Lesson Plan—BATS & HOT DOGS

Summary

This activity allows students, working individually or in small groups, to retrieve information from pre-assigned web sites, retrieve real-time data to compare nitrate and phosphate concentrations at two open ocean monitoring sites, and construct an EXCEL graph using data from two different sites. Each student or group will retrieve data for a specific time frame from public data generated at an ocean observatory and generate a graph for each variable. After graphing the data, students will analyze their graphs, discuss and compare their findings with the class. In conclusion, the students will predict how future Global Climate Changes might affect these nutrients in the open ocean. Student assessment will be based on accuracy of content in a lab summary and active participation in the data collection process and class discussion.

Key Concepts

- Identify patterns and relationships determined from collected data.
- Solve for unknown quantities by manipulating variables.
- Discuss physical and chemical properties of saltwater.
- Describe physical characteristics and processes of oceans.
- Recognize interactions between the atmosphere and the ocean.

Objectives

Students will be able to:

- **Locate** and **describe** the Great Ocean Conveyor Belt
- **Explain** the importance of primary productivity and nutrient regeneration by bacteria in the World's oceans
- **Explain** how the ocean conveyor belt affects both of these processes
- **Identify** physical and chemical properties of ocean water that affect primary productivity in the ocean
- **Collect data** (phosphorus, nitrate, depth) from the HOT and BATS ocean observatory Web sites
- **Analyze the data** to identify trends Predict the effect global climate changes may have on primary productivity in open ocean waters

Materials

- Computers with Internet access, printers
- HOT DOGS and BATS Data Visualization instruction pages
    - http://www.mbari.org/earth/mar_tech/buoys/HOT_DOGS.html
    - http://www.mbari.org/earth/mar_tech/buoys/BATS.html

- HOT DOGS and BATS Graphing instruction pages
  - http://www.mbari.org/earth/mar_tech/buoys/BHD_graph.html
- Access to additional resources (posters, paper for brochure, blog, power point)

Procedure

1. Read the following background information describing the Great Ocean Conveyor Belt
   a. David Suzuki Foundation—The Great Ocean Conveyor
      http://www.davidsuzuki.org/Climate_Change/Science/Conveyor.asp
   b. The Environmental Literacy Council—The Great Ocean Conveyor Belt
      http://www.enviroliteracy.org/article.php/545.html
   c. Windows to the Universe—Transfer and Storage of Heat in the Oceans
      http://www.windows.ucar.edu/tour/link=/earth/Water/ocean_heat_storage_transfer.html

2. Read the following background information describing ocean primary productivity
   a. Oregon State University—Ocean Productivity
      http://www.science.oregonstate.edu/ocean.productivity/
3. Read the following background information describing nutrient cycles
   a. e-subjects—Nutrient Cycles
      http://e-subjects.co.uk/mod/resource/view.php?id=2042
   b. The Encyclopedia of Earth—Marine Nitrogen Cycle
      http://www.eoearth.org/view/article/154479/
   c. The Environmental Literacy Council—Phosphorus Cycle
      http://www.enviroliteracy.org/article.php/480.html
4. Read the following information on physical and chemical properties of ocean water that affect primary productivity
   a. espere—Phytoplankton and nutrients in the oceans
      http://www.atmosphere.mpg.de/enid/1f85756ba5113dcb47a225ee0813c5aa,0/2__Oceanic_nutrients/-_Phytoplankton_and_nutrients_1vf.html
   b. espere—Seasonal cycle of phytoplankton growth
      http://www.atmosphere.mpg.de/enid/1f85756ba5113dcb47a225ee0813c5aa,0/2__Oceanic_nutrients/-_Phytoplankton_growth_1vg.html
5. Answer the following questions on a sheet of paper
   a. What is the correlation, if any, between nutrient concentrations in open ocean waters and ocean primary productivity?
   b. In what ways are phytoplankton blooms beneficial to the health of the open ocean ecosystem?
   c. In what ways are phytoplankton blooms detrimental to the health of open ocean ecosystem?
   d. How might they impact the economic activity of the region?
6. Use the HOT DOGS and BATS Data Visualization instruction pages to download and import nutrient data from each location into Excel
7. Use the HOT DOGS and BATS Graphing instruction pages to produce graphs of the data using Excel
8. Answer the following questions on a sheet of paper
   a. Looking at the nutrient data, were their concentrations uniform through out the water column at both the HOT and BATS sites? If not, describe any differences.
   b. What was the maximum concentration of each nutrient for each site?

 c. At what depth were the highest nutrient concentrations found at each site?

 d. Why are maximum concentrations of each nutrient found at this depth?

 e. What oceanic factors might contribute to the differences found in nutrient concentrations between the HOT site in the Pacific Ocean and BATS site in the Atlantic Ocean?

9. Read the following information about global climate change

 a. espere—Consequences of global warming on ocean circulation
http://www.atmosphere.mpg.de/enid/fe3c53b548f5dad9a8f4a5da78be90ea,0/1__Oceans_and_climate/-_Oceans_and_climate_change_1vr.html

 b. WHOI—The Once and Future Circulation of the Ocean
http://www.whoi.edu/page.do?pid=12455&tid=282&cid=17906

10. On a sheet of paper, write a paragraph predicting the effect global climate changes might have on primary productivity in open ocean waters (Be sure to support your prediction with information from the data and/or readings)

11. Students will present their predictions in the form of a poster, Power Point presentation, skit or blog

Assessment

- **Performance—** Did students accurately follow the directions in the activity? Did students' answers to the questions demonstrate an understanding of nutrient data? Did students successfully create and print an EXCEL graph of defined data sets?

- **Product—**Did students' presentations clearly communicate their predictions? Did students' predictions reflect an understanding of nutrient processes?