# Developing Tomorrow's Anglers and Aquatic Stewards: Formative Evaluation of MinnAqua's Leaders' Guide for Grades 3 - 5

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## ABSTRACT

The Minnesota Department of Natural Resources' (DNR) MinnAqua program educates the state's youth about angling and aquatic resources. In 2001, MinnAqua developed a Leaders' Guide so educators could carryout MinnAqua activities in their own setting. As part of the development process, a formative evaluation was undertaken to answer the questions: (a) To what extent are MinnAqua's rewrite guidelines addressed in individual lessons and the Leaders' Guide as a whole?, and (b) To what extent does the Leaders' Guide meet the educational needs of intended users in both formal and informal education settings? Evaluative feedback was attained from a variety of individuals over two stages of data collection, with revisions made to the Leaders' Guide after each stage. During Stage One, formal and informal educators pilot tested lessons in their respective educational settings and provided input through surveys, critiques, and focus groups. DNR Fisheries staff also critiqued lessons to ensure scientific accuracy. Stage Two involved three types of reviews: 1) instructional design experts verified specific educational content in the lessons, 2) educational outreach partners provided written feedback on how the Leaders' Guide could be used to support their outreach efforts, and 3) an accessibility expert created planning documents to adapt MinnAqua lessons for use with individuals with physical disabilities. The evaluation results were used to verify the incorporation of the rewrite guidelines, identify ways to strengthen the extent to which the guidelines were addressed, and modify the Leaders' Guide to more fully meet educators' needs.

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# INTRODUCTION

Minnesota is known for its "10,000 lakes" and the fishing opportunities these waters hold. In 2005, more than 1.4 million individuals fished Minnesota's waters (Minnesota Department of Natural Resources, 2006). The Minnesota Department of Natural Resource's (DNR) Division of Fish and Wildlife is responsible for managing the state's aquatic resources to ensure that fishing continues to be a frequently engaged in recreational activity. In the late 1980's, the Division created the MinnAqua program to provide Minnesota's citizens with angling and aquatic education. MinnAqua's mission is to "provide life-long educational programming that will increase people's knowledge and understanding about aquatic ecosystems, management, and resource issues; help acquire skills related to aquatic recreation, careers, and teaching; and foster a better stewardship of the state's natural resources" (Minnesota Department of Natural Resources, 2002).

## Background Information About the MinnAqua Program

Many factors led to the initial development of MinnAqua: the availability of federal funds allocated specifically for aquatic education, a needs assessment for an aquatic resources education program conducted by the DNR, and the passage of Minnesota Statute 115A.073 supporting environmental education.

The Federal Aid in Sport Fish Restoration Act of 1950 created a federal program focused on the improvement of America's fisheries (U.S. Fish and Wildlife Service, 2004). With this came the availability of federal funds to states, although it was not until the passage of the Wallop-Breaux Amendment in 1984 that states were allowed to use these funds for aquatic resource education (U.S. Fish and Wildlife Service, 2004). The availability of these funds helped support the DNR's desire to create an aquatic education program.

In 1989, the Fisheries Roundtable[1] requested a needs assessment "to develop a plan for a comprehensive aquatic resources education program based on an assessment of the long term goals of the Fish and Wildlife Division and the needs of the constituents" (Blitz, 1989 p. 2). To carry out the needs assessment, aquatic education programs in other states were reviewed, and

[1] The Fisheries Roundtable brings together individuals and organizations to listen, talk, and learn about issues related to angling in Minnesota and the state's fisheries. The Fisheries Roundtable provides opportunities for stakeholder participation, individual learning, and strengthened relationships.

DNR staff, constituent groups and the general public were consulted. The study identified a need to educate Minnesota's citizens about the state's aquatic resources, fisheries management activities, and fishing regulations (Bilitz, 1989). To address this need, an aquatic education program plan was developed along with the needs assessment.

In 1990, Minnesota legislature passed Minnesota Statute 115A.073, which included the state's goals for environmental education and the need to develop a state environmental education plan titled *A GreenPrint for Minnesota: State Plan for Environmental Education*. The statute's environmental education goals laid out the knowledge and skills necessary for Minnesota's citizens to make informed environmental decisions. The DNR felt they could help address these goals by providing Minnesotans with aquatic resource education.

The availability of Sport Fish Restoration Funds, findings from the 1989 needs assessment, the passage of Minnesota Statute 115A.073, and support from DNR staff and constituents led to the creation of an urban aquatic education pilot project known as MinnAqua. The DNR partnered with the Minnesota Extension Service 4-H Youth Development to create the MinnAqua pilot project which was carried out from June 1990 to October 1992 (Erickson-Eastwood, 1992). The first year the MinnAqua program was delivered to 9 – 13 year olds in urban areas, lasted six hours, and focused on teaching angling skills. The DNR soon realized MinnAqua was not adequately aligning with the outcomes laid out in *A GreenPrint for Minnesota: State Plan for Environmental Education* or their 1989 needs assessment because MinnAqua activities did not tie angling into a larger environmental context (Erickson-Eastwood, 1992). For this reason, MinnAqua expanded their program from teaching only fishing skills to include topics such as aquatic ecology, fisheries management, and aquatic stewardship. MinnAqua also developed more activities, created programs of varying lengths, and expanded their programs statewide.

To guide the development of additional MinnAqua activities, a study was conducted to examine students' knowledge, attitudes, and experiences with Minnesota's aquatic resources as well as teachers' implementation of aquatic education activities in their classroom (Drewes, 1991). Student interest in learning about aquatic resources supported the creation of student materials and educator feedback provided guidance on aquatic education topics to cover in programming. As a result of the study, a youth activity booklet was created in 1991 titled *Fishing…Get in the Habitat.* The youth activity booklet was given to children upon completion

of a MinnAqua program and included a variety of activities designed to review what they learned and expand their knowledge. To aid instructors in teaching aquatic education programs, MinnAqua also created a Leaders' Guide in 1992 titled *Fishing…Get in the Habitat Leaders' Guide*. The Leaders' Guide included 20 activities divided into six chapters titled 1) Habitats and Ecosystems, 2) Minnesota Fish, 3) Water Stewardship, 4) Managing Our Resources, 5) Fishing Equipment and Techniques, and 6) The Fishing Trip. Within each of these chapters, activities were broken down by level of fishing experience and aquatic ecology knowledge to include beginner, intermediate, and advanced activities.

Upon completion of the MinnAqua pilot program, the DNR Division of Fish and Wildlife officially adopted the program. Since 1993, MinnAqua has continued to provide educational outreach through various educational programs, interpretive displays, educational trunks, publications, a youth activity booklet, and Leaders' Guide. The staff consists of a MinnAqua Coordinator, four regional MinnAqua Education Specialists, nine seasonal interns, and one staff member at each area Fisheries office to act as a MinnAqua Liaison by devoting 5% of their time to education outreach. From 1996 to 2005, MinnAqua reached approximately 465,000 individuals.

## Creating a New Leaders' Guide

Over the years, MinnAqua has strived to strengthen the impact they have on fostering stewardship of Minnesota's aquatic resources. In 2000, the MinnAqua Coordinator was involved with the Recreational Boating and Fishing Foundation[2] as a reviewer for their newly developed "Best Practices in Fishing, Boating, and Aquatic Stewardship Education". The Best Practices were "designed to help educators build, enhance, and evaluate their programs based on research and practices shown to be effective" (Recreational Boating and Fishing Foundation, 2003). Through this involvement, it was evident that MinnAqua could be improved by looking at the effectiveness of programs and products in terms of the research-based Best Practices.

MinnAqua decided to focus their program improvement on rewriting and redesigning the Leaders' Guide to better align with the Best Practices. One of the Best Practices states that

[2] The Recreational Boating and Fishing Foundation is "a nonprofit organization whose mission is to increase participation in recreational angling and boating and thereby increase public awareness and appreciation of the need for protecting, conserving and restoring this nation's aquatic natural resources." (Recreational Boating and Fishing Foundation, 2006)

effective programs are developmentally appropriate for participants (Seng & Rushton, 2003). The original Leaders' Guide contained activities labeled as beginner, intermediate, or advanced without age levels identified. MinnAqua created a new Leaders' Guide specifically for grades 3 – 5. Focusing on specific grades was intended to help ensure that concepts in the lessons were appropriate for the developmental levels of the students. MinnAqua also decided to expand their outreach to formal education settings by increasing the number of lessons available in the Leaders' Guide and making the lessons more classroom-appropriate, since the Leaders' Guide had primarily been used in informal education settings. Expanding their outreach to formal classroom environments was supported by a 2001 Environmental Education Survey administered by the DNR and the Minnesota Department of Education (formerly Minnesota Department of Children, Families, and Learning) which found an interest among formal educators in utilizing aquatic education materials in their classrooms (Minnesota Department of Natural Resources & Minnesota Department of Children, Families and Learning, 2001). Another supporting factor for creating classroom-appropriate lessons was the need for MinnAqua to expand its educational outreach without hiring additional staff, specifically to reach target audiences of preK-12 students and teachers as identified in the state's *A GreenPrint for Minnesota: State Plan for Environmental Education* (Ledermann, 2000) and the *2000 Cornerstones Report*[3] (Minnesota Department of Natural Resources, 2000).

In 2001, MinnAqua initiated a Leaders' Guide that could be effectively utilized by educators working with grades 3 – 5 in both formal and informal education settings. MinnAqua's goals for the new Leaders' Guide were that educators would use it to (a) teach about Minnesota fish, aquatic resources, and resource management; (b) lead students outdoors and initiate self-sustaining programs such as volunteer monitoring, shoreline restoration, and other service-learning projects; (c) connect students to their local aquatic resources through the recreational activity of angling; and (d) promote lasting stewardship of Minnesota's aquatic resources. To reach these goals, MinnAqua needed to ensure the Leaders' Guide contained quality lessons that met educators' needs.

Before the Leaders' Guide was rewritten, MinnAqua wanted to gain a clear understanding of what constitutes a quality educational product. One of the Best Practices is to align educational

[3] The *2000 Cornerstones Report*, written by educators and DNR staff, defines the DNR's role in education and includes recommendations of how to improve the DNR's education efforts (Minnesota Department of Natural Resources, 2000).

products with national and state standards (Seng & Rushton, 2003). To ensure that concepts presented in lessons were developmentally appropriate for grades 3 – 5, MinnAqua reviewed the National Research Council's *National Science Education Standards*, North American Association for Environmental Education's *Excellence in Environmental Education: Guidelines for Learning (K-12)* and *Environmental Education Materials: Guidelines for Excellence*, American Association for the Advancement of Science's *Benchmarks for Science Literacy*, Minnesota's *Environmental Literacy Scope and Sequence*, and the Minnesota Academic Standards for all subject areas. The Best Practices also emphasize using educational research in product development (Seng & Rushton, 2003). MinnAqua did an extensive review not only of educational research, but other educational products as well to become familiar with learning theory, developmentally appropriate concepts and skills for students in grades 3 – 5, and features of a lesson plan. Some examples of research and other resources reviewed include *Minnesota Report Card on Environmental Literacy*; biology and earth science textbooks available from the Minnesota Department of Education (MDE); aquatic ecology field guides; educational products similar to the Leaders' Guide, such as Project WET and Project WILD; and literature on topics such as environmental education, the Environment as an Integrating Context Model™, inquiry-based learning, Bloom's taxonomy, authentic assessment, multiple intelligence theory, child development, and effective classroom instruction. In addition, MinnAqua spoke directly to various educational professionals at the MDE and state education conferences in order to gain insight into what features were necessary for the Leaders' Guide to be useful in both formal and informal education settings.

As a result of reviewing a variety of educational resources, talking to educational professionals, and considering Recreational Boating and Fishing Foundation's (RBFF) research-based Best Practices, MinnAqua was able to gain an understanding of what constitutes a quality educational product that would be useful in various educational settings. From this, the MinnAqua Coordinator and Education Specialists created a set of rewrite guidelines under the assumption that if the guidelines were followed, it would help ensure the development of a quality Leaders' Guide that would meet the needs of both formal and informal educators. Rewrite guidelines for individual lessons included:

1) adding background biology information for each lesson,
2) better defining steps and procedures for lesson implementation,

3) aligning with the 2004 Minnesota Academic Standards and Minnesota's *Environmental Literacy Scope and Sequence*[4],
4) including measurable objectives,
5) adding authentic assessment ideas,
6) ensuring activities and concepts are developmentally appropriate and build on students' prior knowledge,
7) accommodating multiple learning styles in lesson activities, and
8) including ideas on how to adapt lessons for use with grades K-2.

Rewrite guidelines for the Leaders' Guide as a whole included:

1) ensuring concepts, environmental issues and problems are addressed with accuracy and fairness,
2) featuring content specific to Minnesota culture, natural resources, and fisheries management,
3) making connections to students' everyday lives,
4) adding more indoor classroom activities,
5) including self-directed, student-centered learning opportunities,
6) incorporating individual and group activities,
7) including interdisciplinary, hands-on, and inquiry-based lessons,
8) adding service-learning ideas,
9) creating lessons to stand alone or be used as part of a unit,
10) improving the appearance of graphics and copy pages,
11) creating a glossary of terms used in lessons, and
12) developing related reading lists for students.

A final measure to help ensure the creation of a quality educational product was to house a MinnAqua Education Specialist at the Minnesota Department of Education through an interagency agreement. This link allowed MinnAqua to stay abreast of and participate in educational conferences, professional organizations, teacher professional development activities, and state initiatives such as developing the 2004 Minnesota Academic Standards. It provided

[4] The *Environmental Literacy Scope and Sequence* "is a tool for educators that provides a systems approach to environmental education in Minnesota for preK through adult learners. It describes key concepts about the interaction of natural and social systems and a sequence in which they are to be taught" (Minnesota Office of Environmental Assistance, 2005).

access to a wide range of MDE education professionals whose expertise was utilized throughout the development of the Leaders' Guide and evaluation process to clarify Minnesota Academic Standards, understand the needs of Minnesota educators, verify age appropriateness of concepts, ensure accuracy of Native American cultural information, provide suggestions on where to recruit educators for reviewing lessons, and serve as instructional design expert reviewers. These professionals included the state subject area specialists, the Service-Learning Specialist, assessment staff, Indian Education staff, and the Director of Academic Standards. The MDE teachers' library was also accessible through this placement; allowing MinnAqua access to a variety of education journals, textbooks, and publications during the development of the Leaders' Guide.

