STROUD
WATER RESEARCH CENTER

Sea Level Rise and Tidal Wetlands

Teacher Guide for High School Lessons

Anthony Prinzo

Produced in partnership with Stroud Water Research Center.
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About Anthony Prinzo

WEST CHESTER AREA SCHOOL DISTRICT

I am a biology teacher and the science department chair at East High School in the West Chester Area School District (Pennsylvania, USA). With a bachelor's degree in marine biology and a master's degree in secondary education in biology, I have taught all levels of biology as well as human anatomy, aquatic ecology, marine biology, and environmental science over the past 10 years. I am most passionate about the aquatic ecology and marine biology classes because it is an opportunity to teach about the estuaries, the environment, and many concepts that all students have experiences with. We all have those childhood water/beach memories that stick with us. This is what I recommend for all teachers jumping into estuary education. Make it relevant for our students. Tap into their life experiences, and they will be interested in the topic.

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Lesson Overview and Information

STEELS Standards:

- *3.4.9-12.C Analyze and interpret how issues, trends, technologies, and policies impact watersheds and water resources.*
- *3.4.9-12.D Apply research and analytical skills to systematically investigate environmental issues ranging from local issues to those that are regional or global in scope.*
- *3.4.9-12.E Plan and conduct an investigation utilizing environmental data about a local environmental issue.*

Timing: This lesson can be done as a 3-6 day unit..

Investigative Phenomenon: Sea level in Philadelphia, Pennsylvania has risen 6 inches since 1980.

Materials:

- Pen/pencil (one per student)
- Laptop w/ internet connection
- Student Materials packet
- Teacher Materials packet
- Post-it (one for every student)
- Stations for day 1
- 1000mL beaker (three per group)
- 2000mL graduated cylinders (one to three per group)
- Stop watch (one per group)
- Google Sheet for class data

Day 1 - Phenomenon Introduction

1. Teacher introduces phenomena by playing this news clip until 1:11.
   a. Find a news clip more local to your area.

2. Students fill in part 1 of the student materials sheet by writing down two observations and two questions they have about the clip individually and silently. *(3 minutes)*

3. Students then discuss their questions in groups (4-6) and identify whether their questions are experimental or general. Students then write their "best question" on a post-it note and place it on a driving questions board in the classroom.Teacher should attempt to direct conversations around what is causing sea level rise, what are some solutions for sea level rise, what areas are impacted most by sea level rise, how this will affect our local area, and how we are impacting sea level rise. *(5 minutes)*

4. Print these slides out and place them around the room. Students then will work in partners (2) and rotate through stations set up around the room. They should complete part 2 in the student materials packet while going from station to station. Each station has a different visual (graph, diagram, image, data table or reading). Students are expected to identify and analyze patterns in the trends from the data or visuals or readings. *(30 minutes)*

5. Wrap up by asking students to cross out any question on the driving question board that was answered today. Do not remove the question yet.

Day 2 - Outdoor Learning Experience

1. Have students sit in groups (4-6) and have a conversation about what they learned the day before. *(2 minutes)*

2. Ask students to add any new questions they have to the driving questions board. *(2 minutes)*

3. Have students read the introduction to the Sedimentation lab (part 3/day 1 of student materials). Have students annotate the introduction by underlining, circling, or highlighting anything that is important to helping understand the investigative phenomenon (you may have to remind students what the phenomenon is). *(8 minutes)*

4. After this, students model where large-sized particles, medium-sized particles, and small particles will be found in the graduated cylinder when a water sample is poured into it and allowed to settle for one minute. *(5 minutes)*

5. Take class outside and have each group retrieve three 900mL water samples from a local stream. (Alternate - let them bring in a water sample from a stream near their home or you bring in a large sample for the whole class to use). Bring water samples back into the classroom and leave it covered overnight. *(0 - 20 minutes)*

