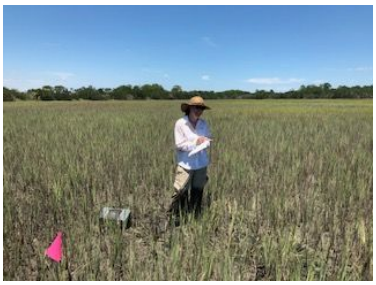
Draft Lesson Plan Summer 2018- Kostka Schoolyard Summer PL

(*Photo to Right: provided by Joel Kostka Lab, 2018)



Content: Earth Space and Life Science

Grade Level: 6-8

Big Idea/Unit: The properties and movements of water shape Earth's surface and affect its systems [ecosystems and landforms]. The ebb and flow of tides, as well as the salinity of the water, determines the location of certain plants in a Saltmarsh ecosystem. As a result, we can predict future changes to the saltmarsh based on changes to the tide height and salinity.

Connection to Schoolyard: This document is a direct result of working with multiple researchers during the GCE LTER Schoolyard program. 1) With Dr. Joel Kostka's lab (Georgia Institute of Technology) I measured Spartina height, number of crab burrows and snails, salinity, and distance from tidal creek. 2) With Lalith Polepeddi (Georgia Institute of Technology Climate Change Stories Project) I brainstormed and helped film a virtual reality lab that focuses on student centered learning through technology and the practices of science. In the virtual reality film, students will have the chance to make observations and inferences, read and graph data collected from research at GCE LTER and imbedded in to the VR in the form of data tables, and then discuss patterns and conclusions that they have found. 3) With Collin and Orlando (University of Florida), I walked and measured a high tidal creek head and observed the height of spartina, crab burrows, and snails present. The drone footage of water flow at both high and low tides is vital to the background of this lesson. 4) With Damon Gannon I listened to and analyzed fish acoustics to identify fish present in the tidal creeks of the marsh. This was vital to adding a second observational component to the virtual reality experience (visual and sound observations)

GSE Content Standard

- **S6E3d.** Obtain, evaluate, and communicate information to recognize the significant role of <u>water</u> in Earth processes; specifically the effects of tides on Earth's [eco]systems.
- **S6E.** Construct an argument using maps and data collected to support a claim of how tides affect Earth's systems [ecosystems and island formation].

NGSS Standards:

- **MS-ESS2a:** The planet's systems interact over scales that range from microscopic to global in size, and they operate over fractions of a second to billions of years. These interactions have shaped Earth's history and will determine it's future.
- **MS-LS2.C** Ecosystems are dynamic in nature; their characteristics fluctuate over time. Disruptions to any physical or biological component of an ecosystem can lead to shifts in all of its populations.

Crosscutting concepts NGSS: Change; pattern;

Overarching Question(s): How do the properties and movements of water shape Earth's surface and affect its systems [ecosystems and landforms]

Content Objectives: Students will understand that...

- Tides have an influence on Salt Marsh ecosystems (and this influences plant species and sediments).
- Plants that live in salt marshes have different levels of salt tolerance and this determines where the plant lives (zone) in the marsh.
- Salt Marshes can be sampled using sediment coring method (fossils) to show changing surface and climate of Earth over time.
- Understanding the water flow patterns within an ecosystem enables people to predict future changes to saltmarsh ecosystems.

Quick Summary (approximately 5-7days)

Engage: KWL and observations of Salt Marsh coastal system

Explore 1: Data and mapping of where each plant lives. Make Claim about each.

Explain: WHY do the plants live where they do? Research evidence to support claim.

- Tides (ebb and flow of water)
- Salinity of water

Explore 2: Past and future

- Where did these plants live in the geologic past? Was it in the same place? Run lab to gather evidence (LP p.45-53 science scope October 2017)

Elaborate

- Hypothesize what will happen to the location of these plants (Georgia's coast) in the future with sea level rise and climate change
- If we look at a map of a coast can we predict possible impact if sea levels rise (climate change) in the future? How do we know?

