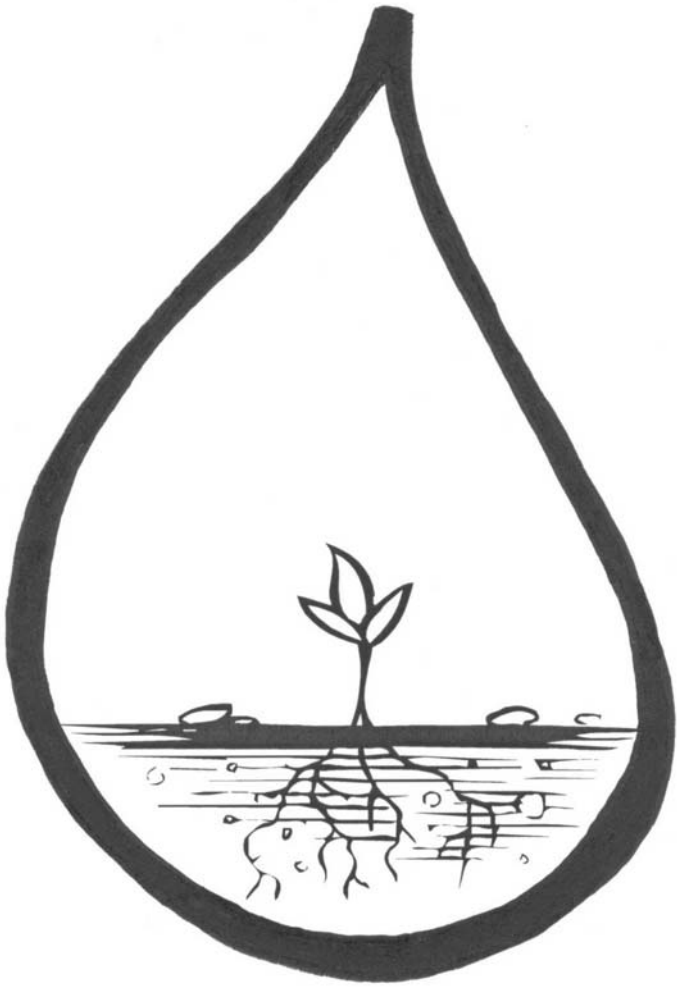
Building Environmental Youth Leadership



A High-School Service-learning Curriculum

Compiled by Nathan J. Meyer and Rebecca L. Meyer
University of Minnesota Extension Service

Made Possible through Collaboration:
Minnesota's Lake Superior Coastal Program
St. Louis County
University of Minnesota Extension Service

Building Environmental Youth Leadership: A High-school Service-learning Curriculum

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Project Planning and Processes

Building Environmental Youth Leadership
A High-School Service-learning Curriculum

Introduction

Background

The Environmental Youth Leadership project was made possible in-part through funding from Minnesota's Lake Superior Coastal Program. Over the course of two years, educators from the University of Minnesota Extension Service worked in collaboration with staff from the Northern Pines Girl Scout Council and Duluth ISD 709 to engage high school students in model service-learning projects. Students in these groups learned the foundations of good leadership through discussion, reflection, team and mission building. They selected and completed environmental restoration projects within the St. Louis River estuary in northern Minnesota. In programs ranging a few weeks to three months, groups successfully tackled the following projects:

- Miles of beach cleanup on Minnesota Point
- Removal of litter from the St. Louis River shoreline
- Planting of 300 saplings to control St. Louis River shoreline erosion
- Construction of 10 herbivory exclosures to protect cedar saplings on Grassy Point
- Insect control of exotic purple loosestrife in riverine wetlands
- Removal of shoreline exotic buckthorn

In hopes of extending the Environmental Youth Leadership program, lessons planned and insights gained from the model process have been compiled in the following curriculum guide. ***The first part of the guide defines and details key components of the service-learning process. Narrative lesson plans focused on team/mission building and action planning comprise part two.*** When combined with existing studies or additional curricula, these provide teachers, youth leaders and families an effective means of cultivating environmental service. Best of luck!

What is Environmental Service-learning?

The Alliance for Service-Learning in Education provides a ubiquitous definition: "a method of teaching through which people learn and develop through active participation in thoughtfully organized service experiences."[1] According to the Search Institute, there are two basic components to service-learning:

- "***Service—***Young people engage in activities that meet the needs of others and the community…."
- "***Learning—***The experiences of serving others are used as an opportunity for self-reflection and learning."[2]

While this approach to education may be employed to various ends, Beery describes ***environmental service-learning*** as "deliberate community service actions, or projects, designed to maintain, protect and/or restore the health of the environment."[3] These projects encourage development of

[1] Alliance for Service-Learning In Education (1995). Standards of Quality for School-Based and Community-Based Service Learning. Downloaded 7/12/06 from www.servicelearning.org.
[2] Search Institute. (2000). *An Asset Builder's Guide to Service-Learning.* Minneapolis: Search Institute.
[3] Beery, T.H. (1993). *Environmental Service: A Partnership with Nature*. Unpublished Masters Thesis. Duluth, Minnesota: University of Minnesota.

positive environmental values and responsibilities.

The Service-learning Process

The Environmental Youth Service process evolved from general service-learning guidelines. It includes important steps for both ***project planning*** and ***implementation:***

When Planning a Project:

1. ***Conduct a needs assessment.*** Strive to identify projects that will satisfy community needs and meet education goals.
2. ***Detail goals and objectives.*** Define in measurable terms hours to be served, tasks to be completed, knowledge gained, values honed, etc.
3. ***Plan for fun and fulfillment.*** Plan ways for participants to benefit from and enjoy their contribution to the group and work.
4. ***Identify collaborators and resources.*** Identify experts, youth organizations, community service organizations, etc. who are interested in helping to achieve project goals. Seek physical resources like meeting space, transportation, and tools requisite to project completion.[4]

While these steps are distinct and necessary for effective service-learning, all are linked and should inform each other. For instance, project objectives may be framed, in part, based on motivations of collaborating organizations (e.g., merit badges, fair projects, or learning standards).

[4] Adapted from:
Payne, D.A. (2000). *Evaluating Service-Learning Activities and Programs.* Lanham, MD: The Scarecrow Press, Inc.

Moreover, student involvement in the planning process is preferable.

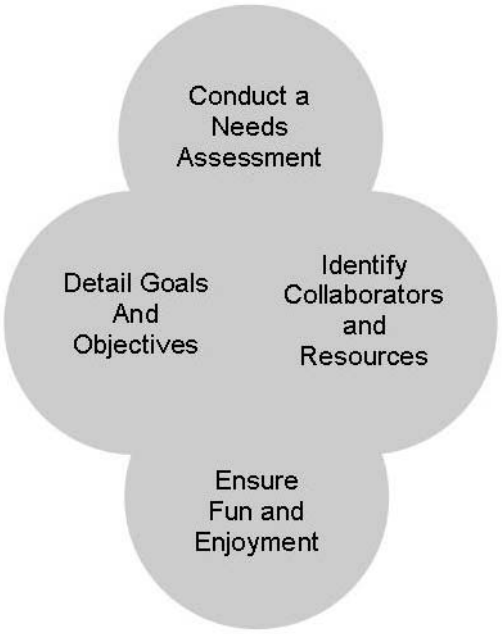


Figure 1. **Four steps inherent to planning a service-project. Steps are related, informing each other.**

When Implementing a Project:

1. ***Encourage teamwork****.* Engage students in activities that cultivate cooperation and group process skills.
2. ***Build a focused mission.*** Work with students to define a strong sense of purpose for the service project.
3. ***Gather background knowledge.*** Connect students with natural resource experts. Help them research the need and feasibility of potential environmental service projects.
4. ***Develop a plan of action.*** Once the group selects a project, engage students in development of a work plan and task lists that map its successful completion.

5. ***Complete the service project.*** Work as a group to achieve service goals.
6. ***Celebrate the success.*** Commemorate and enjoy the lessons learned and community needs fulfilled.

Project implementation steps are not linear in fashion. Depending on group dynamics, students may begin with background research or a sense of mission before exploring teamwork skills. Once initiated, however, each task tends to continue for the duration of the project. For instance, groups will often engage in team-building activities throughout the service-learning experience. No matter the order, project implementation steps should be balanced and tailored to diminish group weaknesses and maximize achievements of project goals.

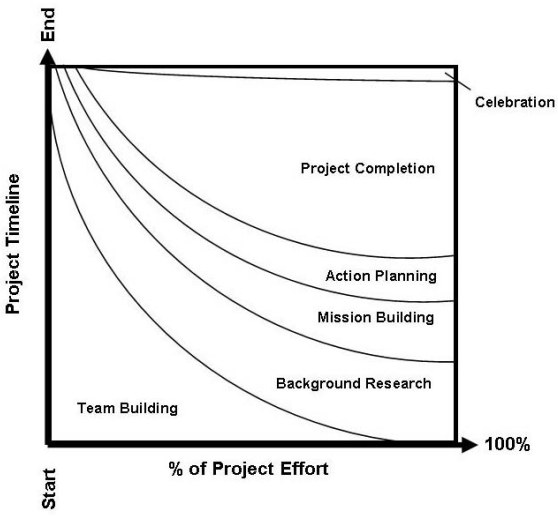


Figure 2. **A graph comparing a potential project timeline with % effort dedicated to each of six implementation steps.**

Keys to Success

Recruitment of Youth Groups

Recruitment of youth volunteers is requisite to the success of environmental service-learning projects, but it is not always easy. Youth inclined to sign on for these projects are often committed already to other clubs and activities. Participation in the service-learning project actually competes for their already overbooked time and attention. Thus, it is imperative to plan a project and activities that attract youth targeted for recruitment.

Over the course of the Environmental Youth Leadership project, the key factors to successful youth group recruitment proved to be ***relevance***, ***project detail***, and ***integration within an existing group structure***. Foremost, adult leaders of these groups needed to know required time commitments for the project. They wanted description of tasks students would complete. Projects that meet established group requirements were more attractive to participation.

The recruitment process for the Environmental Youth Leadership project evolved through experience and benchmark assessments of other agencies.[5] It consists of 8 steps described below:

[5] Adapted in part from *8 Tips for Recruiting Youth to Serve in Intergenerational Programs*. Downloaded 7/12/06 from www.templecil.org. Also *Recruiting Youth to Your Mentoring Program.* Downloaded 7/12/06 from ctb.ku.edu.

When Recruiting Youth

1. ***Enlist Champions****.* Find a small group of students who are eager to participate in an environmental service project. Invite them to be a steering committee, and involve them in planning and implementing the recruitment campaign. Encourage this group to refer others to the program.
2. ***Identify a few short-term "entry" projects that will attract youth participation.*** These projects provide the detail necessary for adult leaders and youth to assess attractiveness of participation. They provide a focus and goal for recruitment.
3. ***Define the characteristics of youth who will participate in the project.*** Based on the goals and requirements of the "entry" projects, draft youth volunteer "job descriptions". At a minimum, these should include:
    - *Position title*
    - *Responsibilities*
    - *Time required*
    - *Skills required*

    See *Appendix B* in the back of this document for help. Use the descriptions to identify youth populations for recruitment.
4. ***List Incentives.*** Unfortunately, hard and sweaty work may not be enough to attract youth to the project. It is important to identify how it will be fun, interesting and worthwhile for target participants.
5. ***Seek project partners*****.** Identify youth-serving organizations in the community that may be interested in participating in an environmental youth leadership program. Get to know their programs and motivations to identify specific benefits of partnership, such as service hours or education standards. Contact education staff or volunteer leaders to discuss a program partnership.
6. ***Create a marketing plan.*** Involve the steering committee and/or partners in designing messages and materials that will attract target populations. If possible, test these with youth and leaders outside the project. Identify where and when to post these materials and messages for maximum impact.
7. ***Advertise the program.*** Implement the marketing plan. Take plenty of pictures as the program progresses. Invite press and public to visit service projects and celebrations. Strive for brand-name recognition of the program among students in the community.
8. ***Continue the process.*** Due to constant turnover of students, recruitment is a constant effort for a long term program. Refresh membership of the steering committee from time to time. Seek new partners. Revise position descriptions and marketing plans as projects change. Keep advertising.

Motivating Existing Youth Groups

Youth-serving programs resident in communities across the United States encourage community service among participants. The following is a partial list of organizations with programs and requirements supportive of

Environmental Youth Leadership activities:

4-H
Connection: Self-directed interest projects with a lot of latitude. Relevant areas include *Citizenship, Youth Leadership, Exploring the Environment, Forest Resources, Water/Wetlands,* and *Wildlife/Biology*. The *Youth Leadership* area is an especially solid connection.[6]
Contact: County 4-H Coordinator/Director or Regional Extension Educator.

Adjudicated Youth Programs
Connection: Community service is often a component of these programs.
Contact: Program directors or coordinators for program specific information.

After School Clubs/Programs
Connection: Key Clubs, National Honor Society and special interest clubs focused on environment, ecology, geography, and community service may commit to environmental service projects.
Contact: School counselors and teachers for existing programs and specifics.

Boy Scouts of America
Connection: Full or partial merit requirements for *Environmental Science*, *Soil and Water Conservation*, and *Fish and Wildlife Management* badges. Eagle Scout service project work is also a good fit.[7]
Contact: Local troop leaders or District Executive.

Boys and Girls Clubs of America
Connection: Teens in the youth directed *TEENSupreme® Keystone Clubs* select and tackle community service projects.
Contact: Area Boys and Girls Clubs.[8]

Camp Fire USA
Connection: Horizon-level children in local clubs identify and tackle service projects in their communities. The *Teens In Action* program focuses on youth directed service learning and leadership.
Contact: Council office.

Church Youth Group
Connection: Many church-affiliated youth groups commit to community service projects as a part of their programming.
Contact: Program directors or church clergy for information about specific programs.

Girl Scouts of the USA
Connection: Full or partial fulfillment of requirements for Studio 2B teen scout interest projects. Relevant topics include *Leadership, Build a Better Future, Eco-Action, From Shore to Sea, Planet Power, Plant Life,* and *Wildlife*. Each project requires completion of a service component.
Contact: Local troop leaders or the council office.[9]

Formal School Classes
Connection: Full or partial fulfillment of Science Standard—*III Earth and Space Science, A. Earth Structure and Processes*, and Social Studies Standards—*V Geography, D.*

[6] Downloaded 7/12/06 from www.fourh.umn.edu.
[7] Downloaded 7/12/06 from www.meritbadge.com.
[8] Downloaded 7/12/06 from www.bgca.org.
[9] Downloaded 1/12/04 from www.girlscouts.org.

Interconnections and E. Essential Skills. Standard completion will require teacher certification.
Contact: Science and social studies teachers or curriculum coordinatiors.

Project Partnerships

Akin to youth recruitment, securing a needs-based project usually also requires enrollment of natural resource professionals. Members of conservation groups or organizations like the University of Minnesota Extension Service, Minnesota Department of Natural Resources, and Soil and Water Conservation Districts, these individuals are essential to project task planning, expert information, access, and ensuring that safety and permitting protocols are followed.

It is important to keep in mind that education is not a primary job responsibility for many of these people. They are busy fulfilling duties other than service-learning. Therefore, service projects that complete a part of their normal work duties will be more attractive than those which require additional efforts. When requesting help from natural resource professionals, be prepared to provide at least the following details:

- Goals and objectives of the project/program.
- Characteristics of students who will be involved.
- Tasks that can/can not be completed by students (i.e., can they use chainsaws or handsaws?)
- Amount of time that can be devoted to the project.
- Specific expectations for their help (i.e., are they expected to be present at work times, additional meetings, class visits?)

Project ideas and partnership with natural resource professionals can usually be secured through a short meeting or phone conversation. However, it may be helpful to use the following approach, especially when contacting people for the first time:

When Contacting Prospective Parners

1. Send a letter with details about the program and the request for help.
2. Schedule a meeting to discuss the proposal.
3. Meet with the individual. Be prepared to answer questions about the project and/or modify the plan to meet their needs.
4. Follow up by phone or a letter of thanks.[10]

Team-building Via Initiative Activities

In the words of Sakofs and Armstrong, "Education has always drawn nourishment from experience."[11] Building a strong sense of teamwork through experiential initiative activities is one foundation of the Environmental Youth Leadership process. In the model programs, students, regardless of membership in existing groups, entered through participation in initiative

[10] Dobbins, R. & Pitman, B. (n.d.) *Greenworks!* American Forest Foundation/Project Learning Tree. Downloaded 7/12/06 from www.plt.org/greenworks/.
[11] Sakofs, M. & Armstrong, G.P. (1996). *Into the Classroom: Outward Bound Resources for Teachers.* Dubuque, IA: Kendall/Hunt Pub. Co.

activities. Initiatives were bunched at the beginning and peppered throughout all successive meetings, allowing participants to develop and hone solid teamwork skills like leadership, communication, collaboration and trust. These skills fed directly into successful mission-building, action planning, and project completion.

Rager (2003) suggests that initiative activities provide an appropriate foundation for environmental service learning because they:

- Bring people together
- Encourage interaction and dependance on group members
- Expose strengths and weaknesses of the group for examination
- Necessitate cooperation and communication.[12]

They are readily available from many sources (see the end of this section for a partial list), and can usually be facilitated by a group leader. However, it is the facilitator's responsibility to ensure the safety of all participants. The following safety guidelines should be observed during all initiative activities:

Activity Safety Guidelines

1. ***Have a risk management plan.*** Ensure that all leaders know how to respond to first-aid emergencies, foul weather, etc. It is recommended that someone leading the group have at least basic first aid certification. See *Appendicies C & D* for help.
2. ***Set clear safety guidelines for all activities.*** These should be non-negotiable boundaries and practices that minimize the chance of injury.
3. ***Stress safety with participants.*** Make sure that group members are aware that safety is a priority. Discuss safety guidelines and the risk management plan before starting activities. Immediately point out and correct unsafe behavior.
4. ***Make sure that activities are appropriate for the group skill level.*** Some activities like trust falls require more physical stamina and close contact than others. These may be inappropriate for some groups.
5. ***Students should spot each other during activities.*** Any group member involved in an activity should be spotted by non-participating peers.

The facilitator is also responsible for integrating four basic elements into the initiative team-building program:

Fun

Supplies the internal motivation to engage in initiative activities. If it is not enjoyable, students will be less apt to try their best.

How To: Model playfulness during activities. Inject humor into discussions. Watch for and point out students enjoying the activities.

Communication

Means by which group members share thoughts, feelings, insights, and solutions. Communication keeps problems from arising.

How to: Encourage group discussion and planning before beginning the

[12] Rager, A. (2003). Initiative Activities. *Minnesota 4-H Camp Counselor Handbook*. Ed. Minnesota 4-H Camping Project Development Committee. St. Paul: University of Minnesota Extension Service.

initiative. Listen to what they say, and press for further detail. Ask individuals to express their opinions about group plans.

Cooperation

Group members collaborate to solve problems. Whole group success is inherent to the structure of initiative activities.

How to: Structure activities to challenge group rather than individual success. Seek and applaud examples of cooperation. Celebrate successes as a group.

Trust

Allows participants to work in close contact with each other, sharing thoughts and feelings without fear of reprisal.

How to: model openness, sensitivity, safety. Encourage, but do not push, input from all group members. Always monitor levels of trust. [13]

No single initiative activity is sufficient to cover all of the key components. It is important to group activities that appropriately span this spectrum. Moreover, it is often helpful to begin with activities that highlight fun, followed by communication, cooperation, and finally trust. This is because trust may develop through and usually requires successful communication and cooperation.

Facilitators should commit plenty of time to forethought and planning prior to beginning an initiative team-building program. A model planning process follows:

When Planning an Initiative Program:

1. ***Detail goals and objectives for the team.*** Identify areas where the group needs work. Align these work areas with the four initiative elements.
2. ***Assess site characteristics and resources.*** Figure out resources available and where to do the activities. Compile safety plans, etc based on these.
3. ***Select a variety of initiative activities that are appropriate for your goals, site and audience.*** Integrate each of the four key components while focusing on work areas. Include activities that are both mentally and physically challenging. Consult multiple sources for activities.
4. ***Pre-plan activity facilitation.*** Consider how to introduce the activity—stories, metaphors, inspirational quotes, focusing questions, etc. Detail information that should be included in activity briefings like safety boundaries. Plan ways of debriefing the activities.
5. ***Begin the activity with a briefing.*** This prepares participants for what they will be doing. The briefing should include instructions, non-negotiable safety information, group goal-setting and planning.
6. ***Complete the activity.*** The facilitator will usually step back and allow students to take over during this part of the process. However, it is important to step in and correct any safety concerns.
7. ***Debrief the activity.*** Prompt group members to reflect on the

[13] Rohnke, K. & Butler, S. (1995). *Quicksilver: Adventure Games, Initiative Problems, Trust Activities and a Guide to Effective Leadership.* Dubuque, IA: Kendall/Hunt Pub. Co.

activity. What did they learn about team communication, cooperation, trust? What made the activity fun? Encourage students to apply lessons learned to their service learning project.

8. ***Celebrate successes.*** Even when the group appears to fail an initiative, applaud the effort and partial success. Include everyone in the festivities.
9. ***Revisit lessons learned.*** Do not let students forget the initiative experience. From time to time, discuss the experiences again. Look for opportunities during the service project to apply lessons learned.[14]

Briefing and Debriefing Initiative Activities

Without proper briefing and debriefing, initiative activities will likely result in nothing but challenging play. Teamwork skills and lessons learned result from group reflection before, during and after the activity. There are a number of considerations and questions that help facilitators successfully brief and debrief groups:

Methods for briefing and debriefing

- Small or large group discussion (essential)
- Solitary reflection
- Answering questions
- Drawings
- Writing or journaling
- Models
- Interviewing other participants
- Role playing
- Readings to spark discussion

When briefing participants

- Provide clear objectives, safety boundaries and time limits upfront.
- Intentionally leave activity instructions a bit fuzzy to leave group members room for interpretation and questioning.
- Encourage group members to follow the initiative-solving process:
  STOP: Stop, Think, Observe surroundings and instructions, and Plan for success.
  Ask them to explain each step of the process.
- Ask group members to set a learning goal for the activity. On which of the key components do they want to focus?
- Prompt the group to detail processes for working out the initiatives. How will they ensure everyone participates in planning? What process will they use to select a solution when many are offered?

When debriefing participants

- Debrief during and immediately after each activity. Also debrief after groups of activities that focus on any key component, and at the end of the program.
- Plan activities to leave adequate time for debriefing. Stick to the timeline.
- Impose a structure that ensures participation by all group members—raised hands, all individuals respond,

[14] Adapted from both:
Rager, A. (2003).
Also Rohnke, K. (1989). *Cowtails and Cobras II: A Guide to Initiatives, Ropes Courses, & Adventure Curriculum..* Dubuque, IA: Kendall/Hunt Pub. Co.

small group discussion with reports to the whole group, etc.
- Debrief all aspects of the experience—communication, judgment, appreciating self and others, respect, inclusion of all members, self-confidence, group decision-making, listening, personal feelings, etc.
- Ask application questions like: How can we use this to achieve our service goals? Provide examples of ways you will change your behavior toward the group in the future? Based on this experience, Should the group do anything differently in the future?[15]

Sources for Initiative Activities and Process

The information included in this guide does not present a comprehensive coverage of team-building through initiative activities. Group leaders should have many questions and are encouraged to seek further information. There are many exemplary guides to initiative activities and processes. The following list are those consulted for the Environmental Youth Leadership project:

Christian, S.S., & Tubesing, N.L. (1997). *Instant Icebreakers*, Sandy Stewart Duluth, MN: Whole Person Associates Inc.

Kaagan, S.S. (1999). *Leadership Games: Experiential Learning for Organizational Development.* Thousand Oaks, CA: SAGE Publications.

Rager, A. (2003). Initiative Activities. *Minnesota 4-H Camp Counselor Handbook*. Ed. Minnesota 4-H Camping Project Development Committee. St. Paul: University of Minnesota Extension Service.

Rohnke, K. & Butler, S. (1995). *Quicksilver: Adventure Games, Initiative Problems, Trust Activities and a Guide to Effective Leadership.* Dubuque, IA: Kendall/Hunt Pub. Co.

Rohnke, K. (1989). *Cowtails and Cobras II: A Guide to Initiatives, Ropes Courses, & Adventure Curriculum..* Dubuque, IA: Kendall/Hunt Pub. Co.

Sakofs, M. & Armstrong, G.P. (1996). *Into the Classroom: Outward Bound Resources for Teachers.* Dubuque, IA: Kendall/Hunt Pub. Co.

Team-building Via Outdoor Adventure

Outdoor adventures like camping, hiking, canoeing, and rock-climbing are also effective means of building team-building. Benefits, key components, and processes for facilitation are essentially identical to those described for initiative activities. But, team-building via outdoor adventure includes the added benefits of excitement and personal growth. For many students, an outdoor adventure will be a rare event, likely including exceptional challenges that test their conventional comforts. Group members must work together to help individuals surpass these challenges and reach personal successes.

[15] Adapted from:
Rager, A. (2003).
Rohnke, K. (1989).
Also Wolf Ridge Environmental Learning Center. (1996). *Initiative Games*. Unpublished lesson plan. Finland, MN: Wolf Ridge Environmental Learning Center.

The rarity of outdoor adventures also adds a special attraction to group membership. In fact, short hikes, ropes course trips and other outings were employed as entry events in model Environmental Youth Leadership programs.

Because of the risks inherent to an adventure trip, however, ***safe facilitation requires specialized training and experience.*** Due to these concerns, a professional outfitter should be partnered or contracted to lead most outings. Use the following guidelines when sub-contracting a group:

- Meet with the outfitter. Ask staff to describe how their trips operate.
- Ask about their safe operating procedures. Ask to see risk management policies, emergency response plans, forms, etc.
- Ask about their staff qualification standards. How are they hired and trained? Can they effectively deal with an emergency?
- Discuss their experience in dealing with groups similar to yours. What special considerations do they identify? How will they handle these?
- Make sure that they are willing to hear and respond to safety and education concerns of their groups.
- Ask about their expectations of the participating group. How many chaperones are required? What items will they provide for participants (i.e., lifejackets, paddles, backpacks, tents, etc.)? Will you be responsible for meal planning and preparation? Etc.