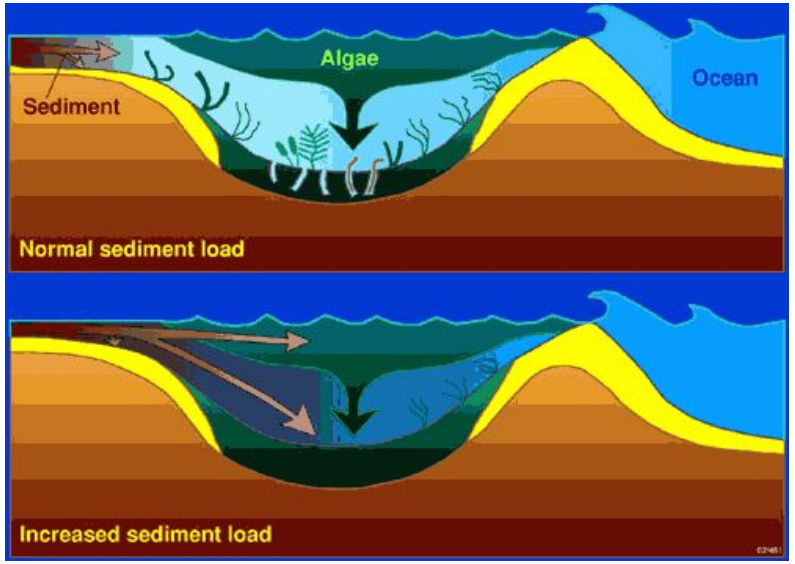
*** If you brought in your own water sample then they can get started with day 3 immediately.*

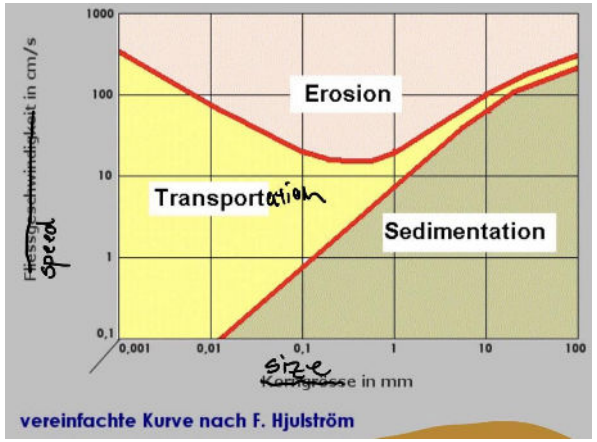
6. Make sure students are prepared to immediately complete the lab tomorrow.

Day 3 - Lab Investigation

1. Students need to immediately start the sedimentation lab (part 3/day 2 of student materials). *(20 minutes- overnight, could have been started the day before)*

2. Groups should put their data on the board so students can analyze class data and not just their own. Students should then create a graph of the class data averages with correctly labeled axis, title, and standard error bars using google sheets or microsoft excel - example (graphing, statistical analysis and use of google sheets/excel should have been taught earlier in the year). Students could also hand-draw their graphs on graph paper. *(45 minutes)*





Day 4 - Explanation and Reflection

1. Have a class consensus discussion (each group shares their results) about the trends and patterns observed in the data from our lab. Then agree as a class on the results. (*10 minutes)*

2. Students should analyze the data and draw a conclusion about the sedimentation rate of their local stream. Then write a claim, evidence, and reasoning (taught earlier in the year) on how the rate of sedimentation could possibly counteract sea level rise in local watersheds. This is located in part 4 of their student materials packet. *(20 minutes)*