- (Clarification: 6th grade students do not go into a lot of detail of effects of global climate change. Focus is on greenhouse gases and evidence for rise in global temperature over historical time frames)

Extend

- What can we do about climate change? (see 3 day LP 30-35 science scope october 2017; cartoon and carbon footprint activities)

Engage-What we know & how we know (Class discussion): We will be discussing Salt Marsh Ecosystems. Have you ever seen a salt marsh? (Pause for responses.) Let's identify what we know about salt marshes, and how we know it (Is our knowledge verified with evidence?) Either a teacher or a student acts as scribe and write's student responses on a T chart on the smartboard/whiteboard. (Teacher remember to question inferences versus observations.) Teacher will need to frequently ask "How do you know this?" and "Do you have any observations to support your knowledge?" and "Is this fact or is it an inference? How do we verify our knowledge?"). Ask students "Why salt marshes are important?" (barrier; storm protection, habitat for organisms, reduce erosion, sequester carbon, economy, breeding ground for fisheries, tourism, etc.) Hopefully get students to identify that salt marshes are made of plants and are found at the coast where the ocean meets land. (One misconception to tease out is whether students understand that there is both freshwater and saltwater found in a salt marsh ecosystem.)


Photos taken by Dr. Joel Kostka (near predator exclusion LTER site)

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The above 5 pictures (and VR video) are of the salt marsh ecosystem...after looking at these pictures/video/virtual reality can we add any more knowledge based on our own visual **observations (evidence)**? What do you observe? More facts are written in the T-chart for what we know and how we know it.

https://zottoli.wordpress.com/saltmarshes/spartina-alterniflora-zone-2/

Explore: Here (above) are pictures of a type of plant that lives in the Salt Marsh, called *Spartina alternaflora* (Spartina). (Waiting for photos of each of these.) What observations can you make based on these photos? What is similar and different in the photos? (size of plant and location in the marsh). Compare and contrast them? Why do you think they live where they do? Make a claim.

Explain: Students research the ecology of the saltmarsh and the geography of tall and short spartina to provide evidence to support their claim answering the question of "WHY do the plants live where they do?

Student research sources

- https://zottoli.wordpress.com/saltmarshes/spartina-alterniflora-zone-2/
- student handout for plants of salt marsh of New England https://www.wellsreserve.org/project/sentinel-site-lesson-plan p. 30

Elaborate and explain that different microscopic plants (plants at even smaller sizes/scales) also have preferred areas they live in the marsh. Show the diatoms...and handout (click on cut out diatoms handout from https://www.dur.ac.uk/geography/ice_sheets_and_sea_level_outreach/teacher_resources/sea_level_change_and_salt_marshes/)

Elaborate: Past and future

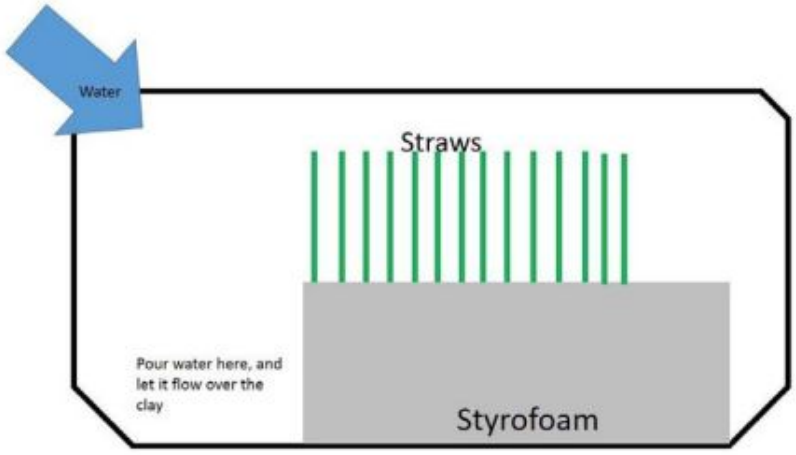
- Where did these plants live in the geologic past? Was it in the same place?
    - Follow Lesson Plan (Lab) from page 45-53 Science scope Oct 2017 "Looking Backward, Looking Forward" by Stapleton et. al.
    - Use google maps and look for historic views of Georgia's coast
- Has the location of these plants changed?
- Hypothesize what will happen with sea level rise and climate change…
    - Thermal expansion and melting ice caps (Stapleton et.al., 2017)
    - Rise in sea level gradual slope verses rocky steep coast (more effect on gradual salt marsh).
- If we look at a map of georgia's coast can we predict possible impact if sea levels rise as predicted?
    - MODELING sea level rise: All students should be presented with the five salt marsh cross sections. Discuss with your class what the effects of rising global sea level will be on each of the five salt marshes. Each team will be given a plastic shoebox in which they will build their salt marsh model. The plastic shoe boxes have been marked with a black line 1 cm from the bottom. Above this line, red lines are 0.5, 1, 1.5, and 2 cm above the black line. The black line represents current sea level and the red lines represent subsequent sea level rises. Divide your students into 5 teams; one team for each of the five salt marsh cards. Each team will make their own plot map of the salt marsh they were assigned.