Permission and Preparation

In addition to working with trained specialists, group leaders should follow their organization's specific guidelines and timelines for securing transportation. Before departing on a trip, make sure that all participants also have a permission slip signed by a legal guardian. This form should conform to any safety needs expressed by trip outfitter. At least, it must:

1. **Clearly communicate all risks associated with the activity.**
2. **Solicit any health conditions that might bar a participant from safely participating.**

Participants also need to dress for the weather forecasted on the trip dates. Prepare a packing list, including items to bring and those to leave at home. Cover trip specifics like where bathrooms and phones will be located, what the landscape will be like, what they will eat, etc. Make sure that all students have this information at least two-weeks prior to the trip. Pre-trip meetings are a good means of disseminating and discussing this information. Trip outfitters should be contacted 1-week prior to the arrival date to confirm procedures, times, concerns, etc.

Like initiative activities, the educational efficacy of these events depends on careful, complete and timely briefing and debriefing. Groups should follow the same processes described for initiative activities when discussing and reflecting on these outdoor adventures.

Mission-building with Youth

Vision and mission statements provide an effective bridge between team-building, action planning and project work. They translate the personal "why am I here?" to a collective statement of purpose and service. The Environmental Youth Leadership model programs used mission and vision planning to engender long-term focus. In this way, the group's conviction and commitment remained focused from project to project and through shifting membership.

Effective mission-building includes three key components:

Shared Vision
Provides the "why" behind the mission statement. Peterson aptly explains: "Without a vision of what the future 'should be' it is hard to get motivated to do anything. If you have an idea of where you want to go or what you want to do it is much easier to motivate yourself and others."[16] Experts from the University of Minnesota suggest that a good vision statement will meet the following criteria:

- Builds on the group purpose to provide an idea of who they want to become—their shared ideals.
- Provides clear images of what they plan to accomplish. [17]

Example: The Environmental Youth Leadership Team envisions a clean and healthy environment for our community.

Group Mission
Defines "how" the group will work toward achieving their vision. Paula Schneider defines a mission as "a written statement of purpose that can be used to initiate, evaluate, and refine all life activities."[18] She suggests it serves as a "roadmap" guiding work decisions. University of Minnesota experts suggest an effective mission:

- Provides a clear and believable statement of team's unique goals or outcomes.
- Becomes the focus for developing and prioritizing team action plans.
- Show how the team serves their community.

Example: The high-school volunteers of the Environmental Youth Leadership Team commit to building a clean and healthy community through environmental restoration and protection.

Team Goals
Define "what" will be done to achieve the mission. Gary Stern explains: "It is important right up front to be as clear as possible about what you want to accomplish. Your goals tell you how you will measure success and focus your attention in order to achieve it."[19]
Effective goals should be SMART:

- ***Specific.*** Each goal should cover a single topic, and answer the 5 W's—who, what, when, where, why.
- ***Measurable.*** Each goal should include concrete criteria that can be tested for success.

[16] Peterson, R.S. (1991). *Seeing the Vision.* Youth Leadership Workbook 5. St. Paul: University of Minnesota Extension Service.
[17] Anderson, M., Anderson, S.R., Laeger-Hagemeister, M., Scheffert, D.R., & Steinberg, R. (1999). *Getting Focused: Vision/Mission/Goals.* Favilitation Resources Volume 3. St. Paul: University of Minnesota Extension Service.
[18] Schneider, P. (n.d.) *Creating a Mission Statement.* Downloaded 12/20/03 from www.medceu.com.
[19] Stern, G. J. (2001). *Marketing Workbook for Nonprofit Organizations.* Volume 1: Develop the Plan. Saint Paul: Amherst H. Wilder Foundation.

- ***Attainable.*** Plan goals that challenge but are achievable by the group.
- ***Relevant.*** Goals should arise from interests and convictions of group members, the mission and vision. However, each goal should also relate to other project goals.
- ***Time-sensitive.*** All goals should include a completion date.[20]

Example: The Environmental Youth Leadership Team will clean 5 miles of beach during the summer of 2003 to relieve human pollution stress on the St. Louis River Estuary.

Ideally, groups work through the components in the order presented above. In model groups, however, this was often not the case. Because students usually signed on to participate in a planned "entry" project, the mission usually preceded their participation. Subsequently, group members were encouraged to work on project goal-setting and action planning at that time. Vision and mission-building activities were pursued after successful completion of the first project when the group began long-term planning. The following process summarizes the model group experience:

When Mission-Building

1. Work with partners and/or core-group of students to define a mission for an "entry" project.
2. As action planning begins for the project, introduce the project mission to the group and encourage them to set SMART goals.
3. Continuing action planning and service work, urge group members to consider and discuss the efficacy of their goals. Did they set a good standard? Was anything missed? Etc.
4. Throughout the progress of the "entry" project, ask group members to seek other possible projects. Encourage them to define what they want to get from the group. What should the group try to accomplish next? Ask them to record their results.
5. Shortly after completion of the "entry" project, convene a group meeting or two for future-planning. Use these meetings to create vision, mission, and goals statements.
6. Refer often to the group's mission and vision. Group members should regularly discuss and revise goals.
7. Set a date, perhaps once each year, to reconvene for future planning. Group members should take this time to revise the vision and mission statements and set new goals.

Sources for Mission-building Activities and Process

Although it may sound easy, mission-building is a multi-faceted and complex process. Professional consultants make their living helping businesses create effective mission statements. Therefore, the information included in this guide cannot present a comprehensive coverage of mission-building with youth. Group leaders should have many questions and are encouraged to seek further information. The following are

[20] Downloaded 7/12/06 from www.projectsmart.co.uk.

two sources that informed the model programs:

Kaagan, S.S. (1999). *Leadership Games: Experiential Learning for Organizational Development.* Thousand Oaks, CA: SAGE Publications.

Peterson, R.S. (1991). *Seeing the Vision.* Youth Leadership Workbook 5. St. Paul: University of Minnesota Extension Service.

Program Evaluation—Getting Better All the Time

Evaluation is critical to effective planning and improvement of service-learning programs. When carefully implemented, it provides feedback essential to measuring the benefits and shortfalls of these programs, offering benchmarks from which enhancements can be made. Ideally, programs will be strategically evaluated and improved throughout the planning and program process.

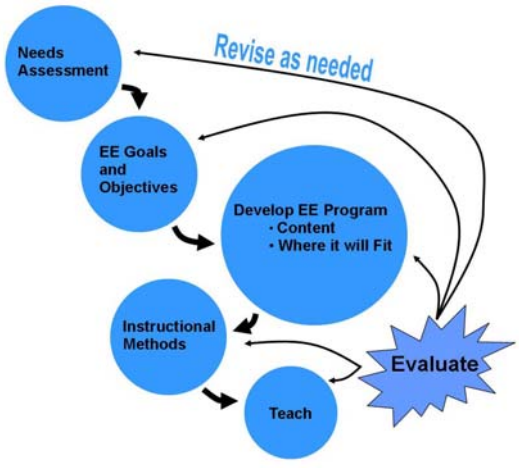


Figure 4. **A representation of the curriculum planning process. Notice that evaluation occurs at each stage of the planning process.[21]**

Youth members should reflect constantly on their project experience, personally evaluating lessons learned. Yet, numerous other contexts and data sources for evaluation are also inherent to service-learning projects. For instance, a Portland State University study offers methods for measuring program impacts on students, faculty, communities and the institutions affiliated with a service-learning experience.[22] Groups may target evaluation of team-building or project components of a program. They may choose to collect data from team members, parents or teachers. Payne (2000) offers a matrix of service learning program components for evaluation:

Program Focus
- Academic learning goals
- Environmental service goals

Program Context
- Classroom
- Project location

He notes that we can collect evaluation data and/or evaluate how the project impacted a variety of people:
- Students
- Teachers
- Administrators
- Parents
- Community Members

While a variety of program factors may be measured, evaluation does not have to be complex or overly time-consuming

[21] Braus , J.A. & Wood, D. (1994). *Environmental Education in the Schools: Creating a Program that Works.* Troy, OH: North American Association for Environmental Education.
[22] Driscoll, A., Gelmon, S.B., Holland, B.A., Kerrigan, S., Longley, M.J., & Spring, A. (1997). *Assessing the Impact of Service Learning: A Workbook of Strategies and Methods.* Portland, OR: Center for Academic Excellence, Portland State University.

in order to be helpful. For instance, group members may circulate a list of team goals and potential projects to parents, partners and community members, asking them to identify the most fitting project. After completing a project, teams could gather for small group discussions about the benefits and shortfalls associated with certain aspects of their program. Journal entries or pictures are also good forms of evaluation information. But, effective program evaluation should meet the following criteria:

When Planning Evaluations

- The evaluation should be planned to target measurable objectives.
- Objectives should be feasible according to budgets and timelines.
- Data collected should be relevant to objectives.
- Evaluation plan should be flexible to changes in objectives, time lines and data sources.
- Evaluation methods must be replicable (i.e., by future group leaders). This begets more trustworthy results.
- All evaluation questions, methods and materials should be tested on target populations before using them.
- Data should be collected, interpreted and reported in an objective and timely fashion.
- Results should be reported to all parties affiliated with the project.[23]

Ideally, students in the group should target, design and implement evaluation of the program. This encourages critical thinking about the program as well as developing practical skills. If possible, groups unfamiliar with program evaluation should seek professional help. Staff from local Universities and University Extension services may offer useful advice on evaluation design and questioning. There are also numerous internet and written guides to program evaluation. One particularly useful source is:

Payne, D.A. (2000). *Evaluating Service-Learning Activities and Programs.* Lanham, MD: The Scarecrow Press, Inc.

Key Components in Service Learning with Youth

Youth Ownership—Youth Empowerment

In a recent study of environmental service learning, Beth A. Covitt discerned differences in motive fulfillment—students' abilities to achieve their personal goals through service-learning—between youth-initiated and teacher-initiated service projects. Students in a pre-packaged teacher-initiated service project reported lower levels of motive fulfillment than their peers in projects with more youth governance. Based on these results, Covitt suggests that leaders planning service projects ask to what extent:

- Are students involved in choosing and planning their service-learning project?

[23] Adapted from Payne, D.A. (2000).

- Is the service-learning work relevant to their lives?
- Does the project include meaningful work with adults and peers?[24]

The bottom line is that service programs and projects that promote youth ownership and governance will likely have a greater impact on personal fulfillment and potentially behavior.

Background Research—A Foundation for Understanding

Developing an environmental knowledge base has long been held as one of the fundamental goals of effective environmental education. Engleson and Yockers suggest: "A knowledge base about how the natural environment functions is essential, for without such knowledge citizens cannot make wise decision about how to interact with the environment and how to prevent and resolve issues resulting from those interactions." They define three types of knowledge:

- Knowledge of specifics like terms and facts.
- Knowledge of ways and means of dealing with specifics like classifications and methods.
- Knowledge of universals and abstractions in the field like theories and generalizations.[25]

It is easy to infer that something of each knowledge type is required for students to effectively plan and complete their service learning projects. Background research—library and internet research, expert interview, experimentation, etc.—is the preferred vehicle for developing this knowledge-base because it maintains student control over the process. While exposure to background information in any form is a must, an ideal service learning program will motivate students to identify, pursue and answer their own questions for success.

In addition, the knowledge and research component of service learning programs often provide the obvious link to school standards. Madigan identified this link as a key strategy for program sustainability.[26] Leaders of formal school groups may pay special attention to background research.

Action Plan Development—Organization and Efficiency

There may be no "I" in "Team". However, there is an "I" in "Action". Though fundamental to the long-term success of an Environmental Youth Leadership program, mission-building results in goals too broad for effective action. These provide no ownership and little direction for day to day service work. Successful completion of service projects requires groups to translate team goals into sub-goals or tasks. Task lists should include:

- Definition of single goal-subordinate actions.

[24] Covitt, B.A. (2002). *Motivating Environmentally Responsible Behavior through Service-Learning.* Paper presented to Corporation for National Service National Service Fellowship Program. Downloaded 7/12/06 from nationalserviceresources.org.

[25] Engleson, D.C., & Yockers, D.H. (1994). *A Guide to Curriculum Planning in Environmental Education.* Madison: Wisconsin Department of Public Instruction.

[26] Madigan, P. (2000). *The Environmental Service-Learning Project: Are Environmental Education and Service-Learning a Natural Fit?* Paper presented to Corporation for National Service National Service Fellowship Program. Downloaded 7/12/06 from nationalserviceresources.org.

- Names of group member(s) responsible for completing the task.
- Date when the task will be done.
- Priorities assigned for same date tasks.

Groups that pay careful consideration to outlining and assigning tasks required to reach their goals will be more orderly and efficient in completion of their projects. Moreover, the process of task-planning exposes students to valuable life skills—another benefit of service learning.

Risk Management Preparation—Keeping It Safe

According to psychologist Abraham Maslow, a sense of safety and security is fundamental to effective learning.[27] Because there is risk of injury inherent to many environmental service learning projects and team-building activities—slipping with a sharp tool, vehicle accident, overactive allergies, a bad fall, etc.—worried students may suffer psychological blocks to learning. To ensure a sound learning experience, therefore, group leaders must plan carefully to engender and maintain safety of the team.

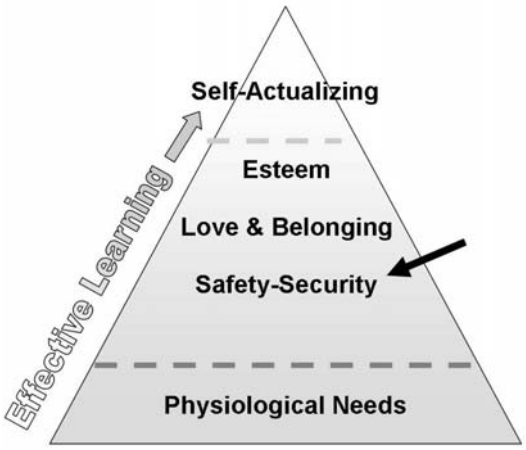


Figure 3. **A graphic representation of Maslow's Hierarchy of Needs. Notice the importance of safety and security near the base of the triangle.**

Risk management, or "a discipline for dealing with the possibility that some future event will cause harm", provides group leaders a means of safety planning.[28] The management process forces assessment of:

- What can go wrong? What types of injuries are possible?
- What actions can leaders take to minimize these risks? Why will this work?
- Who is in charge of making sure the plan is carried out?

Due to the nature of activities associated with Environmental Youth Leadership programming, it is suggested that a person certified in Basic First Aid/CPR or higher is always present. Outdoor adventures or other activities with higher risks should be contracted through professionals. The bottom line: when in doubt, seek help. It only takes one accident to ruin a groups'

[27] Rutledge, A.J. (1985). Section two: A theory foundation. *A Visual Approach to Park Design*. New York: John Wiley & Sons.

[28] Nonprofit Risk Management Center. (1999). *Risk Management Basics.* Downloaded 7/12/06 from www.eriskcenter.org.

perception of safety. There is also a risk assessment/management form included at the end of this guide to aid safety planning.

Celebration—Acknowledging Real Work Done Well

In the midst and focus of hard work associated with an environmental service project, it is easy to miss time for celebration. Yet, the Search Institute highlights the importance of this part of the process: "Affirmation and celebration spotlight the positive things accomplished through service-learning and how participants have personally grown through the experience." They offer a number of celebrations:

- Certificates of accomplishment for youth.
- Letters to the editor thanking group members and supporters for their work.
- Media coverage.
- Letters of thanks from community members.
- Public presentations hailing the success.
- Picnics, potlucks or other gatherings.[29]

Inherent to vision and mission-building processes is a sense of working toward something better. Celebrations encourage students to declare progress toward these goals. Returning to Maslow's Hierarchy, they build the esteem essential to self-actualization and learning.

Any celebration of service success is important. In fact, successful programs affirm even small successes like completion of team-building challenges or task-lists throughout the project. Ideally, students should be involved in planning and implementing some celebrations. However, the unsought accolades of group leaders and community members are truly beneficial.

Presenting Youth Work—Finding a Wider Audience

The value of public presentation as celebration cannot be underestimated. These provide group members a forum in which to illustrate and proclaim their success. Smiles and applause from the audience also bolster self-esteem. Moreover, preparing for the presentation and answering audience questions challenge students to reflect and learn from the project.

Public presentations are also effective marketing vehicles. They provide an obvious gathering site for media. The publicity and accolades generated by presentations may also attract more students to the programs. These individuals aspire to the success and experiences described by their peers.

Good Luck building Environmental Youth Leadership!

[29] Search Institute. (2000). *An Asset Builder's Guide to Service-Learning.* Minneapolis: Search Institute.

Building Environmental Youth Leadership
A High-School Service-learning Curriculum

Project Curriculum

TOPIC:
Team-building,
Mission-building,
Background research
Action-planning

OBJECTIVES:
- Students will record and process lessons learned through service-learning activities.

LENGTH:
Ongoing

ENVIRONMENT:
Indoors or Outdoors. Need a place for students to be comfortable write or draw.

MATERIALS:
- Copies of the journal cover for all students.
- 5-10 pieces of heavy white paper for each student.
- A deep stapler appropriate for binding the journals.
- Art supplies for decoration.

Journaling

Background:
As students move through the service-learning process, they will compile a lot of experience and information. Journaling provides them a way to record and reflect upon these bits and pieces. The format provided allows students to work in varied genres—pictures, words, collage, etc. Group leaders may choose to use the journal like a lab notebook in some instances, interspersing assignments with personal reflection. In this activity, students begin the service-learning process by constructing and personalizing their journals.

Activity Outline:
Beforehand:
Make two-sided copies of the journal cover on colored paper for each student. Lighter colors work best for these covers as they allow student decoration to show. Also, gather 5-10 pieces of heavy white paper for all participants. Lay these materials out on a table with the stapler so that students may collect and construct their journals.

Personalizing the Journal:
Students gather for instructions. Take a moment to preview the objective of the activity. Encourage students to discuss ways that students can use their journals throughout the service-learning process. Then, instruct them to collect materials and construct their journals according to the following guidelines:
- Lay the cover sheet face-down on the table. (This means the title and circle will be facing the table. The mission prompt is facing up.)
- Place 5 to 10 sheets of white paper directly on top of the cover sheet. (1 sheet equals 4 journal pages.)
- Fold these sheets in half width-wise, so the cover and title face outward.
- Staple twice along the fold.

Once all students have constructed their journals, discuss the importance of personalizing them. This provides a means of identifying one's own journal. But, it also signifies ownership. A journal should be an expression of the individual who owns it, a place for free-thought and experimentation. Students should take time to consider their individuality and interests in the service-learning project. What do they want to get out of it? What roles do they envision playing on the team? How will the project affect them? Then, create a journal cover that expresses these feelings and ideas. Provide art supplies—crayons, markers, glitter, glue, magazines, yarn, fabric, leaves, etc.—to use for decorations.

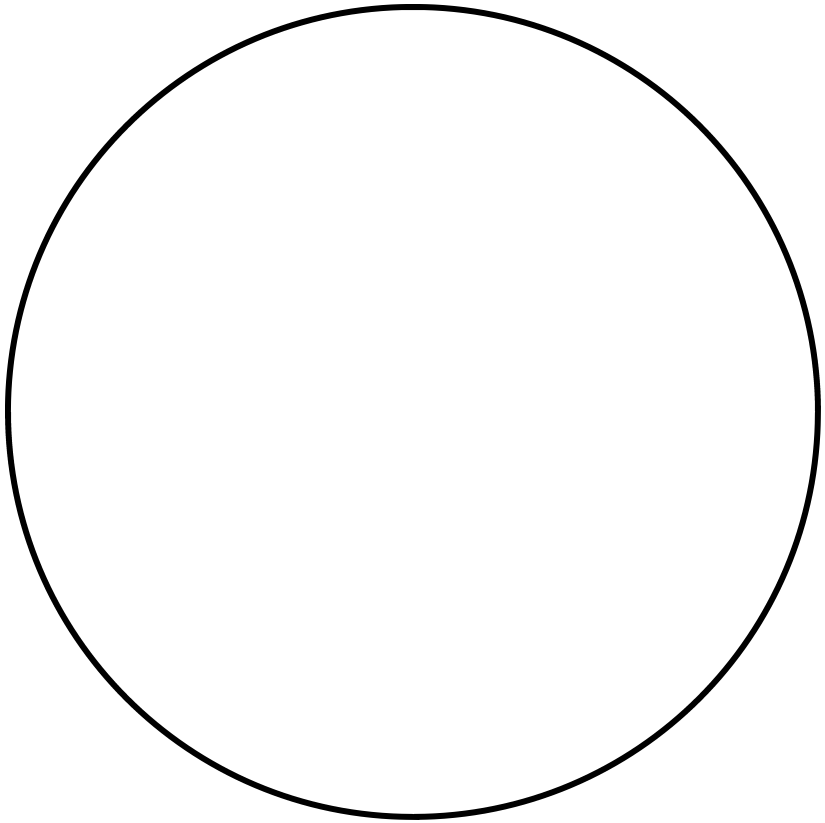
Provide plenty of time for decorating. Then, ask participants to clean up the art supplies and journal materials.

Using the Journals:
Students gather for conclusion. Stress that journals are places for free expression. Although these may be used for assignments from time to time, students should also use their journals for personal recording and reflecting. Remind them of various uses they suggested earlier.

Instruct students that they may make more journals and/or new covers as they progress through the service project. Journalers often make the mistake of sticking with a particular journal even when it no longer feels right. Then, the creativity fades into drudgery. Team members must realize that they will change throughout the service-learning process. The feelings and roles they captured on their cover today may not be the same tomorrow. Some students may also consume their pages more quickly than others. In either case, they should construct and decorate a new journal. Keep the creativity flowing. However, students should not toss out their previous journal. It will contain valuable thoughts and records. Finally, they should be mindful of waste, reusing unwritten pages when possible.

This Journal Belongs To:

Environmental Youth Leadership Team



This project is being funded in part by the Coastal Zone Management Act, by NOAA's Office of Ocean and Coastal Resources Management, in conjunction with Minnesota's Lake Superior Coastal Program and MN DNR Waters.

University of Minnesota Extension Service

Mission:

Similar and Different

TOPIC:
Team-building

OBJECTIVES:
- Students will get acquainted with their co-participants.
- Through small risks, students will begin to trust each other.
- Students will explore their commonalities and differences.

LENGTH:
20 to 30 minutes

ENVIRONMENT:
Indoors or Outdoors. Need a place for students to form small groups for short discussions.

MATERIALS:
- Copies of the *How We Differ* point tally sheet.
- Scrap paper
- Pencils or pens
- A clipboard for each group.
- Color-coded name tags, color chips, or other ways of splitting students into groups.

Background:
Depending on the origin of the team, Environmental Youth Leadership participants may join knowing little or nothing about their new cohorts. This activity creates a fun atmosphere for facilitating the get-to-know-you process. In small groups, students compete to discern the highest number of commonalities among members. In two larger groups, they tally differences, trying to earn the most points.

Activity Outline:
Beforehand:
For each group (plan 3 to 4 students per group), place scrap paper and a pencil on a clipboard. As students enter the meeting, provide them with a color-coded nametag, a color chip, a number or some other creative means of splitting them into small groups. For instance, you may have four red-lettered nametags. However, students should not be made aware of their groupings.

Finding Similarities:
Students gather for instructions. Overview the objectives of the activity. Explain that they are going to introduce themselves and learn about others in the group through a friendly competition. Describe how students are grouped. When the activity begins, they should find other members of their group. One representative should grab a clipboard. Working together, group members should identify and write a list of all the things they have in common. Stress that they should strive for intangible things (i.e., all members enjoy tacos instead of all are wearing stripes). Provide 2 to 3 minutes for brainstorming. Then, one reporter from each group should present the tally, describing some of the similarities. The group with the highest number wins the activity.

Finding Differences:
Split each small group roughly in half. Assign each of these halves to one of two larger groups. This helps to maintain some familiarity, while facilitating interaction among new group members. Explain the objectives of this activity. Essentially, they are exactly opposite of the last. When the activity begins, group members will discern and tally all of their differences according to the *How We Differ* sheet. Groups earn one point for each difference, with bonus points for special circumstances. After five minutes, groups choose a representative to report their point tally. The group with the most points wins the activity.

Variety and Likeness:
Gather the group together for review and synthesis. Begin by asking them to describe how they went about solving the challenge in each activity. Did students just randomly spout answers? Did an orderly way of

identifying commonalities/differences develop? Which activity was easier/harder? Review the results of both activities in terms of the entire group. What things are common/different for the entire team? Ask students to identify any lessons learned in this activity. Have them apply these to successful completion of their service-learning project. Finally, all members should congratulate each other on a job well done.

References:

This lesson is adapted from *Commonalities* and *How We Differ* in:
Rohnke, K., & Butler, S. (1995). *QuickSilver: Adventure Games, Initiative Problems, Trust Activities and a Guide to Effective Leadership.* Dubuque, IA: Kendall/Hunt Publishing Company.

How We Differ

Tally Sheet

Count 1 pt Each for Any Difference. Add Bonus Points as Written.

For each person who has lived on a shore _____

5pts—If it was an ocean _____

For visiting each of the following:
Any of the Great Lakes, Pacific Ocean,
Atlantic Ocean _____

5pts—for three _____

7pts—for four _____

Points for each birth state bordering a Great Lake _____

5pts—Lake Superior _____

For each state you where have lived in the Mississippi River Watershed (minimum 6mos) _____

5pts—for visiting Itasca State Park _____

Points for each person who has danced in the rain _____

5pts—If you danced with a friend _____

7pts—danced without an umbrella _____

For each person who has swam in Lake Superior _____

7pts—for three _____

10pts—for all of them _____

20 pts—for a winter plunge in Superior _____

TOTAL _____

Name Toss

TOPIC:
Team-building

OBJECTIVES:
- Students will get acquainted with their co-participants.
- Students will cooperate to solve a whole-group challenge.

LENGTH:
15 to 20 minutes

ENVIRONMENT:
Indoors or Outdoors. Need a place for students form a group circle.

MATERIALS:
- 5+ soft balls, beanbags or rolled socks.

Background:
This classic game provides an effective way for new group members to learn each others' names. Students take turns tossing a ball to one another, introducing themselves, and memorizing the passing sequence. Attempts are made to pass the ball faster and faster in the same order. Finally, students attempt to pass multiple balls at once.

Activity Outline:
Getting to Know Each Other:
Students gather in a circle, including the instructor. Explain the objectives of the activity. The ball must pass to everyone in the circle. Individuals should memorize both the person who passed the ball to them, and the person to whom they passed the ball. The instructor introduces him or herself to the team. Then, he or she tosses the ball to someone across the circle. That person introduces him or herself and tosses to another student, and so on. Students should raise their hands until they receive the ball. No student should catch the ball twice. The instructor begins timing the activity starting with his or her first throw. Time stops when the last student receives the ball. This is the time to beat.

