorus can cause rapid and extensive growth of aquatic plants and algae, leading to depletion of oxygen dissolved in the water. This adversely affects animal populations. Cattails grow too thick for birds or alligators to nest in, and depleted oxygen levels and increased algae growth prohibits the growth of native invertebrates on the bottom of the food chain.

In order to remove excess phosphorus, the South Florida Water Management District has constructed **Stormwater Treatment Areas (STAs)**. These STAs are constructed wetlands that remove excess nutrients, such as phosphorus, and play a vital role in protecting and restoring America's Everglades. Wetland plants such as cattail, southern naiad, and algae in the STA uptake phosphorus and store it in their roots, stems and leaves. The water leaving the STA has significantly less phosphorus than the stormwater runoff water flowing in. STAs are critical to water quality in the Everglades, but require construction, maintenance, and monitoring which is often costly. In contrast, source control solution such as BMPs can be lower-cost alternatives to reducing pollution in stormwater runoff

Duration: 60 minutes

Materials:

- Copy of Stormwater Treatment Area PowerPoint
- Copy of STA 2-Cell 3 Data Excel Spreadsheet (1 per student)
- Teacher Key for STA 2-Cell 3 Data
- Student Worksheet (1 per student)
- Student Worksheet Teacher Key
- Copy of Below The Surface (one copy for each student group)
- Student science journals

Vocabulary:

- **Phosphorus** - An element that is essential for life. In freshwater aquatic environments, Phosphorus is often in short supply. Increased levels of this nutrient can promote the growth of algae and other plants.
- **Stormwater runoff** - Excess rain that flows from developed land surfaces.
- **Stormwater Treatment Area (STA)** - A large, constructed wetland designed to remove pollutants, particularly nutrients, from storm water runoff using natural processes.
- **Water quality** - The physical, chemical, and biological condition of water as applied to a specific use.

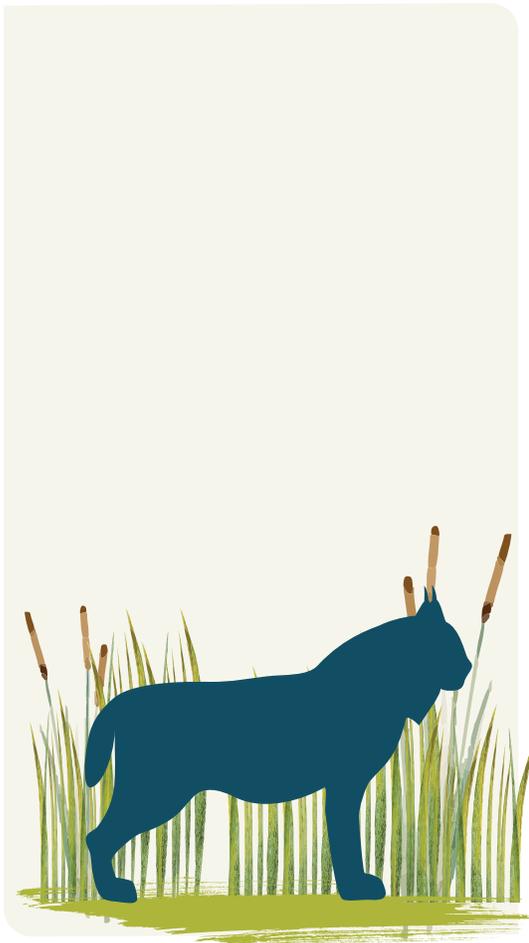
so that less treatment is needed by an STA. STAs are monitored on a regular basis by SFWMD personnel to ensure the quality of water is maintained.

Preparation:

1. Print copies of [Below the Surface](#) article for each student group.
2. Print out student worksheets.
3. Download PowerPoint. Note: The video on slide 9 is embedded and should play when you click the link.

