Salt Marsh Science and Technology

By: Elizabeth Duff
Content /Subject Area: **Technology**
Unit Theme: Humans impact ecosystems in both positive and negative ways.
Focus Concept: Interactions, Stewardship
Essential Understandings: (Learning Standards)

Essential Understandings	Guiding Questions	Activity
Understanding and Using Technology in Society:		
The Tools and machines of Technology		
Tools are useful when used safely and effectively.		Learn proper use of refractometer, binoculars, soil probe, graduated cylinder etc.
Scientific tools help us investigate questions to learn human's impact on an ecosystem.	What tools do you think would be useful to investigate the growth of *Phragmites* on a salt marsh?	Investigate the salt marsh using soil probe, refractometer, meter tapes, graduated cylinder etc.
Resources of Technology:		
Graphs can communicate information effectively.	What type of graph will best help us analyze and communicate our findings?	Graph salinity and fish data collected, both manually, and in excel.
Computers help distribute information widely, and effectively.	How does the internet help communicate data?	Explore the Massachusetts Audubon Salt Marsh Science Site.
		Download data from other sites to compare data from your school with data from another school.
		Search the Web for additional sites with information about *Phragmites*.
	OPTIONAL ACTIVTIES	Design and create your own web-site to communicate your data.
		Design a powerpoint presentation to communicate your findings.
		Design a Microworlds animated program to illustrate the impact of humans on salt marshes.

Salt Marsh Science and Math

By: Elizabeth Duff
Content /Subject Area: Technology
Unit Theme: Humans impact ecosystems in both positive and negative ways.
Focus Concept: Interactions, Stewardship
Guiding Principles:

- Mathematics learning is a lifelong process that begins and continues in the home and extends to school and community settings.
- Mathematics instruction both connects with other disciplines and moves toward integration of mathematical domains.
- Technology is an essential tool for effective mathematics education.

Essential Understandings: (Learning Standards)

Learning Standards	Guiding Questions	Activity
Mathematics skills are useful in investigating fish in a salt marsh. Your background knowledge helps you make predictions.		**Fish investigation:** Predict: Will there be more fish upstream or downstream of the culvert? (Explain why.) Guess: How many fish do you think there will be? Will there be more species upstream or down stream?
Real world problems need mathematical skills to understand.		Calculate how long the traps have been in the water.
Real world problems have multiple steps.		Sort and Classify the fish. Identify them.
Counting, measuring, and multiplying are useful skills in a scientific exploration. Mathematics connect between domains, and other disciplines.		Count how many of each species.
		Measure the volume of each species, using displacement in a graduated cylinder.
Use operations involving fractions, decimals, integers and rational numbers.	How do we figure out the average volume of one fish?	Calculate the average volume of fish.
Mathematical ideas can be understood and modeled through diagrams and graphs.	How can we best represent our findings?	Graph the results.
		Salinity Investigation
Identify when an estimate is appropriate.		Predict where salinity will be the greatest. (S,M,D, which well site.) Estimate level of salinity.
Make and use exact and estimated measurements to describe and compare phenomena.		Measure salinity using a refractometer. Record your results.
		Adjust your prediction based on you findings.

Describe and represent relationships with models, tables, graphs, and rules using sentences and algebraic expressions.		Graph the data.
Analyze tables and graphs to identify properties and relationships.		Analyze the graph. Communicate your understanding.
Collect, organize and describe data systematically.		Analyze the graph. Communicate your understanding.
Construct, read, and interpret tables, charts and graphs.		Analyze the graph. Communicate your understanding.
Make inferences and convincing arguments that are based on data analysis.		Analyze the graph. Communicate your understanding.
		Vegetation Investigation
		Identify vegetation growing on a transect line.
		Measure the tallest Phragmites growing on the transect line.

