

# Purpose

The purpose of this Curriculum Guide is to provide resources that can enhance the learning experience of participants in the Volunteer Stream Monitoring Partnership (VSMP). This packet will provide teachers and citizen group leaders with ideas for lessons to use before or after they go out and monitor a local stream. Pre-monitoring lessons can provide knowledge on fundamental topics such as watershed dynamics, stream ecology, and the impact of land use on water quality. Post-monitoring lessons can help participants explore how to interpret and use their data by introducing topics such as environmental problem solving, community action, and analysis of stream data. Rather than just treating stream monitoring as an interesting field trip, VSMP group leaders can use this Curriculum Guide to improve participants' understanding of the complex factors involved in maintaining healthy waterways and increase their involvement in responsible water resource management.

## Creation of the Curriculum Guide

In order to find curricula appropriate for Minnesota stream monitoring groups, an extensive nationwide search was conducted that involved exploring water curriculum collections, contacting professional water educators, and searching web sites. This Curriculum Guide focuses primarily on curricula for secondary students because that is currently the most common age group of VSMP participants. However, three of the ten curricula in this guide were written for elementary through high school students, so elementary teachers will also find useful material in this packet. In the future hopefully a second VSMP guide will be created focusing on elementary curricula. The curricula in this guide were selected because they are relevant to Minnesota streams, were published recently, are available without attending a workshop, and include a range of educational goals and settings. In addition, many were recommended by multiple water resource professionals. For a list of the ten curricula in this guide, see page 3.

The quality of the ten curricula was evaluated using a reviewing tool created by the North American Association for Environmental Education (NAAEE). This tool, Environmental Education Materials: Guidelines for Excellence (NAAEE, 2000), was chosen because it is the most comprehensive and well-researched guide for reviewers of environmental education curricula currently available. The twenty-eight Guidelines outlined in this publication represent ideal characteristics of high quality environmental education materials (see description of the Guidelines on pages 4-5). Each of the ten curricula in this guide was rated on a 1-5 scale for each of these 28 Guidelines. The results are shared in a 2-page synopsis of each curriculum (see pages 6-25). Although users of the Guidelines for Excellence do not traditionally use a numerical rating scale, this study utilized a 1-5 scale in order to decrease the subjectivity of the review and to give VSMP teachers more detailed information about each curriculum.

### Reference:

North American Association for Environmental Education (2000). Environmental Education Materials: Guidelines for Excellence. Part of the series called the National Project for Excellence in Environmental Education. NAAEE, Washington, D.C.

# How to Use the Curriculum Guide

## Contents:

- List of the Ten Curricula in the VSMP Curriculum Guide ..... page 3
- Description of the 28 Guidelines for Excellence ..... pages 4-5
- Curriculum Reviews (two-page synopsis for each)..... pages 6-25
- Topical Chart of Recommended Lessons ..... pages 26-33

### *Reading the 2-page synopsis for each curriculum*

The synopses were designed to be detailed enough to give you useful information in making curricula choices without being overwhelming. Each synopsis includes the following sections:

- The basics: curriculum title, source, date published, grade level, and number of pages
- A summary paragraph describing the curriculum
- A bulleted list of strengths and weaknesses
- A description of the 1-5 rating scale
- A bar graph that depicts the detailed ratings for each of the 28 Guidelines
- A legend showing what each Guideline (each bar on the graph) represents

### *Searching for lessons on a specific topic related to stream monitoring*

When looking for lessons on a specific topic, such as the link between land use and water quality, start by reading the “Summary” section of each synopsis or consulting the Topical Chart of Recommended Lessons (pages 26-33). Once you choose several curricula that cover the topic, compare the quality of these curricula using the bar graphs to further narrow down your choice.

### *Searching for an entire curriculum*

Start by reading the first page of each synopsis, which gives an overview of each curriculum. Once you choose several curricula that seem appropriate for your class or group, compare their quality by consulting the bar graphs for each one (found on the second page of each synopsis).

### *Searching for instructional materials that focus on specific educational goals*

After refining your own teaching objectives, consult the description of the Guidelines for Excellence (pages 4-5) and note which of the 28 guidelines are most important to you. Then search through the 10 bar graphs to pick curricula that receive high ratings on those guidelines.

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**\*This is a two-page summary of a 100-page master’s thesis. If you are interested in more details about the methods/results/conclusions of this curriculum review and would like a copy of the master’s thesis, contact VSMP Outreach Coordinator Kevin Proescholdt at 612-624-7460 or kevinp@umn.edu.**

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## The Ten Curricula in the VSMP Curriculum Guide

	Title	Source	Date	Grade	# Pages
1	AAW: Water Quality High School Unit	Adopt-A-Watershed, P.O. Box 1850, Hayfork, CA 96041, #530-628-5334, <a href="http://adopt-a-watershed.org">http://adopt-a-watershed.org</a>	1995	10-12	140
2	The GLOBE Program, Hydrology Unit (online)	GLOBE Program, 1315 East-West Hwy. Rm#10600, Silver Spring, MD 20910-3282, or email: <a href="mailto:info@globe.gov">info@globe.gov</a> , MN contact is Dr. Tony P. Murphy at Hamline University: (651) 523-2945, <a href="http://www.globe.gov">http://www.globe.gov</a>	1995*	K-12	125**
3	Investigating Streams and Rivers	GREEN Program, Earth Force, Inc., 1908 Mount Vernon Avenue, 2 <sup>nd</sup> Floor, Alexandria, VA 22301, #703-299-9400, <a href="http://www.green.org">http://www.green.org</a>	1996	6-12	97
4	Rivers Curriculum Guide: Biology	The Rivers Project, Southern Illinois University, Box 2222, Alumni Hall, Edwardsville, IL 62026-2222, #618-650-3788, <a href="http://www.siu.edu/OSME/river">http://www.siu.edu/OSME/river</a>	1998	7-12	242
5	Rivers Curriculum Guide: Chemistry	The Rivers Project, Southern Illinois University, Box 2222, Alumni Hall, Edwardsville, IL 62026-2222, #618-650-3788, <a href="http://www.siu.edu/OSME/river">http://www.siu.edu/OSME/river</a>	1997	7-12	238
6	Rivers of Life (online)	Center for Global Environmental Education, Hamline University Graduate School of Education, 1536 Hewitt Ave., St. Paul, MN 55104-1284, #651-523-2480, <a href="http://cgee.hamline.edu/rivers">http://cgee.hamline.edu/rivers</a>	1997*	3-12	122**
7	Save Our Streams Teacher's Manual	Izaak Walton League of America, 707 Conservation Lane, Gaithersburg, MD, 20878-2983, #800-BUG-IWLA, <a href="http://www.iwla.org/SOS/index.html">http://www.iwla.org/SOS/index.html</a>	1995	1-12	216
8	Water, Water, Everywhere	HACH Company, PO Box 389, Loveland, CO 80539-0389, #800-227-4224, <a href="http://www.hach.com">http://www.hach.com</a>	1991	7-12	144
9	The Water Sourcebook	Water Environment Federation, 601 Wythe St. Alexandria, VA, 22314-1994, #800-666-0206, <a href="http://www.wef.org">http://www.wef.org</a>	1997	9-12	885
10	Watershed Science for Educators	Cornell University/Media & Technology Services Resource Center, 7 Cornell Business & Technology Park, Ithaca, NY 14850 or <a href="mailto:Dist_Center@cce.cornell.edu">Dist_Center@cce.cornell.edu</a> # 607-255-2080, <a href="http://www.cce.cornell.edu/publications/catalog.html">http://www.cce.cornell.edu/publications/catalog.html</a>	1999	7-12	213

\*Publication dates given for online curricula represent the year the core activities were written. However, please note that they are regularly updated online.

\*\*Number of pages for online curricula is approximate and will vary according to monitor size and printer format.

## **Guidelines for Excellence (NAAEE, 2000)**

The 28 Guidelines (1.1, 1.2, etc.) are grouped into 6 Key Characteristics:

**#1 Fairness and accuracy:** Environmental education materials should be fair and accurate in describing environmental problems, issues, and conditions, and in reflecting the diversity of perspectives on them.

- 1.1 Factual accuracy:** Environmental education materials should reflect sound theories and well-documented facts about subjects and issues.
- 1.2 Balanced presentation of differing viewpoints and theories:** Where there are differences of opinion or competing scientific explanations, the range of perspectives should be presented in a balanced way.
- 1.3 Openness to inquiry:** Materials should encourage learners to explore different perspectives and form their own opinions.
- 1.4 Reflection of diversity:** Different culture, races, genders, social groups, ages, etc., are included with respect and equity.

**#2 Depth:** EE materials should foster awareness of the natural and built environment, an understanding of environmental concepts, conditions, and issues, and an awareness of the feelings, values, attitudes, and perceptions at the heart of environmental issues, as appropriate for different developmental levels.

- 2.1 Awareness:** Materials should acknowledge that feelings, experiences, and attitudes shape environmental perceptions and issues.
- 2.2 Focus on concepts:** Rather than presenting a series of facts, materials should use unifying themes and important concepts.
- 2.3 Concepts in context:** Environmental concepts should be set in a context that includes social and economic as well as ecological aspects.
- 2.4 Attention to different scales:** Environmental issues should be explored using a variety of scales as appropriate, such as short to long time spans, localized to global effects, and local to international community levels.

**#3 Emphasis on skills:** EE materials should build lifelong skills that enable learners to address environmental issues.

- 3.1 Critical and creative thinking:** Learners should be challenged to use and improve their critical thinking and creative skills.
- 3.2 Applying skills to issues:** Students should learn to arrive at their own conclusions about what needs to be done based on thorough research and study, rather than being taught that a certain course of action is best.
- 3.3 Action skills:** Learners should gain basic skills needed to participate in resolving environmental issues.

**#4 Action orientation:** EE materials should promote civic responsibility, encouraging learners to use their knowledge, personal skills, and assessments of environmental issues as a basis for environmental problem solving and action.

