Activity 3-10

Measuring the Bayou's Vital Signs

Adapted from BTNEP/LSU AgCenter: *Nonpoint Source Water Pollution*

Focus/Overview

This activity sets up an experimental design to investigate the effect of various concentrations of fertilizer on plant growth.

Learning Objectives

The learner will…

- conduct water quality tests in the field or on water samples brought to the classroom.
- use the test results to assess the health of Bayou Lafourche (or a nearby bayou).

Louisiana Grade Level Expectations (Science)

7 INQ: GLE-22	Use evidence and observations to explain and communicate the results of investigations (SI-M-A7).
7: GLE 37	Identify and describe the effects of limiting factors on a given population (SE-M-A2).
7: GLE 39	Analyze the consequences of human activities on ecosystems (SE-M-A4).
HS INQ: GLE-4	Conduct an investigation that includes multiple trials and record, organize, and display data appropriately (SI-H-A2).
HS INQ: GLE-9	Write and defend a conclusion based on logical analysis of experimental data (SI-H-A6) (SI-H-A2).
HS: Biol-26	Analyze the dynamics of a population with and without limiting factors (LS-H-D3).

BTNEP Connection
Water Quality

Grade Level
7, HS Biol

Duration
1-2 class periods

Subject Area
science

Setting
classroom

Vocabulary
limiting factor

Original Source
"Measuring the Bayou's Vital Signs" in BTNEP/LSU AgCenter: *Nonpoint Source Water Pollution*, Activity 9.

BTNEP BARATARIA-TERREBONNE NATIONAL ESTUARY PROGRAM
www.btnep.org

Materials List*

Water quality test kits to measure:

- dissolved oxygen (DO) and five-day biochemical oxygen demand (BOD5)
- phosphates and nitrates
- turbidity (or secchi disk)
- fecal coliform (optional)
- temperature
- pH
- salinity

These kits are easy to use and are available from at least two main suppliers: Hach and Lamotte (see resource lists)

** You don't need to do all of these tests to explore the topic of water quality. Choose what aspect you and your students are interested in and select those kits or tests, according to your budget.*

Safety equipment:

- rubber gloves
- goggles

Sampling equipment:

- buckets
- rope
- water samplers (optional)
- a long pole
- string

Other optional equipment:

- dip nets
- plankton net
- zippered plastic bags for samples
- extra water sample bottles

Background Information and Procedure

There are different levels to which you may want to test water quality. Just to expose students to the techniques and the concept of measuring water quality, you can collect some water samples yourself or take one field trip to the bayou and get one set of data. If you want to invest a lot of time and energy, and you have a source of funding that allows you to buy equipment, you can collect accurate data over a long period of time to give you and your students an on-going picture of the health of the bayou. This is the most scientific approach. Follow the procedure from the water quality testing materials you have.

Collecting Samples

The most reliable samples are from the middle of a body of water and below the surface. This obviously provides a challenge when sampling with students. This obviously provides a challenge when sampling apparatus by tying the collecting container onto a long pole that will reach out across the bayou and will allow you to dip the bucket or other container into the water, or, if there is a convenient bridge, to drop the bucket on a rope down into the water from the bridge. Alternatively, you ca go out in a boat, collect the samples and bring them back to the classroom.

The Water Quality Tests

pH. Equipment: pH kit from Lamotte.
This test measures the relative acidity of the water. The pH scale ranges from 1 to 14. A low pH denotes high acidity. A pH of 7 is neutral and a high pH, such as 9, denotes alkalinity. Most living things are adapted to a neutral pH. A healthy body of water usually has a pH of around 7.

Salinity. Equipment: salinity kit from Lamotte.
Salinity is the concentration of chloride ions in the water. In Barataria-Terrebonne, salinity is an important issue. If your portion of the bayou is used for drinking water, you would expect a low reading on this test. SAFETY NOTE: The Lamotte salinity kit involves a titration with potassium chromate and silver nitrate. Be sure the students wear gloves and goggles.

Dissolved Oxygen. Equipment: dissolved oxygen kit from Lamotte.
Dissolved oxygen levels in a waterbody determine the ability of the water to support life. The dissolved oxygen level is a good indicator of the overall health. If you can afford only one kit, choose dissolved oxygen and do several tests during the year to observe the effect of temperature changes on the oxygen levels. An important point to make about the dissolved oxygen test is that the first step in the procedure is to “fix” the oxygen level. If this step is not done, your results will not reflect the actual oxygen levels in the bayou. Once you have done step one, you can take the sample back to the classroom and do the rest of the test. Dissolved oxygen levels depend on temperature. The warmer the water, the few oxygen molecules the water can absorb in solution. Tell the students to observe this relationship. SAFETY NOTE: The Lamotte dissolved oxygen kit also involves a titration. Be sure the students wear gloves and goggles.

Nitrates. Equipment: salinity kit from Lamotte.
Nitrates are one of the kinds of nutrients that can occur in excess in the waterways of Barataria-Terrebonne and can be responsible for excessive growth of algae and other aquatic plants. Along with phosphates, nitrates can cause algae blooms. By measuring the nitrate levels in Bayou Lafourche and other waterways and comparing them with the standards set by the state, the students can access whether nutrient nonpoint source runoff is affecting the bayou. NOTE: The color change involved in this test can be very faint, so help students make an assessment using the colorimeter or octet comparator.