GUIDING QUESTIONS:

1. How do changes in salinity and water level affect fish and vegetation in a wetland?
2. What human actions result in the growth of *Phragmites*? Is this a positive or negative impact?
3. What negative impacts do humans have on wetland ecosystems?
4. How do organisms on a salt marsh interact with each other and with non-living things?
5. Describe a food chain as an example of energy flow in a salt marsh?
6. How can humans positively impact this ecosystem?
7. How is soil formed on a salt marsh?
8. Why does a salt marsh smell?
9. How does the Mill Pond region act as a watershed?
10. How does water-flow in the Mill Pond region, include reference to both the water and tide cycles?
11. How have humans changed the land forms and water body in the Mill Pond region?
12. How diverse is the Mill Pond ecosystem?
13. What characteristics are helpful in identifying fish and plants? What traits vary within a species?
14. What are effective ways for organizing and representing scientific data? Which form of data representation best illustrates the idea you are trying to convey?
15. How can scientific tools be used to investigate human impact on the salt marsh?
16. Based on your past experience, what predictions can you make regarding fish populations, salinity, and *Phragmites* growth?

ENABLING ACTIVITIES

Salt Marsh Science and Math

Grades 3-4 Mathematics

	Learning Standard		
Grades 3-4 Data Analysis, Statistics, and Probability	4.D.1 Collect and organize data using observations, measurements, surveys, or experiments, and identify appropriate ways to display the data.	• Measure water salinity in several wells at different locations and record your results. • Walk a transect line and record data about vegetation frequency and height. • Determine volume and numbers of fish caught in traps. Record this information • Observe several different bird species and record data about their numbers and behaviors	• Salinity lab • Vegetation Transect • Fish Lab • Bird Lab
	4.D.2 Match a representation of a data set such as lists, tables or graphs (including circle graphs) with the actual set of data.	• Examine the data sheets compiled by groups in the past. Locate individual data sets on compilation charts and graphs showing changes in fish populations, salinity, and vegetation over time.	Fish, salinity, and vegetation data processing Check www.massadubon.org/saltmarsh for past data.
	4.D.3 Construct, draw conclusions, and make predictions from various representations of data sets, including tables, bar graphs, pictographs, line graphs, line plots and tallies.	Using compilation charts of data collected over time: • Predict which wells will contain water with the highest salinity levels. • Predict whether *Phragmites* can spread to an area of marsh based on measured salinity levels.	• Salinity data processing • Salinity and vegetation data processing

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Grade 5-6 Mathematics
Math Frameworks:

Grades 5-6	Learning Standard	Salt Marsh Science Application	Activity
Number Sense and Operations	6.N.5 Identify and determine common equivalent fractions, mixed numbers, decimals and percents.	• Determine the percentage of fish caught in a trap belonging to each species • Measure water salinity and express as parts per thousand. Convert these figures to find percent salinity • Determine the percent cover of a species of vegetation in a plot	• Fish Data Processing • Salinity Data Processing • Vegetation Lab
	6.N.13 Accurately and efficiently add, subtract, multiply and divide (with double digit divisors) whole numbers and positive decimals	• Find the average number of fish caught per hour in minnow trap • Compute the total numbers of fish caught both upstream and downstream	Fish Lab
	6.N.16 Estimate results of computations with whole numbers, and with positive fractions, mixed numbers, decimals, and percents. Describe reasonableness of estimates.	• Estimate volume of one fish based on total volume and number of fish caught in traps • Estimate number of fish in buckets	Fish Lab
Grades 5-6 Data Analysis, Statistics, and Probability	6.D.1 Describe and compare data sets using the concepts of median, mean, mode, maximum and minimum and range.	• Find the mean, median, and mode for salinity at your site • Find the mean, median, and mode for fish volume	• Salinity data processing • Fish data processing
Grades 5-6 Patterns, Relations, and Algebra	6.P.6 Produce and interpret graphs that represent the relationship between two variables in everyday situations.	Using your data, graph relationships: • Salinity to well depth • Salinity to *Phragmites* growth • *Phragmites* height in restored vs. un-restored areas • Volumes and numbers of fish caught upstream vs. downstream	• Salinity data processing • Salinity and vegetation data processing • Vegetation data processing • Fish data processing

