



## Leader Guide

### Holding onto the

# GREEN ZONE

A Youth Program for the  
Study and Stewardship of  
Community Riparian Areas



A Joint Project of the Bureau of Land Management,  
the University of Wisconsin-Extension, and the  
USDA Cooperative State Research, Education, and Extension Service

Holding onto the GREEN Zone Leader Guide  
A Youth Program for the Study and Stewardship of Community Riparian Areas  
2008

Publication Index Number  
BLM/WO/GI-08/016+8600  
EE8007A

# Acknowledgments

The *Holding onto the GREEN Zone* Action Guide and Leader Guide are products of the Youth Riparian Education Initiative Project, which was made possible with support from the U.S. Department of the Interior, Bureau of Land Management (BLM), U.S. Department of Agriculture, Cooperative State Research, Education, and Extension Service (CSREES), and the University of Wisconsin-Extension.

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This publication was developed by the Youth  
Riparian Education Initiative—a partnership  
of the University of Wisconsin-Extension;  
the Bureau of Land Management; the USDA  
Cooperative State Research, Education, and  
Extension Service; and other universities and  
federal agencies (listed above).

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# The Youth Riparian Education Initiative

*[A riparian area is] ...a form of wetland transition between permanently saturated wetlands and upland areas. These areas exhibit vegetation or physical characteristics reflective of permanent surface or subsurface water influence. Lands along, adjacent to, or contiguous with perennially and intermittently flowing rivers and streams, glacial potholes, and the shores of lakes and reservoirs with stable water levels are typical riparian areas.<sup>1</sup>*

Congratulations! Opening this guide is the first step toward helping young people learn about the importance of riparian zones in their communities. The guide contains step-by-step guidelines for helping students in grades 5-8 or youth group members (ages 10-14) understand these complex and exciting ecosystems.

## Project Overview/ Purpose

The purpose of this new Earth Science curriculum is to encourage collaboration between land managers and youth educators/leaders that promotes public awareness of and sensitivity to fragile riparian resources. Through the processes of science inquiry and experiential learning, learners will enhance their knowledge of science and come to understand the importance of preserving and restoring riparian ecosystems.

Riparian ecosystems are an exciting and dynamic subject for study. These areas

<sup>1</sup> From *Riparian Area Management: Process for Assessing Proper Functioning Condition*, Bureau of Land Management, Technical Reference 1737-9, 1998.

are valuable lands and important wildlife habitats, and they contribute greatly to the environmental health of an area. Definitions for the term “riparian” vary, but in this curriculum, the land called the “GREEN Zone” lies between flowing water and upland ecosystems. Vegetation and soils in this zone provide valuable services for people, livestock, water resources, wildlife, and plant species.

Riparian vegetation protects water quality, for example, by serving as a buffer. Plants trap some of the sediments and other pollutants that are in runoff and keep them out of the stream. Healthy riparian soils that are filled with plant roots and enriched with humus absorb and store moisture. Plants stabilize stream banks and improve stream habitat for fish and other water creatures. Grasses, shrubs, trees, and other plants provide food and cover for domestic animals and wildlife. To succeed in resource management efforts, it is important to promote healthy vegetation and soils in riparian zones.

*Riparian-wetland areas are intimately related to their adjacent waterways since the presence of water for all or part of the growing season is their distinguishing characteristic. Moreover, the nature and condition of a riparian-wetland area abutting a stream channel fundamentally affects the aquatic ecosystem. In addition to water, three other components of the riparian-wetland area essential for management consideration are soil, vegetation, and landform.<sup>2</sup>*

<sup>2</sup> From *Riparian Area Management: Riparian-Wetland Soils*, Bureau of Land Management, Technical Reference 1737-19, 2003.

Riparian zones make valuable economic, recreational, and environmental contributions to society. But despite the best efforts of federal agencies and others to protect them, the health of these important lands is being compromised at an alarming rate. Scientists estimate that "...on average, the lower 48 states have lost more than 60 acres of riparian/wetland areas for each hour that has passed between the 1780's and the 1980's."<sup>3</sup> Regulations, economic incentives, and acquisition programs have succeeded in slowing this trend, but by themselves these programs cannot protect or help restore riparian zones. The best hopes for improving them are continued research, education of the public, and collaboration among states, local governments, schools, tribes, and private citizens. Schools and youth groups (4-H, Scouts, YMCA) are vital points of intervention to introduce this significant subject.

The sponsors of *Holding onto the GREEN Zone* created this curriculum to help teachers and youth leaders address this crucial need to educate the public about protecting and managing wetland and riparian areas.

Instructors have the critical job of keeping the subject interesting and stimulating. Leaders can help young people understand the environmental, technological, and social aspects of science and can encourage them to work together to solve problems. The Action Guide, as a supplemental text, is a basic resource to help science teachers and leaders fulfill this important role. Collaboration with a local natural resource professional will be crucial for access to local information and general expertise. The "General Advice" section on page 7 has suggestions for connecting with natural resource professionals.

The *Holding onto the GREEN Zone* Action Guide is especially designed for learners in grades 5-8 who have had limited introduction to the

<sup>3</sup> Hansen, P.L., Pfister, R.D., Boggs, K., Cook, B., Joy, J., & Hinckley, D.K. (1995). *Classification and Management of Montana's Riparian and Wetland Sites*. Missoula, MT: The University of Montana, Montana Forest and Conservation Experiment Station School of Forestry.

subject. Activities address science education standards most closely linked to an Earth Science curriculum. Most activities are also easily adapted for day camp or after-school settings.

## Riparian Education Tools

This Leader Guide was written to help science teachers/youth leaders make the best use of the *Holding onto the GREEN Zone* Action Guide. The Leader Guide can be used to help meet these important objectives:

- Introduce youth to the important components and functions of riparian zones as they relate to water quality and quantity, soils, vegetation, wildlife, erosion, floods, and land uses
- Encourage community awareness and stewardship of riparian zones
- Relay technical information about riparian zones in simple language and terms for non-scientists
- Assist young people in learning basic Earth Science concepts
- Help schools incorporate riparian education into the science curriculum
- Promote better land use and natural resource management through increased awareness and understanding

Educating children, involving them and their communities in hands-on activities, and encouraging stewardship at the local level are critical steps toward achieving widespread riparian-zone restoration and protection.



This teaching module includes the following riparian education tools:

### **Action Guide**

#### ***Holding onto the GREEN Zone Action Guide – A Youth Program for the Study and Stewardship of Community Riparian Areas***

The Action Guide includes all the information and instructions the learner will need to explore a community riparian zone.

### **Leader Guide**

#### ***Holding onto the GREEN Zone Leader Guide***

Educators will find a variety of information and resources in this guide to take the guesswork out of designing a riparian education program or to enhance an existing program. Background information, a unit-by-unit guide, and safety tips are all included. The Appendices contain additional riparian resources, including

- selected curricula and activities
- a curriculum concept map
- correlations to national education standards
- sources for additional background information

### **Poster**

#### ***RIPARIAN AREAS: Nature's Lifelines***

This colorful poster, an aerial view of the San Pedro River in southern Arizona and northern Mexico, emphasizes the importance of healthy riparian zones, especially in arid regions.

The Action Guide and Leader Guide are available online at [www.blm.gov/education](http://www.blm.gov/education). Additional copies of these guides may also be ordered by teachers and youth leaders. See the BLM website for ordering information.

# Using the GREEN Zone Curriculum

*Riparian-wetland areas are some of the most productive resources found on public and private lands. They are highly prized for their recreation, fish and wildlife, water supply, cultural, and historic values, as well as for their economic values, which stem from their use for livestock production, timber harvest, and mineral extraction.*<sup>4</sup>

## Engaging Youth in Studying the Riparian Zone

*Holding onto the GREEN Zone* is an Earth Science and life science curriculum with a focus on science inquiry and experiential learning. Using questioning, analysis, observation, and investigation, learners will enhance their knowledge of science, boost their critical thinking skills, learn the importance of preserving and restoring vital riparian ecosystems, and have fun. When young people become involved in investigating the GREEN Zone, they are better prepared to take action on local watershed issues now and in the future. They also gain the opportunity to exercise their rights and responsibilities as citizens and community members.

In this curriculum, learners investigate six key elements of the riparian zone:

- Water quality and quantity
- Stream shape, slope, and speed

<sup>4</sup> From *Riparian Area Management: A User Guide to Assessing Proper Functioning Condition and the Supporting Science for Lotic Areas*, Bureau of Land Management, U.S. Forest Service, Natural Resources Conservation Service, Technical Reference 1737-15, 1998.

- Soil qualities
- Plant characteristics
- Erosion and deposition
- Surrounding land uses—human, livestock, and wildlife

When they have completed the classroom and field activities, learners will be able to:

- Locate a riparian zone in their community
- Show the approximate boundaries of a riparian zone
- Describe the services that a riparian zone provides
- List at least three characteristics or functions that natural resource professionals study to determine whether the riparian zone is healthy
- Give one example of how a change in one characteristic or function of the riparian zone could affect one of the other five elements
- Explain how two elements interact to enable the riparian zone to function properly
- List at least one animal activity that affects the riparian zone

The Leader Guide has the information needed to lead a group through the GREEN Zone curriculum and field trip experience. Leaders are strongly encouraged to involve a natural resource professional from a local environmental group or agency. He or she will bring science expertise to the experience and

also will introduce youth to a career in the natural resource professions. (The “General Advice” section, beginning on page 7, has more information on how to find a natural resource professional to work with group members on this project.)

## What is a Riparian Zone?

*Riparian zones are dynamic, transitional ecosystems. They are typically not marked by clear-cut boundaries, but move back and forth between aquatic and terrestrial systems. The impacts of riparian areas in our communities are more than ecological. They include social, aesthetic, and political elements as well.<sup>5</sup>*

The term “riparian” has been defined most narrowly as “lands adjacent to running creeks, streams, and rivers.” More broadly, it is also applied to the edge of any body of water including ponds, lakes, and wetlands. Riparian zones are typically not marked by clear-cut boundaries, so many natural resource professionals prefer to use the term “riparian area.” For purposes of this curriculum, however, and to help young people develop a clear picture of these important ecosystems, the term “zone” is being used.

Riparian zones are characterized by the types of vegetation they support. This vegetation, in turn, indicates the health of the watershed, the status of its ecological function, and its wildlife habitat potential. By observing changes in the plants, scientists can detect the effects of disturbance in a natural system. The plants also provide essential habitat. Fish and wildlife rely on them for food, cover, breeding, nesting, and rearing young. When the vegetation begins to show signs of disturbance, wildlife and water quality will generally be adversely affected in this dynamic system.

A properly functioning, or healthy, riparian zone can provide many benefits or services for our communities. As mentioned on page 13 of the Action Guide, a healthy riparian zone:

- slows the speed of high, fast-moving water, which helps to reduce erosion;
- traps sediment, keeping it out of the water and adding to the soil in the surrounding floodplain;
- stores flood water and recharges groundwater;
- supports root masses that strengthen stream banks;
- creates areas in the water that are calm and deep, providing habitat for fish, waterfowl, and other aquatic animals; and
- supports greater numbers and varieties of plants and animals.

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<sup>5</sup> Russ Radden, University of Arizona, 1999.

# How is the Curriculum Organized?

The GREEN Zone curriculum guides learners in investigating, measuring, and documenting some characteristics of a riparian zone. The five units in the curriculum are described in the chart below with the estimated time needed to complete all suggested activities. At the end of their GREEN Zone adventure, learners will understand how the choices they make today can affect the health of their riparian zone in the future.



Unit number	Unit title and description	Time
Unit 1	<b>GET A CLEAR PICTURE</b> – The photos and fun activities in this unit will help learners discover and unlock the secrets of the GREEN Zone – what is it and why is it important?	2 hours
Unit 2	<b>SOLVE THE PUZZLE</b> – Determining the health of a riparian area is like solving a jigsaw puzzle – to see the big picture clearly, youth need to figure out how all the pieces fit together. Learners are challenged to identify the important parts and functions of the GREEN Zone and then determine what makes a riparian area healthy or unhealthy. Activities at four science stations provide important clues.	6 hours  There are 4 stations and a summary activity in this unit. It takes about 90 minutes to complete all activities at each station.
Unit 3	<b>GET INTO THE ZONE</b> – The group will go on a field trip to explore a stream or river in the community. Learners will form a land management team to collect information about their riparian area. Team members will choose a “career” for the field trip: <ul style="list-style-type: none"> <li>Water ecologists will look at the overall water quality of the selected riparian zone.</li> <li>Soil scientists will record soil types, stream bank condition, channel shape, and signs of erosion and deposition.</li> <li>Biologists will note the plants and animals present.</li> <li>Physical geographers will create a base map of landforms and local features.</li> </ul> Learners try out the role of one of four types of scientists to measure the many characteristics that combine to form a riparian zone. If available, a local natural resource professional may join the group to provide information and guidance.	2-4 hours  Time needed will depend on how far away the area is, how many group members there are, and how much time is available.
Unit 4	<b>PUTTING THE PIECES TOGETHER</b> – Back in the classroom or home base, each specialist group studies and interprets data collected on the field trip. By combining information from all four groups, learners will build a more complete picture of their riparian zone and its health. What is the state of your GREEN Zone right now? Can learners predict what it might be like in the future? What can young people and others in their community do to maintain or improve this vital resource?	2 hours
Unit 5	<b>TELL THE NEWS</b> – Finally, learners will decide how to share what they learned about the GREEN Zone with community leaders and residents. They will present their findings to a group of natural resource professionals for feedback and additional information.	2 hours

## Other Important Features

### Zone Notebooks

The GREEN Zone curriculum features a built-in method of involving youth in partnership roles during their riparian adventures. Scattered throughout the curriculum are questions that help youth think about their experiences. During each unit, youth should take a few minutes to answer these questions their Zone Notebooks. Data sheets and other materials produced during their riparian adventure should be added to their Zone Notebooks, too.

Learners provide their own notebooks and are encouraged to be creative with them. They might:

- Decorate them
- Add newspaper articles
- Create artwork
- Display photos of riparian areas
- Make a collage with pictures of riparian animals and plants
- Include a poem they've written about their riparian area

Besides helping the participants process their experiences as they go, these journals will help leaders evaluate if the group understands the material presented and will also be helpful to youth in telling others what their group learned and accomplished.

### Small group discussion

Questions in the curriculum can help start discussion and help participants learn from the activities. Everyone should be encouraged to contribute. Open-ended questions ("What?" "Why?" and "How?") can promote more discussion among group members. It's important

to remember that the purpose of the discussion is not to expose personal information, but to share perspectives and reactions to activities.

## General Advice

The GREEN Zone curriculum was designed to be kid-friendly. Young people should be able to move through it with little adult guidance. Of course, they will need help finding and gathering materials. They will also need assistance with some activities and with keeping on task throughout the activities.

Most of the details and instructions for GREEN Zone activities are in the youth guide. That information is not repeated here. Instead, the Leader Guide gives an overview, with summaries of each activity, background information, and instructions that may help in completing some activities.

It is not necessary to cover all the material in each unit before moving on. It is possible to pick and choose which units to cover according to time limitations, the abilities of the group, and the number of partners who have been recruited to help with the program. For instance, activities in the Unit 2 science stations can be skipped if the group has already studied watersheds, aquifers, or groundwater.

A field trip is a featured component of the curriculum (Unit 3). Units 1 and 2 prepare youth for the field trip by building skills and curiosity. Seasonal constraints and other circumstances may require, however, that the field trip take place before the other GREEN Zone material is covered. If so, an increased number of well-prepared adults may be needed to help on the field trip. Even if they take the field trip first, group members will still have a fun and educational experience completing the remainder of the curriculum.



## Involve Natural Resource Professionals and Other Community Experts

A local natural resource expert can help ensure the success of this experience. Natural resource professionals and other experts can also help to validate learner interpretation of scientific information, and they can serve as role models, encouraging consideration of possible careers in the natural resource field.

Natural resource partners may be able to offer:

- Supplies such as water testing equipment and measuring devices
- Background information and existing data on local riparian zones
- Ideas for service projects
- Technical assistance in planning and completing a project
- Materials such as posters, maps, or videos
- Names of other community members/organizations that would like to help

If a partner organization has not been contacted, the organizations listed in the box on this page should provide some leads. The local phone book or the Internet has information about these and other potential partners. It may be possible for group members to join a riparian service project already in progress.