Passing for Time:
Try the game again, attempting to pass through the sequence faster than before. Students should continue to introduce themselves when they receive the ball. If the ball falls midway, continue the game. Keep repeating for a better time. Once the team is satisfied with their time, introduce a variation. Pass the ball through the same sequence with students calling out the name of the person to whom they toss the ball. Finally, group members reform the circle in a different order. Try to pass through the sequence, and beat the fastest time.

Multiple Balls:
Students will remain silent during the final game. Explain that the challenge of this activity is to keep multiple balls passing continuously. When the last person receives the ball, he or she should toss it back to the instructor. The instructor keeps passing, adding balls, and increasing pace as the team gets better. Once the group is satisfied with the effort, the game stops.

Around the Circle:
Students maintain the circle for debriefing. Ask volunteers to attempt the names of other students in the circle. Then, the group should revisit the process of solving the challenge. What worked? What can we learn from this challenge? Ask the group to apply lessons learned to their *Environmental Youth Leadership* activities.

References:

This lesson is adapted from *Warp Speed* in:

Rohnke, K. (1989). *Cowstails and Cobras II: A Guide to Games, Initiatives, Ropes Courses, & Adventure Curriculum.* Dubuque, IA: Kendall/Hunt Publishing Company.

Common Waters

TOPIC:
Team-building

OBJECTIVES:
- Students will get acquainted with their co-participants.
- Through small risks, students will begin to trust each other.
- Students will explore their common ties to water.

LENGTH:
20 to 30 minutes

ENVIRONMENT:
Indoors or Outdoors. Need a place for students to pair-off for short discussions.

MATERIALS:
- Small radio with tape or CD player.
- Tape or CD of festive or dance music.
- A clipboard for each student.
- A question form for each student.
- A chalkboard or other large display and chalk or markers for recording group answers.

Background:
Environmental Youth Leadership participants come to the group with many individual and different experiences and attitudes related to water. This activity provides a safe forum for expressing these backgrounds and divining common experiences among group members. For the educator, it provides a foundational assessment of participants' existing water education. This activity also begins to bring group members together, allowing them to slowly get-to-know and trust each other.

Activity Outline:
Beforehand:
Make enough copies of the *Question Form* for each participant to have one. Place these on clipboards with pencils or pens. Make sure that there is a power source for the small radio. Cue the CD or tape to appropriately festive music. Set the volume, etc.

Introduction:
Students gather around for instructions. Begin by stating the objectives of the activity. Then, describe the process. Ask students if they remember playing musical chairs. Explain that this activity is similar—a sort of musical discussion game. When the music is playing, students walk around the room shaking hands with their cohorts. Demonstrate a proper handshake—firm with a nice smile. When it stops, they introduce themselves and discuss a question with the person(s) with whom they were last shaking hands.

- Students will have 2 minutes to discuss each question.
- Discussion questions are listed on the *question form*. When the music stops, a question number will be announced. This is the question that should be discussed. Students may record names and discussion comments on their forms to share with the group later.
- Students who are between handshakes when the music stops should return to the person who last shook their hand, join in discussion with that group, and introduce themselves.
- Students may also create trios: three people in a group, all shaking two hands at once. This creates a more challenging discussion.

Musical Discussion:
Ask students to stand and spread out. It may be useful to mix them up, splitting groups of close friends, and challenge them to branch out and meet others. Then begin the music, allowing it to play for 20 to 30 seconds. Stop the music and announce a question midway through the list. Provide 2 minutes for discussion, warning 30-seconds before the time lapses to record answers. Start the music again, continuing the progression. 3 to 4 questions is usually sufficient for this activity.

Common Waters:
Students congregate for review. Acknowledge that they each got to know 4 to 6 people better than they did before. Encourage them to continue discussions with these and others as the group develops. Then, introduce the concept of *common waters*. Although students likely provided many different answers to questions, common threads may appear when they are listed together. Ask students to call out answers to their first discussion question. List these on the chalk or display board. Then, ask students to seek and point out relationships between them. For instance, students discussing the question—*What is your favorite thing about water?*—may list many different ways of getting wet. Continue this process for each of the discussion questions. Finally, press students to apply this to their emerging *Environmental Youth Leadership Team*. Why is it important for this group to find common waters?

References:
This lesson is adapted from “Slow Disclosure” in *Instant Icebreakers*, Sandy Stewart Christian, MSW, and Nancy Loving Tubesing, EdD, editors. © 1997 Whole Person Associates Inc., 210 West Michigan, Duluth, MN 55802.

Common Waters

Discussion Questions

1. **What is your favorite thing about water?**

2. **What is your first water-related memory?**

3. **Do you have any fear(s) of water? If so, what are these?**

4. **What different things pollute your local water?**

5. **What is the worst kind of pollution that threatens your local water?**

6. **If you had the power to clean water worldwide, how would you start?**

7. **What is strength(s) can you contribute to this group?**

8. **What is one useful skill that you can teach to other group members?**

TOPIC:
Team-building

OBJECTIVES:
- Students will get acquainted with their co-participants.
- Students will begin cooperating to solve problems.
- Students will explore their common knowledge of water-related terms.

LENGTH:
30 to 45 minutes

ENVIRONMENT:
Indoors—preferably a computer lab with internet access. Need a place for students to pair-off for short discussions.

MATERIALS:
- Index cards.
- Markers and scissors.
- A basket.
- Large pieces of newsprint.
- Internet access or access to other science and water reference materials.

A Watershed Puzzle

Background:
Students should be familiar with certain water-related terms in order to effectively identify and plan an environmental service-learning project in their watershed. They need to speak a common language. This activity provides students with an opportunity to explore and define key terminology, and present results to the entire group. The process allows members to become more familiar working together, pooling knowledge and abilities. It also leads to celebration of a group success.

Activity Outline:
Beforehand:
Select from the *vocabulary list* (Appendix A) appropriate terms for your watershed and project possibilities—the activity requires 1 term per 2 to 3 students. Write the terms on index cards in bold marker. Then, cut the index cards into odd-shaped puzzle-pieces. Each card should be split into 2 to 3 pieces depending on group size. Finally, place all of the pieces into a basket, and mix them thoroughly.

Matching the Pieces:
Students gather around for instructions. Begin by stating the objectives of the activity. Then, describe the process. Each will select a puzzle-piece from the passing basket. When the game begins, students should wander among their cohorts, seeking a match for their piece. Stress that students should maintain civility—walk, avoid shoving groupmates, etc. When all matching puzzle pieces have been located, the resulting group should gather and find a place to sit, preferably by a computer or reference materials. A representative from each group should get a piece of newsprint and a few markers.

Defining the Watershed:
Explain that each puzzle contains a water-related term, an important piece of information for our collective understanding of the upcoming project. Unfortunately, defining scientific terms is not always easy. In this case, however, two or three heads are better than one. Students will have 10 to 15 minutes to search the internet or reference materials for a definition to their term. They should write the definition on their newsprint in bold letters that all will be able to read. Pictures, diagrams, etc. can also be added to better illustrate the definition.

Solving the Puzzle:
Each group should choose a student to present their definition. In turns, these reporters stand in front of the entire group, read their definition, and explain any illustrations. They should also discuss briefly where they found the information.

When all have finished presenting, take time to process the group building aspects of the experience. Ask students to consider how they went about solving this problem. How did the work completed in small groups benefit the large group? How did the small groups work together? What lessons are learned? Have students discuss application of these lessons to their service-learning project. Then take time to applaud the group success.

References:

This lesson is adapted from “Match Up” in *Instant Icebreakers*, Sandy Stewart Christian, MSW, and Nancy Loving Tubesing, EdD, editors. © 1997 Whole Person Associates Inc., 210 West Michigan, Duluth, MN 55802.

Crossing Polluted Waters

TOPIC:
Team-building, Mission-building

OBJECTIVES:
- Through small risks, students will begin to trust each other.
- Students will cooperate to solve a group challenge.

LENGTH:
20 to 30 minutes

ENVIRONMENT:
Outdoors. Need a place soft place to absorb potential falls where students can spread out.

MATERIALS:
- 4 to 8 traffic cones or other obvious marking signs.
- A pizza box.
- A timer.
- Possibly 4 to 8 wood boxes, cinder blocks or other sturdy blocks that will hold student weight, and 4 boards (4"X4"X8') that can be safely used as bridges between the boxes.

Background:
In this activity, team members are faced with the challenge of crossing "polluted waters" without a boat. In one variation, students must help each other to cross a marked area in a limited number of steps. In more challenging variation, the group formulates a plan to place bridges that carry the group across blocks in the game area. Either challenge provides an effective forum for trust-building, cooperation, and development of team problem-solving skills.

Activity Outline:
Beforehand:
Choose the variation that works best for the activity setting, and available resources. For either, use the cones to mark a space fifteen 15 to 40 feet wide (larger for *Variation* 2) as the play space. In the bridge-building variation, place blocks in a random pattern throughout the space. Spend time to ensure that blocks are in a functional pattern that allows passage across the area. Also make sure that students can access the blocks by bridge on either side. Then, stack the bridge boards on one side of the play space—the starting point for the activity.

Crossing the Waters—Variation 1:
Students gather for instructions. Begin with an overview of the objectives of the activity. Then, explain that a horrible chemical spill has polluted the water running through the marked play area. While there was once a bridge spanning the area, the chemicals corroded the supports, causing it to crash into the water. Students are members of an elite pizza delivery team, called to get pies to hungry townsfolk across the polluted waters. They can't let the fallen span stop them. However, any student who spends more than ten minutes or takes more than three steps in the stream will die from chemical poisoning. The entire team must reach the other side of the stream with the pizza box in hand. On top of that, team members will lose a fat tip if the trip takes them longer than ten minutes. Take a moment to clarify any vague rules. Set a timer for ten minutes, and set the team to work.

Crossing the Waters—Variation 2:
Introduce the story related in *Variation 1*. In this case, however, a flash fire shortly after the spill set the bridge ablaze. Fortunately, firefighters were able to douse the fire before it destroyed the supports. While there is no longer a complete span, timbers strewn along the edge of the stream should provide enough strength to cross the polluted stream. Again, students are a part of an elite pizza delivery team, who must reach hungry townsfolk on the other side. All must cross in ten minutes or less. In this case, however, a single dip in the stream, even for a second is enough to poison a person. If a student touches the stream, the entire

team must restart the activity. Clarify vague rules. Set a timer for ten minutes, and set the group to work.

Celebration and Synthesis:
Team members cheer each other through the process. Maintain a positive outlook, even if there is a setback. Once all have crossed the play space, take a time for congratulations. Pat each other on the back, etc. Then the team gathers to debrief the experience. Ask team members to describe how they solved the challenge. Were there leaders? How were these chosen? Was everyone able to share ideas? Did they feel a sense of mission? At what point did they know success was imminent? Then, ask for lessons learned from the experience. Have students for ways these apply to their framework as *Environmental Youth Leadership Team* members.

References:
This lesson is adapted from *The Meuse* in:
Rohnke, K. (1989). *Cowstails and Cobras II: A Guide to Games, Initiatives, Ropes Courses, & Adventure Curriculum.* Dubuque, IA: Kendall/Hunt Publishing Company.

Shrinking Watershed

TOPIC:
Team-building

OBJECTIVES:
- Students will get acquainted with their co-participants.
- Through small risks, students will begin to trust each other.
- Students will cooperate to solve a group problem.
- Students will discuss the problems caused by habitat fragmentation.

LENGTH:
20 to 30 minutes

ENVIRONMENT:
Indoors or Outdoors. Need plenty of room and soft landing spots for falling students.

MATERIALS:
- A parachute or other large ground sheet.
- A timer.

Background:
This activity challenges team members to remain standing on an ever shrinking watershed. Students must plan a way to keep the entire group on a parachute for 15 seconds. Each time they succeed, the parachute is folded in half and the challenge renewed. The group must invent new ways of holding together. This activity facilitates cooperation, trust among members and celebration. It also provides a vivid metaphor for beginning discussions about watershed habitat fragmentation.

Activity Outline:
Beforehand:
Find a location with plenty of open space, and preferably grass or carpet to cushion minor falls. Spread the parachute in the middle of this area.

Colonizing the Watershed:
Team members gather near the tarp for instructions. Introduce the objectives of the activity. Explain that students are standing at the edge of a retreating ice age. The massive sheet has just crumbled beyond view, leaving an uninhabited watershed spread before them, full of resources, and awaiting colonization. Students represent migrating plants, fungi, bacteria, animals, etc. When the activity begins, they must move onto the parachute, seeking a spot in the watershed, staking a claim. They must be able to remain on the parachute for 15 seconds. Lest they throw elbows or push others in the effort, explain that their individual survival depends on collective success. All must reside on the watershed at the end of the migration, or the team fails the initiative. Take a moment to clarify any questions. Then the game begins.

Shrinking Watershed:
Team members re-gather at the edge of the tarp after successful completion of the initial migration. Take a moment to celebrate the success. Then, explain that millennia have passed. Warmer weather, competition from other organisms, and the first waves of civilization have changed the area of the watershed. At this point the tarp is folded in half. However, the migration rules remain the same. All members must colonize the tarp to solve the problem. This time, students must remain on the tarp for 15 seconds. Begin the game.

Celebrate the success each time team members succeed the initiative. Then, repeat the process of shrinking the watershed by halving the remaining space. For extremely successful groups, make the activity even tougher by asking them to fold the tarp while standing on it.

Debrief and Synthesis:
Fold up the tarp and move it aside. Students congregate to debrief the activity. Re-introduce the objectives of the activity. Ask students to discuss how they met each objective as a team. As the watershed continued to shrink, how did they keep everyone within? What worked? What didn't? Did they use the same process every time? How did they determine the process? Was everyone allowed to voice an opinion in planning? How many feared falling? Have students brainstorm teamwork lessons learned through this activity, applying these to their work on the service project. Finally, discuss how the activity simulates habitat fragmentation in a watershed. What happened when the habitat decreased? How is this an accurate/inaccurate representation of reality?

References:
This activity is adapted *All Aboard* in:
Sakofs, M., & Armstrong, G.P. (1996). *Into the Classroom: Outward Bound® Resources for Teachers*. Dubuque, IA: Kendall/Hunt Publishing Company.

TOPIC:
Team-building, Mission-building

OBJECTIVES:
- Students will get acquainted with their co-participants.
- Students will focus on communication and cooperation to accomplish a group challenge

LENGTH:
20 to 30 minutes

ENVIRONMENT:
Indoors or Outdoors. Need a place for students to spread out in a large circle.

MATERIALS:
- A length of sturdy rope that measures 4' to 5' per student involved.
- Blindfolds for each student.

A Tangled Predicament

Background:
In this activity, students are tied to a tangled problem. With one hand of each student fixed to a length of rope, the team must figure out how to untie a number of knots. Then, they must silently maneuver the rope into various shapes while blindfolded. This activity stresses cooperation and communication among team members.

Activity Outline:
Beforehand:
Loosely knot the length of rope every 4' to 8'. Lay the rope in a circle where students will have plenty of room to spread out.

Untangling the Team:
Team members gather for the activity. Take a moment to overview the objectives of the challenge. Then, ask students to spread out along the length of rope. They should then reach out and grasp the rope with one hand—whichever feels more comfortable to them. Inform them that an odorless, invisible glue on the rope has completely fixed their hands. Now, all are committed to this tangled predicament. The only way to free their palms is to successfully untie all of the knots in the rope. Clarify any questions, and remind the team that their hands cannot leave the rope or move along its length. Begin the activity.

After succeeding the challenge, students let go of the rope. Celebrate the success. Then, debrief the activity. Ask students to describe the process of solving this problem. Was there one clear leader? How did they communicate the solution throughout the team? Often, students will begin this activity in small groups focused on a single knot. These groups work independently of others until a viable solution is discovered. They then communicate this to other members nearby. All members tend to help and encourage students working out the final knots. Have students describe teamwork lessons learned from this experience. How do these apply to real-life problem solving?

Shaping in Silence:
Lay out the unknotted rope in a straight line. Have students spread out along its length. Hand each a blindfold. They should place these on their heads, preserving visibility for the time-being. Then, request that students again grab the rope with one hand. They are glued again. However, the new challenge is for team members to pull the rope into a requested shape while blindfolded. Clarify any questions without revealing the shape they are to form. Students should also formulate a process for solving the problem prior to beginning the activity. Ask them to blindfold themselves. Then call out *square*.

Try this activity a couple times with different shapes (more sides are usually harder), celebrating each success. Then, make the challenge a bit tougher. This time, team members must form the shape while blindfolded and silent. No talking. Allow them to refine their process. Then try the game a few more times.

Gather blindfolds and the rope, and place these to the side of the space. Then, debrief the activity. Have students describe how the teamwork process was different for this activity. Why was it similar or different? Which required more cooperation? How were conflicts solved in planning? Discuss the importance of both verbal and non-verbal communication among team members. Have students describe any other teamwork lessons learned from this experience. How do these apply to real-life problem solving?

References:

This activity is adapted from:
Blind Polygon in:
Rohnke, K. (1989). *Cowstails and Cobras II: A Guide to Games, Initiatives, Ropes Courses, & Adventure Curriculum.* Dubuque, IA: Kendall/Hunt Publishing Company.

TOPIC:
Team-building, Mission-building

OBJECTIVES:
- Students will get acquainted with their co-participants.
- Students will learn and practice basic compass functions and orienteering procedures.
- Students will work together to solve a small challenge.

LENGTH:
30 minutes to 3 hours

ENVIRONMENT:
Indoors or Outdoors. Need a large wooded or grassy area where destination markers can be camouflaged.

MATERIALS:
- A copy of *Be Expert with Map & Compass: The Complete Orienteering Handbook.*
- A Chalkboard or Dry-erase board.
- A set of orienteering compasses (1 per student).
- A safety whistle for each group.
- A clipboard, paper and pencil for each group.
- A measuring tape or other means of marking off a 100' line.
- 1 Painted coffee can for each station marker (10 total).
- A laminated motivational quote to place in each coffee can.

Orienteering

Background:
According to Karl Rohnke, the word compass comes from the Latin *cum passus* meaning "with step". Following this tradition, participants in this activity must find a common direction in order to follow an invisible path. First, the group learns and explores basic compass operation. Individuals discern their pace lengths. Then, participants work in small teams to navigate from marker to marker through a compass course. These activities provide vivid metaphors for students attempting to develop a mission, and navigate the hidden topographies of a service-learning project.

Activity Outline:
Finding your Bearings:
Neither basic compass operation nor basic orienteering principles are too difficult to grasp and teach, however, they are acquired skills requiring familiarity and practice. To that end, it is suggested that leaders endeavoring to tackle the following activities with students prepare well-beforehand by reading *Be Expert with Map & Compass* by Björn Hjellström. This book, available in many libraries and bookstores, provides an excellent background on the origin and operation of compasses as well as numerous exercises that develop basic orienteering skills.

Beforehand:
This activity takes place in two parts—basic skills development and challenge course navigation—which may take place together or on separate occasions. Whichever route is chosen, each requires some preparation. A chalk or dry-erase board is useful for facilitation of basic compass operation. Draw a large illustration of a compass on the board with all parts labeled. It is also helpful if the needle, orienting arrows, etc. can be erased and redrawn to illustrate various directions. To facilitate pacing, measure and mark both ends of a 100' line in a hallway or open field.

Setting up the challenge course will take a few hours depending on the complexity and number of stations included. Gather a coffee can to mark each station. Paint these bright yellow or green so they will stand out somewhat among trees and foliage. They should not be visible from more than 5-10' away. Label the lid of each can with a letter: A, B, C…. Laminate and place a motivational quote in each can. Create a table that lists each station letter with the corresponding quote. Later, this will provide a means of assessing whether students visited the correct stations.

Choose a wooded or tall-grass location for the course that will not be disturbed prior to the activity. Mark a starting point with can A. Then roughly follow directions for Hjellström's *Schoolyard Compass Game*. The exception is that the distance between cans (usually 50 to 300 paces) should be recorded in addition to bearings. A GPS will be useful in double checking your bearings and distances. Make a map of locations as you go. Take your time, double check your work, and have others check it as well - if you don't set the course up accurately, the participants won't have a prayer!

Students should be informed to dress for the weather on the day of the challenge course activity.

Finding Direction—Basic Skills Development:
Students gather for introductions and instructions. Begin with a discussion of their background experience with orienteering. Have any ever been lost in the woods? A store? How did they find their way? Can anyone describe how he or she has used a compass and map to get from one point to another? Provide a brief background on the origin, history and operation of the compass. Hand a compass to each student. Instruct them to keep the lariats around their necks. Then, explore the various parts of the device. Have everyone practice holding the compass correctly at their chest-level. As a group, face true north, south, west, southeast, etc. Illustrate the process of taking a compass bearing, putting "red in the shed". Show how to reverse direction. Provide various bearings and practice finding a group direction. When all participants can successfully take a compass bearing, gather compasses and move onto pacing.

Students gather along the 100' line. Explain that students have learned one key concept of orienteering—finding a direction. However, they also need to be able to measure distance from point A to B. This is accomplished through pacing. Illustrate an appropriate pace, which is one regular full stride from left-foot to left-foot or right-foot to right-foot. (Students will often miscalculate a half-stride—left-foot to right-foot—as one pace.) Then, practice counting paces as a group. It is often helpful to slap the thigh of the pace-foot (the one that lands on each full stride) and count out loud for each pace. When all group members feel comfortable pacing, ask them to line-up at the beginning of the 100' line. Explain that individuals may have different pace lengths, but the fixed line distance provides means of measurement. Each student walks the line from beginning to end, keeping count of his or her paces. 100 divided by the final pace tally provides the pace length. For instance, a person counting 25 paces from beginning to end has a pace length of 4' (100'/25 paces). Once all group members have discerned their pace lengths, ask them to identify the number of steps required to cover various distances. How many steps to cover 50'? 250'? How about 100 yards?

Hidden Markers—Advanced Orienteering:
Students gather at can A for instructions. Review compass use and pacing learned in the previous activities. Then, introduce students to the *Schoolyard Compass Game* as described in Hjellström's book. Separate students into 10 groups. Hand each a whistle, a clipboard, and paper with starting station and coordinates listed (as in Hjellström's book w/ distances between points added). When given the call to begin, students simply move to their starting point, and follow the given bearing while attempting to estimate the distance. Before beginning, they should check and record on their paper the quote located in their starting can. When they reach each additional marker, they should also record the quote in that can. Use the quote key to measure their progress. Are they finding the correct quotes for their assigned path? If students cannot find a marker, or reach one to which they were not headed, they should backtrack to the last known point and try again. Stress that this is no big deal, just a part of the challenge. However, they will do better if they take careful bearings and pace counts. Finally, groups should only blow the whistle in case of emergency. Show groups to their starting points, and give the signal to begin. Check-in with each group as they progress.

Seeking Deeper Meanings:
Once groups have completed the compass course, students should gather at can A for review and processing. Ask them to read and discuss the meanings of quotes found in the can. Are any particularly meaningful in relation to their service project? Then, identify as a group and explore any lessons learned from the orienteering activity. How do these apply to the service-learning activity? What is the compass for that adventure? How can they pace themselves? Where are the markers? Later in the progression of the project, refer back to this discussion. Ask students if they are following a good bearing, and carefully counting their steps.

References:

Hjellström, B. (1994). *Be Expert with Map & Compass: The Complete Orienteering Handbook*. New York: Macmillan General Reference.

Rohnke, K. (1989). *Cowstails and Cobras II: A Guide to Games, Initiatives, Ropes Courses, & Adventure Curriculum.* Dubuque, IA: Kendall/Hunt Publishing Company.

Wolf Ridge Environmental Learning Center. (1996). *Orienteering.* Unpublished Lesson Plan. Finland, MN: Wolf Ridge Environmental Learning Center.

TOPIC:
Team-building, Mission-building

OBJECTIVES:
- Students will get acquainted with their co-participants.
- Through risks, students will begin to trust each other.
- Students will work as a team to solve various group challenges.

LENGTH:
3 to 5 hours

ENVIRONMENT:
Outdoors and off-site. Students should be prepared for adverse weather conditions.

MATERIALS:
- Access to a safe ropes course facility.
- Van or other transportation off-site travel.
- Permission forms for each student participating on the trip.
- A trained and certified facilitator.

Ropes Course Trip

Background:
In many ways, ropes courses mark the epitome of team-building challenge activities. Depending on the structure of the course, students may engage and overcome initiatives like trust falls, high climbs, swinging bridges and tightropes. Trained facilitators ensure safety throughout the process, support group encouragement, and process life-lessons learned. For many, a well-planned trip to a ropes course is a life-changing experience.

Activity Outline:
Choosing a Course:
Depending on popularity of facilities in your area, efforts should be made to secure a ropes course 2+ months in advance of the trip date. Because of the risks inherent to a ropes course trip, however, safe facilitation requires specialized training and experience. Due to these concerns, a ropes course should not be chosen lightly. Use the following guidelines when sub-contracting a group to facilitate the trip:
- Take a tour of the course. Ask staff to describe how the various course initiatives operate.
- Ask about their safe operating procedures. Ask to see risk management policies, emergency response plans, forms, etc.
- Ask about their staff qualification standards. How are they hired and trained? Can they effectively deal with an emergency?
- Discuss their experience in dealing with groups similar to yours. What special considerations do they identify? How will they handle these?
- Make sure that they are willing to hear and respond to safety concerns of their groups.
- Ask about their expectations of the participating group. How many chaperones are required? Etc.

It may be helpful to contact local recreation departments, camp facilities, and other area youth service organizations to locate a safe and effective ropes course facility.

Permission and Preparation:
Follow facility guidelines and timelines for securing transportation to the ropes course site. Before departing on the trip, make sure that all participants also have a permission slip signed by a legal guardian. This form should conform to any safety needs expressed by course sub-contractors. It should 1) clearly communicate all risks associated with the activity, and 2) solicit any health conditions that might bar a participant from safely participating.

Students need to dress for the weather forecasted on the trip date. Course sub-contractors should be contacted 1-week prior to the arrival date to confirm procedures, times, concerns, etc.

Meeting the Challenge
Upon arrival at the ropes course, lead adults consult facilitators concerning procedures and expectations. These will vary according to the specific program. Some facilitators may request that adults refrain from participation in activities. Others may ask for their help. In either case, trust them to take charge of group movement and activities. Ask before stepping in to "help" with an emotional or misbehaving student unless the safety of a participant is obviously in jeopardy. It may be an expected part of the initiative process. Whether adults are involved or not, student participants lead all team initiatives and tackle process questions. However, all group participants should actively encourage each other, laugh, and savor the challenge.