Grade 7-8 Mathematics

Grades 7-8 Measurement	8.M.1 Select, convert (within the same system of measurement) and use appropriate units of measurement or scale.	• Select the correct cylinder for measuring volume of fish in milliliters • Measure height of vegetation in centimeters	• Fish Lab • Vegetation Transect
Grades 7-8 Data Analysis, Statistics, and Probablity	8.D.1 Describe the characteristics and limitations of a data sample. Identify different ways of selecting a sample, e.g., convenience sampling, responses to a survey, random sampling.	• Identify the strengths and weaknesses of the minnow trap method of sampling fish. • Identify strengths and weaknesses of line transect as method of collecting plant data How accurate do you think your data is?	• Fish Lab • Vegetation Transect
	8.D.2 Select, create, interpret, and utilize various tabular and graphical representations of data, e.g. circle graphs, Venn diagrams, scatterplots, stem and leaf plots, box and whisker plots, histograms, tables and charts. Differentiate between continuous and discrete data and ways to represent them.	• Graph fish and salinity data • Graph percentage frequencies of several different fish species • Find salinity averages and graph them	• Fish lab, salinity lab • Fish Lab • Salinity Lab
	8.D.3 Find, describe, and interpret appropriate measures of central tendency (mean, median and mode) and spread (range) that represent a set of data. Use these notions to compare different sets of data.	Find mean, median, mode, and spread of salinity at your site	Salinity Lab

High School Mathematics

Grades 9-10 Number Sense and Operations	Use estimation to judge the reasonableness of results of computations and of solutions to problems involving real numbers.	Double check your fish calculations	Fish Lab

Salt Marsh Science and Language Arts
Massachusetts English Language Arts Curriculum Frameworks

Grades 5-6, 7-8	Learning Standard	Salt Marsh Science Activity
	LANGUAGE STRAND	
General Standard 1: Discussion *Students will use agreed-upon rules for informal and formal discussions in small and large groups.* Grades 5-6, 7-8, , 9-10, 11-12		**Wetland Metaphors*** Brainstorm in small groups the functions of wetlands.
General Standard 3: Oral Presentation *Students will make oral presentations that demonstrate appropriate consideration of audience, purpose and the information to be conveyed.* Grades 5-6, 7-8, , 9-10, 11-12	3.8 Give oral presentations for various purposes, showing appropriate changes in delivery (gestures, vocabulary, prose, pace, visuals) and using language for dramatic effect.	Prepare a presentation for a coastal science conference. Deliver presentation to students, parents, and the local community.
Grades 5-6, 7-8, , 9-10, 11-12	3.9 Use teacher-developed assessment criteria to prepare their presentation	Develop rubrics and assess students presentations.
General Standard 18: Dramatic Reading and Performance *Students will plan and present dramatic readings, recitations, and performances that demonstrate appropriate consideration of audience and purpose.* 3-4, 4-5, 5-6, 7-8, 9-10, 11-12	18.2 Plan and perform readings of selected texts for an audience, using clear diction and voice quality (volume, tempo, pitch, tone) appropriate to the selection, and use teacher-developed assessment criteria to prepare presentations.	Act out a Conservation Commission hearing for classmates, other schools, and/or parents.
General Standard 19: Writing *Students will write with a clear focus, coherent organization, and sufficient detail.*	**COMPOSITION**	
Gr. 5-6, 7-8, 9-10, 11-12 For informational/expository writing:	19.16 Write brief research reports with clear focus and supporting detail.	Write a cohesive analysis of data collected in the field.

General Standard 19: Writing *Students will write with a clear focus, coherent organization, and sufficient detail.*	**COMPOSITION**	
	19.17 Write a short explanation of a process that includes a topic statement, supporting details, and a conclusion.	Write scientific methodology.
Gr.. 7-8, 9-10, 11-12 For informational/expository writing	19.21 Write reports based on research that includes quotations, footnotes or endnotes and a bibliography.	
Grade 11-12 For informational/expository writing:	19.27 Write well –organized research papers that prove a thesis statement using logical organization, effective supporting evidence, and variety in sentence structure.	
General Standard 22: Standard English Conventions *Students will use knowledge of standard English conventions in their writing, revising and editing*		
Grades 5-6, 7-8	23.7 Group related ideas and place them in logical order when writing summaries or reports.	Use logical order when writing a salinity, fish, or vegetation lab report.
Grades 5-6, 7-8	23.8 Organize information about a topic into a coherent paragraph with a topic sentence, sufficient supporting detail, and a concluding sentence.	Organize information about the salt marsh and *Phragmites* into a coherent paragraph with a topic sentence, sufficient supporting detail, and a concluding sentence.