## Youth as Partners

*Holding onto the GREEN Zone* is designed to enable youth to take the lead in learning about riparian areas and their significance. The curriculum engages youth as partners in riparian stewardship, rather than as subjects who need to be taught what to think or do. This proven education strategy is being promoted because youth are the leaders of the future. New investments in youth water education can

### ***Potential Partners***

Federal, state and local government agencies

Bureau of Land Management

National Park Service

U.S. Department of Agriculture/Natural Resources Conservation Service

U.S. Fish and Wildlife Service and Refuges

U.S. Forest Service

U.S. Geological Survey

Colleges/Universities

Cooperative Extension/4-H (county)

County Environmental Management Councils

Soil and Water Conservation Districts (county)

Departments of Natural Resources, Environmental Conservation, or Environmental Quality (state)

Non-Government Organizations

Lake or river associations

Local chapters of:

Audubon Society

The Nature Conservancy

Sierra Club

Trout Unlimited

*Community volunteers might include parents, retirees, service club members, and others. Older youth can also be effective project partners in working with younger groups.*

make it easy for youth to understand their roles as stewards of our natural resources. Teachers, youth leaders, and environmental managers can help youth develop the skills to implement creative solutions to environmental concerns in their own communities.

Why involve youth in environmental conservation and stewardship activities? Because youth:

- bring enthusiasm, energy, and creativity
- grow as active citizens in the community
- develop a sense of place and learn to take responsibility for their impacts on the environment
- learn how to apply the process of problem solving in their lives
- see how their environmental activities can lead to careers

The key to successful youth science education and service projects is involving young people in developing, planning, organizing, and evaluating activities and projects. When youth lead the project, they gain a sense of ownership of the results. They learn more and work better. The youth service movement has learned much from young people themselves about how to involve youth as community resources.

The following strategies should be considered:

- Encourage youth to set activity goals.
- Arrange opportunities for young people to reflect on what they learn and to apply lessons from their experiences.
- Acknowledge and build on the skills, knowledge, and experiences young people already have.
- Ask older students for help.
- Involve youth as leaders who have never before had the chance to lead.
- Define and maintain accountability; group members must do what they promise.
- Set responsibilities at appropriate levels.
- Model the behaviors that are expected from young people. Expect the same from all staff, partners, and volunteers.

### **Adapting the GREEN Zone curriculum for different age groups**

The *Holding onto the GREEN Zone* curriculum was written for youth in grades 5 through 8. Kids at any age will get the most out of the curriculum if they have an active voice in choosing what they will do and how to proceed.

To adapt the GREEN Zone curriculum to younger audiences, it may be necessary to provide simpler, more directed processes for

existing activities or to choose alternative activities from Appendix A–Selected Riparian Curricula, Activities, and Additional Resources. This information includes the date when a curriculum was published, the targeted grade level, and what riparian background information or activities it offers.

Older groups (high school or older) are ready for more in-depth questions and challenges. They could carefully document observations and tests, relate observations to a broader ecological and human context, explain/predict how factors have changed or will change over time, analyze and/or synthesize information and situations, develop alternative approaches, and use a broader range of information and experiences in tasks and discussion.

## **Planning the GREEN Zone Adventure**

As mentioned previously, the GREEN Zone curriculum can be used in both formal and nonformal settings. This section offers ideas for adapting it to a variety of settings and situations.

### **How long will it take?**

It is recommended that leaders read through the entire curriculum and then use the guides beginning on page 14 to plan a schedule. Ideally, about 15 contact hours will be needed, including adequate time to conduct the field trip, cover all the material, build concepts sequentially, and complete all activities.

A number of the activities require some advance preparation, which is also noted in the Unit-by-Unit guides. Two activities in Unit 2 utilize materials that require significant lead time to prepare or procure. It is important to check out the materials list in Station 3, Activity 2 and Station 4, Activity 1 in the early planning stages.

## Planning a schedule

The table below lists schedule suggestions for a school, youth group, or after-school schedule.

Unit	Time needed	Classroom (45 min. periods)	Camp full day (6 hours)	Camp half-day (4 hours)	After-school (2 hrs./day)
1	2 hours	2-3 periods	Day 1	Day 1	Day 1
2	6 hours	6-8 periods	Day 1 - 3 hrs. Day 2 - 3 hrs.	Day 2 +	Days 2, 3, 4
3 (field trip)	2-4 hours	½ to 1 school day	Day 2 - up to 4 hours	Day 3	Day 5
4	2 hours	2-3 periods	Day 3	Day 4	Day 6
5	2 hours	2-3 periods	Day 3	Day 5	Day 7
Total	14-16 hours	Min. = 12 periods + ½ day field trip	3 days	5 days	7 days

### If time is short –

- Choose activities that will enhance the general Earth Science curriculum.
- Skip activities that cover concepts previously covered.
- Select topics that are relevant to riparian or water-related issues in the local community.
- Choose activities that the youth group will particularly enjoy.

A table such as the one shown in Figure 1 can be used to plan a GREEN Zone schedule suitable for any group.

**Figure 1**

Unit	Time needed	Time available	Concepts to cover	Activities to include	Time needed for each activity
1	2 hours				
2	6 hours				
3 (field trip)	2-4 hours				
4	2 hours				
5	2 hours				
Total	14-16 hours				

# Holding onto the GREEN Zone and Science Education

## Science Inquiry and the “Learning Cycle”

*“During the past 30 years, science educators have identified a sequence, known as the learning cycle, that has proven to be an effective means for learning concepts and processes of science. The learning cycle also has been found effective for developing reasoning abilities and for reducing scientific misconceptions.”<sup>6</sup>*

The GREEN Zone curriculum was designed to inform young people about the importance of riparian areas, to help youth develop reasoning abilities in science, and to increase youth skills in practical science inquiry methods and interpretation. These objectives are met in the curriculum through activities based on the learning cycle instructional model. Three concepts in the learning cycle are emphasized in this curriculum:

**1. Exploration:** The curriculum and field trip activities present group members with experiences that will enable them to develop questions and their own frame of reference about riparian areas. The benefits of the exploration phase are maximized if educators provide only minimal guidance or expectation of specific accomplishments.

**2. Concept Introduction:** Riparian science concepts are introduced through activities that lead youth to apply new patterns of thinking in their experiences with riparian areas. The

activities build youth confidence in identifying and understanding riparian concerns when they encounter them in the outdoors.

**3. Concept Application:** The focus of the curriculum is not just to provide information but to also develop scientific thinking and decision-making skills. This is done by encouraging learners to apply their newfound knowledge and skills.<sup>7</sup>

## Role of the Teacher/Leader

With or without a science background, teachers or leaders can use the Leader Guide to teach youth about riparian areas. It supplies the basic background information needed to guide youth through the curriculum. A natural resource partner(s) can also provide valuable assistance.

The more young people plan and manage their own projects, the more they learn. The leader's role is not to be an expert on riparian zones but to be a coach and mentor of young learners. Leaders should get to know group members and then follow their own judgment about when to urge the group on and when to hold them back.

The leader will:

- Manage the project and keep the group on schedule
- Act as a guide who monitors and encourages rather than directs
- Create opportunities that foster an environment for learning

<sup>6</sup> The Learning Cycle in 4-H SERIES Curriculum. 4-H SERIES Project Introduction. Davis: University of California Extension, 2005.

<sup>7</sup> Adapted from *From Ridges to Rivers: Watershed Explorations*, 4-H SERIES Project. Davis: University of California Extension, 1999.

- Empower young people to be active stewards of riparian areas
- Support youth group members when they make mistakes and applaud when they succeed
- Link young people to land resource managers in the community, including project partners

## Assessment/ Reflection: Helping Youth Communicate Results

What have youth learned by participating in this riparian adventure? What opportunities will they have to demonstrate and apply what they've learned in a meaningful way?

By guiding young people through the GREEN Zone curriculum, the leader not only introduces them to the science of riparian zones but also to the processes of science, including inquiry, analysis, interpretation, and demonstration. As they use these processes in future studies, learners will be able to modify them and incorporate them into more sophisticated investigations in other environmental or problem-solving situations. Repeated experience in applying the scientific method of problem-solving (solving problems in mathematics, understanding land-use management plans, reading environmental impact statements) will enable youth to interact as informed citizens in the social and political arena of riparian zone management as well as with other environmental issues. Having learners actively show they can apply information presented in a curriculum in a meaningful way will show that youth not only know the material but that their knowledge is "usable," too.

The Zone Notes questions and Zone Notebooks can be used as tools for assessing youth performance. Observing youth as they work and listening to youth responses in discussion serve as additional assessment opportunities.

### Other means of reflection

There are many ways young people can express information they've learned from the activities and field trip. Art, English, computer, and math teachers may want to get involved in an interdisciplinary riparian project.

Youth might reflect on their experiences by:

- Creating a poster, display, or sculpture for public display
- Making a video or short skit
- Speaking to community groups or officials about riparian zones
- Writing an article or letter to the editor of the local newspaper
- Writing a project report or developing a PowerPoint presentation

## Curriculum Concept Map

The *Holding onto the GREEN Zone* curriculum is organized to provide sequential learning experiences for youth groups. The curriculum concept map illustrates how the major riparian concepts are broken down into topics that are explored in learning activities. Performance outcomes listed for each unit will help meld the curriculum activities into a more traditional science curriculum.

See Appendix B for the "*Holding onto the GREEN Zone* Curriculum Concept Map."



# Correlations of *Holding onto the GREEN Zone* to Education Standards

Tables and resources have been created to relate youth education activities to the *National Science Education Content Standards*, the North American Association for Environmental Education (NAAEE) *Excellence in Environmental Education – Guidelines for Learning*, and 4-H youth development guidelines. Guidelines and correlations are provided in Appendix C.

## National Science Education Content Standards

The *National Science Education Content Standards*, developed by the National Research Council, outline what youth should know, understand, and be able to achieve to be considered scientifically literate at different grade levels. The Standards help educators and administrators judge which concepts are essential for students to understand before moving on to other, more challenging, scientific topics. The *Holding onto the GREEN Zone* curriculum activities have been correlated with the national standards for grades 5–8 (page 56). More information on the National Science Education Standards can be found in the “Science Content Standards” chapter on the National Academy Press web site at [http://books.nap.edu/openbook.php?record\\_id=4962&page=103](http://books.nap.edu/openbook.php?record_id=4962&page=103)

## NAAEE Excellence in Environmental Education – Guidelines for Learning

The North American Association for Environmental Education (NAAEE) *Excellence in*

*Environmental Education – Guidelines for Learning* (Pre K-12) is another tool educators use to integrate environmental education activities into classroom curricula. For more than 35 years, the NAAEE has promoted environmental education and supported the work of environmental educators in North America and in more than 50 countries throughout the world. The organization has taken the lead in defining, through its guidelines, what makes a balanced, scientifically accurate, and comprehensive environmental education program. Appendix C includes correlations of *Holding onto the GREEN Zone* curriculum activities to NAAEE Guidelines for Learning (page 58). More information about NAAEE can be found at <http://www.naaee.org>. The Guidelines for Learning (Pre K-12) are available online at <http://www.naaee.org/programs-and-initiatives/guidelines-for-excellence/materials-guidelines/learner-guidelines>

## 4-H Youth Development Guidelines

The U.S. Department of Agriculture supports youth and family programs as part of its Cooperative State Research, Education, and Extension Service (CSREES). 4-H is a youth leadership and development program offered by state university Extension systems. As part of this program, CSREES staff has developed 4-H curriculum development. More information on 4-H curriculum criteria can be found at <http://www.4-hcurriculum.org/default.aspx>.

The *Holding onto the GREEN Zone* curriculum meets 4-H standards for curriculum design as outlined in *Evaluating 4H Curriculum through the Design Process*.<sup>8</sup>

See Appendix C (page 59) for more information.

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<sup>8</sup> Barkman, S.J., Machtmes, K., Myers, H., Horton, R.L., & Hutchinson, S. (1999). *Evaluating 4H Curriculum through the Design Process: Pilot Testing and Collecting Data for the 4-H National Jury Review Process* (4-H 898). West Lafayette, IN: Purdue University and The Ohio State University.

# Unit-by-Unit Guide

*Note: Related Internet Resources for activities in these units are listed in Appendix D, page 61.*

## Unit 1 – Get a Clear Picture

*The group will need approximately 2 hours to complete all activities in Unit 1.*

### **Objectives for Unit 1—**

Learners will be able to:

- Identify some differences between a healthy and unhealthy riparian zone
- Describe riparian areas they have visited in the past
- Illustrate the meaning of the term “ecotone”
- Locate riparian zones in photos
- Identify some of the key components of the GREEN Zone
- Explain why animals are attracted to and dependent on riparian areas

### **In Unit 1:**

What is a riparian zone? What does it look like? Where would I find one? Have I ever been to one? Why are we spending time on this? These are just some of the questions that may arise when introducing the GREEN Zone curriculum to young people. The five activities in this unit will help learners answer those questions using pictures, modeling, and some artistic creativity.

### **Unit preparation**

The instructions for each activity are included in the youth Action Guide. The list of activity descriptions that follows will help leaders to manage time, to order and/or prepare materials, and to find background information or additional resources. The “Nature’s Lifelines” poster (Activity 5) should be included with the Action Guide and Leader Guide. If it has been separated, check the following web site for ordering information: [www.blm.gov/education](http://www.blm.gov/education).

During this unit, the poster should be hung on a wall where learners can easily see it. If the poster is to be used outdoors, it could be laminated or attached to foam board so it could be held up, attached to a tree, or set on an easel. An interdisciplinary approach to this unit could engage Art and English teachers in helping youth to describe the GREEN Zone in creative ways.

### **Unit 1, Activity 1—On the Edge**

**Description:** Learners will describe characteristics of water bodies and shorelines that they have visited or that they can view in photographs.

**Duration:** 15 minutes

**Setting:** Indoor or outdoor

**Skills:** Describing

**Objectives:** Learners will describe riparian areas they visited in the past.

**Materials:** Pictures of streams, rivers, or lakes and their shorelines (from magazines or photos of places learners have been)

### **Unit 1, Activity 2—Zone Search**

**Description:** Learners will explore more about riparian areas by locating the GREEN Zones in two photos.

**Duration:** 10 minutes

**Setting:** Indoor or outdoor

**Skills:** Interpreting, observing, visualizing

**Objectives:** Learners will be able to locate riparian zones in photos and will identify some of the key components of the GREEN Zone.

**Materials:** Photos on page 7 of the GREEN Zone Action Guide

### **Unit 1, Activity 3— Ecotone Explorations**

**Description:** Learners are introduced to the term “ecotone” as it applies to riparian areas by

drawing with highlighting markers and paper.

**Duration:** 20 minutes

**Setting:** Indoor or outdoor

**Skills:** Describing, drawing, interpreting, modeling, visualizing

**Objectives:** Learners will be able to describe an ecotone in a drawing and in words.

**Materials:** Blue and yellow highlighting markers, paper

## Unit I, Activity 4— Texas Creek Gets Better

**Description:** Learners will compare “before” and “after” photos and descriptions of a riparian management project to identify differences between an unhealthy GREEN Zone and a healthy one.

**Duration:** 15 minutes

**Setting:** Indoor or outdoor

**Skills:** Analyzing, comparing, interpreting, predicting

**Objectives:** Learners will be able to identify some differences between a healthy and unhealthy riparian zone.

**Materials:** “News articles” on page 10 of the GREEN Zone Action Guide

## Unit I, Activity 5— Lifelines of the West

**Description:** Using the “Nature’s Lifelines” poster, learners will explore why animals are attracted to riparian areas. They will investigate and report on one of the bird species that lives in the GREEN Zone surrounding the San Pedro River in southern Arizona and northern Mexico. They will also consider reasons why animals are attracted to riparian zones and name some animals that are attracted to riparian areas in their community.

**Duration:** 1 hour

**Setting:** Indoor or outdoor

**Skills:** Describing, discussing, explaining, listing, observing

**Objectives:** Learners will be able to explain why animals are attracted to and dependent on riparian areas.

### **Materials:**

- “Nature’s Lifelines” poster
- Field guide to North American birds, especially those of the American Southwest

## Background Information for Unit I

To assist youth with this unit, it will help to be familiar with several key concepts. Riparian areas are lands next to creeks, streams, and rivers where vegetation is strongly influenced by the presence of water. Riparian zones may make up a very small portion of the area in the western United States, but they are among the most productive and valuable of all lands. For example:

- In southeastern Wyoming more than 75% of all wildlife species depend on riparian habitats.
- In Arizona and New Mexico, 80% of all vertebrates depend on riparian areas for at least half their life cycles; more than half of these are totally dependent on riparian areas.
- More than half of all bird species in the southwestern U.S. are completely dependent upon riparian areas.<sup>9</sup>

### **Riparian benefits and services**

A healthy riparian area provides many services for wildlife, domestic animals, and people living in the watershed. Water and vegetation make riparian areas attractive and important to domestic livestock grazing on adjacent, drier uplands. Fish and other aquatic creatures depend totally on the surface water in riparian areas. These areas are the most important habitat for the majority of western wildlife species and are essential to many.

