

Wastewater Issues in Watersheds: The Perfect STEM Topic (Waquoit Bay National Estuarine Research Reserve)

Course description: Wastewater treatment is the perfect topic for incorporating STEM into your curriculum while educating your students on an issue of crucial importance to the future of our region. The goal of this course is to increase understanding of wastewater issues by using it as an example to meet standards in science, technology, engineering and mathematics, and to improve teachers' and students' understanding of the importance of coastal salt marshes and bays and the impact of too many nutrients upon them. Teachers will try out classroom and web-based activities, explore coastal habitats and visit a large wastewater treatment plant and experimental wastewater treatment systems. The course is also designed to promote stewardship of watersheds and estuaries.

The course incorporates investigations in the field and the use of on-line data, and will introduce teachers to research and researchers including Scott Wankel, a researcher at Woods Hole Oceanographic Institution (WHOI) working at Waquoit Bay Reserve studying the interactions between nitrogen and iron cycling in groundwater and aquifer sediments using isotopes (*"Unraveling a cryptic subsurface nitrogen cycle"*). Course content and activities will be aligned with Massachusetts Common Core in the STEM fields and Next Generation Science Standards.

Credit: The course is offered for 1 graduate credit or 22.5 Professional Development Points. Graduate credit is optional and is available from Framingham State College for \$75.00 per credit. PDPs are free and granted through Waquoit Bay Research Reserve.

Grade levels: The course is designed for science and math teachers in grades 7 through 12. Others are welcome to apply.

Schedule: April 10 - 11, 2015

Location: 131 Waquoit Highway (Route 28) Waquoit Bay National Estuarine Research Reserve, East Falmouth, MA 02536

Registration: Please register with Joan Muller joan.muller@state.ma.us or 508-457-0495 x107. Information about Waquoit Bay Reserve including driving directions can be found at www.waquoitbayreserve.org

Instructor:

Joan Muller, Education Coordinator, Waquoit Bay National Estuarine Research Reserve
joan.muller@state.ma.us (508) 457-0495 x 107

Course objectives: Participants will be able to

1. Access and use the on-line Estuaries 101 curriculum and other NERRS/NOAA educational products with students.
2. Describe the nitrogen cycle and how humans have altered it, leading to impacts on coastal systems.
3. Teach basic estuarine concepts by guiding students in using field and laboratory research techniques analogous to those used at Research Reserves.

4. Explain the six Estuarine Principles and Concepts listed below.
5. Lead students in learning activities related to stewardship of the environment.
6. Describe the NERRS system and explain two NERR research projects, including the use of isotopes as markers of different nitrogen sources and microbial processes (led by Scott Wankel (WHOI)).

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.

Course expectations: Participants will be expected to:

1. Attend all components of the two-day session.
3. Complete a pretest and posttest.
4. Complete in-class assignments.
5. Participate in activities and discussions.
6. Keep a reflection journal during the course.
7. Incorporate information, curriculum, and resources provided in class into their own classroom teaching and provide a written reflection upon the experience.
8. Participate in evaluation of the course.

Course Outline **Wastewater Treatment: The Perfect STEM Topic**

Before course: pretest (on-line)

Friday, April 10

9:00 am – 4:00 pm Low tide: 10

am

Morning (Waquoit Bay Reserve boat house):

8:30-9:00: Coffee, sign in (Simple watershed/groundwater movement demo activities will be set up on a table so teachers can take a look during breaks)

9:00-9:30: Introductions of participants and presenters; overview of course, STEM, MA Common Core, Next Generation Science Standards, expectations, journal, folder, bag

Introduction to NERRS system, mission

(Use keypads to ask and go over pre/post questions as they come up in the workshop)

Estuary principles and concepts

Definition of estuary (on bluff) and watershed (at sign)

9:30-10:15: Short introductory presentation about eelgrass and eutrophication

Explore www.estuaries.noaa.gov (video- Joe Costa)