- 4.1 Sense of personal stake and responsibility:** Materials should encourage learners to examine the possible consequences of their behaviors on the environment and evaluate choices they can make which may help resolve environmental issues.
- 4.2 Self-efficacy:** Materials should aim to strengthen learners' perception of their ability to influence the outcome of a situation.

**#5 Instructional soundness:** EE materials should rely on instructional techniques that create an effective learning environment.

- 5.1 Learner-centered instruction:** When appropriate, learning should be based on learner interest and on the learner's ability to construct knowledge to gain conceptual understanding.
- 5.2 Different ways of learning:** Materials should offer opportunities for different modes of teaching and learning.
- 5.3 Connection to learners' everyday lives:** Materials should present information and ideas in a way that is relevant to learners.
- 5.4 Expanded learning environment:** Students should learn in environments that extend beyond the boundaries of the classroom.
- 5.5 Interdisciplinary:** The materials should recognize the interdisciplinary nature of environmental education.
- 5.6 Goals and objectives:** Goals and objectives for the materials should be clearly spelled out.
- 5.7 Appropriateness for specific learning settings:** Claims about the material's appropriateness for the targeted grade level(s) and the implementation of the activity should be consistent with the experience of educators.
- 5.8 Assessment:** A variety of means for assessing learner progress should be included in the materials.

**#6 Usability:** EE materials should be well designed and easy to use.

- 6.1 Clarity and logic:** The overall structure (purpose, direction, and logic of presentation) should be clear to educators and learners.
- 6.2 Easy to use:** Materials should be inviting and easy to use.
- 6.3 Long-lived:** Materials should have a life span that extends beyond one use.
- 6.4 Adaptable:** Materials should be adaptable to a range of learning situations.
- 6.5 Accompanied by instruction and support:** Additional support and instruction should be provided to meet educators' needs.
- 6.6 Make substantiated claims:** Materials should accomplish what they claim to accomplish.
- 6.7 Fit with national, state, or local requirements:** Environmental education materials should fit within national, state, or local standards or curricula.

# **ADOPT-A-WATERSHED: WATER QUALITY HIGH SCHOOL UNIT**

**Source:** Adopt-A-Watershed, P.O. Box 1850, Hayfork, CA 96041

**Phone:** 530-628-5334

**Web site:** <http://adopt-a-watershed.org>

**Date Published:** 1995

**Grade level:** 10-12

**Length:** 140 pages

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## **Summary**

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This unit is part of an integrated K-12 science curriculum that focuses on in-depth exploration of a local watershed. The teacher is a facilitator rather than a direct teacher in this heavily student-directed unit. The Rivers Curriculum Guides (see other synopses) are used as a core text where students learn and teach each other lessons from these guides. (The Rivers Curriculum Guides must be purchased separately). This activity is just one part of a sequential framework of lessons in the Water Quality Unit that focus on taking action: students formulate questions about their watershed on a field trip, explore those questions using the Rivers Curriculum Guides, learn about the complexity of water quality issues in a role play activity, collect water quality data, share results in a Water Quality Symposium and Watershed Fair, carry out a water quality improvement project, and evaluate their work. There is an emphasis on involving local water professionals throughout the curriculum. Students can enter their results into the web site database. Teacher training workshops are available, but typically take place in California.

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## **Strengths**

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- Out of all ten curricula reviewed in this study, this curriculum received the highest overall ratings.
- Uses fair, well-balanced language that discusses both sides of water quality issues.
- Emphasizes using cooperative learning skills and creating an atmosphere of respect and collaboration.
- Encourages students to remove bias from their writings and presentations by clearly distinguishing between facts and opinions.
- Authentic assessment activities included.

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## **Weaknesses**

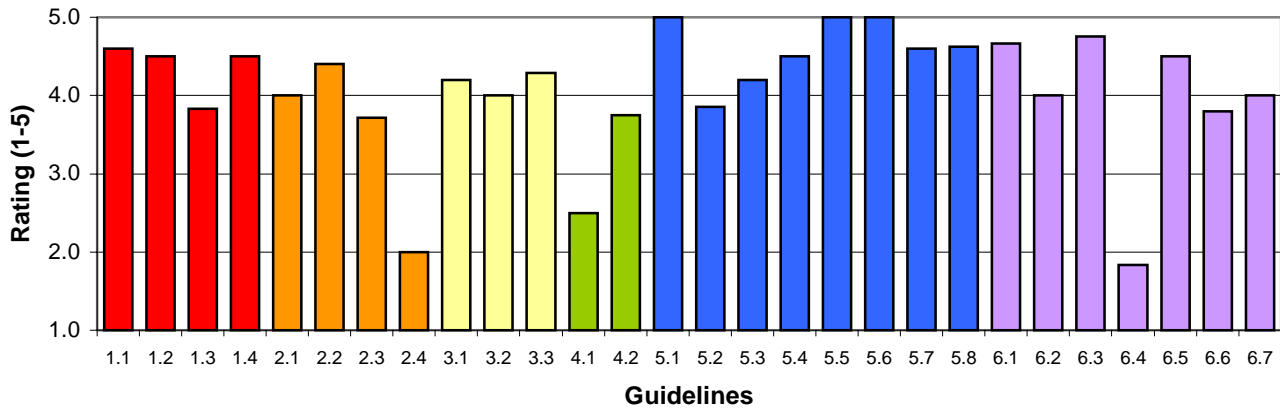
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- Teachers unfamiliar with topographic maps may need additional background information to delineate watershed boundaries.

## Ratings for Adopt-a-Watershed: Water Quality High School Unit

The curriculum was rated according to the Guidelines for Excellence (NAAEE, 2000) using the following 1-5 scale. For an explanation of what each Guideline (each bar) in the graph represents, see description below the graph. The Guidelines are grouped by color into six Key Characteristics (see Legend box). Average ratings for each Key Characteristic are provided in the Legend.

1= The curriculum addressed this guideline 0% of the time.  
 2= The curriculum addressed this guideline approximately 25% of the time.  
 3= The curriculum addressed this guideline approximately 50% of the time.  
 4= The curriculum addressed this guideline approximately 75% of the time.  
 5= The curriculum addressed this guideline 100% of the time.



<span style="color: red;">■</span> <b>Fairness and Accuracy: Average = 4.4</b>	<span style="color: orange;">■</span> <b>Depth: Average = 3.5</b>
<span style="color: yellow;">■</span> <b>Emphasis on Skills Building: Average = 4.2</b>	<span style="color: green;">■</span> <b>Action Orientation: Average = 3.1</b>
<span style="color: blue;">■</span> <b>Instructional Soundness: Average = 4.6</b>	<span style="color: purple;">■</span> <b>Usability: Average = 3.9</b>

### The Guidelines for Excellence (see pages 4-5 for details)

#### #1 Fairness and accuracy

- 1.1 Factual accuracy
- 1.2 Balanced presentation of differing viewpoints and theories
- 1.3 Openness to inquiry
- 1.4 Reflection of diversity

#### #2 Depth

- 2.1 Awareness
- 2.2 Focus on concepts
- 2.3 Concepts in context
- 2.4 Attention to different scales

#### #3 Emphasis on skills

- 3.1 Critical and creative thinking
- 3.2 Applying skills to issues
- 3.3 Action skills

#### #4 Action orientation

- 4.1 Sense of personal stake & responsibility
- 4.2 Self-efficacy

#### #5 Instructional soundness

- 5.1 Learner-centered instruction
- 5.2 Different ways of learning
- 5.3 Connection to learners' everyday lives
- 5.4 Expanded learning environment
- 5.5 Interdisciplinary
- 5.6 Goals and objectives
- 5.7 Appropriateness for specific settings
- 5.8 Assessment

#### #6 Usability

- 6.1 Clarity and logic
- 6.2 Easy to use
- 6.3 Long-lived
- 6.4 Adaptable
- 6.5 Accompanied by instruction and support
- 6.6 Make substantiated claims
- 6.7 Fit with national, state, or local requirements

# THE GLOBE PROGRAM: HYDROLOGY UNIT

**Source:** GLOBE Program, 1315 East-West Hwy. Rm. #10600, Silver Spring, MD 20910-3282

**MN contact:** Dr. Tony P. Murphy, Hamline University

**Phone:** 651-523-2945; **E-mail:** info@globe.gov

**Web site:** <http://www.globe.gov>

**Date Published:** 1995

**Grade level:** K-12

**Length:** approx. 125 pgs.

## Summary

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The GLOBE Program is a worldwide network of teachers, students, and scientists who work together to conduct research in order to better understand the Earth's environment. This online curriculum is split into four areas: hydrology, atmosphere, soil, and land cover/biology. Instructional materials include monitoring protocol guidelines as well as learning activities to enhance the monitoring experience. For this review, I only examined the learning activities of the hydrology unit. This unit focuses on physical and chemical parameters (transparency, temperature, dissolved oxygen, pH, conductivity, salinity, alkalinity, and nitrates), although there is one activity that involves collecting macroinvertebrates and calculating a diversity index. Learning activities also include: exploring and mapping a stream, modeling the local watershed, demonstrating why instruments are needed to measure water quality, playing a pH game, interpreting data, and modeling annual water balance. Attendance at a teacher training workshop or training by a GLOBE mentor is required before submitting data. Schools submit data via the GLOBE web site, and receive feedback from scientists. The lead scientists are available to answer questions, and they work to compile and use the data. A major goal is to collect quality data, and students learn how to judge the validity of their results. There is a Minnesota contact person (listed at top of page) for support, as well as an annual worldwide GLOBE conference.

## Strengths

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- Emphasis on global understanding and collaboration.
- Balanced language, presenting both sides of issues.
- Well-developed web site with an extensive "Resource Room," tools to help analyze data, and worldwide examples of student projects that have made a difference.
- Lesson 6 provides a thorough introduction to data analysis, including seasonal trends and outliers.
- Suggests multiple ways to involve parents and volunteers.
- Letters from Scientists in the "Implementation Guide" motivate students to do quality work, by sharing with students why their data is important and how it will be used.