Keeping in mind the rewrite guidelines and goals for the new Leaders' Guide, MinnAqua began the Leaders' Guide development process. MinnAqua used their mission, the Minnesota Academic Standards, RBFF's Best Practices, and Minnesota's *Environmental Literacy Scope and Sequence* as guidance for the creation of a conceptual framework for the Leaders' Guide. The conceptual framework laid out the themes of each chapter, possible lessons to include, and concepts addressed by each lesson. Next, objectives and a summary were written for each lesson, reviewed by MinnAqua staff, and then developed into a complete lesson. The lessons were written by MinnAqua Education Specialists who have backgrounds in fish and wildlife management, biology, environmental science, formal education, and informal education[5]. The lessons were structured in a lesson plan format to provide educators with the variety of information necessary to successfully carry out an activity. Key features of the lessons included vocabulary words; Minnesota Academic Standards for Science, Math, Language Arts and Social Studies; Minnesota's *Environmental Literacy Scope and Sequence*; measurable learning objectives; extensive biology background for the educator teaching the lesson; a warm up and wrap up for the activity; authentic assessments; K-2 options; and extensions for added learning on the lesson topic.

The resulting Leaders' Guide had 39 lessons arranged into six chapters: (1) Aquatic Habitats, (2) Minnesota Fish, (3) Water Stewardship, (4) Fish Management, (5) Fishing Equipment and

[5] MinnAqua Education Specialists' expertise and training includes B.S. in Environmental Science, Certificate in Early Childhood Administration, and M.A. in Curriculum and Instruction; B.S. in Biology and M.S. in Environmental Biology; B.A. in Natural Science Teaching and M.S. in Biology; B.A. in Biology and Secondary Education Licensure in Life Sciences; B.S. in Fish and Wildlife Management; and Certificate in Elementary Education.

Skills, and (6) Safety and the Fishing Trip. Each chapter contributes to a better understanding of Minnesota's aquatic systems and basic fishing skills. The guide also contained detailed appendices of supplemental resources including a glossary; participant reading lists; and matrices identifying Boy Scout, Girl Scout, and 4-H activity correlations with MinnAqua lessons. (For a complete outline of the Leaders' Guide, see Appendix A.) MinnAqua's hope is that the Leaders' Guide will be a useful tool for educators and the variety of features in the Leaders' Guide will enhance opportunities for students to have authentic experiences in their local surroundings, leading to a deeper understanding of their role in their environment and ultimately helping guide them toward a path of stewardship.

## Evaluation During the Leaders' Guide Development Process

The Best Practices emphasize the importance of evaluation during educational product development (Seng & Rushton, 2003). Moreover, carrying out a formative evaluation can improve an educational product's learning effectiveness significantly when compared to educational materials that have not undergone any type of evaluation (Nathenson & Henderson, 1980; Tessmer, 1993). For this reason, a formative evaluation of the Leaders' Guide was carried out upon completion of the first draft. The goal of the formative evaluation was to improve the Leaders' Guide during its development by ensuring the rewrite guidelines were addressed and the needs of intended users were met. From this goal came two evaluation questions, which guided the evaluation design.

The first evaluation question was "To what extent are MinnAqua's rewrite guidelines addressed in individual lessons and the Leaders' Guide as a whole?" As stated earlier, MinnAqua created rewrite guidelines to direct the development of the Leaders' Guide with the assumption that following the guidelines would help ensure the guide's quality and usability. The evaluation was carried out to verify that the guidelines were incorporated and, if necessary, strengthen the extent to which they were addressed, thus helping to increase the overall quality of the Leaders' Guide.

While the first evaluation question examined the use of the rewrite guidelines, the second question, "To what extent does the Leaders' Guide meet the educational needs of intended users in both formal and informal education settings?", guided the evaluation to determine if the product developed following the guidelines adequately met all educators' needs or if any features

based on the guidelines needed to be strengthened to increase the utility of the Leaders' Guide. Additionally, MinnAqua was interested in any unanticipated educator needs not addressed by the rewrite guidelines.

## LITERATURE REVIEW

### Formative Evaluation

Formative evaluation is "designed and used to improve an object, especially when it is still being developed" (Joint Committee on Standards for Educational Evaluation, 1994). Formative evaluations improve a product's quality through the ongoing process of gathering data, making revisions, and then gathering data about the revisions (Beyer, 1995). Additionally, formative evaluations improve the quality of an educational product by attaining data necessary to increase the likelihood a product meets the needs of intended users, works in intended settings, achieves instructional goals and objectives, and meets criteria set by product developers (Beyer, 1995; Tessmer, 1993; Weston, Mc Alpine, & Bordonaro, 1995). Information gathered from formative evaluations can include feedback on a product's strengths, weaknesses, clarity, technical quality, content accuracy, learning effectiveness, usability, and content quality (Beyer, 1995; Patton, 1997; Tessmer, 1993).

A variety of individuals are essential to the formative evaluation process: intended users, experts, and stakeholders (Beyer, 1995). Intended users of educational materials can include formal and informal educators and the students with whom they work. Experts include specialists in specific content area, with subject matter experts and instructional design experts being the most common types utilized in formative evaluations (Beyer, 1995; Saroyan, 1993; Weston, 1987). Stakeholders include all other individuals affected by the educational product, such as organizations with similar educational interests and, more specifically, "gatekeepers" who make the decision to use an educational product in their organization (Beyer, 1995). The involvement of intended users and stakeholders can create a sense of ownership of educational materials, leading to increased likelihood of use of the finished version and endorsement of its use to other educators (Tessmer, 1993).

### Methods Used in the Literature

Before designing the evaluation of the MinnAqua Leaders' Guide, the literature was reviewed to gain insight into how similar educational products[6] were evaluated during the

[6] Educational products developed by informal education organizations with intended use in formal and/or informal education settings were considered similar to the MinnAqua Leaders' Guide.

formative stage. The products evaluated varied in their scope and intended audiences. Materials meant for a national audience included *Project WET (Water Education for Teachers) K-12 Curriculum and Activity Guide*, *Project Learning Tree*, *Project WILD: Secondary Activity Guide*, *Exploring Your Environment*, and National Park Service's *Fire Ecology* lessons. Other educational materials reviewed were either region-specific or state-specific. *Rediscovering Agroforestry! A New Agriculture through Working Trees* was created for a regional Upper Midwest audience. Materials developed for state audiences included *The Great Salt Lake Story: An Interdisciplinary Activity Guide* for Utah, *Wildlife and Environmental Education: Issues and Actions* for New York, and a variety of materials focused on Wisconsin *One Bird – Two Habitats, KEEP Activity Guide,* and *LEAF Wisconsin K-12 Forestry Lesson Guide.*

As demonstrated in the literature, formative evaluations employ various methods to gather sufficient data to guide improvement efforts. Methods used in the evaluations reviewed included intended users piloting the materials in the intended settings; educators reviewing materials; students providing feedback; and content experts verifying the accuracy of scientific and educational content.

### *Pilot Testing*

Formative evaluations often include pilot tests by intended users to determine how well a product works in its intended real world settings (Beyer, 1995; Weston et al., 1995). To do an appropriate pilot test and gain the most useful data, it is important that piloting is carried out by all types of intended users and includes all intended real world settings, which can include both formal and informal education environments. Piloting can be especially important to determine whether a new educational product can be integrated into a preexisting educational curriculum, which is the intended use of many educational materials developed by informal organizations (Tessmer, 1993).

A majority of the evaluations reviewed included pilot testing of the materials. The most common type of pilot testing feedback provided by educators was answering questions on a survey and/or providing written comments directly on materials. *Project WET K-12 Curriculum and Activity Guide* was piloted by 462 formal and informal educators across the country with various grades. Each educator piloted five lessons and provided feedback related to their educational content, how activities were used, the lesson format, and the lessons' overall

effectiveness (The Watercourse & The Council for Environmental Education, 1995). *The Great Salt Lake Story: An Interdisciplinary Activity Guide* was reviewed by 79 teachers who each piloted three lessons and commented on student learning, students' reactions, lesson usability, and content clarity (Zicus, 1995). The *LEAF Wisconsin K-12 Forestry Lesson Guide* was piloted by 52 teachers (Wisconsin Department of Natural Resources - Division of Forestry & Wisconsin Center for Environmental Education, 2004). Each lesson was piloted by three educators who provided feedback on an evaluation form (S. Hoffman, personal communication, April 29, 2003). The National Park Service's *Fire Ecology* lessons were piloted by three teachers. Each teacher piloted one activity and provided comments on the usability, appropriateness, design, and content of the lesson they tested as well as the rest of the *Fire Ecology* materials (Cox, 1993). For the evaluation of the *KEEP Activity Guide*, an unspecified number of teachers piloted lessons and provided written feedback on how well the lessons achieved their stated objectives and accurately addressed KEEP energy concepts (Lane, 1995). The formative evaluations of *Project WILD: Secondary Activity Guide* and *Project Learning Tree* involved classroom teachers piloting lessons and providing feedback; however, the feedback method was not specified in the literature (Project Learning Tree, n.d.; Western Regional Environmental Education Council, 1985).

In some cases, pilot testing can go beyond collecting written feedback from educators. The evaluation of *Environmental Education and Wildlife: Issues and Actions* involved 13 teachers piloting both instructional units and four piloting only one of the units. Educators were interviewed before they finished piloting to gain early feedback on any potential problem areas. Upon completion of the pilot test, educators also provided feedback on a questionnaire regarding the layout, usability, appropriateness for fourth graders, student enjoyment, and overall opinion of the materials (Gigliotti, 1992). The pilot testing of *One Bird-Two Habitats* included the most thorough data collection of all formative evaluations reviewed. Twenty-two educators piloted the curriculum, completed questionnaires, and participated in a focus group. Educators were asked about implementation issues and suggestions for revision. Seventeen of the classrooms were also observed throughout the pilot testing period, with one classroom observed for an entire unit, to understand how lessons were implemented (Row, 1994).

### *Educator Reviews*

Formative evaluations may include educator reviews in place of or in addition to educators piloting materials. In some cases, formative evaluation may not include pilot testing of materials because funding is not available to carry out a pilot test, the time frame won't allow for it, or the materials are not complete enough. Instead, educators are asked to read through lessons and provide feedback, which was the case for the evaluations of *Rediscovering Agroforestry! A New Agriculture through Working Trees* and *Exploring Your Environment*. Twenty individuals, both teachers and Extension educators, were asked to read one or two chapters of *Rediscovering Agroforestry! A New Agriculture through Working Trees* and skim the entire 170 page curriculum. Feedback was provided through a survey asking about the content, style of delivery, and appropriateness of the individual chapters and overall curriculum for the intended high school audience (Sorley, 2000). The *Exploring Your Environment* materials were composed of three youth guides and a leader's guide. Fifteen youth educators were asked to review one or two of the guides and provide feedback on the content and age appropriateness of the materials by filling out a questionnaire and commenting directly in the guides (Hartz, 2000).

There were also cases in which educators reviewed educational materials in addition to performing a separate pilot test. For the *KEEP Activity Guide*, some educators did not pilot activities, but simply provided feedback on how well the activities achieved identified objectives and the accuracy in which energy concepts were addressed (Lane, 1995). *Environmental Education and Wildlife: Issues and Actions* used educator reviews during the initial workshop they held with 65 educators interested in piloting the materials. Feedback obtained was in relation to the organization of the activities, their appropriateness for fourth graders, and overall impression of the materials. Only 17 of the educators who attended the workshop ended up piloting materials, so feedback from the additional educators at the workshop added to pilot testing data (Gigliotti, 1992).

### *Student Feedback*

The use of student feedback during formative evaluations varies depending on the goals of the evaluation. In some cases, student feedback is not gathered until a summative evaluation of completed materials is carried out. A number of evaluations reviewed in the literature utilized student input during the formative process.

The development of formal education materials, such as textbooks, often includes a measure of student achievement during the formative evaluation process (Weston, 1987; Weston, Le Maistre, Mc Alpine, & Bordonaro, 1997). This method is sometimes used during the development of supplemental materials as well. The evaluations of *One Bird - Two Habitats* and *Wildlife and Environmental Education: Issues and Actions* both involved the use of pre and post-surveys to measure student achievement (Gigliotti, 1992; Row, 1994). In addition, the evaluation of *Wildlife and Environmental Education: Issues and Actions* asked students specific questions to measure changes in attitudes and interests as a result of exposure to the materials (Gigliotti, 1992). *Project WET K-12 Curriculum and Activity Guide* and the National Park Service's *Fire Ecology* lessons were evaluated using only post-measures of student achievement (Cox, 1993; The Watercourse & The Council for Environmental Education, 1995).

When educational materials include a component in which students are the primary intended users, it is important they have an opportunity to provide feedback. *Exploring Your Environment* was composed of three youth activity guides. Focus groups were held with students ages 8 to 18 to gain feedback about the visual appearance and layout of the youth guides (Hartz, 2000). Students participating in the pilot of the National Park Service's *Fire Ecology* lessons gave their feedback by describing their impressions of the lesson (Cox, 1993).

### *Content Experts*

Feedback from content experts is another important component of a formative evaluation. Experts involved in formative evaluations often include individuals knowledgeable about the topics covered in the educational materials under development. These experts help ensure the scientific accuracy of the information presented and can include individuals from a variety of scientific backgrounds. *Rediscovering Agroforestry! A New Agriculture through Working Trees* was reviewed by University of Nebraska agroforestry experts (Sorley, 2000). *LEAF Wisconsin K-12 Forestry Lesson Guide* received feedback from forestry professionals (Wisconsin Department of Natural Resources - Division of Forestry & Wisconsin Center for Environmental Education, 2004). Experts in energy-related fields reviewed the content of the *KEEP Activity Guide* (Lane, 1995). *Project WILD: Secondary Activity Guide*, *Project WET K-12 Curriculum and Activity Guide,* and *Project Learning Tree* were all reviewed by experts from various science fields, such as chemistry, physics, wildlife biology, and life science (Pitman, 2004; Project

Learning Tree, n.d.; The Watercourse & The Council for Environmental Education, 1995; Western Regional Environmental Education Council, 1985).

