Reading the River, Summer 2002

Examining a Low Quality and a High Quality Stream

Seventh Grade Science

Subject Areas in Physical, Biological and Earth Sciences

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Objectives:

Students will be able to accurately measure water temperature, pH, and dissolved oxygen (DO) and explain how these factors affect water quality. Students will be able to accurately identify group 1,2, and 3 taxa using the Kentucky Water Watch Biological Monitoring Assessment and Keys, and they will be able to explain how these benthic macroinvertebrates serve as biological indicators of stream quality.

Program of Studies:

2.1 Scientific Ways of Thinking and Working

Oral and written communication of scientific procedures, results, and conclusions.

2.2 Analysis and Use of Patterns

Examine cyclical patterns that occur in the streams.

2.6 Living and Non-living Things Change Over Time

Examine ongoing changes in the two streams.

Examine how human activities have altered the two streams.

Core Content:

SC-M-1.1.1 A substance has characteristic physical properties.

SC-M-1.1.2 The chemical properties of a substance cause it to react in predictable ways with other substances to form compounds with different characteristic properties.

SC-M-1.3.2 Heat energy moves in predictable ways, flowing from warmer objects to cooler ones, until both objects reach the same temperature.

SC-M-2.1.2 Landforms are a result of a combination of constructive and destructive forces.

SC-M-2.1.4 Soil consists of weathered rocks and decomposed organic material.

SC-M-2.1.5 Water, which covers the majority of the Earth's surface, circulates through the water cycle. Water dissolves minerals and gases.

SC-M-2.2.1 The Earth's processes we see today are similar to those that occurred in the past.

SC-M-3.4.1 Biological change over time accounts for the diversity of species.

SC-M-3.4.2 Biological adaptations include changes in structures, behaviors, or physiology that enhance survival and reproductive success in a particular environment.

Materials:

Handouts on water temperature, pH, and DO. Identification keys for benthic macroinvertebrates and biological monitoring assessment report forms. Worksheets.

Activity Procedure:

Students will receive 3-4 periods of classroom instruction before they do any water quality monitoring in the field. This classroom instruction will involve a combination of lecture, demonstration, and student participation.

The first lesson will begin with a review of acid/base reactions, how the pH scale works, and what is being measured when we measure the pH of a solution. Next we will discuss what pH range is safe for most aquatic life,

and what kinds of human impact can cause the pH of a stream to become toxic. The synergism between pH toxicity and the toxicity of heavy metals, ammonia, and other elements and compounds will also be addressed. I will demonstrate how to use the LaMotte pH test kit and students will have a chance to work in teams and practice using the kits on samples in the classroom.

The second lesson will begin with a discussion of what dissolved oxygen is and how it gets into and out of the water. I will then proceed to give the students an elementary explanation of the processes of photosynthesis and aerobic respiration, and how these two biological processes cycle oxygen and carbon dioxide. Next, we will look at some of the factors that influence the levels of dissolved oxygen in water, such as water temperature, atmospheric pressure, and the rates of photosynthesis and respiration. Students will learn what levels of dissolved oxygen are considered good, fair, and poor for a warm water stream. Finally, I will demonstrate how to use the LaMotte DO test kit, and students will have an opportunity to work in teams and use the kits on water samples in the classroom.

The third lesson will begin with a discussion of the toxic effects of high water temperature on aquatic life. The relationship between water temperature, dissolved oxygen, and the solubility heavy metals, ammonia, and other toxic compounds will be explained to the students.

Finally, students will have an opportunity to observe live specimens of some of the various members of the group one, two, and three taxa that are described in the Kentucky Water Watch Macroinvertebrate Identification

Key before they go into the field. We will discuss what adaptation means and how adaptations allow different species of organisms to live in different habitats with different environments. Next, we will discuss how we can use the group one, two, and three taxa as indicators of good, fair, and poor quality streams.

After the students gain some experience using the test kits and identifying macroinvertebrates, we will take a field trip to monitor the water quality of two different streams. First, we will monitor at a site on Otter Creek, in Meade County, Kentucky. This stream is one of the cleanest left in the central part of the state. It flows through forested portions of Fort Knox Military Reservation and then through Otter Creek Park, which is owned and run by the city of Louisville. Otter Creek empties into the Ohio River at Otter Creek Park. We will monitor at a site located approximately two miles upstream from the mouth of the creek. Students will test for pH and dissolved oxygen, take water temperature readings, and survey the macroinvertebrate community. Students will also take notes on the general types of stream bank vegetation that inhabit this site, and any human activities that might be degrading the quality of the stream. The site will also be photographed by the students.

Next, we will travel to Pond Creek. The Pond Creek Watershed is impacted by intensive residential, commercial, and industrial development. Stuart Middle School is located in the Pond Creek Basin, so we will discuss the fact that our school and many of our homes discharge wastewater into Pond Creek. We will monitor this stream at a site located near it's mouth, where it

empties into the Ohio River. Students will repeat all of the same tests and observations that were performed at Otter Creek.

After all the data are collected, students will write a short environmental impact assessment for each of the streams. Students will report on their analysis of the results of this investigation and their assessment of the water quality of each stream. Students will then propose plans to mitigate the human impact on these streams.

Handouts:

See appendix.

Definition/Explanation of concept/skill:

pH: A measure of the number of hydrogen ions in a solution. Stream pH is important because biochemical reactions necessary for life are pH dependent. Also, the toxicity of heavy metals, ammonia and other compounds is pH dependent. Finally, effective wastewater treatment is also pH dependent.

Dissolved Oxygen: Oxygen gas dissolves in water. Water temperature, atmospheric pressure, and rates of photosynthesis and aerobic respiration in aquatic communities affect the levels of dissolved oxygen in a stream. Low levels of dissolved oxygen in a stream will kill most aquatic life because anaerobic respiration cannot occur.

Water Temperature: High water temperatures have toxic effects on aquatic life. Higher temperature water holds less dissolved oxygen than lower temperature water. Higher temperature water also dissolves more toxic metals and compounds than lower temperature water.

Environmental Indicator Species: Different species of organisms are adapted to different kinds of habitats. The presence and/or absence of certain species of organisms in a habitat can be used as indicators of the quality of the habitat.

Method to Assess Stated Objectives:

Verbal assessment of student learning will be done throughout the classroom instruction. A quiz at the end of classroom instruction will also be used to assess student learning. Finally, the written reports produced by the students will also serve as part of their learning assessment.

References:

Reading the River 2002. Kentucky Water Watch.