## Weaknesses

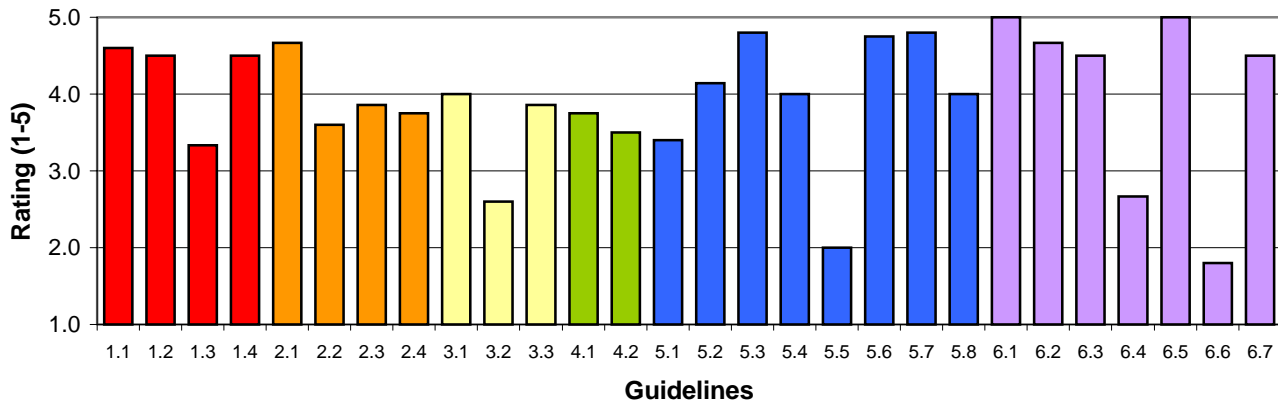
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- Data is accepted on the web site for chemical and physical parameters, but not for macroinvertebrate data.
- Provides few details on how to implement local action projects, although it is encouraged.
- Little coverage of social science topics.

## Ratings for The GLOBE Program

The curriculum was rated according to the Guidelines for Excellence (NAAEE, 2000) using the following 1-5 scale. For an explanation of what each Guideline (each bar) in the graph represents, see description below the graph. The Guidelines are grouped by color into six Key Characteristics (see Legend box). Average ratings for each Key Characteristic are provided in the Legend.

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|--|---|
| <b>■ Fairness and Accuracy: Average= 4.2</b>       | <b>■ Depth: Average= 4.0</b>              |
| <b>■ Emphasis on Skills Building: Average= 3.5</b> | <b>■ Action Orientation: Average= 3.6</b> |
| <b>■ Instructional Soundness: Average= 4.0</b>     | <b>■ Usability: Average= 4.0</b>          |

### The Guidelines for Excellence (see pages 4-5 for details)

#### #1 Fairness and accuracy

- 1.1 Factual accuracy
- 1.2 Balanced presentation of differing viewpoints and theories
- 1.3 Openness to inquiry
- 1.4 Reflection of diversity

#### #2 Depth

- 2.1 Awareness
- 2.2 Focus on concepts
- 2.3 Concepts in context
- 2.4 Attention to different scales

#### #3 Emphasis on skills

- 3.1 Critical and creative thinking
- 3.2 Applying skills to issues
- 3.3 Action skills

#### #4 Action orientation

- 4.1 Sense of personal stake & responsibility
- 4.2 Self-efficacy

#### #5 Instructional soundness

- 5.1 Learner-centered instruction
- 5.2 Different ways of learning
- 5.3 Connection to learners' everyday lives
- 5.4 Expanded learning environment
- 5.5 Interdisciplinary
- 5.6 Goals and objectives
- 5.7 Appropriateness for specific settings
- 5.8 Assessment

#### #6 Usability

- 6.1 Clarity and logic
- 6.2 Easy to use
- 6.3 Long-lived
- 6.4 Adaptable
- 6.5 Accompanied by instruction and support
- 6.6 Make substantiated claims
- 6.7 Fit with national, state, or local requirements

## **INVESTIGATING STREAMS AND RIVERS:**

**An Interdisciplinary Curriculum Guide for Use with Mitchell and Stapp's Field Manual for Water Quality Monitoring**

**Source:** GREEN Program, Earth Force, Inc., 1908 Mt. Vernon Ave., 2<sup>nd</sup> Floor, Alexandria, VA 22301

**Phone:** 703-299-9400

**Web site:** <http://www.green.org>

**Date Published:** 1996

**Grade level:** 6-12

**Length:** 97 pages

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### **Summary**

This curriculum promotes student inquiry and action about local streams. It was designed for use with W.B. Stapps' Field Manual for Water Quality Monitoring, or another similar guide to monitoring protocols, as part of the Global Rivers Environmental Education Network (GREEN). Students thoroughly explore their local stream using mapping, site visits, and oral history, as well as monitoring of physical, chemical, and biological parameters. The curriculum culminates in a student-directed community action project. Computer networking with other groups doing water quality testing in your watershed is strongly emphasized. Students can enter their results into the RiverBank database on GREEN's web site.

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### **Strengths**

- Emphasis on collaboration with other groups in the local watershed to build a “community of learners” and promote cross-cultural understanding.
- Comprehensive guidelines are provided for carrying out the community action project including: identifying problems, visualizing the future, selecting a project, contacting stakeholders, developing an action plan, taking action, and evaluating the project.
- Specific ideas for computer networking are provided for all twelve lessons.
- Web site offers additional activities, resources, graphing tools for student data, and the ability to create a special page for your school's project.

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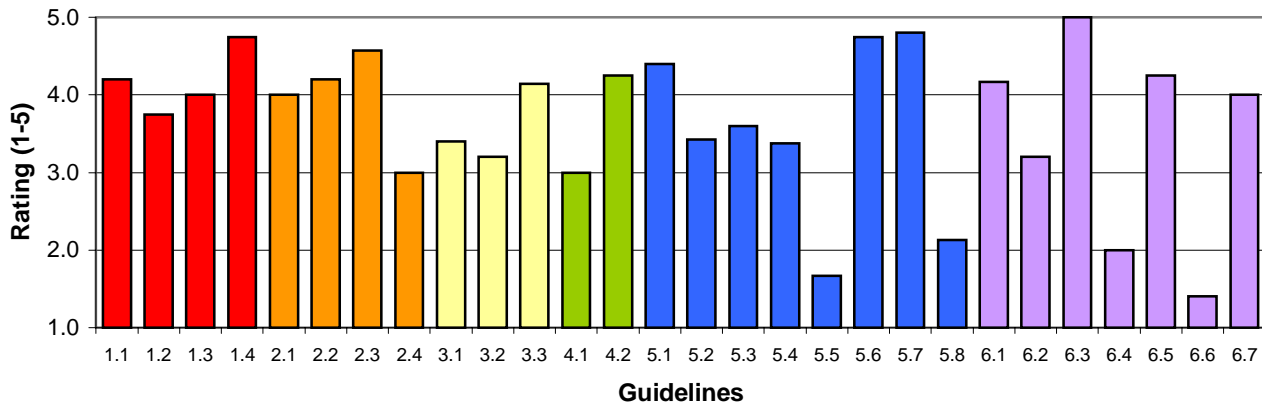
### **Weaknesses**

- Curriculum promotes the negative perspective that all rivers have problems, and none are healthy.
- Encourages students to critically evaluate information from diverse sources, but provides no specific guidelines to help students with this task.
- No assessment activities included except the final group evaluation of the action project.

## Ratings for Investigating Streams and Rivers

The curriculum was rated according to the Guidelines for Excellence (NAAEE, 2000) using the following 1-5 scale. For an explanation of what each Guideline (each bar) in the graph represents, see description below the graph. The Guidelines are grouped by color into six Key Characteristics (see Legend box). Average ratings for each Key Characteristic are provided in the Legend.

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<p><span style="color: red;">■</span> <b>Fairness and Accuracy: Average= 4.2</b></p> <p><span style="color: yellow;">■</span> <b>Emphasis on Skills Building: Average= 3.6</b></p> <p><span style="color: blue;">■</span> <b>Instructional Soundness: Average= 3.5</b></p>	<p><span style="color: orange;">■</span> <b>Depth: Average= 3.9</b></p> <p><span style="color: green;">■</span> <b>Action Orientation: Average= 3.6</b></p> <p><span style="color: purple;">■</span> <b>Usability: Average= 3.4</b></p>
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### The Guidelines for Excellence (see pages 4-5 for details)

#### #1 Fairness and accuracy

- 1.1 Factual accuracy
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- 1.3 Openness to inquiry
- 1.4 Reflection of diversity

#### #2 Depth

- 2.1 Awareness
- 2.2 Focus on concepts
- 2.3 Concepts in context
- 2.4 Attention to different scales

#### #3 Emphasis on skills

- 3.1 Critical and creative thinking
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- 3.3 Action skills

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- 5.1 Learner-centered instruction
- 5.2 Different ways of learning
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- 5.5 Interdisciplinary
- 5.6 Goals and objectives
- 5.7 Appropriateness for specific settings
- 5.8 Assessment

#### #6 Usability

- 6.1 Clarity and logic
- 6.2 Easy to use
- 6.3 Long-lived
- 6.4 Adaptable
- 6.5 Accompanied by instruction and support
- 6.6 Make substantiated claims
- 6.7 Fit with national, state, or local requirements

## RIVERS CURRICULUM GUIDE: BIOLOGY

**Source:** The Rivers Project, Southern Illinois University, Box 2222, Alumni Hall, Edwardsville, IL 62026-2222

**Phone:** 618-650-3788

**Web site:** <http://www.siu.edu/OSME/river>

**Date Published:** 1998

**Grade level:** 7-12

**Length:** 242 pgs.

### Summary

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This middle and high school curriculum is part of a six-volume series focusing on rivers. Other units include: chemistry, geography, earth science, language arts, and math. Each volume was designed to supplement current school programs, and can be used alone or together with other volumes. Summer teacher training sessions are available. Goals of this series are to increase understanding of river-related issues and concepts, attain skills to properly investigate and report river data, and inspire action. The Biology unit encourages partnering with an expert from a local agency as the class explores stream ecology, water quality indices, macroinvertebrates, dissolved oxygen, and fecal coliform. It culminates in a mock or real environmental impact assessment on a local river issue. This unit emphasizes hands-on labs and field trips, but also includes readings, class discussions, and journal writing activities.