To verify the instructional accuracy of materials, various educational experts are often used in formative evaluations. *Project WET K-12 Curriculum and Activity Guide* and *Project WILD: Secondary Activity Guide* were both reviewed by environmental education experts (The Watercourse & The Council for Environmental Education, 1995; Western Regional Environmental Education Council, 1985). *Project WILD: Secondary Activity Guide* also had curriculum specialists ensure the educational soundness of their materials (Pitman, 2004), while the content of *Project WET K-12 Curriculum and Activity Guide* had additional reviews by experts from museums, universities, and government agencies (The Watercourse & The Council for Environmental Education, 1995).

### *Summary of Methods Used in the Literature*

As illustrated in Table 1, the designs of educational materials' formative evaluations can include the use of educator reviews, pilot testing, student feedback, and/or content experts. When looking more closely at the literature, the utilization of these methods and the individuals involved varied across evaluations depending on the product being evaluated, the goals of the evaluation, the type of feedback sought, the amount of time allotted to carry out the evaluation, and the funds available.

Table 1: Methods Used in Formative Evaluations of Educational Materials

| | Educator Reviews | Pilot Testing | Student Feedback | Content Experts |
|---|---|---|---|---|
| *Project WET (Water Education for Teachers) K-12 Curriculum and Activity Guide* | | X | X | X |
| *Project Learning Tree (PLT)* | | X | | X |
| *Project WILD: Secondary Activity Guide* | | X | | X |
| *Fire Ecology Lessons* | | X | X | |
| *Exploring Your Environment* | X | | X | |
| *Rediscovering Agroforestry! A New Agriculture through Working Trees* | X | | | X |
| *The Great Salt Lake Story: An Interdisciplinary Activity Guide* | | X | | |
| *Wildlife and Environmental Education: Issues and Actions* | X | X | X | |
| *LEAF Wisconsin K-12 Forestry Lesson Guide* | | X | | X |
| *KEEP Activity Guide* | X | X | | X |
| *One Bird - Two Habitats* | | X | X | |

## EVALUATION DESIGN

### MinnAqua Leaders' Guide Formative Evaluation Design

The formative evaluation of the MinnAqua Leaders' Guide was designed to obtain data necessary to answer the evaluation questions. The design took into account the characteristics of the Leaders' Guide, and the methods used in formative evaluations of similar educational materials. Figure 1 provides an illustration of the design of the formative evaluation of the MinnAqua Leaders' Guide.

Keeping in mind the ongoing nature of formative evaluations, the Leaders' Guide evaluation design included two stages of data collection and revisions. Originally, funds were only set aside to hire an evaluator to carry out Stage One. However, during Stage One MinnAqua realized the necessity to include additional intended users and stakeholders, so another round of data collection and revisions was added. The resulting evaluation design provided the opportunity for lessons to receive multiple reviews from a variety of intended users and stakeholders. The advantage of the two-stage design was that Stage Two reviewers verified and improved upon comments from Stage One to increase the quality and usability of the Leaders' Guide.

Stage One involved two main types of reviews. With the extensive amount of fisheries management, aquatic ecology, and other science information included in the lessons, MinnAqua also recognized the need to have DNR Fisheries staff review lessons to ensure the scientific accuracy of the lessons' biology content. Input during Stage One was used to make necessary revisions to the Leaders' Guide before Stage Two of the evaluation.

Stage Two involved three types of reviews. Instructional design experts verified specific educational content in the lessons. In addition, educational outreach partners MinnAqua had previously partnered with provided feedback on how the Leaders' Guide could be used to support their outreach efforts. Finally, an accessibility expert was consulted to determine the best method to ensure activities were inclusive of intended users with physical disabilities. MinnAqua then made additional revisions based on these reviewers' comments. Upon completion of Stage Two, the Leaders' Guide was ready for layout, graphics, and final editing.

The evaluation was carried out from January 2003 when the process of designing the evaluation began to May 2005 when the final data and recommendations from Stage Two were

given to MinnAqua. Stage One spanned from December 2003 to June 2004. Formal educators piloted lessons from December 2003 to March 2004 so winter lessons could be tested. Informal educators piloted lessons from April 2004 to June 2004 to test spring and summer lessons. DNR Fisheries experts were given from December 2003 to May 2004 to ensure they could find time in their busy field schedules to provide a thorough review. Between June 2004 and November 2004 MinnAqua staff reviewed Stage One data and recommendations and revised lessons. All reviews for Stage Two began in December 2004 and most were completed by February 2005, with some taking as long as May 2005. MinnAqua then took the data and recommendations from Stage Two and made additional revisions. The Leaders Guide will be published in Fall of 2006.

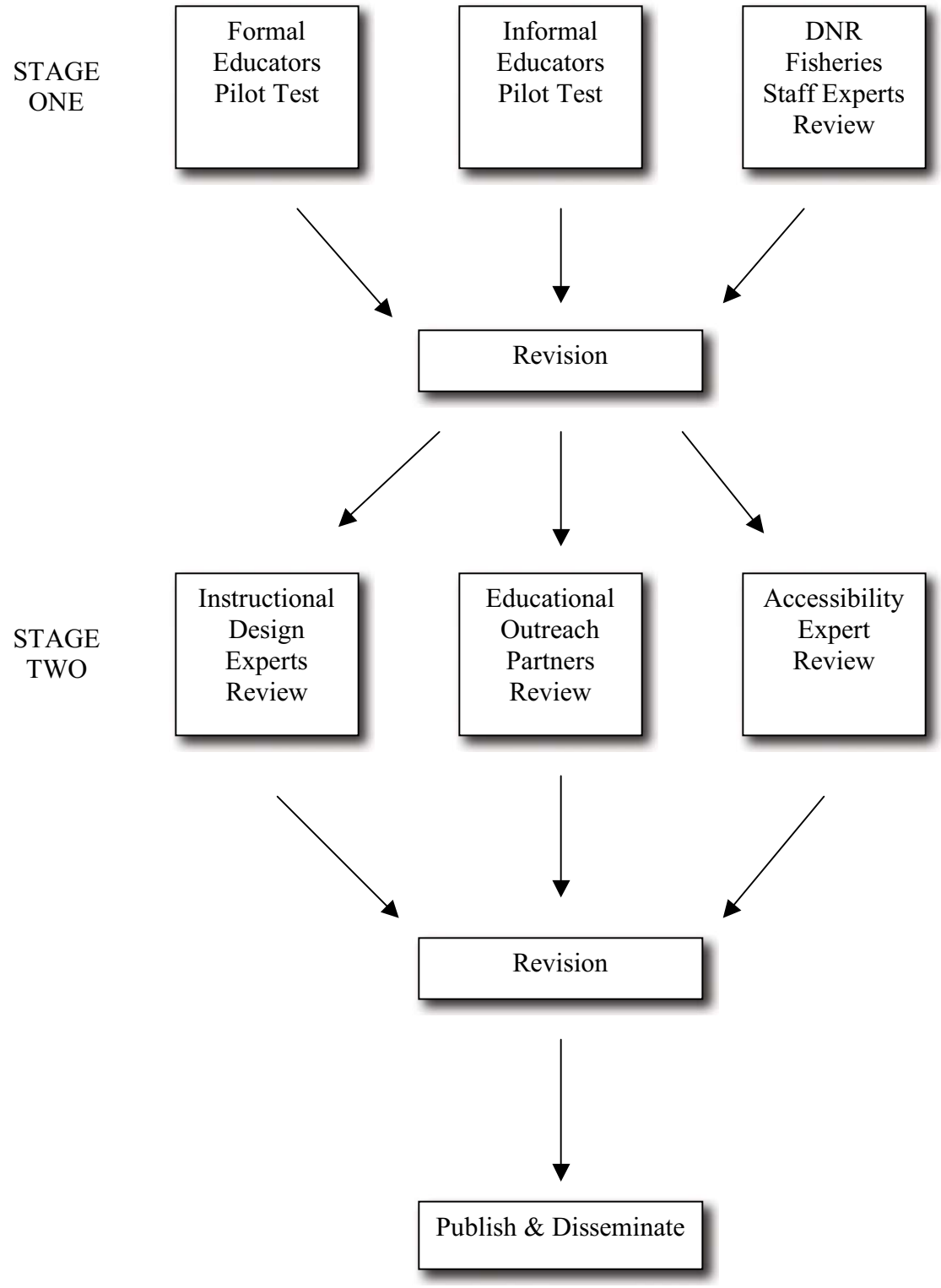


Figure 1: Leaders' Guide Formative Evaluation Process

## Limitations of the Evaluation Design

There were several limitations to the evaluation design. One limitation was external validity, or the generalizability of the results. However, the purpose of a formative evaluation is not to generalize findings to a larger population, but to improve a specific product or program (Patton, 1990; Tessmer, 1993). For this reason, formative evaluations often use qualitative methods and purposive sampling techniques to provide the deep levels of understanding necessary to guide the improvement of a product (Patton, 1990). Qualitative methods used to evaluate the Leaders' Guide included interviews and focus groups. A purposive sampling technique was used to choose educators to pilot lessons and instructional design experts to verify content. The educators who piloted were self-selected so it is likely they were more interested in angling, environmental education, and incorporating hands-on activities into their classroom than the typical educator. However, because these educators were self-selected, they had a high level of interest in MinnAqua and were committed to the review process. This resulted in the in-depth feedback necessary for product improvement. Additionally, instructional design experts were chosen because of their level of expertise in relation to a particular content area so they would provide the most valuable and useful feedback.

A second limitation was the amount of time and financial resources available to carryout the evaluation. The evaluation of the Leaders' Guide was limited to one round of pilot testing by educators because of the length of time needed to recruit educators, pilot the materials, and incorporate feedback. Ideally, revisions based on educator suggestions would have been piloted a second time to ensure the changes adequately addressed problems with a lesson. However, an additional round of piloting was not possible under MinnAqua's publication timeline or evaluation budget. To address this limitation, instructional design experts were asked to review the lessons. It was acknowledged that although their comments on how a lesson would work in a classroom were inferential, they provided additional feedback and in some cases echoed educators' concerns with certain lessons. The three-ring binder format of the Leaders' Guide will also allow flexibility to make any necessary changes to lessons after the Leaders' Guide is published.

As mentioned above, financial resources limited the evaluation design and time allocated to the evaluation. The amount of travel associated with the evaluation was also limited by funds available. Observations of educators piloting MinnAqua lessons would have provided first-hand

accounts of how lessons were administered, as was done in the *One Bird-Two Habitats* evaluation (Row, 1994). However, educators were spread throughout the state so travel to pilot testing sites would have been too costly. To address this limitation, a variety of data collection methods were used to gather a broad range of information from educators about the implementation of the lessons. Educators were also reminded to pilot lessons exactly as written and if they adapted the lesson at all to describe the adaptations on the pilot testing questionnaire.

Personal meetings with Stage Two reviewers were also limited due to financial resources. Personal funds were used to meet with reviewers within ten miles of the DNR Central Office in St. Paul. Reviewers outside of this area were sent detailed information about MinnAqua, the Leader's Guide, and the evaluation, similar to what was provided during personal meetings. Each of these reviewers also received a phone call before they began the review to discuss the information they received and answer any questions about their role in the evaluation.

A third limitation of the evaluation design was that it did not include a measure of student achievement. MinnAqua chose not to solicit student feedback because assessment ideas were not included in all of the lessons and MinnAqua was looking to the educators and instructional design expert reviewers to suggest assessment ideas and provide feedback to strengthen assessments. To address this limitation, MinnAqua developed lessons based on the Best Practices and various educational standards shown to enhance student learning. Educators pilot tested the lessons to ensure their quality and usability under the assumption that if various components of the lessons were done poorly, the outcome of student learning would also be low. During Stage Two, experts also verified the lesson content to ensure the various components of the lessons were accurate and age appropriate. MinnAqua plans to carry out a summative evaluation of the Leaders' Guide upon publication, at which point student achievement will be measured. The Leaders' Guide will be published in a three-ring binder format so lessons can be easily updated if it becomes apparent during the summative evaluation that changes still need to be made.

The final limitation was the subjective nature of the evaluation process and the potential for researcher bias. Evaluation is a value-laden process, from designing the evaluation to generating recommendations. However, an evaluator must ensure their personal values and beliefs do not bias the evaluation in such a way that they significantly affect the overall outcome of the evaluation (Worthen, Sanders, & Fitzpatrick, 2001). This is especially important for

internal evaluators because of their intimate relationship with the program. Measures were taken to ensure the internal evaluator's intense involvement did not bias the results and recommendations. The evaluator was not involved in the process of developing the Leaders' Guide, which provided distance from the project and made it easier to remain objective. The use of questionnaires, critiques, and focus groups to gather pilot testing feedback provided triangulation of data to ensure the validity of data gathered. Additionally, an outside consultant was hired to transcribe focus group data to reduce the potential for bias. Throughout the data analysis and reporting period, the goals of the evaluation were always kept in mind and MinnAqua staff was reminded to look to the data for guidance instead of anecdotal information they may have remembered hearing from educators.

## STAGE ONE: METHODOLOGY

### Formal and Informal Educators Pilot Test

The Leaders' Guide was piloted by the intended users of the materials: educators who taught grades 3 - 5 in both formal and informal education settings. The goals of the pilot test were to (a) determine the usefulness of the Leaders' Guide in various educational settings, (b) identify the Leaders' Guide's strengths and needed improvements, and (c) obtain suggestions for dissemination and training. Before the implementation of Stage One, the methodology, instruments, and a consent form were approved by the University of Minnesota's Institutional Review Board[7] (see Appendix B for consent form).