Extensions

- Google Earth: Google Earth tutorial so students can make their own maps: https://www.american.edu/ctrl/upload/Intro-to-Google-Earth.pdf Google Earth time slider feature: https://support.google.com/earth/answer/183758?hl=en
- What can we do about climate change? (see 3 day LP 30-35 science scope october 2017; cartoon and carbon footprint activities)
- Modeling of salt marsh
    1) Clay model (http://omp.gso.uri.edu/ompweb/doee/teacher/pdf/act22.pdf or see TOTE LP https://www.wellsreserve.org/project/sentinel-site-lesson-plan)
    2) straw/styrofoam and filter papers (http://www.vims.edu/research/units/centerspartners/map/education/profdev/VASEA/docs/SeaLevelRise/VASEASeaLevelRise.pdf)
        a) "Students should be split into four groups for this portion (if more than 4 students per group, create more groups, each with their own bin setup). Each group will receive one mock marsh (bin/clay/straw setup). Have the students place 2 filters amidst the straws (grass) on top of the clay. Each group will also be given a water source. Students will slowly pour the water into the bin, until the water is up over the clay (marsh surface). While students are doing this, orient them to what the straws, clay, and water represent (marsh plants, marsh surface, and tides, respectively). After all the students have pour their water into the bins, let the water sit for a few minutes (so the dirt can settle out onto the clay and filter). While waiting for the dirt to settle out, have the students count the "stems" in their individual bins, to quantify stem density. After dirt has settled out, scoop the water out from the end the clay isn't covering, so that there is no standing water on the clay. Some of the dirt should be left on the clay, filter, and straws. Have the students weigh the filters, and compare values between the bins with lower "sediment" in the water. Have the students compare their stem density values to the weight of the filter + the sediment deposited on it. They should have heavier filters in the bins with higher stem density."

Mock Marshes:

Set up of plastic bins (representing marshes) should be done prior to lesson. Each bin will have a rectangle piece of thick Styrofoam (representing the marsh surface). In each of the bins, stick straws (representing marsh grass) into the Styrofoam. In one of the four bins, place less straws (grass) than there is in the other bins. The below diagram would be an example of the bins with more grass. Significantly less straws (1/2 or less) should be used in the bin with less grass. Use the following diagram for bin setup:



Misconceptions *(*Sawicki, M.,1999)

- The Moon pulls harder (has more gravity) during the full moon
- Swimming pools, lakes and bodies of water other than the oceans "do not experience tides because the water at different locations within each of these reservoirs is still at the same distance from Moon, so no *difference* in gravitational pull exists."
- Everywhere in the world experiences the same number and change in tides per day.
- Tidal effect is only caused by the Moon or only caused by the Sun.
- *Correct Tidal Explanation: Tides are caused by gravity between the moon and the Earth, as well as between the sun and the Earth. "Under the force of lunar gravity, the rock on the side of Earth closest to the Moon should accelerate faster and get ahead of the center of the Earth, while the rock on the side of Earth facing away from the Moon should accelerate less and be left behind the center of the Earth. Fortunately, the Earth's own gravity easily overcomes these tendencies of both rocks, so the net result is that the Moon's gravity tries to deform the Earth into a football shape. Since the Earth is quite rigid, it can't deform much in response - in fact the resulting tidal stretch of the Earth is only about 2 ft."*
- *Plant heights do not vary with different environmental conditions (Spartina alterniflora is a marsh plant that always grows to be the same height.)*

