Teacher's Pages

HOW DOES YOUR WATER COMPARE?

Purpose: The students will perform water quality tests on their local stream and compare this data to water quality data collected from the Ft. McHenry site located on the Patapsco River.

Benchmarks Addressed:

- 4B (The Earth) Fresh water, limited in supply, is essential for life and also for most industrial processes. Rivers, lakes, and groundwater can be depleted or polluted, becoming unavailable or unsuitable for life.
- 1A (The Scientific World View) When similar investigations give different results, the scientific challenge is to judge whether the differences are trivial or significant, and it often takes further studies to decide.
- 1B (Scientific Inquiry) Although there is no fixed set of steps that all scientists follow, scientific investigations usually involve the collection of relevant evidence, the use of logical reasoning, and the application of imagination in devising hypotheses and explanations to make sense of the collected evidence.
- 12 D (Communication Skills) Read simple tables and graphs produced by others and describe in words what they show.

National Science Standards Addressed:

- Content Standard F (Natural Hazards) Human activities can induce hazards through resource acquisition, urban growth, land-use decisions, and waste disposal. Such activities can accelerate many natural changes.
- Content Standard G (Nature of Science) Scientists formulate and test their explanations of nature using observation, experiments, and theoretical and mathematical models.
  -It is part of scientific inquiry to evaluate the results of scientific investigations, experiments, observations, theoretical models, and the explanations proposed by other scientists. Evaluation includes reviewing the experimental procedures, examining the evidence, identifying faulty reasoning, pointing out statements that go beyond the evidence, and suggesting alternative explanations for the same observations. Although scientists may disagree about explanations of phenomena, about interpretations of data, or about the value of rival theories, they do agree that questioning, response to criticism, and open communications are integral to the process of science. As scientific knowledge evolves, major disagreements are eventually resolved through such interactions between scientists.

Maryland Science Content Standards Addressed:

- 6.8.5 Analyze how human activities can accelerate or magnify many naturally occurring changes (i.e. erosion, air and water quality, populations). (MLO 6.2)
- 1.8.1 Access and process information from readings, investigations, and/or oral communications. (MLO 1.1.1)

- 1.8.5 Demonstrate safety when conducting an investigation.
- 1.8.6 Use appropriate instruments and metric units when making measurements and collecting data. (MLO 1.1.5)
- 1.8.14 Provide supporting evidence when forming conclusions, devising a plan or solving a practical problem. (MLO 1.2.4)
- 1.8.21 Use the knowledge of science and available scientific equipment to devise a plan to solve a global problem. (MLO 1.3.3)

Materials: (for each student group)

Part I: tape measure (in meters)
clipboards

Part II: thermometer
Dissolved Oxygen kit
calculator
pH strips or kit (kit is more accurate)
clipboards

Part IV: Maryland state map
Post-it Notes
Internet access to "real-time" data

Background:

Grade level- 6-8
Time Frame- 4-5 90 minute class periods

In this lesson students will make observations and collect data using different water quality tests in a local stream in their area. Students will then compare their stream data to data collected from Ft. McHenry, a site on the Patapsco River. It is important that students are familiar with this CD and the Chesapeake Bay section of the National Aquarium in Baltimore's website (http://www.aqua.org) so that they have an understanding of watersheds and the vocabulary that is used in the student activity packet.

The overall goal is for students to learn how to determine whether a waterway is healthy and to realize that this type of testing happens in the "real-world" and to access this information. The students will hopefully obtain a global understanding of how their behaviors in their own neighborhood impact the health of the Chesapeake Bay and what they can do to help.

It is suggested that the students work on the activity packet in heterogeneous groups of 3-4 students. The activity packet is divided up into four parts. Parts 1, 2 and 4 should be done on separate days and Part 3 be done as a journal activity or as a homework assignment. If it is possible, do Parts 2 and 3 in the same class period.

Procedure:

I. Engagement
1. Ask your students to picture any stream. Ask the students what they might see that would indicate that the stream was healthy. Ask the students what they might see that would indicate that the stream was unhealthy.

2. Ask the students if it would be possible for a stream without any visible evidence, such as trash, to be unhealthy. Have them explain their answer.
3. Tell them that today they will be investigating the health of their local stream by performing both chemical tests and taking important stream measurements.
4. Divide the class into heterogeneous groups of 3-4 students.
5. Pass out the student activity packet. Review the steps involved in Reading to Perform a Task.

Steps for Reading to Perform a Task

Before You Read…..

- What do you know?
- Why are you reading this material?
- Read through the material.
- Look at any pictures, diagrams, or illustrations.
- Identify the steps in the process.
- Will you be able to follow the directions?
- Rewrite the information on an organizer.
- Do you need a better understanding of the task?
- Do you have all the materials you need?
- Do CUCC to the steps.

While You Read….

- Read the directions for each step. Then look at any graphics that go with that step.
- Pause after each step to check and make sure you are doing things correctly.
- Think about what you have to do next.
- Keep a mental picture in your head about what it is you are doing.

After You Read…..

- Decide if you have finished the task correctly.
- What would you do to make it easier the next time?
- Evaluate the results.
- Talk to someone about the selection.

II. Exploration

Day 1

1. Tell the students that they will now be investigating their local stream. They will need their student activity packet, a clipboard (if available), pencil, and a tape measure for their group.
2. Before going outside:
   *Review Part I and explain the rating scale of *Great!, Good, Okay, Not Good,* and *Bad.*
   *Review the vocabulary that is used in this section (see glossary on website): vegetation, runoff, pollutants, buffer zone, and vegetation.