Riparian areas have many other values that are not well known and are commonly misunderstood. They occupy relatively small

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<sup>9</sup> Adapted in part from *Livestock Grazing on Western Riparian Areas*, U.S. Environmental Protection Agency, 1990.

areas of land but can have a relatively large effect on how watersheds function. Riparian areas influence both the quality of water and the timing of its release. As a result, the condition of a riparian area can have far-reaching economic and environmental consequences.

### **Evaluating riparian condition**

Scientists evaluate the condition of riparian areas by studying the characteristics of the water, vegetation, soils, landforms, and land uses, and how these features interact. One important characteristic is diverse vegetation. Woody and herbaceous plants slow down flood flows and provide a protective blanket against the erosive force of water. Their foliage shields the soil from wind and sunlight, which keeps soil temperatures low and reduces evaporation. They produce a variety of root systems that hold the soil in place. Natural resource specialists refer to an effective riparian area as an area in “proper functioning condition” or PFC. To help learners understand this complicated concept, the Action Guide refers to a riparian area in PFC as being “healthy.”

### **Land use impacts**

Riparian lands are naturally productive and have relatively gentle terrain. These characteristics and the nearby water attract a variety of human activities. Consequently, riparian areas are the most modified land type, especially in the West. Cultivation, road building, mining, urbanization, logging, and damming of rivers have widely and severely affected riparian areas, damaging their functions and values. Livestock grazing has had the most geographically extensive effects. The resulting economic and environmental costs have captured the attention of growing numbers of people concerned about the long-term productivity of our watersheds. Land managers are continually challenged to allow for a variety of land uses while ensuring riparian health. Youth will be future partners in managing and protecting these vital riparian ecosystems.<sup>10</sup>

<sup>10</sup> Adapted in part from *Livestock Grazing on Western Riparian Areas*, EPA, 1990.

### **Potential**

Natural resource professionals use the phrase “at its potential” to refer to the “highest ecological status a riparian-wetland area can attain given no political, social, or economical constraints.”<sup>11</sup> Riparian zones do not all look alike; they can still be functioning properly even though they are not “lush and green.” Some areas may support the growth of trees and shrubs, while others may have conditions suitable for sedges and grasses. Still others may have little or no vegetation. Each can be considered in proper functioning condition according to its potential. In the same way, a stream may have a natural pH of less than 5 or greater than 9 and still provide habitat for creatures suited to that environment. Such a stream is still at its potential. As they undertake their riparian studies, youth need to be aware of their zone’s potential. A natural resource partner will be able to help with this difficult concept and to advise group members about the potential of the zone they have chosen to study.



<sup>11</sup> *Riparian Area Management: A User Guide to Assessing Proper Functioning Condition and the Supporting Science for Lotic Areas*, BLM, FS, NRCS, Technical Reference 1737-15, 1998.

# Unit 2 – Solve the Puzzle

*The group will need approximately 4-6 hours to complete all activities in Unit 2.*

## **Objectives for Unit 2—**

There are 11 activities at 4 different stations in Unit 2, each with its own objectives. See Activity Descriptions for specific objectives.

## **Before beginning this unit...**

Group members should know:

- What a watershed is
- How to describe the water cycle, specifically what the water cycle is and what are the stages of water as it moves through the cycle
- How to make observations
- How to take notes about their observations and interpret what their observations mean

## **In Unit 2:**

Learners will explore components and functions of the GREEN Zone by completing four science stations:

Station 1 – Shaping the GREEN Zone

Station 2 – Water Quantity and Soils in the Zone

Station 3 – Water Quality and Plants in the Zone

Station 4 – Land Uses in the Zone

Through the processes of science inquiry and cooperative learning, group members will explore these important aspects of riparian areas. They will work in small teams to complete the activities at each station. More details on each station are provided after the general introduction to Unit 2.

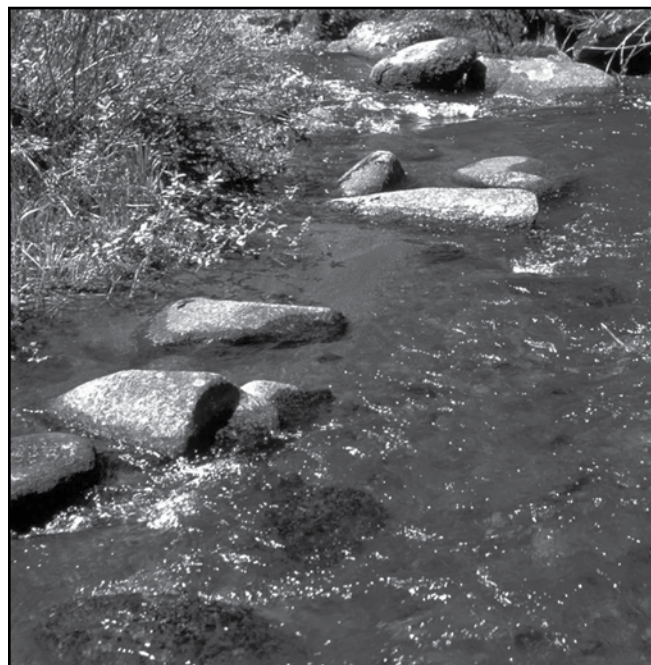
## **Unit preparation**

The science stations should be set up in advance. Stations can be located in different areas. Each should be clearly marked with the title of the station and the page number in the Action Guide that gives directions for that station. Each

station should be divided into separate activity areas where learners can find the materials needed for that particular activity. The activity descriptions that follow have a detailed supply list for each activity.

The group should be divided into 4 or more teams. Team sizes should be small (5 or less). If there are more than 4 teams, time and space will need to be managed more carefully. Here are some suggestions:

- Additional areas can be set up with tables and chairs where learners can finish work on a project while waiting to move on to another station.
- Enrichment activity stations can be set up with additional reading materials on riparian areas as well as computers to allow for exploration of web sites on riparian areas. In addition to those resources identified in the Appendices, an extensive list of riparian-related resources can be found at [www.blm.gov/education](http://www.blm.gov/education).





## Background Information for Unit 2

To assist youth with this unit, it will help to be familiar with several key concepts. Scientists need a gauge or measuring system to assess the condition of riparian or wetland areas. Natural resource specialists use an assessment method called “proper functioning condition” (PFC) to determine the health of a riparian ecosystem. The PFC is a qualitative method for assessing the condition of riparian-wetland areas, using a consistent approach for evaluating water, vegetation, and soils. More specifically, scientists investigate:

- Water quality and quantity
- Soil qualities
- Plant characteristics
- Stream shape, slope, and speed
- Stream erosion and deposition
- Land uses – human, livestock, and wildlife

A riparian area is considered to be in proper functioning condition (healthy) when the water,

vegetation, soils, landforms, and land uses are working together to:

- slow the speed of high, fast-moving water, which helps to reduce erosion;
- trap sediment, keeping it out of the water and adding to the soil in the surrounding floodplain;
- store flood water and recharge groundwater;
- support root masses that strengthen stream banks;
- create areas in the water that are calm and deep, providing habitat for fish, waterfowl, and other aquatic animals; and
- support greater numbers and varieties of plants and animals (biodiversity).

A PFC evaluation assesses whether the physical processes are functioning in a riparian area to provide services for the community such as a clean, abundant water supply; wildlife habitat; forage for livestock; and recreational opportunities.<sup>12</sup> As mentioned on page 16, a PFC evaluation also takes into account the particular riparian area’s potential.

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<sup>12</sup> Adapted from *Riparian Area Management: A User Guide to Assessing Proper Functioning Condition and the Supporting Science for Lotic Areas*, BLM, FS, and NRCS, Technical Reference 1737-15, 1998.

# Unit 2, Station 1 – Shaping the GREEN Zone

*The group will need approximately 1½ hours to complete all activities in Station 1.*

## Unit 2, Station 1, Activity 1— River Profiles

**Description:** Learners will locate the major landforms in a photo and a diagram of a river valley.

**Duration:** 10 minutes

**Setting:** Indoor or outdoor

**Skills:** Describing, discussing, labeling, working in small groups

**Objectives:** Learners will be able to recognize a floodplain; list benefits floodplains provide a community.

**Materials:**

- Copies of the “River Profiles” diagram (see next page)—one for each member of your group
- Team members should have copies of the GREEN Zone Action Guide with them so they can refer to the aerial photo of the river valley on page 19.

**Advance preparation:** Photocopy the “River Profiles” diagram. Make a copy for each member of the group.

## Unit 2, Station 1, Activity 2— Putting on the Brakes

**Description:** Learners will make a shoe-box model of a stream and will devise ways to slow down water (a marble) in their shoe-box stream to demonstrate the relationship between water speed and stream shape in the riparian zone. This activity works best if learners can work in teams of two.

**Duration:** 45 minutes

**Setting:** Indoor

**Skills:** Cooperating, describing, designing, calculating, labeling, constructing with media,

recording data, working in small groups, testing, timing, visualizing

**Objectives:** Learners will be able to demonstrate how the shape of a stream affects the velocity of the water.

**Materials:**

- A shoe box for each team and extras for backup
- Ruler for each team (cm)
- Marble
- Stopwatch
- Paper and pencils with eraser for calculations
- Glue, staples, tacks, different types of tape (masking, duct, invisible), paper clips
- Scraps of cardboard and various types of paper
- Scissors
- Books, blocks, etc. to raise one end of each shoe box approximately 2-3 cm high
- Miscellaneous craft materials such as toothpicks, cotton balls and swabs, pipe cleaners

**Advance preparation:** Ask group members to bring in shoe boxes for this activity. Each team should have a box and one or two extras for backup.

## Unit 2, Station 1, Activity 3— Plant Power

**Description:** Learners will observe detailed drawings of plants and examine characteristics that can help maintain a healthy riparian zone.

**Duration:** 35 minutes

**Setting:** Indoor

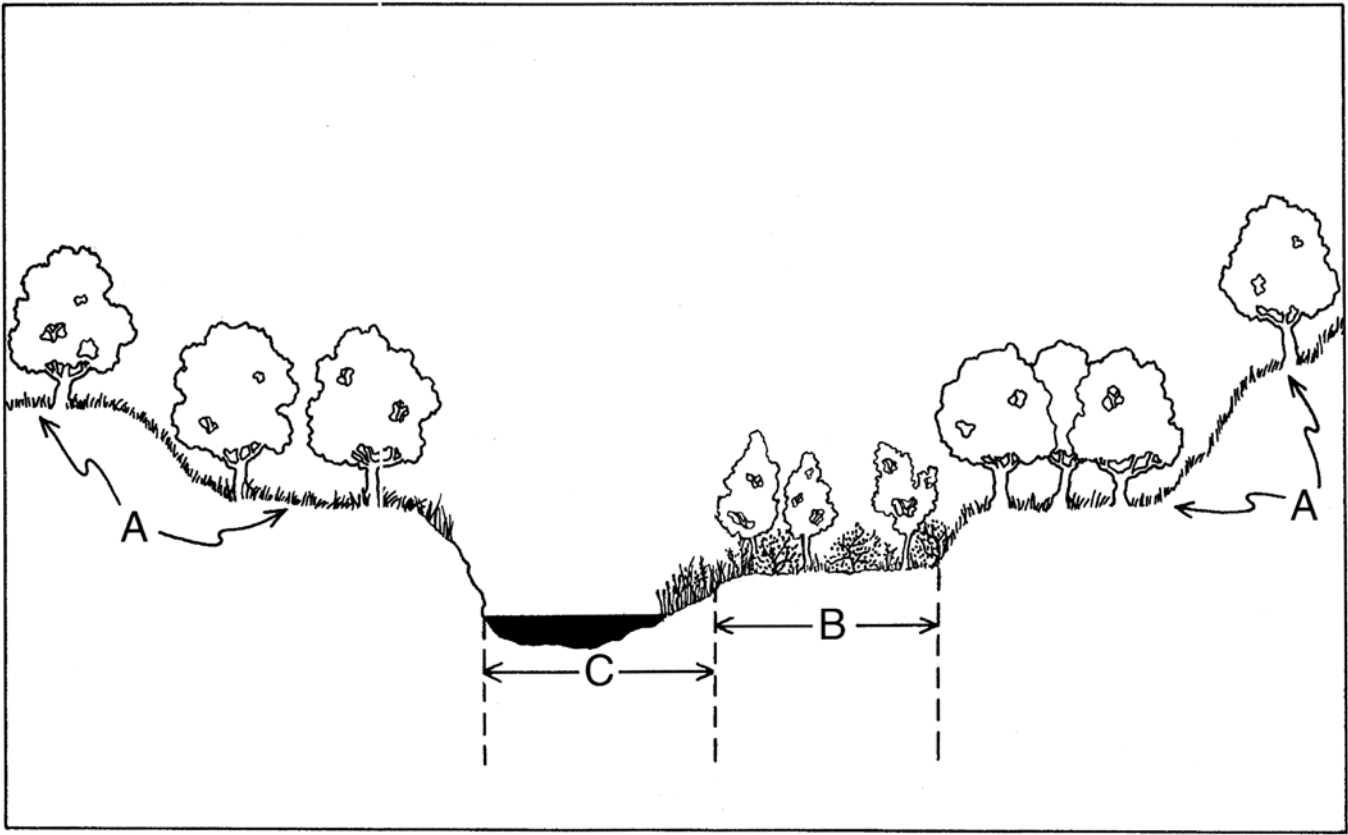
**Skills:** Categorizing, comparing, describing, observing, recording data, visualizing

**Objectives:** Learners will be able to describe characteristics of plants that allow them to help maintain a healthy riparian zone.

**Materials:**

- “Plant Characteristics” sheet from page 25 in the GREEN Zone Action Guide
- Pencils

## Unit 2, Station 1, Activity I—River Profiles



Fill in the blanks below with one of the following terms:

- stream channel
- floodplain and riparian zone
- upland zone

A \_\_\_\_\_

B \_\_\_\_\_

C \_\_\_\_\_

## Background Information for Station I

The processes of erosion and deposition are constantly at work as water moves through a riparian area. Sediment—consisting of soil, rock fragments, and other material—is transported by the moving water of streams. Stream equilibrium depends on the continual supply and transport of sediment over the long term. When water and sediment move in balance, the stability of soils and plants in a riparian area is increased.

Land uses that change the kind or amount of vegetation in a catchment/watershed may upset the balance of these processes and prevent the riparian area from functioning properly. Changes in vegetative cover can lead to less infiltration of rain or snowmelt into the soil, which means increased runoff into streams, as well as increased soil (sediment) movement into streams.

The force of water and the erosion and deposition of soils create floodplains in the riparian zone. Floodplains are flat areas on either or both sides of a stream or river that are created by periodic flooding. Floodplains serve many important functions; they:

- reduce erosion by allowing water to spread out and slow down;
- slow water enough during floods so it can seep into soil, recharge groundwater, and later slowly return (or drain back) to the stream; and
- filter sediment that settles from the water to build deep, rich soils.

Learners may wonder if a riparian zone and a floodplain are the same. This is not a simple question to answer. In arid and semi-arid regions, the riparian area can be smaller than the floodplain if groundwater is not a large component of the water input to the area. In areas where groundwater coming to the surface is involved or where precipitation, flooding, and groundwater are all part of the picture, then the

riparian area and floodplain are more likely to be similar.

As mentioned earlier, it's important for learners to be aware of the stream's potential, including its potential vegetation and channel shape. Then it can be determined if there has been a change in the kinds or amounts of vegetation that has affected the channel shape. If vegetation in the area no longer has root masses capable of withstanding high stream-flow events, excessive erosion of the stream banks or streambed can occur. When that happens, the channel becomes larger and can hold more water. Water might not overflow its banks, and the channel will then lose its connectivity with its associated floodplain.

The shape of a stream channel can tell scientists a great deal about the stream's equilibrium. There are many different types of streams depending on the geology, landform, and bioclimatic region. A natural resource partner can help to identify the stream type and associated channel shapes involved at the field site being studied in Unit 3. Channel shape concerns the width of the stream and the corresponding depth, along with sinuosity and slope.

Riparian vegetation produces a variety of root systems that bind the soil and hold it in place. It traps sediment that builds stream banks and forms productive wet meadows and floodplains. Vegetation reduces sedimentation that can pollute water supplies, affect hydroelectric reservoirs, and clog waterways.<sup>13</sup>

**Colonizers** are plants species that become established in open, barren areas; they are among the first plants to occupy open sites. In riparian areas, they colonize edges of areas of deposition, such as point bars, or areas where stream banks have freshly eroded. Their specialized root systems spread quickly, but the

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<sup>13</sup> Adapted in part from Adams, B., Fitch, L. (1998). *Caring for the Green Zone: Riparian Areas and Grazing Management*, Pub. No. I-581. Cows and Fish Project.

roots are shallow and the stems are relatively weak. Colonizers are stoloniferous—they send out stems above ground and where the nodes touch the soil, roots grow down into the soil. Colonizers initiate shallow roots every few centimeters, and as the force of water aligns their stems parallel to the water's edge, they develop temporary bands or stringers of vegetation along stream edges. Their primary function is to filter and catch very fine, flour-like sediments and build substrate for the stronger, more permanent stabilizing species. As such, they play a crucial role in initiating recovery and maintenance of stream banks.

