ENVIRONMENTAL ECOLOGY

High School

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Below you will find a description of the lesson and class materials that I have created for my high school environmental ecology class as a result of my workshop experiences and pre-conference reading (particularly – The World of the Saltmarsh by Charles Seabrook and Field Guide to Coastal Wetland Plants of the Southeastern United States by Ralph Tiner.) In addition, I have noted revisions made to other lessons that I offer for other grade levels

Environmental Ecology –the new lesson for my high school students will make up one half day of my four-day Environmental Ecology course. It will supplement an existing lesson on aquatic ecosystems.

Curriculum Standards Addressed:

SEV1. Obtain, evaluate, and communicate information to investigate the flow of energy
d. Evaluate claims, evidence, and reasoning of the relationship between the physical factors and organismal adaptations within terrestrial biomes.
e. Plan and carry out an investigation of how chemical and physical properties impact aquatic biomes in Georgia. (Consider the diverse aquatic ecosystems across the state such as streams, ponds, coastline, estuaries, and lakes.)

Course Materials/Handouts Created for the Lesson (attached):

- Guiding questions for "Georgia's Vanishing Coast", Atlanta Magazine June 2018

- Powerpoint: The powerpoint covers Georgia's rivers and estuaries, types of coastal wetlands and their salinity ranges, factors that effect salinty, and 15 photos of coastal wetland organisms (organisms that students research for their homework assignment). File too large to attach.

- Research Homework: Student independent research of an assigned plant or animal native to Georgia's coastal wetlands.

- Estuary Handout: Diagram of coastal wetland types taken from "Field Guide to Coastal Wetland Plants of the Southeastern United States" by Ralph Tiner. Attach this handout to homework listed above.

- Research Table: Table for students to complete which compiles research presentations from the whole class.

- Video Clip of Altamaha (recorded at the workshop). File too large to attach.

- Graph of River Discharge for the Altamaha River 1998-2018 (Source: USGS)

- Series of graphs showing the salinity of coastal rivers (Source "Trends in Salinities and Flushing Times of Georgia's Estuaries" by M. Alber)

- SALTex project Summary (from GCE-LTER website)

The lesson consists of two homework assignments and two class activities:

1.) Students will read "Georgia's Vanishing Coast", Atlanta Magazine June 2018 and answer questions that I have created.
2.) Students will conduct independent research on an organism native to Georgia's coastal wetlands and present their findings to the rest of the class. In their research, they will include a photo of the organism, determine where it lives, describe the organism, and describe at least one adaptation.
Research assignments include 15 different species (class size is 15): smooth cordgrass, black needle-rush, mud fiddler crab, red-jointed fiddler crab, ribbed mussel, eastern oyster, pistol shrimp, marsh periwinkle, blue crab, clapper rail, mud minnow, common grass shrimp, ribbed mussel, perennial glasswort, giant cutgrass and bald cypress
3.) Students will present their independent research to the class. The class will compile all independent research in one table – listing each organism and adaptation under the correct wetland type.
Students will view a two-minute video of the Altamaha shoreline. The video clearly shows the change in the landscape with a concentration of dead trees caused by salt intrusion. Working in pairs, students will discuss what they observed and speculate on the cause. Then pairs will share their ideas with the rest of the table. Each table will receive a packet of evidence and use the evidence to 1.) state their claim - what they think caused the problem, 2.) list their evidence, and 3.) state their reasoning. They can also apply what they learned from reading "Georgia's Vanishing Coast".
The packet of evidence includes:
    - a graph of the river discharge of the Altamaha River from 1998-2018 which clearly shows evidence of drought in 2012.
    - a series of graphs showing the salinity of coastal rivers over time including the Altamaha. These graphs clearly show a trend of increasing salinity .
    - "A Balancing Act for Coastal Freshwater Marshes", a summary of the SALTex project that states that saltwater intrusion is caused by sea level rise and drought.

Additional benefits from the workshop that can be applied to other lessons that I teach.