3. Take your students out to the stream. Direct the students to Part I of the student packet. Give the student groups approximately 30 minutes to complete Part I.
4. When each group has completed Part I have them sit down in a specified area for a class discussion.
5. Review each group's answers to Part I. Discuss the differences between the data collected by each group. Have the students identify the possible causes of these differences. Stress the fact that each group might have slightly different answers because groups could have analyzed different areas of the streams, groups might have "guesstimated" different percentages, etc. Make sure that the students understand that all answers are acceptable but in order to get a more accurate estimate more of the stream would need to be sampled.

Day 2

Set-Up*:* Set up 3 stations outside by the stream: a temperature station, Dissolved Oxygen (DO) station, and pH station. You should have 2 to 3 student groups at each station, and rotate stations approximately every 15 minutes. Each station should include written directions on how to use the equipment to collect the data, i.e. how to use the thermometer, directions on how to use the DO kit and pH strips. In addition to the written directions each station will need the required materials: temperature station will need 2-3 thermometers, the DO station will need 2-3 DO kits and calculators (you will need to stay with this station to help them), and the pH station will need a container of pH strips.

1. Begin class by reviewing their answers to question #6 in Part 1: Based on their stream observations, do they think their stream is healthy?
2. Tell the class that today they will continue their investigation of the stream. It will be slightly different though, instead of just analyzing what can be seen with the naked eye they are going to investigate the "invisible" data, water quality (dissolved oxygen, water temperature, and pH). Stress to the students that good water quality is extremely important to the survival of all aquatic life.
3. Discuss as a class what aquatic life was visible in their stream (insects, fish, underwater grass, algae, worms, etc.) Discuss what would happen if the water quality was not good enough to sustain these animals. If possible review this information in the context of a food web.
4. Before going outside:
   *Review the vocabulary that will be used in this section: dissolved oxygen, pH, and acid rain.
   *Review the set-up they will find outside and basically how each station should be performed. Explain the importance of safety goggle and glove use at the DO station because of the chemicals that will be used.
   *Explain to the students that today they will be "real" scientists and it is important to act accordingly. Using chemicals and thermometers is serious but will be a lot of fun as long as they follow the directions correctly.
5. Take your students out to the stream. Each group should be designated to a station. Tell the students that they will have 15 minutes at each station and

will be given a five-minute clean-up warning. They will not be permitted to leave their station until it looks exactly the way it did when they started.
6. Students will have a total of 60 minutes to work on Part II.
7. If students finish Part II before class is over they should begin work on Part III. If they do not have the opportunity to finish Part III, it is suggested that they work on this section for homework.

III. Explanation

1. Students will complete Part III of the activity packet either during class time or as homework. In this section they will analyze all of the data they have collected and determine whether or not they believe their stream is healthy. If they are having difficulty understanding the different water quality components suggest they refer back to the website pages (http://www.aqua.org) on this information.
2. After each student has answered the two questions place them into random groups of 3-4 students. **Do not use the same groups that were used for the investigation!**
3. Have each group discuss their answers to the two questions. In their discussion they should be focusing on these questions (write them on the board as a reminder): Do each of the groups believe the stream is healthy? Have the students discuss the data that supports their conclusion. Was this an easy decision to make? Did their answer change from Part I to Part II? If they could do this investigation again, what would they change next time to make it better?
4. Each group should come up with a final response to the question of whether their stream is healthy or not. It is important that this is a unanimous decision for their group and they should debate as necessary.
5. Place a chart up on the board with two columns: healthy and unhealthy. Have one student from each group come up and place a check under the column that represents his or her group's decision.
6. Discuss the results as a class.

IV. Extension

1. In Part IV of the student activity packet the students will use a website that gives them real-time water quality data that is collected from Ft. McHenry on the Patapsco River and compare this data to the data they obtained from the stream investigation.
2. Students should complete this section individually if possible and will need Internet access. If access is not available the information can be printed off of the site and distributed to students to use.
3. Before beginning the computer section, have the students find where Ft. McHenry is located using a Maryland state map. This will give them a perspective of where their stream is located compared to this site and will give them something to refer back to when they are comparing their results. It is also important they note the differences in the two areas and the

surrounding land use. This will help them to analyze why the two areas might have different water quality results.

4. After completing Step 1 as a class the students should work on the rest of Part IV independently. The teacher should walk around and monitor the student's progress, specifically making sure that they are obtaining the correct information from the site.
5. When all students have completed Part IV discuss their findings as a class.
6. Ask the class whether they would like to swim in the Patapsco River based on the data they obtained from the website and the location of the river. Discuss with the class the fact that this river used to be used as a beach and for recreation in the 1900's. Ask them what this tells you about changes in water quality and discuss why they think these changes occurred.

V. Evaluation
   1. Have students use the watershed website to research at least 3 different things they could realistically do within their neighborhood, school or home to help the Chesapeake Bay.
   2. Collect student activity packets and assess/evaluate student understanding using their responses in each section. Students should also be graded on their participation in class discussions.

References:

American Association for the Advancement of Science, Benchmarks for Science Literacy, New York: Oxford University Press, 1993.

Chesapeake Bay Foundation, "Chesapeake Choices and Challenges: The Catch of the Bay," Section 3, Activity 2.

National Research Council, National Science Education Standards, Washington, DC: National Academy Press, 1996.

Parts I & II Modified From: Chesapeake Bay Foundation, "Chesapeake Choices and Challenges: The Catch of the Bay," Section 3, Activity 2.