If possible, take detailed notes describing participants' emotional reactions to initiatives, group processes, and answers to process questions.

Solidifying the Metaphor
In theory, ropes course experiences are effective because of their rich metaphorical representation of life challenges. Perceived risks and fears associated with the initiatives melt participants' established values and attitudes, allowing them to shift and reform. However, it is incredibly hard for a single and relatively short experience to significantly impact a lifetime of experience. Therefore, continual reminders of the experience are imperative to increased effectiveness. Afterward, refer often to notes of the experience, asking students to recall emotions and answers to questions. Students should often explicitly apply the metaphor to the team service-learning effort.

References:

Rohnke, K. (1989). *Cowstails and Cobras II: A Guide to Games, Initiatives, Ropes Courses, & Adventure Curriculum.* Dubuque, IA: Kendall/Hunt Publishing Company.

Wade, I. (2001). *Subcontracting for Adventure Programs*. Downloaded 7.12.06 from www.adventuresafety.org.

TOPIC:
Team-building, Mission-building, Background research

OBJECTIVES:
- Students will get acquainted with their co-participants.
- Through small risks, students will begin to trust each other.
- Students will identify water quality problems in a watershed.
- Students will understand how different specialists work with issues, and how to access those people.
- Students will identify a project to complete.

LENGTH:
A few hours to 3 days

ENVIRONMENT:
Outdoors in a wilderness setting.

MATERIALS:
- Access to a wilderness trail or boating area.
- Access to camping and tripping equipment.
- Disposable cameras for all students.
- Van or other transportation off-site travel and gear movement.
- Permission forms and supply lists for each student participating on the trip.
- A trained and certified trip leader.

Observation and Adventure Trip

Background:
This activity serves multiple purposes, and may be a high point for many participants. The adventure trip is central to the lesson, and may stand alone as a capstone experience for students who have developed a strong team identity. In this case, however, the trip is augmented with self-directed identification of environmental stewardship needs, and meetings with natural resource professionals who deal with these issues. At the conclusion of the activity, students employ their experience and new-found knowledge to select a service project. Thus, this activity provides an effective bridge between team and mission-building and project implementation.

Activity Outline:
Choosing an Adventure:
Depending on popularity of campgrounds, trails and waterways in the area, efforts should be made to plan the trip months in advance of the leave date. Determine the length of program, and overnight accommodation needs. For most groups, plan to cover a novice distance on trail or water (usually 5 to 10 miles). Contact staff from the Department of Natural Resources, National Forests, Parks and Recreation Departments and outfitters for help in selecting an appropriate location.

Because of the risks inherent to an adventure trip, safe facilitation requires specialized training and experience. Due to these concerns, a professional outfitter should be contracted to lead the trip. Use the following guidelines when sub-contracting a group:
- Meet with the outfitter. Ask staff to describe how their trips operate.
- Ask about their safe operating procedures. Ask to see risk management policies, emergency response plans, forms, etc.
- Ask about their staff qualification standards. How are they hired and trained? Can they effectively deal with an emergency?
- Discuss their experience in dealing with groups similar to yours. What special considerations do they identify? How will they handle these?
- Make sure that they are willing to hear and respond to safety and education concerns of their groups.
- Ask about their expectations of the participating group. How many chaperones are required? What items will they provide for participants (i.e., lifejackets, paddles, backpacks, tents, etc.)? Will you be responsible for meal planning and preparation? Etc.

Permission and Preparation:
Follow facility guidelines and timelines for securing transportation to the site. Before departing on the trip, make sure that all participants also have a permission slip signed by a legal guardian. This form should conform to any safety needs expressed by trip leaders. It should 1) clearly communicate all risks associated with the activity, and 2) solicit any health conditions that might bar a participant from safely participating.

Students need to dress for the weather forecasted on the trip dates. Prepare a packing list, including items to bring and those to leave at home. Cover trip specifics like where bathrooms and phones will be located, what the landscape will be like, what they will eat, etc. Make sure that all students have this information at least two-weeks prior to the trip. Pre-trip meetings are a good means of disseminating and discussing this information. Trip leaders should be contacted 1-week prior to the arrival date to confirm procedures, times, concerns, etc.

Finding Presenters:
Once a location and trip length have been determined, natural resource professionals should be identified and contacted about presenting to students about their jobs and understanding of environmental stewardship in the area. Consider contacting staff from the University Extension Service, Department of Natural Resources, Pollution Control Agency, City Environmental Services, other public and private organizations dealing with environmental restoration. Present them with a choice of two or three specific timeslots during your trip, and a preferred length and topic of presentation. Before the trip, along the trail at an access point, in the canoe, at a lunch stop, at the evening campsite, etc. are all good locations to plan presentations for students. Work with your trip leaders to identify workable presentation locations.

Trip Itinerary:
A reputable outfitter will take care of most trip planning details. However, the unique details of this activity require cooperation of facilitators. Make sure that the trip leaders understand the educational mission of the trip. Plan extra time for exploration and interpretation along the route. Make sure that the group will arrive at presentation spots on time, and that a representative will be able to meet the presenter ahead of time.

It may be helpful to camp and dine in locations accessible by van. In this case, students need to carry nothing but education supplies, snacks, and extra clothing on the trip. The van can ferry all food and camping equipment ahead for setup before group arrival. Lunches can be prepared, camp set-up, and presenters greeted while the group is enroute.

Both parents and students should be provided a detailed itinerary ideally at the same time that they receive their packing list and permission forms. It should contain contact information for all points on the trip where students may receive emergency information.

Adventuring and Observing:
Upon arrival at the trip location, provide students a few minutes to explore and get used to their surroundings. Once the novelty of the setting has diminished, ask students to gather for directions. Introduce trip leaders, and allow them to discuss rules and expectations. Review the agenda and answer questions. Rather than hosting a presentation or education activity at this point in the trip, harness students' excitement and head out. Spend time chatting with students, singing songs, sucking deep breaths, savoring the freedom of the adventure.

Plan an initial stop an hour or so into the trip. This is a good point for adjustment, answering new questions, and even hosting the first presentation if possible. It is also an ideal time to discuss the educational purpose of the adventure. This trip isn't just about getting out, and celebrating good team-work and fun. While those are a part of the adventure, students are also going to learn about and critically examine the area for possible service projects. Ask them to brainstorm things they might see that would signify damage to the environment. Explain that in accord with presentations students will also be expected to seek out and catalogue these signs of damage. Provide each with a camera. When students see any sign of environmental damage that might be interesting to adopt as a stewardship project, they should snap a picture. Later, the group will examine these pictures to pick a project focus. Remind students that they only get 1 camera, and 12, 24, or 36 pictures. They should try to reserve film for pictures throughout the trip. Don't take them all of friends along the trail.

Answer any additional questions, and head out again, snapping pictures along the way. Keep a careful watch on time, so that the group arrives promptly for presentations and meals. It may be advantageous to collect cameras at the end of each day to mitigate midnight flashes, crushed cameras, etc.

At the end of the trip, ask students to gather for concluding remarks. As a group, thank the trip leaders for their vigilance and hard work. Allow them to congratulate the students, etc. Recall the goals of the trip. Ask students to relate what they have learned along the adventure in regard to 1) teamwork, 2) the environment, and 3) possible service projects. Remind students that they will soon gather to look over the developed pictures

and choose a service project. Finally, ask students to write their names on their cameras, and collect them. Give a cheer for the successful trip.

Choosing a Project:
When dropping off the film for processing, ask the developer to clearly mark the name of the student from the camera on the film envelope. This will make identification of owners much easier. In preparing pictures for discussion, simply mark the owners' initials on the back of each picture in the envelope. Then, the shots can be mixed up, moved around, traded, etc. without losing to whom they belong.

Spread the environmental photos on tables, floors or other areas in a way that allows easy access and movement of student perusing them. Mark each with a number for identification. Place personal photos in a similar fashon elsewhere.

Gather students for the activity. Remind them of the focus and pictures taken during the trip. To mitigate concerns, explain briefly how ownership has been labeled and preserved. Students do not have to worry getting their picture back at the conclusion of the activity. Instead, they should scrutinize carefully all of the environmental photos laid out for possible projects. Considering their experience on the trip and lessons learned from presenters, they must critically consider the feasibility, time-requirements, etc. of any problem accepted for service. As a group, brainstorm things that students should consider when looking over the pictures. Then, set students free for 30-40 minutes to look over the pictures, devising solutions to some of the problems. Gather again to discuss these proposed solutions. Weed out any problems that will not be feasible to solve under the constraints of the project. Finally, ask students to re-visit the pictures and find an interesting project. Have them to list their top 3-5 choices by identification number on a piece of paper.

When students have finished making their choices, gather and tally the votes. The project with the most votes represents the popular choice. However, take a moment before certifying this as the official service project to again re-visit feasibility. Will students succeed at the project? How will the problem be solved? Once these questions are legitimately answered, the project is accepted. Congratulate the group on a fine job.

Then, take some time to peruse the personal photos, recalling fun on the adventure.

References:

Submitted by Regional Extension Educator, Amy RB Rager based on her experience in The Minnesota River Adventurers program.
Safety Guidelines adapted from:
Wade, I. (2001). *Subcontracting for Adventure Programs*. Downloaded 7.12.06 from www.adventuresafety.org.

Observation and Adventure Trip

Sample Letter to Students

The following letter is adapted from the Minnesota River Adventures Program for a group canoe trip:

Dear Adventurers:

Greetings I hope this letter finds you well and enjoying the season. We are all ready for you to come on the Adventure with us. We will be leaving at 10:00am from _____. This is located _____.

Each person needs to bring clothing for outdoors (see enclosed list), sleeping bag, bug spray, sun screen, toiletries, towel, life jacket (we will have extras if you don't have one) notebook, pen/pencil and health card. You will need to have a metal pie tin and metal silverware labeled with masking tape and your name. You also need a reuseable plastic glass. We will be camping out 2 nights. The first night we will be at _____ and the second night we will be at _____. There is running water and showers at each campsite. Each team needs to provide enough tents for their members, so be sure and talk to your classroom teacher and see who needs to bring tents. We will canoe several lengths each day with some shuttling in between. We will have ground support to bring our gear from site to site, so that we will not have to have the camping stuff in the canoes. Pack as lightly as possible-this means that you are allowed one duffel bag to have your stuff in, plus your sleeping bag, and life jacket.

Remember the purpose of this trip is to gain an understanding of what a watershed is. We will be in the _____ watershed. As we travel down the river, various experts will talk with us about many related topics. These experts will help to give your team a taste of what kind of project you would like to design.

We will complete the trip at 11:00am on _____ at _____. We will then shuttle canoeists and boats back to _____ to be picked up or to get cars.

If you have any questions please feel free to contact the _____ at _____.

See you at the River!

Amy RB Rager
Extension Educator
Environment & Natural Resources

Enc.: maps, clothing list

Observation and Adventure Trip

Student Packing Checklist

The following letter is adapted from the Minnesota River Adventures Program for a summer group canoe trip:

Clothing

- ❑ Wind breaker/light jacket
- ❑ Nylon pants
- ❑ 2-3 pair of shorts
- ❑ socks
- ❑ shoes that can get wet-(not flip-flops-they must tie, buckle or Velcro)
- ❑ underwear
- ❑ 2-3 t-shirts
- ❑ 1 Sweatshirt
- ❑ 1 pair pants
- ❑ Swimsuit
- ❑ hat
- ❑ towel
- ❑ Toiletries-Toothbrush, toothpaste, deodorant, etc. (no make-up, curling irons, blow dryers)

Note: jeans are not the best pants to wear canoeing, as if they get wet, they are very heavy and uncomfortable. Nylon pants (like the running pants) are the best they dry quickly and are not heavy even if they are wet. Cotton pants are okay too.

Other Items to Bring

- ❑ sunscreen
- ❑ bug spray
- ❑ health card
- ❑ notebook
- ❑ pen/pencil
- ❑ Life Jacket
- ❑ Metal Pie Tin
- ❑ Silver Ware
- ❑ Plastic Glass
- ❑ SMILE

What is Youth Leadership?

TOPIC:
Mission - building

OBJECTIVES:
- Students will brainstorm qualities of a good leader
- Students will identify personal leadership traits

LENGTH:
50 minutes

ENVIRONMENT:
Indoors and/or outdoors, large open area is needed

MATERIALS:
- White Erase Board or chalkboard
- Dry Erase markers or chalk
- Soft ball or balloon
- Clipboards
- Blank Paper
- Pencils
- Markers/crayons

Background:
In this lesson, students explore characteristics and traits that encompass leadership positions. This provides students with an opportunity to discuss potential qualities of leaders and how these are situational. Students participate in a non-competitive *moonball* game to introduce and experience a leadership situation with minimal direction provided by the facilitator. Based on this activity, students process qualities of a good leader. This will lead to discussion of potential leadership roles in service projects.

Activity Outline:
Beforehand:
Find a large open area to have students participate in the *moonball* game.

Moonball:
Students gather for instructions. Take a moment to review objectives of the activity. Explain rules of the game, stress safety and non-competitiveness. The rules are simple. Students should work as a team to keep the ball from coming in contact with the floor. However this is harder than it seems. Encourage participants to plan a strategy. Prompt students as needed to bolster success. Allow students to repeat game as necessary until they're happy with results.

Leadership Qualities:
After the game, team members gather for discussion. Using a chalkboard or white erase board, list traits or characteristics stated by participants that were displayed during the moonball activity. Use this as a jumping off point and prompt students to brainstorm additional leadership qualities. Ask students to share elements of leadership displayed during the activity. What skills were contributed by participants? What actions supported the mission? How did the group adapt the activity during the experience? Is leadership individual or collective? This process will permit students an opportunity to discern characteristics of leadership leading into more meaningful discussion.

Encourage participants to develop a definition of leadership, distinguishing qualities of good leaders. Discussion should also relate to how leadership is situational and that sometimes certain situations work better with particular characteristics of leadership.

Transition the group's discussion toward the environmental service project. Prompt them to process where the project includes leadership needs. What types of leaders are needed? Who wants to consider leadership for various project points? Does the group have

recommendations for leaders? Record these answers for consideration of leadership positions during the project. It may be helpful to return to this discussion during the *Mission Shield* activity.

References:

Peterson, R.S. (1991). Understanding my traits. St. Paul, MN: Minnesota Extension Service, University of Minnesota.

Rohnke, K. & Butler, S. (1995). Quicksilver: Adventure games, initiative problems, trust activities and a guide to effective leadership. Dubuque, IA: Kendall/Hunt Publishing Company.

TOPIC:
Mission-building

OBJECTIVES:
- Students will get acquainted with their co-participants.
- Students will identify strengths they offer the team.
- Students will envision and depict their role in the mission of the team.

LENGTH:
30 minutes to 1 hour

ENVIRONMENT:
Indoors or Outdoors. Need a place for students to work alone

MATERIALS:
- Copies of the Mission Shield worksheet.
- Crayons, markers, colored pencils.
- A clipboard or desk for each student.
- A chalkboard, dry-erase board or other means of depicting the assignment.

Mission Shield

Background:
The team mission statement provides a collective aim to guide group members in completion of their service project. However, it lacks clear definition of students' contributions. This activity extends definition of the mission to individual aspiration and roles. Within the frame of a heraldic shield, participants artistically render the team mission, surrounding it with their own mottos, strengths, aspirations. Through sharing these symbols, students begin the process of characterizing individual roles on the team.

Activity Outline:
Beforehand:
Make copies of the mission shield for all team members prior to their arrival. Using a chalkboard, dry-erase board, etc., draw the shield with prompts so that students will be able to read them clearly (see Fig. 1).

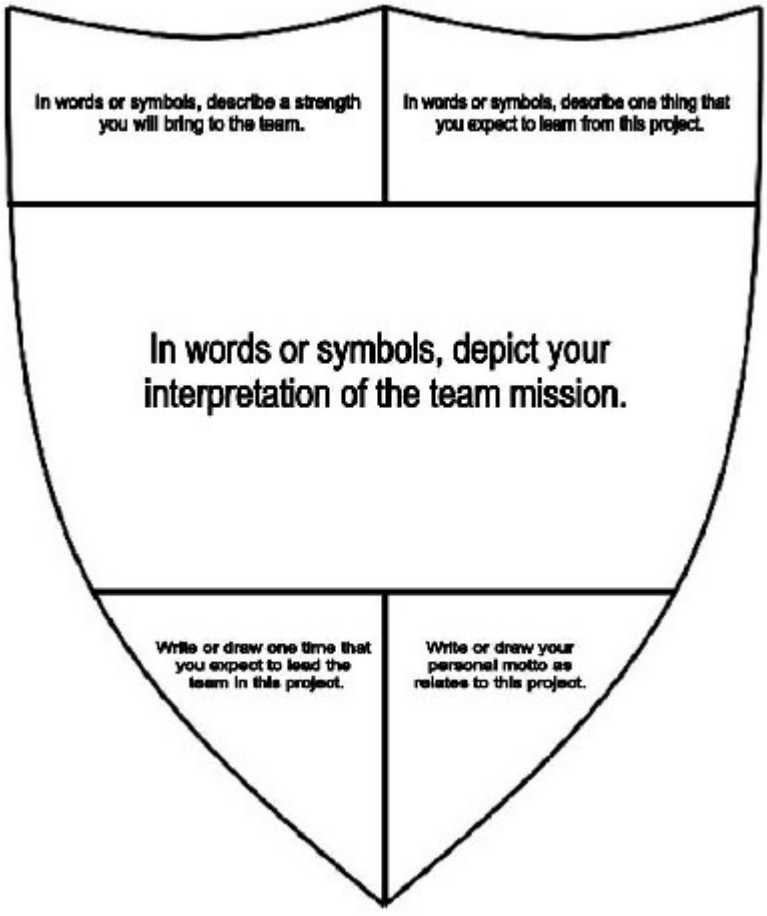


Figure 1. Mission Shield with prompts for students.

Shield Design:
Students gather for instructions. Take a moment to preview the objectives of the activity. Point out the prompts on the board, and stress that students may design their shield in the way they feel most comfortable—words, symbols, drawings, etc. However, they should be prepared to share their creation with the class at the end of the activity.

Answer any questions. Hand out copies of the Mission Shield worksheet. Direct team members to spread out and work on their shields.

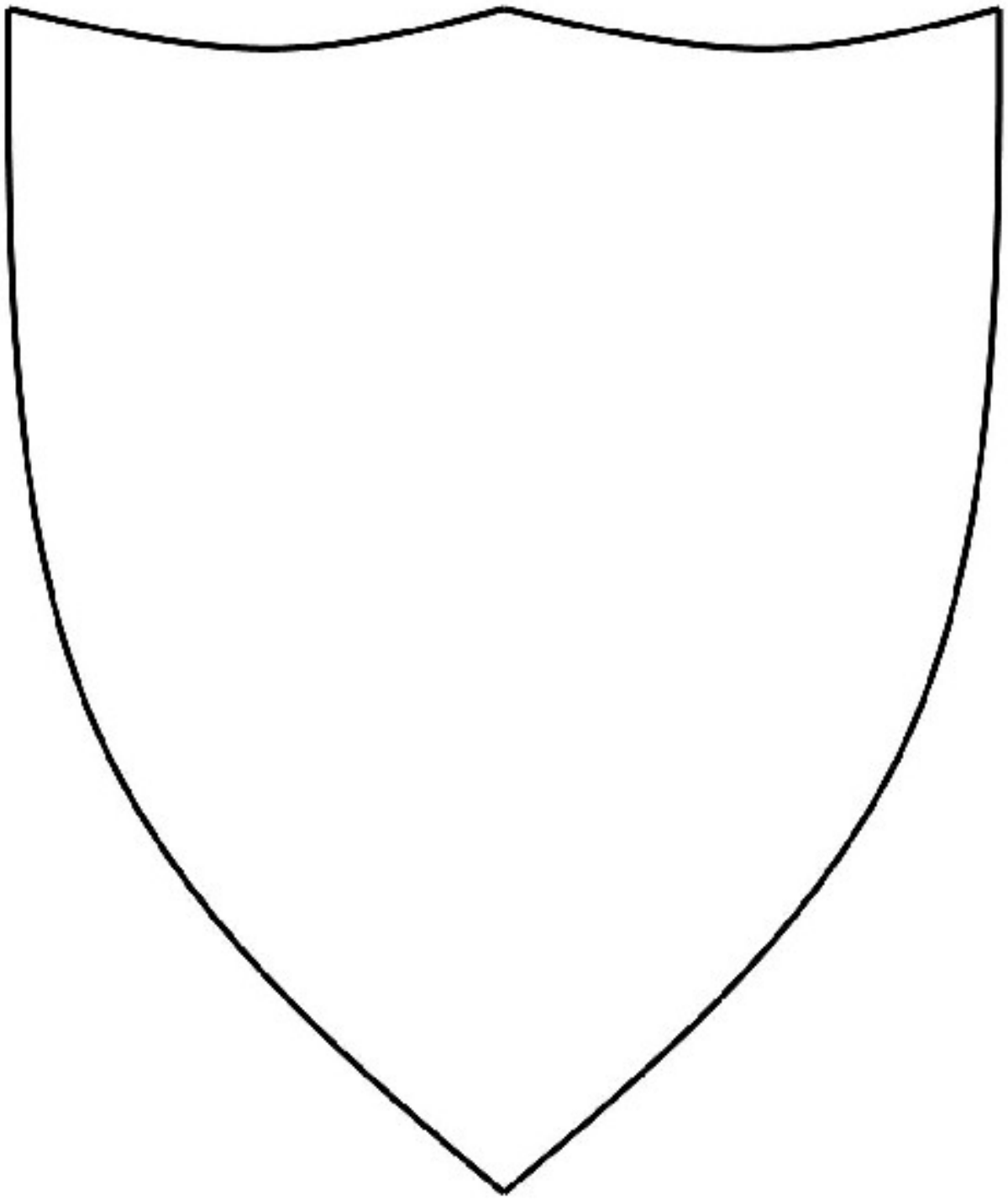
Sharing Shields:
Once work has finished, the team gathers for discussion and sharing. Students should take turns briefly showing and describing their work to the group. After all have presented, discuss the results. Ask students to point out any similarities between shields. Are their common mottos? Strengths? Is there obvious connections between students expecting to lead the group? Apply the results. How can the team make sure that members meet their aspirations for learning? Are there gaps in team leadership? Can these be solved?

It may be useful to have students fix these shields into journals or lab notebooks, or hang them on the meeting room wall. Continual reminders of this experience are imperative to increased effectiveness. Afterward, refer often to students' creations and lessons learned, asking them to recall emotions and answers to questions. Students should often revisit their shield, further assessing their roles in the team service-learning effort.

References:
This lesson is adapted from *Creative Heraldry* in:
Rohnke, K., & Butler, S. (1995). *Quicksilver: Adventure Games, Initiative Problems, Trust Activities and a Guide to Effective Leadership.* Dubuque, IA: Kendall/Hunt Publishing Company.

Mission Shield

Mission Shield Worksheet



Designing Team Mission

TOPIC:
Mission building

OBJECTIVES:
- Students will identify key elements of mission statements
- Students will develop a team mission statement

LENGTH:
1 – 2 hours

ENVIRONMENT:
Indoors

MATERIALS:
- Reference Books on Vision and Mission
- Examples of Mission statements
- Mission worksheet
- Pencils
- Access to library and/or Internet for research
- Board/Flip chart
- Dry erase markers or flip chart markers

Background:
The team mission statement provides a collective aim to guide participants in completion of their service project. It is important to develop and adopt a team mission because it provides a common goal for the group to accomplish. In this activity, students research aspects of both vision and mission statements, determining effective elements of each. The group convenes and presents ideas to the team. Based on this research, participants then develop a team mission.

Activity Outline:
Beforehand:
Gather reference books on vision and mission statements. Find examples of mission statements from various organizations and groups to use as discussion and processing with students. Prepare copies of the mission worksheet. Secure access to Internet-ready computer lab or library.

Convening Students:
Students gather for instructions. Introduce objectives. Provide a brief introduction on characteristics and aims of vision and mission statements. The students may also independently work through research to define these characteristics. Regardless of set up, however, participants should be guided through the tasks before they are set to research elements of vision and mission statements. Divide youth into small groups. Instruct each group to research elements of effective vision/mission statements using provided materials. They should be prepared to report their findings to group members. Assign groups questions like the following: How many words are in a mission statement? What questions should a mission statement answer? Also ask groups to find examples of mission and vision statements from other organizations, etc. Ask for questions. Then allow students time to research elements of good vision and mission statements.

Group Reports:
Gather students for group reporting. Prompt students to share information from the research process (Internet, library, etc.). Ask each to discuss elements or qualities inherent to effective vision and/or mission statements. Then ask students to present and critique vision and mission statements from various companies and organizations with the larger group. Record findings on a board or use a flip chart.

Developing Team Mission:
Using the Mission worksheet, guide participants through the aspects to consider when designing a mission statement. The whole group should brainstorm a vision for the future. What does the group want to accomplish in the next few years?

Once a vision is established, split participants into smaller groups to develop a team mission. Ask youth to reflect on effective characteristics to use in a mission and examine these aspects as related to their project. Each group should develop a draft mission statement based on the vision.

Once each group has developed a team mission, have them present it to the team. Ask the team to critique each mission. Remind them to stress the positives. What is strong about this statement? Record critiques.

After mission statements are presented, reviewed, and critiqued, the whole group will need to adopt a team mission statement. Based on critique of small group drafts, the team should draft a full statement that meets group consensus. Prepare a document with this team mission and have youth provide signatures as part of a contract the group adheres to during the project.

Afterward:
Refer back to the team mission as work progresses. Are participants meeting their goals and vision?

References:

Peterson, Randall S. (1991). *Seeing the Vision*. Minnesota 4-H Youth Leadership Workbook 5. St. Paul, MN: Minnesota Extension Service, University of Minnesota. 4H-BU-5731-S

Peterson, Randal S. (1991). *Reflecting on Action*. Minnesota 4-H Youth Leadership Workbook . St. Paul, MN: Minnesota Extension Service, University of Minnesota. 4H-BU-5733-S

Building Environmental Youth Leadership
A High-School Service-learning Curriculum

The Mission

EXAMPLE:

We, the Environmental Leadership Team, are resolved to solve the growing problem of pollution in our school. Therefore, we intend to work with teachers and administrators to develop a school-wide recycling program.