General Standard 22: Standard English Conventions *Students will use knowledge of standard English conventions in their writing, revising and editing*	**LANGUAGE STRAND**	
Grade 7-8, 9-10, 11-12 **General Standard 23:** **Organizing Ideas in Writing** Students will organize ideas in writing in a way that makes sense for their purpose.	*23.10* Organize information into a coherent essay or report with a thesis statement in the introduction, transition sentences to link paragraphs and a conclusion.	
General Standard 24: Research *Students will gather information from a variety of sources, analyze and evaluate the quality of the information they obtain, and use it to answer their own questions.* 5-6, 7-8, 9-10, 11-12	24.3 - Use an expanded range of print and non-print sources (atlases, data bases, electronic, on-line resources) - Follow established criteria for evaluating information; - Locate specific information within resources by using indexes, tables of contents, electronic search key words; - Organize and present research using the grades 5-6 Learning Standards in the Composition Strand as a guide for writing	Use the web to extend our coastal research. - Use an expanded range of print and non-print sources (atlases, data bases, electronic, on-line resources) - Follow established criteria for evaluating information; - Locate specific information within resources by using indexes, tables of contents, electronic search key words; - Organize and present research using the grades 5-6 Learning Standards in the Composition Strand as a guide for writing
	MEDIA STRAND	
General Standard 26: Analysis of Media *Students will identify, analyze and apply knowledge of the conventions, elements and techniques of film, radio, video, television, multimedia presentations, the Internet, and emerging technologies, and provide evidence from the works to support their understanding.* Grade 5-6, 7-8, 9-10, 11-12	27.3 Create a media production using effective images, text, music, sound effects, or graphics.	Develop powerpoint presentation for coastal science conference.

Salt Marsh Science and Social Studies

Grades 5-8 Social Studies Learning Standards

Learning Standard	Activity
Strand 2: Geography **Learning Standard 9:** The effects of Geography: Students will learn how physical environments have influenced particular cultures, economies, and political systems, and how geographic factors have affected population distribution, human migration, and other prehistoric and historical developments, such as agriculture, manufacturing, trade and transportation.	Analyze the impact of a road, culvert, berm and/or storm drains on a nearby wetland ecosystem. Monitor vegetation, fish, and salinity over time.
Strand 2: Geography: **Learning Standard 10:** Human Alteration of Environments. Students will describe the ways in which human activity has changed the world, such as removing natural barriers; transplanting some animal and plant species, and eliminating others; increasing or decreasing natural fertility of land; and the mining of resources. They explain how science, technology, and institutions of many kinds have affected human capacity to alter environments.	Assess: Is there a tidal restriction affecting this marsh? How does it impact the environment? Write: What actions do you suggest for improving this environment? Are there any human interests that would conflict with this plan?
Strand Four: Civics and Government: Students will learn the rights of civic virtue in a school, a community, a nation; and identify major obstacles and threats to civil rights.	Learn about the Wetlands Protection Act. Participate in a mock Conservation Commission hearing. Role play a conservation commission member or a local citizen.
Strand 3 Economics: American and Massachusetts Economic History Students will describe the development of the American economy, including Massachusetts and New England from colonial times to the present.	Read "Life and Death of the Salt Marsh" first 50 pages. Research the town's history. Write a report describing the changes in uses and attitudes toward wetlands over time. View "Voices of the Great Marsh" video. Interview local citizens regarding their memories of the marsh.

Salt Marsh Science: an Inquiry Based Integrated Curriculum.
Science and Technology/Engineering Curriculum Frameworks

The Skills of Inquiry

Grades 3-5:

- Organize objects into groups according to shared properties (similarities and differences) and characteristics.
- Ask questions and make predictions that can be tested.
- Keep accurate records while conducting a simple investigation.
- Extend observations and make measurements using scientific tools such as scales, microscopes, and tools to measure liquid volumes.
- Recognize simple patterns in data and use data to create a reasonable explanation for the results of an investigation.
- Communicate findings to others using graphs, charts, maps, models, and oral and written reports.