### Strengths

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- Excellent “Extending the Lesson” activities.
- Emphasis on critical and higher level thinking.
- Good coverage on biological indices.
- Includes authentic assessment activities.

### Weaknesses

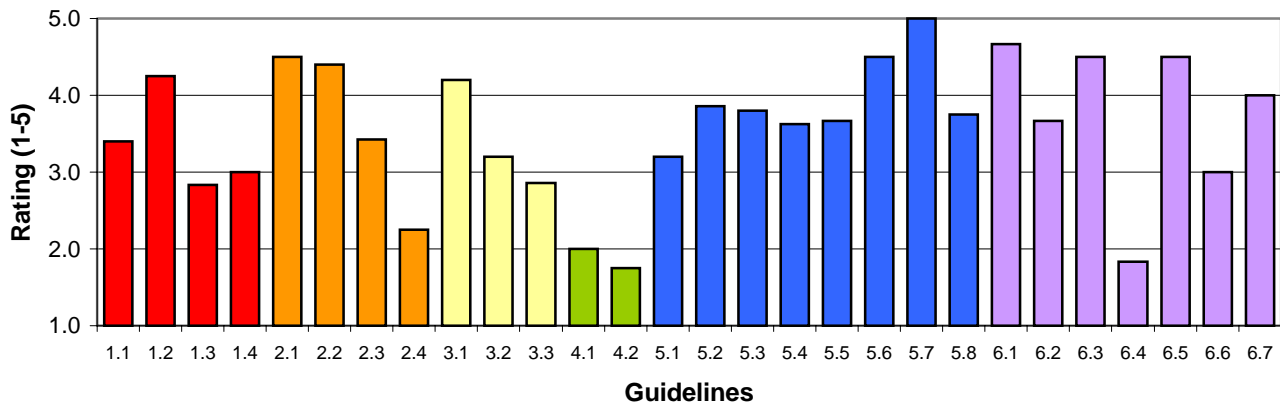
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- Unit is not strong on developing action skills.
- Although the majority of the language used is balanced, there is sometimes a focus on the negative side. For example, there is an assumption that all stream sites have problems. It is never suggested that there may be high quality sites that simply need to be preserved. In addition, eutrophication is referred to as a process that “causes the death of that body of river, stream, lake, or pond (p.129).”

## Ratings for Rivers Curriculum Guide: Biology

The curriculum was rated according to the Guidelines for Excellence (NAAEE, 2000) using the following 1-5 scale. For an explanation of what each Guideline (each bar) in the graph represents, see description below the graph. The Guidelines are grouped by color into six Key Characteristics (see Legend box). Average ratings for each Key Characteristic are provided in the Legend.

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<b>Fairness and Accuracy: Average= 3.4</b>	<b>Depth: Average= 3.6</b>
<b>Emphasis on Skills Building: Average= 3.4</b>	<b>Action Orientation: Average= 1.9</b>
<b>Instructional Soundness: Average= 3.9</b>	<b>Usability: Average= 3.7</b>

### The Guidelines for Excellence (see pages 4-5 for details)

#### #1 Fairness and accuracy

- 1.1 Factual accuracy
- 1.2 Balanced presentation of differing viewpoints and theories
- 1.3 Openness to inquiry
- 1.4 Reflection of diversity

#### #2 Depth

- 2.1 Awareness
- 2.2 Focus on concepts
- 2.3 Concepts in context
- 2.4 Attention to different scales

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- 3.2 Applying skills to issues
- 3.3 Action skills

#### #4 Action orientation

- 4.1 Sense of personal stake & responsibility
- 4.2 Self-efficacy

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- 5.1 Learner-centered instruction
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- 5.3 Connection to learners' everyday lives
- 5.4 Expanded learning environment
- 5.5 Interdisciplinary
- 5.6 Goals and objectives
- 5.7 Appropriateness for specific settings
- 5.8 Assessment

#### #6 Usability

- 6.1 Clarity and logic
- 6.2 Easy to use
- 6.3 Long-lived
- 6.4 Adaptable
- 6.5 Accompanied by instruction and support
- 6.6 Make substantiated claims
- 6.7 Fit with national, state, or local requirements

## RIVERS CURRICULUM GUIDE: CHEMISTRY

**Source:** The Rivers Project, Southern Illinois University, Box 2222, Alumni Hall, Edwardsville, IL, 62026-2222

**Phone:** 618-650-3788

**Web site:** <http://www.siu.edu/OSME/river>

**Date Published:** 1997

**Grade level:** 7-12

**Length:** 238 pages

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### Summary

This middle and high school curriculum is part of a six-volume series focusing on rivers. Other units include: biology, geography, earth science, language arts, and math. Each volume was designed to supplement current school programs, and can be used alone or together with other volumes. Summer teacher training sessions are available. Goals of this series are to increase understanding of river-related issues and concepts, attain skills to properly investigate and report river data, and inspire action. The Chemistry unit encourages partnering with an expert from a local agency as the class explores pH, temperature, flow, turbidity, total solids, dissolved oxygen, biochemical oxygen demand, phosphates, nitrates, and fecal coliform in a nearby river. Materials emphasize hands-on labs and field trips, but also include readings, class discussions, and journal writing activities.

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### Strengths

- Excellent “Extending the Lesson” activities.
- Emphasis on critical and higher level thinking.
- Many low-cost alternatives to equipment.
- Includes authentic assessment activities.
- Final lesson calculates overall water quality index, which ties together all previous lessons.

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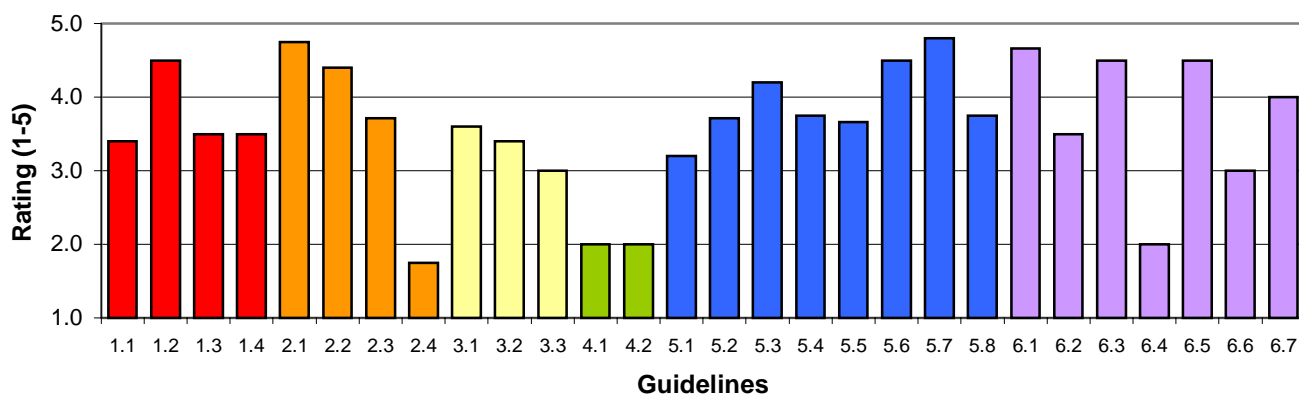
### Weaknesses

- Although the curriculum teaches students how to collect lots of high quality data, it does not emphasize applying what they have learned in a comprehensive action project or sharing their results directly with the community (Students may choose to post data on the Rivers Project web site, but the local community may not access it there).
- Weak on student-directed learning.

## Ratings for Rivers Curriculum Guide: Chemistry

The curriculum was rated according to the Guidelines for Excellence (NAAEE, 2000) using the following 1-5 scale. For an explanation of what each Guideline (each bar) in the graph represents, see description below the graph. The Guidelines are grouped by color into six Key Characteristics (see Legend box). Average ratings for each Key Characteristic are provided in the Legend.

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 5= The curriculum addressed this guideline 100% of the time.



<b>■ Fairness and Accuracy: Average= 3.7</b>	<b>■ Depth: Average= 3.7</b>
<b>■ Emphasis on Skills Building: Average= 3.3</b>	<b>■ Action Orientation: Average= 2.0</b>
<b>■ Instructional Soundness: Average= 3.9</b>	<b>■ Usability: Average= 3.7</b>

### The Guidelines for Excellence (see pages 4-5 for details)

#### #1 Fairness and accuracy

- 1.1 Factual accuracy
- 1.2 Balanced presentation of differing viewpoints and theories
- 1.3 Openness to inquiry
- 1.4 Reflection of diversity

#### #2 Depth

- 2.1 Awareness
- 2.2 Focus on concepts
- 2.3 Concepts in context
- 2.4 Attention to different scales

#### #3 Emphasis on skills

- 3.1 Critical and creative thinking
- 3.2 Applying skills to issues
- 3.3 Action skills

#### #4 Action orientation

- 4.1 Sense of personal stake & responsibility
- 4.2 Self-efficacy

#### #5 Instructional soundness

- 5.1 Learner-centered instruction
- 5.2 Different ways of learning
- 5.3 Connection to learners' everyday lives
- 5.4 Expanded learning environment
- 5.5 Interdisciplinary
- 5.6 Goals and objectives
- 5.7 Appropriateness for specific settings
- 5.8 Assessment

#### #6 Usability

- 6.1 Clarity and logic
- 6.2 Easy to use
- 6.3 Long-lived
- 6.4 Adaptable
- 6.5 Accompanied by instruction and support
- 6.6 Make substantiated claims
- 6.7 Fit with national, state, or local requirements

## RIVERS OF LIFE

**Source:** Center for Global Environmental Education, Hamline University Graduate School of Education, 1536 Hewitt Ave., St. Paul, MN 55104-1284

**Phone:** 651-523-2480

**Web site:** <http://cgee.hamline.edu/rivers>

**Date Published:** 1997

**Grade level:** 3-12

**Length:** Approx. 122 pages

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### Summary

This online experiential curriculum is designed to increase student awareness of the cultural, historical, and ecological importance of local (as well as global) rivers. It includes four inquiry-based projects that explore human relationships with rivers. The Energy Odyssey explores energy use in the local watershed, and students conduct home energy audits and write contracts to save energy. The Steamer Trunk project uses artifacts to document the local watershed in a “culture box” without naming it. This box is exchanged with another school, which tries to identify the mystery watershed. Rivers Through Time examines the past and current view of a local river through the lenses of anthropology, archaeology, and history. Students conduct a river clean-up and create sculptures of some collected items. Chasing the Flood involves students in monitoring local precipitation and runoff as well as researching runoff of global rivers to learn about floods, erosion, wetlands and related topics. The web site provides profiles of world rivers, watershed maps, assessment tools, technical assistance, and a conference center for networking opportunities. A highlight of the curriculum is that each year, about 10 high school students are chosen for a week-long expedition to explore a section of the Mississippi. Live dialogues via the internet link these students to all participating schools during the expedition.

