**2022 Teachers on the Estuary: Investigating a Changing Environment**

**Waquoit Bay National Estuarine Research Reserve**

**Course description:** This course is a research and field-based teacher training initiative of the National Estuarine Research Reserve System, part of the National Oceanic and Atmospheric Administration (NOAA). The goal of teachers on the Estuary (TOTE) is to improve teachers’ and students’ understanding of the environment using local examples and to provide resources and experience to support the incorporation of watershed, estuary and climate change topics into classroom teaching to promote scientific literacy and stewardship of watersheds and estuaries. Participants will learn how to facilitate the design and carrying out of investigations by their students as outlined in the Next Generation Science Frameworks and Massachusetts Science and Technology/Engineering Standards. The National Estuarine Research Reserves’ Sentinel Sites project (a national effort to determine the effects of changing sea level and inundation on coastal habitats) will serve as an example of how scientists design and carry out investigations. The course will introduce teachers to information and research about coastal systems, specifically salt marshes and coastal impacts of climate change, and to lessons and activities for teaching about these systems. The course incorporates investigations in the field, classroom activities, and the use of on-line data. More information about the Teachers on the Estuary program is available at [Estuary Education (noaa.gov)](https://coast.noaa.gov/estuaries/) .

**Grade levels:** The course is designed for middle and high school science, engineering, technology, and math teachers.

**Schedule:** Monday, August 1:    6:30-8 pm (virtual)

Wednesday, August 3      9:00 am – 7:30 pm

Thursday, August 4  9:00 am – 4:30 pm

Wednesday, November 16 6:00-8 pm (virtual)

**Location:** Waquoit Bay National Estuarine Research Reserve, 131 Waquoit Highway, Waquoit, MA 02536

**Cost and meals:** This course is offered free of charge. Snacks and lunch are provided.

**Support:** Each participant will receive equipment and other resources. Those who elect to present at the last session about how they have implemented the resources with their students can earn a $100 presentation stipend.

**Lodging:** If you need lodging, please contact Joan Muller for options [joan.muller@mass.gov](mailto:joan.muller@mass.gov).

PDPs: Course follows all MA requirements for PDPs. Participants will receive a certificate of completion which they can present to their administration for PDPs.

**Registration:** Register at[Event Registration – Waquoit Bay National Estuarine Research Reserve (waquoitbayreserve.org)](http://waquoitbayreserve.org/event-registration/?ee=1179)

**Instructor:**Joan Muller, Education Coordinator, Waquoit Bay NERR   [joan.muller@mass.gov](mailto:joan.muller@mass.gov)

617-259-0209

**Course objectives:** Participants will be able to

1. Describe the National Estuarine Research Reserve System, Blue Carbon research at Waquoit Bay Reserve and the NERRS Sentinel Sites project.
2. Access and use the Sentinel Site Student Activities, Bringing Wetlands to Market STEM Curriculum, and other NERRS/NOAA educational products with students.
3. Describe major physical, biological, chemical, and geological estuarine processes as well as impacts of human activities on coastal systems, especially salt marshes.
4. Locate, download, and graph data relevant to the coast.
5. Teach basic estuarine concepts by guiding students in using field and laboratory research techniques analogous to those used at Research Reserves.
6. Describe three impacts of climate change on coastal ecosystems.
7. Lead students in designing and carrying out an investigation exploring a question of local significance to the students, as well as related stewardship activities.

**Estuarine Principles and Concepts**

1. Estuaries are interconnected with the world ocean and with major systems and cycles on Earth.

2. Estuaries are dynamic ecosystems with tremendous variability within and between them in physical, chemical, and biological components.

3. Estuaries support an abundance of life, and a diversity of habitat types.

4. Ongoing research and monitoring is needed to increase our understanding of estuaries and to improve our ability to protect and sustain them.

5. Humans, even those living far from the coast, rely on goods and services supplied by estuaries.

6. Human activities can impact estuaries by degrading water quality or altering habitats; therefore, we are responsible for making decisions to protect and maintain the health of estuaries.

**Course expectations:** Participants are expected to:

1.     Review pre-course materials from on-line sources.

2.     Attend all components of the session (pre- virtual, 2 days on site, post virtual).

4.     Complete in-class assignments and participate in activities and discussions.

6.     Implement course materials with their own students.

7.     Participate in evaluation of the course including an on-line survey after having time to implement resources from the workshop.

9.     Share information and photos of student activities/projects.

**Science Practices (from Next Generation Science Standards)**

* Asking questions and defining problems
* Planning and carrying out investigations
* Analyzing and interpreting data
* Using mathematics and computational thinking
* Constructing explanations and designing solutions
* Engaging in argument from evidence
* Obtaining, evaluating, and communicating information

**Disciplinary Core Ideas (from Next Generation Science Standards)**

* **MS-ESS3-3:** Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.
* **MS-LS-4:** Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations. (Emphasis is on recognizing patterns in data and making warranted references about changes in populations, and on evaluating empirical evidence supporting arguments about changes to ecosystems).