1.) Environmental Ecology Population Sampling lesson: In this lesson students conduct vegetation sampling in a Piedmont Forest. Before students conduct their own sampling I discuss different population sampling methods used by scientists and provide real-life applications of each sampling method. I will now include the Altamaha Cypress Forest research with John Schalles as an example of quadrat sampling.
2.) "Hatched From an Egg"/2nd grade lesson: In this 90-minute lesson students participate in various hands on activities related to animals that lay eggs. I include an activity about sea turtles. Now, I will be able to incorporate my experience with the sea turtle patrol.
3.) "Habitats of Georgia"/3rd grade lesson: In this 60-minute lesson, I showcase animals (models or mounted specimens) that live in different ecoregions of the state. I use models of a male and female fiddler crab to talk about the coastal marsh and a loggerhead skull to talk about the beaches. Now, I will be able to incorporate my experience with fiddler crabs and sea turtles.
4.) "Exploring the Parts of a Plant"/ 1st grade lesson: The lesson begins with a show and tell about seeds and includes a coconut. We talk about how coconuts can float from place to place. While at the workshop I found an old coconut that had washed up on the beach which I will now share with my first graders.

STT Environmental Ecology – Georgia's Vanishing Coast

Guided Group Practice

Name: _____ Group: _____ Date: _____

Read "Georgia's Vanishing Coast", a story published in the June 2018 issue of Atlanta Magazine, and answer the following questions. **This assignment is due on DAY 4 of Environmental Ecology.** The article can be found online: http://www.atlantamagazine.com/great-reads/georgias-vanishing-coast/

1. What is the length of the Georgia coastline in miles?

   What percentage of the remaining salt marsh on the eastern coast of the United States is found in Georgia?

2. Journalists may not always get the science exactly "right" as we see in the author's statement about king tides. Spring tides which typically occur twice per month are high, high tides; they result from the alignment of the moon, earth and sun and coincide with a full moon or new moon. King tides happen if this alignment occurs when the moon is closest to earth in its elliptical orbit; they only happen a few times a year during a full moon or new moon.
   How could you change the author's statement to make it more accurate?

3. Name two recent hurricanes that hit the Georgia coast and the year that they occurred.

4. The occurrence of powerful storms on the Georgia coast has varied over the years and the effects will no doubt be more severe with climate change. How has the occurrence of storms and tidal flooding in the past 50 years differed from occurrences in the last 50 years of the 1800s?

   The Galloway family on Tybee Island has lived in their home for 49 years. How often has it flooded during that time and, when did the flooding occur?

5. Storms naturally shape the everchanging coastline of Georgia's barrier islands. What will be the effect of constructing a groin on the southern tip of Sea Island and, why do you think environmentalists oppose the idea?

6. According to the article how much did sea level rise in the 20th century?

   How much sea level rise do experts predict for the Georgia coast in the 21st century?0

7. What steps are planners in St. Marys and on Tybee taking to address rising water levels in the next 50 years?

   What will they need to consider in 150-200 years?

8. What is SALTex?

   What did the SALTex scientists test during the first four years of their project?

   What will the SALTex scientists focus on during the next several years of the project?

Environmental Ecology Research

Guided Group Practice

Name: _____ Group: _____ Date: _____

Research your assigned organism and complete the questions below. **This assignment is due on Day 4 of Environmental Ecology.** Be prepared to present your organism to the rest of the class on Day 4.

Insert a photo of your organism.

_____

Common Name

_____

Latin Name

Check where it lives (see attached pg.):