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### Strengths

- Balanced coverage of environmental science and social science topics.
- Thorough references.
- Emphasis on publishing student work on web site.
- Consistently shares balanced perspectives, presenting both sides of issues.
- Activity 7 in Chasing the Flood helps students learn how the topical focus of media coverage influences human perceptions of flood events.
- The curriculum is aligned with Minnesota and U.S. standards.

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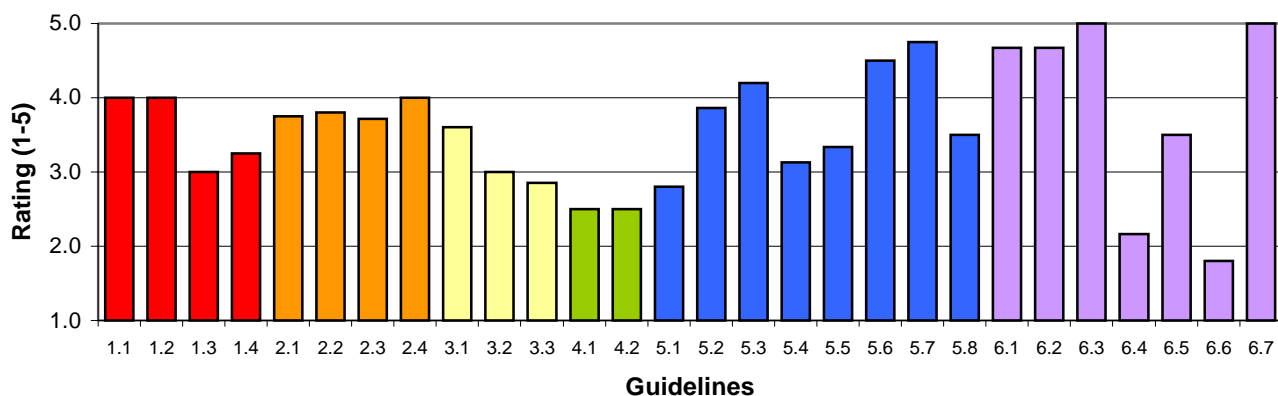
### Weaknesses

- Activities do not include typical lesson format describing learner outcomes, time needed, subjects addressed, setting, etc. Most simply note background, materials, and procedure.
- Some activities do not stand well on their own; they are linked in a sequential series in the curriculum.

## Ratings for Rivers of Life

The curriculum was rated according to the Guidelines for Excellence (NAAEE, 2000) using the following 1-5 scale. For an explanation of what each Guideline (each bar) in the graph represents, see description below the graph. The Guidelines are grouped by color into six Key Characteristics (see Legend box). Average ratings for each Key Characteristic are provided in the Legend.

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<b>■ Fairness and Accuracy: Average= 3.6</b>	<b>■ Depth: Average= 3.8</b>
<b>■ Emphasis on Skills Building: Average= 3.2</b>	<b>■ Action Orientation: Average= 2.5</b>
<b>■ Instructional Soundness: Average= 3.8</b>	<b>■ Usability: Average= 3.8</b>

### The Guidelines for Excellence (see pages 4-5 for details)

#### #1 Fairness and accuracy

- 1.1 Factual accuracy
- 1.2 Balanced presentation of differing viewpoints and theories
- 1.3 Openness to inquiry
- 1.4 Reflection of diversity

#### #2 Depth

- 2.1 Awareness
- 2.2 Focus on concepts
- 2.3 Concepts in context
- 2.4 Attention to different scales

#### #3 Emphasis on skills

- 3.1 Critical and creative thinking
- 3.2 Applying skills to issues
- 3.3 Action skills

#### #4 Action orientation

- 4.1 Sense of personal stake & responsibility
- 4.2 Self-efficacy

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- 5.6 Goals and objectives
- 5.7 Appropriateness for specific settings
- 5.8 Assessment

#### #6 Usability

- 6.1 Clarity and logic
- 6.2 Easy to use
- 6.3 Long-lived
- 6.4 Adaptable
- 6.5 Accompanied by instruction and support
- 6.6 Make substantiated claims
- 6.7 Fit with national, state, or local requirements

# THE SAVE OUR STREAMS TEACHER'S MANUAL

**Source:** Izaak Walton League of America, 707 Conservation Ln., Gaithersburg, MD, 20878-2983

**Phone:** 800-BUG-IWLA

**Web site:** <http://www.iwla.org/SOS/index.html>

**Date Published:** 1995

**Grade level:** 1-12

**Length:** 216 pgs.

## Summary

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This low-cost, low-technology stream monitoring curriculum for schools and youth groups was developed by the Izaak Walton League of America. It promotes the “Adopt-A-Stream” idea that encourages year-round monitoring and sharing of results to get citizens directly involved in stream protection. This curriculum focuses on biological monitoring of macroinvertebrates, but chemical parameters are also discussed briefly. It includes activities and readings that focus on exploring and learning about watersheds, measuring local stream health, and examining water quality’s link to land use. It also provides multiple action project ideas and “Urban Case Studies.” A separate 47-page “Science Project Guide for Students” is available, which is ideal for students doing independent stream monitoring projects.

## Strengths

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- Chapter 3 provides excellent coverage of the connection between land use and water quality. Ten different units address topics such as construction, agriculture, wetlands, forests, and landfills. Each provides a balanced discussion of the topic and a student worksheet of discussion questions that highlight local issues.
- Balanced language is used to present contrasting views on issues, and students are encouraged to do the same in their own writings.
- Comprehensive guide to creating a newsletter and newspaper article.
- Emphasizes interaction with community on multiple levels.
- Excellent background information, “extension activities,” resource list, and coverage of topic of interdependence.

## Weaknesses

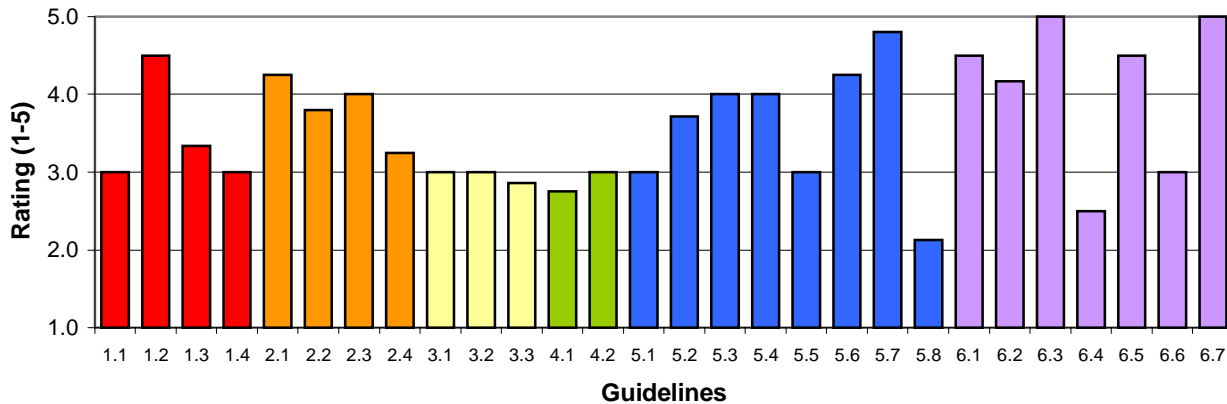
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- Not well-referenced.
- Glossary is not comprehensive.
- No discussion of student assessment, although worksheets with discussion questions are included.
- A few directions are confusing, but teachers can use the toll-free number for help (1-800-BUG-IWLA).

## Ratings for the Save Our Streams Teacher's Manual

The curriculum was rated according to the Guidelines for Excellence (NAAEE, 2000) using the following 1-5 scale. For an explanation of what each Guideline (each bar) in the graph represents, see description below the graph. The Guidelines are grouped by color into six Key Characteristics (see Legend box). Average ratings for each Key Characteristic are provided in the Legend.

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 5= The curriculum addressed this guideline 100% of the time.



<b>■ Fairness and Accuracy: Average= 3.5</b>	<b>■ Depth: Average= 3.8</b>
<b>■ Emphasis on Skills Building: Average= 3.0</b>	<b>■ Action Orientation: Average= 2.9</b>
<b>■ Instructional Soundness: Average= 3.6</b>	<b>■ Usability: Average= 4.1</b>

### The Guidelines for Excellence (see pages 4-5 for details)

#### #1 Fairness and accuracy

- 1.1 Factual accuracy
- 1.2 Balanced presentation of differing viewpoints and theories
- 1.3 Openness to inquiry
- 1.4 Reflection of diversity

#### #2 Depth

- 2.1 Awareness
- 2.2 Focus on concepts
- 2.3 Concepts in context
- 2.4 Attention to different scales

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- 3.3 Action skills

#### #4 Action orientation

- 4.1 Sense of personal stake & responsibility
- 4.2 Self-efficacy

#### #5 Instructional soundness

- 5.1 Learner-centered instruction
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- 5.3 Connection to learners' everyday lives
- 5.4 Expanded learning environment
- 5.5 Interdisciplinary
- 5.6 Goals and objectives
- 5.7 Appropriateness for specific settings
- 5.8 Assessment

#### #6 Usability

- 6.1 Clarity and logic
- 6.2 Easy to use
- 6.3 Long-lived
- 6.4 Adaptable
- 6.5 Accompanied by instruction and support
- 6.6 Make substantiated claims
- 6.7 Fit with national, state, or local requirements

## THE WATER SOURCEBOOK: Grades 9-12

**Source:** Water Environment Federation, 601 Wythe St. Alexandria, VA, 22314-1994

**Phone:** 800-666-0206

**Web site:** <http://www.wef.org>

**Date Published:** 1997

**Grade level:** 9-12

**Length:** 885 pages

### Summary

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This resource was created by two Alabama universities in cooperation with the U.S. Environmental Protection Agency, with the goal of developing student awareness, knowledge, and skills for sound water use decisions. This 800+ page document provides 77 activities divided into four subject areas: drinking water and wastewater treatment, surface water, groundwater, and wetlands/coastal. Activities were designed to blend with existing curricula in multiple subject areas. There is no sequential flow of activities; this document was designed as a “sourcebook” rather than as a comprehensive curriculum. Lessons were created for classroom use rather than outdoors, so there is heavy use of models to demonstrate water resource concepts. Lessons typically require low-cost and low-technology materials.

