Engaging Classroom Teachers through the New Science Technology/Engineering Framework

Elizabeth Duff, Mass Audubon
Brianna Wilkinson, Museum Institute for Teaching Science
Jane Heinze-Fry, Ph.D.

Hands - on
Minds - on
Inquiry - based

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Agenda

- Welcome/Introductions
- Case Study: Mass Audubon's Salt Marsh Science Project
- Standards and Strand Maps
- Weather/Climate Change Strand Map
- Worktime
- Wrap-up

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Mass Audubon's Salt Marsh Science Project

Using links to standards to work effectively with teachers.

Guiding Philosophy of Mass Audubon's Salt Marsh Science Project

- Long term ecological studies provide unique value
- Hands on
  - immersion in field work
  - students get wet and dirty!
  - citizen science
- Consistent with MA and US curriculum frameworks

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Salt Marsh Science Project

GOALS:

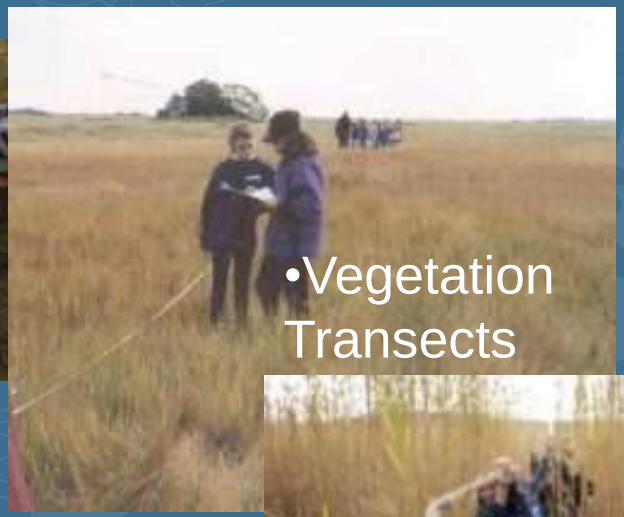
1) Excite students and their teachers about science through hands on activities in their own backyards;
2) Encourage students to consider a career in science;
3) Inspire environmental stewardship.

Most sites are in the Great Marsh Region.

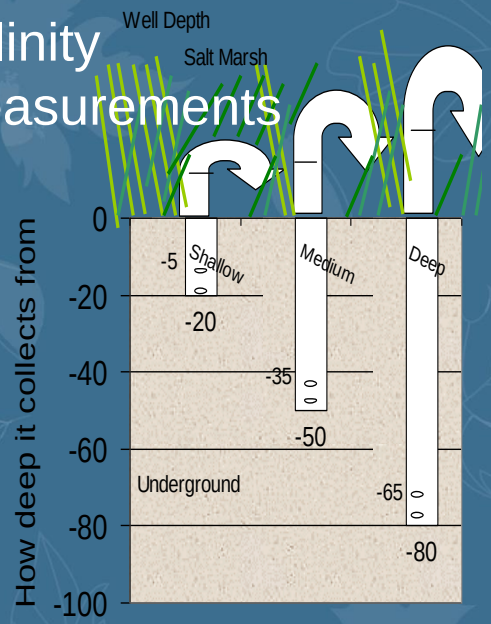
Up to 21 years of data!

Site	Years Monitored	# of years
Byfield- GA	2008, 2015	2
Danvers	1998-2016	19
Essex	1998-2016	18
Gloucester- MP	1998-2016	19
Gloucester- EP	1999-2016	18
Ipswich JNR	1999-2016	18
Ipswich CPT	1999-2016	17
Ipswich TFR	1996-2016	21
Newburyport: Joppa	1999-2016	18
Neponset	2004-2009	7
PRNWR Refuge	2001-2016	16
Rockport	1998-2016	17
Rowley	1996-2016	21
Salem	2002-2016	15
Salisbury	1998-2016	19
Thompson Island	2005-2009	4

Classroom teachers and Mass Audubon Education Coordinators partner to lead student field studies.