☐ Estuary

☐ Salt Marsh

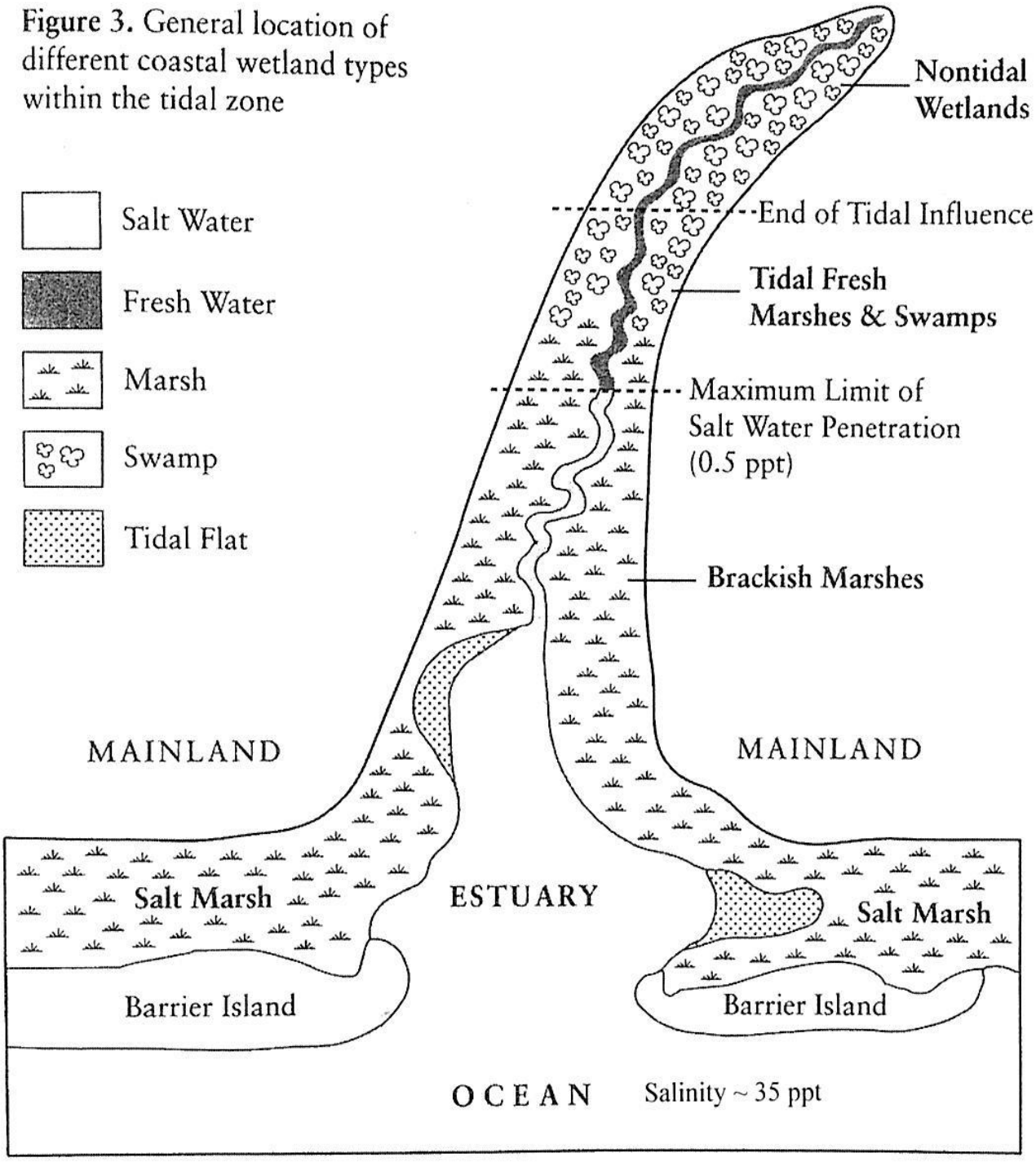
☐ Brackish Marsh

☐ Tidal Fresh Marsh & Swamp

Description (*include what kind of organism it is - a tree, a snail etc., and distinguishing physical characteristics including size*):

Adaptation: (*describe at least one adaptation of your organism and explain how it benefits the organism; it may be a structural or behavioral adaptation*):

Figure 3. General location of different coastal wetland types within the tidal zone



Taken from "Field Guide to Coastal Wetland Plants of the Southeastern United States" by Ralph Tiner

