



Education and Research: Testing Hypotheses

Lesson Plan—BATS and HOT Nuts!

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

- Locate and Describe the 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.
- Identify Ocean Observation Systems and the technology they use to measure various properties of ocean water.
- Collect Real-time data (phosphorus, nitrate, salinity, temperature, depth) from the HOT and BATS ocean observatory web sites. Analyze the data collected after constructing Excel graphs from the two sites.
- Predict the affect Global Climate Changes may have on primary productivity in open ocean waters.

Materials

- Computers with Internet access & printers
- Copies of the activity.
- Include any additional worksheets or resources (posters, paper for brochure, Blog, power point)

Procedure

1. Read the background information describing the Ocean Conveyor Belt
http://www.windows.ucar.edu/tour/link=/earth/Water/ocean_heat_storage_transfer.html
ocean primary productivity and nutrient recycling
<http://www.wsu.edu/~dybdahl/lec10.html>,
<http://www.amnh.org/sciencebulletins/bio/v/opp.20040115/> and
<http://users.rcn.com/jkimball.ma.ultranet/BiologyPages/N/NitrogenCycle.html> and
<http://www.enviroliteracy.org/article.php/480.html> physical and chemical properties of ocean water that affect primary productivity
http://www.atmosphere.mpg.de/enid/1f85756ba5113dcb47a225ee0813c5aa,0/2_Oceanic_nutrients/-_Phytoplankton_and_nutrients_1vf.html and
http://www.atmosphere.mpg.de/enid/1f85756ba5113dcb47a225ee0813c5aa,0/2_Oceanic_nutrients/-_Phytoplankton_growth_1vg.html.
2. 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 open ocean ecosystem?
 - c. In what ways are phytoplankton blooms detrimental to the health of open ocean ecosystem? How might this impact the economic activity of the region?
3. Read the following information about Ocean Observatories:
<http://www.oceansites.org/links/index.html>
4. Go to the HOT web site <http://hahana.soest.hawaii.edu/hot/hot-dogs/> and review the following data: phosphorus, nitrates, salinity, temperature from the following cruise #178 (February 2006). Use the attached graphing information sheet to graph the nitrate data (only) collected from that cruise. Print your graph.
5. Go to the BATS web site <http://bats.bios.edu/> and review the following data: phosphorus, nitrates, salinity, temperature from the following cruise #10209 (February 2006): Use the attached graphing information sheet to graph the nitrate data (only) collected from that cruise onto the existing graph from the HOT web site.
6. Repeat steps 4 and 5 to graph phosphate data.
7. Analyze the data presented on the Excel graph.

- 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?
 - 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 difference found in total 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
http://www.atmosphere.mpg.de/enid/1f85756ba5113dcb47a225ee0813c5aa,0/Oceans/more_1vp.html
- 10.** Predict the affect Global Climate Change might have on primary productivity in open ocean waters.

Assessment

- **Performance**— students will follow the directions in the activity answering questions posed in the procedures section, creating and printing an EXCEL graph of defined data sets,
- **Product**—students will present their predictions in the form of a poster, power point presentation, skit or blog (www.blogger.com)
- Assessment rubrics that you would use in the classroom are also helpful

Additional Resources

Please list any Web sites, books, publications, or other resources that would be helpful for teachers or students preparing for this lesson.