A purposive sampling technique was used to choose the pilot testing sample. Purposive sampling provides a deep understanding of the object under study from individuals who are considered "information-rich cases" (Patton, 1990). Maximum variation sampling is a type of purposive sampling where individuals are chosen based on a set of diverse characteristics (Diamond, 1999). The variation provides the opportunity to understand what common feedback and experiences exist across the diverse sample (Patton, 1990). In the case of pilot testing the Leaders' Guide, MinnAqua focused recruitment to include intended users in intended settings. Educators were recruited from various types of formal and informal education settings spread throughout the state in urban, suburban, and rural areas. Additionally, recruitment efforts were focused to ensure the sample included similar numbers of 3rd, 4th, and 5th grade educators, so each lesson could be piloted in the intended grade levels. Recruitment strategies included advertising on email lists, web sites, and at conferences of various statewide formal and informal education organizations[8]; postings on the DNR and the Minnesota Office of Environmental Assistance Sharing Environmental Education Knowledge (SEEK) website; sending letters directly to educators who expressed interest in aquatic education on the 2001 DNR/DCFL Environmental Education Survey; and contacting principals at private, charter and rural area

[7] "The Institutional Review Board reviews research projects involving human subjects to ensure that two broad standards are upheld: first, that subjects are not placed at undue risk; second, that they give uncoerced, informed consent to their participation." (University of Minnesota, 2005).

[8] Education organizations included Minnesota Sustainable Communities Network, Science Museum of Minnesota, Minnesota Naturalists, Minnesota Association of Environmental Education, Minnesota Homeschoolers Association, Minnesota Science Teachers Association, and Education Minnesota.

schools in Minnesota to increase the chance of obtaining individuals from diverse settings and locations for the sample.

All educators who expressed interest were chosen as part of the sample. Ideally there would have been a pool of interested educators from which to draw a sample for piloting the Leaders' Guide. Yet, as illustrated in Table 2, the sample included a diverse group of educators from a wide variety of educational settings in which the Leaders' Guide is intended to be utilized. (For more detailed information about the characteristics of individual educators in the sample, see Appendix C.) Fewer informal educators reviewed the guide because many of the lessons were written and used by MinnAqua Education Specialists whose experience was in informal education. The only intended users not represented in the sample were charter schools, Girl Scouts, and museums. Representatives from Girl Scouts and a science museum were originally on the review team, but ultimately were unable to pilot test, at which point it was too late to find suitable replacements. Letters were sent directly to some charter schools as part of the recruitment process, but no interest was expressed.

Educators received a variety of incentives for pilot testing lessons from the Leaders' Guide. Incentives included aquatic education teaching materials (a set of rods and reels, canvas storage bags for rods and reels, rubber fish replicas for fish printing, an aquatics poster, fish families posters, and a set of fish-shaped pillows for fish identification), continuing education credit (for classroom teachers), acknowledgement in the Leaders' Guide, and a copy of the Leaders' Guide upon publication. In order to help understand the ease or difficulties educators may encounter when finding lesson materials, educators were also reimbursed for any materials they had to purchase to pilot their lessons.

Table 2: Characteristics of Pilot Testing Sample

| Formal Educators (n=17) | Informal Educators (n=5) |
|---|---|
| Educational Setting<br>• Public[a] school: 14<br>• Private school: 2<br>• Homeschool: 1<br><br>Geographic Location<br>• Twin Cities metro area[b]: 5<br>• Outside metro area: 12<br><br>Grade Taught<br>• Third grade: 9<br>• Fourth grade: 4<br>• Fifth grade: 8 | Educational Setting<br>• 4-H: 2<br>• Nature center: 1<br>• Cub Scouts: 1<br>• Tribal Community Waste Management: 1<br><br>Geographic Location<br>• Twin Cities metro area[b]: 1<br>• Outside metro area: 4 |

a. Public schools included a fine arts public school, tribal community school, and Montessori school.
b. "Twin Cities metro area" includes Anoka, Carver, Dakota, Hennepin, Ramsey, Scott, and Washington county.

Educators attended a six hour introductory meeting to learn about the MinnAqua program, the Leaders' Guide, and the evaluation process to clearly define their role in relation to the evaluation's goals. At the meeting they practiced implementing and critiquing a lesson to become comfortable with the data collection instruments. Educators were then asked to choose six lessons, one from each chapter if possible, to pilot test at their site. Educators chose their own lessons to allow for easier integration into their regular curriculum during the three month pilot testing period. Each lesson was piloted by a minimum of one formal educator at each grade level (third, fourth, and fifth) and one informal educator, who in most cases piloted the lesson with various grade levels. Since there was a small number of fourth grade teachers in the sample, some lessons were tested in two third or two fifth grade classrooms under the assumption that if the lessons worked for third and fifth graders they would work with fourth graders as well.

Educators provided pilot testing feedback through surveys, critiques, and focus groups. More than one data collection method was used to allow for data triangulation. Triangulation ensures the consistency of findings by cross-checking data from the same individual over

multiple methods, thus increasing an evaluation's reliability and validity (Bryman, 2004; Patton, 2003). The variety of methods also provided the deep understanding necessary to identify lessons' problem areas and possible solutions, specifically in relation to the rewrite guidelines.

Educators completed a questionnaire and critique for each lesson they piloted. The questionnaire had 22 questions for formal educators and 29 questions for informal educators. The questionnaire asked for feedback about lesson content, delivery, and adaptations made to lessons. The additional questions for informal educators were to understand the population in which they piloted the lesson and the setting in which it occurred. Before being used by educators, MinnAqua interns piloted the questionnaire to ensure questions were clear and would obtain desired feedback. Critiquing lessons involved critically reviewing each component of a lesson and providing targeted suggestions for improvement. (Both the questionnaire and instructions for critiquing lessons can be found in Appendices D and E, respectively.)

Educators participated in a two-hour focus group within a month after completing their pilot test. A total of four focus groups were held throughout the state, three with formal educators and one with informal educators. The purpose of the focus group was to gain a deeper understanding of the pilot testing experience, understand how students reacted to lessons, gain additional feedback on how to improve the Leaders' Guide, and discuss ideas for disseminating the Leaders' Guide. Focus group questions can be found in Appendix F. Some educators were also asked clarifying questions about problems with specific lessons they had indicated on their critiques and questionnaires. Three educators could not attend a focus group so they were interviewed individually over the phone. To ensure data accuracy, focus groups and interviews were audio taped, with focus groups also videotaped. All audio recordings were transcribed, with a majority of them transcribed by an outside consultant to help avoid any potential bias[9]. After transcripts were received, nonverbal language (i.e. head nods for agreement or disagreement) from the video was added. The transcription process was used to increase the accuracy of the results by ensuring all relevant feedback was included in the analysis.

The data collection instruments were developed to address the first evaluation question concerning the use of the MinnAqua rewrite guidelines. Table 3 indicates which guidelines were addressed by each of the three data collection methods. The focus group questions did not

[9] All formal educator focus groups were transcribed by an outside consultant. The informal educator focus group and individual interviews occurred later in the evaluation process so they were transcribed by the evaluator to ensure MinnAqua received the results and analysis in a timely manner.

directly address many of the rewrite guidelines, but instead were written to provide insight into both educator and student experiences. However, issues related to many of the guidelines came up repeatedly in focus group discussions, as illustrated in Table 3.

Pilot testing also provided information to answer the second evaluation question regarding how the Leaders' Guide meets the needs of educators in formal and informal education settings. Feedback on critiques and questionnaires allowed educators to reflect on how individual lessons worked in their setting, while the focus group gave educators the opportunity to discuss the usability of not only the individual lessons but the Leaders' Guide as whole. Focus groups also allowed educators to build upon others' comments in order to provide a deeper understanding of the usability of the Leaders' Guide with educators of diverse backgrounds in various types of educational settings and locations.

During pilot testing, educators were not asked to comment on the entire Leaders' Guide as in some of the formative evaluations discussed in the Literature Review (Cox, 1993; Gigliotti, 1992; Row, 1994; Sorley, 2000). However, the pilot test was meant to model the intended use of the Leaders' Guide, which is not meant to be used as a whole. The lessons were designed to stand on their own, but because each chapter builds on knowledge from previous chapters (i.e. from habitats, to fish species, to fishing equipment, to going fishing) educators are encouraged to create their own units using lessons from the six chapters. Educators piloted a lesson from each of the six chapters to model this suggested use. Educators were not asked to review the entire Leaders' Guide because there was a concern that reviewing the over 1,000 page Guide would be burdensome and possibly affect the quality and depth of the review provided for the six lessons they piloted.

Table 3: Rewrite Guidelines Addressed By Pilot Test Data Collection Methods

| Method | Rewrite Guidelines Addressed |
|---|---|
| Questionnaire | • Better defining steps and procedures for lesson implementation.<br>• Ensuring activities and concepts are developmentally appropriate and build on students' prior knowledge.<br>• Accommodating multiple learning styles in lesson activities.<br>• Making connections to students' everyday lives.<br>• Improving the appearance of graphics and copy pages.<br>• Developing related reading lists for students. |
| Critique | • Adding background biology information for each lesson.<br>• Better defining steps and procedures for lesson implementation.<br>• Aligning with the 2004 Minnesota Academic Standards & Minnesota's *Environmental Literacy Scope and Sequence*.<br>• Including measurable objectives.<br>• Adding authentic assessment ideas.<br>• Ensuring activities and concepts are developmentally appropriate and build on students' prior knowledge.<br>• Including ideas on how to adapt lessons for use with grades K-2.<br>• Adding more indoor classroom activities.<br>• Incorporating individual and group activities.<br>• Creating a glossary of terms used in lessons. |
| Focus Group | • Adding background biology information for each lesson.<br>• Better defining steps and procedures for lesson implementation.<br>• Aligning with the 2004 Minnesota Academic Standards.<br>• Ensuring activities and concepts are developmentally appropriate and build on students' prior knowledge.<br>• Accommodating multiple learning styles in lesson activities.<br>• Including ideas on how to adapt lessons for use with grades K-2.<br>• Featuring content specific to Minnesota culture, natural resources, and fisheries management.<br>• Making connections to students' everyday lives.<br>• Incorporating individual and group activities.<br>• Including interdisciplinary, hands-on, and inquiry-based lessons.<br>• Creating lessons to stand alone or be used as part of a unit.<br>• Improving the appearance of graphics and copy pages.<br>• Creating a glossary of terms used in lessons. |

## Fisheries Staff Expert Review

One of MinnAqua's rewrite guidelines is to feature content specific to Minnesota culture, natural resources, and fisheries management. Another guideline, based on the Best Practices, is to ensure all environmental information is presented with fairness and accuracy (Seng & Rushton, 2003). To provide information to address these guidelines, an expert review was carried out by various DNR Fisheries staff. Thirty-eight MinnAqua Liaisons each reviewed two lessons to verify the scientific accuracy of the lessons' biology and fisheries management content. Tessmer (1993) and Weston (1987) both suggest restricting the number of experts reviewing the same materials in order to limit the number of contradictory and counterproductive suggestions, for this reason no more than two Fisheries experts were asked to review each lesson. Additionally, Liaisons' reviews were each limited to two lessons since Liaisons are only required to devote five percent of their time to MinnAqua activities and the time of year in which they were asked to do the reviews was a very busy period for fisheries management activities. Liaisons provided feedback using a short questionnaire (see Appendix G for the Fisheries Liaison questionnaire). They identified any necessary changes to ensure the lesson's scientific accuracy. Since Liaisons were also intended users, they also commented on the potential usefulness of the lessons for their educational outreach activities. This input provided data for the second evaluation question. During Stage One, relevant Fisheries Program and Management staff also reviewed lessons to verify the accuracy of policy and regulation information.

## Data Analysis and Reporting For Stage One

Current literature lacks clear direction on how to present and interpret results obtained for individual lessons from a pilot test, so a question was posted on the American Evaluation Association's listserv. Responding evaluators recommended presenting the data to MinnAqua and letting them decide what feedback to incorporate as opposed to generating recommendations for each lesson. To facilitate processing questionnaire and critique data from Stage One, feedback was compiled for each lesson by color-coded pages corresponding to the type of reviewer (informal educator, formal educator, Fisheries staff). This allowed MinnAqua to easily compare input from the various reviewers for a single lesson. The evaluator also provided guidance on how to interpret the variety of feedback for the lessons.

Focus group transcripts were analyzed using the qualitative analysis software *Atlas Ti,* and responses were coded by themes that emerged during the analysis. Focus group data were presented separately from the compiled lesson data, and major findings and recommendations were generated structured around the various themes (see Stage One: Results). However, both formal and informal educator comments related to specific lessons were pulled out of focus group transcripts, color-coded by type of educator, and included with the questionnaire and critique feedback for each lesson.

A two-day meeting was held with the MinnAqua Coordinator and MinnAqua Specialists to discuss the compiled lesson results, guidance for interpreting feedback for the lessons, focus group data, and recommendations based on results from Stage One. Recommendations were generated to assist MinnAqua in using the results by drawing attention to frequent concerns educators and Fisheries staff had with certain lessons, providing suggestions for changes to the overall Leaders' Guide, and discussing educator ideas for future dissemination of the Leaders' Guide. After the meeting, it was up to the MinnAqua Specialists to decide what changes and additions would be made to the Leaders' Guide before Stage Two of the evaluation.

## STAGE ONE: RESULTS

Results from educators' questionnaires and critiques, focus group comments about specific lessons, and feedback from DNR Fisheries staff were compiled by lesson and presented to MinnAqua as described earlier. Presented here is a summary of the questionnaire rating scale data, focus group results, and feedback from DNR Fisheries staff.

### Questionnaire Rating Scale Data

Educators completed a questionnaire for each of the six lessons they piloted. A total of 131 questionnaires were received, with 101 from formal educators and 30 from informal educators. The first part of the questionnaire asked educators to rate their level of agreement with a series of ten statements. Results for these statements were compiled by lesson and included with the rest of the pilot testing results so MinnAqua could review all feedback for a lesson at once.

Additional analyses were carried out with the rating scale data to understand educators' overall experience with the lessons and determine if any differences existed between the educators based on recruitment characteristics. Educators' reviews were analyzed based on educator location (metro, rural) and grade level taught (grades 3, 4, 5). Responses were positive overall and ratings were similar across locations and grade levels. Since educational setting was the main educator characteristic MinnAqua sampled for, the following pages include the complied ratings for each statement from all 131 questionnaires broken down by formal and informal educator. Note in the following figures that "n" is the number of educator reviews or questionnaires (101 formal educator reviews and 30 informal educator reviews), not the number of educators who piloted lessons.

