

2023 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, 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 implementation 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) and System-Wide Monitoring Program (a national effort to monitor water quality) will serve as examples 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 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 \(noaa.gov\)](http://www.noaa.gov/estuaries/education) .

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

Schedule:	Monday, July 24	6:30-8 pm (virtual)
	Wednesday, July 26	9:00 am – 6:00 pm (on site)
	Thursday, July 27	9:00 am – 4:00 pm (on site)
	Wednesday, November 8	6:30-8:30 pm (virtual- teacher presentations)

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: Lodging at the Sea Education Association on Woods Hole Road is available at no cost for those participants living beyond commuting distance, but space is limited and reservations are required. Accommodations are in a house with multiple bedrooms and shared living space. If you need lodging, please contact Laurie Tompkins for options laurie.tompkins@mass.gov

PDPs: Participants who complete all requirements will receive 18 PDPs.

Registration: Register at <http://waquoitbayreserve.org/event-registration/?ee=1337>

Instructor: Joan Muller, Education Coordinator, Waquoit Bay NERR joan.muller@mass.gov

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, SWMP on-line graphing application 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 (Subject to change)

Monday, July 24: 6:30-8:00 pm (virtual on zoom)

Introduction to NOAA On-Line Resources

- NOAA Estuary Education Resources: [Estuary Education \(noaa.gov\)](http://noaa.gov)
- Sentinel Site Student Activities [Teacher's Sentinel Site Lesson Plan – Wells Reserve](#)
- Bringing Wetlands to Market STEM Curriculum” [Teachers – Waquoit Bay National Estuarine Research Reserve \(waquoitbayreserve.org\)](#)
- Ask Our Researchers videos and Parks as Classrooms activities.
- SwMP Mysteries

Wednesday, July 26: low tide- 12:20 pm (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

Water Quality Monitoring: (*Theo Collins, WBNERR Research Associate*)

Make on-line water quality graphs.

Try out equipment that can be used with students.

Analyze data. Compare with WBNERR data.

Bay Exploration

Lunch:

Afternoon:

Oysters and Nitrex Barrier as Solutions (visit oyster aquaculture and Permeable Reactive barrier site)

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
- 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

Osprey Exercise Break: Observations and educational activities

Debrief: How to apply to classroom

Daily teacher reaction feedback and Journal time

Break

4:00-6:00: Boat trip to Washburn Island (weather permitting)

Thursday July 27

9 am – 4:00 pm

low tide: 1:11 pm

Sentinel Sites: Investigating a Changing Environment

Morning:

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

Traveling through time walk (evidence of sea level rise)

Lunch

Sentinel Site and SET presentation (Dr. Megan Tyrell)

Salt Marsh exploration (3 groups)

 Quadrats (compare to WBNERR Sentinel Site data)

 Plants.

 Fiddler crabs

Discussion: Student-led stewardship projects

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

Exit survey

Wednesday, November 8 6:30-8:30 pm (virtual)

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

(Those teachers who present about how they implemented the resources in their classrooms will receive a \$100 presenter's honorarium).

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.
4. 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 way appropriate for their students.
5. Participate in evaluation of the course including some on-line surveys.
6. Share information and photos of the class investigation, stewardship project, or other way(s) you implemented the course materials with your students.
7. Communicate with class instructor as needed over school year.

Reflection and Evaluation: A written reflection paper (format will be provided) will be due before the last class in November. Teachers will have the opportunity to present a summary of their experiences with their class (or classes) on the course follow up session November 8, 2023, 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. 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.