### Strengths

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- Broad range of topics covered including unique lessons on risk analysis, bottled water research, well-head protection, water careers, and many others.
- Addresses water issues on local, national, and global scales.
- Besides science subjects, good coverage on historical, ethical, economical, and sociopolitical issues.
- Includes over 90 pages of “fact sheets” that provide additional background information.
- Extensive resource section provides 75 pages of nationwide contact information for State Agencies, Water Pollution Control Administrators, Association of State Drinking Water Administrators, Beach Cleanups by state, and many others.

### Weaknesses

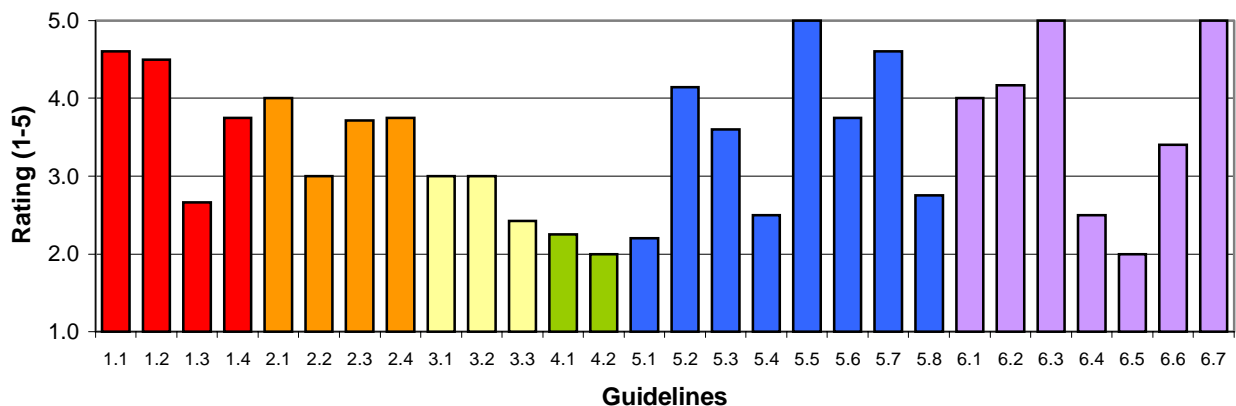
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- Teaching methods are less cutting-edge than other curricula; repeatedly directs teachers to put new vocabulary on board before students enter the classroom, does not provide much authentic assessment, includes multiple word searches/crosswords for students, etc.
- Coastal chapter has regional focus on Gulf of Mexico issues.
- Due to limited background information for each lesson, some teachers will need to do research in the resources section before implementing activities.
- Over 25% of lessons contain one minor error (such as typographical errors, unlabeled figures, or imprecise directions).
- 13% of lessons list learner objectives that are not accomplished by the activity.

## Ratings for The Water Sourcebook: Grades 9-12

The curriculum was rated according to the Guidelines for Excellence (NAAEE, 2000) using the following 1-5 scale. For an explanation of what each Guideline (each bar) in the graph represents, see description below the graph. The Guidelines are grouped by color into six Key Characteristics (see Legend box). Average ratings for each Key Characteristic are provided in the Legend.

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 5= The curriculum addressed this guideline 100% of the time.



<b>■ Fairness and Accuracy: Average= 3.9</b>	<b>■ Depth: Average= 3.6</b>
<b>■ Emphasis on Skills Building: Average= 2.8</b>	<b>■ Action Orientation: Average= 2.1</b>
<b>■ Instructional Soundness: Average= 3.6</b>	<b>■ Usability: Average= 3.7</b>

### The Guidelines for Excellence (see pages 4-5 for details)

#### #1 Fairness and accuracy

- 1.1 Factual accuracy
- 1.2 Balanced presentation of differing viewpoints and theories
- 1.3 Openness to inquiry
- 1.4 Reflection of diversity

#### #2 Depth

- 2.1 Awareness
- 2.2 Focus on concepts
- 2.3 Concepts in context
- 2.4 Attention to different scales

#### #3 Emphasis on skills

- 3.1 Critical and creative thinking
- 3.2 Applying skills to issues
- 3.3 Action skills

#### #4 Action orientation

- 4.1 Sense of personal stake & responsibility
- 4.2 Self-efficacy

#### #5 Instructional soundness

- 5.1 Learner-centered instruction
- 5.2 Different ways of learning
- 5.3 Connection to learners' everyday lives
- 5.4 Expanded learning environment
- 5.5 Interdisciplinary
- 5.6 Goals and objectives
- 5.7 Appropriateness for specific settings
- 5.8 Assessment

#### #6 Usability

- 6.1 Clarity and logic
- 6.2 Easy to use
- 6.3 Long-lived
- 6.4 Adaptable
- 6.5 Accompanied by instruction and support
- 6.6 Make substantiated claims
- 6.7 Fit with national, state, or local requirements

# WATER, WATER, EVERYWHERE

**Source:** HACH Company, PO Box 389, Loveland, CO 80539-0389

**Phone:** 800-227-4224

**Web site:** <http://www.hach.com>

**Date Published:** 1991

**Grade level:** 7-12

**Length:** 144 pages

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## Summary

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This curriculum published by the HACH water testing equipment company includes three volumes. The Student Reading Unit focuses on human-caused water pollution such as excess nutrients, thermal pollution, toxic waste and radioactive materials. The Teacher's Guide and Experiments includes nine lessons focusing on water quality tests that measure physical and chemical parameters. All experiments take place in the class lab, but the curriculum recommends a later field trip to study the same parameters in a local body of water. Several tests and a take-home exam are provided. The Water Quality Factors Reference Unit describes 23 physical and chemical water quality parameters, and gives acceptable limits of each for various uses (such as drinking or swimming). The 23 factors include: ammonia, chloride, copper, mercury, oxygen, phosphates, sulfates, lead, and others. This curriculum was designed to be an "educational exercise" rather than as a program to gather high quality data the community can use. There is no significant community action component.

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## Strengths

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- Sixty question pre-test helps assess prior knowledge of students on water topics.
- Parents/guardians are involved in assessing student presentations and grading take-home exams.
- The Water Quality Factors Reference Unit provides a wealth of information to help put numeric water quality results into perspective, including pollutants' effects on aquatic and terrestrial life and the synergistic effects of multiple pollutants.
- Toll-free number is available for technical support.

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## Weaknesses

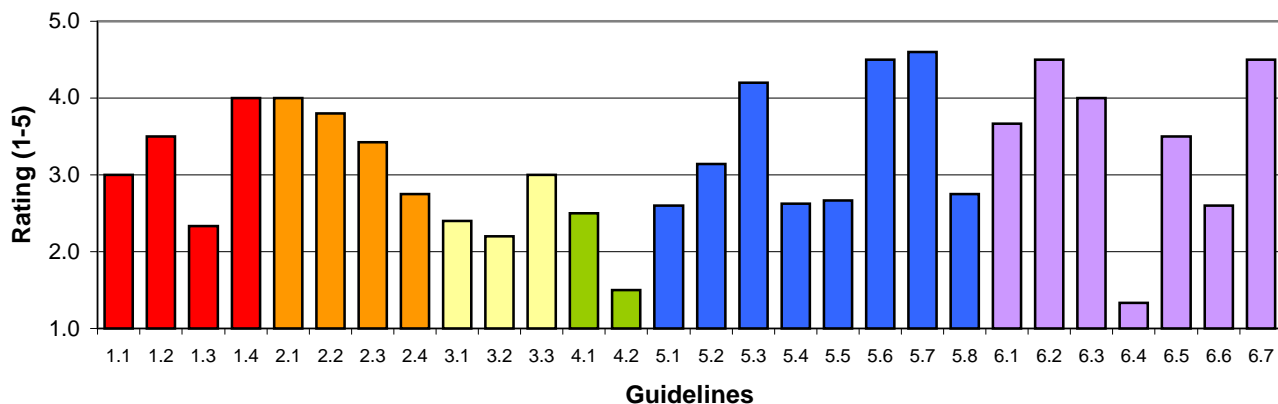
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- Out of all ten curricula reviewed in this study, this curriculum received the lowest overall ratings.
- The acceptable pollutant levels listed in the Water Quality Factors Reference Unit are from sources published in the 1960s and 1970s.
- Although the other two volumes in this series use appropriate language, the Student Reading Unit sometimes uses alarmist language such as "disturbing" and "frightening," and at times makes generalizations without supporting evidence, such as "most reclamation projects don't do a very good job."
- The Teacher's Guide and Experiments includes some typographical errors and several confusing directions. People concerned about animal rights might not like the experiment which takes goldfish "very close to their thermal death point" to observe respiratory changes.

## Ratings for Water, Water, Everywhere

The curriculum was rated according to the Guidelines for Excellence (NAAEE, 2000) using the following 1-5 scale. For an explanation of what each Guideline (each bar) in the graph represents, see description below the graph. The Guidelines are grouped by color into six Key Characteristics (see Legend box). Average ratings for each Key Characteristic are provided in the Legend.