Adaptations in Georgia's Estuaries

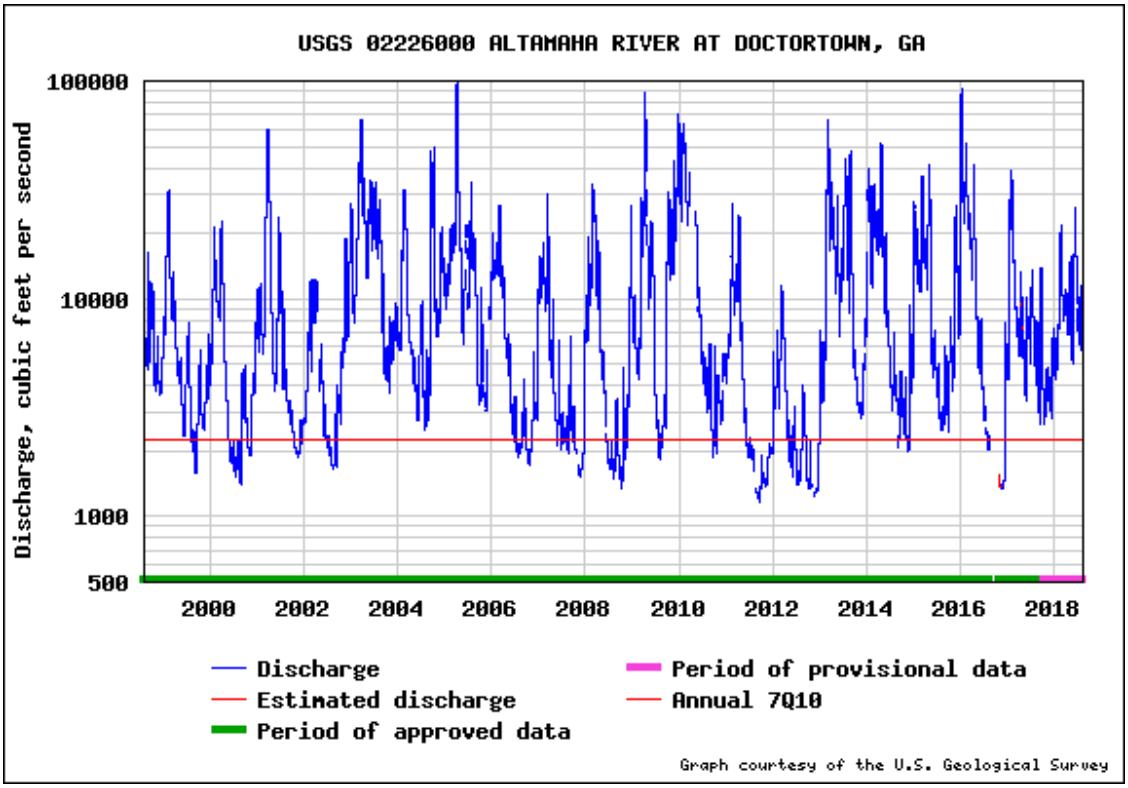
Observe student presentations. List each organism presented along with their adaptations under the appropriate category: Estuary, Salt Marsh, Brackish Marsh or Tidal Fresh Marsh & Swamp. Refer to the Coastal Wetlands Diagram to see where each organism can be found.

Salt Marsh	
Organisms:	Adaptations:
Estuary/Tidal Creeks	
Organisms:	Adaptations:

Brackish Marsh	
Organisms:	Adaptations:
Tidal Fresh Marsh & Swamp	
Organisms:	Adaptations:

River Discharge of the Altamaha River 1998-2018

River discharge is defined as the volume of water passing a measuring point or gauging station in a river in a given time. It is measured in cubic feet per second



Salinity is defined as the concentration of dissolved salts in water etc., usually expressed in parts per thousand by weight.