**Stabilizers** are plant species that become established along edges of streams, rivers, ponds, and lakes in the riparian zone. Although they generally require wet conditions for

establishment, some may persist in drier conditions once they have become firmly established. They commonly have strong, cord-like rhizomes as well as deep fibrous root masses. Additionally, they have coarse leaves and strong crowns, which, along with their massive root systems, are able to buffer stream banks against the erosive forces of moving water. Along with enhancing stream bank strength, they filter sediments and, with the forces of water, they build and rebuild eroded portions of stream banks.<sup>14</sup>

It is important to note that there are specific plant species that have the root masses necessary to hold onto stream banks. A natural resource partner should be able to advise the group on plants in the area that have these characteristics and those that do not.

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<sup>14</sup> Adapted in part from Winward, A.H. (2000). *Monitoring the Vegetation Resources in Riparian Areas*, USDA Forest Service, General Technical Report RMRS-GTR-47.



# Unit 2, Station 2 – Water Quantity and Soils in the Zone

*The group will need approximately 1½ hours to complete all activities in Station 2.*

## Unit 2, Station 2, Activity 1— Angel Food Aquifer

**Description:** Learners will demonstrate how: water is stored underground; water levels are affected by the interactions between the water in a stream or lake and water in an adjacent aquifer; and people access groundwater supplies.

**Duration:** 30 minutes

**Setting:** Indoor

**Skills:** Modeling, observing, predicting

**Objectives:** Learners will be able to:

- List the major components of an aquifer
- Demonstrate how water is stored underground and how people access groundwater supplies
- Illustrate how aquifers are drained and re-charged
- Describe how water levels are affected by the interactions between the water in a stream or lake and water in an adjacent aquifer

**Materials:**

- A slice of angel food cake, approx. 25 cm diameter and 5 cm thick
- 2-liter bottle of clear soda
- Crushed ice
- Large, clear mixing bowl, approx. 25 cm diameter
- Large, clean spray bottle
- Drinking straw—one per team
- Groundwater diagram on page 27 of the GREEN Zone Action Guide
- 2 washable markers, different colors

**Advance preparation:**

- Materials listed are for one demonstration set-up. If there is more than one team, the

quantities of materials should be changed accordingly.

- Purchase or bake the angel food cakes. Cut circular slices, 5 cm thick—one for each team. Finished slices should look like doughnuts.
- Purchase 2-liter bottles of clear soda, crushed ice, drinking straws. (Ask parents, PTA, or other community groups to donate these materials or the money needed to purchase them.)

## Unit 2, Station 2, Activity 2— Texture Test

**Description:** Learners will explore basic soil characteristics.

**Duration:** 20 minutes

**Setting:** Indoor or outdoor

**Skills:** Analyzing, describing, observing, predicting, recording

**Objectives:** Learners will be able to describe basic soil characteristics and explain how to determine if local soil is more similar to sand or to clay soils.

**Materials:**

- Enough samples of sand, clay, and a local soil so that each learner is able to use approximately a teaspoonful of each type
- A container that has a lid that will drip water, such as a plastic sports water bottle (1 for every 4-5 learners)
- Copies of the “Texture Test” chart (see next page)—one for each member of the group

**Advance preparation:**

- Collect the three different soil types; a local nursery, garden store, or county Extension office should be able to provide assistance, if needed.

## Unit 2, Station 2, Activity 2 – Texture Test

The Scoop on Soil –Texture Test			
	Sand	Clay	Local Soil
Can you form a ball?			
Can you form a ball and then roll the ball into a snake?			
Can you form a ring with the snake shape you made?			
Does your sample feel gritty or sandy?			
Does your sample feel smooth, like flour?			
Does the sample feel neither gritty nor smooth?			
What color is the soil?			

## Unit 2, Station 2, Activity 3 – Percolation Test

(Note: Your prediction should go in shaded areas; your observations go in unshaded sections. Use the right-hand column to explain your predictions and observations.)

Prediction/Observation	Sand	Clay	Local Soil	Explanation
Will the water run out through the bottom of the bottle? Yes/No				
The water ran out of the bottom of the bottle. Yes/No				
How much water will run out?				
How many mL of water percolated through?				
How many seconds will it take for the water to pass through the soil?				
The time it took for the water to pass through the soil was...				
What will the water look like when it comes through? Clear, murky, very dirty, etc.				
The water was... (Describe its appearance.)				
Will the water still have food dye in it? Yes/No				
It looks like the water had...(same amount of dye, less dye, no dye)				
Will the soil look different where the water has gone? Yes/No				
The soil looked...(Same/Different)				

- Find containers for the soil. Small buckets work well.
- Gather the plastic bottles and fill with water.
- Photocopy the “Texture Test” chart. Make a copy for each member of the group.

## Unit 2, Station 2, Activity 3—

### Percolation Test

**Description:** Learners will time the flow of water through different soils; measure the amount of water held in these soils; observe the ability of soils to filter water.

**Duration:** 40 minutes

**Setting:** Indoor

**Skills:** Explanation, measuring, observation, prediction, timing, comparing and contrasting

**Objectives:** Learners will be able to predict how long it takes for water to percolate through different soils to recharge groundwater resources in a riparian area and compare percolation rates among different soils.

#### **Materials:**

- Three clear 2-liter bottles with the bottoms cut off for each team
- Three 500-ml beakers or similar clear containers
- One clear 500-ml measuring container marked in ml
- Soil samples (sand, clay, and a local soil)
- Extra container of sand
- 3 pieces of window screen or other fine mesh (circles, each approx. 10 cm in diameter)
- Water
- Clock with a second hand or timer
- Black and red washable markers
- One color of food dye
- Copies of the “Percolation Test” chart (see previous page)—one for each member of the group

#### **Advance preparation:**

- Ask group members to bring in clean, 2-liter plastic bottles. Each team will need 3 bottles.
- Cut the bottoms off the plastic bottles.
- Collect soil samples.
- Collect and cut pieces of window screen into circles approx. 10 cm in diameter. Each team will need 3 pieces.

- Photocopy the “Percolation Test” chart. Make a copy for each member of the group.

## Background Information for Station 2

Because of the presence of water, riparian-wetland areas have soil properties that differ from those of upland areas. Soils that are seasonally saturated with water during some part of the growing season can, when combined with microbial activity, become anaerobic, which means they lack oxygen. Spots of rusty red or orange in the soil form during anaerobic conditions. Soil nodules or coatings that are rusty red or orange indicate that the soils have at some point in time been saturated.

In upland areas, most soils are derived from in-place weathering processes. Relatively little soil material comes from off-site sources. In contrast, riparian-wetland soils are constantly changing because of the influx of new soils being deposited by storm events and overland flow. Great variability in soil types can occur over short distances in riparian areas. This variation in soils has an effect on the water and vegetation, as well as on the processes of erosion and deposition. The soil along stream banks, in floodplains, and in the substrate under the channel, acts as a sponge to retain water. This stored water is released over time as subsurface water or groundwater, extending the availability of water in the watershed for a longer period during dry seasons or recharging the underground aquifer. Water-restricting soil types such as clay or hardpans often have impermeable layers that support the water table of standing water riparian ecosystems such as marshes.

Vegetative composition of riparian-wetland areas is also strongly influenced by the amount of moisture and oxygen levels in the soil. For example, the type of riparian-wetland soil, the amount of soil organic matter, the depth to which the water table will rise, the climate, and the season and duration of high water will

determine the kinds of plants that will grow in riparian-wetland areas.<sup>15</sup>

In this station, learners will experiment with various types of soils, including sand, clay, and a local soil. Soils they find in the riparian zone during the field trip in Unit 3 will most likely be

different from the soils used in Unit 2 activities. But these experiments will help point out the different qualities soils may have depending on their composition. Learners should realize that although proportions may vary, all soils have the same components—mineral and organic matter, water, and air.

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<sup>15</sup> Adapted from *Riparian Area Management: Riparian-Wetland Soils*, BLM, Technical Reference 1737-19, 2003.

# Unit 2, Station 3 – Water Quality and Plants in the Zone

*The group will need approximately 1½ hours to complete all activities in Station 3.*

## Unit 2, Station 3, Activity 1— Filter Plants

**Description:** Learners will demonstrate that plants can filter some pollutants from a riparian area.

**Duration:** 5-10 minute set-up one day; next day 20 minutes

**Setting:** Outdoor or indoor

**Skills:** Comparing, discussing, observing, predicting, recording

**Objectives:** Learners will be able to describe one way that riparian vegetation can remove pollutants from water and will be able to suggest one reason why the capability of the GREEN Zone to absorb contaminants is limited.

**Materials:**

- 2 fresh celery stalks for each team
- 2 plastic water cups
- Masking tape
- Red food coloring
- White vinegar
- 2 measuring cups
- Paring knife or plastic knife
- Ruler (cm)
- Paper towel
- Piece of notebook paper for each team

**Advance preparation:**

- Purchase several bundles of fresh celery; trim the bottom end off each stalk. No stalk should be longer than 25 cm. Use stalks with leaves if possible.
- Buy red food coloring and white vinegar.

## Unit 2, Station 3, Activity 2— Erosion in the Zone

**Description:** Learners will compare and contrast the effects of rainfall on bare soil and on land protected by vegetation.

**Duration:** 30 minutes (Some preparation time may be needed several weeks in advance.)

**Skills:** Modeling, measuring, recording, calculating, observing, describing, discussing, comparing and contrasting

**Setting:** Indoor

**Objectives:** Learners will be able to define the term “sediment” and explain how plants can capture sediment, improving the quality of water in a stream.

**Materials:**

- Two large plastic trays (such as kitty litter boxes)
- A portable hand drill with 3/8" drill bit
- A watering can with sieve-style head
- Soil mix (soil, sand, and gravel)
- Rapid-growth grass seed or a piece of sod from a garden shop
- Two coffee filters and coffee filter holders or fine strainers
- Two large empty coffee cans
- Duct tape
- Two empty juice cans or cartons of about 240 ml capacity
- Wooden blocks to support the trays
- Water

**Advance preparation:** If you choose to plant grass seed in one of the trays, you should do so several weeks in advance. Otherwise, prepare trays in advance with soil and sod, and assemble other materials needed.

## Unit 2, Station 3, Activity 3— Critter Cube Count

**Description:** Learners will determine a water quality score for an imaginary stream by counting macroinvertebrates in a cube game. This activity gives learners a chance to practice gathering and using information to make judgments about the quality of water.

**Duration:** 15-30 minutes

**Skills:** Calculating, describing, identifying, interpreting, recording

**Objectives:** Learners will be able to use macroinvertebrate data to evaluate stream health.

### **Materials:**

- Macroinvertebrate Tally Sheet (see next 2-sided page)
- Key to Macroinvertebrate Life in the River (see Appendix F; also available on the Internet—see internet resources for this station in Appendix D, page 61)
- Four critter cubes (see instructions in “Advance preparation”)
- An ice cream bucket or similar container
- A clear, flat surface like a card table or a clear area on the floor
- Scissors and glue

### **Advance preparation:**

- Make copies of the Macroinvertebrate Tally Sheet – one for each team.
- Make the critter cubes. Cut blocks of wood 4-6 cm square or use toy building blocks or plastic cubes of similar sizes. Make a copy of the macroinvertebrate drawings on the Tally Sheet. Cut out each of the drawings. Don’t worry about cutting along lines, just cut out a circle or oval around each drawing. Glue the pictures onto the sides of the cubes making sure each cube has critters from each of the four groups pasted on it.
- Display the “Key to Macroinvertebrate Life in the River” chart for group members to refer to during the activity.

## Background Information for Station 3

Riparian vegetation maintains or improves the quality of water in a stream by trapping sediment and other pollutants from runoff and keeping them out of the stream. Both colonizing and stabilizing plants (see Station 1) play critical roles in the ability of the riparian area to function properly. Each stream or river bank must develop and maintain adequate numbers and varieties of these plant species to create, over time, a balance between the eroding and rebuilding forces of water. In some cases, anchored logs or rocks will perform this function. When the erosion and deposition forces are out of balance, sediments and soils will accumulate in the stream channel, degrading the quality of water, harming fish and other aquatic organisms, and clogging waterways.

Through complex microbial processes, plants can also break down, remove, and assimilate a variety of chemical pollutants that are present in the soils and subsurface water of riparian areas, keeping many of these harmful substances out of rivers and streams.

Riparian specialists use a variety of methods to test the quality of surface water in a riparian area, including water clarity testing, chemical testing, and biological testing. Testing water clarity usually involves a turbidity test, which measures materials suspended in the water. Turbidity affects how much light can penetrate the water. Chemical testing includes tests for dissolved oxygen and pH levels. Along with temperature, these levels are important to fish and other aquatic life. Biological testing usually involves a macroinvertebrate survey. Some macroinvertebrates (water insects, worms, clams, crayfish, and snails) are more sensitive to water pollutants than others. Finding a number of the sensitive organisms in field-testing would indicate that the local aquatic ecosystem is healthy and, therefore, the riparian zone is functioning well.



# Unit 2, Station 3, Activity 3—Critter Cube Count

**Group 1: These are sensitive to pollutants. Circle each animal found.**



Stonefly Larva



Dobsonfly Larva

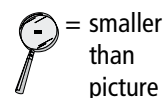
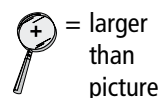


Alderfly Larva



Water Snipe Fly Larva

Relative Size Key:



Number of group 1 animals circled:

**Group 2: These are semi-sensitive to pollutants. Circle each animal found.**



Caddisfly Larva\*



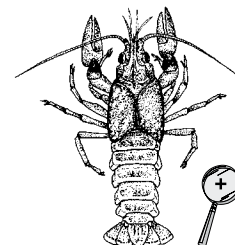
\*All Caddisfly Larva = 1



Dragonfly Larva



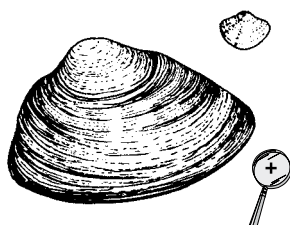
Water Penny



Crawfish



Crane Fly Larva



Freshwater Mussel or Fingernail clam



Mayfly Larva



Damselfly Larva



Damselfly tail (side view)



Riffle Beetle Larva\*



Riffle Beetle Adult\*

\*All Riffle Beetles = 1

Number of group 2 animals circled:

**Group 3: These are semi-tolerant of pollutants. Circle each animal found.**



Black Fly Larva



Non-Red Midge Larva



Snails: Orb or Gilled (right side opening)



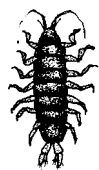
Amphipod or Scud

Number of group 3 animals circled:

**Group 4: These are tolerant of pollutants. Circle each animal found.**



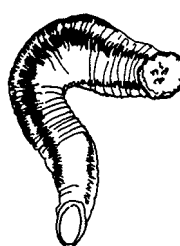
Pouch Snail (left side opening)



Isopod or Aquatic Sowbug



Bloodworm Midge Larva (red)



Leech



Tubiflex Worm

Number of group 4 animals circled:

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**Water Action Volunteers**

## Unit 2, Station 3, Activity 3—Critter Cube Count

### Macroinvertebrate Tally Sheet Recording Form \*

Name: \_\_\_\_\_ Date: \_\_\_\_\_

Stream Name: \_\_\_\_\_ Time: \_\_\_\_\_  
(make up a name)

Number of animal types from Group 1: Sensitive \_\_\_\_\_ x 4 = \_\_\_\_\_

Number of animal types from Group 2: Semi-sensitive \_\_\_\_\_ x 3 = \_\_\_\_\_

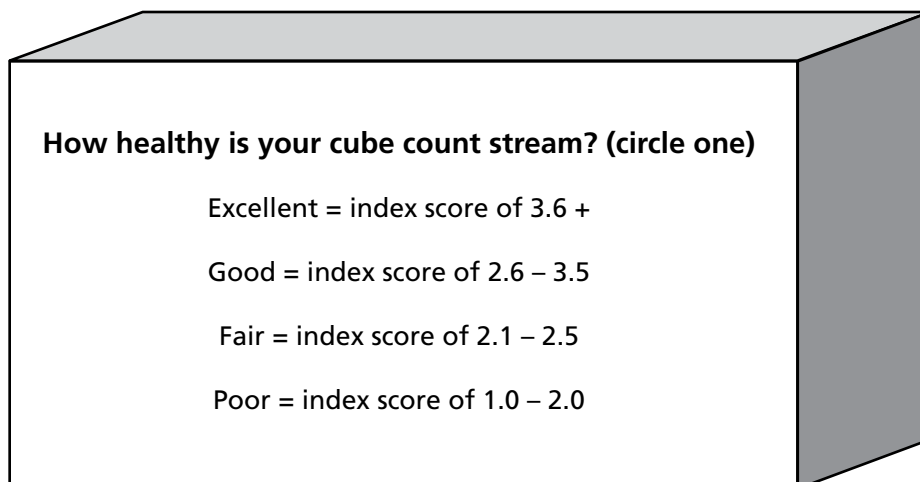
Number of animal types from Group 3: Semi-tolerant \_\_\_\_\_ x 2 = \_\_\_\_\_

Number of animal types from Group 4: Tolerant \_\_\_\_\_ x 1 = \_\_\_\_\_

TOTAL NUMBER OF ANIMAL TYPES (A) \_\_\_\_\_ TOTAL VALUE (B) \_\_\_\_\_

Index score (C) = The total value (B) divided by the total number of animal type (A)  
(C = B / A)

My stream had an index score of: \_\_\_\_\_



**How healthy is your cube count stream? (circle one)**

Excellent = index score of 3.6 +

Good = index score of 2.6 – 3.5

Fair = index score of 2.1 – 2.5

Poor = index score of 1.0 – 2.0

\* Adapted from *Water Action Volunteers*, Univ. of Wisconsin-Extension and Wisconsin Dept. of Natural Resources, 2008.