Educators were asked to rate their level of agreement with four statements related to the usability of the lessons they reviewed. Both formal and informal educators felt the lessons were easy to use. As illustrated in Figure 2, educators could easily understand the entire lesson they piloted the first time they read it (85% of formal educator reviews, 97% of informal educator reviews), they thought the lesson format was easy to follow (90% of formal educator reviews, 100% of informal educator reviews), and they felt the lesson they piloted would fit into their regular curriculum (90% of both formal and informal educator reviews). A majority of educators

did not feel the length of the lesson they piloted would turn them of from doing the lesson (67% of formal educator reviews, 80% of informal educator reviews).

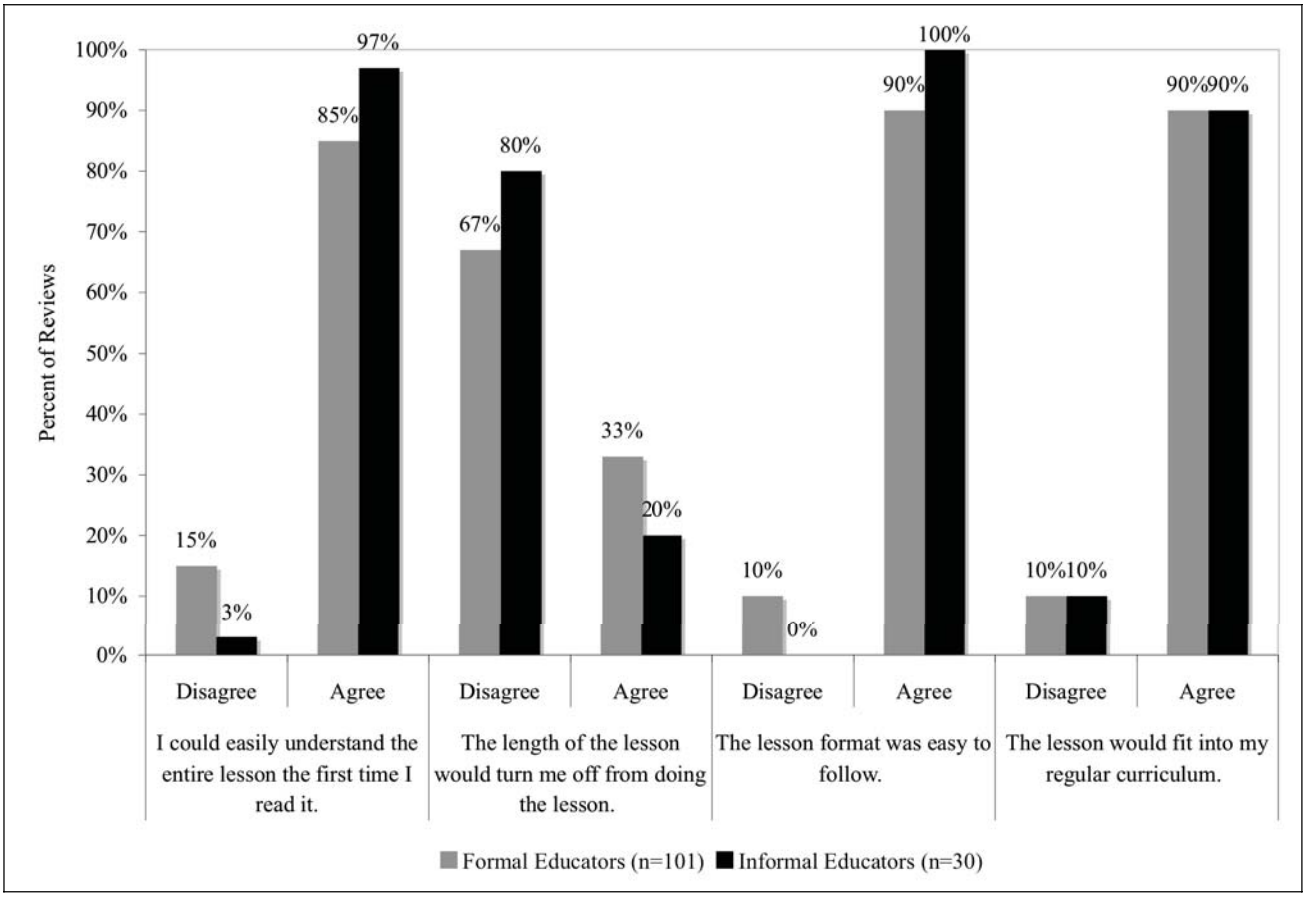


Figure 2: Educator Feedback on Usability of Lessons Reviewed

Educators were asked to rate their level of agreement with four statements related to how the lessons they piloted worked with students. Overall, educators felt the lessons worked well with their students as illustrated in Figure 3. Lessons successfully accommodated different learning styles (90% of formal educator reviews, 93% of informal educator reviews), made connections to students' daily lives (88% of formal educator reviews, 90% of informal educator reviews), and built upon students' prior knowledge (91% of formal educator reviews, 87% of informal educator reviews). An overwhelming number of both formal and informal educator reviews (97%) indicated that students were interested in the lesson piloted.

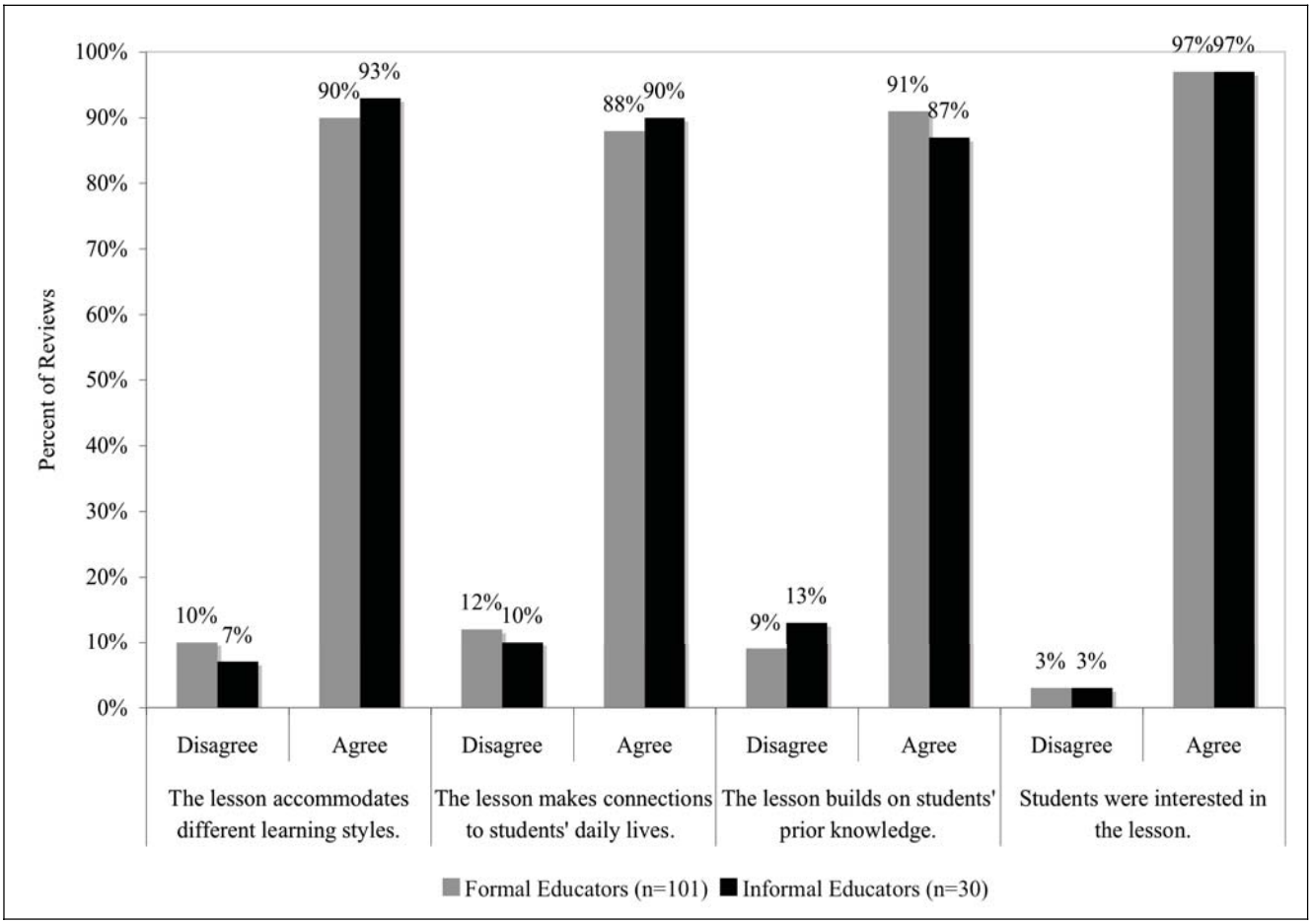


Figure 3: Educator Feedback on How Lessons Worked With Students

Educators were also asked to rate their level of agreement with two statements related to their overall satisfaction with the lessons they piloted. As illustrated in Figure 4, educators enjoyed teaching the lesson they piloted (95% of formal educator reviews, 93% of informal educator reviews) and would use the lesson again in the future (93% of formal educator reviews, 90% of informal educator reviews).

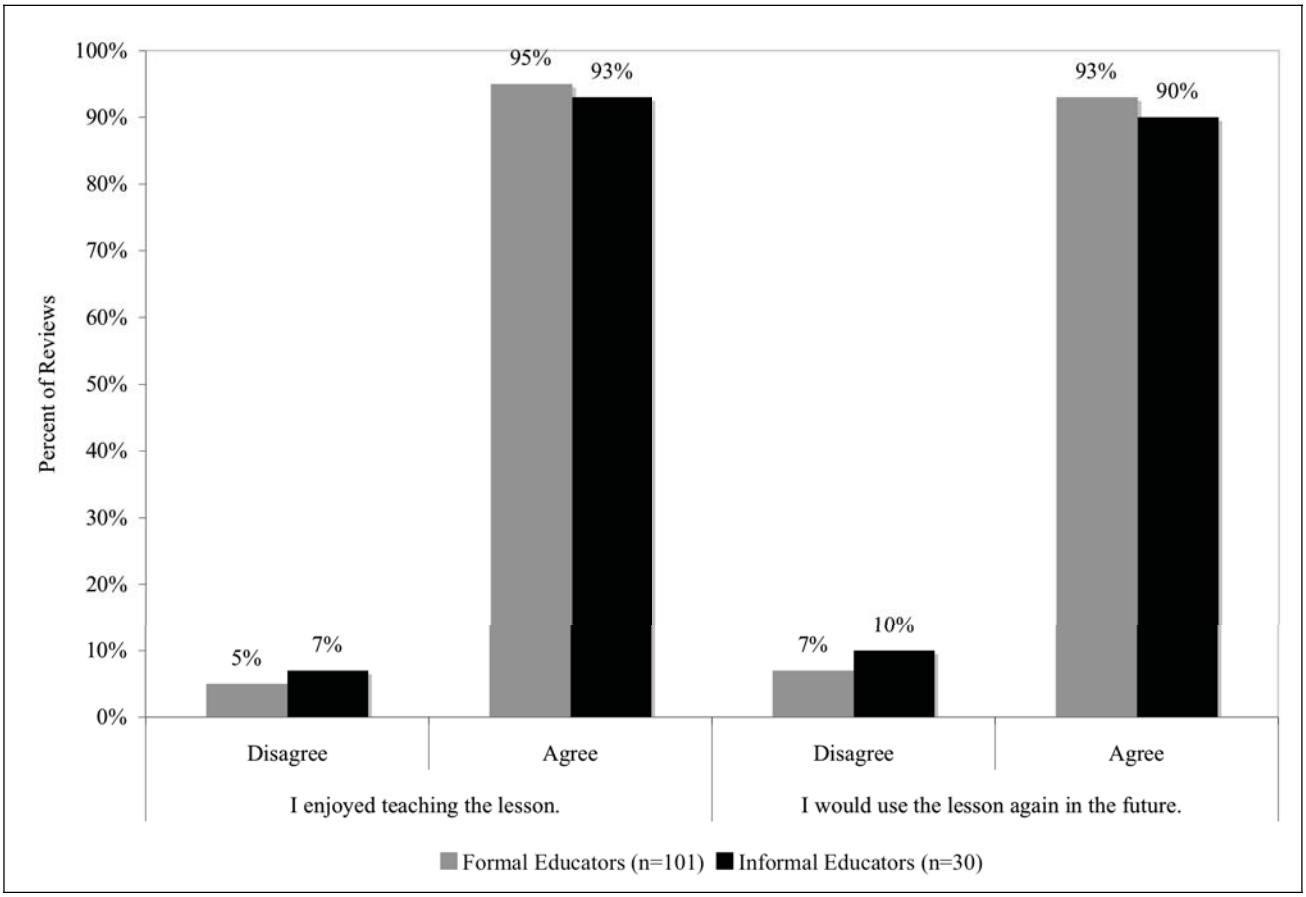


Figure 4: Educator Overall Satisfaction With the Lessons Reviewed

## Focus Group Data

Presented below is a condensed version of the results from the three formal educator focus groups, one informal educator focus group, and three individual interviews (one with a formal educator, two with informal educators). MinnAqua was presented with a more detailed version to make sure they saw the full range and depth of comments when deciding upon revisions and additions to the Leaders' Guide. Focus group data are presented here based on the following themes:

- Educators' experience with the Leaders' Guide
- Students' reaction to the Leaders' Guide
- Use of the Leaders' Guide to support Minnesota Academic Standards
- Suggested changes to Leaders' Guide
- Materials needed to implement MinnAqua lessons
- Dissemination and training of the Leaders' Guide

### *Educators' Experience with the Leaders' Guide*

#### *Educators' Overall Impression*

Educators were asked about their overall impression of the lessons they tested. There was favorable feedback from all educators with responses such as, *"overall all it was a lot of fun", "pleased with the quality of the lessons",* and *"it is going to be a wonderful resource".* A number of educators were uncomfortable with angling but did not find that to be a problem when implementing the lessons. *"I could understand the lesson. I could understand the background. I thought they were very usable lessons."* A few educators expressed appreciation that the Leaders' Guide was Minnesota-based and connected students to their local environment.