What is the Problem:

Why is it a problem:

Why are you interested:

What do you plan to accomplish:

How will you reach your accomplishment:

Our Mission

Adapted From:
Bass, Melissa. (1994). *Making the Rules: A Public Achievement Guidebook—For Young People Who Intend to Make A Difference.* Minneapolis: Humphrey Center.

Behavior Code

TOPIC:
Team-building, Mission-building, Action-planning

OBJECTIVES:
- Students will develop codes to guide individual actions and responsibilities as members of the team.

LENGTH:
30 minutes to 1 hour

ENVIRONMENT:
Indoors in a classroom.

MATERIALS:
- A chalkboard or other large display and chalk or markers for recording group answers.

Background:
Team- and mission-building activities are essential to developing efficient group operation. At some point, however, lessons learned in these activities must be translated into a code of behavior that group members agree to follow. This set of ethics provides easy access to responsibilities and expectations of individuals to the team and mission. In this activity, students explore memories, journal entries, etc. to recall lessons learned about teamwork. Through prompting questions, they translate these into a draft behavior code for the team.

Activity Outline:
Beforehand:
Prior to tackling a draft of the Behavior Code, it is assumed that team members have 1) completed a number of team-building activities and 2) drafted their mission statement. Students should be working together fairly efficiently at this point.

Leaders should also take time prior to the activity to become familiar with discussion prompts listed below. It may be useful to note lessons cited by students in team- and mission-building activities that apply to each prompt. These may be used to spark discussion.

Code Creation:
Students gather for instructions. Take a moment to introduce the objective of the activity. Remind them of the mission drafted for the group. Then provide participants a few minutes to reflect on their team experiences, peruse journal entries, re-visit old photos to recall lessons learned about group-work and ethics. Stress that students should focus on lessons important to achieving their mission. Suggest they write these down for easy reference in group discussion. Sometimes lessons are hard to translate into words.

Once participants have collected their thoughts, re-gather for group discussion. Explain that the code of behavior will translate lessons learned in previous activities into a set of standards to guide future work on the service project. For instance, a lesson learned may be *good solutions usually result from cooperation of more than one group member*. A resulting standard might be *any problems facing the group will be open to input from all members.* The standards should ensure that lessons learned are heeded in group process, that individuals are treated fairly as members of the group, and responsibilities are shared equally and taken seriously. Stress that everyone must agree to and believe in the code for it to work.

Begin by listing lessons learned on the board. Ask students to group any related lessons. Then, split students into small groups. Depending on the number of lessons learned, these may contain 2-5 students. Assign each small group with 1-2 lessons or groups of lessons. Provide them time to translate these lessons into standards for the code of behavior.

Once small groups have completed their standards, gather again as a team. Repeat the process of listing and grouping. Ask participants to identify and fill any gaps in the standards—ensuring that all lessons learned are reflected in the code. Likewise, they should point out and fix any unrealistic standards. Some leaders may challenge students to clarify obscure language or amend wordiness. Then, team members can determine the order in which standards should appear in the code.

As a last, but important measure, the team should vote to accept or deny the code. A code of conduct will only work when all agree to abide. If there is disagreement, the "nay-sayers" should suggest amendments that will secure their vote. Other group members can accept, decline or bargain with the amendment before another vote. Continue the process until reaching agreement of the entire team.

Living by the Code:
A code of conduct is powerless without explicit consequences for misbehavior. Once the team has agreed on their code, ask members to brainstorm appropriate consequences. It may help them to discuss and compare consequences for misbehavior in other parts of their lives, such as school, sports, home…. What happens when they breech the code of conduct in these spheres? How will the group assess misbehavior and assign consequences?

Repeat again the process of listing and grouping the consequences. Team members should also debate and vote to accept these as binding. Then, the consequences can be added to the bottom of the code of conduct.

Reminders:
Draft a master copy of the complete code of conduct with space signatures of all team members. Students may sign the contract in ceremonious fashion. Provide each with a copy of the original for their journals. Place the master copy in a prominent location. Return briefly to the code with the team before outings, speakers, discussions and decisions.

Building Environmental Youth Leadership
A High-School Service-learning Curriculum

Watershed Geography

TOPIC:
Background research

OBJECTIVES:
- Describe characteristics of watersheds.
- Understand the role that rivers have in watershed identity.
- Identify which drainage basin in which they live
- Identify the watershed in which activities are located.
- Explain the role of the property within the watershed.
- Discuss the movement of water on the property.
- Discuss land use on a watershed

LENGTH:
50 minutes

ENVIRONMENT:
Indoors and/or Outdoors.

MATERIALS:
- Lake Superior floor map
- MN map with drainage basins outlined
- Map of St. Louis River watershed
- Drawing paper
- Large Pieces Heavy Paper
- Clipboards
- Pencils
- Markers/crayons

Background:
In this lesson, students are introduced to the concept of watersheds, A brief overview of Minnesota's drainage areas will be introduced. Once students have examined these large watershed drainage areas, the students are guided through considering Minnesota – Lake Superior Drainage – St. Louis River watersheds. Some guided activities and group discussion assists them in this transition from big picture to smaller picture. Students then map their immediate landscape for drainage characteristics.This is an opportunity for team members to directly experience the geography of watersheds, and how interactions occur that cause environmental stresses. It is particularly appropriate for teams considering erosion control projects.

Activity Outline:
Beforehand:
It may work best to complete this activity at the proposed project site.

Create maps of Minnesota with appropriate watershed boundaries defined. This is something that can be copied and distributed to all students or a set for wall-viewing. Gather additional supplies for group work including drawing paper, pencils, markers or crayons, etc.

Mapping the Watershed:
Students gather for introductions. Prompt them to discuss definitions for watershed, sharing knowledge on how water movement is critical to establishing watershed boundaries. Once students are comfortable with the idea of watersheds, explore the maps. Ask them to point out watershed boundaries at the Minnesota, Lake Superior, and St. Louis River levels. Finally prompt them to suggest characteristics of water movement relevant in their local landscape.

After classroom discussions and illustrations, students explore outdoors to find examples of drainage areas. Split students into small groups and assign each to map out a specific area including location of buildings, parking lots, playground, and natural areas. After general mapping, groups should investigate and predict the direction of water flow in their areas.

Groups then reassemble to compile information and complete the mapping project - a classroom mural created on heavy paper. In essence, the students depict the flow of water on the immediate property. All groups should share their maps with the team. Comparing the various depictions prompts discussion of the similarities and differences between students' work. All maps should be displayed, and a wrap-up discussion hosted to review information on watersheds.

Additional Investigation :
Later, the students may venture out on a rainy day to determine the accuracy of their investigations. How is the water moving? Where are puddles located? Is there a focal point to which all water is moving?

If interested and relevant, contact the City Water and Sewer division and request a site visit. The City can provide additional resources to compliment this activity. For instance, using video equipment, they may place a robot vehicle in the city water pipes to provide feedback on how and where water is moving. Additionally, different dye colors can be added to water to trace movement. The City can also offer various map images to assist the learning process.

References:

Lake Superior Center. (1998). *More Than Just a Lake*. Lake Effects, The Lake Superior Curriculum Guide for Grades K-8. Duluth, MN: Lake Superior Center.

Western Regional Environmental Education Council, Inc. (1987). *Watersheds*. Aquatic Project WILD. Bethesda, MD: Western Regional Environmental Education Council.

The Watercourse and Council for Environmental Education. (1995). *Color Me A Watershed*. Project WET. Bozeman, MT: The Watercourse and Council for Environmental Education.

The Watercourse and Council for Environmental Education. (1995). *Rainy-Day Hike*. Project WET. Bozeman, MT: The Watercourse and Council for Environmental Education.

Remedial Action

TOPIC:
Background research

OBJECTIVES:
- Students will compare their proposed project to problems identified and remedial action steps proposed in an environmental restoration plan.
- Students will practice basic research and presentation skills.

LENGTH:
2 hours

ENVIRONMENT:
Indoors or Outdoors. Need a place for students to pair-off for short discussions.

MATERIALS:
- Copies of the *Threats to the Lower St. Louis River Ecosystem* or *St. Louis River Habitat Plan.*
- Copies of the Study Guide Worksheet for Students.

Background:
Service-learning is not only concerned with satisfaction, team-work and lessons learned through student involvement and hard work. A truly successful service-learning project should benefit the environment and community in which it takes place. The objective of this activity is to compare proposed service projects with actions suggested in a scientific restoration plan. Students read and summarize parts of the plan. Then, the group works together to assess the value of proposed projects. As a result, the group develops a more focused understanding of the value of their service.

Activity Outline:
Beforehand:
While this activity may be used to brainstorm possible service projects, it will be more effective as a means of assessing existing project ideas. Therefore, it is suggested that the group complete an activity like *Observation and Adventure Trip* to define one or more potential projects before starting this activity.

Copies of the *Threats to the Lower St. Louis River Ecosystem* can be printed. Or copies of the full *St. Louis River Habitat Plan* should be requested from the St Louis River Citizens Action Committee or downloaded from their website www.stlouisriver.org prior to beginning the activity. This is a fairly large pdf document (1.4MB) so make sure to use a computer with an appropriate internet connection. Leaders may choose to copy all 100+pp of the plan, including history and geology of the river, assessment methods, threats and mitigation actions. This is good information for students to explore and summarize. However, the scope of this activity demands only that students work with the final two chapters: Threats to the Lower St. Louis River Ecosystem, and Strategies for Mitigating Threats.

Leaders may also choose to copy and assign students the accompanying *Study Guide* worksheet. This will help students summarize what they read. Leaders may not choose to assign the entire guide to all students. However, they should take time to split questions into manageable sections that small groups can complete. At the conclusion of the activity, the group should be able to answer all questions.

If the extent of this plan is inappropriate for the location of a proposed service project, group leaders should check with representatives of local planning departments, Soil and Water Conservation Departments, Natural Resource Conservation Services, University Extension Service, Department of Natural Resources, environmental advocacy groups, etc. for appropriate plans. However, these can be extremely technical in

nature. Take time to assess the suitability of the plan for students involved.

Reading the Plan:
Students gather for instructions. Briefly overview the objectives of the activity. Having selected one or more potential service projects, group members need to identify benefits to the environment and community before making a final decision. After all, a project with no benefits is little more than wasted time. Explain that students will work in small groups to read, understand and present sections of a scientific habitat plan, which notes environmental problems in the St Louis River and ways these may be mitigated. Armed with this information, the team can assess how proposed projects measure up, and decide whether to proceed.

Introduce the *St. Louis River Habitat Plan*. The introduction of the full document (pp1-4) provides requisite background information. Take a moment to answer student questions. Then, split them into small groups that will explore various parts of the plan, and report their findings back to the team. An easy way to divvy the reading is to assign each group a few questions from the study guide. However, groups may also be allotted a section or two from the guide (i.e., Loss of Habitat under Stresses or Commercial Shipping under Sources of Stress). In the latter instance, the team may choose to answer Study Guide questions during group presentations.

Students take time to split into small groups, read, and plan a presentation for their assigned portions of the plan.

Presentations:
Students gather for presentations. Starting with the beginning of assigned sections, ask students to briefly (5min or less) summarize information they read. If they were assigned specific study guide questions, they should provide these answers. Otherwise, the entire team may take some time at the end of each presentation to assess which questions, if any, were answered by the group. Finally, each group should answer any follow-up questions asked by their peers.

Project Assessment:
Once all groups have presented their information and answered study guide questions, the entire team should assess environmental and community benefits of potential service projects. For each project, identify a threat which it addresses. Where does it fit within the stresses and sources of stress identified in the plan? Then, evaluate whether each project fits within remedial actions proposed in the plan. Brainstorm any additional benefits associated with the projects that are not proposed in the *Habitat Plan*.

Finally, students can rank each potential project according to their benefits assessment.

References:

St. Louis River Citizens Action Committee. (2002). *Lower St. Louis River Habitat Plan.* St. Louis River Citizens Action Committee, Duluth, MN. Downloaded from www.stlouisriver.org on 7/12/06.

THREATS TO THE LOWER ST. LOUIS RIVER ECOSYSTEM
Adapted from Lower St. Louis River Habitat Plan
Compiled by St. Louis River Citizens Action Committee

Definitions for ***bold face words*** appear in the Glossary at the end of the report

To identify ways of managing and enhancing the health of the Lower St. Louis River ***ecosystem***, it is necessary to understand the requirements of a healthy ecosystem and what factors may be causing harm.

Threats can be described in two parts: a ***stress*** and a ***source of stress***. Stresses are the processes or events that have direct impacts on the ***watershed***. The sources of stress are the people, plants, animals, actions or conditions that cause the stress. Stresses are what need to be eliminated or minimized to protect the watershed, but this can only be done by acting on the sources of the stress. For example, poor water quality may be a stress to fish, mussels, or other plants and animals. However, this stress may be caused by any number of factors like increased ***runoff*** and ***erosion*** from large development projects, pollution from factories or farms. To eliminate the stress, the cause of degraded water must be clearly identified.

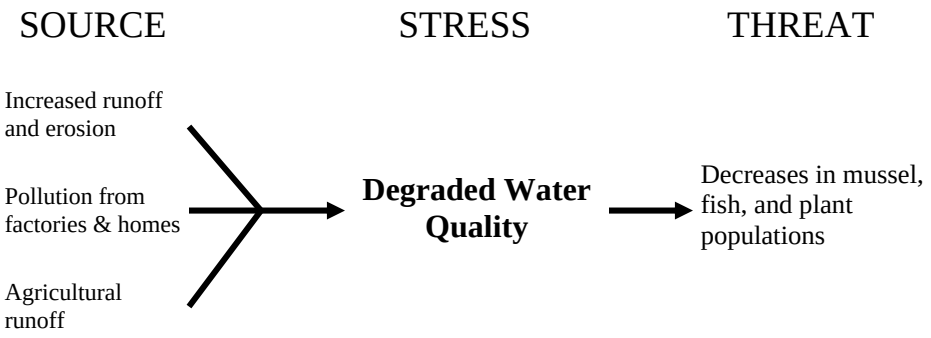


Figure 1: **An example of the relationship between source, stress, and threat to water quality on the Lower St. Louis River ecosystem.**

Often, a single activity causes multiple stresses, thereby contributing to multiple threats. For example, commercial and residential development (building new homes and businesses) contributes to four of the major stresses to the Lower St. Louis River ecosystem. Sometimes multiple activities contribute to a single stress, and some threats occur at scales far greater than that of the Lower St. Louis River project area (such as global climate change and airborne pollution). It is beyond the scope of this report to develop strategies to mitigate such effects.

It is important to recognize that the intent of this report is to catalog and explain the human activities that have or are expected to have a negative impact on the health of the Lower St. Louis River ecosystem—the birds, fish, mussels, wetlands, forest, and other entities. However, it is not intended to suggest or imply that all human activities are "bad," or should be eliminated. Instead, this report highlights the need for careful

planning of future developments and other endeavors, as well as the need to decrease the effects of current human activities.

Overview of Stresses and Sources of Stress

The most critical stresses and sources of stress to the watershed are summarized below. These are stresses and sources of stress for which various strategies have been developed in this report.

Critical Stresses to the Lower St. Louis River Watershed

- **Loss of *habitat*** directly eliminates animals and plants in the watershed
- **Increased *sedimentation* (filling in of bays and waterways)** threatens the survival of many habitats, especially the sheltered bays
- **Competition for food and habitat from undesirable exotic species** threatens the survival of animals and plants that naturally live in the watershed
- **Exposure to river bottom *pollution*** threaten the health of animals and plants in the watershed
- **Poor water quality** impairs the health and diversity of habitats, as well as plants and animals that live in the watershed

Critical Sources of Stress to the Lower St. Louis River Watershed

- **Home, shopping and factory developments** within the watershed and harbor result in the loss of natural habitat, increased erosion and sedimentation, lowered water quality, and the introduction and spread of exotic species
- **Commercial Shipping** results in the need for ***dredging*** (digging out) and filling waterways, resulting in loss of habitat, increased erosion, and the introduction and spread of exotic species
- **Polluted sediments** from a variety of historical factory and commercial sources expose plants and animals to pollution that might harm or kill them
- **Forest management practices** contribute to increased water flow after rainstorms, which result in erosion and sedimentation

The following table summarizes the five major stresses and sources of stress in the Lower St. Louis River Watershed.

Table 5 ***Primary stresses and sources of stress in the Lower St. Louis River Watershed.***

Stress	Source of Stress
Loss of habitat	Development Commercial Shipping (dredging and filling) Other sources
Increased Sedimentation	Development Forest management practices Other sources
Competition from Exotic species	Commercial Shipping Development Other sources
Contact with polluted river bottom	Pollution from historic commercial and industrial sites, sewage Other sources
Lower water quality	Development Commercial Shipping Polluted river bottom Forest management practices Other sources

Stresses

Loss of Habitat

Loss of habitat directly eliminates plants and animals we are trying to conserve. It is generally caused by the conversion of forests, wetlands and other natural landscapes to another use, such as providing homes for people, shopping developments, factories, and growing crops.

Historical habitat losses in the Lower St. Louis River include the elimination of much of the Great Lakes coastal wetlands and shoreline aquatic habitats, which were filled to create land for various developments or dredged for shipping.

Increased Sedimentation

Sedimentation from soils eroded into the river is a serious and ongoing threat, particularly to the sheltered bay habitats and their accompanying wetlands. Sedimentation is also a problem for some bays and river mouths. The bays provide important habitat for fish spawning, bird nesting, and feeding for a wide range of plants

and animals. Sediments slowly fill these bays, causing the decline and loss of wetland vegetation. In addition, particles of clay floating in the water reduce penetration of sunlight in the already dark waters of the rivers. This makes it harder for underwater plants to grow. Fewer plants result in loss of food and habitat for fish and birds.

Competition from Undesirable Exotic Species

Undesirable ***exotic species*** of plants and animals are one of the biggest threats to the Lower St. Louis River Ecosystem. By competing for habitat, food, and breeding areas, undesirable exotic species can eradicate other animals and plants that usually live in the river, reduce fishing, spread disease, and reduce the overall diversity of animals and plants in the ecosystem.

Some exotic animals found in the watershed are: Zebra mussels (*Dreissena polymorpha*), Eurasian ruffe (*Gymnocephalus cernuus*), Round goby (*Neogobius melanostomus*), Rainbow smelt (*Osmerus morax*), Sea lamprey (*Petromyzon marinus*), Threespine stickleback (*Gasterosteus aculeatus*), Rusty crayfish (*Orconectes rusticus*).

Some exotic plants found in the watershed are: Purple loosestrife (*Lythrum salicaria*), Common reed *(Phragmites australis*), Reed canarygrass (*Phalarus arundinacea*), Hybrid cattail (*Typha x glauca*), Beachgrass (*Ammophila breviligulata*).

River Bottom Pollutants

Elevated levels of pollution in the river bottom, including metals, pesticides and other chemicals are causing a number of concerns on the Lower St. Louis River. These include threats to fish, plants and microorganisms living in the river. In addition, river bottom pollutants lead to restrictions on eating fish, and increased costs to industry.

Degraded Water Quality

Water quality in the Lower St. Louis River watershed has improved greatly since 1978, when the water treatment plant (Western Lake Superior Sanitary District) began operating. However, improvements are still needed. Pollutants previously released into the river remain suspended in the water. Moreover, several sources of pollution (from road and grass runoff like fertilizers and oil) still contribute to lower water quality in the watershed. These threaten fish, birds and other animal and plant populations.

Sources of Stress

Home, shopping and factory developments

Home, shopping and factory development projects result in many changes to the land and water. The most obvious effect of these projects is the loss and degradation of habitats and the resulting negative effects on animals and plants that utilize those

habitats. Development is the primary cause of habitat loss and sedimentation, contributing to lower water quality. It is also a factor in the spread of exotic plants.

Natural forest land and other vegetation cover absorbs water and slows the movement of runoff. Wetlands and forest soils act as natural sponges to hold water and release it gradually. But when land is developed, the loss of forests, wetlands and other vegetation cover, in combination with increases in roads, parking lots and other surfaces that don't absorb water causes runoff to move more quickly. This leads to greater erosion of stream banks and channels, and sedimentation in the Lower St. Louis River.

In addition to increasing sedimentation, runoff may also carry pollutants into the river.

Seeds from exotic plants (like purple loosestrife) planted in gardens can also be carried into local wetlands and stream banks. However, it is now illegal for nurseries to sell known exotics in Minnesota and Wisconsin.

Commercial Shipping

Dredging and deliberate filling of river areas have been two causes of habitat loss in the Lower St Louis River, and they remain a continual threat. Development projects are often the cause of deliberate filling, but filling is also a result of maintenance dredging of the main shipping channel and some of the industrial slips and navigation channels. Whenever materials are dredged from the river bottom, they must be deposited somewhere. Erie Pier is the facility that currently processes and stores dredge materials. Previous ideas for dredge materials have been using it to fill some bays, shipping slips and deep holes found on undredged portions of the river. Such filling would result in a loss of habitat, and threats to fish and plants.

Commercial shipping is also the primary cause of the introduction of exotic species into the Lower St. Louis River. ***Ballast water*** from ships that is released into the river may carry exotic animals and plants. Other ways of spreading exotics include intentional and unintentional fish stocking, construction of canals and water diversions, transport in bait buckets and on fishing boats, planting for road construction, dispersal from gardens, and release from aquariums.

The spinning propellers on ships can also stir up river bottom pollutants.

River Bottom Pollution

Pollution on the river bottom is a concern on portions of the Lower St. Louis River. Pollutants result from many sources, including factory operations, city wastewater, stormwater, and runoff from homes and businesses.

Forest Management

Some current and historical forest management practices (cutting and planting trees) have contributed to increased sedimentation of the Lower St. Louis River. For example, many of the remaining forests within the area are fairly young, and contain a lot of aspen and birch. Studies suggest that snowmelt occurs 2 to 3 times faster in these forests than those that are over fifteen years of age. This causes an increase in runoff and erosion.

In addition, logging roads built to harvest trees lead to loss of habitat and increased runoff and erosion. They also provide pathways for introduction of exotic plants and animals.

STRATEGIES FOR DECREASING THREATS

Having identified the threats to the health of the Lower St. Louis River watershed the next step in the process was to develop strategies to eliminate or abate these threats. The following are some strategies for decreasing threats:

Protect Critical Remaining Natural Areas

- Increase public understanding and awareness of the importance of the beach and dune communities (Minnesota and Wisconsin Points) to migratory birds and the need to minimize harm to this habitat.
- Encourage people to stay on designated trails on Wisconsin Point and Minnesota Point
- Survey plants and birds within the Magney-Snively Forest to provide data for monitoring the health of the forest
- Inventory and document erosion areas in all area forests and stream banks
- Ensure that land surrounding sheltered bays is maintained with natural vegetation

Clean Polluted Sediments and Restore Natural Functions

- Encourage action to clean contaminated sediments and restore natural functions

Reduce High Stream Flows that Result from Land Development

- Protect wetlands and forests in the watershed
- Re-plant evergreen forests in appropriate areas of the watershed

Control Pollution from Roads and Parking Lots

- Educate the Public on the impacts of sand and salt in water environments
- Work to reduce the use of road salt on roads in winter
- Install traps to capture sand in storm sewers and ditches before it reaches streams and wetlands
- Keep and enhance natural plant buffers on roadsides and in parking lots to capture sediment and salt before it enters storm drains and ditches.

GLOSSARY

ballast water: water carried by ships to provide stability and adjust a vessel's trim for optimal steering and propulsion. It is collected and released at sea, along coastlines, and in port. As a result, a diverse mix of plants and animals from different ports are transported and released around the world with the ballast water of ships.

clay: very fine inorganic sediments under 2 µm in diameter; not gritty, feels slippery between fingers.

dredging: Removal of mud from the bottom of water bodies. This can disturb the ecosystem and causes silting that kills aquatic life. Dredging of contaminated muds can expose biota to heavy metals and other toxics.

ecosystem: All of the interacting organisms in a defined space in association with their interrelated physical and chemical environment.

erosion: The wearing away of land surface by wind or water, intensified by land-clearing practices related to farming, residential or industrial development, road building, or logging.

exotic species: A species that is not indigenous to a region.

habitat: The place where a population (e.g. human, animal, plant, microorganism) lives and its surroundings, both living and non-living.

polluted runoff: Rainwater or snowmelt that picks up pollutants and sediments as it runs off roads, highways, parking lots, lawns, agricultural lands, logging areas, mining sites, septic systems, and other land-use activities that can generate pollutants.

pollution: Generally, the presence of a substance in the environment that because of its chemical composition or quantity prevents the functioning of natural processes and produces undesirable environmental and health effects.

runoff: Water from rainfall, snowmelt, or otherwise discharged that flows across the ground surface instead of infiltrating the ground.

sedimentation: The removal, transport, and deposition of detached soil particles by flowing water or wind. Accumulated organic and inorganic matter on the lake bottom. Sediment includes decaying algae and weeds, precipitated calcium carbonate (marl), and soil and organic matter eroded from the lake's watershed.

source of stress: the people, plants, animals, actions or conditions that stress the watershed.

stress: the processes or events that have direct impacts on the watershed.

watershed: All land and water areas that drain toward a river or lake; also called Drainage Basin or Water Basin.

Definitions from: www.duluthstreams.org, www.epa.gov/OCEPAterms/hterms.html

ACKNOWLEDGEMENTS

This report is edited verbatim from the *Lower St. Louis River Habitat Plan* with minor verbiage revision for non-technical readers and omission of content for reading time. It is intended only for educational use to provide a brief and general overview of the threats identified on the Lower St. Louis River.

Lower St. Louis River Habitat Plan was compiled by the St. Louis River Citizens Action Committee. Go to www.stlouisriver.org to download a full copy of the plan.

Building Environmental Youth Leadership

A High-School Service-learning Curriculum

Remedial Action

Study Guide

Complete the following questions while reading the assignment.

1. What is the difference between a *stress* and a *source of stress*? Which one must we minimize or eliminate in order to protect the watershed?