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 5= The curriculum addressed this guideline 100% of the time.



<b>■ Fairness and Accuracy: Average= 3.2</b>	<b>■ Depth: Average= 3.5</b>
<b>■ Emphasis on Skills Building: Average= 2.5</b>	<b>■ Action Orientation: Average= 2.0</b>
<b>■ Instructional Soundness: Average= 3.4</b>	<b>■ Usability : Average=3.4</b>

### The Guidelines for Excellence (see pages 4-5 for details)

#### #1 Fairness and accuracy

- 1.1 Factual accuracy
- 1.2 Balanced presentation of differing viewpoints and theories
- 1.3 Openness to inquiry
- 1.4 Reflection of diversity

#### #2 Depth

- 2.1 Awareness
- 2.2 Focus on concepts
- 2.3 Concepts in context
- 2.4 Attention to different scales

#### #3 Emphasis on skills

- 3.1 Critical and creative thinking
- 3.2 Applying skills to issues
- 3.3 Action skills

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- 4.1 Sense of personal stake & responsibility
- 4.2 Self-efficacy

#### #5 Instructional soundness

- 5.1 Learner-centered instruction
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- 5.3 Connection to learners' everyday lives
- 5.4 Expanded learning environment
- 5.5 Interdisciplinary
- 5.6 Goals and objectives
- 5.7 Appropriateness for specific settings
- 5.8 Assessment

#### #6 Usability

- 6.1 Clarity and logic
- 6.2 Easy to use
- 6.3 Long-lived
- 6.4 Adaptable
- 6.5 Accompanied by instruction and support
- 6.6 Make substantiated claims
- 6.7 Fit with national, state, or local requirements

## WATERSHED SCIENCE FOR EDUCATORS

**Source:** Cornell University/Media & Technology Services Resource Center, 7 Cornell Business & Technology Park, Ithaca, NY 14850

**Email:** Dist\_Center@cce.cornell.edu

**Phone:** 607-255-2080

**Web site:** <http://www.cce.cornell.edu/publications/catalog.html>

**Date Published:** 1999

**Grade level:** 7-12

**Length:** 213 pages

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### Summary

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This middle and high school curriculum gets students involved in a detailed exploration of their local watershed through the use of topographic maps and aerial photos, as well as on-site monitoring of physical, chemical, and biological parameters. Students participate in designing the monitoring plan, predicting water quality after exploring land uses, gathering data, and analyzing results. Materials are appropriate for exploring both lakes and streams, but streams get more emphasis. Goals of this curriculum are to increase science knowledge as well as to improve observation and research skills. (For even more in-depth activities that use aerial photos and topographic maps to explore land use, the environment, and community history, see [Explorations from an Aerial Perspective](#) also published by Cornell University).

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### Strengths

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- Excellent units on topographic maps, aerial photos, and physical monitoring.
- Includes 10 fold-out copies of real aerial photos for small group analysis. Examination of local aerial photos clearly emphasizes the link between land use and water quality.
- Excellent wrap-up section. It includes details on what kinds of graphs and charts are best for which data, hints for trouble-shooting contradictory results, and advice for data that do not fit with the rest.
- Discussion of each chemical parameter includes section called “Effect on aquatic ecosystem.”

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### Weaknesses

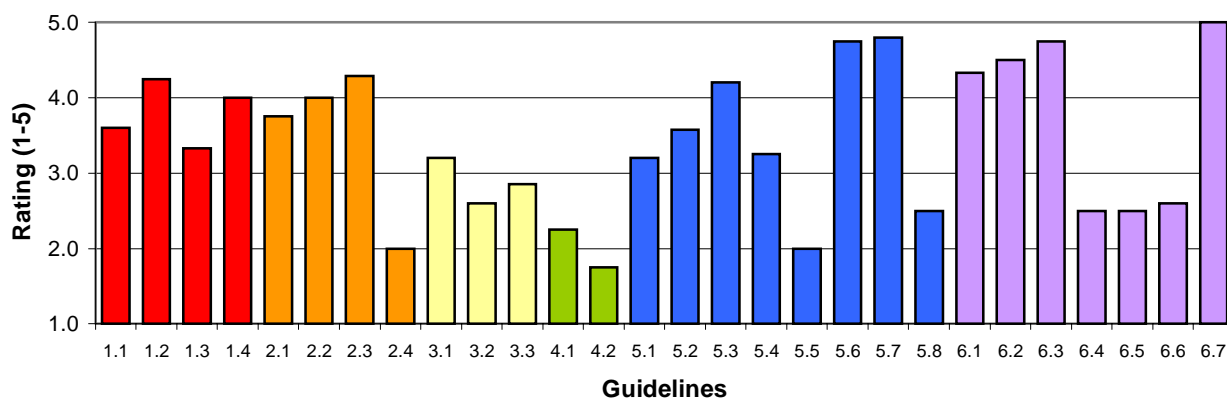
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- Goal of having students participate in local decision-making about water quality is not fully accomplished. No real action project outside of class is carried out as part of the curriculum, although there is a note that students “may also want to present their results to the local community (p.193).”

## Ratings for Watershed Science for Educators

The curriculum was rated according to the Guidelines for Excellence (NAAEE, 2000) using the following 1-5 scale. For an explanation of what each Guideline (each bar) in the graph represents, see description below the graph. The Guidelines are grouped by color into six Key Characteristics (see Legend box). Average ratings for each Key Characteristic are provided in the Legend.

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<span style="color: red;">■</span> <b>Fairness and Accuracy: Average= 3.8</b>	<span style="color: orange;">■</span> <b>Depth: Average= 3.5</b>
<span style="color: yellow;">■</span> <b>Emphasis on Skills Building: Average= 2.9</b>	<span style="color: green;">■</span> <b>Action Orientation: Average= 2.0</b>
<span style="color: blue;">■</span> <b>Instructional Soundness: Average= 3.5</b>	<span style="color: purple;">■</span> <b>Usability: Average= 3.7</b>

### The Guidelines for Excellence (see pages 4-5 for details)

#### #1 Fairness and accuracy

- 1.1 Factual accuracy
- 1.2 Balanced presentation of differing viewpoints and theories
- 1.3 Openness to inquiry
- 1.4 Reflection of diversity

#### #2 Depth

- 2.1 Awareness
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## TOPICAL CHART OF RECOMMENDED LESSONS

### **Key to Curriculum Title Abbreviations:**

**AAW**= Adopt-a-Watershed Water Quality High School Unit

**BIO**= Rivers Curriculum Guide: Biology

**CHEM**= Rivers Curriculum Guide: Chemistry

**GLOBE**= The GLOBE Program

**ISR**= Investigating Streams and Rivers

**ROL**= Rivers of Life

**SOS**= Save Our Streams Teacher's Manual

**SOURCE**= The Water Sourcebook

**WWE**= Water, Water, Everywhere

**WSHED**= Watershed Science for Educators

### **TOPICS :**

ANALYZING, INTERPRETING, & PRESENTING STREAM DATA

AUTHENTIC ASSESSMENT

BIOLOGICAL MONITORING

CHEMICAL AND PHYSICAL MONITORING

COMMUNITY ACTION PROJECTS

CULTURAL ASPECTS OF STREAMS

ECOLOGY OF STREAMS

ENVIRONMENTAL ASSESSMENT

EVALUATION

FLOODS

GETTING TO KNOW YOUR STREAM SITE

HISTORY OF STREAMS

LAND USE'S LINK TO WATER QUALITY

SAFETY

WRITING ABOUT STREAMS

## **ANALYZING, INTERPRETING, & PRESENTING STREAM DATA**

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- AAW “Lesson 5: Reporting Data: A Water Quality Symposium.” Students organize a symposium to present, compare, and discuss their results with peers. They use posters, slides, and other visual aids to share their findings. A guest resource specialist helps them with analysis.
- GLOBE “Water, Water, Everywhere. How Does it Compare?” Students learn how to explain seasonal trends and anomalies in GLOBE data sets, then design a unique study to analyze their own data.
- WWE “Water Quality Factors Reference Unit.” This volume (out of 3 in the series) describes 23 physical and chemical water quality parameters, and gives acceptable limits of each for various uses (such as drinking or swimming). The 23 factors include: ammonia, chloride, copper, mercury, oxygen, phosphates, sulfates, lead, and others. It provides a wealth of information to help put numeric water quality results into perspective, including pollutants’ effects on aquatic and terrestrial life and the synergistic effects of multiple pollutants.
- CHEM “Activity 10.4: Calculating the Overall Water-Quality Index.” In this culminating lesson, students use all data they have collected (on physical and chemical parameters) to determine the overall water-quality index for their stream.
- CHEM “Lesson 1.4: The Quality of Your River or Stream.” Good introduction to Q-values, and overall water quality index.
- CHEM “Lesson 1.5: Accuracy and Precision of Data.” Great introduction to statistical data analysis, including mean, standard deviation, and the proper way to report values.
- CHEM “Lesson 1.6: Should All Data Be Used?” Describes how to do a quotient test in order to determine whether to reject or include an outlier.
- SOS “Chapter 2, Measuring Stream Health.” Subsection called “Monitoring Water Quality, p.49” provides good introductory discussion on differences between chemical and biological monitoring, and when they are most appropriate. Discusses a study that showed that biological monitoring detected the presence of water quality impairment in streams more often than chemical monitoring.

## **AUTHENTIC ASSESSMENT**

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- CHEM “Appendix A: Assessment Tools.” Ideas for authentic assessment: science notebook, river collage, and portfolio.
- BIO “Appendix A: Assessment Tools.” Ideas for authentic assessment: river collage, portfolio, telecommunications project.

ROL “Creating an Electronic Portfolio,” online. Good authentic assessment. Students create long-term portfolio of their work.

## **BIOLOGICAL MONITORING**

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GLOBE “Macroinvertebrate Discovery.” A highlight of this sampling lesson is the Habitat Parameters for Selected Macroinvertebrates: three charts show acceptable ranges of pH, temperature, and dissolved oxygen for various families of macroinvertebrates.