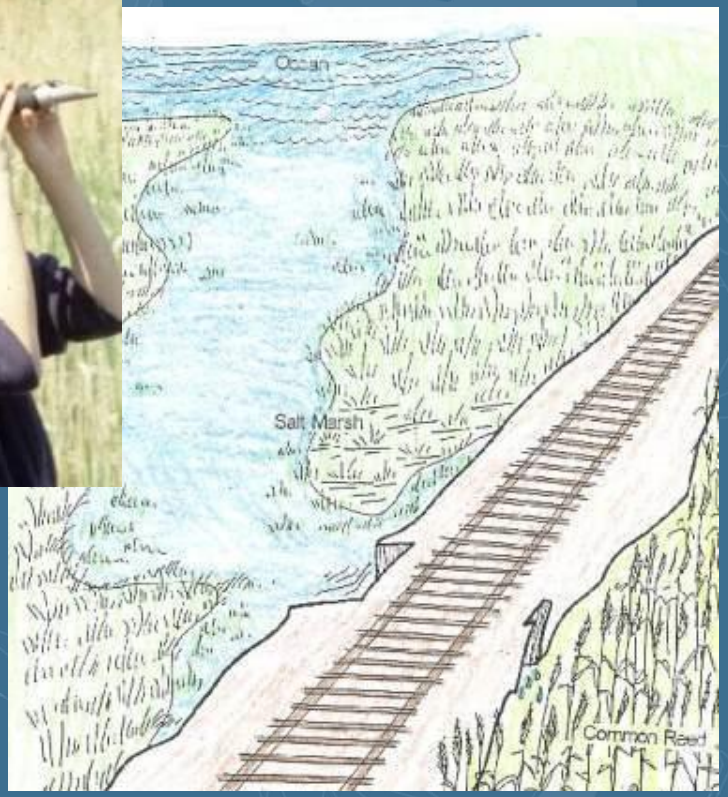


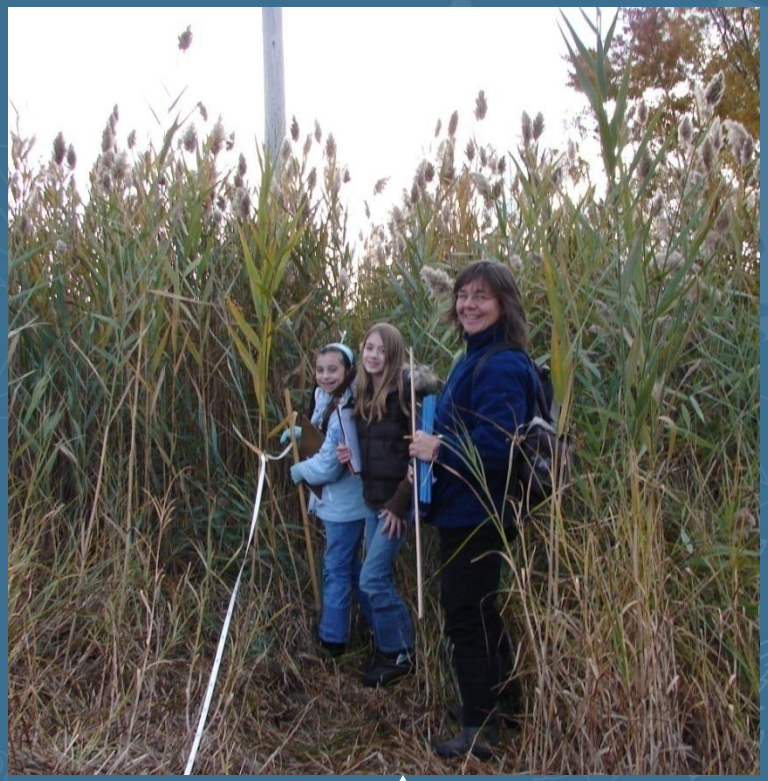
Salinity
Measurements



- Collecting real data
- Participating in a wider scientific study
- Investigating sites in their own towns and watersheds

Primary Focus: Investigating the invasive reed *Phragmites*. And salinity (How salty the water is.)





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An Annual Conference Brings Students & Scientists Together

SMS website hosts the data

ENDICOTT WILDLIFE SANCTUARY

- About
- News & Events
- Schools
- Get Involved
- Salt Marsh Project
  - Science Summary
  - Participants
  - Results & Data
  - Resources & Links
- Sanctuary Guidelines

Salt Marsh Science Project

Since 1996, students in grades 5 through 12 on the North Shore have been working with Mass Audubon scientists to learn about salt marshes and common reed (*Phragmites australis*), an invasive plant that

www.massaudubon.org/saltmarsh

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New Questions Related to Climate Change

How do we expect the salt marsh to change over time as sea level rises?

Check the things below that would indicate a healthier salt marsh:

Higher salinity _____ Lower salinity _____

More low marsh _____ Less low marsh _____

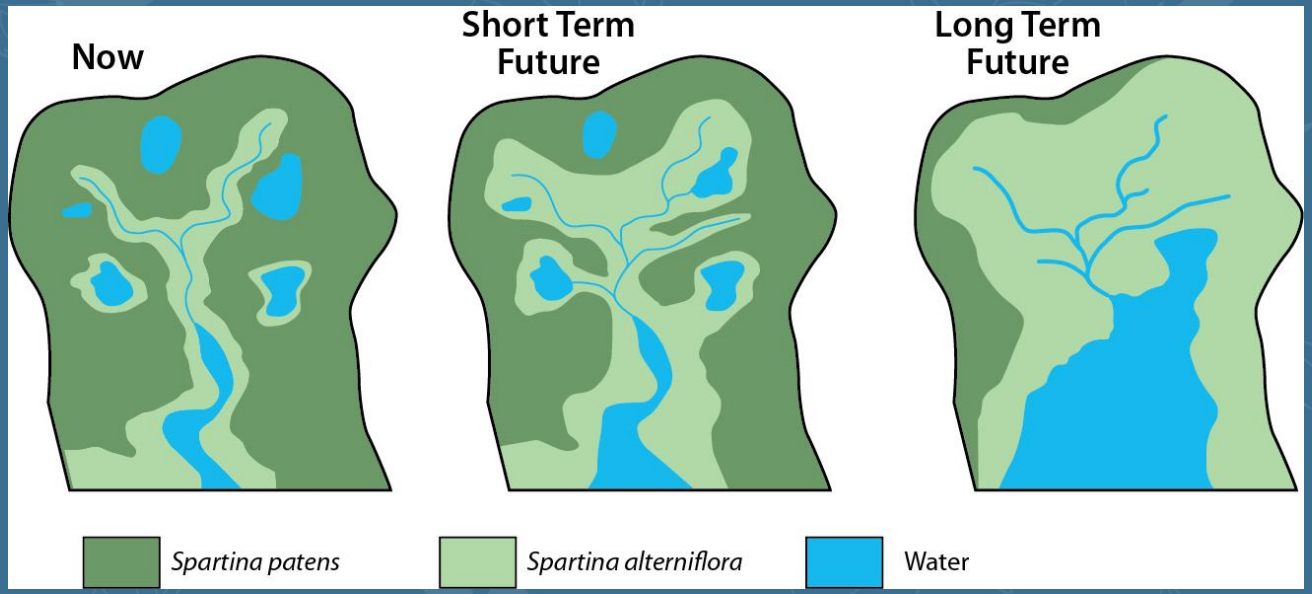
More salt marsh cordgrass _____ Less salt marsh cordgrass _____