**Crosscutting Concept (best fit from Next Generation Science Standards)**

**Stability and Change:** For natural and built systems alike, conditions of stability and determinants of rates of change or evolution of the system are critical elements of study.

**Draft Course Outline Teachers on the Estuary**

**Monday August 1**  6:30-8:00 pm (virtual on zoom)

Introduction to NOAA On-Line Resources

* NOAA Estuary Education Resources: [Estuary Education (noaa.gov)](https://coast.noaa.gov/estuaries/)
* Sentinel Site Student Activities [Teacher's Sentinel Site Lesson Plan – Wells Reserve](https://www.wellsreserve.org/project/sentinel-site-lesson-plan)
* Bringing Wetlands to Market STEM Curriculum” [Teachers – Waquoit Bay National Estuarine Research Reserve (waquoitbayreserve.org)](http://waquoitbayreserve.org/research-monitoring/salt-marsh-carbon-project/phase1/teachers/)
* Ask Our Researchers videos and Parks as Classrooms activities.

**Wednesday, August 3:** low tide- 10:20 am (in-person)

**Introductions, Waquoit Bay Reserve**

**Morning: Field Studies**

Check in, coffee, breakfast snacks.

Introductions of participants and presenters; overview of course

Introduction to National Estuarine Research Reserve System, mission

Estuary principles and concepts

Definition of estuary and watershed

Introduction of journal, evaluation strategies

Inquiry activity

Salt Marsh Exploration

Salt marsh values- basic salt marsh ecology exploration, the wetland as a system, inquiry activity, generate questions, introduce with “Adopt-a-Wetland” sheet from Bringing Wetlands to Market” Curriculum, learn how to use water quality monitoring equipment

**Lunch:**

**Afternoon: Classroom Activities**

*Bringing Wetlands to Market: STEM Curriculum Linking Wetlands and Climate Change* Classroom activities example activities from each part)

* Blue Carbon (reading graphs)
* Photosynthesis and carbon sequestration (Lego activity)
* Sedimentation demo (from CCNS)
* Carbon Cycle (video)
* Video about research project
* Carbon markets (Blue Carbon Trading game
* Ecosystem services: (wetlands metaphors activity)

Introduction to *Student Sentinel Sites at Schools: Investigating a Changing Environment*module:

* Sea level Rise Activity
* Measuring Change in a Salt Marsh
* Student Sentinel Sites and stewardship projects

Debrief: How to apply to classroom

Daily teacher reaction feedback and Journal time

Break

5:30-7:30: Networking reception (Stuffed quahogs, corn chowder, and sassafras tea) and presentation on Wampanoag Connections to the Estuary by Kitty Hendricks, Cultural Education Specialist, Mashpee Wampanoag Tribe.

**Thursday August 4**    9 am – 5:00 pm low tide: 11:06 am

**Sentinel Sites: Investigating a Changing Environment**

Morning:

Sentinel Sites presentation

Load up cars and drive to South Cape Beach

Visit South Cape Beach State Park WBNERR component with a focus on Sentinel Site, salt marsh restoration site, and Blue Carbon research site.

Meet the scientists in the field

Traveling through time walk (evidence of sea level rise)

Lunch

Steps to designing investigation

* + Question asked or define problem studied
  + Analyze and interpret data
  + Demonstrate use of mathematics and computational thinking
  + Construct explanations and design solutions
  + Engage in argument from evidence
  + Evaluate evidence and process
  + Communicate information

Discussion: Student-led stewardship projects

Divide into groups by subject/grade, brainstorm ideas for class investigations, stewardship projects

Exit survey

**Wednesday, November 16 6-8 pm (virtual)**

**Presentations by teachers on student investigations /stewardship projects or plans.**

**Course texts and materials:** Readings and reference materials will be drawn from NOAA and other web sites. Additional lesson plans and curriculum materials for teaching about estuaries, watersheds, and climate change will be provided.

**Course requirements:** Participants will:

1. Review pre-course materials.

2. Attend all sessions.

3. Complete in-class and homework assignments and participate in activities, and discussions.

6. Using guidance from the *Student Sentinel Sites: Investigating a Changing Environment*

module, guide their students in developing an investigation (students can focus on non-wetland area if no wetland is easily accessible to them, or even something in their own school yard) or stewardship project or use course resources in some other appropriate way with their students.

8. Participate in evaluation of the course including some on-line surveys.

9. Share information and photos of the class investigation, stewardship project, or other way(s) you implemented the course materials with your students.

10. Communicate with class instructor as needed over school year.

# **Student Sentinel Site Investigation and Stewardship Project Reflection and Evaluation:** Teachers who (at the final virtual session) present a summary of their experiences with their classes guiding their students in implementing workshop materials including a field investigation and/or stewardship project or are eligible to receive a presentation honorarium of $100. Teachers will present a summary of their experiences with their class (or classes) on the course follow up session November, 16, 2022, 6:00-8:00). This day also provides an opportunity for teachers to share ideas with each other and request input from other educators on any challenges they are facing.