TOTE 2025 Overall Agenda

Teachers on the Estuary: Wastewater in Watersheds

November 13th -14th (in person at WBNERR) and December 16th (virtual)

Registration: https://waquoitbayreserve.org/events/teacher-workshop-wastewater-in-the-watershed

Workshop Description

Participants will explore coastal habitats, conduct field investigations, meet researchers, and discover the importance of wastewater treatment to Cape Cod and beyond! The goal of this course is to improve teachers' and students' understanding of the importance of coastal salt marshes and bays, the impact of too many nutrients upon them, and how to increase stewardship of watersheds and estuaries. Teachers get hands-on with classroom and web-based activities, explore estuaries and ponds, and visit a wastewater treatment plant and experimental wastewater treatment systems. The course incorporates investigations in the field and the use of online data to help educators bring local and national data into the classroom. It will introduce teachers to local research and researchers including Dr. Scott D. Wankel, a WHOI scientist working at Waquoit Bay studying a range of nitrogen cycling processes in natural waters and sediments. Teachers will take home a classroom kit to be able to replicate the activities in their own classroom. Course content and activities will be aligned with Massachusetts state science and math frameworks and Next Generation Science Standards.

Workshop Audience

- Designed for teachers of grades 4-12

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

Cost and meals: This course is offered free of charge. Light breakfast, snacks and lunch are provided.

Support: Each participant will receive equipment and other resources. Those who elect to present at the virtual session about how they have implemented, or plan to implement, the resources with their students can earn a $150 presentation stipend.

Lodging: Dorm style lodging is available at no cost for those participants living beyond commuting distance, but space is limited and reservations are required. If you need lodging, please contact Laurie Tompkins for options: laurie.tompkins@mass.gov.

PDPs: Participants who complete all requirements will receive 16 PDPs.

Graduate Credit: The course is offered for 1 graduate credit. Graduate credit is optional and is available from Bridgewater State University for $75.00 per credit. Please register and pay for graduate credit through Bridgewater State University at (*graduate credit registration link will be added when available*).

Instructor: Sonia Ahrabi-Nejad, Education Coordinator, Waquoit Bay NERR Sonia.Ahrabi-Nejad@mass.gov

Workshop Goal

- Increase teachers' understanding of estuary science and their ability to engage their students in the investigation of changes in their local environment using data obtained from the reserve's monitoring programs and community conservation projects.

Workshop Objectives: Participants will be able to:

- Access and use NERRS/NOAA educational products with students.
- Describe the nitrogen cycle and how humans have altered it, leading to impacts on coastal systems.
- Teach basic estuarine concepts by guiding students in using field and laboratory research techniques analogous to those used at Research Reserves.
- Lead their students in experiential learning activities that improve their students' abilities to become stewards of the environment.
- Meet Massachusetts Learning Standards and Next Generation Science Standards appropriate to the grade and subject they teach. (see list of a few examples below)
- Give evidence to support the basic concepts in the Estuary Principles (see below).

Estuarine Principles

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.

Next Generation Science Frameworks

Life Sciences 2 Ecosystems: Interactions, Energy, and Dynamics

LS2.A Interdependent Relationships in Ecosystems

LS2.B Matter and Energy in Organisms and Ecosystems

LS2.C Ecosystems Dynamics, Functioning and Resilience

Earth Systems Science 2 Earth's Systems

ESS2.C: The Roles Of Water In Earth's Surface Processes

Earth Systems Science 3 Earth and Human Activity

ESS3.C: Human Impacts On Earth Systems

Massachusetts Science, Technology, and Engineering Standards (a few examples, not inclusive)

5-ESS3-1. Obtain and combine information about ways communities reduce human impact on the Earth's resources and environment by changing an agricultural, industrial, or community practice or process. (Examples of changed practices or processes include treating sewage, reducing amounts of materials used, …preventing runoff from agricultural activities.)

7.MS-LS2-1. Analyze and interpret data to provide evidence for the effects of periods of abundant and scarce resources in the growth of organisms and the size of the population in an ecosystem.