Taller cordgrass_____ Shorter cordgrass _____

More salt marsh hay _____Less salt marsh hay_____

Marsh spreading into the uplands___ Upland spreading into the marsh ___

Marsh accreting _____ Marsh eroding _____



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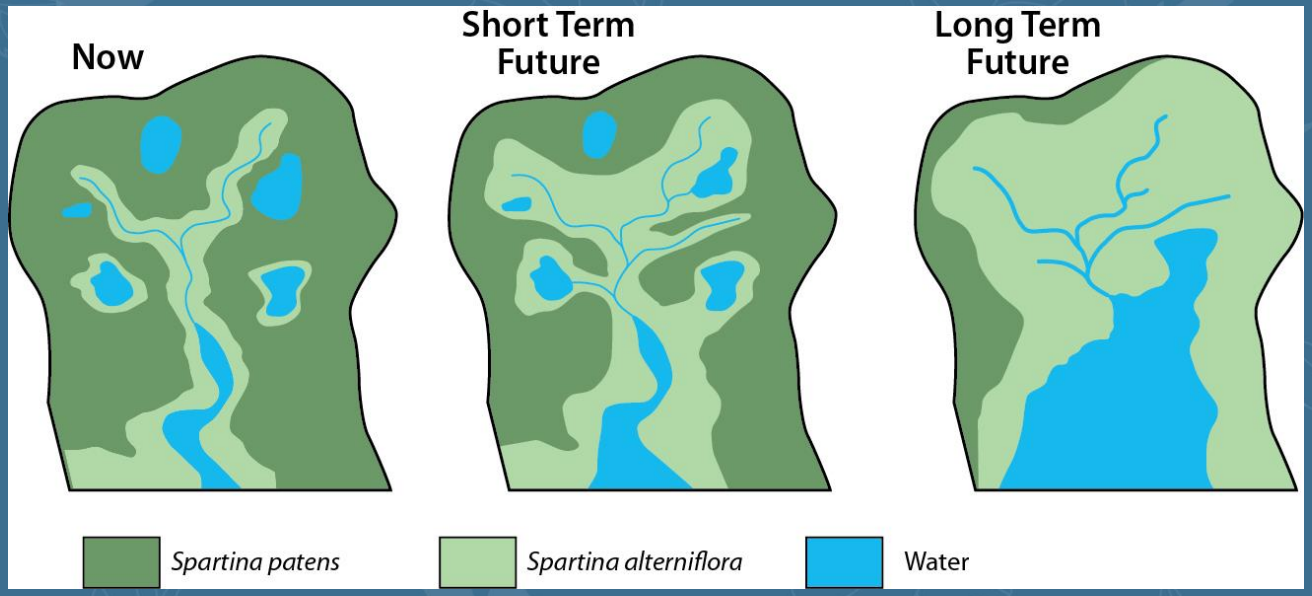
Taller cordgrass____x_____ Shorter cordgrass _____

More salt marsh hay _____Less salt marsh hay_____x_____

Marsh spreading into the uplands__x_ Upland spreading into the marsh ___

Marsh accreting _____ Marsh eroding ___x_____



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- Accretion- The gradual pile up of additional layers of sediment.

- Erosion- The wearing away of sediment.

- Sediment- sand, soil, clay, dust etc.

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http://www.pwrc.usgs.gov/blackwaterburn/measuringelevation.cfm
http://cache.boston.com/resize/bonzai-fba/Globe_Photo/2009/02/08/1234151290_4763/539w.jpg
* http://eps.mcgill.ca/~sundby/MarineGeochemistry/Ocean%20thumbs1.html

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What is a Marker Horizon?

- For measuring vertical sediment accretion (gradual pile up of additional layers of sediment).