# Unit 2, Station 4 – Land Uses in the Zone: Working Toward a Healthy Balance

*The group will need approximately 1½ hours to complete all activities in Station 4.*

## Unit 2, Station 4, Activity 1— Where is my Watershed?

**Description:** Learners will locate the riparian areas in their community watershed on street or topographical maps and will identify how people and animals use these areas.

**Duration:** 45 minutes

**Setting:** Indoor

**Skills:** Describing, drawing, identifying, interpreting, mapping, tracing, visualizing

**Objectives:** Learners will be able to locate the riparian areas and watershed(s) on a map of their community and identify at least three human activities that take place near one riparian zone. They will also help choose a site to study in Unit 3.

**Materials:**

- A copy of a street map and/or topographic map that includes the local watershed and community for each team
- A display map showing the location of the local watershed and, if possible, the location of major aquifers in the community
- Colored pencils
- Pencil with eraser for each person

**Advance preparation:**

- Make 8.5 x 11" colored copies of a street map or topographic map of your area. To order a topographic map, see *Finding and Ordering USGS Topographic Maps* (Internet reference for this station in Appendix D, page 61), or call 1-888-ASK-USGS. Consult with local natural resource specialists for information about the local watershed and aquifers. Where possible, mark these on a large map and display the map where all members of the group can see it.

## Unit 2, Station 4, Activity 2— Wildlife in the Zone

**Description:** Learners will investigate some of the positive and negative effects of animal activities in the riparian zone.

**Duration:** 45 minutes

**Setting:** Indoor

**Skills:** Interpreting, constructing with media, modeling, reading, researching

**Objectives:** Learners will be able to list ways that domestic animals and wildlife, particularly beavers, affect the health of the GREEN Zone.

**Materials:**

- Poster board
- Poster paint
- Plastic containers (at least 10 cm deep)
- Glue
- Modeling clay
- Grab bag full of materials that might be used in the beaver dam building or diorama projects (include twigs, dried leaves and grass)
- Markers, crayons, pencils
- Books, field guides, and other printed material about beavers with pictures or diagrams of beaver dams and lodges
- Jar of water/sand mix (500 ml of water and ¼ cup of sand)

**Advance preparation:**

- Ask group members who choose to make beaver dioramas to bring in plastic containers (at least 10 cm deep) and a selection of dry plant materials such as twigs, leaves, and grasses.
- Purchase art supplies as needed.
- Ask school or public library staff to set aside books about beavers in a special collection for use by the group.

## Background Information for Station 4

Land uses in the riparian zone by wildlife, livestock, and people can have profound effects on the ability of the riparian area to function properly. Among the major human land use activities that cause disturbance in riparian areas are:

- Agriculture—vegetative clearing, in-stream modifications, soil exposure and compaction, irrigation and drainage, sediment and contaminants
- Forestry—removal of trees, transportation of products, site preparation
- Domestic livestock grazing—loss of vegetative cover, physical impacts from livestock
- Mining—vegetative clearing, soil disturbance, altered hydrology, contaminants, spoils deposition
- Recreation—vegetative clearing, physical impacts from facilities, equipment, and people
- Urbanization—altered hydrology, altered channels, sedimentation and contaminants, road construction, surface runoff, wastewater disposal
- Dams—altered hydrology, altered channels

Riparian land managers also monitor ecological disturbances caused by invasive plant species such as loosestrife and leafy spurge. In addition, livestock (cattle, horses, sheep, and hogs) and wildlife, such as deer and elk, can trample fragile stream banks and damage riparian areas by crushing and overgrazing vegetation. They can also compact the soil, altering drainage and plant growth. Riparian specialists work with landowners to employ a variety of grazing controls and systems to maximize riparian function on private and public lands.

Beavers are also recognized for their potential to influence riparian systems in positive and negative ways. Dams built by beavers can improve water quality by trapping sediments behind dams and by reducing stream velocity. Beaver ponds can alter water chemistry by trapping nutrients and bacteria. The activities of beavers in the riparian zone can increase the diversity and abundance of birds, amphibians, reptiles, and mammals.<sup>16</sup>

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<sup>16</sup> Adapted in part from *Stream Corridor Restoration: Principles, Processes, and Practices*, The Federal Interagency Stream Restoration Working Group, 1998.

# Unit 3 – Get into the Zone

*The group will need approximately 2-4 hours to complete the field trip activities in Unit 3.*

## **Objectives for Unit 3—**

Learners will be able to:

- Understand and employ some simple field measurement and collection methods
- Compile scientific information about a riparian area in their community

## **Before beginning this unit...**

Group members should know:

- Definition of a riparian zone and a watershed
- Name of the stream that will be studied during the field trip
- Location of the stream in the local watershed
- Field trip safety guidelines as outlined on page 36 of this guide and in the field trip packets
- Meaning of the word “career”

## **In Unit 3:**

Learners will choose a science specialty (water ecology, soil science, biology, physical geography) and then will collect field data related to that specialty. The scientific methods they will use and the checklists they will complete are simplified versions of those used during a PFC assessment. Learners will use their scientific inquiry and critical thinking skills to describe both the physical characteristics and the condition of their site. All the information and data sheets/checklists that group members will need for the field trip are included in the Action Guide.

The field trip will be the highlight of the riparian curriculum for many youth and adults. It is important to make the trip educational but even more important to make it fun! Part of the fun will be in giving young people the opportunity to explore this ecosystem on their

own, working as independently as their ages and safety considerations allow. If possible, some downtime should be scheduled so the kids can just enjoy being outdoors in the GREEN Zone.

## **Background Information for Unit 3**

To facilitate youth understanding of this section, it will help to be familiar with several key concepts. There are a number of indicators of riparian ecosystem condition that natural resource specialists measure and study to determine if an area is healthy or unhealthy:

- Physical indicators
- Physical/hydrological functions
- Chemical functions
- Biological functions

In order to facilitate communication about the condition of riparian areas in the western United States, three U.S. government agencies—the Bureau of Land Management, the Fish and Wildlife Service, and the Natural Resources Conservation Service—combined efforts to establish a method that uses common terms and definitions for assessing the condition of these ecosystems. The term “proper functioning condition” (PFC) describes this method as well as the state or health of the riparian area.

A PFC assessment requires a team of natural resource specialists to compile data on a standard checklist. This method determines whether the physical processes are functioning in a riparian area to provide services for the community such as a clean, abundant water supply; wildlife habitat; forage for livestock; and recreational opportunities. See Appendix E, page 63, for an example of a standard checklist used during a PFC assessment of a lotic (flowing water) ecosystem.

# Planning the Field Trip

## Where will the group go?

The following factors should help to determine the suitability of a particular site:

- Safety—Will group members be able to wade in the water safely? Are poison ivy, barbed wire, broken glass, or other hazards present?
- Public or private land—Will special permission be needed to use the site? Will the group need to pay a fee to use the site?
- Accessibility—Will the site accommodate a bus or many cars? Can members of the group walk to the edge of the water safely (barbed wire, steep slopes, loose rock, etc.)? Will learners with physical challenges be able to participate at this site?
- Seasonal changes—a site that is suitable in the fall might be dangerous during the spring when waters are high and fast. Will the stream be running in late summer or during a period of drought? Will the site be too wet and muddy?
- Distance from school or home base—How much travel time will be needed to get to and from the site?

## How much time will be needed?

The day's schedule should be carefully planned, keeping in mind such questions as: How long will teams be allowed to collect their data? Will the group eat lunch on site? What time do group members need to be back at home base?

## If there is no riparian area nearby...

In addition to streams and rivers, it is possible to study riparian areas near lakes, ponds, or reservoirs during the field trip. If a field trip is not possible, it may be possible to set up a stream table or watershed model. These items can be purchased or constructed from readily available materials. A natural resource partner should be able to provide more information.

## Work with a natural resource professional

The "General Advice" section on page 7 has suggestions on where to find a local natural resource partner to help plan and carry out

the field trip. Not only should these resource professionals be able to provide expertise on riparian science, they might also offer:

- Advice on choosing an appropriate site
- Background/historical information on a particular stream, including water test results, soil tests, well information, etc.
- Testing equipment and other supplies
- Resources, including brochures, pamphlets, posters, topographical maps, field guides, aquifer models, supplemental activities

## Role of field trip leader

During the field trip, the role of the leader is that of a facilitator, helping to structure the learning experiences so that each group member can successfully participate and interact with the environment. The field trip activities are designed so that learners will have opportunities for independent data collection and interpretation. By working together and developing inquiry skills through the activities and by answering questions in their Zone Notes, learners will be able to both think independently and participate in group discussions. This approach can be valuable in the following ways:

- Environmental investigations can be developed to allow groups to combine skills and knowledge as they collect and interpret their own information.
- The group leader has a way to identify the group's level of understanding of a topic.
- Everyone participates at his or her personal level of interest and motivation.
- A group works together in a problem-solving situation.
- A group summarizes its own findings, values, and feelings before comparing them to the findings, values, and opinions of other groups, specialists, or professionals.<sup>17</sup>

## The Field Trip Packets

Learners will take on the roles of natural resource specialists during the field trip. They will choose to be a water ecologist, soil scientist, biologist, or physical geographer for the day.

<sup>17</sup> Adapted from *Investigating Your Environment*, U.S. Forest Service, 1993



Once on site, they will work in specialist teams to complete activities in a field guide packet. All learners who choose to be water ecologists will work with the water ecologist specialty team; those who choose to be soil scientists will work with the soil scientist team, and so on. The teams should be kept small (4-6 learners each) so that all team members have a role in collecting data.

Each specialist team has a packet—a “Field Guide”—with a materials checklist, safety checklist, data sheets, information and instructions, as well as a Zone Notes section. Learners should be able to work independently as a team, but an adult should be close by to answer any questions that may arise, to ensure that safety precautions are followed, and to help the teams adhere to the day’s schedule.

**The Field Guides are found in the Action Guide beginning on page 57. Copies of the field guide packets should be made for each of the four specialty teams.** If there is more than one team of a particular specialty, an additional packet should be made for that team.

## Materials List

Well in advance of the field trip, the following materials need to be collected for the entire group:

- First aid kit
- Plastic trash bags
- Transect line (50-meter-long rope marked at 5-meter intervals with permanent marker)

In addition, the following materials will be needed for each team:

### Water Ecologist

- Key to Macroinvertebrate Life in the River (see Appendix F, page 65)
- White bucket or tray
- White ice cube trays
- Magnifying glass
- Plastic cups
- Tweezers
- Spoons

- A fine-meshed net with a long handle
- Clipboard
- 2 pencils with erasers
- Tape measure (metric)
- 4 marker flags
- Timer (stopwatch or watch with a second hand)
- Meter stick
- Thermometer
- pH test kit
- 3 apples or 3 oranges
- Other \_\_\_\_\_

### Soil Scientist

- Garden spade
- Meter stick
- Calculator
- Clipboard
- 2 pencils with erasers
- 10-meter-long string
- Other \_\_\_\_\_

### Biologist

- Clipboard
- 2 pencils with erasers
- Length of rope (50 cm)
- Ocular tube or toilet paper roll
- Tape measure (metric)
- Ruler (metric)
- Field guide to local plants
- Field guide to local animals
- Other \_\_\_\_\_

### Physical Geographer

- Spade
- Clipboard
- 2 pencils with erasers
- Tape measure (metric) or measuring string (10 meter length)
- 2 stakes (approx. 30 cm long)
- Mallet
- 2 meter sticks
- Level
- Compass
- Colored pencils or markers for site map
- Poster paper for site map drawing
- Optional: Digital or 35-mm camera and film or video camera and videotape
- Other \_\_\_\_\_

Materials such as thermometers, nets, and pH test kits are sometimes available on loan from local agencies and environmental groups. They can also be ordered from scientific supply companies. More information can be obtained from a natural resource partner or the Internet. The materials for each team should be put in a separate, labeled container with a lid (such as a plastic storage bin). The container should be capable of keeping the materials dry in the event of rain.

## Field Trip Tips and Safety Considerations

Getting outside and exploring is the best way to learn about riparian areas. When working with young people, it is important to plan for both education and safety, particularly around water.

Once the field trip is scheduled, a letter can be sent to parents inviting them to join the group. The age of the youngsters participating will determine exactly how much adult supervision is necessary. It is important for the adults to be clear about their roles. Prior to the field trip, all group members should work together to establish rules for conduct, comfort, and safety.

Considerations in planning the trip include:

- Who to contact to gain permission from the landowner to bring a group to the riparian area.
- Weather conditions expected and the type of clothing required for comfort and safety. Participants should have footwear that is sturdy and can get wet. Sandals are not recommended.
- Are restroom facilities available? If not, what is the plan for restroom needs?
- Who is trained in first aid and will carry a first aid kit?
- What is the closest source of additional medical help?
- Should a lifeguard accompany the group? The water conditions and age of the young people in the group will affect this decision.
- Should everyone pack and carry food and fresh water for the day?

- Who knows where the group is going and the scheduled return time? Who will summon help if there is a delay in your return?
- If carpools are being used to get to the site, are there forms that must be completed at the school, county Extension office, etc. to authorize transportation of youth?
- Is cell phone service available? Who will bring a cell phone on the trip for use in an emergency?
- Are there learners with special needs such as medications?
- Are any group members severely allergic to mold, pollen, insect bites, bug spray, or stinging plants?

The GREEN Zone curriculum includes activities that use water quality test kits. The test kits are available from a variety of sources. Each kit, and the chemicals and procedures for its use, will be different. Each kit should come with a Material Safety Data Sheet (MSDS) that explains safe handling and disposal procedures for the tests they contain. The adult helper for each group should become familiar with the applicable MSDS prior to using these tests with a group of young people.

### When you arrive

If possible, it would be helpful to set up the transect line prior to the group's arrival. If it is necessary to set it up on the same day, a small group can be assigned to work on this project upon arrival at the site. The guest natural resource professional could oversee the group and provide advice on the best location for this important data collection tool. This would be a good opportunity to review safety rules, warning group members about specific hazards and reminding them what to do in case of emergency.

### When you leave

A group should be assigned—with at least one member from each specialist team—to be in charge of cleanup. Each team should return its own investigation equipment to the plastic containers. But an overall site cleanup is important too—especially if this riparian field trip might become an annual event!

# Unit 4 – Putting the Pieces Together

*The group will need approximately 2 hours to complete Unit 4.*

## Objectives for Unit 4—

Learners will be able to:

- Describe in great detail a riparian area in their community
- List the services this GREEN Zone provides for residents of the community
- Describe three relationships between living and non-living things that support a diversity of life in the GREEN Zone
- Explain why a healthy riparian zone is necessary for preserving the biodiversity of the area

## Before beginning this unit...

Group members should know:

- How to make simple mathematical calculations
- How to organize observations and data into logical descriptions and explanations

## In Unit 4:

The *Holding onto the GREEN Zone* Action Guide offers learners opportunities to experience, reflect, generalize, and apply content related to specific riparian topics. Group members will practice their cooperative learning and critical thinking skills as they combine all the data they collected during the field trip to seek comprehension and appreciation of riparian concepts in their own communities. (See page 11 to review information about science education and the learning cycle.) After the field trip, each team will determine how to present its data and findings to the whole group. Learners will then reflect on biodiversity and how the biodiversity of a stream relates to the health of its riparian area. The leader's role will again be that of a facilitator as described in Unit 3.