BIO “Lesson 3: Indices of River and Stream Water Quality.” Good student readings that introduce the importance of indices, pollution tolerance of macroinvertebrates, and how to calculate a water-quality index.

SOS “Chapter 2, Measuring Stream Health.” Subsection called “Monitoring Water Quality, p.49” provides good introductory discussion on differences between chemical and biological monitoring, and when they are most appropriate. Discusses a study that showed that biological monitoring detected the presence of water quality impairment in streams more often than chemical monitoring.

## **CHEMICAL AND PHYSICAL MONITORING**

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GLOBE “Introduction: The Big Picture.” Good introduction to physical and chemical parameters. Provides basic description, typical values, and effects on living things. Reading level is upper high school grades.

WWE “Water Quality Factors Reference Unit.” This volume (out of 3 in the series) describes 23 physical and chemical water quality parameters, and gives acceptable limits of each for various uses (such as drinking or swimming). The 23 factors include: ammonia, chloride, copper, mercury, oxygen, phosphates, sulfates, lead, and others. It provides a wealth of information to help put numeric water quality results into perspective, including pollutants’ effects on aquatic and terrestrial life and the synergistic effects of multiple pollutants.

WSHED “Background Information Sheet 7.1: Commonly Tested Water Chemistry Parameters.” Good background information on physical and chemical parameters including a section called “Effect on aquatic ecosystem” for each. Parameters covered include: dissolved oxygen, pH, alkalinity, hardness, nitrate, phosphates, chloride, carbon dioxide, silica, turbidity, and temperature.

CHEM “Activity 10.4: Calculating the Overall Water-Quality Index.” In this culminating lesson, students use all data they have collected (on physical and chemical parameters) to determine the overall water-quality index for their stream.

- CHEM “Lesson 1.4: The Quality of Your River or Stream.” Good introduction to Q-values, and overall water quality index.
- CHEM “Lesson 1.5: Accuracy and Precision of Data.” Great introduction to statistical data analysis, including mean, standard deviation, and the proper way to report values.
- CHEM “Lesson 1.6: Should All Data Be Used?” Describes how to do a quotient test in order to determine whether to reject a piece of data.
- BIO “Student Information 4.3” Describes importance of various aspects students will investigate in a habitat assessment of their site, including flow, depth, substrate, stream bank, channel, cultural factors, and aesthetic characteristics.
- SOS “Chapter 2, Measuring Stream Health.” Subsection called “Monitoring Water Quality, p.49” provides good introductory discussion on differences between chemical and biological monitoring, and when they are most appropriate. Discusses a study that showed that biological monitoring detected the presence of water quality impairment in streams more often than chemical monitoring.

## **COMMUNITY ACTION PROJECTS**

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- AAW “Lesson 5: Reporting Data: A Water Quality Symposium.” Students organize a symposium to present, compare, and discuss their results with peers. They use posters, slides, and other visual aids to share their findings. A guest resource specialist helps them with analysis.
- ROL “Rivers Through Time Project, Objective 7: It’s Clean Up Time!!” Activities 9 and 10 involve students in a river clean up with an archeological twist. Students carefully map and excavate the trash from a 40 foot diameter site. Then they analyze what they collected to reveal insight into local culture and attitudes towards rivers. Earlier activities in this project provide students with the basics of archaeological research.
- ROL “Rivers of Life Interactive Youth Expedition.” Each year, about 10 high school students are chosen for a week-long expedition to explore a section of the Mississippi. Live dialogues via the internet link these students to all participating schools during the expedition. Students are involved in community education projects and do independent studies, which are published on the ROL web site.
- SOS A separate 47-page “Science Project Guide for Students” is available, which is ideal for students who want to do an independent stream monitoring project and take action. Action projects suggested include creating a community display of data, planting vegetation, doing a stream cleanup, and educating the community via new articles, presentations, brochures, etc.

- SOURCE “Keep Our Community Beautiful,” p. 1-125. In this activity, students come up with project proposal to reduce the dumping of trash in streams, (including a budget, justification of budget, and community campaign). This activity gives students a realistic perspective of the pressure and confusion environmental professional have to deal with when making environmental decisions.
- SOS “Chapter 4, Extension Activities: Creating a Class Newsletter.” Comprehensive guide with good tips for students on how to design a newsletter.
- SOS “Chapter 4, Extension Activities: Getting Stream Stories in the News.” Comprehensive guide with good tips for students on how to write and submit newspaper articles.
- AAW “Lesson 6: Water Quality Improvement Project: What Can We Do To Help?” In this learner-directed lesson, students write a project proposal, implement the project, write a project report, and help create a scoring rubric for final evaluation. Includes student guides to four projects including public education and restoration work.
- ISR “Part III: Problem Solving.” In this learner-directed section, activities 6-12 guide students through each step of planning, implementing, and evaluating a community action project. These steps include narrowing down the topic, contacting stakeholders, writing and carrying out an action plan, and evaluating it.
- BIO “Lesson 7: Environmental Assessment.” Students learn about the procedures required to obtain a permit to conduct changes that affect wetlands and streams. They use their own data to create a mock or real environmental assessment of a local issue. Covers permit request, permit review, public meeting, and final statement of findings.

## **CULTURAL ASPECTS OF STREAMS**

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- ROL “Steamer Trunk Project.” In this activity students explore the cultural as well as environmental aspects of their local watershed. Students use artifacts to document their watershed in a “culture box” without naming it. This box is exchanged with another school, which tries to identify the mystery watershed. Teachers must register with ROL to participate in this exchange.
- BIO “Student Information 4.3” Describes importance of various aspects students will investigate in a habitat assessment of their site, including flow, depth, substrate, stream bank, channel, cultural factors, and aesthetic characteristics.
- ROL “Rivers Through Time Project, Objective 7: It’s Clean Up Time!!” Activities 9 and 10 involve students in a river clean up with an archeological twist. Students carefully map and excavate the trash from a 40 foot diameter site. Then they analyze what they collected to reveal insight into local culture and attitudes

towards rivers. Earlier activities in this project provide students with the basics of archaeological research.

## **ECOLOGY OF STREAMS**

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BIO “Lesson 2: River and Stream Ecology.” Includes student reading that covers energy flow, food webs, wetlands, and adaptations to aquatic environments. Three activities illustrate interconnections in streams.

## **ENVIRONMENTAL ASSESSMENT**

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BIO “Lesson 7: Environmental Assessment.” Students learn about the procedures required to obtain a permit to conduct changes that affect wetlands and streams. They use their own data to create a mock or real environmental assessment of a local issue. Covers permit request, permit review, public meeting, and final statement of findings.

## **EVALUATION**

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AAW “Lesson 7: Water Quality: Have We Made a Difference?” Includes ideas for individual and group evaluation.

ISR “Activity 12: Follow-up.” Students evaluate the effectiveness of their action project and the entire water quality monitoring program.

## **FLOODS**

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ROL “Chasing the Flood Project.” Thirteen activities involve students in monitoring local precipitation and runoff as well as researching runoff of global rivers to learn about floods, erosion, wetlands and related topics. Activity 7 provides unique insight into media coverage of floods.

## **GETTING TO KNOW YOUR STREAM SITE**

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BIO “Student Information 4.3” Describes importance of various aspects students will investigate in a habitat assessment of their site, including flow, depth, substrate, stream bank, channel, cultural factors, and aesthetic characteristics.

ROL “Steamer Trunk Project.” In this activity students explore the cultural as well as environmental aspects of their local watershed. Students use artifacts to document their watershed in a “culture box” without naming it. This box is exchanged with another school, which tries to identify the mystery watershed. Teachers must register with ROL to participate in this exchange.

WSHED “Chapter 4: Topographical Maps.” Comprehensive introduction to topo maps. Includes background information on identifying landforms and human-made features,

as well as understanding scale, symbols, colors and patterns. Activities include making a topographical map out of a three-dimensional model landscape, creating a three-dimensional model landscape from a topographical map, and delineating the local watershed boundaries.

WSHED “Chapter 5: Aerial Photographs.” Comprehensive coverage of aerial photographs. Includes 10 fold-out copies of real aerial photos for small group analysis. Students first learn to interpret these, before examining historic and current aerial photos of their local sampling site. Provides great insight into land use patterns and their link to water quality.

## **HISTORY OF STREAMS**

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ISR “Activity 3: Rivers and People.” Students learn local river history by developing interview skills, designing a questionnaire, interviewing community members, and compiling the results.

ROL “Steamer Trunk Project.” In this activity students explore the cultural as well as environmental aspects of their local watershed. Students use artifacts to document their watershed in a “culture box” without naming it. This box is exchanged with another school, which tries to identify the mystery watershed. Teachers must register with ROL to participate in this exchange.

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## **LAND USE’S LINK TO WATER QUALITY**

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SOS “Chapter 3: The Relationship Between Land Use and Water Quality.” Excellent coverage of the connection between land use and water quality. Ten different units address: construction, agriculture, wetlands, forests, industrial/municipal dischargers, residential, commercial, dams, mining and landfills. Each provides a balanced discussion of the topic and a student worksheet of discussion questions that highlight local issues. Many include student activities as well.

WSHED “Chapter 4: Topographical Maps.” Comprehensive introduction to topo maps. Includes background information on identifying landforms and human-made features, as well as understanding scale, symbols, colors and patterns. Activities include making a topographical map out of a three-dimensional model landscape, creating a three-dimensional model landscape from a topographical map, and delineating the local watershed boundaries.

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## **SAFETY**

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BIO/CHEM “Lesson 1, Safety Guidelines and Contract.” Covers both laboratory and field safety issues in a contract that students sign before participating in activities. Includes scenarios of unsafe behavior for class discussion and analysis.

## **WRITING ABOUT STREAMS**

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BIO/CHEM “Journal Writing.” Describes value of keeping a journal/science notebook and includes suggestions for format. Throughout these curricula, there are ideas for journaling topics that include personal reflection, poetry, and art as well as recording monitoring results.

SOURCE “Biography of a River,” p. 3-1. Students write biographies of local rivers including birth information (geological formation), historical events, contribution to society, etc.