Grades 6-8:

- Design and conduct an investigation specifying variables to be changed, controlled, and measured. Be able to form a testable hypothesis.
- Present and explain data and findings using multiple representations, including tables, graphs, mathematical and physical models, and demonstrations.
- Draw conclusions based on data or evidence presented in tables and graphs, and explain the reasoning for the conclusion based on patterns or trends in the data.
- Communicate scientific procedures, results, and explanations using appropriate science and technology terminology.
- Offer explanations and critique and revise investigation procedures.
- Use more complex tools (e.g., microscopes, graduated cylinders, and timers), technologies (e.g. computer probes) and appropriate measurement units to make observations, and to collect and organize quantitative and qualitative data.

High School:

- Pose questions and state hypothesis based on prior scientific experiences.
- Use mathematics to analyze and support findings and to model conclusions.
- Questions interpretations or conclusions for which there is insufficient supporting evidence, and recognize that any conclusion can be challenged by further evidence.
- Model physical data using multiple representations.
- Communicate and defend a scientific argument.
- Formulate and revise scientific models.
- Design and complete an advanced scientific investigation- either individually or part of a student team – that extends over several days or weeks.

Grade 3-5 Science

3-5 Earth Science	Learning Standard	Essential Understandings	Enabling Activities
Soil	4. Explain and give examples of the ways in which soil is formed (the weathering of rock by water and from the decomposition of plant and animal remains).	Salt marsh soil is formed by the decomposition of dead plant and animal matter (detritus) and the deposition of tidal sediments.	*How Thirsty is the Ground?* *Do You Dig Wetland Soil?* *Soil Lab*
	5. Recognize and discuss the different properties of soil, including color, texture (size of particles), the ability to retain water, and the ability to support the growth of plants.	Decomposition in salt marsh soil is slowed by anaerobic conditions created by saturated soil.	*How Thirsty is the Ground?* *Do You Dig Wetland Soil?*
The Water Cycle	10. Describe how water on earth cycles in different forms and in different locations, including underground and in the atmosphere.	Rain falls and moves by gravity from higher to lower areas. This natural flow region is called the watershed.	*Color me a Watershed* *The Incredible Journey* *Get the Groundwater Picture* Predict salinity levels at different depths based on your understanding of the water cycle and tide cycle.
Earth's History	12. Give examples of how the surface of the earth changes due to slow processes such as erosion and weathering and rapid processes such as landslides, volcanic eruptions and earthquakes.	Waves and tides change the shape of the coastline. Marshes and dunes serve as barriers, lessening the ocean's impact on the land behind them. Humans can change the shape of the coastline by interfering with waves and tides.	• Look at maps from different time periods to observe changes in landscape over time. • Observe signs of erosion at tidal restrictions. • Observe erosion of salt marshes along stream banks.
3-5 **Life Science**: Character-istics of Plants and Animals	1. Classify plants and animals according to the characteristics that they share.	A fish or plant species in the salt marsh can be identified by observing traits common to all members of a species (body shape, location of fins). There may also be minor variations within species (color, size, etc.)	• Fish Lab:Sort and identify salt marsh fish • Vegetation lab: Identify plants using a dichotomous key, and labeled diagrams.