Before

After

http://pie-lter.ecosystems.mbl.edu/content/marker-horizon-core

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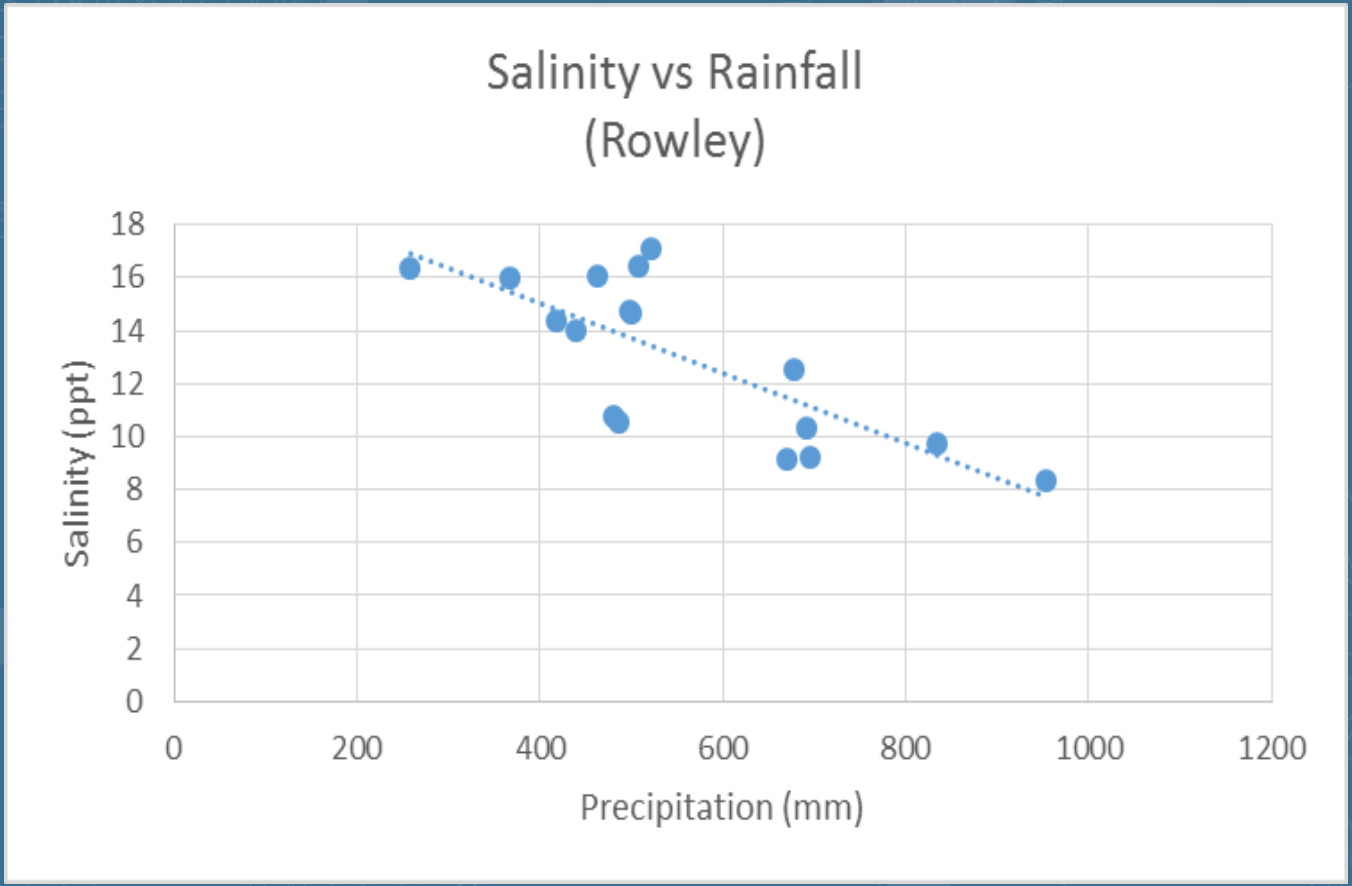
Rainfall and Salinity