## Unit 4 Activity—

### Specialist Team Presentations

**Description:** Learners will use data collected in the field to prepare a presentation on their investigations for the larger group; then following the specialist team presentations, the group will discuss the results of their findings.

**Duration:** 2 hours

**Setting:** Indoor

**Skills:** Describing, interpreting, mapping, reporting, working in small groups

**Objectives:** Learners will be able to describe in detail a riparian area in their community and will be able to list the services this GREEN Zone provides for residents of the community.

### Materials:

- Completed data sheets for each specialist team
- Zone Notes compiled by each team member
- “Key Pieces of the Puzzle” chart (one copy for each team member—see pages 39-40)
- Copy of the map produced by the physical geographer team

**Advance preparation:** Make a copy of the “Key Pieces of the Puzzle” chart for each team member.



## Background Information for Unit 4

To facilitate youth understanding of this section, it will help to be familiar with several key concepts.

Healthy riparian areas support a great diversity of plant and animal life. This diversity of life, or biodiversity, is enhanced because the riparian zone is an ecotone, where upland and aquatic habitats blend.

Biodiversity refers to the number and variability of plants or animals within a single species, the

variety of the species themselves, and the variety of ecosystems. Greater biodiversity promotes a healthier GREEN Zone that is more capable of adapting to changing conditions such as storm events and pests. A diverse riparian ecosystem supports a variety of species in a given area, as well as large numbers of those species. It is the interaction of this variety of life with the non-living parts of the riparian ecosystem that promotes a healthy GREEN Zone capable of providing numerous services or benefits for communities.

## Unit 4 – Key Pieces of the Puzzle

### What the data tell us about our GREEN Zone

Characteristics	Questions	My Observations
<b>Water Quality and Quantity</b>	<p>Is there enough water above and below the ground to sustain a diversity of life?</p> <p>Is the water clean?</p>	<hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/>
<b>Soil Qualities</b>	<p>Can the soil in the zone hold water? Will it support plants with roots that can hold onto soil?</p>	<hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/>
<b>Plant Characteristics</b>	<p>Are there riparian plants with strong, soil-holding roots? Are the plants holding the stream bank together? Do the plants provide cover and food for wildlife and livestock?</p>	<hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/>

## Unit 4 – Key Pieces of the Puzzle

### What the data tell us about our GREEN Zone

Characteristics	Questions	My Observations
<b>Stream Shape, Slope, and Speed</b>	How does the shape of the land in the riparian zone affect the speed of the water? How has the speed of the water shaped the land?	<hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/>
<b>Erosion and Deposition</b>	Is this GREEN Zone able to balance erosion and deposition, and control the amount of sediment entering the stream?	<hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/>
<b>Land Uses— Human, Wildlife, Livestock</b>	How do the activities of people, wildlife, and livestock affect the ability of the zone to function properly?	<hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/>



# Unit 5 – Tell the News

*The group will need approximately 2 hours to complete all activities in Unit 5.*

## **Objectives for Unit 5—**

Learners will be able to:

- Describe a local riparian area to members of their community
- Critique and enhance their work in the GREEN Zone with feedback from natural resource professionals

## **Before beginning this unit...**

Group members should know how to:

- Write a letter
- Plan a meeting
- Present information in front of a group

## **In Unit 5:**

The group has combined all of the information they gathered in their specialist teams. They know about the water quality and quantity, erosion, soil characteristics, as well as the vegetation, wildlife, and land uses at the field trip site. By sharing the information they collected, learners develop critical thinking skills. They also demonstrate that what they discovered is important to members of their community. (It is important for learners to realize, however, that professional natural resource specialists study riparian areas in detail, for long periods of time, before they're able to draw conclusions about proper functioning condition.)

Group members are encouraged to be creative about how they present their findings. The two activities in this unit are just suggestions for how they might proceed. The natural resource partner should have ideas on who to contact for an audience that will not only appreciate the work the group has completed but will be able to provide feedback and additional information about local riparian areas.

## Unit 5, Activity 1—Tales of Our GREEN Zone Adventure

**Description:** Learners will plan and present a demonstration about their GREEN Zone adventure to a group in their community.

**Duration:** 1 hour

**Setting:** Indoor

**Skills:** Describing, interpreting, reporting, working in a large group

**Objectives:** Learners will be able to plan and present a program describing a local riparian area to members of their community.

**Materials:** To be determined by learners

**Advance preparation:** To be determined by learners

## Unit 5, Activity 2— Meet with the Pros

**Description:** Learners will meet with local natural resource professionals to discuss and obtain feedback on their findings.

**Duration:** 1 hour

**Setting:** Indoor

**Skills:** Describing, discussing

**Objectives:** Learners will be able to plan a meeting during which they present and discuss findings of an ecosystem investigation, define a riparian zone, and describe their roles as stewards of riparian areas.

**Materials:** To be determined by learners

**Advance preparation:** To be determined by learners

## **Zone Notes – Tell the News**

Unit 5 Zone Notes questions are special because they give youth a chance to demonstrate their comprehension of the major themes of the entire *Holding onto the GREEN Zone* curriculum. Teachers/leaders can use youth responses to these questions, along with their Zone Notebooks, as a means of measuring the success of their riparian education efforts.

## Background Information for Unit 5

To facilitate youth understanding of this section, it will help to be familiar with the following key concept:

“Students need opportunities to present their abilities and understanding and to use the knowledge and language of science to communicate scientific explanations and ideas. Writing, labeling drawings, completing concept maps, developing spreadsheets, and designing

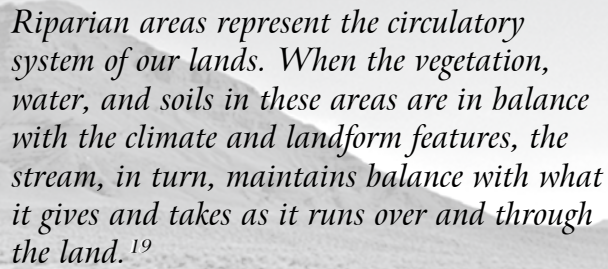
computer graphics should be a part of the science education. These should be presented in a way that allows students to receive constructive feedback on the quality of thought and expression and the accuracy of scientific explanations.”<sup>18</sup>

Personal and civic responsibilities are based in knowledge. By broadening our knowledge of the environment, we strengthen our decision-making and citizenship skills.

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<sup>18</sup> From the *National Science Education Standards*, National Academy of Sciences, 1995.

# Conclusion



*Riparian areas represent the circulatory system of our lands. When the vegetation, water, and soils in these areas are in balance with the climate and landform features, the stream, in turn, maintains balance with what it gives and takes as it runs over and through the land.<sup>19</sup>*

As all participants will discover during their GREEN Zone adventure, human activity and natural forces can easily tip the delicate

ecological balance in the riparian zone. After completing the riparian curriculum, youth should be encouraged to learn more about the social, economic, and management aspects of riparian areas. Will they go on to become volunteer stewards of these valuable resources or, someday, work as natural resource managers themselves? Only time will tell, but congratulations on planting that seed. These young people now have the base of knowledge needed to consider those goals for themselves and their communities.

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<sup>19</sup> Winward, A.H. (2000). *Monitoring the Vegetation Resources in Riparian Areas*, USDA Forest Service, General Technical Report RMRS-GTR-47.



# Appendices

## Appendix A

### Selected Riparian Curricula, Activities, and Additional Resources

The riparian curricula and activities listed below provide background information and/or supplemental activities that complement the *Holding onto the GREEN Zone* curriculum. This information might be used to expand your scientific understanding of riparian areas or offer enrichment opportunities for learners.

#### ***Creek Watchers: Exploring the World of Creeks and Streams***

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**For ages:** 10-15  
**Publication date:** 1993  
**Contact:** CASEC California Aquatic Science Education Consortium  
(916) 752-8824  
**URL:** <http://www.rain.org/casec/index.html>

<i>Activities</i>	<i>Riparian Information/Concepts Covered</i>
<i>Be a Friend of Creeks and Streams</i>	Brainstorm actions to protect and restore streams and riparian areas.
<i>Creekwalk</i>	Explore procedures for assessing the health of a creek and riparian vegetation.
<i>Creek of Dreams</i>	Recognize the components of a healthy stream ecosystem; compare healthy creek habitats with those that have been significantly altered from their natural states.
<i>These Sheltering Trees</i>	Identify riparian trees and the roles they play in promoting the overall health of a stream.

#### ***Discover Wetlands***

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**For grades:** K-12  
**Publication date:** 1988, revised 1995  
**Publication number:** 88-16a  
**Contact:** Washington State Department of Ecology  
(360) 407-6147  
**URL:** <http://www.ecy.wa.gov/biblio/8816a.html>

<i>Activities</i>	<i>Riparian Information/Concepts Covered</i>
<i>Water, Water Everywhere</i>	Explore the ways wetlands purify water.
<i>Dragonfly Pond</i>	Illustrate impacts from human use of wetlands.
<i>Wetlands and Native Americans</i>	Examine the importance of wetland plants to Native Americans.

### **Environmental Education Resource Guide: Nonpoint Source Pollution Prevention**

**For grades:** 9-12  
**Publication date:** 1993  
**Contact:** Air & Waste Management Association  
(412) 232-3444  
**Email:** [info@awma.org](mailto:info@awma.org)  
**URL:** [http://www.awma.org/enviro\\_ed/resources1/eerg/enviro\\_ed\\_curriculum.html](http://www.awma.org/enviro_ed/resources1/eerg/enviro_ed_curriculum.html)

<i>Activities</i>	<i>Riparian Information/Concepts Covered</i>
<i>Eee-Aye-E.I.S.</i>	Explore environmental and economic trade-offs of agricultural practices; roles of agriculture and livestock management practices in nonpoint source pollution; Best Management Practices (BMP's).
<i>Mined Over Water</i>	Study how sediment from mining contributes to nonpoint source pollution; simulate surface mining and reclamation.
<i>The Grass is Always Cleaner</i>	Illustrate land use practices; erosion and sedimentation; importance of BMP's.

### **From Ridges to Rivers: Watershed Explorations**

**For ages:** 9-12  
**Publication date:** 1999  
**Contact:** 4-H SERIES Project, 4-H Center, UC Davis  
(916) 752-8824  
**URL:** <http://clubs.ca4h.org/sanluisobispo/r2rwe/pdf/element.pdf>

<i>Activities</i>	<i>Riparian Information/Concepts Covered</i>
<i>Run, River, Run</i>	Study the dynamics of river flow.
<i>We've Got the Watershed in Our Hands</i>	Explore changes in creek banks due to man-made and environmental factors

### **Hands On Save Our Streams: Science Projects Guide for Students**

**For grades:** 6-12  
**Publication date:** 1994  
**Contact:** Izaak Walton League of America  
Save Our Streams Program  
1-800-BUG-IWLA  
**URL:** <http://www.iwla.org/index.php?id=19>

<i>Activities</i>	<i>Riparian Information/Concepts Covered</i>
<i>Water Pollution Runs Downhill</i>	Construct a watershed model containing a stream, lake, and wetland; illustrate pollution flow and the effects of management practices.
<i>Making the Land and Water Connection</i>	Read about the effects of agriculture, mining, forestry, dams, and construction and road-building; use of BMP's to minimize impacts; apply concepts learned to study of adopted stream.



### ***Investigating Your Environment***

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**For grades:** 6-12  
**Publication date:** 1996  
**Contact:** U.S. Department of Agriculture Forest Service  
St. Paul Field Office, Conservation Education Office  
(651) 649-5239  
**URL:** <http://www.na.fs.fed.us/spfo/ce/resources/resources.htm>

<i>Activities</i>	<i>Riparian Information/Concepts Covered</i>
<i>Introduction to Riparian Areas</i>	Offers in-class study and contrast of a disturbed and healthy riparian zone.
<i>Riparian Areas and Watersheds</i>	In-field construction of a watershed; analyze components of the watershed that reduce and control erosion.
<i>A Transect of Riparian Vegetation</i>	Field identification of riparian vegetation along a transect; infer vegetation zones, correlate with environmental factors.
<i>Wildlife Blind</i>	Observe and record data about wildlife.
<i>Riparian Assessment</i>	Analyze health of a riparian ecosystem; discuss management strategies.

### ***Land and Water***

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**For grade:** 4  
**Publication date:** 1997  
**Contact:** Carolina Biological Supply Company  
1-800-334-5551  
**URL:** <http://www.carolinacurriculum.com/stc/units/land.asp>

<i>Activities</i>	<i>Riparian Information/Concepts Covered</i>
<i>Plants: Protecting Sloped Land from Erosion</i>	Use stream table demonstrations to show how plants affect the flow of water on land.
<i>Dams: How Humans Change the Direction and Flow of Water</i>	Examine the effects of dams on water direction and flow.

### ***Project WILD Aquatic***

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**For grades:** K-12  
**Publication date:** Revised in 2000  
**Contact:** Project WILD National Office  
(713) 520-1936  
**Email:** [info@projectwild.org](mailto:info@projectwild.org)  
**URL:** <http://www.projectwild.org/resources.htm>

<i>Activities</i>	<i>Riparian Information/Concepts Covered</i>
<i>Riparian Retreat</i>	Explore characteristics of riparian habitat; animals that inhabit riparian habitat; importance of riparian areas to wildlife and humans.
<i>Blue Ribbon Niche</i>	Examine the ecological roles of organisms that live in riparian ecosystems; characteristics of riparian habitats; effects of natural and man-made changes in riparian habitats.
<i>Migration Headache</i>	Identify factors affecting populations of migrating waterbirds; effects of riparian/wetland habitat loss and degradation on populations of migrating waterbirds.

### ***River Cutters***

**For Grades:** 6-8  
**Publication Date:** 1992  
**Contact:** GEMS, University of California  
(510) 642 – 7771  
**URL:** <http://www.lhs.berkeley.edu/gems/GEMSRivercutters>

<i>Activities</i>	<i>Riparian Information/Concepts Covered</i>
<i>Dams and Toxic Waste</i>	Stream table investigations of how land use changes river systems.

### ***Rivers Curriculum Guides (Interdisciplinary Series)***

**For grades:** 9-12  
**Publication date:** 1997-1998  
**Contact:** Rivers Curriculum Project, Southern Illinois University  
Dale Seymour Publications  
1-800-872-1100  
**URL:** <http://www.siu.edu/OSME/river/Ordering%20Materials/Order.html>

<i>Earth Science</i>	
<i>Activities</i>	<i>Riparian Information/Concepts Covered</i>
<i>Completing a Habitat Assessment</i>	Identify components of habitat assessment; rate the quality of a stream's habitat.
<i>Geography</i>	
<i>Activities</i>	<i>Riparian Information/Concepts Covered</i>
<i>What are the Characteristics of the River?</i>	Introduce the physical and human characteristics of a river environment to learners.
<i>Tracing the History of a Local Family</i>	Explore the roles waterways have in family and community histories.

### ***Stream Scene (The): Watersheds, Wildlife and People***

**For grades:** 6-12  
**Publication date:** 1990  
**Contact:** Oregon Department of Fish and Wildlife  
(503) 872-5264 x 5366  
**URL:** <http://www.oregon-plan.org/OPSW/archives/streamscene/streamscene.shtml>

<i>Activities</i>	<i>Riparian Information/Concepts Covered</i>
<i>A Dirty Subject... Soil, Vegetation, and Watersheds</i>	Explore water infiltration rates in compacted vs. non-compacted soils; relationships among vegetation, soils, runoff, and wildlife in riparian habitats.
<i>Things That Go "Bump in the Night"</i>	Demonstrate a method of sampling small mammal populations in riparian areas; use a simulation exercise to estimate a small mammal population.

### ***Wetlands and Wildlife: Alaska Wildlife Curriculum Teacher Manuals and Guides***

**For grades:** K-6, 7-12  
**Publication date:** 1992  
**Contact:** U.S. Fish and Wildlife Service, Anchorage, AK  
(907) 235-8757  
**URL:** <http://alaska.fws.gov/external/education/resources/curricula.htm>

<i>Activities</i>	<i>Riparian Information/Concepts Covered</i>
<i>Rate a Wetland</i>	Field study—evaluate wetland water quality, wildlife, visual quality, hydrology, vegetation, invertebrates, and human use.
<i>Ecological Puzzler</i>	Explore the influence of beavers on fish and waterfowl.