When discussing their overall impression of the Leaders' Guide, educators brought up some areas of concern. There were concerns about the amount of time needed to prepare lessons, finding materials for lessons, grade appropriateness of some of the lessons, and having to spend time providing students with background knowledge they lacked in order to pilot some lessons. Even with these concerns, many educators said they will utilize the lessons again. *"Anything worth doing takes a lot of time and a lot of material."*

*What Educators Learned*

Throughout focus groups and interviews, educators said they learned new knowledge by reading the background information and piloting the lessons. Two educators, who considered themselves avid outdoorsmen/women, were surprised at what they did not know. Many educators were excited about the new knowledge they acquired. *"Every one of these lessons I learned something new and had the opportunity to get excited….I was so excited that the excitement came out and the kids got excited."*

In one of the focus groups, educators discussed what they learned about their students by piloting the lessons. They were surprised at the lessons their students enjoyed the most and the amount of angling prior knowledge some of their students had.

*Shared Experience with Others*

All of the educators shared their piloting experience with other educators in some capacity. Some approached individuals they thought might be interested in the Leaders' Guide; others had educators ask them directly about MinnAqua. A number of teachers said educators in their building found out about the program from seeing fishing related materials in their classroom, observing them teaching MinnAqua lessons, and viewing student projects created for lessons. *"If you model something, that's how you get interest from other educators. Not from saying, 'Here's a good curriculum. I want you to work and try to fit it in.' That doesn't work so well. But if you can see what's being done, then curiosity comes, and that's how you spread the program."* In two of the focus groups, educators mentioned it was the students' excitement that sparked the interest and curiosity of other educators. Overall, educators felt individuals they talked to were interested in the Leaders' Guide. *"They were very interested. They had no idea that fishing could be tied into the science curriculum."*

*Students' Perceived Reaction to the Leaders' Guide*

All of the educators said their students enjoyed the lessons they piloted and stressed the high level of student engagement with the lessons. They contributed the students' engagement to the hands-on nature of the activities, the connection the lessons made to the local environment,

and the angling knowledge some students already had. In one focus group, a few metro area[10] educators discussed how the MinnAqua lessons provided an opportunity for students, especially those from diverse cultures, to become more involved in classroom activities by sharing their fishing experiences and knowledge with other students. *"What was neat for this was a lot of my kids, especially some of the kids that don't participate all that much or maybe try to participate and it doesn't work out for them, had a chance to be shining stars on some of this information."*

Students' requests to do MinnAqua lessons also illustrated the high level of engagement. A number of educators mentioned their students, as well as students from other classes, would inquire about doing MinnAqua lessons. One educator said he heard from parents that students were talking about MinnAqua lessons at home and asking if they could go fishing.

Educators were asked how MinnAqua lessons worked with English Language Learners and students with disabilities. These students enjoyed the lessons and the hands-on nature of the lessons worked well for them. A number of educators found putting students in groups of varying abilities was successful because students could help each other with the lesson. In two cases, the assistance of classroom aids helped students with disabilities participate in the lesson.

### *Use of the Leaders' Guide to Support Academic Standards*

Formal educators were asked how they felt the lessons were useful in supporting the Minnesota Academic Standards. All educators felt it beneficial to have the standards as part of each lesson because it saved them the work of having to align the lessons with the standards. In two of the focus groups, educators particularly liked that standards spanned the various disciplines, making it easy for lessons to cross curricular areas.

In one focus group, educators discussed the difficulties that might be encountered when trying to incorporate MinnAqua lessons into a district's regular curriculum, although they felt the presence of the standards will help gain support from administrators to use MinnAqua lessons in place of their regular curriculum. "*That gives the whole credibility in doing it [the curriculum]." "I can justifiably say these relate. It's not just something I'm doing for the fun of it so I get a half day to go fishing."*

[10] Metro area includes the seven counties of Anoka, Carver, Dakota, Hennipen, Ramsey, Scott, and Washington.

Throughout the focus groups, a number of educators said the lessons made doing the standards fun. *"I think most of us would like to get through this teaching the standards as painlessly as we can and if we can do something fun with the kids…that's much more inviting."*

### *Suggested Changes to the Leaders' Guide*

The following are educators' suggested changes to the Leaders' Guide in order of most frequently mentioned changes.

#### *Preparation Time and Activity Time*

Duration was an issue brought up throughout focus groups and on many critiques and questionnaires. Educators said the indicated preparation time was insufficient for many of the lessons. However, they felt it would be difficult to come up with an accurate time since the amount of preparation needed for a lesson depends on whether an educator has done the specific lesson before, the materials they need to collect and prepare, their prior knowledge with the lesson topic, and if their definition of preparation time includes finding and purchasing materials. Educators also pointed out that listing longer, more accurate preparation times may discourage some educators from doing the lesson.

Activity time was also variable, with many lessons running longer than stated. Many educators agreed that activity time is important to keep in the lesson, but needs to be as accurate as possible.

#### *Lesson Matrix*

In two focus groups and an interview, educators mentioned providing a matrix that could be used to create a cross-curricular unit of lessons spanning all chapters. Suggestions included creating matrices by activity time, concept, academic standards, season, and location of activity (indoors or outdoors).

#### *Lesson Identification and Index*

Throughout focus groups, educators expressed trouble identifying where the lessons fit back into the three-ring binder after they had removed them. This was due to the fact that the

draft lessons did not include the name of the lesson, chapter it belonged to, and page numbers. Educators in one of the focus groups also mentioned the need for an index to easily find lessons and corresponding copy sheets. MinnAqua had already planned for an index in the final layout of the Leaders' Guide but it was missing in the draft version.

*Lesson Layout*

Educators in the various focus groups provided suggestions of how to layout the lessons. Many comments stressed the need for the front page of the lesson to be eye-catching and include the information necessary to decide if an educator wants to do a lesson or not. *"I like the idea of listing the materials you needed on the front page and if there's any special circumstances--whether you need to be off-site, weather conditions--so you can look at it right away and say 'I can't do this right away. I'll file it away until later.'"*

*Written Length of Lessons*

Repeated throughout focus groups was the concern about the amount of time needed to have enough familiarity with the lesson's activity and background information to feel comfortable teaching the lesson. Two informal educators suggested creating lessons with less detail. *"Make the lessons detailed enough to provide some information but basic enough so I can look at it quick and it is ready to go."*

*Copy Sheets*

The topic of copy sheets came up in two of the focus groups and an interview. Some educators felt copy sheets should be uniquely identified throughout the Leaders' Guide, or as one educator suggested have a separate section specifically for copy sheets. If educators were unable to do a lesson because of weather, they felt copy sheets could serve as handouts to still cover the lesson topic. Some informal educators also said copy sheets could be given to kids to bring home after participation in a program.

*Kids' Book*

Classroom teachers thought the background information was valuable and many ended up sharing it with their students. In one focus group, educators suggested creating a kids'

version of the background information tailored to their reading level and comprehension. "*Flashy bits of information here and there that'll intrigue them. Almost a magazine with a picture and a caption that's easy to read."* Educators also felt having lesson-related information available for kids on the web would be beneficial.

*Age Appropriateness*

Some of the third grade teachers in one of the focus groups had a concern about the reading level of some of the lessons, specifically the lessons "The Lake Game" and "Fish Surveys". An informal educator also had a concern about the age appropriateness of some lessons and the amount of vocabulary and concepts introduced during a short program. "*Vocabulary was at times too difficult for (especially) 3rd graders as were some of the concepts. The information in the activities was not appropriate age wise for students. I guess it was maybe too many vocabulary words in some of the activities."*

*Sample Posters and Publications*

A number of lessons refer educators to publications, posters, or media available through the DNR. During one of the focus groups, educators suggested including sample images of the materials in the Leaders' Guide so they knew what they were requesting. They also wanted to know where they could obtain these materials and suggested making DNR contact information prevalent throughout the Leaders' Guide.

*Rubric*

A discussion came up in one of the focus groups about rubrics. Rubrics are an assessment tool used to score student's work based on various criteria and levels of quality from low to high for each of the criteria. All teachers in the focus group felt it beneficial to include rubrics for scoring the assessment activities included in each lesson. Rubrics were also seen as a tool to help document the standards their students were working on. Additionally, teachers felt rubrics would benefit their students by providing guidance of what they needed to accomplish to achieve a certain score. Teachers acknowledged they would probably change the rubric over time, but to have one up front "*would be a real luxury."* Many educators agreed rubrics would help sell the Leaders' Guide.

*Glossary*

During one of the focus groups, educators discussed the need for a glossary, especially for people unfamiliar with angling. MinnAqua mentioned at the introductory review team meeting that a glossary would be included in the final Leaders' Guide, which may explain why educators in other focus groups did not suggest a glossary.

*MinnAqua Participation Recognition*

Educators in one of the focus groups came up with the idea of providing students with something tangible to recognize the completion of a MinnAqua unit. *"I can sell it to my administration real quick. It aligns with the standards and they're getting certified from the DNR, and we're collaborating on this." "It's a recognizable goal that they can see that the child has actually successfully completed something."* Ideas for recognition included:

- A paper vest to put fish stickers on
- A small card, similar to a license, that they put stickers on
- A MinnAqua patch
- A sticker to put on a tacklebox
- A piece of tackle
- A discount coupon for an outdoors store

Educators liked the idea of a small license-like card best.

*DNR Information and Career Profiles*

In one focus group, a MinnAqua staff member asked educators about including career information in the Leaders' Guide. All educators liked the idea. They felt it would help students learn more about what the DNR does as well as provide exposure to various careers in the natural resources field. Ideas of how to incorporate this information into the Leaders' Guide included creating a lesson, video, or a separate book.

*History and Culture*

In two focus groups, educators suggested adding more history and culture into the lessons. Examples of content to add to the lessons included history of tackle, importance of fishing in the state, Native American issues, and human impact on the natural environment.

*Lesson Options*

Two of the informal educators wanted more options in the lessons such as age options, extensions, field trip ideas, and pre- and post-activities to give teachers who visit their site.

### *Materials Needed to Implement MinnAqua Lessons*

All of the educators felt difficulties finding materials could prevent individuals from teaching some of the lessons. *"I think if a teacher can't scare up a lot of the materials, they won't do the lesson."* Educators were concerned with the variety of materials needed for angling lessons since many educators do not already have those materials and would need to purchase them to do certain lessons. However, two informal educators felt finding materials may not be as big of an issue for them because they tend to already have many of the materials at their site or have a budget they can use to purchase materials. As shown below, educators had a variety of suggestions of what MinnAqua could do to address the concern of finding materials for lessons.

*Create Kits*

In three of the focus groups, educators felt MinnAqua could provide kits of materials for educators to check out. Some educators suggested focusing kits on lessons that require equipment most educators normally would not have or creating kits with materials to do a unit of various lessons. In one focus group educators talked about charging a fee for kits in order to replace materials as needed, although they said educators may complain about that. In another focus group, educators suggested making kits available to purchase from the DNR instead of through a check-out system.

In two focus groups, educators discussed obtaining equipment from places other than the DNR. They suggested that school districts could collect materials to create their own "kit" and have them available for all educators in their district. *"If there would be a possible person in the school to start developing and collecting and storing the equipment and having that as an access person ... That might be one step."* An informal educator said their organization already makes materials available for educators to check out and could have MinnAqua materials available as well.

In one focus group, educators suggested that MinnAqua direct educators to grants which could fund the purchase of materials to create their own kits. In two other focus groups

MinnAqua brought up the idea of the DNR providing grants for educators to purchase their own materials. Educators liked this idea and some felt, from MinnAqua's standpoint, providing grants would relieve MinnAqua from the burden of checking out and maintaining kits.

*Find Resources*

In two of the focus groups and one interview, educators were unsure of where to purchase materials and ask for donations. Some educators were able to find individuals knowledgeable in angling who could assist with lessons by sharing their expertise and/or bringing in fishing supplies. Educators felt the Leaders' Guide should include a listing of individuals, local conservation organizations, businesses, and fishing supply companies they could contact to obtain donations, discounts on materials, or help teach lessons. One educator mentioned her students could even write letters requesting materials. *"Great skill for the kids to be able to write to those companies – 'We're going fishing. Do you guys have samples?' You know, persuasive writing, letter writing."* In addition to information of how to obtain materials, some educators thought it would be beneficial if the Leaders' Guide included images of materials needed for lessons and estimates of how much they might cost.

During the focus groups, educators were asked if they utilized their local DNR office while pilot testing the lessons. Only five of the 22 educators contacted the DNR, although some educators mentioned they had utilized the DNR in the past by visiting a fish hatchery, contacting a Conservation Officer or fisheries staff person to visit the classroom, having a MinnAqua intern help with a program, and/or calling to request materials. Educators felt it would be helpful if MinnAqua could provide contact information for the state's fish hatcheries and names of various DNR staff willing to visit classrooms or help with lessons in other capacities. *"You hate to call somebody cold and try to explain yourself and the program and then ask for a favor, it would be better."*

*Provide Materials after Attending a Workshop*

Educators in two focus groups and an individual interview thought it would be advantageous to provide materials at workshops. They felt this could attract individuals to a workshop as well as make it easier to use lessons once educators returned to their educational

setting. Suggestions of materials to provide ranged from a set of fish posters to enough materials to carry out one lesson with a group of students.

*Encourage Kids to Bring Materials*

In one focus group, educators said they could ask their students to bring in some of the materials; specifically materials related to fishing since a large number of kids go fishing.

*Utilize Funding Sources*

Formal educators in one of the focus groups suggested that the DNR could work with teachers to help them utilize available funding sources for training and supplies. Educators mentioned various funds they have utilized.

*Identify Commonly Used Materials*

During an interview, it was suggested to create a list of materials for all lessons so educators can see which materials are used most often throughout the Leaders' Guide. *"…if you can only afford so many items we recommend these items to start and be able to do this much of the curriculum… Then if I was going to go out and collect them I would probably start with the items that are used the most often."*

*Dissemination and Training of the Leaders' Guide*

The following are suggestions provided by educators on how to disseminate the Leaders' Guide through educator workshops.

