Neptune's World

Duration:
1 class

Objectives:
Students will:
- Examine real data from a time series in Barkley Sound
- Look for trends, extrapolate, and discuss the graphs

Vocabulary:
Density
The mass in a given unit of volume; a more dense substance has more molecules in a given area than a less dense one
Salinity
Amount of salts dissolved in water
Dissolved oxygen
The amount of dissolved oxygen gas in water
Chlorophyll
A pigment in plants that captures light and facilitates photosynthesis

British Columbia PLO's:
Science 6, 7, 8
Math 6, 7, 8

Background:
In this activity students will examine existing time series data from Barkley Sound that will be enhanced by the addition of the Neptune Node at Folgers Passage in Barkley Sound. This is a good activity for students who have already been introduced to climate change and the impacts it will have on the oceans.

Project NEPTUNE will enable researchers to collect real time data of salinity, temperature, chlorophyll, density, and dissolved oxygen from land-based control centres. By examining these attributes we can observe trends that will affect the biota of the marine environment. In Barkley Sound, the Folgers Node will be used in many studies looking at long-term oceanographic patterns in the area.

Dr. Rich Pawlowicz has been working in Barkley Sound, BC at the Bamfield Marine Sciences Centre for many years. In 2004, Dr. Pawlowicz with the help of others started to collect oceanographic data throughout the year. Salinity, temperature, chlorophyll, density, and dissolved oxygen were all collected at Sarita Hole. This 200-meter hole is in Trevor Channel, just off the Sarita River, in Barkley Sound on the west coast of Vancouver Island. Water properties here are representative of locations throughout Trevor Channel and the lower parts of the Alberni Inlet.

"By lowering an electronic sensor package through the water using a winch we can measure the changes in water properties with depth. Temperature and salinity are basic parameters for oceanography, and can be used to compute water density. Ocean water is stratified - light water lies on top of heavy water - and changes in density from place to place drive currents. When heavy water appears on the continental shelf it can flow into the Sound, replacing the existing deep water in a process called "renewal". Measuring the dissolved oxygen content helps in identifying this process - newer water tends to be higher in dissolved oxygen content than older water, because as water sits in one place decomposition of organic debris sinking down uses up oxygen." (From Dr. Pawlowicz's website: www.eos.ubc.ca/%7Erich/BSTS/bark_plots.html). And by looking at the data collected we can better understand how water conditions are affected by the environment.

Materials:

- *Ocean News* article *Neptune Nearby*
- Barkley Sound time series plots printed off for the appropriate number of groups
- Chart of Barkley Sound (can be found at a chart or marine store, or can be ordered online)
- Station worksheet for the students

Procedure:

1. As a class or individually read the *Ocean News* article *Neptune Nearby*.
2. With the students look at a chart of Barkley Sound and find where the Folgers Passage Node will go in relation to the other Nodes. Also locate the Bamfield Marine Sciences Centre.
3. Ask the Students to find Sarita Hole. Tell them that it is a 200 meter deep hole off the Sarita River and see if they can find it.
4. Depending on the number of students split the class into 3 or 6 groups. If you have a small class 3 is good, if you have a large class go with 6 groups (2 of each of the 3 stations) so that there are roughly 4 to 5 people in each group.
5. Distribute the plots and station instructions for each of the stations to the groups. This information will stay behind as they move on to the next station.
6. Have them spend 7 to 10 minutes at each station discussing the questions on the worksheets and the patterns they see in the graphs. Have the students record their answers and ideas directly into their notebooks.

Temperature (Temperature and Lighthouse Comparison plots)

1. Have the students examine the temperature data plots.
2. Ask them to determine the meaning of the units and values represented on the plot.
3. Have the students discuss the questions on the worksheet and then write them down to be handed in at the end of the class.
4. What affects the water temperature in Barkley Sound?
5. Why does temperature vary with depth?

Salinity (Salinity and Lighthouse Comparison plots)

1. Have the students examine the salinity data plots.
2. Ask them to determine the meaning of the units and values represented on the plot.
3. Have the students discuss the questions on the worksheet and then write them down to be handed in at the end of the class.

Dissolved Oxygen (Dissolved oxygen and chlorophyll plots)

1. Have the students examine the dissolved oxygen data plots.
2. Ask them to determine the meaning of the units and values represented on the plot.
3. Have the students discuss the questions on the worksheet and then write them down to be handed in at the end of the class.

Wrap-up

1. Once the students have rotated and visited all three stations have them return to their seats.
2. Ask the students to pair up with someone who was not in their group and compare the answers and ideas their groups discussed while moving through the stations.
3. Choose a few of the discussion questions the students were asked and go over them with the class. Choose a few from the *Discussion* section and have the students answer them on their handouts as well.
4. Get the students to hand in their worksheets from the three stations either immediately or take them for homework to be handed in the next day depending on the amount of time available.

Discussion:

- How does salinity affect animals in the marine environment?

- How do temperature and salinity affect density? Encourage the students to draw out density problems for a visual aid.
- How does density affect circulation in the oceans?
- How will abrupt climate change affect the temperature, salinity and oxygen content in the Barkley Sound area? What impacts will this have the marine life in the area?
- How will adding large amounts of freshwater affect the density and, hence, oceanic circulation in some parts of the world?
- How will the collection of data at the new Folgers Passage node contribute to this data set? What information would you like to see added to this data set?

Extension and Resources:

- Dr. Rich Pawlowicz's website for the Ocean Dynamics Lab http://www.eos.ubc.ca/%7Erich/BSTS/bark_home.html
- The graphs used in this activity are used with Dr. Rich Pawlowicz's permission and can be found at http://www.eos.ubc.ca/%7Erich/BSTS/bark_plots.html
- If you have a computer with Internet connection in the classroom you can check out the Bamfield Marine Sciences Centre webcam that looks out over Trevor Channel, providing a live view of Barkley Sound. You can have this up on the screen while the students are rotating through the stations. http://www.bms.bc.ca/computing/webcam/index.htm
- The *Ocean News* article *Changing Currents* is a good lead-in or follow-up to this lesson.
- More about the NEPTUNE project can be added to the lesson depending on the goals of the lesson, visit www.neptunecanada.ca for more information
- This activity also ties in well to the article and lesson plan examining *Long Term Data* in the *Ocean News Climate Change* issue.
- Chart of Barkley Sound is number 3671. It can be purchased online or at a marine supplies store. You can get maps online that show the area but they may not show the underwater topographical lines.
- If you are working with very large groups or if you do not want to double-up at the stations, Dr. Pawlowicz also has data on chlorophyll and density that can be used separately for extra stations.
- A good explanation of oceanic circulation patterns can be found at http://en.wikipedia.org/wiki/Ocean_circulation
- Larger ocean patterns are discussed at www.uwsp.edu/geo/faculty/ritter/geog101/textbook/circulation/ocean_circulation.html
- A good website for students to learn about ocean circulation http://www.windows.ucar.edu/tour/link=/earth/Water/deep_ocean.html&edu=high