7.MS-LS2-3. Develop a model to describe that matter and energy are transferred among living and non-living parts of an ecosystem and that both matter and energy are conserved through these processes.

7.MS-LS2-5. Evaluate competing design solutions for protecting an ecosystem. Discuss benefits and limitations of each design.
7.MS-LS2-6 (MA). Explain how changes to the biodiversity of an ecosystem- the variety of species found in an ecosystem -may limit the availability of resources humans use.
HS-LS2-1. Analyze data sets to support explanations that biotic and abiotic factors affect ecosystem carrying capacity.
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 support by evidence ecosystems with greater biodiversity tend to have greater resistance to change and resilience.
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 health.
HS-ESS3-3. Illustrate relationships among management of natural resources, the sustainability of human populations, and biodiversity. (Examples include waste management and the development of new technologies.)

Course expectations: Participants will be expected to:

1. Attend all components of the two-day session and a two-hour evening virtual follow up session.
2. Complete in-class assignments.
3. Participate in activities and discussions.
7. Keep a reflection journal during the course.
4. Incorporate information, curriculum, and resources provided in class into their own classroom teaching and provide a written reflection upon the experience, or, if the timing isn't appropriate, write up a plan for how it will be implemented into the curriculum next year.
5. Participate in evaluation of the course.

Course texts and materials: Readings and reference materials will be drawn from the following sources, as well as from NOAA and other web sites.

- Estuary Education (noaa.gov), NOAA Data in the Classroom: Monitoring Estuarine Water Quality: Teacher Resources | NESDIS (noaa.gov), Watershed in a Box (noaa.gov)

Grading criteria

Participants earning graduate credit and those earning PDPs must complete exercises assigned as part of class work. Participation in the in-person field, classroom, and computer-based activities completed during the course is worth 30%. Participation and contributions to discussions during the in-person workshop is worth 20%. Writing in a reflection journal during the workshop is worth 20%. The write-up of the classroom implementation experience is worth 30%.

Teachers on the Estuary: Wastewater in Watersheds Course Outline

Day 1 (in-person) 9:00am-4:00pm

- Boathouse meeting space
    - Introduction (15 min)
    - Education Intro (NERRS, relevant education activities) (35 min)
    - Overview of environmental nitrogen cycling by Dr. Scott D. Wankel and WHOI students (60 min)
- Bay water sampling (60 min)
- Lunch (60 min)
- Pond sampling (75 min)
- Lab water sample analysis, recap Nitrogen impacts in watershed (80 min)

Day 1 Field Experiences:
Oyster aquaculture site: This site has been used to raise shellfish for the Town of Falmouth and research on the role oysters play in taking up nitrogen has been conducted here. (Waquoit Bay Reserve)
Nitrex Barrier Pilot Site: This pilot project is still removing nitrogen from groundwater entering the Waquoit Bay (Waquoit Bay Reserve Headquarters)

Day 2 (in-person) 9:00am-4:00pm

- Meet at WBNERR then drive to Falmouth WWTF (30 min)
- Falmouth WWTF (60 min)
- Massachusetts Alternative Septic System Testing Center (60 min)
- Lunch (60 min)
- Back at WBNERR Classroom
    - NOAA online resources (30 min)
    - Review Nitrogen impacts and final message (20 min)
- Small and full group discussion (55 min)

Day 2 Field Experiences:
Falmouth Wastewater Treatment Facility: This facility is part of the Public Works department of Falmouth, MA, and it processes wastewater within Falmouth. (154 Blacksmith Shop Road, Falmouth)
The Massachusetts Alternative Septic System Testing Center (MASSTC): MASSTC is the nation's leading third-party testing and research facility for innovative/alternative (I/A) onsite septic system treatment technologies. (4 Kittredge Road, Sandwich, MA)

Day 3 (Virtual) 6:00pm-8:00pm

Teachers will present about how they implemented the TOTE workshop resources with their students. Each teacher will have five minutes to present and then there will be discussion with the whole group.