Grade 3-5 Science

3-5 **Life Science**:	Characteristics of Plants and Animals		
Plant Structures and Functions	3. Recognize that animals and plants go through predictable cycles that include birth, growth, development, and death.	A salt marsh is crucial habitat for some species during important stages of their lives, such as breeding providing a nursery for young, or migrating, while some species are dependent upon the salt marsh during all life stages. Organisms are as essential to the composition of the salt marsh after they die and become detritus as they are while they are living.	• Wetland Metaphors* • Fish Lab: Do during different seasons. • Compare size in different seasons. Discuss fish life cycle. • Bird Lab: Observe during different seasons.
Adaptations of Living Things	7. Explain how the structures of living things are adaptations to their environment that help them survive. Give examples of how change in the environment has caused some plants and animals to die or move to new locations.	*Phragmites* is an example of a new plant population in the salt marsh resulting from dramatic short term changes caused by human impact (tidal restrictions, drainage, changes in soil elevation). Short term changes in water level, salinity, and moisture may result in a change in the number of organisms of an ecosystem.	Discuss how *Phragmites'* adaptations allow it to out-compete other native salt marsh plants. Discuss how some native plants die as a result. • ***Water's Going On?*** • **Fish Field Lab** • **Vegetation Transect**
	8. Describe how organisms meet some of their needs in an environment by using behaviors (patterns of activities) in response to information (stimuli) received from the environment. Recognize that some animal behaviors are instinctive and others are learned.	Salt marsh plants and animals interact with each other and with non-living parts of their environment.	*Salt Marsh Players** *Wetland Metaphors** Discuss: What actions do salt marsh species take to adjust to the changing level of the tide? How does that help them survive?
	9. Recognize plant behaviors, such as the way seedling's stems grow toward light and their roots grow downward in response to gravity. Recognize that many plants and animals can survive harsh environments because of seasonal behaviors, e.g. in winter, some trees shed leaves, some animals hibernate and other animals migrate.	• Salt marsh plants and animals have behaviors specifically adapted to coping with the harsh and constantly changing conditions of the marsh. They must also have ways of coping with seasonal changes. • Salt marshes provide food and shelter to seasonally migrating birds	Investigate: How does *Phragmites* spread? What does it do when conditions are less favorable? Research: Choose a salt marsh species and investigate how it's behavior changes seasonally. Observe birds in different seasons. What differences do you see? Why do you think these differences occur?

Grade 3-5 Science

3-5 **Life Science**:	Characteristics of Plants and Animals		
	10. Give examples of how organisms can cause changes in their environment to ensure survival. Explain how some of these changes may affect the ecosystem.	• *Phragmites* is an example of an invasive plant that has crowded out competing species in order to ensure its own survival. • Humans alter the ecosystems in which they live to ensure their own survival and comfort.	How does *Phragmites* change a salt marsh ecosystem? How do human activities (building roads through a salt marsh or depositing stormwater onto a marsh) change a salt marsh ecosystem?
Energy and Living Things	11. Describe how energy derived from the sun is transferred within a food chain from producers to consumers to decomposers.	Plants and animals interact in a variety of ways. Energy flows through the ecosystem as matter is cycled and recycled through these interactions.	*Marsh Munchers** Describe a salt marsh food chain. Indicate which ones are producers, consumers and decomposers.

Grade 6-8 Science

Grades 6-8 Earth Science	Learning Standard		Salt Marsh Science Activity
Mapping the Earth	1. Recognize, interpret, and be able to create models of the earth's common physical features in various mapping representations, including contour maps.	Maps of the physical features of a salt marsh can provide valuable clues to help interpret data about plants and wildlife.	Using a contour map of your salt marsh site, record the location of wildlife, plants, and human impact.
Earth's History	6. Describe and give examples of ways in which the earth's surface is built up and torn down by natural processes, including deposition of sediments, rock formation, erosion and weather.	Waves are one of the primary forces impacting the growth or recession of the salt marsh. The sea level, tides, and tidal restrictions all affect the rate of decay of organic matter. As much of the soil is composed of organic matter, the activities of plants and animals also contribute to the formation of the soils.	- Investigate salt marsh soils. - Read about how salt marsh soils are built up. - Compare salt marsh soils upstream and downstream of a tidal restriction.
Grades 6-8 Life Sciences			
Characteristics of Plants and Animals	1. Classify organisms into the currently recognized kingdoms according to the characteristics that they share. Be familiar with organisms from each kingdom.	A fish or plant species in the salt marsh can be identified by observing traits common to al members of the species (body shape, location of fins). There may also be minor variations within species (color, size, etc.)	Sort and identify salt marsh fish and plants using a dichotomous key, and labeled diagrams.
Living Things and Their Environment	13. Give examples of ways in which organisms interact and have different functions within an ecosystem that enables the ecosystem to survive.	Plants and animals interact with each other and with non-living parts of their environment.	*Salt Marsh Players** Study interactions of salt marsh species
Energy and Living Things	14. Explain the roles and relationships among producers, consumers, and decomposers in the process of energy transfer in a food web.	In any ecosystem, each organism has a role to play to keep energy flowing through. A unique quality of the salt marsh is that decomposers play an especially important role, as most of the first order consumers feed on detritus that has already been decomposed.	*Salt Marsh Players**

