PROJECT O*CEANOLOGY*

Sewage Plant Study Data Analysis
Teaching Notes

Overview
This lesson is designed to complement Project Oceanology's "Sewage Plant Study" boat trip, although it can also be used as a stand-alone lesson. Students use Project Oceanology's water quality dataset to look at geographic and seasonal variation in nutrient concentrations and other water quality parameters. The activity can take place in the Project Oceanology computer lab immediately before or after a trip, or in the classroom after students have returned home.

Materials Needed
Project O Sewage Plant Study data file
Student access to graph-making program (instructions are written for MS excel)
Materials for Sewage Discharge Demo (if using):

- Sand
- Plastic bin (shoebox size or similar)
- Bendable plastic straw
- Eyedropper
- Coffee (ideally strong, black, and room temperature)
- Water

Teaching Notes

Engage:

Option 1: Sewage Discharge Demo.

Ahead of class:

1. Pile sand on one end of the bin. Bend the straw and bury it so that the short end sticks out the top of the pile of sand, and the long end leads to the open end of the bin
2. Fill the empty part of the bin with water

In class:
Explain that the straw represents a raw sewage discharge pipe. In many parts of the world, including areas of the USA, this is how sewage is handled.

1. Use an eyedropper to drop the coffee into the short end of the pipe. This represents raw sewage
2. Observe 'sewage' plume
3. Ask the class: why is this a problem? What could be done? Level and direction of discussion will depend on background already covered, and focus of the class (sustainability, nutrient cycles, etc).

Option 2: Sewage Treatment Videos
National Ocean Service: Eutrophication
https://oceanservice.noaa.gov/facts/eutrophication.html
This 1 minute video offers a general overview of the causes and consequences of eutrophication

WaterOperator.org: Sewage Treatment
http://wateroperator.org/blog/PostId/1321/featured-video-nitrogen-removal-in-wastewater-treatment
This 12 minute video provides an excellent overview of the chemistry of sewage treatment, including both nitrification and denitrification.

Explore:

1. Students choose (or are assigned) a variable to examine:
    a. Ammonium
    b. Nitrate
    c. Phosphate
    d. Temperature (surface, average, or bottom)
    e. Salinity
    f. Dissolved Oxygen
    g. pH (surface or bottom)
2. Students examine the dataset and the **Thames River Map** showing the sampling stations, and then discuss if and how their assigned variable has changed over time. They sketch a graphic showing that trend on a large sheet of paper/the board. Some students can also be assigned to look at seasonality.

    Note: the dataset has two tabs. Use the first 'Easy to View' tab if you will print out the dataset to distribute. The second tab ('For Analysis') is what you want for data analysis on a computer.

Explain: Group discussion of each variable in turn. Would you expect this variable to change along an estuary, from the headwaters down to the mouth? Would you expect it to change with season? Why and how?
See notes on teacher key to results.

Elaborate:

Option 1: Students make their graphs in excel (or google sheets). They work through step by step instructions to make the graph, then print out the graph. Optional: students add their own datapoint with a marker.

Option 2: Students redesign their graphs to include season as well as location, either on paper again or on a computer.

Educator circulates and helps with the graph making process

Evaluate: Students present their results to eachother. As they listen, students should fill out their data table as a reference point for discussion afterwards. How does the physical environment of the Thames River change from the headwaters to the mouth? How does it change during a year? How might these changes impact the organisms that live in the Thames River and in Long Island Sound?

Discussion questions can be answered as homework, or in class