## Teaching Notes

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**Course Information**

Institution: Oxford College of Emory University (2-year liberal arts branch of Emory University)

Department: Environmental Sciences

Course Name: Introduction to Environmental Studies

Level: **Lower/Upper Undergraduate** (select one) Lower Undergraduate

Course type: **Lab/Lecture/Both** (other, please describe) (select one) Both lab and lecture

Students: **Majors/Non-majors** (select one) Mixture, but primarily non-majors

Number of Students: 22

**Module Information**

Original Module Name: Water Quality

Link to Original: <https://serc.carleton.edu/eddie/enviro_data/activities/water_quality.html>

Modified Module Name: Water Quality Investigation

Files associated with modification: (ie. Class Worksheet, Summative Quiz, Lecture Powerpoint, etc) Class worksheet, Pre-Class Readings (2 NY Times articles), Pre-Class Quiz (given online via Canvas), Lecture PowerPoint, Final Exam questions)

**Teaching Notes**

*(Think about what you would like to read about this activity if you came back to it in 2 years)*

* How did this module fit into your overall course curriculum (e.g., relationship to other content, relationship to course learning objectives)?

This module was an excellent fit with my overall course curriculum. We had just finished a section on Agriculture and Ecology of Food, so transitioning to thinking about Nitrate as both a nutrient and pollutant was perfect. It also was a great place to start thinking about Water Quality issues in general. This module was completed over 2 course periods and was then followed by a third class thinking about water quality issues more broadly (rather than focusing on just one nutrient/pollutant) and a fourth class that was a discussion on the Tri-State Water Wars. I found students utilizing knowledge from this module in their discussion points. The module also fit in with Part 2 of the larger division of the class, where Part 1 was focused on understanding the natural world (topics include population dynamics, community interactions and change, evolution, ecosystems, and biodiversity) and Part 2 was understanding human impact on the natural world (human population growth, agriculture and ecology of food, air pollution, water quality, nonrenewable energy source, renewable energy sources, and climate change). The module also fit in nicely with my course learning objectives:

The two **overarching goals** of this course are:

1) to peak your curiosity about the Earth they inhabit, gain knowledge about the natural world, and to share that curiosity and knowledge with others. You should be able to observe the world around you, marvel at what you see, and understand the processes at work.

2) to impart to you a relevance of scientific knowledge and processes so that you can become more critical thinkers and better decision-makers – economically, politically, socially, and personally.

At the completion of this course, you will be able to:

* ***Discuss*** the major themes in environmental science
* ***Understand*** the natural world and the human impact on its processes, and how those impacts can be mitigated
* ***Observe*** the natural world, generate questions, and evaluate evidence
* ***Develop*** field techniques and ***analyze*** real-world data
* ***Evaluate*** ongoing environmental issues through the lens of sustainability
* ***Communicate*** scientific information both verbally and in writing
* Did you use the entire EDDIE modules as presented? If not, which components did you use?

I utilized Activities A – D.

* What did you change about the module and why?

I ended up shortening the PowerPoint and discussion (Activity A) because of time constraints. Also, I felt like my students already possessed some of the background information.

* What was the prep like?
	+ What did you do to prep ahead of module implementation?

To prep for implementing the module, I read through the module instructor’s document and PowerPoint Presentation. I also attempted to following the instructions from the student handout to try and determine if they needed to be changed in any way to make anything more clear. I ended up shortening the PowerPoint presentation. My mistake was not fully working through the entire module ahead of time. I only worked through one of the examples that utilized data from the USGS site and assumed that the rest of the components that used other USGS data would work, which was not the case. I would recommend anyone utilizing these modules to work through the entire module themselves so ensure that all of the links/data sets are still working and available. Additionally, I read the 2 NY Times articles and created an online (via Canvas) pre-class quiz based on the reading.

* + How much time went into prep?

About 1.5 hours, but it would have been longer if I had actually worked through the entire module in advance.

* How did the activity go?
	+ What went well and why?
	+ What went wrong and why?
* What do you think students took away from the activity?
* Where did students struggle the most?
* Would you do this activity again?
	+ If yes, what would you change in the future?
	+ What suggestions would you give to a colleague before they used it in their teaching?
* Is there anything else you’d like to make note of?

Despite cutting out material from provided PowerPoint, it still took too long to get through the introductory material on PowerPoint. Students were frustrated that it took too long to get started on the activity because the intro lecture took too long.

Solution/Modification - Will find a reading for students to do in textbook or elsewhere that covers some of the basics of nutrient vs toxins, watershed management, etc. Will also cover Nitrogen cycle and Phosphorus cycle together during section on Agriculture and Ecology of Food Section. Way too much to cover at the start of this module, with only have 2 75-min classes available for implementation.

Took too long for students to work through Activity B Parts 1 and 2 (Explore Impaired Streams by looking at local 303d lists). Students struggled with finding the asked for information because information provided so differently for each state. My students come from all over the country, so there was no way for me to be prepared to help students find info for each state.