Vocabulary (modified from TOTE sentinel site lesson plan)
https://www.wellsreserve.org/project/sentinel-site-lesson-plan

Abiotic – all of the non-living things in an ecosystem such as temperature, soil and wind

Biotic – all of the living organisms within an ecosystem, including plants and animals

Brackish – a mixture of salt water and fresh water

Estuary – a semi-enclosed body of water that has a free connection to the open sea and within which seawater is measurably diluted by fresh water derived from land drainage

Ecosystem – the biotic community and its abiotic environment

Habitat – the specific environment where an animal or plant is able to survive

High Marsh – located between the low marsh and the upland edge; generally only flooded during higher than average tides. Low plant diversity with dominant species being saltmeadow hay (Spartina patens), spikegrass (Distichlis spicata) and black rush (Juncus gerardii)

Low Marsh – located along the seaward edge of the salt marsh; usually flooded at every tide and exposed during low tide. This area is typically dominated by salt marsh cordgrass, Spartina alterniflora

Transect Sampling – a method designed to sample within-plot variation and quantify changes in plant species cover and height, and/or ground cover over a spatial distance

Quadrat – a small area, usually a square meter, selected to conduct point-intercept sampling

Salt Marsh – coastal wetlands that are flooded and drained by salt water brought in by the tides

Sea Level Rise – the rising level of the ocean due to thermal expansion caused by the warming of the oceans (since water expands as it warms) and the loss of land-based ice (such as glaciers) due to increased melting

Upland – land elevated above water or other land.

Upland Edge – marks the transition area from salt marsh to upland; generally only flooded at extreme astronomical tides and under irregular conditions such as storm and wind-driven tides

Relevant references:

See How use and obtain 3D VR field trips
http://ditchthattextbook.com/2016/08/18/12-ways-to-use-google-cardboard-in-your-class/

Sawicki, M. (1999) “Myths about Gravity and Tides”; The Physics Teacher; 37, pp. 438 - 441. Downloaded from https://www.jalc.edu/mikolajsawicki/tides_new2.pdf on 16 July 2018.

Related LP see: Activity 2 Salt Marsh Vegetation & Sampling Techniques from https://www.wellsreserve.org/project/sentinel-site-lesson-plan VERY SIMILAR

Andrew C. Kemp, Benjamin P. Horton, Jeffrey P. Donnelly, Michael E. Mann, Martin Vermeer, Stefan Rahmstorf. **Climate related sea-level variations over the past two millennia**. *Proceedings of the National Academy of Sciences*, 2011; DOI: 10.1073/pnas.1015619108

Penn State. (2011, June 20). Salt marsh sediments help gauge climate-change-induced sea level rise. *ScienceDaily*. Retrieved June 13, 2018 from www.sciencedaily.com/releases/2011/06/110620161258.htm

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Ward, L.G., Zaprowski, B.J., Trainer, K.D., Thompson Davis, P. (2008) Stratigraphy, pollen history and geochronology of tidal marshes in a Gulf of Maine estuarine system: Climatic and relative sea level impacts. Marine Geology 256;1–17.

http://www.vims.edu/research/units/centerspartners/map/education/profdev/VASEA/docs/SeaLevelRise/VASEASeaLevelRise.pdf (modeling salt marsh wtih straws)

http://omp.gso.uri.edu/ompweb/doee/teacher/pdf/act16.pdf (sea level rise and topographic maps LP)

http://omp.gso.uri.edu/ompweb/doee/teacher/pdf/act22.pdf (clay modeling of salt marsh and sea level rise predictions LP)

http://omp.gso.uri.edu/ompweb/doee/teacher/pdf/act11.pdf (greenhouse gases LP)