ENVIRONMENTAL FACTORS OF THE EVERGLADES
Lesson 1

The Heart of a Watershed

Grade Level: 9th - 12th

Objective:

Students will be able to:

- Design a model depicting the main components of the K-O-E watershed.
- Illustrate the alterations to the historic K-O-E watershed.
- Discuss the environmental impacts resulting from the channelization of the Kissimmee River.

Standards:

- SC.912.L.17.16 - Discuss the large-scale environmental impacts resulting from human activity… and surface and groundwater pollution.
- SC.912.L.17.8 - Recognize the consequences of the losses of biodiversity due to catastrophic events, climate changes, human activity, and the introduction of invasive, non-native species.
- LAFS.K12.W.1.1 - Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence.

Everglades Literacy Conceptual Framework Connections:

- Fundamental Concept 3

Duration: 60 minutes

At A Glance:

In small groups, students build a model landscape to illustrate the uniqueness of the Kissimmee-Lake Okeechobee-Everglades (K-O-E) watershed and use a model to demonstrate how alterations have affected it.

Background:

Geographically, the Everglades is a region known as the Greater Everglades watershed or the Kissimmee-Lake Okeechobee-Everglades watershed draining nearly 18,000 square miles (over 46,600 square kilometers). This is a large, diverse, and complex region that includes 16 counties, from Orange County in the north to Monroe County in the south, and from Collier County on the west coast to Miami-Dade, Broward, and Palm Beach counties on the east. To the north, it includes the Upper Chain of Lakes and the Kissimmee River floodplain. At the center is Lake Okeechobee, dubbed "the heart of the Everglades". South of Lake Okeechobee the Everglades encompasses areas such as the Everglades Agricultural Area, Loxahatchee National Wildlife Refuge (also known as Water Conservation Area 1), Water Conservation Areas 2 and 3, Big Cypress National Preserve, Everglades National Park, and Florida Bay. The marine environment of Florida Bay is also considered part of the Everglades because its sea grasses and aquatic life are attracted to the constant discharge of fresh water.

Water is the dominant element in the Everglades, and it shapes the land, vegetation, and animal life of southern Florida. The southern Florida climate was once arid and semi-arid, interspersed with wet periods. Between 10,000 and 20,000 years ago, sea levels rose, submerging portions of the Florida peninsula and causing the water table to rise. Fresh water saturated the limestone, eroding some of it and creating springs and sinkholes. The abundance of fresh water allowed new vegetation to take root, and through evaporation formed thunderstorms. Limestone was dissolved by the slightly acidic rainwater. The limestone wore away, and groundwater came into contact with the surface, creating a massive wetland ecosystem. Although the region appears flat, the wearing away of the limestone in some areas created slight valleys and plateaus—a difference of inches in elevation—that affected not only the flow of water, but also types of vegetation present.

Watersheds are separated from each other by areas of higher elevation called a ridge line or divide (ex. The Central Florida Ridge is a divide). Near the divide of a watershed, water channels are narrow and water moves fast. At lower elevations, the slope of the land decreases, causing water to flow more slowly. As smaller streams merge together, the width of the channel increases. Eventually, water collects in a wide river that empties into a body of water, such as a lake or an ocean.

Materials:

- Animated version of the watershed flow

For each group:

- Pan
- Modeling Clay
- Toothpicks
- Small Post-its
- Water
- Measuring Cup
- 2-inch-thick book or binder
- Map of Historic Everglades
- Map of Altered Everglades
- Student Instruction Pages

Vocabulary:

- **Channelization** - Reducing the length of the channel by substituting straight cuts for a winding course.
- **Divide** - A ridge of land between two drainage basins.
- **Drainage basin** - An extent or an area of land where surface water from rain converges to a single point at a lower elevation, usually the exit of the basin, where the waters join another water body, such as a river, lake, reservoir, estuary, wetland, sea, or ocean.
- **K-O-E watershed** - Kissimmee - Lake Okeechobee - Everglades watershed, an area of about 9,000 square miles that once extended as a single hydrologic unit from present-day Orlando 250 miles south to Florida Bay.
- **Swamp and Overflow Land Act of 1850** - Made all Florida swamp lands the property of the state.
- **Watershed** - A region draining into a river, river system, or other body of water.