2. What is the intent of the report you are reading? What does the report *not* imply?

3. Which *critical stress* especially threatens the survival of sheltered bay habitats?

4. Which *critical sources of stress* contribute to the introduction and spread of exotic species?

5. What generally causes *loss of habitat*?

6. What are two main effects of *sedimentation*?

7. Name two undesirable *exotic plants* and two *exotic animals* found in the St. Louis River Watershed.

8. How do *river bottom pollutants* affect fishermen and factories?

9. What are two pollutants that *still contribute* to degraded water quality on the St. Louis River?

10. How does *home, shopping and factory development* change the way water is absorbed into the soil?

11. Define *ballast water*. Explain how it may affect the Lower St. Louis River watershed.

12. How can young aspen forests affect runoff?

13. What are two ways of protecting *Wisconsin Point and Minnesota Point*?

14. What types of forest should be planted to *reduce high stream flows*?

15. Where and why should we *install sediment traps*?

TOPIC:
Background research, Action-planning

OBJECTIVES:
- Students will define information requisite to planning their service project.
- Students will gain expert advice to use in planning their service project.

LENGTH:
2 to 3 hours

ENVIRONMENT:
Indoors in an area appropriate for a group presentation.

MATERIALS:
- An expert associated with the service project that is willing and prepared to speak with students.

Expert Advice

Background:
Due to the technicality of some environmental service projects, it is often helpful to introduce an expert speaker that can provide background detail and advice concerning action planning. In this activity, students prepare for their presentation by brainstorming details and questions that might be useful to ask an expert. Provided these details beforehand, the expert can plan a more focused presentation and better advise project planning.

Activity Outline:
Beforehand:
An expert speaker may be an appropriate addition to various points in the service-learning process: background research, project selection, action planning, project work days. In fact, it is advisable to enlist the help of one or more experts for the duration of the project. However, selecting an appropriate speaker is important. Depending on the demand and accessibility of experts, booking the engagement weeks or even months in advance is worthwhile. Contact representatives from organizations like Soil and Water Conservation Departments, Natural Resource Conservation Services, University Extension Service, Department of Natural Resources, etc. for help identifying appropriate speakers. Provide the following criteria when asking about possible presenters:
- Describe your goals and expectations for the speaker. What kind of background information should he or she be prepared to provide? Will the presentation be canned or open student direction? Are you looking for motivation? Etc.
- Decide on a timeframe for the presentation. When do you need the speaker? How long will he or she be expected to speak? Is this a one-time presentation or multiple engagements? The more flexible the timeframe the easier it will be to secure a speaker.
- Determine the budget for speaking fees. Announce upfront any funds available. Although many experts will speak for free, it is also important to note that he or she will volunteer the presentation.
- Describe the speaking arrangements. How large will the audience be? Where will the presentation take place? Will access to an internet capable computer be available? Will there be a projector?

Enlist students to help determine goals for the speaker. Ask them to consider what kinds of information they need to keep moving forward with their project. Do they need to know certain background information? Where to look for a suitable project? How much work will be involved in completing a potential project? Brainstorm a list of broad topics for the presentation. Split students into small groups, and assign each a topic. Provide a few minutes for groups to translate their topic(s) into specific questions that a presenter may be asked. These questions can then be used to describe presentation goals to prospective presenters.

One to two weeks before the engagement, send a short reminder letter to the presenter with the following information:

- Start and stop time
- Location with specific directions about parking, entry procedures, etc.
- Any fee that has been negotiated, including meals, mileage, etc.
- Name of the individual(s) who will meet her or him
- A brief summary of the room setup with a list of speaking aides provided like microphone, LCD projector, dry-erase board, lectern, etc.
- An agenda, including any meals before or after the event that presenters are invited to attend

Enclose with the reminder the questions previously generated by students. Offer to answer any questions or concerns before the presentation. Also, ask the presenter to send a short biography as soon as possible that can be used for introduction.

The Presentation:
Select one or two students to greet the presenter and make sure she or her is signed into the facility appropriately. Upon arrival, take a moment to orient her or him to the setting. While the presenter is setting up, students gather for the presentation. Remind them of the goals they identified and suggest they listen professionally. Finally, assign each student one question from the brainstorming list. Ask them to listen for and record the answer during the presentation.

When he or she is ready, introduce the speaker. During the presentation, sit in a location that affords silent and easy access to mitigate student interruptions. Thank the presenter when she or he finishes. If time allows, ask for student questions.

Once the presenter has packed, select one or two students to lead her or him to the appropriate exit.

Afterward:
Students gather for discussion. As a group, take turns providing answers to questions asked of the presenter. Discuss any questions that were not answered. Have students note any other lessons learned from the presentation. Then, consider application of the information. How can it be used as intended to keep the group moving forward? Can decisions be made based on the new information?

Send the presenter a thank-you note immediately after her or his presentation. Detail some of the answers, lessons and applications identified by the group.

References:

Illinois Farm Bureau. (n.d.) *Guidelines for Securing a Speaker*. Retrieved 7/12/06 from www.ilfb.org/databases/ifbdatabases/speakers/Guidelines.asp.

VanHooser, P. (n.d.) *Selecting a Speaker*. Retrieved 10/28/03 from Vanhooser.com.

Refining the Details

TOPIC:
Background research

OBJECTIVES:
- Students will define information requisite to planning their service project.
- Students will practice basic research and presentation skills.

LENGTH:
1 to 3 hours

ENVIRONMENT:
Indoors with locations for small group discussions. Need access to a library and/or internet.

MATERIALS:
- Dry-erase, blackboard, overhead or other means of visibly recording student discussion.
- Computer(s) with internet access.
- Access to library materials.

Background:
Service projects are often identified through a mix of participants' personal interests and basic details of an environmental management problem. However, team members need to develop a deeper understanding of the problem in order to effectively determine a project's solvability, imagine a solution and design an action plan. This activity serves to focus research efforts of the group. Students begin by brainstorming information that they need to know about the problem. In teams, they search for these details, and present their findings to the larger group. The group can use this information to make a final project decision.

Activity Outline:
Beforehand:
It is imperative to the success of this activity that students have identified one or more service projects beforehand. Therefore, they should complete the *Adventure Observation Trip*, *Reading the Remedial Action Plan*, *Expert Advice* or comparable activities prior to tackling this project.

Success in this activity also depends on students' familiarity with the content and context of their problem. For instance, students comparing three possible wetland revegetation projects will have an easier time brainstorming information needed if they already hold a basic understanding of the subject. For students with little background, leaders should identify and present foundational information prior to this activity. This might take the form of guided internet research, reading assignments, expert speakers, etc. In such cases, leaders should also spend more time planning guided questions to facilitate a successful brainstorming session.

Finally, the meeting room should be set in an arrangement conducive to group discussion and sharing (i.e., seats in a circle, semi-circle or square, etc.) with a dry-erase, chalkboard or other means of visibly recording student comments in a prominent location.

Storming the Brain:
Students gather for instructions. Briefly introduce the objective of the activity. The group has selected one or more potential service-learning projects. But what do they really know about the work needed to complete these tasks? The group needs to determine what it will take to complete each project, and whether it is feasible under budget and time constraints. Explain that the team will start by brainstorming information about each project that needs to be gathered. They will then work in small groups to research and present the information to the group.

Write all potential projects on the board. Then, ask students to begin brainstorming needed information. It may be helpful to begin by soliciting general information that is not project specific. For instance, it may be helpful to know average daily temperatures and frost-free dates to help in selecting feasible dates for the project. The group should also pay attention to grouping their information requests. Are some needs subordinate to others, requiring certain information be gathered before others? Are some needs likely to be found in similar areas? This will help the team divvy the search among small groups.

Leaders should also urge the group through constructive follow-up questions to uncover finer details. If students suggest a need to define the cost of a wetland revegitation project, follow by asking what factors they need to include in defining the cost or how they can find that information? If students ask how much time it will take to plant 300 trees on an eroding hillside, follow by asking how they can devise a good estimate.

Seeking the Details:
Once the students have brainstormed and grouped information needed, the team splits into small groups, selects pieces to pursue, and begins research. This part of the activity will comprise the largest part of the project. However, groups should be constrained to a predetermined research period, such as 1 or 2 hours.

Leaders can augment the effectiveness of students' research during the work period by checking-in periodically to assess progress and offer suggestions. This will help groups overcome roadblocks in finding information, and generate further questions that extend their efforts.

Presentation and Choice:
After a predetermined research period, students gather for presentations. These can be short and informal. However, it will be useful to record information as it is presented, ideally on the same record where questions were originally posted. Students should be given a few moments after each presentation to question the group about the details of their information. Again, this may help to draw out fine points.

Once all groups have presented, ask students to identify any information gaps, questions that remain to be answered. Task these out to willing groups. Then discuss whether the information presented provides enough clarity to comfortably choose a service project. Should a decision be put off until remaining questions are answered? Should a choice be made pending final answers? If the group must decide between more than one project, open the decision to a group vote. For choice between 3 or more

projects, allow students to vote for their top two choices. In any case, the project with the most votes wins.

Duluth Streams

TOPIC:
Background research

OBJECTIVES:
- Students will practice basic internet research skills.
- Students will explore the breadth of information available on the Duluth Streams website.

LENGTH:
30 minutes to 1 hour

ENVIRONMENT:
Indoor location with computers and internet access.

MATERIALS:
- Computers with internet access
- A computer projection screen
- Copies of the Duluth Streams Scavenger Hunt for all students
- A copy of the answer sheet
- Prizes such as candy or pencils for all students

Background:
The internet provides a powerful tool for students seeking background information for environmental service-learning projects. The Duluth area is fortunate to have the comprehensive Duluth Streams website, which includes a wide array of scientific and social statistics for the streams and surrounding landscape. This website also has links to real-time water quality data for some streams in the area watershed. Because of comprehensive nature of the site, however, it can be hard to locate specific pieces of information. Therefore, students explore the website in this activity through a scavenger hunt. Once oriented, they will find it easier to identify and locate information that might be found there.

Activity Outline:
Beforehand:
Because the Duluth Steams website is so comprehensive, it is imperative to spend 1-2 hours exploring the contents before beginning the activity. The *highlights for new users* link on the homepage connects to a concise summary of the website construction—*Explore Duluth, Understanding, The Streams, Citizen Involvement,* and *Stormwater Management*—and contents. The *Search, Glossery,* and *Sitemap* links located on the bottom of the homepage are also helpful means of exploring the site.

Complete any procedure necessary to secure access to an internet-connected computer lab. This activity will work best if the lab includes a computer connected to a projection screen, which can be used to guide students through the website. For added efficiency, all computers may also be set so the Duluth Streams website (www.duluthstreams.org) is the homepage.

Copy the scavenger hunt worksheet for all students.

Searching the Site:
Instruct students to arrange themselves at computers in groups of 2-4. When all are seated, remind students of the objective of the activity. The internet, especially the Duluth Streams website, is a powerful tool for finding background information for their service projects. Provide a brief introduction to the Duluth Streams website, contents and navigation. If possible, demonstrate navigation around the site using a projector. Suggest that a challenge might help students explore the site more effectively. Plus, it will be more fun!

Make sure that all students are grouped for the activity—2 to 4 per group. Students will work in these groups to explore the site looking for answers to the scavenger hunt. They should record every step in navigating from the homepage to the answer, so they can describe how to get back later. Mention that

students who can accurately tell the class how to find an answer at the conclusion of the hunt may win a prize.

To ensure that all questions on the worksheet are answered, assign half of the groups to begin with the front side of the sheet, and half to begin with on the back. Answer any questions. Then, provide students 15 to 20 minutes to work quietly on the scavenger hunt. Visit briefly with each group, noting any answers that seem to be particularly difficult to find.

Awarding Good Work:
At the conclusion of the work time, ask students to return to the Duluth Streams homepage. Ask if there were any answers that groups could not find. Select other groups willing to describe where to find each of these answers. If correct, award prizes to these students. Because there is often more than one path to the correct answer, it will be useful to allow multiple groups to describe the paths they identified. The entire group can discuss which paths are easiest. The answer sheet may also describe additional paths to answers.

Continue the process until all questions have been answered. Students should record paths to any answers they were unable to locate.

Make sure that all students receive a prize.

Lessons Learned:
Ask students to return to the homepage. In fact, it may be useful for them to switch off monitors in order to focus more fully on group discussion. Review again the objective of the activity. Discuss with students what information might be available on the site to aid their project research. Where might they look to find it? Ask for the keys to navigating the site. What is the best way of getting around the site? Finish review by expanding the discussion. What other organizations or websites might we explore for background information on the service project. What are some searches that we might do to find other websites? If time permits, try a few of these searches, and explore interesting links that turn up.

Duluth Streams

Scavenger Hunt

Test your knowledge of Duluth-Area streams! Work in teams to explore the website www.duluthstreams.org. Answer the following questions with information from the website. Raise your hand when you have finished the scavenger hunt.

1. What's new on the Duluth Streams Site?

2. What is the *average precipitation* for this month as recorded at Duluth International Airport?

3. How many streams are there in the Duluth Area?

4. What is an *impervious surface*, and what harm does it cause to a watershed? Which Duluth-Area trout streams are above the Stream Impact Threshold?

5. Where are good brook trout *fishing spots* on Miller Creek?

6. What *online data sheets* are available for St. Louis River Watch?

7. What is the definition of *Eutrophication*?

8. How does the *central mudminnow* survive periods of low water?

9. Which Duluth-Area streams have *real-time data* available? What is the name of the machine used to collect this data?

10. What are 2 steps that you can take today to *make a difference* in your watershed?

11. What is an *illicit discharge*? Why is Duluth concerned about illicit discharges?

Building Environmental Youth Leadership

A High-School Service-learning Curriculum

Duluth Streams

Scavenger Hunt Answers

Test your knowledge of Duluth-Area streams! Work in teams to explore the website www.duluthstreams.org. Answer the following questions with information from the website. Raise your hand when you have finished the scavenger hunt.

Answers in Italics. **How to get there is in Bold Type.**

1. What's new on the Duluth Streams Site?

Click the WHAT'S NEW link at the bottom right corner of the HOME PAGE. This will take you to a page that explains periodic updates on the website.

2. What is the *average precipitation* for this month as recorded at Duluth International Airport?

About 1.9 in**. Click the EXPLORE DULUTH link on the HOME PAGE. Click the CLIMATE link on the next page. Then click HISTORICAL WEATHER DATA. Use the graphs to solve this problem. The EXPLORE DULUTH page includes information about the local environment and history.**

3. How many streams are there in the Duluth Area?

42**. This is stated on the HOME PAGE. You can also click the THE STREAMS link. Then select STREAM LOCATOR MAP under any of the SELECT A STREAM links**

4. What is an *impervious surface*, and what harm does it cause to a watershed? Which Duluth-Area trout streams are above the Stream Impact Threshold?

Land surfaces such as roads, parking lots, buildings, etc that prevent rainwater from soaking into the soil. The water increases in velocity causing more erosion; it warms causing potential heat stress for downstream trout; it picks up roadway contaminants; and the loss of vegetation removes a "sink" for dissolved nutrients - plant uptake. **You can find this information in the GLOSSERY link located at the bottom of the HOME PAGE. Also clicl UNDERSTANDING. Then, click WATER QUALITY IMPACTS in the black box. Finally, click the IMPERVIOUS SURFACES link. Use the graph to answer the second question.**

5. Where are good brook trout *fishing spots* on Miller Creek?

Fishing spots for wild brook trout include Lincoln Park, Lake Superior college campus and the Chambersburg area. **Click EXPLORE DULUTH on the HOME PAGE. Then click RECREATION in the black box. Finally, click the link for FISHING HOLES on the left hand side of the page. The RECREATION page also includes information about trout fishing, hiking and skiing.**

6. What *online data sheets* are available for St. Louis River Watch?

Invertebrate Collection Protocol, Invertebrate Tally Worksheet, Stream Discharge Worksheet, Water Quality Worksheet and Monitoring Site Sketch Worksheet. **Click CITIZEN INVOLVEMENT from the HOME PAGE. Then click VOLUNTEER ACTIVITIES in the black box. Click the link for ST. LOUIS RIVER-RIVER WATCH on the left side of the page. Finally, click the link for DATA SHEETS on the left side of the page.**

7. What is the definition of *Eutrophication*?

The process by which lakes and streams are enriched by nutrients (usually phosphorus and nitrogen) which leads to excessive plant growth - algae in the open water, periphyton (attached algae) along the shoreline, and macrophytes (the higher plants we often call weeds) in the nearshore zone. **Click GLOSSERY at the bottom of the HOME PAGE. Then click "E". Finally, scroll down the page to find the definition.**

8. How does the *central mudminnow* survive periods of low water?

Central mudminnows survive periods of low water levels by "burrowing" into soft sediments. They can also breathe air. **Click UNDERSTANDING from the HOME PAGE. Then click ORGANISMS in the black box. Click the FISH link on the left side of the page. Finally, click CENTRAL MUDMINNOW under FISH IDENTIFICATION on the right half of the page. Scroll the information for your answer.**

9. Which Duluth-Area streams have *real-time data* available? What is the name of the machine used to collect this data?

Chester, Kingsbury and Chester Creeks and the St. Louis River. **Click THE STREAMS from the HOME PAGE. Then select the STREAM LOCATOR MAP under the SELECT A STREAM menu in the black box. Use the DATA AND INFORMATION AVAILABLE FOR DULUTH STREAMS table to find information available about Duluth Streams—including real-time data.**

Stream Monitoring Units (SMUs). **Click THE STREAMS from the HOME PAGE Then click ABOUT DATA in the black box. Finally, click the MONITORING EQUIPMENT link on the left side of the page. The ABOUT DATA section discusses how data is collected and controlled.**

10. What are 2 steps that you can take today to *make a difference* in your watershed?

There are 10 Steps You Can Take Today on a Citizen Fact Sheet. **Click CITIZEN INVOLVEMENT from the HOME PAGE. Then click CITIZEN ACTION in the black box. Finally, click TEN STEPS YOU CAN TAKE TODAY along the left side of the page. This section provides information about how you can help maintain watershed health.**

11. What is an *illicit discharge*? Why is Duluth concerned about illicit discharges?

An Illicit Discharge is the result of an illegal and/or improper waste discharge into storm drainage systems and receiving waters. The City of Duluth contains 42 creeks, 12 of which are protected trout streams. The citizens of Duluth have repeatedly demonstrated that the quality of the environment is extremely important. As such the City of Duluth has made a commitment to protect and preserve the quality of the creeks within its jurisdiction. **Click on STORMWATER MANAGEMENT on the HOME PAGE. Then click on STORMWATER**

MANAGEMENT PLAN in the black box. Finally, click on ILLICIT DISCHARGES on the left side of the page. Scroll the information.

TOPIC:
Background research

OBJECTIVES:
- Students will develop and test hypotheses through collecting and recording water quality data.

LENGTH:
2 to 3 hours

ENVIRONMENT:
Outdoors in a location with safe stream access for students.

MATERIALS:
- Access to a water resource professional
- Transparency Tube
- Water quality monitoring kit w/ dissolved oxygen and pH tests
- Oranges and 10' lengths of string for each group
- 2 pairs of wading boots for each student group
- A clipboard for each student
- Copies of the data forms for all students
- Maps and pictures of test sites and streams
- Access to a van or other means of transporting students to monitoring sites.

Testing the Water

Background:
Scientific processes are central to identifying, researching, planning and completing environmental service-learning projects. In this activity, students explore the scientific method observing, hypothesizing and testing water quality at various locations along a safe stream. They develop a valuable understanding of parameters associated with water quality. Through this activity, students may also realize that threats to stream environments may be more complex than previously predicted.

Activity Outline:
Selecting Monitoring Sites:
Identify a water resource professional to work with the team before and during the activity. Due to the technical nature of water quality monitoring, it is essential that students learn from someone familiar with techniques and equipment. Professionals will also provide valuable advice concerning sampling locations and dates. Contact representatives from organizations like Soil and Water Conservation Departments, Natural Resource Conservation Services, University Extension Service, Department of Natural Resources, etc. for help identifying appropriate personnel. It may be worthwhile to connect this activity with either *Expert Advice* or the *Observation and Adventure Trip* activities.

Select locations for stream testing at least 2 to 4 weeks before the activity date. Either multiple locations along a single stream or different streams that exemplify different characteristics relevant to the service project (i.e., flat vs. steep, muddy vs. clear water, etc.) may be selected. In any case, monitoring sites should allow students safe access to water from the stream bank. Good sites will have shallow sturdy banks that go right to water's edge. Water should be reachable from a crouched position and no deeper than the tops of wading boots.

Cut a 10' length of string, and gather one orange for each group of students to use for measurement of water velocity. Transparency tubes and water quality monitoring kits also need to be secured in sufficient numbers for students to work in groups of 5 or less. Water resource professionals may have access to these materials. Otherwise, leaders should purchase from a scientific supply catalogue. Because accuracy is not overly important to the objectives of this activity, inexpensive test kits will suffice.

Permission and Preparation:
Follow facility guidelines and timelines for securing transportation to the site. Before departing on the trip, make sure that all participants also have a permission slip signed by a legal guardian. This form should conform to any safety needs expressed by trip leaders. It should 1) clearly

communicate all risks associated with the activity, and 2) solicit any health conditions that might bar a participant from safely participating.

Students need to dress for the weather forecasted on the trip dates. Prepare a packing list, including items to bring and those to leave at home. Cover trip specifics like where bathrooms and phones will be located, what the landscape will be like, etc. Make sure that all students have this information at least two-weeks prior to the trip. Pre-trip meetings are a good means of disseminating and discussing this information. Water resource professionals should be contacted 1-week prior to the arrival date to confirm procedures, times, concerns, etc.

In addition, assemble clipboards and copies of the data forms for all student groups. Make sure students are prepared with pencils for recording data. Prepare maps and pictures of test sites for group scrutiny.

Testing the Waters—In Class Exercise:
Students gather for the activity. Take a moment to review the objectives. In order to better understand water quality and how it is measured, students will plan an experiment, collect and interpret water quality data. Ask students to define and detail steps of the scientific process—observation, formulation of hypothesis, experimental design, data collection, interpretation, conclusion. Discuss each of these, and answer any questions. Then, brainstorm a list of threats to water quality in local streams. Ask students to link these with potential stressors. For instance, they might suggest loss of underwater plant life as a threat caused in part by increased stream turbidity. It might be useful to complete *Remedial Action* before tackling this part of the activity.

Describe each of the water quality parameters students will test. Note how these parameters relate to stressors identified previously by students. Background information is available in the *Understanding* section of the Duluth Streams website www.duluthstreams.org.

Finally, recall attention to the scientific process outlined earlier. Lest team members just go through the motions of testing parameters, it is imperative that they observe the sites, make some predictions about their tests, develop some hypotheses, and design experiments before heading out into the field. Split students into test groups of 4-5 that will work together in the field. Provide each group with pictures and maps of the sites as well as their data collection forms. Ask them to explore these pieces, consider the weather, etc., and predict values for each of the sites. Once all have finished, ask students to discuss and explain their predictions. Develop hypotheses based on group predictions. For

instance, the group might hypothesize that turbidity will be lower at test site #1 than test site #2.

Collect data forms for safe-keeping. Remind students to dress for the weather and turn in any required permission forms.

Testing the Waters—Field Exercise:
Upon arrival at the first test site, provide students a few minutes to explore and get used to their surroundings. Once the novelty of the setting has diminished, ask students to gather for directions. Briefly discuss rules and expectations. Take a few moments to introduce the water resource expert who will help with the activity. Allow time for the specialist to describe his or her interests, background and job responsibilities. Then, review the agenda, safety protocols and answer questions.

Remind the team of hypotheses generated earlier. Preview in detail how students can test these hypotheses using monitoring kits, oranges and string. Follow directions for kit tests and transparency tubes. To test water velocity, two students from each group should pull taught the ends of their 10' length of string at a point up- to downstream. Drop the orange in the water at the upstream edge of the string, and count the number of seconds it takes to reach the downstream edge. Divide the count by 10, which provides an approximate velocity in feet per second. Answer questions. Then, provide groups with their data forms, suggest they spread out along the stream, and allow them time to test the water. The resource expert may float around helping groups and discussing results.

Repeat the novelty reduction and testing process at each site.

Conclusion:
Students gather after recording data at the final site. Review again the objectives of the activity. Remind them of the scientific process, and hypotheses generated prior to the tests. Then, ask each group to share 1) their results, 2) how these compare with their predictions made in class, and 3) how their results compare with hypotheses. As a team, consider and discuss any lessons learned through the process. For instance, groups may discover in many instances that water quality is much more uniform in and across streams than expected. Have students apply these lessons to their service project. Does this have any effect on our action planning or research? Provide the resource expert time to interpret the results for students.

Afterward, refer often to the experience, asking students to recall lessons learned and expert interpretation of their results. Students should often explicitly apply these lessons to the team service-learning effort.

Test Site #1:

Describe the Site: What does the water look like? What does the land around the water look like? What might some problems in this part of the stream be? Describe in as much detail is you can. You can write your description, draw a picture, or whatever makes the most sense to you.	
Temperature Predicted Value: ____ °C Actual Value: ____ °C	**pH** Predicted Value: ____ Actual Value: ____
Dissolved Oxygen Predicted Value: ____ ppm (parts per million) Actual Value: ___ ppm	**Velocity:** Predicted Value: ____ fps (feet per second) Actual Value: ___ fps
Turbidity Predicted Value: ____ cm Actual Value: ____ cm	**Comments:**

Test Site #2:

Describe the Site: (Same Directions as First Test site)	
Temperature Predicted Value: ____ °C Actual Value: ____ °C	**pH** Predicted Value: ____ Actual Value: ____
Dissolved Oxygen Predicted Value: ____ ppm (parts per million) Actual Value: ___ ppm	**Velocity:** Predicted Value: ____ fps (feet per second) Actual Value: ___ fps
Turbidity Predicted Value: ____ cm Actual Value: ____ cm	**Comments:**

Test Site #3:

Describe the Site: (Same Directions as First Test site)	
Temperature Predicted Value: ____ °C Actual Value: ____ °C	**pH** Predicted Value: ____ Actual Value: ____
Dissolved Oxygen Predicted Value: ____ ppm (parts per million) Actual Value: ___ ppm	**Velocity:** Predicted Value: ____ fps (feet per second) Actual Value: ___ fps
Turbidity Predicted Value: ____ cm Actual Value: ____ cm	**Comments:**

Test Site #4:

Describe the Site: (Same Directions as First Test site)	
Temperature Predicted Value: ____ °C Actual Value: ____ °C	**pH** Predicted Value: ____ Actual Value: ____
Dissolved Oxygen Predicted Value: ____ ppm (parts per million) Actual Value: ___ ppm	**Velocity:** Predicted Value: ____ fps (feet per second) Actual Value: ___ fps
Turbidity Predicted Value: ____ cm Actual Value: ____ cm	**Comments:**

Tasking Out the Project

TOPIC:
Action -planning

OBJECTIVES:
- Students will identify and assign tasks requisite to completion of the service project

LENGTH:
1 hour

ENVIRONMENT:
Indoors in a classroom where students can gather in small groups.