Procedure:

1. Begin the lesson by asking students if anyone knows what stormwater runoff is. After allowing for some student responses, explain that Southern Florida's primary source of fresh water is from rainfall. Excess rainwater, or stormwater, drains away in the canal system that protects southern Florida from flooding. This excess water is called stormwater runoff. Tell students that stormwater runoff has caused many pollution problems, especially in the Everglades, but scientists have designed one effective method to minimize one of the primary nutrients causing the pollution by using managed wetlands.
2. Tell students they will now jigsaw an article to learn more about the problems caused by stormwater runoff and how scientists are using these wetlands to combat the problem (Optional: read more about the [jigsaw reading strategy](#)). Divide students into seven groups (one for each section of the article) and assign each group a section from the article, Below The Surface – an in-depth look at Everglade Stormwater Treatment Areas. All groups should read page one and then their assigned section. Give students five minutes to read their section (they are very short) and choose a representative from their group to report out the main ideas in their own words from their section to the entire class. Create a chart on the board for each group to also record these ideas.
3. Now show students the PowerPoint with additional background information on Stormwater Treatment Areas (STAs). Stop the PowerPoint when you get to slide 13. Ask students to add any new information to their class chart about Stormwater Treatment Areas that they learned from the PowerPoint. Tell students they are going to look at real-life data gathered from STA-2, a Stormwater Treatment Area that is located just north of the Everglades Protected Area. Point out STA-2 on the map.
4. Advance the PPT to the next slide (14) – a graph of the performance of STA-2 from the year 2000 to 2012. Point out to students that the green bar shows the amount of phosphorus coming into STA-2 and the grey bar shows the amount of phosphorus going out. Guide students to notice the reduction in phosphorus at the outflow compared to the inflow, and that the outflow is almost always below 20 ppb despite how high the inflow is. Guide them to notice what year had the biggest amount of phosphorus reading. Point out the tropical storm icon pointing to that year. Ask students why they think a hurricane would affect phosphorus? Ask students what other weather events might affect phosphorus levels?



5. Advance the PowerPoint to slide 15 – the diagram of STA-2. Tell students that they will be looking at data collected from cell 3 of STA-2. Tell students that cell 3 is a 2,324-acre portion of an over 15,000 acre STA that contains plants and algae that uptake phosphorus and remove it from the water stream. Tell them that water enters the cell from the Hillsboro canal at the north end, at G333 and flows south through the vegetation until it is pumped out of the cell at G334. Point out these areas on the diagram. Depending on rainfall, the water will spend various amounts of time in the cell. Periodic testing is done to collect phosphorus levels.
6. Give students a copy of the Excel directions and the Student Worksheet. Tell them this is actual data collected by SFWMD in 2012. Ask them to look at the data in Excel and answer the questions on the Student Worksheet.
7. Conclude lesson with whole class discussion. Show the final slides with the final graphs and review the questions on Student Worksheet.
8. Have students answer questions in their science journal (see assessment).

Assessment:

In their science journal, have students answer the following questions:

1. What is the main source of phosphorus found in the Everglades? (Fertilizer from stormwater runoff from farms, but also from lawns, roadways and other developed areas).
2. Explain the process that removes the phosphorus from the stormwater runoff (See background information).
3. How does weather affect the amount of phosphorus present? (More precipitation means more stormwater runoff, which leads to more phosphorus).
4. What do you think would happen to the Everglades if the Stormwater Treatment Areas were removed? (Phosphorous levels would increase, and the algae would increase, changing the oxygen levels and affecting the ecosystems).
5. What is one additional benefit of the STAs? (They have become home to a great deal of Florida wildlife).

Resources:

Below the surface- an in depth look at Everglades Stormwater Treatment Areas. South Florida Water Management District. Retrieved from https://my.sfwmd.gov/portal/page/portal/xrepository/sfwmd_repository_pdf/bts_sta.pdf

FAU/Pine Jog Environmental Education Center.

Piccone, T., & Zamorano, M. STA Schematic Maps. In 2013 South Florida Environmental Report (Appendix 5-1). Retrieved from http://my.sfwmd.gov/portal/page/portal/pg_grp_sfwmd_sfer/portlet_prevreport/2013_sfer/v1/appendices/v1_app5-1.pdf

Pietro, K. (2012). Synopsis of the Everglades Stormwater Treatment Areas, Water Year 1996–2012. South Florida Water Management District. STA Cell 3 Data retrieved from DB HYDRO database: <https://www.sfwmd.gov/science-data/dbhydro>