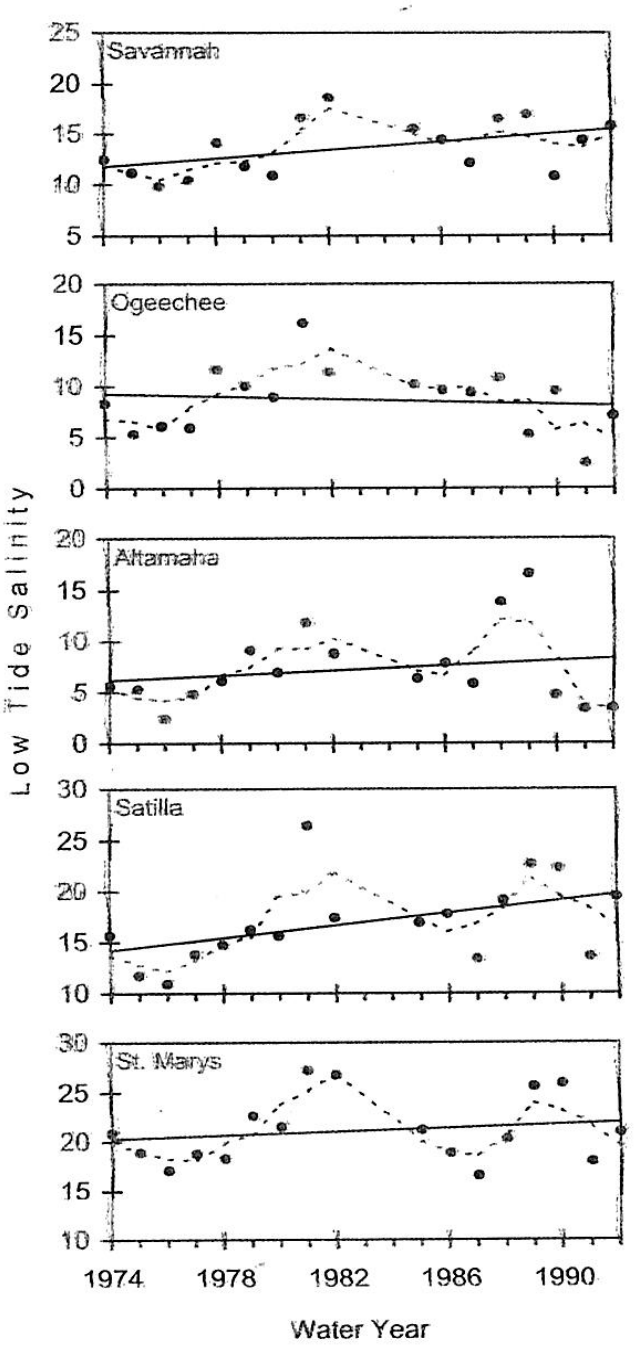


Figure 2. *Salinity* at EPD stations over 19 years. Dots are water-year averages, dashed lines are 3-year moving averages, and solid lines are linear regressions of 3-year moving averages.

A Balancing Act for Coastal Freshwater Marshes

Published July 26, 2018, LTER Network News

Hudson Creek, part of the Georgia Coastal Ecosystems LTER site.
Photo Credit: *Wade Sheldon*

On the boundaries of fresh and saltwater systems, coastal marshes give rise to diverse, productive ecosystems that act as carbon sinks. Their secret? Freshwater marsh plants receive just the right amount of nutrients and salt from periodic seawater tides to thrive. However, incursions of saltwater into these systems are increasing —often caused by drought and sea level-rise—and threaten this delicate balance of salt and freshwater. A long-term study at Georgia Coastal Ecosystems LTER found that seawater intrusions have rippling effects on coastal marshes that ultimately decrease plant productivity and carbon sequestration.

Scientists replicated natural conditions and increased seawater intrusion conditions in several plots of marshland as part of SALTEx (the Seawater Addition Long Term Experiment). They treated some plots with periodic—or "pulse"—saltwater additions to mimic the naturally occurring tides that flow into coastal marshes, and exposed others to a constant dose of saltwater—or "press" doses—to replicate seawater intrusion conditions.

They found that chronic seawater intrusion altered the system's chemistry and salinity—spurring a chain reaction of ecological effects. Most notably, plant abundance and growth decreased, which reduced cycling and sequestration of carbon, but also suppressed methane emissions. Fewer plants also mean there is less decomposing plant matter to regenerate the soil. Without constantly building up a fresh layer of new soil, coastal marshes may be more vulnerable to sea level rise.

"This study adds to a growing body of literature illustrating how increased salinity, either chronic or acute, can release nutrients stored in freshwater marshes, potentially contributing to eutrophication in open waters as the nutrients are flushed out of marsh soils," explains lead author Dr. Ellen Herbert.

The scientists point out that more gradual seawater intrusion events may have different effects on the system, such as the emergence of brackish vegetation in place of less-tolerant freshwater plants. Nonetheless, these results confirm that even the smallest changes in water chemistry, soil nutrient availability, and other aspects of coastal marshes can upset the balance of these ecologically valuable systems, and change their contributions to climate warming via carbon and methane cycling.

-Tia Kordell

STT Environmental Ecology

Guided Group Practice

Group Members: _____ Group: _____

_____ Date: _____

Observe the video presented in class and work with your group to determine "What is happening on the Altamaha?" Use the evidence provided by your Instructor to explain why it is happening.

STATE YOUR CLAIM

Your claim explains what is happening on the Altamaha River.

EVIDENCE

What evidence do you have to support your claim?

REASONING

What is the REASONING for your claim? Reasoning describes how the evidence supports the claim and often draws on scientific theories or principles.