Areas of the K-O-E watershed deviate from this pattern. While there are smaller streams draining into Lake Okeechobee, the principle conduit for water from the north is the Kissimmee River. Historically, there was not a single recognizable watercourse on the southern border of the lake. Instead, water spilled over the southern portion of the lake and slowly moved in a wide sheet through the flat and level grasslands of the Everglades, eventually emptying into Florida Bay. Only a few small rivers flowed eastward through the coastal ridge. The pace at which the sheet-like flow of water moved across the historic Everglades could take anywhere from a month to a year. Water that moved down the flat and level surface landscape flowed so slowly that, in effect, it was stored from one season for use in another. Because of this storage and slow flow in the natural system, summer rains kept wetlands flooded and maintained freshwater flows to coastal estuaries well into the dry winter season. This made water available to wildlife and reduced susceptibility to changes in rainfall, which can vary dramatically from season to season.

In the mid 1800's, the wetlands of southern Florida covered an area of almost nine million acres and provided a variety of wildlife habitats. This large area was vast enough to support animals that had large feeding ranges or special habitat needs, and was big enough to recover from natural disasters such as hurricanes, fires, and other natural disturbances.

Human interference in the natural water flow systems of the Everglades began as early as the mid 1800s, when Congress passed the **Swamp and Overflow Land Act of 1850**. This law made all Florida swamp lands the property of the state, and was the first move to drain the land so people could use it. From 1962 to 1970, the United States Army Corps of Engineers embarked on a **channelization** project, dredging the C-38 Canal down the Kissimmee Valley. This shortened the 103-mile (166 km) distance from Lake Kissimmee to Lake Okeechobee to just 56 miles (90 km). After the river was channelized, 40,000 acres of floodplain below Lake Kissimmee dried out, reducing the quality of waterfowl habitat by 90%, and the number of herons, egrets, and wood storks by two-thirds. By changing the speed of the flow in the river, it changed the dissolved oxygen levels. Populations of largemouth bass in the river were consistently lower after the channelization. Stabilized water levels also eliminated adult fish spawning and foraging habitat, as well as reducing the shallow, protected areas for juvenile fish. While the Kissimmee was not a significant source of pollution for Lake Okeechobee before channelization, in the 1970s and beyond the river contributed about 25% of the nitrogen and 20% of the phosphorus flowing into the lake.

Today, all water movement into and out of the lake and though the Everglades system, except local rainfall, is controlled by water managers. There are 1,800 miles of canals and dams with water control points and pump stations that divert the natural flow of water.

Everglades National Park is located at the base of the watershed, rather than at its origin. This aspect of the K-O-E watershed has led to many problems. Water quality and quantity for Everglades National Park depends primarily on what happens to upper portions of the watershed. Channelization projects, diversion projects, dikes, and levees have all made their mark on the Everglades.

Preparation:

1. Gather all materials.
2. Print out Map of Historic Everglades and Map of Alterned Everglades (1 per group).
3. Load PowerPoint presentation. Read the notes sections on each slide for further information and discussion prompts.
4. Load The Everglades: River of Grass video.

Procedure:

5. Show students the background PowerPoint, sharing the information contained in the notes section on each slide. Stop at Slide 2 and ask students where they think the Everglades is. Tell students that the historic Everglades once started just below Lake Okeechobee in the Chain of Lakes and stretched down to the Florida Bay. Point out these places on the map.
6. To assess prior knowledge – have students make a concept map, incorporating the vocabulary words. Have them look up any words they don't know, or you can go over the vocabulary prior.
7. Stop at Slide 3 and ask students to jot down the answers to the Anticipation Guide prior to watching the video.
8. Show students the video The Everglades: River of Grass.
9. After watching the video, revisit the Anticipation Guide and ask students to correct any answers from what they have learned. Discuss their answers. Explain that you will be making a model of the watershed. Provide students with the Map of the Historic Everglades watershed (prior to human alterations). Show students the animated version of the watershed flow.
10. Point out how it was once a vast, free-flowing river of grass extending from the Kissimmee chain of lakes to Florida Bay covering almost nine million acres. Tell students that these sub-tropical wetlands supported a rich diversity of plants, fish, and other animals. Point out how the water ran from the Kissimmee River into Lake Okeechobee, and then filtered down through the Everglades to Florida Bay. Tell them that the water that moved down the flat and level surface landscape flowed so slowly that, in effect, it was stored from one season for use in another. Because of this storage and slow flow in the natural system, summer rains kept wetlands flooded and maintained freshwater flows to coastal estuaries well into the dry winter season. This made water available to wildlife and reduced susceptibility to changes in rainfall, which can vary dramatically from season to season.
11. Divide students into small groups (3 students).
12. To build the model:
    A. Place the pan on a flat surface. Designate a "north" side and a "south" side.
    B. Take the clay and spread in the northern ⅔ of the pan in the shape of the Florida peninsula. Leave the south side empty to represent Florida Bay.
    C. In the center of the clay, make a 3" diameter indentation, about ½" deep to represent Lake Okeechobee.