Solution/Modification - Students liked the connection to their home town/area, so need to include this in some way. Maybe I need to find links for easier to use 303 d material? Maybe I need to assign this as homework or pre-class activity instead?

Was never really able to have a full class discussion on material because everyone was working at such different paces.

Solution/Modification - I think the biggest variability with timing came with working through first parts of Activity B, so if that part is made as pre-work or homework, that might help.

Neither of the sites used in Activity D (Indian Creek at Fairbury, IL or Leewood, KS) are available on the USGS website.  The issue with using the excel data is that it requires the students to then make the graphs themselves, rather than just evaluating the graphs that the USGS website creates for them.  For me, there was a time issue with doing this. I had the students work with excel for Part C and wanted them to just use the already created graphs for Part D. I didn't notice the post from Jen Klug on the QUBES forum in enough time to make the graphs in advance to give to the students. It would be great if the graphs of discharge and Nitrate concentration for the date range for each site could be provided on the EDDIE page for this module, in addition to the raw data. Or if different sites could be selected and inserted into the module.

My students were very familiar with using Excel because we use it a lot in the lab component of class and I had already done a “Learn How to Use Excel” lab at the start of the semester, but I can see how this component would slow down others trying to implement the module.

I will consider just providing students some of the excel sheets or graphs in the future if I need to save time. I think the main focus of the module could be data interpretation rather than understanding how to access online datasets from the USGS, as most of my students are not majors.

Overall, I think the module has a great deal of potential and I would definitely utilize it again. I just need to think more intentionally about how to allow for the important discussions associated with the topic. When I asked students on the end of the semester evaluation what aspects of the course should be continued in the future, several students mentioned the EDDIE modules done in class.

Assessment Questions:

Pre-Class Quiz Questions Associated with NY Times articles:

1. Select all of the sources of phosphorus being washed into Lake Erie
	1. Fertilized farms
	2. Cattle feedlots
	3. Leaky septic systems
	4. Burning fossil fuels
	5. Car washes
2. What is the result of tides of phosphorus being washed into Lake Erie?
	1. Algal blooms
	2. Climate change
	3. Air pollution
	4. Ozone depletion
3. What is the consequences of algae fed by phosphorous runoff?
	1. Oxygen-free dead zones
	2. Depleted ozone
	3. Air pollution
	4. Climate change
4. Phosphorous can be considered a point-source pollutant.
	1. True
	2. False
5. There are no enforceable limits on phosphorous run-off in Ohio.
	1. True
	2. False
6. What pollution is the course of concern in the article about Iowa?
	1. Nitrate
	2. Phosphorous
	3. Iron
	4. Lead
7. Select all of the following that are conservation practices designed to keep nutrients in the fieild and out of the water system.
	1. Limiting tilling
	2. Planting rows of switch grass
	3. Filling wetlands with native grasses
	4. Banning the use of synthetic fertilizers

Exam Questions Related to Module Material:

1. All are examples on non-point source pollution, except?
	1. Nutrient run-off from agricultural lands
	2. Salt run-off from urban areas
	3. Sediment from improperly managed construction sites
	4. Leaking septic tank
2. Our atmosphere is almost 80% nitrogen. What chemical form does nitrogen take and how does it leave the atmosphere to other reservoirs in the nitrogen cycle?
	1. NO3; nitrogen fixation
	2. N2; nitrification
	3. NO3; assimilation
	4. N2; nitrogen fixation
3. In which form do plants need nitrogen in order to utilize it (assimilation)?
	1. Nitrate
	2. Ammonium
	3. Nitrite
	4. Nitrogen dioxide
4. What form of nitrogen is produced by decomposers (mineralization)?
	1. Nitrate
	2. Ammonium
	3. Nitrite
	4. Nitrogen dioxide
5. What reaction shown below represents the process of Nitrification?
	1. Ammonium → Nitrate → Nitrogen gas
	2. Nitrate → Nitrite → Ammonium
	3. Ammonium → Nitrite → Nitrate
	4. Nitrogen gas → Nitrate → Nitrite
6. What reaction shown below is carried out by denitrifying bacteria?
	1. Ammonium → Nitrate
	2. Nitrogen gas → Ammonium
	3. Nitrate → Nitrogen gas
	4. Ammonium → Nitrogen dioxide

A Dead Zone forms in the Gulf of Mexico annually. Explain why this happens and what management practices might help reduce the Dead Zone.

How is nitrate both a nutrient and a toxin? Compare and contrast nitrate dynamics between a rural and urban stream. What are sources of natural and anthropogenic variability in the nitrate concentration at each location? How might rainfall, surface runoff, infiltration, and base flow separately influence nitrate concentrations in both streams? Which hydrogeologic component is likely to be largest in each setting?