*Recruitment*

Educators had a wide range of suggestions on where MinnAqua could advertise their workshops. In all of the focus groups, ideas were provided of various conferences and events in which to advertise workshops and/or offer them. During one focus group, educators suggested MinnAqua have a presence at various outdoor shows and/or the state fair through either mini-workshops or a booth. Educators saw these events as an opportunity to reach a wide range of individuals including scout leaders, 4-H leaders, educators (especially those that may not go to regular educator workshops) and parents who could pass on the information to their child's

teacher or group leader. In one focus group, educators suggested getting buy-in from school administrators. They felt district support may help get educators to workshops and increase the likelihood of MinnAqua lessons being used in their classroom.

*Other Considerations for Advertising*

Educators had additional considerations regarding advertising. In two of the focus groups, educators suggested including sample lessons in advertising materials. They thought seeing an actual lesson might spark educators' interest in attending a workshop. Educators in one of the focus groups said to tailor advertising around a particular local aquatic resource and focus on how the Leaders' Guide could help utilize that resource. A few educators suggested using quotes from pilot testing in marketing materials because they felt their experiences may attract other educators to a MinnAqua workshop.

*Workshop Location*

Educators suggested a variety of locations to hold workshops. In two focus groups, educators stressed the importance of making workshops accessible to all educators by holding them throughout the state. Educators also mentioned having workshops near a water body that could be utilized during the workshop. In one focus group, educators suggested holding trainings at various environmental learning centers. These trainings could focus on training the learning center staff in addition to the public.

*Incentives*

During a focus group and interview, educators said part of selling the Leaders' Guide is letting educators know what they and their students will get out it. *"When I go look at new curriculum or when I look into seeing something new, I want to feel little something about, 'Well what am I going to get out of this curriculum? Why should I use this in my classroom? What's going to be exciting to my students?'"*

In one focus group, educators felt providing credit could draw people to workshops. They thought MinnAqua could work with a local college/university to offer credits for both pre-service and in-service teachers who attend a workshop. Additionally, educators suggested that

MinnAqua consider offering continuing education credit for a MinnAqua training held as part of a school's staff development.

*Cost*

At one focus group, educators said the cost of a workshop may prevent teachers from attending; especially if administrators are the ones trying to find money to pay for the workshop. Providing grant money for educators to attend workshops was one suggestion of how cost could be addressed. Informal educators were asked if cost was an issue for them. Some of the informal educators said they did not have a problem paying for workshops if they can apply what they learn to their work.

*Workshop Format*

Educators stressed the need for workshops to be "hands-on" and include an opportunity to try out lessons. Many educators liked the format of the initial MinnAqua training they received before pilot testing the Leaders' Guide. They appreciated the opportunity to walk through the lesson format, try lessons, and share ideas of how lessons could be used in various educational settings. Educators also felt it would be beneficial for workshops to include a discussion of how lessons address the Minnesota Academic Standards.

Educators provided a variety of suggestions on the types of lessons to use in a workshop. In one focus group, educators suggested using lessons of high interest during a workshop to get educators excited about the Leaders' Guide. *"Can I take it back and do it tomorrow?"* In another, educators felt workshops should include some of the more complex lessons so educators could see how they are done. *"It's easy to see a Pop Can caster. That's easy to do, but some of these more difficult ones, you'd like to see how logistically they can all be put together and carried through."* Educators in one focus group also thought it would be helpful for educators to critique lessons in addition to trying them out (similar to what they did during the initial review team training). *"Not just keying in on the activity, the objective, and the summary. It made me go through and see the whole picture … it helped me identify where things were in the lesson…it made me see the work that had been done and put into it."*

One educator had the idea of setting up an in-depth training where people could go to various sessions. *"Somewhat like going to a science convention where you could pick and*

*choose."* Someone also suggested that attendees to longer, in-depth trainings could become facilitators for future workshops.

*Post-Workshop Support*

Formal educators were asked about the usefulness of a regional contact teacher. MinnAqua envisioned contact teachers delivering support and answering questions about lesson supplies, instructional best practices, standards alignment, assessment methods, subject content, and any other questions, concerns or ideas educators would have after attending a workshop. These teachers could also have kits available to check out. Formal educators thought contact teachers would be a beneficial feature of the MinnAqua program. *"I think that could make or break your program."* They saw contact teachers being most valuable in helping them through rough spots, providing suggestions on how to adapt an activity, and either having materials available to check out or helping locate materials. Educators stressed the value added by being able to talk to both MinnAqua staff and someone who is actually working in the classroom.

In addition to contact teachers, one focus group discussed creating an online support network where conversations could occur between educators using the Leaders' Guide as well as with MinnAqua staff. *"See what other people are doing with this, what frustrations, what are they thinking....Or I have the best idea. I wish I could share it." "Getting a lot of other ideas to go along with the lesson other than what's on the paper."* They felt online support may increase educator use of the Leaders' Guide after the initial workshop and the conversations about the use of the Leaders' Guide may get other educators interested in attending a workshop.

*Summary of Focus Group Results*

Educators provided a variety of focus group feedback. They commented on their overall impression of the Leaders' Guide, the new knowledge they acquired from the lessons, who they shared their piloting experience with, their students' perceived reactions to the lessons, and the usefulness of the lessons in supporting Minnesota Academic Standards. The bulk of educators' feedback was suggested changes to the Leaders' Guide. Educators suggested modifications to the lesson format related to preparation time, activity time, a lesson's front page content, written length of lessons, copy sheets, rubrics for lesson assessments, and age appropriateness of some lesson content. Educators also recommended adding various features to the Leaders' Guide such

as lesson matrices, identification text on each page, an index of lessons, a kids' book, sample posters and publications, a glossary, participant recognition program, DNR information and profiles, more historical and cultural information, additional field trip ideas, and pre- and post-visit activities for informal educators to give classroom teachers.

In addition to providing suggestions on how to make the Leaders' Guide easier to use and more instructionally sound, educators provided suggestions on how to address potential difficulties in accessing materials needed to implement lessons. Suggestions included making kits available through the DNR, providing resources for educators to create their own kits, assisting educators in locating materials, providing materials after attending a MinnAqua workshop, encouraging students to bring materials from home, directing educators to available funding sources, and identifying commonly used materials across lessons.

Once the Leaders' Guide is published, it will be disseminated to educators through workshops. Educators provided insight into means for recruiting educators to these workshops. They also offered suggestions on how to structure the workshops, where they should be held, what to charge for attending a workshop, what types of incentives to offer, and how to provide post-workshop support.

## Fisheries Staff Feedback

Feedback from MinnAqua Liaisons focused mainly on the scientific accuracy of angling, aquatics, and fisheries management information in the lessons. However, since Liaisons allocate 5% of their time to educational outreach, they were also asked to comment on their ability to use the lessons they were reviewing in their outreach programming. MinnAqua acknowledged that Liaisons would find some lessons difficult to adapt to meet their needs since outreach activities and audiences varied for each Liaison. MinnAqua plans to address these difficulties in future trainings by providing Liaisons with ideas on how they can adapt lessons to use with their unique audiences.

Liaisons each reviewed two lessons; resulting in a total of 64 Liaison reviews. As illustrated in Figure 5, 66% of the time Liaisons' responded that they could use the lesson they reviewed in their educational outreach efforts. They felt the lessons were well written, seemed easy to use, provided a fun means to teach important topics, and could address certain concepts they regularly cover in their programming. Liaisons acknowledged that they may not always use

the lesson as written because of time constraints, age of participants, and/or the size of a group, but they felt they could adapt the lesson or integrate pieces of it into their programming.

On one-third of the reviews (31%), Liaisons said they would not use the lessons they reviewed in their outreach efforts. A variety of reasons were cited including: the lesson topic would not fit with their outreach programming, the lesson would be difficult to do with the size and/or age of the groups they usually work with, they would not have enough time with their audiences to be able to complete the lesson, the lesson seemed more appropriate for a classroom than an outdoor setting, and they did not have the computer access required to carry out some of the lessons. There were some cases in which Liaisons acknowledged that although they would not utilize the entire lesson in their outreach programming, they could possibly use parts of a lesson for a demonstration or to frame a discussion about fishing regulations.

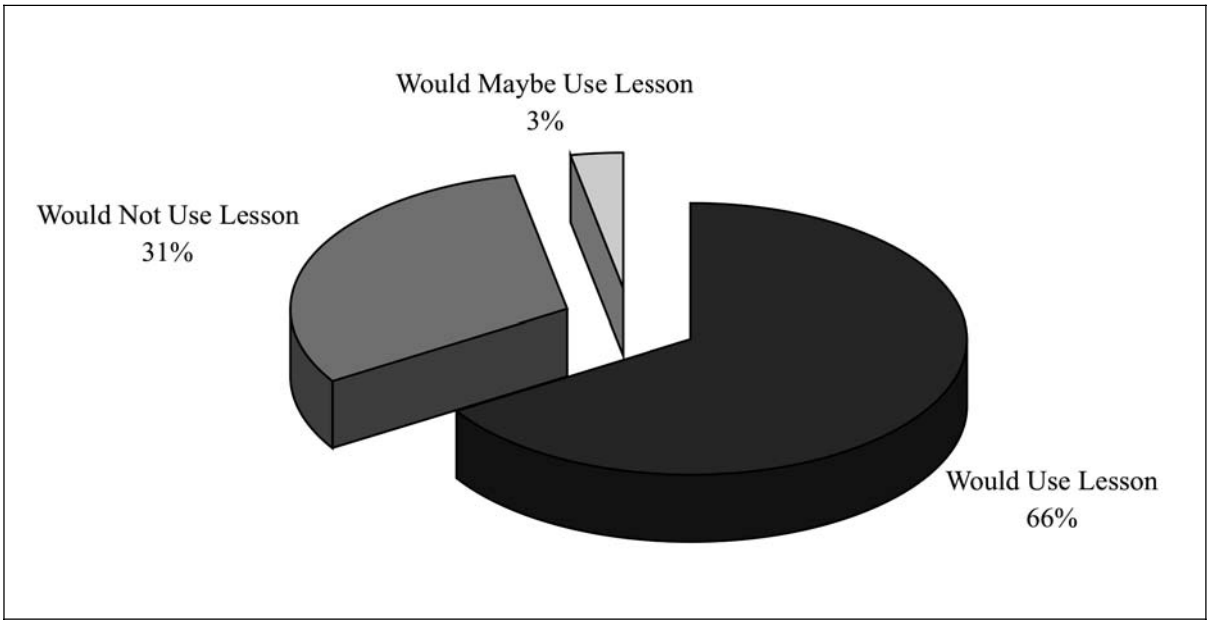


Figure 5: Liaisons' Potential Use of Reviewed Lesson in Outreach Efforts (n = 64)

A number of Fisheries Program and Management staff also provided feedback on the accuracy of policy and regulation information in the lessons. Suggestions were provided to ensure definitions in the lessons aligned with definitions in Minnesota's rules and regulations, fisheries management information was accurate, content was consistent with the DNR's views on various stewardship issues, fisheries management issues reflected the current political and social climate, and lessons included aquatic stewardship behaviors.

## STAGE ONE: DISCUSSION

### MinnAqua Leaders' Guide Addressing the Rewrite Guidelines

The first evaluation question was, "To what extent are MinnAqua's rewrite guidelines addressed in individual lessons and the Leaders' Guide as a whole?" Discussed below are the major findings and recommendations from Stage One which describe the extent to which the rewrite guidelines were addressed in the Leaders' Guide and what changes could be made to more fully address the guidelines.

#### *Major Findings*

Overall, educators had positive feedback about the Leaders' Guide in relation to the rewrite guidelines. As apparent from the rating scale results, educators felt the lessons were easy to understand the first time they read them, built on students' prior knowledge, made connections to students' daily lives, and accommodated students' variety of learning styles. The high level of educator agreement provides evidence that these guidelines were adequately addressed in the lessons.

Following the rewrite guidelines, MinnAqua added biology background information to each lesson. This resulted in some lessons being over 20 pages in draft length. As illustrated in the rating scale data, educators often felt the length of the lesson would not turn them off from using the lesson.

As planned for in the rewrite guidelines, MinnAqua lessons listed the Minnesota Academic Standards for Science, Math, Language Arts and Social Studies that aligned with the lesson content. Educators appreciated the inclusion of the standards because it saved them the work of having to align the lessons with the standards themselves. The variety of standards made it easy for educators to teach across disciplines, providing evidence that the rewrite guideline, "including interdisciplinary lessons", was addressed. Additionally, educators felt the inclusion of academic standards would help gain administrative support to integrate MinnAqua lessons into their regular curriculum.

MinnAqua also addressed the rewrite guidelines by creating hands-on lessons that could be used with varying group sizes. Educators contributed the hands-on nature of the lessons to the high level of student engagement and ease of use with students of varying abilities.

Additionally, educators felt the inclusion of both individual and group activities helped ensure the success of all students, particularly students with disabilities and English Language Learners, by providing opportunities for students to work together and learn from one another.

*Recommendations*

Recommended revisions were generated based on Stage One results. The recommended changes were intended to increase the extent to which the rewrite guidelines were addressed. The recommendations were also meant to address the second evaluation question by increasing the extent to which educators' needs are met. Recommendations included:

1. Revising specific lessons where concepts, vocabulary, and overall reading level were not developmentally appropriate for grades 3 – 5. This would help to more fully address the rewrite guideline, "ensuring activities are developmentally appropriate and build on students' prior knowledge." After incorporating changes, it is recommended to pilot the revised lessons with students.
2. Developing rubrics for each lesson to add value for educator use of the Leaders' Guide. Adding rubrics would also increase the utility of the authentic assessment ideas added to the lessons per the rewrite guidelines.
3. Making sure the "Preparation" section of a lesson includes enough detail so educators can plan their prep time accordingly. This would replace the lesson "Preparation Time", which varied significantly for educators. Even though most educators found the lesson plan format easy to follow, this change would help to more fully address the rewrite guideline of "better defining steps and procedures for lesson implementation".
4. Creating matrices to make it easier for educators to develop units out of MinnAqua lessons based on standards, topics, season, and activity time. The matrices will help to address the guideline, "creating lessons to stand alone or be used as part of a unit".
5. Developing a standardized method to identify copy sheets throughout the Leaders' Guide and listing their location in an index or table of contents. This recommendation allows MinnAqua to go beyond the guideline of "improving the appearance of graphics and copy pages", by making the improved copy pages easier for educators to use.