### ***WOW! The Wonders of Wetlands***

**For grades:** K-12  
**Publication date:** 2000 (5<sup>th</sup> Ed.)  
**Contact:** Environmental Concern Inc.  
(410) 745-9620  
**URL:** <http://www.wetland.org/>

<i>Activities</i>	<i>Riparian Information/Concepts Covered</i>
<i>Run for the Border</i>	Observe differences between wetland and upland communities.
<i>Wetland Metaphors</i>	Explore characteristics, importance, and ecological functions of wetlands.
<i>Tracking Plants and Keeping Track</i>	Collect, name, and identify wetland plants.
<i>Soak it Up!</i>	Examine interactions between wetlands, surface water, and groundwater.
<i>Nutrients: Nutrition or Nuisance</i>	Study the effects of nutrients on a marsh; filtering ability of wetland plants.
<i>Runoff Race</i>	Demonstrate how wetlands filter sediment.
<i>Wetland in a Pan</i>	Create a model to illustrate the flood-buffering and filtering effects of wetlands.
<i>Do You Dig Wetland Soil?</i>	Explore the physical characteristics of wetland soils.

A list of additional riparian resources can be found at [www.blm.gov/education](http://www.blm.gov/education). For information on test kits and other water quality testing equipment, check: <http://www.usawaterquality.org/volunteer/Outreach/EquipmentSuppliers2.pdf>.



# Appendix B

## *Holding onto the GREEN Zone Curriculum Concept Map*

What are the key concepts/topics covered in the curriculum? Use the concept map as a guide for planning, establishing correlations to state standards, and measuring outcomes.

<b>GREEN Zone Units</b>	<b>Riparian Concepts</b>	<b>Areas of Study</b>	<b>Outcomes</b>
<b>Unit 1— Get a Clear Picture</b>	<p>Riparian zones are significant natural areas in your community.</p> <ul style="list-style-type: none"> <li>A healthy riparian area is able to support a diversity of organisms because it is a place where biotic and abiotic components of terrestrial and aquatic ecosystems blend together.</li> <li>Healthy riparian areas attract wildlife, aquatic organisms, livestock, and people because they provide an abundance of food, water, and shelter.</li> </ul>	<ul style="list-style-type: none"> <li>Riparian ecosystems/ecotones</li> <li>Identification of riparian zones</li> <li>Healthy vs. unhealthy zones</li> <li>Three basic components of all riparian zones: water, soil, and plants</li> </ul>	<p>Youth will be able to:</p> <ul style="list-style-type: none"> <li>identify some differences between a healthy and unhealthy riparian zone</li> <li>describe riparian zones they visited in the past</li> <li>illustrate the meaning of the term “ecotone”</li> <li>locate riparian zones in photos</li> <li>identify some of the key components of the riparian zone</li> <li>explain why animals are attracted to and dependent on riparian zones</li> </ul>
<b>Unit 2— Solve the Puzzle</b> (See the Stations described below for additional Unit 2 concepts, studies, and outcomes.)	<p>A riparian zone is healthy (in proper functioning condition) when it can perform many services or jobs in the community.</p>	<p>To determine if a riparian zone is in proper functioning condition, natural resource specialists investigate six factors:</p> <ul style="list-style-type: none"> <li>Water quality and quantity</li> <li>Soil qualities</li> <li>Plant characteristics</li> <li>Stream shape, slope, and speed</li> <li>Stream erosion and deposition</li> <li>Land uses—human, livestock, and wildlife</li> </ul>	<p>General Outcomes</p> <p>Youth will be able to:</p> <ul style="list-style-type: none"> <li>describe a riparian zone</li> <li>list six characteristics or functions of riparian zones</li> </ul>
<b>Unit 2, Station 1— Shaping the GREEN Zone</b>	<p>The shape of the riparian zone is always changing through the processes of erosion and deposition.</p> <p>The stream in a healthy riparian zone:</p> <ul style="list-style-type: none"> <li>moves water and sediment in balance</li> <li>is able to access the floodplain</li> <li>has banks that are protected by riparian vegetation</li> </ul>	<ul style="list-style-type: none"> <li>Landforms in the riparian zone (floodplains, terraces, and meanders) and their functions</li> <li>Riparian plant characteristics</li> </ul>	<p>Youth will be able to:</p> <ul style="list-style-type: none"> <li>recognize a floodplain</li> <li>list the benefits floodplains provide a community</li> <li>demonstrate how the shape of a stream affects the velocity of the water</li> <li>describe characteristics of plants that allow them to help maintain a healthy riparian zone</li> </ul>

<b>GREEN Zone Units</b>	<b>Riparian Concepts</b>	<b>Areas of Study</b>	<b>Outcomes</b>
<b>Unit 2, Station 2— Water Quantity and Soils in the Zone</b>	The conditions necessary for a riparian zone to maintain sufficient quantities of water to function properly are related to: <ul style="list-style-type: none"> <li>• soil characteristics in the zone</li> <li>• a give-and-take relationship between surface water and groundwater sources</li> </ul>	<ul style="list-style-type: none"> <li>• Aquifers—structure and composition</li> <li>• Groundwater recharge</li> <li>• Soil characteristics</li> <li>• Connections between surface water and groundwater resources</li> </ul>	Youth will be able to: <ul style="list-style-type: none"> <li>• list the major components of an aquifer</li> <li>• demonstrate how water is stored underground and how people can access groundwater supplies</li> <li>• illustrate how aquifers are drained and recharged</li> <li>• describe how water levels are affected by the interactions between the water in a lake or stream and water in an adjacent aquifer</li> <li>• describe basic soil characteristics and explain how to determine if local soil is more similar to sand or to clay soils</li> <li>• compare percolation rates among different soils</li> <li>• predict how long it takes for water to percolate through different soils to recharge groundwater resources in a riparian zone</li> </ul>
<b>Unit 2, Station 3— Water Quality and Plants in the Zone</b>	Riparian vegetation keeps the GREEN Zone healthy in a variety of ways.	<ul style="list-style-type: none"> <li>• Role of riparian vegetation in filtering sediment and other pollutants and reducing erosion</li> <li>• Macroinvertebrates as indicators of water quality</li> </ul>	Youth will be able to: <ul style="list-style-type: none"> <li>• describe one way that riparian vegetation can remove pollutants from water</li> <li>• suggest one reason why the capability of the riparian zone to absorb contaminants is limited</li> <li>• define the term “sediment”</li> <li>• explain how plants can capture sediment, improving the quality of water in a stream</li> <li>• use macroinvertebrate data to evaluate stream health</li> </ul>
<b>Unit 2, Station 4— Land Uses in the Zone</b>	The health of a riparian zone is related to the natural and man-made communities that surround it in the watershed.	<ul style="list-style-type: none"> <li>• Location of riparian zones in a community watershed</li> <li>• Identification of human activities in a local watershed that may impact riparian zones</li> <li>• Role of beavers in riparian zones</li> </ul>	Youth will be able to: <ul style="list-style-type: none"> <li>• locate riparian zones and watersheds on a map of their community</li> <li>• identify at least three human activities that take place near one riparian zone in their community</li> <li>• choose a site to study in Unit 3</li> <li>• list ways that wildlife, particularly beavers, and livestock affect the health of riparian zones</li> </ul>

<b>GREEN Zone Units</b>	<b>Riparian Concepts</b>	<b>Areas of Study</b>	<b>Outcomes</b>
<b>Unit 3— Get into the Zone</b>	<p>Natural resource professionals collect and analyze data from the GREEN Zone to:</p> <ul style="list-style-type: none"> <li>• describe the health of the ecosystem</li> <li>• determine if the zone is functioning properly</li> <li>• recommend future action for preserving or restoring a particular riparian zone</li> </ul>	<p><b>WATER ECOLOGY</b></p> <ul style="list-style-type: none"> <li>• Water pollution</li> <li>• Water odor</li> <li>• Litter</li> <li>• Water quality, temperature, and pH</li> <li>• Stream velocity</li> <li>• Stream flow</li> <li>• Water levels of stream</li> <li>• Macroinvertebrates</li> </ul> <p><b>BIOLOGY</b></p> <p>Plant characteristics</p> <ul style="list-style-type: none"> <li>• Canopy cover/shading</li> <li>• Plant diversity</li> <li>• Changes in the plant community</li> <li>• Stream bank condition</li> </ul> <p>Animal survey</p> <ul style="list-style-type: none"> <li>• Animal sounds, sightings, signs</li> </ul> <p><b>SOILS</b></p> <ul style="list-style-type: none"> <li>• Soil types</li> <li>• Signs of erosion</li> <li>• Streambed deposits</li> <li>• Stream channel condition</li> <li>• Stream bank condition</li> </ul> <p><b>PHYSICAL GEOGRAPHY</b></p> <ul style="list-style-type: none"> <li>• Signs of disturbance</li> <li>• Slope estimate</li> <li>• Topography</li> <li>• Stream width</li> <li>• Meanders</li> <li>• Channel alterations</li> </ul>	<p>Youth will be able to:</p> <ul style="list-style-type: none"> <li>• understand and employ some simple field measurement and collection methods</li> <li>• compile scientific information about a riparian zone in their community</li> </ul>
<b>Unit 4— Putting the Pieces Together</b>	<p>Determining the health of a riparian zone requires the collection of scientific data and observations that are integrated to assess the functioning condition of the zone.</p> <p>Natural resource professionals have specialized skills to gather and analyze information about ecosystems and how they function.</p>	<ul style="list-style-type: none"> <li>• Synthesis of field data and observations to describe a local riparian zone</li> <li>• Biodiversity in the riparian zone</li> </ul>	<p>Youth will be able to:</p> <ul style="list-style-type: none"> <li>• describe in great detail a local riparian zone in their community</li> <li>• list the services a local riparian zone provides for residents of the community</li> <li>• describe three relationships between living and non-living things that support a diversity of life in the riparian zone</li> <li>• explain why a healthy riparian zone is necessary for preserving biodiversity</li> </ul>



<b>GREEN Zone Units</b>	<b>Riparian Concepts</b>	<b>Areas of Study</b>	<b>Outcomes</b>
<b>Unit 5— Tell the News</b>	<p>Natural resource specialists, land managers, and other community members:</p> <ul style="list-style-type: none"> <li>• use scientific processes to gather information about riparian ecosystems</li> <li>• evaluate data from scientific processes and use the results to make recommendations about how people can protect the functions of the riparian zone</li> </ul>	<ul style="list-style-type: none"> <li>• Communication of scientific observations and ideas</li> <li>• Riparian management in the community</li> </ul>	<p>Youth will be able to:</p> <ul style="list-style-type: none"> <li>• plan a meeting and present/discuss findings of an ecosystem investigation</li> <li>• describe a local riparian zone to members of their community</li> <li>• critique and enhance their work in the riparian zone with feedback from natural resource professionals</li> <li>• investigate how natural resource specialists manage the riparian zones in their community</li> <li>• describe their roles as stewards of riparian zones</li> </ul>

# Appendix C

## Correlations to Education Standards

*Holding onto the GREEN Zone* materials and activities have been correlated to:

- *National Science Education Content Standards* for Grades 5-8 (Appendix C-1, p. 56)
- North American Association for Environmental Education *Excellence in Environmental Education – Guidelines for Learning, Pre K-12* (Appendix C-2, p. 58)
- 4-H Youth Development Guidelines (Appendix C-3, p. 59)

# Appendix C-I

## Correlations to National Science Education Content Standards – Grades 5-8

NATIONAL SCIENCE EDUCATION CONTENT STANDARDS—Grades 5-8	Holding onto the GREEN Zone												
	Unit 1—Get a Clear Picture	Unit 2—Solve the Puzzle	• Shaping the GREEN Zone	• Water Quantity and Soils in the Zone	• Water Quality and Plants in the Zone	• Land Uses in the Zone	Unit 3—Get into the Zone	• Water Ecologist	• Soil Scientist	• Biologist	• Physical Geographer	Unit 4—Putting the Pieces Together	Unit 5—Tell the News
<b>Content Standard A: Science as Inquiry</b>													
<u>Abilities necessary to do scientific inquiry:</u> Design and conduct a scientific investigation; use appropriate tools and techniques to gather, analyze, and interpret data; develop descriptions, explanations, predictions, and models using evidence; think critically and logically to make the relationships between evidence and explanations; communicate scientific procedures and explanations; use mathematics in all aspects of scientific inquiry.	X	X	X	X	X	X	X	X	X	X	X	X	X
<b>Content Standard C: Life Sciences</b>													
<u>Populations and ecosystems:</u> A population consists of all individuals of a species that occur together at a given place and time. All populations living together and the physical factors with which they interact compose an ecosystem. The number of organisms an ecosystem can support depends on the resources available and abiotic factors, such as quantity of light and water, range of temperatures, and soil composition.	X	X	X	X	X	X	X	X	X	X		X	
<b>Content Standard D: Earth and Space Science</b>													
<u>Structure of the earth system:</u> <b>Land forms</b> are the results of a combination of constructive and destructive forces. Constructive forces include crustal deformation, volcanic eruption, and deposition of sediment, while destructive forces include weathering and erosion. <b>Soils</b> consist of weathered rocks and decomposed organic materials from dead plants, animals, and bacteria. Soils are often found in layers, with each having a different chemical composition and texture. <b>Water</b> ... circulates through the crust, oceans, and atmosphere in what is known as the “water cycle.” Water evaporates from the earth’s surface, rises and cools as it moves to higher elevations, condenses as rain or snow, and falls to the surface where it collects in lakes, oceans, soil, and in rocks underground.		X	X	X	X	X	X	X	X	X	X	X	
		X	X	X	X	X	X		X	X		X	
		X	X	X	X	X	X	X	X	X	X	X	

# Appendix C-I (continued)

## Correlations to National Science Education Content Standards – Grades 5-8

NATIONAL SCIENCE EDUCATION CONTENT STANDARDS—Grades 5-8	Holding onto the GREEN Zone												
	Unit 1—Get a Clear Picture	Unit 2—Solve the Puzzle	• Shaping the GREEN Zone	• Water Quantity and Soils in the Zone	• Water Quality and Plants in the Zone	• Land Uses in the Zone	Unit 3—Get into the Zone	• Water Ecologist	• Soil Scientist	• Biologist	• Physical Geographer	Unit 4—Putting the Pieces Together	Unit 5—Tell the News
<b>Content Standard F: Science in Personal and Social Perspectives</b>													
<u>Populations, resources, and environments:</u> Causes of environmental degradation and resource depletion vary from region to region and from country to country.	X			X	X	X	X	X	X	X	X	X	
<u>Natural hazards:</u> Internal and external processes of the earth system cause natural hazards, events that change or destroy human and wildlife habitats, damage property, and harm or kill humans. Natural hazards include earthquakes... floods, storms, and even possible impact of asteroids. Human activities also can induce hazards through resource acquisition, urban growth, land-use decisions, and waste disposal. Such activities can accelerate many natural changes.		X	X			X	X			X	X	X	X
<b>Content Standard G: History and Nature of Science</b>													
<u>Science as a human endeavor:</u> Women and men of various social and ethnic backgrounds—and with diverse interests, talents, qualities, and motivations—engage in the activities of science, engineering, and related fields.... Some scientists work in teams, and some work alone, but all communicate extensively with others. Science requires different abilities, depending on such factors as the field of study and type of inquiry. Science is very much a human endeavor, and the work of science relies on basic human qualities, such as reasoning, insight, energy, skill, and creativity—as well as on scientific habits of mind, such as intellectual honesty, tolerance of ambiguity, skepticism, and openness to new ideas.							X	X	X	X	X	X	
<u>Nature of science:</u> It is part of scientific inquiry to evaluate the results of scientific investigations, experiments, observations, theoretical models, and the explanations proposed by other scientists.													X

# Appendix C-2

## Correlations to NAAEE Excellence in Environmental Education – Guidelines for Learning (Pre K-12)

NAAEE Guidelines for Learning	Holding onto the GREEN Zone												
	Unit 1—Get a Clear Picture	Unit 2—Solve the Puzzle	• Water Shapes the GREEN Zone	• Water Quantity and Soils in the Zone	• Water Quality and Plants in the Zone	• Land Uses in the Zone	Unit 3—Get into the Zone	• Water Ecologist	• Soil Scientist	• Biologist	• Physical Geographer	Unit 4—Putting the Pieces Together	Unit 5—Tell the News
<b>Strand 1—Questioning and Analysis Skills</b>													
Questioning	X	X	X	X	X	X	X	X	X	X	X	X	X
Designing investigations		X	X	X	X		X					X	
Collecting information	X	X	X	X	X	X	X	X	X	X	X	X	X
Organizing information		X	X	X	X	X	X	X	X	X	X	X	X
Working with models and simulations		X	X	X	X	X					X		
Developing explanations		X		X	X	X	X	X	X	X	X	X	
<b>Strand 2—Knowledge of Environmental Processes and Systems</b>													
<b>Strand 2.1—The Earth as a Physical System</b>													
Processes that shape the Earth	X	X	X	X	X		X	X	X		X	X	
<b>Strand 2.2—The Living Environment</b>													
Organisms, populations, and communities	X	X	X		X	X	X			X	X	X	
Systems and connections	X	X		X	X	X	X	X		X		X	
<b>Strand 2.4—Environment and Society</b>													
Human/environment interactions	X	X		X	X	X	X	X	X		X	X	X
Places	X	X	X	X		X	X	X	X	X	X	X	X
<b>Strand 3—Skills for Understanding and Addressing Environmental Issues</b>													
<b>Strand 3.1—Skills for Analyzing/Investigating Environmental Issues</b>													
Identifying and investigating issues	X	X			X	X	X	X	X	X	X	X	
Sorting out the consequences of issues	X	X		X								X	X

# Appendix C-3

## 4-H Youth Development Guidelines

Leaders will find that the *Holding onto the GREEN Zone* curriculum meets the following goals of 4-H curricula:

### Experiential Learning

- Enough background information is provided so youth can do each activity.
- Youth are meaningfully involved with content so that knowledge and skill will be retained. Activity moves from concrete experience to abstract where youth can apply what they learned to the future.
- Youth are allowed to take responsibility for their own learning by applying skills that allow them to comprehend, appreciate, and apply content.
- Activities generate data, questions, or insights that can be discussed and processed. May have the opportunity to visually express what they have learned on the page.
- Processing questions are open-ended rather than yes/no or true/false questions and relate to outcomes (youth development and subject matter).
- A variety of levels of experience are provided throughout the curriculum.
- Opportunities are included for involving volunteers and youth as partners in planning, implementing, and evaluating the learning process.