D. Using the Map of the Historic Everglades as a guide, make channels in the clay to represent the Kissimmee River and Lake Kissimmee, as well as the Caloosahatchee River, and St. Lucie River. Notice how the historic Caloosahatchee River barely connects with Lake Okeechobee.

13. Pour water into the The Kissimmee River and check to see if it flows into Lake Okeechobee. The lake should overflow at its southern end. Keep pouring water until water flows into Florida Bay.
14. Discuss with students the natural flow of the water and how long it would take the water to flow from the lake down to Florida Bay. Ask students what the advantage of having a slow, steady flow of water would be to the ecosystems and animals that lived in them. Guide students in making the connection that the slow water flow would help keep the Everglades saturated well after the rainy season ended, and would provide water for ecosystems through most of the dry season.
15. Now tell students that they will be making a model to demonstrate some of the ways that the water flow of the K-O-E watershed has been changed since the mid 1800's through human intervention. Provide students with a Map of the Altered Everglades.
16. Show students the animated version of the watershed flow.
17. Ask students to point out the differences from the historic flow. Guide students to notice that the Kissimmee River was modified from a meandering channel to a straight channel, and water is now diverted out of Lake Okeechobee into two primary channels instead of spilling out on the southern end of the lake. These channels are the Caloosahatchee River and the St. Lucie River.
18. Modify the clay model to represent the altered Everglades, using the map as a guide. Change the meandering shape of the Kissimmee River to a straight channel, and add a channel from each side of Lake Okeechobee to represent the Caloosahatchee River and the St. Lucie River.
19. Pour water into the Kissimmee River. As water flows into Lake Okeechobee and then through the Caloosahatchee and St. Lucie River, note how much of the water makes it to Florida Bay.
20. Have students compare the map of the altered Everglades with their model.
21. Wrap-up: Ask students what they think the effects the channelization of the Kissimmee River and the altered flow through the Caloosahatchee River and St. Lucie River had on the natural ecosystems? Guide students to consider the effects of the changes in flow rate, the area of flood plain, the change in water levels and any changes that might occur to the plants and animals that live there. Guide students to make the connection that the faster flow rate would have an effect on shore line habitats, where fish lay their eggs and juvenile fish develop. Help students make the connection that the fewer seeds settling in the banks of the river would affect habitat development and food sources for several organisms.
22. Optional: Show the students the What's At Stake video.

23. Assessment 1: Have students draw diagrams of both models and label the components of each model. Have students write a summary paragraph that compares the historic flow of water through the greater Everglades ecosystem with the present day flow.
24. Assessment 2: Have students write a paragraph discussing the large-scale environmental impacts resulting from altering the original flow of the KOE watershed. Tell students to be sure include impacts from loss of diversity and also to the economy. Make sure they provide evidence from what they have learned from the activity and PowerPoint to back up their claims.

Assessment:

1. Have students draw diagrams of both models and label the components of each model. Have students write a summary paragraph that compares the historic flow of water through the greater Everglades ecosystem with the present day flow.
2. Have students write a paragraph discussing the large-scale environmental impacts resulting from altering the original flow of the KOE watershed. Be sure to include impacts from loss of diversity and also to the economy. Make sure you provide evidence from what you have learned from the activity and PowerPoint to back up your claims.

Resources:

(2013, November 5). *The Changing Everglades.* The Water Channel. Clip taken from Water's Journey: Everglades. Karst Productions, Inc. Retrieved from http://www.youtube.com/watch?v=SMnHcqttWgk/.

(2014) *The Everglades, River of Grass* from http://www.odysseyearth.com/videos/the-everglades-river-of-grass/

FAU/Pine Jog Environmental Education Center.

Lane, J., Robinson, G.B., & Robinson, S.C. (1996). Heart of a Watershed. In *Discover a Watershed: The Everglades* (160-164). Bozeman, MT: The Watercourse, Montana State University.

(2014, February 10). *What's At Stake.* The Everglades Foundation. Video retrieved from http://vimeo.com/35761672.