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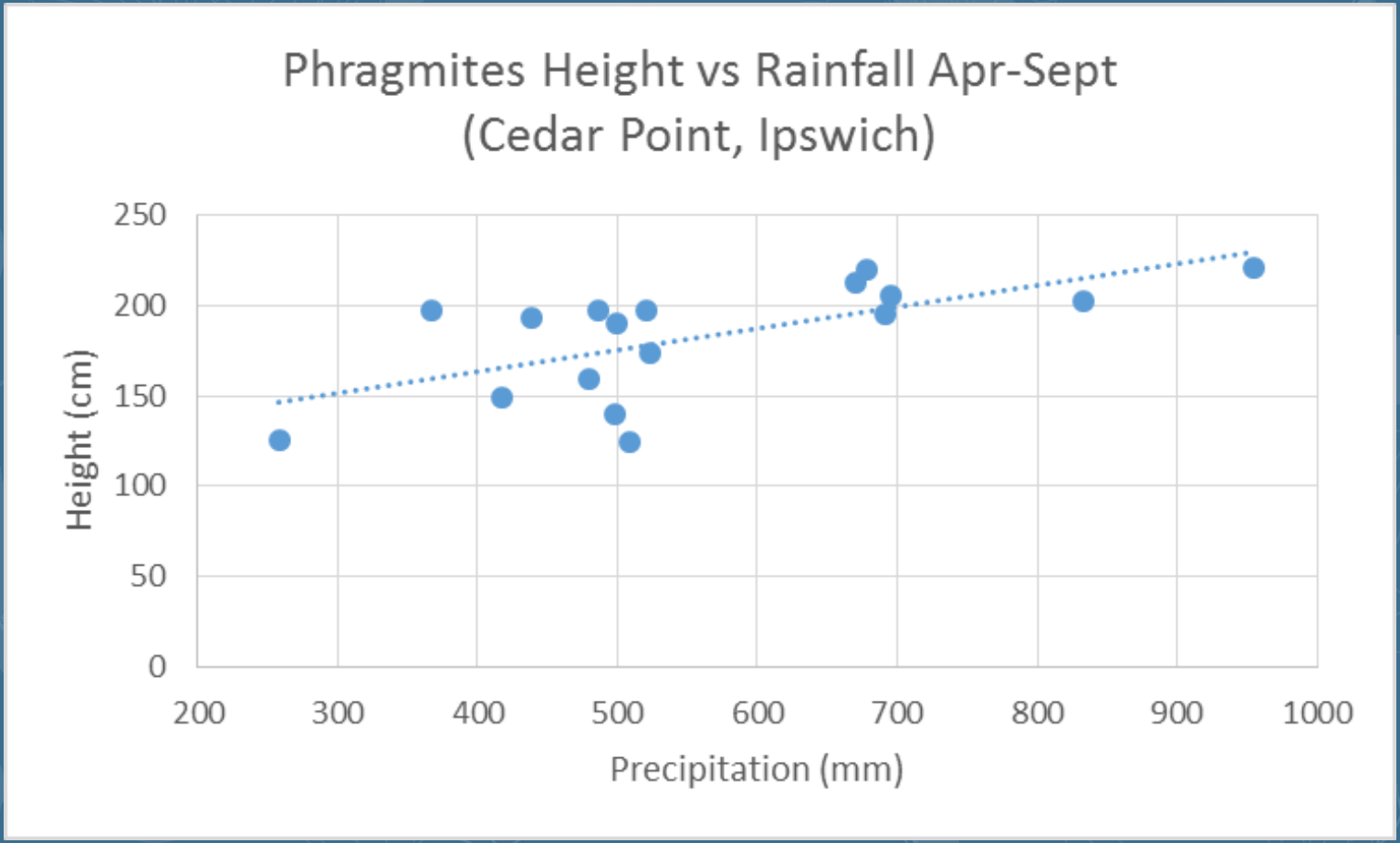
Rainfall vs *Phragmites* Height



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Connections to Middle School MA Science Learning Standards

Grade Level	Learning Standard	Description	Salt Marsh Science Activity
6	6.MS-ETS2-3(MA)	Choose and safely use **appropriate measuring tools**, hand tools, fasteners, and common hand-held power tools used to construct a prototype.*	Measure fish volume using appropriate graduated cylindar
7	7.MS-LS2-1	**Analyze and interpret data** to provide evidence for the effects of periods of abundant and scarce resources on the growth of organisms and the **size of populations in an ecosystem**.	Vegetation Transect, Fish Data, Salinity
7	7.MS-LS2-2	Describe how **relationships** among and between organisms in an ecosystem can be **competitive, predatory,** parasitic, and mutually beneficial and that these interactions are found across multiple ecosystems.	Salt Marsh Players (Project Wet Version 1)
7	7.MS-LS2-4	Analyze data to provide evidence that **disruptions** (natural or human-made) to any physical or biological component of an ecosystem can lead **to shifts in all its populations**	Data Analysis: Fish, Salinity, Vegetation, www.massaudubon.org/saltmarsh
7	7.MS-LS2-5	Evaluate competing **design solutions** for **protecting an ecosystem**. Discuss benefits and limitations of each design.*	Tidal Restriction restoration.
7	7.MS-LS2-6(MA)	Explain how changes to the biodiversity of an ecosystem—the variety of species found in the ecosystem—may limit the availability of resources humans use	Wetland Metaphors, Invasive Species studies
8	8.MS-LS1-5	Construct an argument based on evidence for how **environmental and genetic factors influence the growth of organisms**	Analyze Impact of drought on Phragmites

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Connections to High School MA Science Learning Standards

Grade Level	Learning Standard	Description	Salt Marsh Science Activity
HS	HS-LS2-1	Analyze data sets to support explanations **that biotic and abiotic factors** affect ecosystem carrying capacity.	Salinity and Vegetation study
HS	HS-LS2-2	Use mathematical representations to support explanations that **biotic and abiotic factors affect biodiversity,** including genetic diversity within a population and species diversity within an ecosystem.	Salinity and Vegetation Graphing and Data Analysis
HS	HS-LS2-6	Analyze data to show ecosystems tend to maintain relatively consistent numbers and types of organisms even when small changes in conditions occur but that extreme fluctuations in conditions may result in a new ecosystem. Construct an argument supported by evidence that ecosystems with **greater biodiversity tend** to have greater **resistance to change and resilience.**	Salt Marsh Science Introduction
HS	HS-LS2-7	Analyze direct and indirect **effects of human activities** on biodiversity and ecosystem health, specifically habitat fragmentation, introduction of non-native or **invasive species**, overharvesting, pollution, and **climate change**. Evaluate and refine a **solution for reducing the impacts** of human activities on biodiversity and ecosystem health.*	Invasive Species Investigations, Climate Change investigation: Vegetation Transect and Marker Horizon, Marsh Edge Erosion, Fiddler Crab Study

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Connections to Mathematics

Grade 5

Measurement and Data

•Convert like measurement units within a given measurement system.
•Represent and interpret data.
•Geometric measurement: Understand concepts of volume and relate volume to multiplication and to addition.