### Learner Centered

- Includes a variety of educational experiences for varied learning styles: cognitive, psychomotor, and affective activities.
- Reading level is developmentally appropriate for each level.
- Learning experiences are sequential and age-suitable when appropriate.
- Activities are fun and excite youth to do and learn more.

- Curriculum is sensitive, reflective, and respectful of audience diversity.
- User-friendly according to the targeted age for each level.

### Subject Matter/Content

- Subject matter and methods are accurate, current, and appropriately used.
- Scope and sequence are appropriate for the content and age.

### Youth Development Components

- Includes information explaining performance outcomes of the curriculum.
- Includes information on the experiential learning processes and/or path.

### Facilitator/Helper Guide

- Information supports both the youth development and subject matter outcomes.
- Provides enough information to enable the facilitator/helper to support the youth in doing the activity (i.e., focus, support and feedback, and debriefing).
- Provides answers to the questions contained in the youth manuals where applicable.

### Design Format/Components/ Common Elements

- Title of curriculum series creates interest.
- Titles of levels are appealing and support overall theme for series.
- Names and icons of repeated common elements reinforce overall theme for curriculum series (i.e., chapter titles, background info, further exploration, glossary, experiential learning steps, etc.)
- Facilitator/Helper Guide is user-friendly.
- Activity format and components are consistent throughout the curriculum.

### **Writing Style**

- Uses conversational second-person voice throughout.
- Uses one writing style throughout.
- Uses acceptable grammar, punctuation, and spelling.

### **Acknowledgments**

- Includes all design team members' names.
- Includes names of collaborating organizations.

The GREEN Zone curriculum also offers youth the opportunity to develop the following Life Skill Areas:

- Problem-solving and decision-making
- Managing resources
- Workforce preparedness
- Communicating and relating with others

- Acquiring, analyzing, and using information
- Working with groups
- Psychomotor skills

The **4-H program areas** covered by the curriculum are:

- Citizenship and civic education
- Plants and animals
- Communication and expressive arts
- Environmental and Earth sciences
- Science and technology

It includes the following 4-H specified components:

- Learner Manual
- Leader Manual
- Activity Sheets



# Appendix D

## Related Internet Resources for Activities

### Unit 2, Station 1, Activity 1— River Profiles

- USGS Science for a Changing World, *Floods and Flood Plains*, <http://pubs.usgs.gov/of/1993/ofr93-641/pdf/ofr93-641.pdf>
- Chapter 1 of *Stream Corridor Restoration—Principles, Processes, and Practices*, Federal Interagency Stream Corridor Restoration Working Group at [http://www.nrcs.usda.gov/technical/stream\\_restoration/PDFFILES/CHAPTER1.pdf](http://www.nrcs.usda.gov/technical/stream_restoration/PDFFILES/CHAPTER1.pdf)

### Unit 2, Station 1, Activity 2— Putting on the Brakes

- Chapter 1 of *Stream Corridor Restoration—Principles, Processes, and Practices*, Federal Interagency Stream Corridor Restoration Working Group at [http://www.nrcs.usda.gov/technical/stream\\_restoration/PDFFILES/CHAPTER1.pdf](http://www.nrcs.usda.gov/technical/stream_restoration/PDFFILES/CHAPTER1.pdf)

### Unit 2, Station 1, Activity 3— Plant Power

- *The Value of Riparian Vegetation*, King County, Natural Resources and Parks, WA, at <http://dnr.metrokc.gov/wlr/pi/ripveg.htm>
- *Line Drawings of Common Trees and Shrubs that Grow in Montana Riparian and Wetland Sites*, Riparian and Wetland Research Program Educational Pages at <http://www.ecologicalsolutionsgroup.com/Documents/Educational%20posters/leaves%20and%20things2/afront.htm>
- *Examples of Ecological and Management Relationships of Riparian and Wetland Types of Montana*, Riparian and Wetland Research Program Educational Pages at [http://www.ecologicalsolutionsgroup.com/Documents/Educational%20posters/POSTER%20III/poster\\_III.htm](http://www.ecologicalsolutionsgroup.com/Documents/Educational%20posters/POSTER%20III/poster_III.htm)
- Natural Resources Conservation Service: Plants Database—Wetland Indicator Status at <http://www.plants.usda.gov/wetland.html>

### Unit 2, Station 2, Activity 1— Angel Food Aquifer

- *Ground Water and Drinking Water Kids' Page, Classroom Activities and Experiments*, US Environmental Protection Agency (EPA) at [http://www.epa.gov/safewater/kids/teachers\\_4-8.html](http://www.epa.gov/safewater/kids/teachers_4-8.html)
- *Water Science for Schools*, US Geological Survey, Earth's Water at <http://ga.water.usgs.gov/edu/mearth.html>

### Unit 2, Station 2, Activity 2— Texture Test

- *Soil Science Education*, NASA/Global Learning and Observations to Benefit the Environment (GLOBE) at <http://soil.gsfc.nasa.gov/index.html>

### Unit 2, Station 2, Activity 3— Percolation Test

- *Soil Science Education*, NASA/Global Learning and Observations to Benefit the Environment (GLOBE) at <http://soil.gsfc.nasa.gov/index.html>

### Unit 2, Station 3, Activity 1— Filter Plants

- *Role of Plants in Water Filtration*, US EPA Environmental Education at [http://www.epa.gov/safewater/kids/pdfs/activity\\_grades\\_4-8\\_plantsinwaterfiltration.pdf](http://www.epa.gov/safewater/kids/pdfs/activity_grades_4-8_plantsinwaterfiltration.pdf)

### Unit 2, Station 3, Activity 2— Erosion in the Zone

- *Buffer Strips: Common Sense Conservation*, USDA Natural Resources Conservation Service at <http://www.nrcs.usda.gov/FEATURE/Buffers/>
- *Introduction to Riparian Buffers*, Connecticut River Joint Commission at <http://www.crjc.org/buffers/Introduction.pdf>

## Unit 2, Station 3, Activity 3— Critter Cube Count

- *Water Quality and Aquatic Macroinvertebrates*, Science Junction, North Carolina State University at <http://www.ncsu.edu/sciencejunction/depot/experiments/water/lessons/macro/>
- *Key to Aquatic Macroinvertebrates*, NYS Department of Environmental Conservation at <http://www.dec.ny.gov/animals/35772.html>
- *Aquatic Macroinvertebrate Identification Key*, Save Our Streams, Izaak Walton League of America at <http://people.virginia.edu/~sos-iwla/Stream-Study/Key/MacroKeyIntro.HTML>
- *Citizen Monitoring Biotic Index*, Water Action Volunteers, Volunteer Monitoring Factsheet Series at <http://watermonitoring.uwex.edu/pdf/level1/FactSeries-Bugs.pdf> and *Recording form for the Citizen Monitoring Biotic Index* at <http://watermonitoring.uwex.edu/pdf/level1/data-Biotic.pdf>
- *Key to Macroinvertebrate Life in the River*, Water Action Volunteers, Volunteer Monitoring Factsheet Series at <http://watermonitoring.uwex.edu/pdf/level1/riverkey.pdf>

## Unit 2, Station 4, Activity 1— Where is my Watershed?

- Surf Your Watershed, U.S. Environmental Protection Agency at <http://cfpub.epa.gov/surf/locate/index.cfm>
- What Do Maps Show? U.S. Geological Survey. Order a Teaching Packet at 1-888-ASK-USGS or download the information at <http://erg.usgs.gov/isb/pubs/teachers-packets/mapshow/mapshowindexpdf.html>
- Finding and Ordering USGS Topographic Maps at [http://topomaps.usgs.gov/ordering\\_maps.html](http://topomaps.usgs.gov/ordering_maps.html)

## Unit 2, Station 4, Activity 2— Wildlife in the Zone

- *Streambank Stewardship, A Saskatchewan Riparian Project*, Saskatchewan Wetland Conservation Corporation at <http://www.swa.ca/publications/documents/StreamBankStewardship.pdf>
- *Habitat Improvement—Leave It to Beavers*, excerpt from Idaho Wildlife, 1994, at <http://www.epa.gov/owow/info/NewsNotes/pdf/44issue.pdf>

# Appendix E

## PFC LOTIC CHECKLIST\*

Name of Riparian-Wetland Area: \_\_\_\_\_ Segment/Reach ID: \_\_\_\_\_  
 Date: \_\_\_\_\_ Acres: \_\_\_\_\_  
 Miles: \_\_\_\_\_  
 ID Team Observers: \_\_\_\_\_

Yes	No	N/A	HYDROLOGIC
			1) Floodplain above bankfull is inundated in “relatively frequent” events.
			2) Where beaver dams are present, are they active and stable?
			3) Sinuosity, width/depth ratio, and gradient are in balance with the landscape setting (i.e., landform, geology, and bioclimatic region).
			4) Riparian-wetland area is widening or has achieved potential extent.
			5) Upland watershed is not contributing to riparian-wetland degradation.

Yes	No	N/A	VEGETATION
			6) There is a diverse age-class distribution of riparian-wetland vegetation (recruitment for maintenance/recovery).
			7) There is a diverse composition of riparian-wetland vegetation (for maintenance/recovery).
			8) Species present indicate maintenance of riparian-wetland soil moisture characteristics.
			9) Stream bank vegetation is comprised of those plants or plant communities that have root masses capable of withstanding high stream-flow events.
			10) Riparian-wetland plants exhibit high vigor.
			11) Adequate riparian-wetland vegetative cover is present to protect banks and dissipate energy during high flows.
			12) Plant communities are an adequate source of coarse and/or large woody material (for maintenance/recovery).

Yes	No	N/A	EROSION/DEPOSITION
			13) Floodplain and channel characteristics (i.e., rocks, overflow channels, coarse and/or large woody material) are adequate to dissipate energy.
			14) Point bars are revegetating with riparian-wetland vegetation.
			15) Lateral stream movement is associated with natural sinuosity.
			16) System is vertically stable.
			17) Stream is in balance with the water and sediment being supplied by the watershed (i.e., no excessive erosion or deposition).

\* Adapted from “A User Guide to Assessing Proper Functioning Condition and the Supporting Science for Lotic Areas” (Bureau of Land Management, U.S. Forest Service, Natural Resources Conservation Service Technical Reference 1737-15, 1998). Land managers use checklists like this to assess proper functioning condition in riparian areas.

## Summary Determination

### Functional Rating:

- ☐ Proper Functioning Condition
- ☐ Functional – At Risk
- ☐ Nonfunctional
- ☐ Unknown

### Trend for Functional – At Risk:

- ☐ Upward
- ☐ Downward
- ☐ Not Apparent

Are factors contributing to unacceptable conditions outside the control of the manager?

- ☐ Yes
- ☐ No

If yes, what are those factors?

- ☐ Flow regulations
- ☐ Mining activities
- ☐ Upstream channel conditions
- ☐ Channelization
- ☐ Road encroachment
- ☐ Oil field water discharge
- ☐ Augmented flows
- ☐ Other (specify)

**Remarks**

# Appendix F

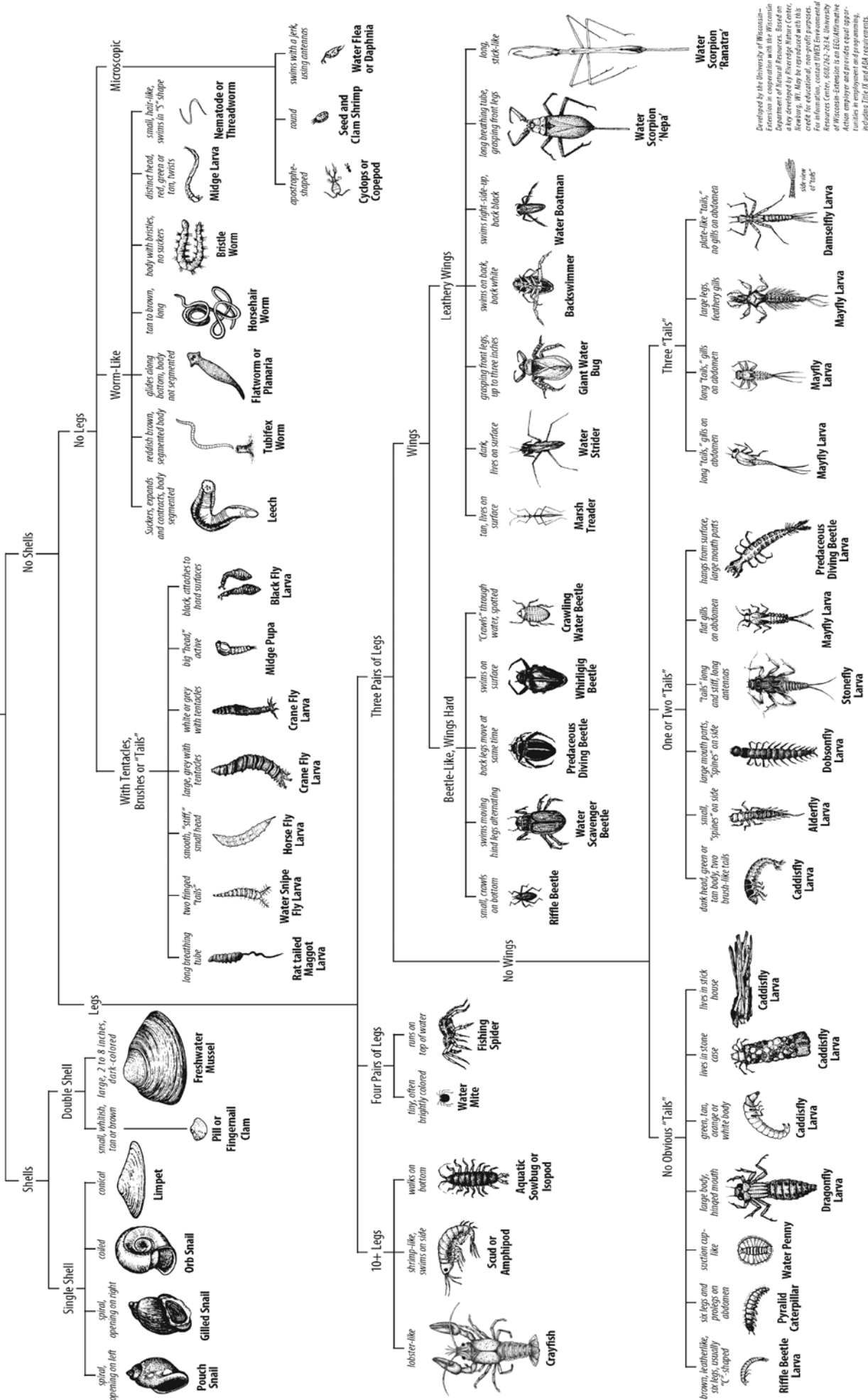
## Key to Macroinvertebrate Life in the River

For best results, it is recommended that the Key be enlarged on a photocopier by approximately 130% onto 11" x 17" paper.



# Key to Macroinvertebrate Life in the River

(Sizes of illustrations are not proportional.)



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