Kimberly Holland Schoolyard Unit Plan

Georgia Coastal Ecosystems LTER
High School Honors Biology Unit Plan
By: Kimberly Holland

The following teaching unit was inspired by my GCE Schoolyard experience on Sapelo Island in July of 2018. This unit is non-traditional in the sense that it will span the length of the entire school year. My field research experience on Sapelo will become the theme for the school year as my students learn to "do science" through the Honors Biology course. The following lessons were inspired by the freshwater cypress swamp forestry survey (Dr. Shalles and Dr. Alber), the *Spartina* microbiome research project (Dr. Kostka), the sea turtle patrol (Sydney Sheedy), and quadrat sampling (Dr. Pennings) and hydrology study (Dr. Wilson).

I will introduce the unit and scientist's research projects at the beginning of the school year, and continually "loop" back to the projects to reveal more information about them as the year progresses (and as we progress through the Honors Biology Units (macromolecules, cell structure/function, cell transport, cell energy, cell division, transcription/translation, genetics, biotechnology, ecology, and evolution). Sapelo Island and it's ecosystems will be our primary topic, and I will challenge students to collect data from sites near our school so that they, too, can have a hands-on field investigation experience. Additionally, I would like to begin developing our own long-term data sets. Students will be challenged to utilize their higher order thinking skills as they compare and contrast environments on Sapelo with ecosystems near our school. Finally, I plan to connect with Jose and Max (Dr. Kostka's team) and hopefully have them "skype" with my students regarding the ongoing progress of the *Spartina* experiment.

August: Students will become familiar with Sapelo Island, its ecosystems, the UGA marine institute and the research process as I share information about my summer experience.

Lesson Activity # 1 (2 days)

-I will begin class by asking students questions: "How many of you guys have been to the beach?" , "What did you do while you were there?", "Did you know there are organisms that live in the sand? Give some examples.", "Were you able to visit the salt marsh while you were there?" "What was your favorite part about your trip?".

-I will show a map of Georgia's coast and barrier islands and ask student questions like "How do you think these islands formed?", "Where did the sand come from?" "How old do you think these islands are?", "Could the sand ever move from island to island?"

-I will give a brief explanation of river basins, estuaries, and tides so that students have a visual "anchor" with which to attach their new learning.

-Student teams (2-3 students) will receive a topic and be expected to generate as many questions as they can on the topic. Students will write these questions a large piece of butcher paper. Next, students will participate in a gallery walk in which they add to other team's ideas or ask for clarification (they will use an annotation key that I provide & sticky notes to make comments). Then, students will view their peer's ideas and use available resources to become "experts" on these topics. Student teams will share what they learned verbally with the class so that all students will have a better understanding of our "research site", Sapelo Island.

Topics for student teams:

1. How did the barrier islands form and how old are they? What is the sand sharing system? Pleistocene? Holocene?
2. What organisms inhabit Sapelo Island? Include plants and animals. Do we have any of the same plants and animals near our school? Include a food web with at least 4 trophic levels. Include information on nutrient cycling and organisms that may use the land (terrestrial environment) and water (aquatic environment).
3. Why are estuaries so important? What keystone species is essential to an estuary? How to barrier islands help protect organisms that live in an estuary
4. Salt marsh cordgrass (*Spartina alterniflora*). How does it adapt to life in the salt marsh. What type of photosynthesis does it use?
5. Adaptations of organisms that live salt marsh/estuary.
6. Quadrat sampling: What is it? Why is it helpful for scientists? What is a dichotomous key?
7. Water quality monitoring: why is this important? What are we testing the water for, specifically?
8. What is the UGA Marine Institute on Sapelo Island, and how does it contribute to our understanding of marine ecosystems? Why is long-term ecological research important?

Lesson Activity #2 (1 day)

I will share pictures and and overview of information about the following experiments:

- freshwater cypress swamp forestry survey (Dr. Shalles and Dr. Alber)
- the *Spartina* microbiome research project (Dr. Kostka)
- the sea turtle patrol (Sydney Sheedy)
- quadrat sampling (Dr. Pennings)
- hydrology study (Dr. Wilson)

Lesson Activity # 3 (2 days)

I will guide students to conduct quadrat sampling along our school's nature trail. Student teams will complete a picture scavenger hunt associated with ecology vocabulary.

Lesson Activity # 4 (1 day)

I will guide students as they engage in water quality sampling and macroinvertebrate sampling in our creek.

*I will ask our video technology department to use the drone to capture an aerial view of our school grounds.

November: Students will repeat quadrat sampling and water quality sampling in the same areas; drone imagery

February: Students will repeat quadrat sampling and water quality sampling in the same areas; drone imagery.

May: Students will repeat quadrat sampling and water quality sampling in the same areas; drone imagery.

*Samples of other topics/items of interest to be interwoven into established units:

1. scientific process: Sapelo is the control site for sea turtles and various treatments are used on the nests; explain the difficulty of getting into the cypress swamp and marking off the area measuring trees; had to really think through equipment and specimen storage with *Spartina* experiment and taking specimens back to GA tech and preventing

growth of bacteria since that is what you are testing; hydrology study: layers of soil did not align with conceptual model & problem of hole filling in when you pull instrument out
2. Biochemistry: *Spartina* experiment--fluorescent dye attached to substrate (enzymes); enzyme assay and nutrient cycling
3. Adaptations: Dr. Pennings--salt water plants prevent uptake with specialized cells in roots, secrete it (*Spartina*), or store excess salt in special vacuoles
4. Genetics: DNA from sea turtle eggs is taken from outside of the shell; *Spartina* experiment--look for plant RNA/protein
5. Ecology--data collected from all experiments shows us how the environment is changing over time; how might organisms in the area change over time?

Lesson Activity # 5

Student's culminating learning experience will include each team designing and implementing their own student-designed experiment or research project . Projects must be approved by me, and students must base their idea on one of the topics that was most interesting to them throughout the year. Student lab write-ups will include an additional section in which they address standards SB5c and SB5e, below.

Standards

SB5. Obtain, evaluate, and communicate information to assess the interdependence of all organisms on one another and their environment.
a. Plan and carry out investigations and analyze data to support explanations about factors affecting biodiversity and populations in ecosystems. (Clarification statement: Factors include population size, carrying capacity, response to limiting factors, and keystone species.)
b.Develop and use models to analyze the cycling of matter and flow of energy within ecosystems through the processes of photosynthesis and respiration.

- Arranging components of a food web according to energy flow.
- Comparing the quantity of energy in the steps of an energy pyramid.
- Explaining the need for cycling of major biochemical elements (C, O, N, P, and H).

c. Construct an argument to predict the impact of environmental change on the stability of an ecosystem.
d. Design a solution to reduce the impact of a human activity on the environment. (Clarification statement: Human activities may include chemical use, natural resources consumption, introduction of non-native species, greenhouse gas production.)
e. Construct explanations that predict an organism's ability to survive within changing environmental limits (e.g., temperature, pH, drought, fire).