Geometry

•**Graph points** on the coordinate plane to solve real-world and mathematical problems.

STANDARDS FOR MATHEMATICAL PRACTICE

1. **Make sense of problems and persevere in solving them.**
2. **Reason abstractly and quantitatively.**
3. **Construct viable arguments and critique the reasoning of others.**
4. **Model with mathematics.**
5. **Use appropriate tools strategically.**
6. **Attend to precision.**
7. **Look for and make use of structure.**
8. **Look for an express regularity in repeated reasoning.**

Connections to Common Core Standards: ELA Literacy

CCSS.ELA-Literacy.RST.6-8.3 Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks

CCSS.ELA-Literacy.RST.6-8.9 Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic.

Grade 9-10 Literacy

CCSS.ELA-Literacy.RST.9-10.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.

CCSS.ELA-Literacy.RST.9-10.9 Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts.

Grade 11-12 Literacy

CCSS.ELA-Literacy.RST.11-12.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.

CCSS.ELA-Literacy.RST.11-12.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.

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Connections to Common Core Standards: ELA Writing/Reading

Writing Grades 6-12

- CCSS.ELA-Literacy.WHST.1 Write arguments focused on *discipline-specific content*

- CCSS.ELA-Literacy.WHST.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.

- **Reading Grades 6-12**

- CCSS.ELA-Literacy.RI.11-12.1 Cite strong and thorough textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text, including determining where the text leaves matters uncertain.

- CCSS.ELA-Literacy.RI.11-12.2 Determine two or more central ideas of a text and analyze their development over the course of the text, including how they interact and build on one another to provide a complex analysis; provide an objective summary of the text.

- CCSS.ELA-Literacy.RI.11-12.3 Analyze a complex set of ideas or sequence of events and explain how specific individuals, ideas, or events interact and develop over the course of the text.

Connections to Social Studies

Roles of Citizens in the United States
USG.5.2 Describe roles of citizens in Massachusetts and the United States, including voting in public elections, **participating in voluntary associations to promote the common good**, and participating in political activities to influence public policy decisions of government.

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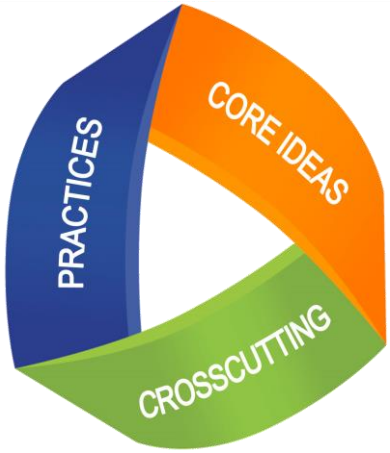
Massachusetts and the Next Generation Science Standards (NGSS)



- Adapted not adopted
- Common Features:
  - Integrated Science and Engineering Practices
  - Grade-by-grade elementary standards
  - Application of science in engineering contexts
- Adaptations
  - Emphasize Technology/Engineering
  - Crosscutting concepts not included
  - "Balance broad concepts with specificity to inform consistent interpretation"
  - High School standards organized by MA course options
  - *Standards that are not aligned to NGSS are marked with (MA)*

Source: 2016 MA STE Curriculum Framework, pg. 19

Slide courtesy of Massachusetts Department of Elementary & Secondary Education

What an STE standard looks like

5-PS1 Matter and Its Interactions
5-PS1-1. Use a model of matter as made of particles too small to be seen to explain common phenomena involving gasses, and phase changes between gas and liquid and between liquid and solid. [Clarification Statement: Examples of common phenomena the model should be able to describe include adding air to expand a balloon, compressing air in a syringe, and evaporating water from a salt water solution.] [Assessment Boundary: Assessment does not include the atomic-scale mechanism of evaporation and condensation or defining the unseen particles.]

