

9-12

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# INTRODUCTION

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Nonpoint water pollution now comprises the largest source of water pollution. Most nonpoint sources are related to land use activities. For example, rainwater washes over farmlands and carries topsoil and residues from farm chemicals into nearby streams. Primary nonpoint sources of water pollution include runoff from agriculture, urban areas, mining, forestry, and construction activities. Pollution prevention, as it applies to nonpoint source pollution, starts with understanding how human activities affect the quality of air, land, and water and the natural interrelationships that exist between these components of the environment. Nonpoint sources contribute 65 percent of all contaminants in water bodies as compared with 9 percent from industrial sources and 17 percent from municipal sources. For years we have concentrated on reducing point sources of pollution, pollution that can be traced to a single source, only to find that our waters were not free from contamination. Nonpoint sources of pollution were often overlooked because they come from many diffuse sources and are often difficult to pinpoint and control.

This 9-12 grade activity guide has been developed to educate students about nonpoint source water pollution. Activities in the guide fall into three broad categories: (1) What is it; (2) Where does it come from; and (3) What can we do about it. Some activities may focus on one or more of these questions. For example, a single activity may focus on a specific source of nonpoint pollution and also address ways to reduce the source.

The guide contains activities on agricultural, mining, forestry, and urban sources of nonpoint pollution. Activities focus on the four main types of water pollutants—sediment, nutrients, bacteria, and toxics—and best management practices to control nonpoint source pollution. Wherever possible, special emphasis is placed on acceptable pollution prevention alternatives.

All of the activities are "hands-on" and designed to blend with existing curricula in the areas of general science, life science, physical science, earth science, chemistry, biology, physics, ecology, algebra, geometry, and agriculture. Each activity contains (1) objectives, (2) subject(s), (3) time, (4) materials, (5) background, (6) follow-up, (7) extension, and (8) resources. Factsheets and a glossary section included at the end of the guide contain concepts and words used in the text which may be unfamiliar.

Achieving future clean water goals will require an informed citizenry capable of understanding the complex issues surrounding water management, and motivated to take action. It is our goal that wherever possible, students not only understand these issues but are given an opportunity to take action now. For this reason, we have provided suggestions on ways individuals can reduce nonpoint source pollution in their daily lives. It is the ultimate goal of this program to assure that the decision makers of tomorrow are equipped with a basic understanding of nonpoint pollution problems and can use this information to make knowledgeable judgments on the difficult water-related issues that we as a global society will inevitably face.

## Organization of Individual Activities

Each activity is organized in the same way, detailing objectives, materials needed, background information, and procedures. Following is a brief summary of what you should expect to find in each activity.

**OBJECTIVES:** Describes what the student should be able to do when the activity is completed.

**SUBJECT:** The general subject(s) to which the activity applies: earth science, general science, life science, physical science, biology, chemistry, physics, ecology, algebra, geometry, and agriculture.

**TIME:** The approximate number of class periods (45-minute sessions) needed to complete the primary exercise(s). More time may be needed for the follow-up exercises. Some activities or follow-ups may require collecting data over several days/weeks, but will only need full class periods at the beginning and end of the activity to explain, present information, and reach conclusions.

**MATERIALS:** List of materials needed to complete the primary activity. Alternatives and optional materials are listed where appropriate. Occasionally, when simple but specialized equipment must be ordered, an address is given. This equipment can usually be reused by other classes or in other years. If the basic materials are not immediately available in your classroom, they can often be borrowed from other areas in the school or from a local college or university science department.

**BACKGROUND INFORMATION:** Background information needed for the specific activity. This material is suggested as a basis for teacher lecture and/or student discussion when the activity is introduced. (More general background information can be found in the factsheets located in the back of the guide.)

#### **ADVANCED**

**PREPARATION:** Directions for the teacher and/or students to prepare materials in advance.

**PROCEDURE:** Complete directions to conduct the entire activity including follow-up and extension ideas. Includes overhead masters, student sheets, quizzes, and teacher keys.

**Setting the Stage** Introduction of the activity to the students. This section uses both student discussion questions/topics and sharing of pertinent background information.

