



The Past, Present, and Future of Salem's Shorelines

Grade: Grade 6

Place of Focus: Beach at Palmer Cove, Salem, MA

Citizen Science Protocol:

- **Primary:** Beach Profiling
- **Secondary:** Intertidal Biodiversity Monitoring
- **Tertiary:** Beach Cleanup Data Collection using CleanSwell

Massachusetts Curriculum Framework for Science and Technology/Engineering Standards

- **4-ESS1-1.** Use evidence from a given landscape that includes simple landforms and rock layers to support a claim about the role of erosion or deposition in the formation of the landscape over long periods of time.
- **4-ESS2-2.** Analyze and interpret data from maps to describe patterns of earth's features.
- **7.MS-ESS2-2.** Construct an explanation based on evidence for how Earth's surface has changed over scales that range from local to global in scale.
- **7.MS-LS2-4.** Analyze data to provide evidence that disruptions (natural or human-made) to any physical or biological components of an ecosystem can lead to shifts in all its populations.



Learning Objectives

By the end of the field lesson, students will:

- Be familiar with the history of the shoreline closest to their school (and some of their homes) by using historical maps to make observations about where & how the intersection of land and water has changed over time.
- Understand the process for measuring and recording a “beach profile”.
- Compare current beach conditions to past and future conditions using online models.
- Recognize various intertidal species that are found in Salem Sound (and thus, in their neighborhood).

Pre-Visit Learning

Prior to the site trip, students should understand:

- The different “forces” that cause a shoreline to change over different periods of time (daily changes versus monthly changes, etc).
 - Why/how humans impact the shoreline,
 - How tides and the ocean impacts the shoreline,
 - How changing sea levels may impact the shoreline (to be solidified after site-visit).

Essential Questions

- How is the land shaped differently in different locations?
- What is the role of water in shaping the land?
- What is the role of humans in shaping the land?
- How do rocks form and change?
- How do changes (physical and/or biological) in an ecosystem affect the ecosystems populations?



Guiding Questions

1. What has changed at the beach since the last time it was visited? (*Are the same species here? Is the profile the same? Is the amount/type of debris the same?*)
2. What has caused the changes we are observing?
3. What do you expect it to look like the next time we are here?

Field Visit Preparations

Time

Before conducting any field visits, students will be introduced to the project in the classroom. They will use online resources such as the [USGS Historical Topo Map Explorer](#) and [CZM's MORIS Viewer](#). With these tools, they will better understand the history of the site they will be exploring. This lesson will take one 50 minute class period.

The time required for each of the field activities may vary and will not be performed synchronously. First, students will visit the site and perform a “preliminary survey” of the area and conduct a beach clean up. This excursion would be done in one 50 minute class period (10-15 minutes for walking each way). This type of visit could be conducted 2-3 times throughout the year in connection with other surveys, but is not as crucial to the overall lesson.

The second “field visit” would not be to the study area, but would include practicing beach profiling techniques in the hilly school yard. This would require thorough discussion of expectations and procedures while in the classroom, but would also be conducted during a 50 minute class period.

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Time (cont.)

The third field visit would include the beach profiling and intertidal species monitoring. This would be conducted during a longer, double-block period and would require cooperation from administration regarding shifted curriculum. Not including the walk to and from the school, students would have approximately an hour to conduct the beach profiling, species survey and share their results with each other. This type of visit will be repeated 2-3 times throughout the year.

Following the field visits and associated data collection, students will spend another full 50 minute class time reviewing their findings and eventually comparing them to previous visits. During this class period, they will also use the [NOAA Sea Level Rise Viewer](#) and maps created by Woods Hole Group for the city of Salem to make their own predictions about what the shoreline may look like in the future.

Materials and Supplies

General Field Visit Materials

- 3 x Beach Survey Kits (details below)
- Beach Profiling Data Sheets (in lieu of google form)
- Clipboards
- Pencils
- 3 x Intertidal Monitoring Quadrats (meter x meter PVC squares)
- Intertidal Identification Cards (hard copy of these, or similar: [Umass Boston/SLL Cards](#))
- Marine Invasive Identification Cards (hard copy of cards found here: [SSCW MIMIC Cards](#))
- Nitrile Gloves
- ~ 6 x 5 gallon buckets
- Trash Bags
- 1 x Spring Scale

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Materials and Supplies

Materials for Beach Profiling “Survey Kits”

<i>Item</i>	<i>Quantity</i>	<i>Cost</i>
Refurbished iPads (TechtoSchool)	4	\$189 ea
Telescoping Survey Poles (Amazon)	3	\$39.99 ea
Telescoping Horizon Poles (Amazon)	2	\$33.99 ea
Bubble Levels for Horizon Poles (Amazon)	3	\$11.04 ea
String for connecting emery rods		
Electrical tape for marking 4ft and 5ft increments on horizon poles		
TOTAL COST		\$980

Logistics

The Study Area:

The study area is located approximately a quarter mile from the front door of the Saltonstall School. The small beach is in the corner of a busy marina, next to a popular park and community space.

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Logistics (cont.)