Grade 6-8 Science

6-8	**Life Sciences**		
Energy and Living Things	15. Explain how dead plants and animals are broken down by other living organisms and how this process contributes to the system as a whole.	• Plants and animals interact in a variety of ways. Energy flows through the ecosystem as matter is cycled and recycled through these interactions. • The marsh serves as a productive breeding and feeding ground for many animals as detritus is broken down.	*Marsh Munchers** *Wetland Metaphors** Explain how organisms are broken down in a salt marsh. How does this impact the soil?
Changes in Ecosystems Over Time	17. Identify ways in which ecosystems have changed throughout geologic time in response to physical conditions, interactions among organisms, and the actions of humans. Describe how changes may be catastrophic such as volcanic eruptions or ice storms.	• Marshes are low lying, wet regions that purify the environment and act as buffer zones to prevent flooding and erosion. • Human activity has had a negative impact on wetland ecosystems through pollution and by changing physical conditions • Humans can have a positive impact on an ecosystem through conservation, restoration, and protection through legislation.	• *Wetland Metaphors** • *A Grave Mistake** • Mapping Human Impact • Wetland Protection Act: Mock Conservation Commission Hearing • Read: Life and death of a Salt Marsh. Discuss the changes of a salt marsh over time? • Wetland Video • Web-site: Restoration
	17. Recognize that biological evolution accounts for the diversity of species developed through gradual processes over many generations.	• In some habitats with fewer stresses and many niches, natural selection leads to a large number of diverse species. • Natural selection leads to a low number of species that are all expertly adapted to the salt marsh ecosystem.	Discuss natural reasons for low biodiversity in salt marshes. (Short length of existence, many daily stresses.)
6-8	**Physical Science**		
Properties of Matter	2. Differentiate between volume and mass.	Understand how to measure both the volume and mass of salt marsh fish species	Fish Lab: Through displacement. measure the volume of organisms caught in minnow traps.
	3. Recognize that the measurement of volume and mass requires understanding of the sensitivity of measurement tools (e.g. rulers, graduated cylinders, balances) and knowledge and appropriate use of significant digits.	When measuring fish, it is important to choose the correct instrument. Both the size of the organism and the number of organisms you will be measuring will determine the size of the cylinder you use.	Choose an appropriately- sized graduated cylinder for measuring one fish, or 100 fish. Measure fish through displacement.

High School: Earth Science	Learning Standard	Essential Understandings	Enabling Activities
Oceans: Oceans redistribute matter and energy around the earth, through surface and deep water currents, tides, waves, and interaction with other earth spheres.	1.12 Describe the effects of longshore currents, storms, and artificial structures (jetties, sea walls) on coastal erosion in Massachusetts.	When people construct barriers to natural wave activity, these barriers change the natural flow of the water and can quickly and dramatically impact coastal ecosystems.	Investigate the impact of tidal restrictions on ecosystems.
	1.13 Explain what causes the tides and describe how they affect the coastal environment.	• Tides are caused by the gravitational pulls of the sun and moon. • As the tides change, *intertidal* areas are alternately flooded and left dry, causing changes in the behavior of organisms.	• Project Wet: Salt Marsh Players • Keep a journal of the tidal levels and the phases of the moon and chart their interaction.
Earth Processes and Cycles: Interactions among the lithosphere, hydrosphere, atmosphere, have resulted in ongoing evolution of the earth system over geologic time.	3.1 Explain both physical and chemical weathering and how these processes lead to the formation of sediments, soils, soil texture, and structure, and soil horizons.		Investigate Salt Marsh soils. Observe soil horizons, sediments texture etc. Compare storm-water deposits to tidal deposits.
	3.2 Describe how glaciers, gravity, wind, waves and rivers cause weathering and erosion. Give examples of how the effects of these processes can be seen in our local environment.	Wind, waves, and estuary currents can cause the development or erosion of salt marshes.	Investigate erosion in salt marsh ecosystems.