Phosphates. Equipment: salinity kit from Lamotte.
Phosphates are one of the nutrients that limit plant growth in aquatic ecosystems. Algae use up phosphates very fast. Excess phosphates in the water can lead to an algae bloom. When algae blooms occur, the water looks very green (there are also tests for algae levels that you can use). The algae use up oxygen during the dark hours and oxygen levels decline. Also, as they complete their life cycle and die, the individual algae plants fall to the bottom and decay. The decay process also uses a lot of oxygen. Algae blooms can lead to low oxygen levels, or hypoxia. Hypoxia usually occurs during hot weather when oxygen levels are already low and algae can grow fast. NOTE: As with the nitrate kit, the color change is often subtle and students may have trouble reading the results of the test.

Turbidity. Equipment: secchi disk.
The waters of Barataria-Terrebonne are typically turbid (cloudy) and rarely clear. High turbidity is generally considered negative, but it may be quite normal here. The reasons for high turbidity is in our waterways include high levels of organic matter and sediment in the water. Suspended sediment from the Mississippi River can cloud Bayou Lafourche. But, during algal blooms the water will be extra turbid because of all the microscopic algae suspended in the water column. It is useful to collect turbidity data and keep a record over time of the changes. You can choose a simple secchi disk or a kit to measure turbidity. You can easily make a secchi disk and, if your budget doesn't allow for purchasing the other its, you may want to make turbidity your one parameter to measure. NOTE: A secchi disk is an 8-inch disk, the surface of which id divided into four quadrants painted alternately black and white. It is attached to a rope marked in 1-foot increments. To measure the turbidity of a waterbody, simply lower the disk on the rope into the water, stopping at the point at which you can no longer see the pattern on the disk. The depth to which the disk is submerged is then recorded.

Coliform Bacteria. Equipment: fecal coliform kit from Lamotte or Hach.
Coliform bacteria can indicate the possible presence of harmful bacteria in water. Fecal coliform bacteria are present in the digestive systems of all warm-blooded animals, including humans, and are present in the feces of these animals. They also grow on plants and may not indicate fecal contamination. A common example of coliform bacteria is *E. coli*. Fecal coliform bacteria are not in themselves harmful or pathogenic, but, when they are found in large quantities, there is a greater chance of the potential presence of pathogenic or disease-causing organisms in the water. Therefore authorities responsible for determining a waterbody's suitability for drinking, swimming, fishing, oyster harvesting or boating measure the levels of fecal coliform to get an estimate of the presence of pathogens. If fecal coliform counts are higher than 200 colonies per 100 ml of water sample, there is a greater chance of pathogenic organisms being present, and swimmers may become ill. NOTE: As with other tests, you can do a simple test to see if coliform bacteria are present, or you can do a more complex procedure to determine the quantity and quality of the bacteria in the water. Most test procedures require an incubator. Determine which, if any, of these procedures you are quipped to do in your school. There are many products on the market. Some measure total coliform and are used to test drinking water, and other measure fecal coliform specifically.

Water Temperature. Equipment: thermometer.
A simple thermometer is all you need to collect water temperature data. If you are collecting samples from a particular part of the waterbody, be sure to take the temperature in the same place so you can use the temperature data for comparison with other data. Always take the temperature when doing a DO test. You can use the temperature reading to calculate % saturation of dissolved oxygen using the simple scale from the dissolved oxygen kit.

Air Temperature, Weather. Equipment: thermometer.
The student responsible for collecting water temperature should also measure air temperature (in the shade) and note the weather conditions. All of these factors are important when assessing the overall health of the bayou.

Blackline Master
None.

Assessment
- Assess student's data, results and conclusions drawn from the experiment.

Resources
Websites:
U.S. Geological Survey, Water Science for Schools, 30-Aug-2005, **Common Water Measurements**, accessed January 9, 2006, at http://ga.water.usgs.gov/edu/characteristics.html.
Clear information about basic water quality testing.

U.S. Environmental Protection Agency, 9-Sept-2003, **Monitoring and Assessing Water Quality**, accessed January 9, 2006, at http://www.epa.gov/owow/monitoring/monintr.html.
Information about EPA water quality testing.

Blackline Master #1

Measuring the Bayou's Vital Signs

Water Quality Data Table

Site location _____

Parameter	Result of Test	Range indicating poor water quality	Does waterbody pass? Yes or no
water temperature	_____ °C	Above 27°C or 81°F	
dissolved oxygen	_____ mg/l or _____ ppm	3-5 ppm = stress 1-2 ppm = poor (hypoxia) 0 = anoxia	
salinity	_____ ppt	NA	
nitrates	_____ mg/l or _____ ppm	above 0.08 ppm	
phosphates	_____ mg/l or _____ ppm	above 0.65 ppm	
turbidity	_____ NTU	above 8 JTU or NTU	
pH	_____ pH units	below 5.6, above 8.5	
coliform bacteria		for swimming: above 200 colonies/100 ml	
rain in last 24 hours	_____ cm	NA	
air temperature	_____ °C	NA	

Description of weather: _____

_____

Appearance of the bayou – color of water: _____

_____

Floating aquatic vegetation? Y/N _____

Height of water (if tide gauge is available) _____

Depth of water (if possible) _____

Fish, wildlife, insects observed: _____

_____

_____

Blackline Master #2

Conclusions:
Measuring the Bayou's Vital Signs

Conclusions:
How's the bayou doing?

Are these the first data you have collected?

If not, how many other sets of data do you have?

If this is the first set of data collected, write your general impression of how healthy the bayou is based on where your measurements of each parameter falls in the "range" column.

If you have collected previous data, write a paragraph to describe how this set of data compares with previous data collected. Has the bayou improved since last time, or is it doing worse?

Why do scientists collect data through several trials or experiments?