The Beach:

The beach is approximately 65 ft x 100 ft at low tide (according to a rough measurement on google maps); which may not be large enough for big gatherings and makes it easy to overlook. It is a very dynamic corner of the marina and can become a dumping ground for floating marine debris as the tides come in and out. There are always several distinct wrack lines on the sandy beach, which are often full of debris and microplastics.

The Project:

This project will require coordination with [Salem Sound Coastwatch](#), a local environmental group with great experience in beach/environmental stewardship. Their expertise will be especially important for the Intertidal Biodiversity Monitoring and looking at the sea level rise projections.

Site Map:





Scientific Protocol

1. The highest priority protocol, the one that will give them the most direct answers to their guiding questions, is the **Beach Profiling Protocol** - using the Emery method. Students will use a slightly modified version of the field data sheet provided by SLL. Future iterations of this project could include digital data sheets.
2. Students will also be performing an **Intertidal Biodiversity Survey** with support from Salem Sound Coastwatch, who has their own protocols that they regularly train participants for. For this protocol, students will need associated data sheets.
3. The last protocol students will be following is data collection through the **CleanSwell Marine Debris Tracker**. They will be able to keep track of how much of different types of debris they find and compare it to other beach cleanups in the area using <https://www.coastalcleanupdata.org/>

Field Visit Outline

Introduction

Before visiting the site, students will have practiced the emery method in their schoolyard and will be familiar with the equipment and steps of procedure. They will also be familiar, though not “scientifically familiar” with the site, as it is incredibly close to their school and located within a neighborhood that many of them live.

To keep students safe, we will be accompanied by the science coach and at least one paraprofessional. On at least one of the site visit days, Salem Sound Coastwatch staff will also be meeting us on site.



Learning Tasks

Field Day 1 - Preliminary Site Visit

- 00:00 - 00:10 - Re-introduce the CleanSwell app (on ipads) and designate three data collectors and three counters. A teacher will transport cleanup materials if SSCW is unavailable for support.
- 00:10 - 00:20 - Get outside to site.
- 00:20-00:25 - Distribute cleanup materials and setup “drop station”.
- 00:25 - 00:40 - Perform beach cleanup. Small groups of students will pick up trash and bring it back to “drop station” where data collectors and counters are itemizing debris. Trash pickup will be coordinated with the Salem DPW and can be left on site.
- 00:40-00:50 - Go back inside

Field Day 2 - Emery Practice

- 00:00 - 00:10 - Gather materials in the classroom and remind students of expectations when outside. Students will be in groups of 4-5, each with a clipboard and data sheet. A teacher will transport survey equipment.
- 00:10 - 00:15 - Get outside to schoolyard.
- 00:15 - 00:20 - Remind students of expectations going forward and point out the three work areas (delineated ahead of time with posts/string). The groups, of which there will be 4-5, will either practice the beach profiling, or do a rock identification activity (in connection with Amplify Rock Transformations unit).
- 00:20 - 00:33 - Rotation 1
- 00:33 - 00:45 - Rotation 2
- 00:45 - 00:50 - Go back inside

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Learning Tasks (cont.)

Field Day 3 - Beach Profiling and Biodiversity Surveying

- 00:00 - 00:10 - Gather materials in the classroom and remind students of expectations when outside. Re-assign groups of 4-5, each with a clipboard and data sheets (beach profiling and biodiversity monitoring).
- 00:10 - 00:20 - Get outside to site.
- 00:20 - 00:25 - Remind students of expectations going forward and point out the three profile transects (delineated ahead of time with posts/string).
- 00:25 - 00:30 - Salem Sound Coastwatch staff will introduce students to the intertidal species monitoring protocol and some of the expected species.
- 00:30 - 00:55 - Rotation 1
- 00:55 - 01:20 - Rotation 2
- 01:20 - 01:30 - Wrap-up and brief reflection of findings
- 01:30 - 01:40 - Go back inside

Reflection

Questions to be discussed in the reflection (and continued during a summative lesson after the field visit during which students can begin work on their summative presentations):

- Which side of the beach had the steepest slope (most sand at the top, less sand at the water line)?
- Which side of the beach had the smoothest slope (same amount of change in each increment)?
- Which side of the beach experienced the most change since the last time we visited?
- What caused the changes you observed?
- What species did we see the most of (was it native or invasive)?



Post-Visit Learning

Students will have a choice on how to present/share their findings. Their final products should include a comparison of at least two time periods, either historical versus current, beginning of the year versus end of the year, current versus projected future, etc. Their options for final products could include a poster, google slide presentation, photo series, graphical representation, or whatever else they can come up with.

In collaboration with Salem Sound Coastwatch, who is doing on-going outreach in the Palmer Cove neighborhood regarding climate resilience and flood preparedness, it is possible that student work could be made available to the public (<https://www.publicinput.com/thepoint>).

Full Unit Outline

In the first year of this lesson execution, the five total lessons (introduction to digital tools and site history, three outdoor days and an in-class reflection time) will be spread out over the course of several months at the beginning of the year. In future years, the content can be revisited at the end of the year, giving students more data to use in their comparisons. The applicable units at the beginning of the year are “Geology on Mars”, followed by “Rock Transformations”, which both support the essential questions listed above.