MATERIALS:
- A chalkboard or other large display and chalk or markers for recording group answers.
- Copies of the Task List for each student group.

Background:
Service project goals are achieved through completion of many small tasks. Consequently, detailing and assigning responsibilities for these duties is essential to effective action planning. In this activity, team members generate their action timelines. They define goals requisite to completion of their project, segment these into prioritized tasks, and assign individuals to complete them. Resulting task lists provide the team a clear map for attaining success in their projects.

Activity Outline:
Beforehand:
Set up the work area so that 1) an initial whole-team brainstorming session can be conducted and results recorded, followed by 2) a break-out session where students work in small groups to detail action timelines.

Copies of the Task List worksheet should also be made for each student group. Because the number of groups will derive from major goals identified during brainstorming, however, it is difficult beforehand to identify an exact number of copies needed. One copy per 2 to 3 students is likely a good estimate.

Defining Major Goals:
Students gather for instructions. Take a moment to preview the objective of the activity. Then, introduce the initial brainstorming activity, in which the entire team segments major goals to be accomplished in completion of the service project. It is helpful to depict this as part of a 3-level breakout chart (see Fig. 1).

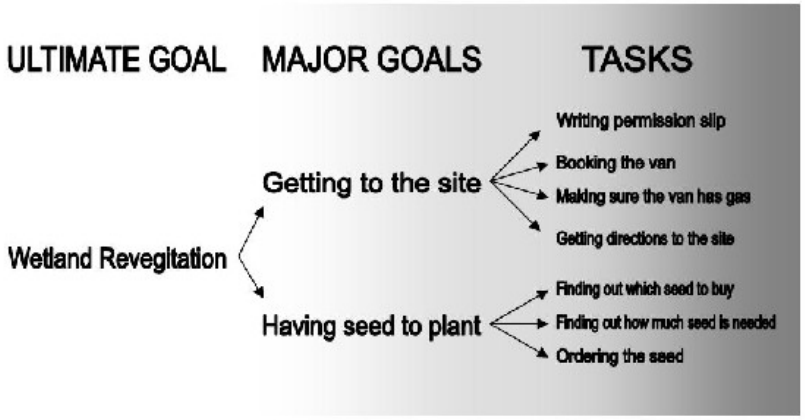


Figure 1. Example breakout chart.

The ultimate project goal, such as wetland revegitation, is depicted at the top of the chart. In this activity, group members should focus on defining the next level of subordinate goals. For instance, they might suggest "getting to the site," or "having seed to plant" as goals at this level. Stress, however, that team members should not yet focus on individual tasks, such as "booking the van" or "ordering seed," as these fall under the third level of the chart. Small groups will detail these in the next activity. Answer any questions about the activity or difference between levels of the breakout chart. Spend time as a group detailing major goals requisite to completion of the service project.

Upon completion, revisit the second-level list of goals. Ask team members to call out repetition or suggest subordination of any third level tasks that made it into the list. Prioritize the list, and set target dates for completion of each goal. Once members are satisfied, move to small group work.

Setting Tasks:
Divide the team into small groups of 2 to 5 students. Introduce the activity. Groups will adopt one or more of the major goals defined before to segment into individual tasks, including priority, person responsible for completing the task, and date to be completed. These should be as detailed as possible. For instance, students may break down "getting to the site" into tasks like "writing a permission slip," "booking a van," "making sure the van has gas," "getting directions to the site," etc. Stress that groups adopting a goal take charge of ensuring its completion by the target date. Similarly, individuals will be expected to complete tasks assigned to them. Success of the team depends on taking these responsibilities seriously.

Hand out copies of the Task List worksheet. Each group should fill-in the major goal at the top of the sheet, brainstorm and list tasks, etc. Once all tasks have been listed, then group members can assign priorities and completion dates. Students should think carefully about the tasks necessary to achieve their goals. But, it is important to suggest that additional tasks may be added later if they arise. Answer any questions.

Fairly assign one or more goals to each group. For instance, groups might choose order of selection by taking numbers from a hat or rolling a dice. Then provide team members time to work on their task lists. Visit briefly with students during work-time to assess their progress and suggest additions.

Mapping the Action:
Once all groups have finished their task lists, students gather for conclusion. Review the objective of the activity. Then ask each group

briefly re-state their goal and describe tasks assigned. It may be helpful to conglomerate these on a master timeline. Provide team members a moment at the end of each presentation to suggest additions or deletions. After all have described their tasks, discuss lessons learned from the activity. Was developing task lists really necessary? Why? How might this process be improved? Etc.

Assess the progress of task completion periodically throughout the project. Visit with groups to ensure their work is progressing. Once every week or two, groups should briefly update the team on their achievements and stumbling blocks.

Building Environmental Youth Leadership

A High-School Service-learning Curriculum

Tasking Out the Project

Task List

Priority	*Task*	*Person Responsible*	*Additional Notes*	*Date To Be Completed*

Building Environmental Youth Leadership

A High-School Service-learning Curriculum

Appendix A

Terms and Definitions from www.duluthstreams.org

A

abiotic:

Not alive; non-biological; for example, temperature and mixing are abiotic factors that influence the O_2 content of lake water whereas photosynthesis and respiration are biotic factors that affect O_2 solubility.

acid:

A solution that is a proton (H^+) donor and has a pH less than 7 on a scale of 0-14. The lower the pH the greater the acidity of the solution.

acidity:

A measure of how acid a solution may be. A solution with a pH of less than 7.0 is considered acidic. Solutions with a pH of less than 4.5 contain mineral acidity (due to strong inorganic acids), while a solution having a pH greater than 8.3 contains no acidity.

acid rain:

Precipitation having a ph lower than the natural range of ~5.2 - 5.6; caused by sulfur and nitrogen acids derived from anthropogenic emissions.

acidification:

The process by which acids are added to a water body, causing a decrease in its buffering capacity (also referred to as *alkalinity* or *acid neutralizing capacity*), and ultimately a significant decrease in pH that may lead to the water body becoming acidic (pH < 7).

adhesion:

The molecular force of attraction between unlike bodies that that acts to hold them together.

algae:

Simple single-celled, colonial, or multi-celled, aquatic plants. Aquatic algae are (mostly) microscopic plants that contain chlorophyll and grow by photosynthesis, and lack roots and stems ((non-vascular), and leaves. They absorb nutrients (carbon dioxide, nitrate, ammonium, phosphate and micronutrients) from the water or sediments, add oxygen to the water, and are usually the major source of organic matter at the base of the food web in lakes. Freely suspended forms are called *phytoplankton;* forms attached to rocks, stems, twigs, and bottom sediments are called periphyton.

alkalinity:

Acid neutralizing or buffering capacity of water; a measure of the ability of water to resist changes in pH caused by the addition of acids or bases and therefore, the main indicator of susceptibility to acid rain; in natural waters it is due primarily to the presence of bicarbonates, carbonates and to a much lesser extent occasionally borates, silicates and phosphates. It is expressed in units of milligrams per liter (mg/l) of $CaCO_3$ (calcium carbonate) or as microequivalents per liter (ueq/l) where 20 ueq/l = 1 mg/l of $CaCO_3$. A solution having a pH below about 5 contains no alkalinity.

anaerobic:

Technically this means "*without air*" but in limnology it is used synonymously with *"anoxic."*

aquifer:

A subsurface formation of rock, glacial material, or other deposits that contains water and is capable of storing and yielding water to a well or spring.

anions:

Negatively charged ions.

anoxia:

Condition of being without dissolved oxygen (O_2).

anoxic:

Completely lacking in oxygen.

anthropogenic:

Human caused.

aquatic respiration:

Refers to the use of oxygen in an aquatic system including the decomposition of organic matter and the use of oxygen by fish, algae, zooplankton, aquatic macrophytes, and microorganisms for metabolism.

atmospheric (Barometric) Pressure:

Measure of the pressure of the earth's atmosphere per unit area. It is 760 mm Hg at sea level and decreases with increasing elevation.

attenuation:

Decrease.

aufwuchs:

The community of algae and other microorganisms that attach to surfaces such as rocks, twigs, and aquatic plants; essentially the same as "*periphyton*" that means "*attached algae*."

B

base:

A substance which accepts protons (H^+) and has a pH greater than 7 on a scale of 0-14; also referred to as an alkaline substance.

base Flow:

The portion of stream flow that is not runoff and results from seepage of water from the ground into a channel slowly over time. The primary source of running water in a stream during dry weather.

basin:

Geographic land area draining into a lake or river; also referred to as *drainage basin* or watershed.

bedload:

inorganic material that moves along the stream bottom in the stream's current. Bedload can be contrasted with suspended solids, which refers to material that moves up in the water column. In a typical summer rainstorm in the Upper Midwest, bedload usually consists of particles at least 250 µm in diameter. Bedload is usually coarser sands, gravel, and possibly even cobbles and boulders in a very strong storm or during the high discharges/velocities brought on in the spring by a large amount of rapidly melting snow. Smaller material is usually in suspension.

benthic:

Refers to being on the bottom of a lake or stream.

Best Management Practice (BMP), nonstructual:

Strategies implemented to control stormwater runoff that focus on pollution prevention such as alternative site design, zoning and ordinances, education, and good housekeeping measures.

Best Management Practice (BMP), structual

Engineered devices implemented to control, treat, or prevent stormwater runoff pollution.

bicarbonate:

The anion HCO_3^-

bioaccumulation:

The increase in concentration of a chemical in organisms that reside in environments contaminated with low concentrations of various organic compounds. Also used to describe the progressive increase in the amount of a chemical in an organism resulting from rates of absorption of a substance in excess of its metabolism and excretion. Certain chemicals, such as pcbs, mercury, and some pesticides, can be concentrated from very low levels in the water to toxic levels in animals through this process.

bioavailable:

Able to be assimilated (absorbed) by organisms.

Biochemical Oxygen Demand (BOD):

Sometimes referred to as *Biological Oxygen Demand (BOD)*. A measure of the amount of oxygen removed (respired) from aquatic environments by aerobic microorganisms either in the water column or in the sediments. The parameter BOD uses the maximum rate of O_2 consumption over a 5 day period in the dark at 20^0 to estimate the total amount of "biodegradable" organic matter in the system. Typically too insensitive to be useful for pristine lakes and so is used primarily for wastewater "streams" or systems impacted by organic pollution.

biomass:

The weight of a living organism or assemblage of organisms.

biotic:

Referring to a live organism; see also abiotic.

bioretention:

The use of vegetation in retention areas designed to allow infiltration of runoff into the ground. The plants provide additional pollutant removal and filtering functions while infiltration allows the temperature of the runoff to be cooled.

brownfields:

Abandoned or underutilized properties where development is complicated by real or perceived contamination.

buffer:

A substance which tends to keep pH levels fairly constant when acids or bases are added.

buffering capacity:

Ability of a solution to resist changes in ph when acids or bases are added; the buffering capacity of natural waters is mostly due to dissolved carbonate rocks in the basin; equivalent to acid neutralizing capacity (anc). Typically considered to be exhausted.

buffer zone:

A designated transitional area around a stream, lake, or wetland left in a natural, usually vegetated state so as to protect the waterbody from runoff pollution. Development is often restricted or prohibited in a buffer zone.

C

calorie:

A basic measure of energy where 1 calorie is equal to the total amount of heat required to raise the temperature of 1 gram of water 1 degree Celsius.

capillary Action:

The action by which water is drawn around soil particles (or any other solid substance like a small bore tube) because there is a stronger attraction between the soil or solid particles and the water molecules themselves.

carbon cycle:

The circulation of carbon atoms through the earth's whole ecosystem.

carbon dioxide:

A gas which is colorless and odorless; when dissolved in water it becomes carbonic acid; CO_2 is assimilated by plants for photosynthesis in the "dark" cycles of photosynthesis.

carbonate ion:

The CO3-2 ion in the Carbonate Buffer System the collective term for the natural inorganic chemical compounds related to carbon dioxide that exists in natural waterways. Combined with one proton, it becomes Bicarbonate, HCO3- and with two protons, Carbonic Acid. The carbonate ion forms a solid precipitant when combined with dissolved ions of calcium or magnesium.

carbonate buffering system:

The most important buffer system in natural surface waters and wastewater treatment, consisting of a carbon dioxide, water, carbonic acid, *Bicarbonate*, and *Carbonate* ion equilibrium that resists changes in the water's pH. If acid (hydrogen ions) is added to this buffer solution, the equilibrium is shifted and carbonate ions combine with the hydrogen ions to form bicarbonate. Subsequently, the bicarbonate then combines with hydrogen ions to form carbonic acid, which can dissociate into carbon dioxide and water. Thus the system pH is unaltered (buffered) even though acid was introduced.

carnivores:

"Meat" eaters; organisms that eat other organisms.

catchbasin:

An inlet to a storm or combined sewer equipped with a sediment sump, and sometimes a hood, on its outlet pipe to the sewer. Catchbasins can collect some of the sediment and debris washed off the streets, and help to provide a water seal against the venting of sewer gases. Catchbasins should be cleaned out regularly to function properly.

cations:

Positively charged ions.

channel:

An open conduit either naturally or artificially created that may convey water.

channel erosion:

The widening, deepening (called channel scour), and upstream cutting of a stream channel caused by moderate and extreme flow events. Channel erosion is one way that a stream reacts to changes in flow patterns.

chemical equilibrium:

Concentrations of reactants and products at which a reaction is in balance; there is no net exchange because the rate of the forward reaction is taking place at the same rate of the reverse reaction.

CHEMetrics water quality test kits:

CHEMetrics, Inc. (website: http://www.chemetrics.com/) is one of a number of companies that market a variety of test kits and field and lab instruments for water quality testing. Additional companies commonly cited are Hach and LaMotte, and there are probably numerous others accessible to the reader through various educational resources or scientific lab products catalogues. *Water on the Web* does not endorse any particular company's products. Some test kits have been "approved" by state or federal agencies for certain types of tests in specific types of water or wastewater.

chlorophyll:

Green pigment in plants that transforms light energy into chemical energy in photosynthesis.

clarity:

Transparency; routinely estimated by the depth at which you can no longer see a sechi disk. Transparency tubes - clear, 60 or 120 cm-long tubes with colored disks on the bottom are used for determining a depth at which a small secchi disk is visible. The clarity of stream water depends on how much sediment, algae, and other materials are suspended in the water.

clay:

very fine inorganic sediments under 2 µm in diameter; not gritty, feels slippery between fingers.

climber:

a macroinvertebrate which moves by climbing on aquatic vegetation.

clinger:

a macroinvertebrate which clings to rocks; may be a very good crawler.

cobble:

a piece of rock about the size of a grapefruit or tennis ball, 6.4 to 25 cm.

collector-filterer:

a macroinvertebrate method of feeding in which the organism uses some sort of netlike apparatus to catch small particles drifting on the current.

collector-gatherer:

a macroinvertebrate type of feeding behavior characterized by collection of all manner of small particles for food.

conductivity (electrical conductivity and specific conductance):

Measures water's ability to conduct an electric current and is directly related to the total dissolved salts (ions) in the water. Called EC for electrical conductivity and is reported in micromhos per centimeter (umhos/cm) which has been recently renamed as uS/cm (microSiemans per centimeter). EC is temperature sensitive and increases with increasing temperature. Most modern probes automatically correct for temperature and standardize all readings to 25°C and then refer to the data as *specific* EC.

confluence:

the point at which two streams converge.

constructed stormwater wetland:

A water quality BMP, design to have similar characteristics and functions to a natural wetland, with the specific purpose of treating stormwater runoff through uptake, retention, and settling.

consumers:

Organisms that must eat other organisms for their energy metabolism; organisms that cannot produce new organic matter by photosynthesis or chemosynthesis (producers).

convection currents:

Air or water movement caused by changes in density or thermal (temperature) gradients.

conveyance system:

A pipeline, canal, natural channel or other similar facility that transports water from one location to another.

CPOM:

coarse particulate organic matter, defined operationally in streams as organic (nonmineral) matter that is greater than 1 millimeter in diameter, generally derived from terrestrial plant parts and macrophytes.

cyanobacteria:

Bluegreen algae; phylum or organisms that are biochemically bacterial in nature but perform plant photosynthesis.

D

decomposition:

The breakdown of organic matter by bacteria and fungi.

denitrification:

Anaerobic bacterial process metabolism in which nitrate is used instead of oxygen during the oxidation of organic carbon compounds to yield energy (respiration). The process oxidizes organic carbon and (chemically) reduces nitrate to the gaseous end products N_2 (nitrogen gas) or N_2O (nitrous oxide). This is the major process used in wastewater treatment plants to ultimately convert *combined* nitrogen to a non-polluting state.

density:

The mass of a substance or organism per unit volume (kg/cubic meter; grams/liter).

depositional habitat:

macroinvertebrate habitat type characterized by slow-moving water/pools.

depression storage:

The volume of water contained in natural depressions in the land surface, such as puddles.

detention:

The storage and slow release of stormwater following a precipitation event by means of an excavated pond, enclosed depression, or tank. Detention is used for both pollutant removal, stormwater storage, and peak flow reduction. Both wet and dry detention methods can be applied.

detritus:

Dead or decaying organic matter; technically called organic detritus to distinguish it from the mineral detritus classified by geologists.

diatom:

Group of algae characterized by glass (silica) cell wall, beautifully ornamented; often the brown stuff attached to rock surfaces.

diel:

A 24 hour period of time.

diffusion:

The movement of a substance from an area of high concentration to an area of low concentration. Turbulent diffusion, or mixing, results from atmospheric motions (wind) diffusing water, vapor, heat, and other chemical components by exchanging parcels called eddies between regions in space in apparent random fashion. Molecular diffusion, which operates in stagnant zones, such as at the bottom sediment-water boundary in a deep lake, occurs much, much more slowly and so is important only on a very small scale such as right at the bottom.

Dipteran:

True flies.

direct runoff:

the runoff entering stream channels promptly after rainfall, exclusive of base flow. Direct runoff equals the volume of rainfall excess (total precipitation minus losses).

discharge:

the volume of water that passes through a given cross section per unit time. Discharge is commonly measured in cubic feet per second (cfs) or cubic meters per second (cms). It is also referred to as flow.

dissolved oxygen (DO or O_2):

The concentration of free (not chemically combined) molecular oxygen (a gas) dissolved in water, usually expressed in milligrams per liter, parts per million, or percent of saturation. Adequate concentrations of dissolved oxygen are necessary for the life of fish and other aquatic organisms and the prevention of offensive odors. DO levels are considered the most important and commonly employed measurement of water quality and indicator of a water body's ability to support desirable aquatic life. Levels above 5 milligrams per liter (mg O_2/L) are considered optimal and most fish cannot survive for prolonged periods at levels below 3 mg O_2/L. Levels below 1 mg O_2/L are often referred to as *hypoxic* and when O_2 is totally absent *anoxic* (often called anaerobic which technically means *without air*). Secondary and advanced wastewater treatment systems are generally designed to degrade organic matter to ensure adequate dissolved oxygen in waste-receiving waters (from North American Lake Management Society.

dissolved solids concentration:

The total mass of dissolved mineral constituents or chemical compounds in water; they form the residue that remains after evaporation and drying. Often referred to as the *total dissolved salts* (TDS) concentration or dissolved ion concentration. In seawater or brackish water this is approximated by the *salinity* of the water. All of these parameters are estimated by the electrical conductivity (EC).

dry deposition:

Fine particulate matter and aerosols settling from the atmosphere onto lake and land surfaces during periods with no precipitation.

E

ecological pyramid:

Conceptual scheme whereby the amount of biomass or energy at each level of the food "chain" decreases as you move from primary producers through the different levels of consumers.

ecoregion:

An environmental area characterized by specific land uses, soil types, surface form, and potential natural vegetation.

ecosystem:

All of the interacting organisms in a defined space in association with their interrelated physical and chemical environment.

electrical conductivity (EC):

See Conductivity.

electromagnetic radiation:

Radiation that travels through space at the speed of light that includes light, radio waves, x-rays, and gamma rays.

embeddedness:

how much a larger particle (usually cobbles or larger gravel) is buried in finer material, typically loose, unconsolidated sands and silts. A rock sitting on a hard, empty tabletop would have zero embeddedness. A rock buried in a bucket of sand would be highly embedded.

equilibrium:

See Chemical Equilibrium.

erosional habitat:

macroinvertebrate habitat type characterized by rapidly moving water/riffles.

estuary:

A semi-enclosed coastal waterbody such as a bay, mouth of a river, salt marsh, or lagoon, where freshwater and saltwater mix. These waters support a rich and diverse ecology.

euphotic zone:

Layer of water where sunlight is sufficient for photosynthesis to occur.

eutrophication:

The process by which lakes and streams are enriched by nutrients (usually phosphorus and nitrogen) which leads to excessive plant growth - algae in the open water, periphyton (*attached* algae) along the shoreline, and macrophytes (the higher plants we often call *weeds*) in the nearshore zone.

evaporation:

The process of converting liquid to vapor.

evapotranspiration:

The loss of water to the atmosphere through the combined processes of evaporation and transpiration, the process by which plants release water they have absorbed into the atmosphere.

event mean concentration (EMC):

A method for characterizing pollutant concentrations in a receiving water from a runoff event often chosen for its practicality. The value is determined by compositing (in proportion to flow rate) a set of samples, taken at various points in time during a runoff event, into a single sample for analysis.

Excel:

Refers to Microsoft's Excel spreadsheet software.

excess precipitation:

the precipitation in excess of infiltration capacity, evaporation, transpiration, and other losses. It is also referred to as effective precipitation.

export rates:

Amount of a particular nutrient or contaminant annually transported from its source to a lake or stream; usually related to land uses and expressed per unit area per year.

filter strip:

Grassed strips situated along roads or parking areas that remove pollutants from runoff as it passes through, allowing some infiltration, and reductions of velocity.

fines (or fine material):

sands, silts, and clays, collectively; inorganic material under 2000 µm (2 mm).

fix:

Convert CO_2 to carbohydrate or N_2 to $NH4^+$ (carbon fixation and nitrogen fixation);

flashy stream:

A stream or river that is characterized by dramatic fluctuations in flow, in which sharply higher flows in wet weather can be followed by very low flows in dry weather.

floatables:

Materials found in runoff that are buoyant, such as polystyrene, plastic, some organic material, or cigarette butts.

floodplain:

Can be either a natural feature or statistically derived area adjacent to a stream or river where water from the stream or river overflows its banks at some frequency during extreme storm events.

flow rate:

The rate at which water moves by a given point; in rivers it is usually measured in cubic meters per second (m^3/sec) or cubic feet per second (cfs).

flushing rate:

The retention time (turnover rate or flushing rate), the average length of time water resides in a lake, ranging from several days in small impoundments to many years in large seepage lakes. Retention time is important in determining the impact of nutrient inputs. Long retention times result in recycling and greater nutrient retention in most lakes. Calculate retention time by dividing the volume of water passing through the lake per year by the lake volume.

food chain:

The transfer of food energy from plants through herbivores to carnivores. An example: insect-fish-bear or the sequence of algae being eaten by zooplankton (grazers; herbivores) which in turn are eaten by small fish (planktivores; predators) which are then eaten by larger fish (piscivores; fish eating predators) and eventually by people or other predators (fish-eating birds, mammals, and reptiles).

food web:

Food chains hooked together into a complex interconnected web.

G **gas solubility**:

The ability of a gas to dissolve into another substance.

Geographic Information System (GIS):

A computer system which allows for input and manipulation of geographic data to allow researchers to manipulate, analyze and display the information in a map format.

gravel:

rock pieces 2 mm up to 6.4 cm, pea to marble-sized.

grazers:

Herbivores; zooplankton in the open water zone.

groundwater:

Water that flows below the ground surface through saturated soil, glacial deposits, or rock.

H **Hach Water Quality Test Kits**:

Hach, Inc. (Website: http://www.hach.com/) is one of a number of companies that market a variety of test kits and field and lab instruments for water quality testing. Additional companies commonly cited are LaMotte and CHEMetrics, and there are probably numerous others accessible to the reader through various educational resources or scientific lab products catalogues. *Water on the Web* does not endorse any particular company's products. Some test kits have been "approved" by state or federal agencies for certain types of tests in specific types of water or wastewater.

hardwater:

Lakes that have a high buffering capacity and are not generally sensitive to acid deposition. These lakes have dissolved salt concentrations greater than 120 mg/L.

herbivores:

Plant eaters.

heterogeneous:

Not uniform; patchy.

hydric soil:

a soil that is saturated, flooded, or ponded long enough during the growing season to develop anaerobic (no oxygen) conditions in the upper layers.

hydrogen:

Colorless, odorless and tasteless gas; combines with oxygen to form water.

hydrogen bond:

A type of chemical bond caused by electromagnetic forces, occurring when the positive pole of one molecule (e.g., water) is attracted to and forms a bond with the negative pole of another molecule (e.g., another water molecule).

hydrogen ion:

An individual atom of hydrogen which is not attached to a molecule and therefore has a positive (+) charge.

hydrology:

The study of water's properties, distribution and circulation on Earth.

hydroperiod:

the time it takes for water level to rise and then fall back to normal baseline levels in a given stream for a given amount of rainfall or snowmelt. Streams that have short hydroperiods (those that rise and fall back down quickly) are said to be flashy.

I

illicit connections:

Illicit connections are discharges to the stormwater system that are not normal stormwater. They could consist of anything from a garage drain that flows to a storm drain to an individual dumping oil down a catch basin. Some discharges may be continuous and other one time.

impaired:

a water body that does not meet the water quality criteria for a designated use (e.g., aquatic life use). Water quality criteria can be based on chemical, physical, or biological conditions. (See index of biotic integrity.)

impervious surfaces:

Land surfaces such as roads, parking lots, buildings, etc that prevent rainwater from soaking into the soil. The water increases in velocity causing more erosion; it warms causing potential heat stress for downstream trout; it picks up roadway contaminants; and the loss of vegetation removes a "sink" for dissolved nutrients - plant uptake.

Index of Biotic Integrity (IBI):

A measure of the condition of a biological community and typically contains metrics related to biodiversity, % pollution tolerant or intolerant species, the balance of trophic (food web) levels, and/or aquatic organism health (deformities, lesions, tumors, etc.).

infiltration:

The process or rate at which water percolates from the land surface into the ground. Infiltration is also a general category of BMP designed to collect runoff and allow it to flow through the ground for treatment.

inflow:

Water flowing into a stream.

inflow and infiltration (I&I):

The penetration of water from the soil into sewer or sanitary pipes through defective joints or connections and/or the penetration of water through the ground water into the subsurface soil.

inorganic:

Substances of mineral, not carbon origin.

ion:

An electrically charged particle.

isothermal:

Constant in temperature.

