SAMPLE TEXT FROM

Watershed Science for Educators

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Introduction

Water is a local issue no matter where you go in the world. Everyone needs water to survive, and everyone, every- where lives in a watershed. A watershed is an area that includes a body of water and all the land that drains water to it. The actions of individuals and their neighbors affect the quality and quantity of water in their watershed.

Watershed monitoring helps students see the connections between humans and their environment. It also links subjects that are typically taught separately such as biology, chemistry, and earth science, or even social studies and nonscience disciplines. As your students begin to explore and monitor the many components of their own watershed, they will apply knowledge from the classroom to real-life situations while learning the skills of observation, measurement, and data interpretation.

We encourage teachers and students to work together to decide what questions to ask about their watershed. Allow students to help design your study so that they have a clear grasp of what they are monitoring and why. Including students in the project from the outset also allows them to be active participants in evaluating whether the group's objectives have been met.

Water monitoring means measuring the biological, chemical, and physical parameters of a body of water. Some groups may choose to conduct observational or single-discipline projects such as discovering the creatures that live in their pond or stream. Other groups may want to collect information about several factors, including the interactions among organisms, chemical parameters such as pH or dissolved oxygen, and physical characteristics like flow rate or discharge. Together these factors can give us an idea of the quality of water in a stream, river, or lake.

Watershed monitoring means relating the land uses surrounding a body of water to the biological, chemical, and physical measurements of its water quality. This goes beyond focusing on the water in a stream or lake. Studying maps and aerial photographs, taking field trips to sites within a watershed, and interviewing longtime residents can help students understand what a watershed is, how land uses within it affect water quality, and how land use in their community has changed over time.

Using the watershed approach, students can go one step further in their investigations and make predictions about the quality of water in their local lake or stream based on land uses surrounding the body of water. They can then test their hypotheses using water monitoring techniques.

Because scientists cannot keep track of all streams, lakes, ponds, and rivers, the monitoring that your group does could help detect problems or areas that might require the further attention of a water quality professional; your group even may be able to affect decisions of policy makers.

Chapter 2 Planning Your Watershed Monitoring Program

This packet was written for high school and middle school teachers and students who wish to incorporate watershed monitoring into both science and humanities classes or into after-school environmental or science clubs. It includes teacher’s pages with objectives, advance preparation, suggestions, and examples of assessment questions. Background information gives the educator a foundation for each topic. Student activity pages and worksheets help the educator direct the lesson. An extra copy of assessment questions from each chapter without answers is included at the end of this packet. These assessment sheets may be photocopied for student use. In addition, 10 extra copies of aerial photographs used in the activities are included. Appendixes provide information on resources that support the activities.

This information can be used in different ways. You could work with other groups and have your students share their findings at a school-organized watershed conference. Your group could team up with community groups interested in water quality, such as Cooperative Extension, lake associations, citizens' water monitoring groups, or natural resources agencies. Or you might work individually in your own subject area and integrate the information in this packet with the required science curriculum. Individual chapters can stand alone and be used by teachers of biology, chemistry, or earth science to augment existing curricula.

Two reasons for conducting watershed monitoring are to increase students’ understanding of science and to promote good water quality in a local body of water. These two goals do not need to be mutually exclusive because a watershed monitoring

project allows students to see how science can contribute to solving local environmental problems.

The overall goal of the watershed monitoring program described in this packet is to help students enhance their understanding of the biological and physical sciences, hone their observational skills of the natural world, enhance their ability to conduct research investigations, and participate in local decision making concerning water quality.

Watershed monitoring programs can be designed to suit different age groups and to meet a variety of goals. If you work with young students, you might want to limit your study to an exploration of the aquatic organisms in a local stream. If your students are older, you can use watershed monitoring to engage them in scientific research. Students can collect background information, formulate and test hypotheses, and analyze and interpret their data.

We recommend that all teachers read Chapter 1, "How to Use This Packet"; Chapter 2, "Planning Your Watershed Monitoring Program"; and Chapter 9, "Wrap-Up," before developing a watershed monitoring program. The first chapter helps you focus on the specific goals of your project. Chapter 2 provides background information on watershed monitoring and explains how to design a monitoring project with students. Chapter 9 gives guidelines for interpreting your data to help you to determine how land use and other factors have affected water quality in your watershed.

Chapters 3 through 8 will help you customize the project to your group's needs. Chapter 3 introduces students to the concept of a water- shed and explains how land use within a watershed affects water quality. Chapters 4 and 5 describe how topographic maps and aerial photographs can be used to investigate land uses in a watershed. Chapters 6 through 8 outline the concepts and procedures necessary for conducting chemical, biological, and physical monitoring of a water body. The resources section contains a list of materials that provide additional information and curricula on water monitoring.

Conducting a watershed monitoring program presents several options for student assessment. Students could

- develop portfolios documenting their projects with photographs, details of their activities, and results of their data.
- keep notebooks recording their methods and results.
- give public presentations about their findings.
- make recommendations for future watershed studies or actions to be taken to protect or enhance water quality.
- Students will learn to
- *Read topographic maps.* Reading maps enables students to understand where they live in relation to other features in the landscape, including local bodies of water.
- *Interpret aerial photographs.* This helps students understand how various land uses, such as housing or industrial developments, and natural features, such as forests or lakes, are related to water quality and quantity.
- *Predict potential water quality impacts.* Using a visual record of their watershed over time, students can make informed estimates about how development (and sometimes reforestation or land reclamation) can affect the entire watershed.

- *Identify aquatic invertebrates.* This helps students gain the foundations for conducting biomonitoring or bioassessment.
- *Calculate water quality indexes.* Using data collected from invertebrate sampling, students can arrive at a quantitative measurement of water quality. This measurement can be compared to results of biomonitoring at other sites or other times.
- *Conduct water chemistry tests.* Testing parameters such as dissolved oxygen, pH, alkalinity, hardness, and nutrients can help stimulate further discussions of land uses in the watershed and how they might affect water chemistry.
- *Take physical measurements of a waterway.* When parameters such as stream flow, water temperature, water clarity, water color, and water depth are compared over time, patterns may emerge to help explain the "big picture" of the watershed.
- *Organize and interpret data.* This helps students make sense of the raw data they have accumulated and see how their measurements fit together to create a picture of the dynamics of their watershed.

Good luck, and enjoy discovering your watershed!

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