Eelgrass activity/mini video

10:15-10:30: Break

10:30-12:30: A Closer Look at the Nitrogen Cycle: Scott Wankel, WHOI

Presentation by Dr. Wankel (nitrogen cycle including microbes, reactive barrier, his research) (1 hour)

Classroom and field activity: compare nitrogen levels and varieties in various habitats around Reserve headquarters using basic laboratory techniques (Include Nitrex site when going outside, have previously started plates)

12:30-1:00: Lunch: (provided)

Lunch at Coonamesett Farm

Afternoon:

1:30-2:00: Board bus, drive to oyster cultivation site

2:00- 2:30: Tour of oyster cultivation project by Ron Zweig

2:30-2:45: Drive to Wankel lab, Quisset Campus

3:00-4:00: Split into two groups (1/2 hour each) and switch:

Scott/Carly: Tour Dr. Wankel's lab, nitrogen bacteria culture activity

Joan/Shona: Wrap up- - how to incorporate day's activities in class, journal reflection

4:00: Head back to WBNERR

Saturday, April 11

9:00 am – 4:00 pm Low tide: 11 am

Morning

8:30: Meet at WBNERR, board bus

9:00- 10:00: Tour oyster farms and Falmouth Harbor Upwellers

10:00-10:30: Drive to Wankel lab

10:30-11:45: Split into two groups to tour Wankel lab/compare alternative systems

Noon-12:45: Lunch in Woods Hole

12:45-1:15: Bus back to Reserve

Afternoon

1:15- 2:15: Teachers create nitrogen cycle poster appropriate for their students

2:15-2:45: How are towns on Cape Cod working together to find solutions?

2:45-3:00: Review expectations

3:00-3:15: Break

3:15-3:45: Brainstorm- how to incorporate in classroom- share ideas from journal

3:45-4:00: Wrap up.

After class: on-line post test and course evaluation

Course texts and materials: Readings and reference materials will be drawn from the following sources, as well as from NOAA and other web sites. In addition, lesson plans and curriculum materials will be provided.

Estuaries 101 Middle and High School Curriculum <http://www.estuaries.noaa.gov>

Other resources and papers on studies done at Waquoit Bay NERR

Paper from Ken Forman (Nitrex Barrier)

Paper from Rick York (Oysters as filters)

Paper from Scott Wankel, (WHOI)

Course requirements: Participants will be expected to:

1. Attend all components of the two-day session
3. Complete a pretest and post test (will not affect grade).
4. Complete in-class and homework assignments.
5. Keep a reflection journal during the course.
6. Incorporate information, curriculum, and resources provided in class, into their own classroom teaching and reflect upon the experience
7. Participate in evaluation of the course.

All requirements must be completed by June 30, 2015 for students who sign up for graduate credit.

Grading criteria

Participants earning graduate credit and those earning PDPs must complete exercises assigned as part of class work. The field, classroom, and computer-based activities completed during the course will be worth 30 percent of the grade, participation and contributions to discussions will be worth 20%, the reflection journal will be worth 20 percent and the write up of the classroom experience will be worth 30 percent.

Participants taking the course for PDPs but not for graduate credit will not be graded, but should complete all assignments. They will have until the end of the school year to complete requirements.

Assignments: The follow up reflection piece (including photos or scanned examples of student work) should be sent to Joan Muller via e-mail at joan.muller@state.ma.us no later than June 30, 2015.

Reflection on teaching experience: Teachers will incorporate information, curriculum, and materials introduced in the class into their classroom. After trying out the activity, they will write a reflection piece describing what they did and analyzing how the lesson went.

Format: Reflection piece should include:

1. Teacher's name, school
2. Grade level, subject area, number of students in class
3. What you were hoping to accomplish- Learning objectives or expected outcomes
4. Relevant science or math standards
5. Relevant estuarine concepts and principles
6. Materials and equipment
7. What you did- how it went
8. Tips and hints for other teachers
9. Lessons learned/reflection – what you would do differently, how you would improve it, what worked really well
10. Your sources of information and recommended references and links