J

K

L **LaMotte Water Quality Testing Kits**:

The LaMotte Company (website: http://www.lamotte.com/) is one of a number of companies that market a variety of test kits and field and lab instruments for water quality testing. Additional companies commonly cited are Hach and CHEMetrics, and there are probably numerous others accessible to the reader through various educational resources or scientific lab products catalogues. *Water on the Web* does not endorse any particular company's products. Some test kits have been "approved" by state or federal agencies for certain types of tests in specific types of water or wastewater.

landuse:

The primary or primary and secondary uses of land, such as cropland, woodland, pastureland, forest, water (lakes, wetlands, streams), etc. The description of a particular landuse should convey the dominant character of a geographic area and establish the dominant types of human activities which are prevalent in each region.

landscape:

All the natural geographical features, such as fields, hills, forests, and water that distinguish one part of the earth's surface from another part. These characteristics are a result not only of natural forces but of human use of the land as well.

latent heat (energy):

The amount of heat (energy) released from or absorbed by a substance when it undergoes a change of state; also known as Heat of Transformation.

leach:

To remove soluble or other constituents from a medium by the action of a percolating liquid, as in leaching salts from the soil by the application of water.

limnetic zone:

Open water zone.

littoral:

Nearshore out from shore to the depth of the euphotic zone where it is too dark on the bottom for macrophytes to grow.

loading rates:

The rate at which materials (typically suspended sediment, nutrients [N and P], or contaminants) are transported into a water body.

M **macrophytes**:

Higher aquatic plants; in the sense of "higher" evolutionarily than algae and having roots and differentiated tissues; may be emergent (cattails, bulrushes, reeds, wild rice), submergent (water milfoil, bladderwort) or floating (duckweed, lily pads).

marl:

Encrustation of calcium carbonate that forms on plants in high ph/alkalinity lakes and on your faucet from the precipitation of calcium carbonate.

mesotrophic:

Moderately productive; relating to the moderate fertility of a lake in terms of its algal biomass.

mean depth:

The average depth of a stream.

metabolism:

The chemical and physical processes continually going on in living organisms and cells, by which the energy is provided for cellular processes and activities, and new material is assimilated to repair waste.

micronutrient:

Trace nutrients required by microrganisms or zooplankton such as molybdenum and cobalt; nitrogen and phosphorus are considered to be macronutrients.

motile:

Able to move at will.

N **National Pollution Discharge Elimination System (NPDES)** :

A provision of the Clean Water Act that prohibits discharge of pollutants into waters of the United States unless a special permit is issued by the EPA, a state, or (where delegated) a tribal government or and Indian reservation.

natural buffer:

A variable width area maintained with natural vegetation between a pollutant source and a waterbody that provides natural filtration and other forms of protection.

NEMO (Nonpoint Education for Municipal Officials):

A University of Connecticut educational program for land use decision makers that addresses the relationship of land use to natural resource protection. The NEMO coordinator for Minnesota's North Shore is Jesse Schomberg.

nitrification:

Bacterial metabolism in which ammonium ion (NH_4^+) is oxidized to nitrite (NO_2^-) and then to nitrate (NO_3^-) in order to yield chemical energy that is used to *fix* carbon dioxide into organic carbon. The process is a type of chemosynthesis which is comparable to photosynthesis except that chemical energy rather than light energy is used. These bacteria are aerobic and so require dissolved oxygen in order to survive.

nitrogen fixation:

The conversion of elemental nitrogen in the atmosphere (N2) to a form (e.g., ammonia) that can be used as a nitrogen source by organisms. Biological nitrogen fixation is carried out by a variety of organisms; however, those responsible for most of the fixation in lakes are certain species of bluegreen algae.

non-motile:

Not able to move at will.

non-polar molecule:

A molecule that does not have electrically charged areas (poles).

non-polar gas:

A gas that is electrically neutral.

nonpoint source:

Diffuse source of pollutant(s); not discharged from a pipe; associated with land use such as agriculture or contaminated groundwater flow or on-site septic systems.

nuisance blooms:

Referring to obnoxious and excessive growths of algae caused by excessive nutrient loading; often due to scum forming cyanobacteria (bluegreen algae) that can regulate their buoyancy to float high in the water column to obtain sunlight.

nutrient loading:

Discharging of nutrients from the watershed (basin) into a receiving water body (lake, stream, wetland); expressed usually as mass per unit area per unit time (kg/ha/yr or lbs/acre/year.

O **oligotrophic**:

Very unproductive; lakes low in nutrients and algae, usually very transparent with abundant hypolimnetic oxygen if stratified.

omnivorous:

Capable of eating plants, fungi and animals.

Ordinary High Water Level (OHW):

The ordinary high water level (OHW) is a reference point that defines the DNR's regulatory authority over development projects that are proposed to alter the course, current, or cross section of public waters and public waters wetlands. For lakes and wetlands, the OHW is the highest water level that has been maintained for a sufficient period of time to leave evidence upon the landscape. The OHW is commonly that point where the natural vegetation changes from predominately aquatic to predominantly terrestrial. For watercourses (rivers and streams), the OHW is the elevation of the top of the bank of the channel. For reservoirs and flowages, the OHW is the operating elevation of the normal summer pool. The OHW is also used by local units of government as a reference point from which to determine structure setbacks from water bodies and watercourses.

organic:

Substances which contain carbon atoms and carbon-carbon bonds.

outfall:

The point of discharge from a river, pipe, drain, etc. to a receiving body of water.

outflow:

Water flowing out of a lake.

outliers:

Data points that lie outside of the normal range of data. Ideally, outliers must be determined by a statistical test before they can be removed from a data set.

oxygen:

An odorless, colorless gas; combines to form water; essential for aerobic respiration.

oxygen solubility:

The ability of oxygen gas to dissolve into water.

P **parameter**:

Whatever it is you measure; a particular physical, chemical, or biological property that is being measured.

partial pressure:

The pressure exhibited by a single gas in a gas mixture.

patch:

a discrete area differing in appearance from its surroundings. Patches can occur at different scales, e.g., patches of different land cover, or patches of different algal communities growing in a stream.

peak discharge:

The greatest volume of stream flow occurring during a storm event.

Performance Standard:

An established amount or limit of a specified pollutant that can be discharged from a land-use activity or BMP.

periphyton:

Attached algae; the green slime that attaches shoreline and bottom vegetation and the brown stuff attached to rock surfaces.

Petri dish:

A shallow, round glass dish + lid used for culturing microorganisms.

pH

A measure of the concentration of hydrogen ions.

pH Scale:

A scale used to determine the alkaline or acidic nature of a substance. The scale ranges from 1-14 with 1 being the most acidic and 14 the most basic. Pure water is neutral with a pH of 7.

phosphorus:

Key nutrient influencing plant growth in lakes. Soluble reactive phosphorus (PO_4^{-3}) is the amount of phosphorus in solution that is available to plants. Total phosphorus includes the amount of phosphorus in solution (reactive) and in particulate form.

photosynthesis:

The process by which green plants convert carbon dioxide (CO_2) dissolved in water to sugars and oxygen using sunlight for energy. Photosynthesis is essential in producing a lake's food base, and is an important source of oxygen for many lakes.

photosynthesizers:

Organisms that produce their energy via phtosynthesis.

phytoplankton:

Microscopic floating plants, mainly algae, that live suspended in bodies of water and that drift about because they cannot move by themselves or because they are too small or too weak to swim effectively against a current.

planktivores:

Animals that eat plankton; usually refers to fish that feed on zooplankton but can also refer to fish that graze on algae; includes invertebrate predators, such as the phantom midge.

polarity:

An unsymmetrical distribution of electron density found in a covalent bond.

polar gas:

A gas which is made up of molecules that have electrically charged areas (poles).

polar molecule:

A molecule in which one structural end (an atom or atoms) possesses a slight negative charge and another structural end possesses a slight positive charge but the charges do not cancel one another out but rather create two separate poles.

polluted runoff:

Rainwater or snowmelt that picks up pollutants and sediments as it runs off roads, highways, parking lots, lawns, agricultural lands, logging areas, mining sites, septic systems, and other land-use activities that can generate pollutants.

pools:

the deeper, often wider areas of a stream that typically have lower water-flow velocities. Sediments are most likely to settle out and collect in a pool. Depositional zone.

ppb:

Part-per-billion; equivalent to a microgram per liter (ug/l).

ppm:

Part-per-million; equivalent to a milligram per liter (mg/l).

predator:

a macroinvertebrate type of feeding behavior characterized by the organism eating other organisms.

pressure (p):

The force exerted per unit area.

primary consumers:

First level of consumers according to the ecological pyramid concept; organisms that eat herbivorous grazers.

primary producers:

Organisms that convert co_2 to biomass. Usually refers to photosynthesizers, but also includes the chemosynthetic bacteria that use chemical instead of light energy to ***fix*** co_2 to biomass.

primary productivity:

The productivity of the photosynthesizers at the base of the food chain in ecosystems. This refers to the yield of new biomass (plant) growth during a specified time period. The entire year's accumulation is termed annual production. In the open water of lakes it is typically estimated by measured growth rates of phytoplankton (algae), either via O_2 accumulation in light relative to dark bottles of lake water or by the uptake of added radioactive carbon dioxide in sealed bottles of lake water.

productivity:

The time rate of production of biomass for a given group of organisms; essentially the net growth rate of organisms.

profile:

A vertical, depth by depth characterization of a water column, usually at the deepest part of a lake.

Q

R **radiation**:

The movement of energy through any medium via heat, light or radio waves.

radioisotopes:

Radioactive isotopes; radioactive forms of carbon, phosphorus, and other nutrients are used to measure rates of their absorption into biological communities; radioisotopes derived from fallout from atmospheric nuclear weapons testing are used to date layers of lake sediments

respiration:

The metabolic process by which organic carbon molecules are oxidized to carbon dioxide and water with a net release of energy. Aerobic respiration requires, and therefore consumes, molecular oxygen (algae, *weeds*, zooplankton, benthic invertebrates, fish, many bacteria, people). Certain bacteria can use nitrate in place of oxygen (denitrifiers) or sulfate (sulfate reducers), but only under anaerobic (anoxic) conditions - typically present only in the sediments or in the hypolimnion after prolonged oxygen depletion has occurred.

riparian zone:

The strip of land adjacent to a natural water course such as a river or stream. Often supports vegetation that provides the best fish habitat values when growing large enough to overhang the bank.

runoff:

Water from rainfall, snowmelt, or otherwise discharged that flows across the ground surface instead of infiltrating the ground.

S **sanitary sewer system**:

Underground pipes that carry only domestic or industrial wastewater to a sewage treatment plant or receiving water.

saturation:

The point at which a substance has the maximum amount of another substance at a given temperature and pressure; also see supersaturation.

scraper:

a macroinvertebrate method of feeding in which the organism scrapes algae off surfaces for food.

secchi disk:

A disk with a 4-6 inch radius that is divided into 4 equal quadrates of alternating black and white colors. It is lowered into a section of shaded water until it can no longer be seen and then lifted back up until it can be seen once again. A small secchi disk is used inside transparency tubes used for measuring clarity in streamwater. Averaging the two depths gives the clarity of the water; see also clarity.

secondary consumers:

Consumers such as plankton eating fish or predaceous zooplankton that eat other zooplankton.

sedimentation:

The removal, transport, and deposition of detached soil particles by flowing water or wind. Accumulated organic and inorganic matter on the lake bottom. Sediment includes decaying algae and weeds, precipitated calcium carbonate (marl), and soil and organic matter eroded from the lake's watershed.

SSO (separate sewer overflow):

Wastewater entering sanitary sewers may be so great, because of blockage, a lack of capacity, inflow and infiltration, or other reasons, that the collection system or sewage treatment plant cannot handle the increased flow. As a result, untreated sewage empties directly into receiving waters, often from manholes or up through sewer connections.

sewage sludge:

The solid portion of sewage that contains organic matter, and a whole community of algae, fungi, bacteria and protozoans that consume it. The terms Biosolids, Sludge, and sewage sludge can be used interchangeably.

shoreline:

The zone where lake and land meet. Shorelands are defined as the lands 1000 ft from the ordinary high water level.

shredders:

a macroinvertebrate method of feeding in which the organism shreds up plant material, usually leaves, for food.

silt:

fine inorganic sediments 2 - 62.5 µm, not gritty.

skater:

a macroinvertebrate who moves by skating on the surface tension of water

solubility:

The ability of a substance to dissolve into another; also see gas solubility.

solute:

A substance which can be dissolved into another substance.

solution:

A homogenous mixture of two substances.

solvent:

A substance which has the ability to dissolve another; also see Universal Solvent.

spate:

rapidly occurring floods of short duration.

specific conductance:

A measure of the ability of water to conduct an electrical current as measured using a 1-cm cell and expressed in units of electrical conductance (EC), i.e. siemans (uS or mS) at 25 C.

specific heat:

The amount of heat required to raise the temperature of one gram of substance one degree Celsius.

stable isotopes:

different forms of naturally occurring elements that differ in weight. For example 15N and 14N both occur naturally, but 14N is much more common. Heavier forms of an element often have a lesser probability of participating in a reaction, so for example, the process of denitrification leads to a build-up of 15N in the sediment. The ratios of different stable isotopes are used as an indicator of sources of food or trophic level in a food chain. Unlike radioisotopes, these isotopes do not undergo radioactive decay, hence they are called "stable".

stormwater discharge:

Precipitation and snowmelt runoff from roadways, parking lots, roof drains that is collected in gutters and drains; a major source of nonpoint source pollution to water bodies and a major headache to sewage treatment plants in municipalities where the stormwater is combined with the flow of domestic wastewater (sewage) before entering the wastewater treatment plant.

storm sewer system:

A system of pipes and channels that carry stormwater runoff from the surfaces of building, paved surfaces, and the land to discharge areas.

stormwater:

Water derived from a storm event or conveyed through a storm sewer system.

stormwater utility:

A utility established to generate a dedicated source of funding for stormwater pollution prevention activities where users pay a fee based on land-use and contribution of runoff to the stormwater system.

stratification:

An effect where a substance or material is broken into distinct horizontal layers due to different characteristics such as density or temperature.

stratified:

Separated into distinct layers.

stratigraphic:

Relating to stratigraphy, the branch of geology which treats the formation, composition, sequence and correlation of the layered rocks as parts of the earth's crust.

substrate:

Attachment surface or bottom material in which organisms can attach or live-within; such as rock substrate or sand or muck substrate or woody debris or living macrophytes.

surface water:

Water that flows across the land surface, in channels, or is contained in depressions on the land surface (e.g. runoff, ponds, lakes, rivers, and streams).

surface tension:

A phenomenon caused by a strong attraction towards the interior of the liquid action on liquid molecules in or near the surface in such a way to reduce the surface area.

supersaturation:

When a substance is more highly concentrated (more saturated) in another substance than is normally possible under normal temperature and pressure.

suspended sediment (SS or Total SS[TSS]):

Very small particles which remain distributed throughout the water column due to turbulent mixing exceeding gravitational sinking; also see turbidity.

suspension:

A heterogeneous mixture in which solute-like particles settle out of solvent-like phase some time after their introduction.

swale:

A natural or human-made open depression or wide, shallow ditch that intermittently contains or conveys runoff. Can be used as a BMP to detain and filter runoff.

TDS:

Total dissolved salts or solids in a volume of water; usually in mg/l; estimated by EC (electrical conductivity).

temperate:

Refers to lakes located in a climate where the summers are warm and the winters moderately cold. The Temperate Zone is between the Tropic of Cancer and the Arctic Circle.

temperature:

A measure of whether a substance is hot or cold.

tertiary consumers:

Larger consumers in the fourth trophic level like adult northern pike, ospreys and humans that eat fish.

thermal stratification:

Existence of a turbulently mixed layer of warm water (epilimnion) overlying a colder mass of relatively stagnant water (hypolimnion) in a water body due to cold water being denser than warm water coupled with the damping effect of water depth on the intensity of wind mixing.

thermocline:

The depth at which the temperature gradient is steepest during the summer; usually this gradient must be at least 1^0C per meter of depth.

topography:

Configuration of physical surface of land; includes relief imprints and locations of all man-made and natural features.

Total Dissolved Solids (TDS):

The amount of dissolved substances, such as salts or minerals, in water remaining after evaporating the water and weighing the residue.

Total Maximum Daily Load (TMDL):

A TMDL or Total Maximum Daily Load is a calculation of the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards, and an allocation of that amount to the pollutant's sources.
Water quality standards are set by States, Territories, and Tribes. They identify the uses for each waterbody, for example, drinking water supply, contact recreation (swimming), and aquatic life support (fishing), and the scientific criteria to support that use.
A TMDL is the sum of the allowable loads of a single pollutant from all contributing point and nonpoint sources. The calculation must include a margin of safety to ensure that the waterbody can be used for the purposes the State has designated. The calculation must also account for seasonal variation in water quality.
The Clean Water Act, section 303, establishes the water quality standards and TMDL programs.
USEPA 12/2002 (http://www.epa.gov/owow/tmdl/intro.html)

tributary:

Feeder stream.

trophic state:

Eutrophication is the process by which lakes are enriched with nutrients, increasing the production of rooted aquatic plants and algae. The extent to which this process has occurred is reflected in a lake's trophic classification or state: oligotrophic (nutrient poor), mesotrophic (moderately productive), and eutrophic (very productive and fertile).

trophic webs:

Conceptual model of the interconnections of species of organisms according to their different feeding groups.

turbidity:

Degree to which light is blocked because water is muddy or cloudy. See also clarity.

turnover:

Fall cooling and spring warming of surface water act to make density uniform throughout the water column. This allows wind and wave action to mix the entire lake. Mixing allows bottom waters to contact the atmosphere, raising the water's oxygen content. However, warming may occur too rapidly in the spring for mixing to be effective, especially in small sheltered kettle lakes.

U

universal solvent:

A substance that has the ability to dissolve both bases and acids, such as water.

V

vertical extinction coefficient:

A measure of the ability of a particular water sample to exponentially attenuate(decrease) light shining on it. It is the constant **k** in the equation i (z) = i(0)* exp(-k*z) where z is any depth in meters, and "**exp**" refers to the base "**e" the** for the exponential.

W

water column:

A conceptual column of water from surface to bottom sediments.

water density:

The ratio of water's mass to its volume; water is the most dense at four degrees Celsius.

watershed:

All land and water areas that drain toward a river or lake; also called Drainage Basin or Water Basin.

watershed storage:

the fraction of watershed area covered by lakes and wetlands, i.e., capable of storing runoff following rainfall events and reducing peak stream flows.

weathering:

The mechanical and chemical breakdown and dissolution of rocks.

wet deposition:

Precipation of all kinds.

wet detention ponds:

A BMP consisting of a permanent pool of water designed to treat runoff by detaining water long enough for settling, filtering, and biological uptake. Wet ponds are also often designed to have an aesthetic or recreational value.

wetlands:

"lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water... Wetlands must have one or more of the following three attributes:

1. at least periodically, the land supports predominantly hydrophytes,
2. the substrate is predominantly undrained hydric soil, and
3. the substrate is nonsoil and is saturated with water or covered by shallow water at some time during the growing season of each year."

(Cowardin et al. 1979).

Winkler Titration Kit:

A "wet" chemistry analytical procedure used to determine the oxygen content of water via the Winkler reaction.

winterkill:

A sudden and dramatic mass fish death caused by insufficient oxygen in a frozen lake.

X

Y

Z **zooplankton**:

The animal portion of the living particles in water that freely float in open water, eat bacteria, algae, detritus and sometimes other zooplankton and are in turn eaten by planktivorous fish.

Appendix B
Youth Volunteer
Job Description Tool

Complete the following description for each job associated with a service project.

Job Title:

Specific Skills Required:

Time Commitment:

Specific Job Responsibilities:

Appendix C

Program Risk Assessment/Management Form

Complete this form and be familiar with its content for every education program.

Program/Activity Name:_____ Location: _____ Date or Season: _____

Potential accident, injury, or other damage which may occur:	

	People:	Equipment:	Environmental:
Potential causes for the above:			
Strategies for reducing the potential risk:			

Strategies for dealing with emergencies (including emergency contacts and access points):	

Recommended Policies/guidelines	

Skills needed by staff:	

Completed by: __ _____ Date: _____ Approval: Your supervisor
_____

FORM MUST BE APPROVED BEFORE PROGRAM/ACTIVITY CAN OCCUR
✹ One hard copy goes on file in Office, Save computer file
SOURCE:
Adapted from UMD Outdoor Program Risk Assessment/Management Forms

Appendix D

Confidential Incident and Accident Report

Please fill out this form completely for any incident or accident occurring in conjunction with this event. Hand completed forms to the event organizer.

DETAILS OF THE ACCIDENT/INCIDENT

Date:_____ Time:_____am/pm Location:_____
_____

Briefly describe the accident/incident:

Were there any Witnesses? Please provide correct details for each (use back of sheet for additional witnesses):
Name_____ Telephone_____
Home Address:

WAS ANYONE INJURED?

Name_____ Age_____ School_____
School or Home Address: Male or Female

Briefly describe any injuries (include specific body parts, injury details):

HOW WERE THEY TREATED?

☐ **None** ☐ **First Aid** ☐ **Advised to see own doctor** ☐ **Called Paramedics**

☐ **Any other treatment details:**

WHO COMPLETED THIS REPORT?

Name_____ Telephone_____
Work or Home Address:

Appendix E

Potential Projects and Partners

Potential Service-learning projects:

Beach Sweep
Take part in a concerted effort around the Great Lakes to clean-up beach litter. This annual event takes place on Minnesota Point on Lake Superior's northern shore. Along with land cleanup, divers also collect underwater litter. In addition to beach cleanup, other states have implemented river sweeps.
Contact: Great Lakes Aquarium

Stream Cleanup
With nearly fifty streams in the Duluth-area, there are miles of littered stream shores that could use cleanup. Some stretches can be monitored from shoreline trails. Take a hike with trash bags and gloves. Other areas are particularly polluted (i.e., discarded washers, car tires, etc.) and may require collaboration with trash collection agencies.
Contact: City of Duluth Water Resources

Purple Loosestrife Inoculation
In this MN SeaGrant / 4-H partnership, students collect dormant purple loosestrife to grow at home in controlled conditions. Later in the summer, they collect beneficial beetles to inoculate their home plants. These beetle populations feed on the plants, explosively growing over a few weeks. Finally, resulting populations of millions of beetles are released onto wild loosestrife, eating them and weakening their ability to grow back.
Contact: MN SeaGrant, University of Minnesota Extension Service 4-H program

Buckthorn Removal
Bust the European buckthorn! In some coastal areas, this plant can become so thick that it impedes growth of desirable native species. However, groups can go in to cut down and pull up plants in heavily infested areas.
Contact: Hartley Nature Center, MN SeaGrant

Storm Drain Stenciling
In this project, teams increase awareness that pollutants poured down storm drains may not be treated before dumping into waterways. Groups paint storm drains with a common stencil warning potential polluters of the direct link to streams and rivers.
Contact: City of Duluth Water Resources

Herbivory Exclosures
Native tree plantings can sometimes be destroyed by browsing deer. However, groups can construct fences to keep out these hungry herbivores. Once trees mature for a few years the fences can be removed.

Contact: St. Louis River Citizens Action Committee, Soil and Water Conservation District Offices, US Forest Service, MN Department of Natural Resources and/or State Parks

Erosion Control

Sediments washed from eroding shorelines can be a major source of stress for aquatic environments. Teams may help to mitigate erosion in a number of ways—planting trees and other vegetation to erecting erosion barriers. However, these projects usually require permits and planning, so seek partnership with contact agencies.

Contact: Soil and Water Conservation District Offices, US Forest Service, MN Department of Natural Resources and/or State Parks

Potential Service-learning Partners in Northeast Minnesota:

Boulder Lake Environmental Learning Center
7448 Nordberg Road
Duluth, MN
218.721.3731

EAGLE (Environmental Association for Great Lakes Education)
394 Lake Avenue Suite 222
Duluth, MN
218.726.1828

Fond du Lac Ceded Territory Wildlife Biologist
1720 Big Lake Road
Cloquet, MN
218.879.8088

Fond du Lac Natural Resources
1720 Big Lake Road
Cloquet, MN
218.878.8088

The Minnesota Land Trust
394 South Lake Avenue
Duluth, MN
218.786.9377

The Nature Conservancy
394 South Lake Avenue
Duluth, MN
218.727.6119

Minnesota for Responsible Recreation
205 West 2nd Street
Duluth, MN
218.740.3175

The Institute for a Sustainable Future
32 East 1st Street
Duluth, MN
218.525.4781

St. Louis River Citizen Action Committee
394 South Lake Avenue
Duluth, MN
218.733.9520

Lake Superior Maritime Visitor Center
Canal Park
Duluth, MN
218.727.2497

The Old Deetz Slate Mine Quarry
234 Highway 61
Thompson Township
218.879.6063

Hartley Nature Center
PO Box 3503
Dulurh, MN
218.724.6735

Duluth Parks and Recreation
12 East 4th Street
Duluth, MN
218.723.3337

Minnesota Department of Natural Resources
1.800.652.9747

Isle Royale National Park
1.906.482.0984

Lake County Soil & Water Conservation District
218.834.8370

St. Louis County Soil & Water Conservation District
218.723.4867

Carlton County Soil & Water Conservation District
218.384.3891

Cook County Soil & Water Conservation District
218.387.3000

Great Lakes Aquarium& Freshwater Discovery Center
353 Harbor Drive
Duluth, MN
218.740.3474

Lake Superior Zoo
72 Avenue W & Grand Avenue
Duluth, MN
218.733.3777

North House Folk School
500 West Highway 61
Grand Marais, MN
218.387.9762

Wolf Ridge Environmental Learning Center
6282 Cranberry Road
Finland, MN
218.353.7414

University of Minnesota Extension Service
Regional Center Cloquet
179 University Road
Cloquet, MN
218.726.6464
1.888.241.0724

University of Minnesota Sea Grant Program
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Duluth, MN 55812-1445
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Environmental Protection Agency
ORD/NHEERL
6201 Congdon Boulevard
Duluth, MN 55804
218.529.5192

Minnesota Office of Environmental Assistance
525 S. Lake Avenue, Suite 400
Duluth, MN
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