★Articulates expected performance/demonstration

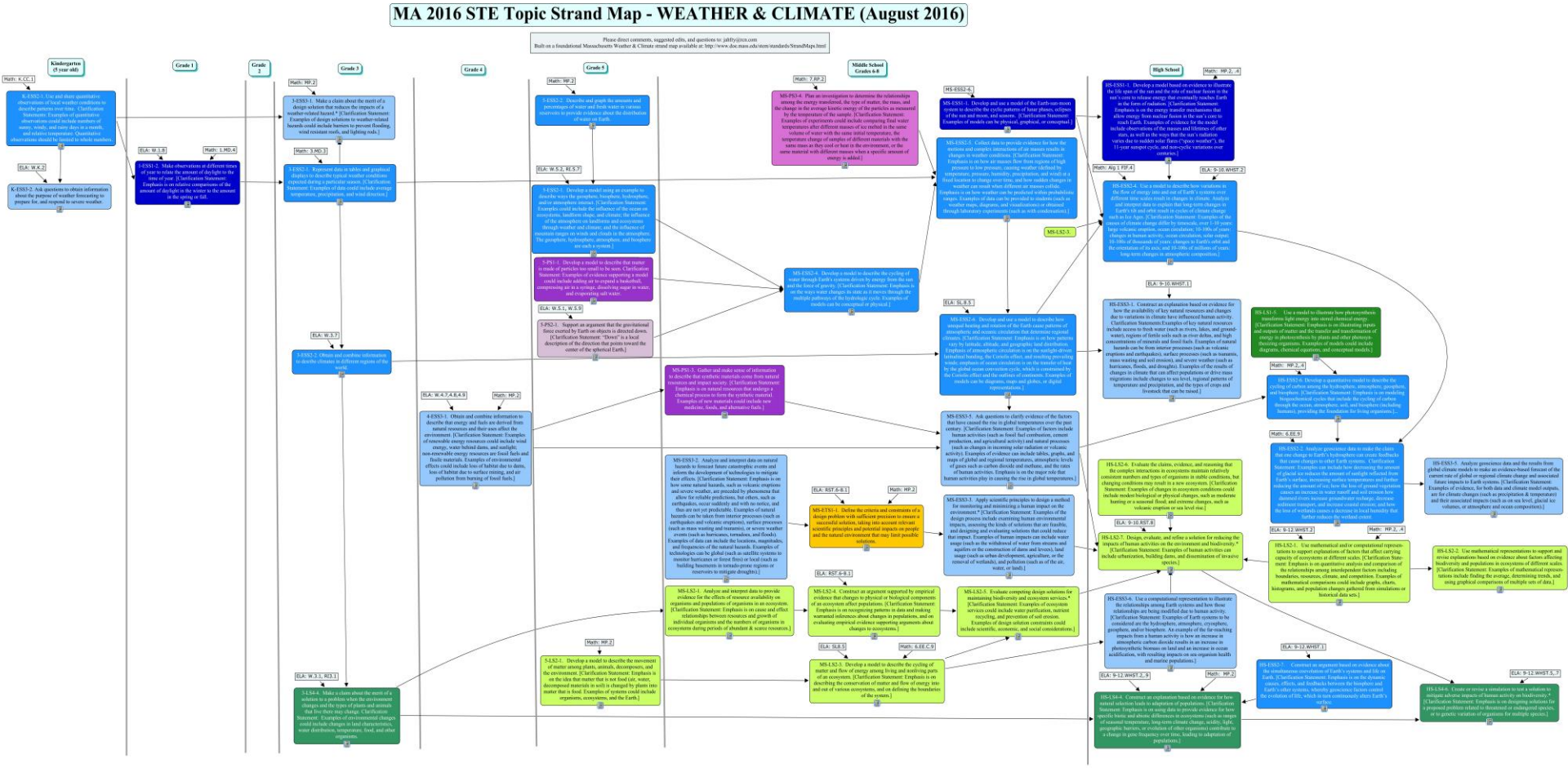
★Does not limit curriculum and instruction to the included practice