3. Allow students to peer review their CER's. *(5 minutes)*

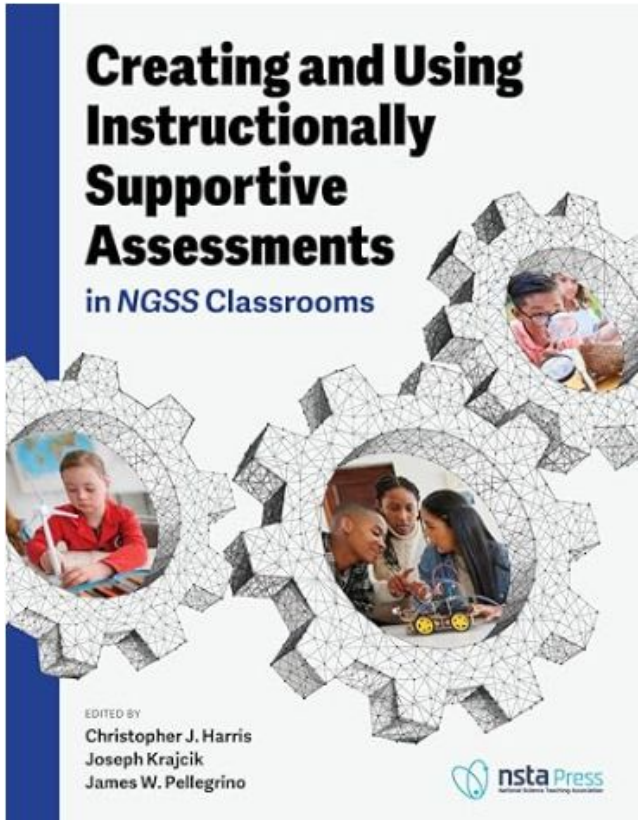
4. Students complete investigation reflection - part 5 in student materials packet. *(2 minutes)*

5. Students should cross out any question on the driving question board that has been answered to close out the lesson. Not all questions will be answered which provide enrichment opportunities. *(2 minutes)*

**If you want this to be a three-day unit, step 1 can be skipped and steps 2, 3, and 4 can be done for homework.

Assessment

- This skills based, three-dimensional assessment could be given following the unit.
  - It can be done individually or in groups.



Local Environmental Issues and Watersheds Skills-Based Assessments

Directions: Complete the assessment below using any materials from your unit packet.

Figure 1: From NOAA Sea Level Trends website. Sea Level Trends in Philadelphia, Pa.

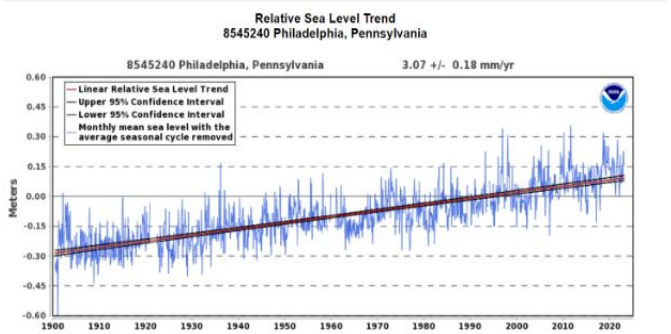
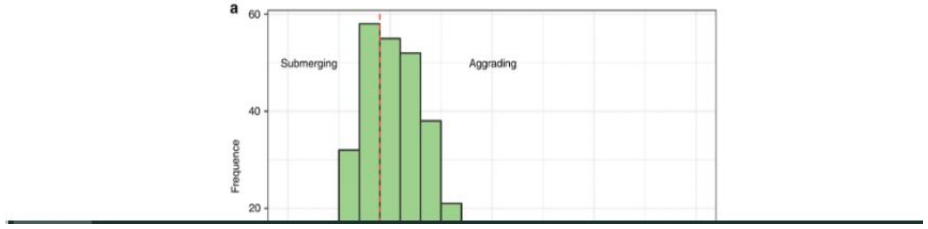


Figure 2: From Tidal Resilience Study (Nature, 2019). Land Submerging vs. Accretion (sedimentation) in wetlands across the United States.



Extension

- Visit a tidal wetlands area for a student program
  - Example program