**Activity** Step-by-step description of how to do the activity. This ends with questions to demonstrate that the students understand what they have done.

**Follow-Up** Conclusion of the activity by summarizing the information and drawing conclusions if applicable.

**Extension** Suggestions for extending the activity and/or suggestions for other related, non-laboratory activities.

**Resources** Reference materials either used in developing the activity or to provide additional information and addresses for ordering materials used in the activity.

These special notations appear within some activities.

**CAUTION:** Special care is needed for this step/procedure.

**NOTE:** Further explanation about a procedure, used to clarify or reemphasize important directions.

**OPTIONAL:** Optional procedure or materials that may enhance part of the activity.

### **Activity Preparation**

Once you have decided on the activity(ies) you will be doing, check the materials list. You will need to take into account the number of students or student teams in your class(es). Many materials are readily available, but some may need to be borrowed or purchased ahead of time. Prepare copies of all the needed student handouts and/or transparencies or other materials for your use. If you plan to have the students

do part or all of the Extension suggestions, you will want to add additional materials to your list. You may also need to locate other sources of information or telephone numbers to complete the Extension. Some Extensions can be started simultaneously with the regular activity.

As you read through the activity, highlight any CAUTION or NOTE and decide whether you will do OPTIONAL suggestions. Check the suggested time for completion of the activity and add time needed to do any extension activities. The time needed may vary from class to class. These activities have all been field-tested in high school classrooms. However, you might want to do a trial run of the activity yourself to evaluate the time needed and identify areas where minor problems might occur. It is also a good idea to mark points in the text where natural breaks can be taken to divide the activity into class periods.

The factsheets included at the end of the guide and the background material included in each activity should provide information necessary for your preparation. Further reading on the subject can be found in the lists of resources at the conclusion of each activity. If these are not readily available, you may want to check other books on environmental concerns.

TOPICS	ACTIVITIES	FACTSHEETS
Water Pollution Sources	Lingo Bingo Watershed Woes Pollution P.I.	Water Water Quality Factors Water Pollution Land Use and Water Quality
Point vs. Nonpoint	Lingo Bingo Watershed Woes Pollution P.I.	Water Water Quality Water Quality Factors Land Use and Water Quality
Sediment Pollution	It's Sedimentary, My Dear Watson Breathtaking Slip Slidin' Away	Water Pollution Land Use and Water Quality Sediment Water Pollution
Nutrient Pollution	Fed Up Breathtaking	Water Pollution Land Use and Water Quality Nutrient Water Pollution
Bacterial Pollution	Wasted Waters	Water Pollution Land Use and Water Quality Bacterial Water Pollution
Toxic Pollution	All Messed Up and No Place To Go Mined Over Water Lethal Lots	Water Pollution Land Use and Water Quality Toxic Water Pollution
Agricultural Sources	Fed Up It's Sedimentary, My Dear Watson Breathtaking Slip Slidin' Away Wasted Waters The Grass is Always Cleaner Eee-Aye-E.I.S.	Water Pollution Land Use and Water Quality Best Management Practices

TOPICS	ACTIVITIES	FACTSHEETS
Urban Sources	Fed Up It's Sedimentary, My Dear Watson Breathtaking Wasted Waters All Messed Up and No Place To Go R.I.P. Rain Lethal Lots Home Is Where The Hazard Is The Grass Is Always Cleaner	Water Pollution Land Use and Water Quality Best Management Practices Individual Actions
Mining Sources	It's Sedimentary, My Dear Watson Slip Slidin' Away Mined Over Water The Grass Is Always Cleaner	Water Pollution Land Use and Water Quality Best Management Practices
Forestry Sources	It's Sedimentary, My Dear Watson Slip Slidin' Away The Grass is Always Cleaner	Water Pollution Land Use and Water Quality Best Management Practices
Industrial Sources	Lingo Bingo Pollution P.I. R.I.P. Rain	Water Pollution Land Use and Water Quality Best Management Practices
Best Management Practices	Watershed Woes Slip Slidin' Away Mined Over Water R.I.P. Rain Home Is Where the Hazard Is The Grass is Always Cleaner Eee-Aye-E.I.S.	Land Use and Water Quality Best Management Practices Individual Actions