Learning Progressions

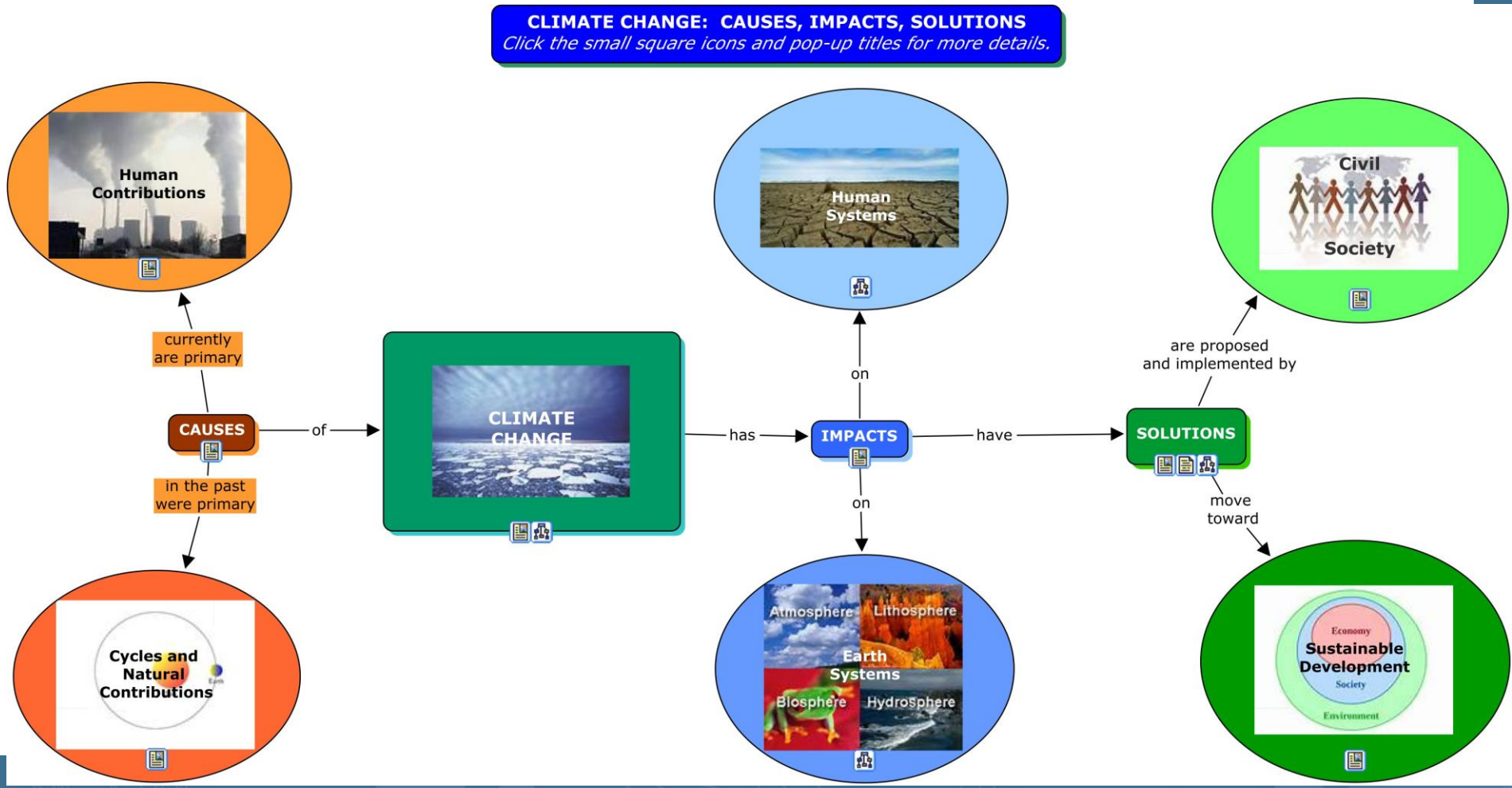
	Pre-K–2	3–5	6–8	9–10
ESS3.C Human impacts on Earth systems	Things people do can affect the environment but they can make choices to reduce their impacts.	Societal activities can help protect Earth's resources and environments.	Human activities have altered the biosphere, sometimes damaging it, although changes to environments can have different impacts for different living things. Activities and technologies can be engineered to reduce people's impacts on Earth.	Sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources.

K–2 Condensed Practices	3–5 Condensed Practices	6–8 Condensed Practices	9–12 Condensed Practices
Asking questions and defining problems in K–2 builds on prior experiences and progresses to simple descriptive questions that can be tested.	Asking questions and defining problems in 3–5 builds on K–2 experiences and progresses to specifying qualitative relationships.	Asking questions and defining problems in 6–8 builds on K–5 experiences and progresses to specifying relationships between variables, clarify arguments and models.	Asking questions and defining problems in 9–12 builds on K–8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations.
• Ask questions based on observations to find more information about the natural and/or designed world(s).	• Ask questions about what would happen if a variable is changed.	• Ask questions that arise from careful observation of phenomena, models, or unexpected results, to clarify and/or seek additional information. • Ask questions to identify and/or clarify evidence and/or the premise(s) of an argument. • Ask questions to determine relationships between independent and dependent variables and relationships in models. • Ask questions to clarify and/or refine a model, an explanation, or an engineering problem.	• Ask questions that arise from careful observation of phenomena, or unexpected results, to clarify and/or seek additional information. • Ask questions that arise from examining models or a theory, to clarify and/or seek additional information and relationships. • Ask questions to determine relationships, including quantitative relationships, between independent and dependent variables. • Ask questions to clarify and refine a model, an explanation, or an engineering problem.

NGSS Weather/Climate Strand Map



Concept Map of Climate Change and Climate Change Education



Environmental Educators: Where (on the strand maps/in the standards) do you see things that support your work?

Classroom Teachers: How can environmental educators help you meet the standards you are trying to meet in your classroom?

Thank you for your kind attention.

Contacts:

Elizabeth Duff, lduff@massaudubon.org

Brianna Wilkinson, bwilkinson@mits.org

Jane Heinze-Fry, Ph.D., jahfry@mits.org

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Professional Development for Teachers

Museum Institute for Teaching Science

INSTITUTES SEMINARS CUSTOMIZED SCHOOL SERVICES PARTNERS SCIENCE BY CONNECTIONS WORKSHOPS

2017 Summer Professional Development Institutes: North Shore Region

North Shore Region

One-Week Institute for Middle and High School Educators

Research and Resiliency: Investigating the Local Effects of Global Changes

Collaborators: Mass Audubon's Endicott Wildlife Sanctuary, Plum Island Ecosystems Long Term Ecological Research, Ipswich River Watershed Association, US Fish and Wildlife Services, Ipswich High School, Boston University, Salem Sound Coastwatch

Dates: July 17-21 (8:30 am – 3:30 pm); Half Day Introductory Session June 17; Half Day Fall Call-back November 4

Registration Fee: $400/participant; $375/participant for team of 2 or more teachers from the same school district

PDPs and Graduate Credit: Framingham State University (3 credits, 67.5 PDPs, $225); 40 PDPs available without graduate credit.

Learn more about the North Shore Region

http://mits.org/2017-summer-professional-development-institutes-north-shore-region/

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