## MinnAqua Leaders' Guide Meeting the Needs of Intended Users

The second evaluation question was, "To what extent does the Leaders' Guide meet the educational needs of intended users in both formal and informal education settings?" Discussed here are the major findings from Stage One which describe the extent to which the needs of formal and informal educators were met by the Leaders' Guide along with recommendations on how to more fully meet those needs.

### *Major Findings*

Educators had a favorable impression of the Leaders' Guide. As apparent from the rating scale results, most educators enjoyed teaching the lessons, thought the lesson format was easy to follow, would use the lessons again in the future, and felt lessons would fit into their regular curriculum. Educators were excited about the new knowledge they acquired, even those who considered themselves avid anglers. Educators unfamiliar with angling did not find their lack of experience a barrier to implementing lessons, but an opportunity to bring in guest speakers to assist with a topic.

All of the educators said their students seemed to enjoy the MinnAqua lessons; stressing the high level of student engagement they observed. They contributed their students' engagement to the hands-on nature of the activities, the connection the lessons made to the local environment, and the prior angling knowledge of some students. Students already familiar with fishing were able to share their skills and knowledge with classmates, which as described in a metro area classroom, gave some students who might not otherwise actively participate in class, a chance to shine.

### *Recommendations*

Recommended changes were also provided to increase the extent to which the Leaders' Guide meets the educational needs of formal and informal educators.

Recommendations included:

1. Adding extension ideas suggested in critiques because informal educators appreciated a variety of extensions in a lesson.
2. Creating a kids' version (print or online) of some of the lessons' background information since educators often shared this information with their students. Information about the DNR

and aquatic-related careers could also be included to more fully address the rewrite guideline, "featuring content specific to Minnesota culture, natural resources, and fisheries management."

3. Creating a recognition program for students' receiving instruction of MinnAqua lessons. As educators stated, it may help engage students and serve as a selling point for administrators. A recognition program could also be tied in with tracking student participation in MinnAqua and related educational outcomes.
4. Availability of Leaders' Guide information either online or on a CD-ROM. Information accessible digitally could include sample lessons, links referred to in lessons, suggestions of where to find materials, contact lists, online support from other educators and MinnAqua staff, training schedules, and lesson updates.
5. Making it easier for educators to obtain resources for lesson implementation by various means such as:
    - Providing free materials during trainings (posters, books, etc) to help educators implement lessons they may otherwise lack materials for.
    - Creating kits of materials for educators to check out or purchase.
    - Providing grants for educators to obtain their own supplies.
    - Developing a list of individuals, organizations, and businesses willing to provide supplies or assist educators with teaching lessons.
    - Supplying contact information for DNR staff willing to visit classrooms, provide materials, or help with lessons in other capacities.

## Dissemination and Training of the Leaders' Guide

In addition to providing feedback on the Leaders' Guide, MinnAqua turned to educators for ideas on how to disseminate materials through workshops. Drawing from educators' feedback, recommendations were provided to help guide the dissemination and training of the Leaders' Guide. These recommendations also address the second evaluation question because trainings must meet educators' needs to ensure educators will feel confident in using the Leaders' Guide after they leave the training. These recommendations included:

1. Making it easy for educators to access trainings by holding them throughout the state.
2. Attending a wide variety of conferences, meetings, and shows to advertise workshops.

3. Marketing to educators whose educational setting is located near a water body, focusing on how MinnAqua lessons could help them utilize their local aquatic resource.
4. Finding ways to connect educators who already have an interest in fishing with MinnAqua.
5. Marketing the ease of use of the Leaders' Guide for educators who do not have a strong science background or prior interest in fishing.
6. Using testimonials from educators stating how the Leaders' Guide worked in their educational settings as a means to focus marketing to specific intended users.
7. Including a sample lesson with advertising materials to peak educator interest in learning more about the Leaders' Guide.
8. Gaining educator interest by highlighting the value of the Leaders' Guide in helping to address Minnesota Academic Standards and engaging students by connecting with their prior knowledge and experiences.
9. Providing credit for attending a workshop, such as teacher renewal credits or college credit. Educators thought this extra incentive might be enough of a draw to get individuals to workshops who might not otherwise be interested. Providing credit can also help gain administrative support.
10. Making workshops as hands-on as possible, with plenty of opportunities to try out the lessons. Ideally, workshop locations should be near water bodies so the hands-on experiences can include angling lessons.
11. Creating an activity to do during a workshop, similar to the act of critiquing a lesson. This provides an opportunity for educators to become familiar with the various lesson components.
12. Designing workshops so educators leave feeling confident in their ability to use the Leaders' Guide. Workshops should include a variety of lessons to show the ease in which lessons can be implemented, especially those that may seem complex at first glance. However, the most complicated lessons should be avoided in workshops to prevent intimidating educators. Extended workshops could also be held to provide in-depth coverage of angling and aquatic topics that may be unfamiliar to educators with limited angling experience.
13. Training educators to facilitate their own MinnAqua workshop.

14. Providing post-workshop support by creating regional MinnAqua-trained contact teachers and developing a web site where educators, as well as MinnAqua staff, can have online discussions related to lesson implementation.

## Changes to Leaders' Guide Before Stage Two

MinnAqua used the raw data, major findings, and recommendations from Stage One to guide revisions to the Leaders' Guide before Stage Two of the evaluation. MinnAqua examined a variety of factors when determining what feedback to incorporate. First, MinnAqua considered who the feedback came from and what type of feedback that reviewer was asked to provide. Comments about using the lesson with students had more weight if it came from educators who had piloted the lessons than Liaisons who were making inferences on how a lesson might work with students. Similarly, educators' comments about the accuracy of scientific content were compared to Fisheries Liaisons' feedback before changes were incorporated. For the most part, technical comments from Fisheries Liaisons were incorporated to ensure the scientific accuracy of the lessons and more fully address the corresponding rewrite guideline.

Secondly, MinnAqua kept their mission[11] in mind throughout the rewrite process. Any changes that would steer the lesson away from the mission were given thorough consideration but usually not incorporated into the lesson.

Finally, MinnAqua developed rewrite guidelines to guide the creation of a quality educational product. These guidelines were considered when deciding whether to add or remove lesson content. Most often changes were made that would strengthen the extent to which the guidelines were addressed and thus increase the educational quality and utility of the Leaders' Guide. For example, rubrics were added to increase the utility of the assessments for educators.

All lessons underwent some form of revision, but most revisions did not significantly change the lessons from what was tested. Instead, revisions focused on making lesson components easier to understand, helping to ensure the scientific accuracy of information, and increasing the usability of the Leaders' Guide for intended audiences.

[11] MinnAqua's mission is to "provide life-long educational programming that will increase people's knowledge and understanding about aquatic ecosystems, management, and resource issues; help acquire skills related to aquatic recreation, careers, and teaching; and foster a better stewardship of the state's natural resources" (Minnesota Department of Natural Resources, 2002).

There were, however, two lessons that received substantial changes as a result of Stage One feedback. These lessons were "From Frozen to Fascinating" which examines the organisms that emerge from a thawing sediment sample collected from a local water body and "The Lake Game" where students role-play situations affecting a local lake. A variety of educators expressed frustration with the lack of organisms that emerged during "From Frozen to Fascinating". In some cases, this resulted in decreased interest in the lesson from both students and educators. Revisions were made to help avoid common frustrations and increase interest. The first revision addressed issues which were a result of educators collecting samples from aquatic areas not ideal for finding high numbers of aquatic organisms. Instructions for collecting soil and water samples were revised to clarify where samples should be obtained to help increase the likelihood of observing a variety of organisms. Secondly, some frustrations were a result of incorrect assumptions of the diversity and number of organisms that would emerge over the course of the lesson. To address this, MinnAqua created a reference guide of common aquatic organisms that might emerge, since the lesson did not make this explicit. The concerns with "The Lake Game" were related to the advanced wording of the student cards for grades 3 - 5. As a result, MinnAqua rewrote some of the cards to make them more age appropriate. After incorporating changes, MinnAqua did not pilot these lessons a second time to see if educators' concerns were adequately addressed. Instructional design experts reviewed these lessons so they were able to offer some feedback, but as Beyer (1995) notes, without a second pilot test it cannot be assumed the revisions resolved the problems.

There were a number of features recommended by educators that MinnAqua had already planned for in the Leaders' Guide, but were unable to complete before Stage One. These features included a glossary; information about the history of fishing in Minnesota; a lesson's first page formatted to contain information necessary for educators to decide if they want to do a lesson; and lesson pages labeled with the name of the lesson, chapter, and page number. Educators' feedback validated the necessity to include these features, which were incorporated before Stage Two reviews.

## STAGE TWO: METHODOLOGY

A second round of reviews was carried out upon completion of revisions to the Leaders' Guide. Based on the goal of the evaluation, the literature, and the Best Practices, the three goals for Stage Two were 1) verification of the educational content of the Leaders' Guide by instructional design experts, 2) increased support from various educational outreach partner organizations and identifying future partnership opportunities, and 3) working with an accessibility expert to address inclusion of individuals with physical disabilities in MinnAqua lessons.

All reviewers during Stage Two were given approximately two months to complete the review, although some reviews took up to four months. The time commitment varied for each reviewer based on the information requested, the number of lessons they had to review, and how carefully they needed to review each lesson in order to provide feedback. Reviewers were provided with background information about MinnAqua, the new Leaders' Guide, and the evaluation process in order to make sure they had a clear understanding of the evaluation's purpose and the importance of their role in the review. The evaluator then met with reviewers or contacted them by phone to ensure they were comfortable with their tasks for the review and to answer any questions about the evaluation. Incentives for reviewers during Stage Two were either a $100 honorarium or $100 in fishing supplies for their program use, acknowledgement in the Leaders' Guide, and a copy of the Leaders' Guide upon publication. The specifics of the three types of reviews are described below.

### Instructional Design Expert Review

Educational content had to be accurate to ensure a quality Leaders' Guide. For this reason, instructional design experts were included in Stage Two to verify the Guide's instructional content. Content areas verified by instructional design experts aligned with the rewrite guidelines (see Table 4) and included service-learning components and resources; K-2 options; objectives, assessments and rubrics; Minnesota Academic Standards; and Minnesota's *Environmental Literacy Scope and Sequence*.

Table 4: Instructional Design Expert Reviewers and Rewrite Guidelines Addressed

| Content Area of Review | Rewrite Guideline Addressed | Expert's Title |
|---|---|---|
| Service-Learning Components | Adding service-learning ideas. | • Service-Learning Specialist, Minnesota Department of Education |
| K-2 Options | Including ideas on how to adapt lessons for use with grades K-2. | • Kindergarten teacher<br>• Second grade teacher, Minnesota Science Teachers Association Elementary Representative, President of Society of Elementary Presidential Awardees, Member of MDE's Quality Teaching Network |
| Objectives, Assessments, Rubrics | Including measurable objectives and authentic assessment ideas. | • Two Science Assessment Specialists, Minnesota Department of Education<br>• Two Language Arts Assessment Specialists, Minnesota Department of Education<br>• Two Math Assessment Specialists, Minnesota Department of Education |
| Minnesota Science Academic Standards | Aligning with the 2004 Minnesota Academic Standards. | • District Science Chair, Member of MDE's Quality Teaching Network<br>• Catalyst Science Coach, Member of MDE's Quality Teaching Network |
| Minnesota Social Studies Academic Standards | Aligning with the 2004 Minnesota Academic Standards. | • District Secondary Curriculum Coach (Former Social Studies Specialist for Minnesota Department of Education) |
| Minnesota Math Academic Standards | Aligning with the 2004 Minnesota Academic Standards. | • Principal, Member of MDE's Quality Teaching Network |
| Minnesota Language Arts Academic Standards | Aligning with the 2004 Minnesota Academic Standards. | • Second grade teacher, Member of MDE's Quality Teaching Network<br>• Middle School Lead<br>• English teacher, President of Minnesota Council of Teachers of English |
| Environmental Literacy Scope and Sequence | Aligning with Minnesota's *Environmental Literacy Scope and Sequence*. | • Education Specialist, Minnesota Office of Environmental Assistance |

Instructional design expert reviewers were chosen using a purposive sampling technique. As described in Stage One, purposive sampling techniques provide a deep understanding of the object under study by selecting individuals most informative to the study's goals (Neuman, 2000; Patton, 1990). A purposive sample of instructional design experts was obtained based on individual's expertise of a specific educational content area, which corresponded to one of the rewrite guidelines. (See Table 4 for a listing of instructional design experts, the content area they reviewed, and the rewrite guideline addressed.) Instructional design experts were recruited from the Minnesota Department of Education (MDE), MDE's Quality Teaching Network[12], school district offices, and state education organizations. In some cases more than one expert was chosen for a content area because the review involved delving into all 39 lessons, which would have been a substantial task for one reviewer in the allotted time. The number of instructional design experts was limited to no more than three individuals per content area to help avoid contradictory and counterproductive as recommended in both Tessmer (1993) and Weston (1987).

As suggested in Tessmer (1993) and Weston et al. (1995), reviewers were only asked about their area of expertise and given a set of questions specific to the educational content area they were asked to review. They were not asked about areas in which they were novices, nor were they asked to predict how lessons would work with students. (See Appendix H for review instructions for each type of instructional design expert.)

### Educational Outreach Partners Review

The Best Practices stress the involvement of stakeholders throughout program development, with an emphasis on developing partnerships to strengthen a program (Seng & Rushton, 2003). To increase the likelihood that the Leaders' Guide would be a useful tool for various organizations MinnAqua had partnered with in the past, they recognized the value of including these partner organizations as part of the formative evaluation process. For this reason, the goals for the educational outreach partner review were to gain approval and support for the

[12] The Minnesota Department of Education's Quality Teacher Network is composed of "educators who are selected on the basis of their content knowledge, pedagogical skill, leadership and professional development experience". These educators, with the support of MDE's content specialists, serve districts through professional development, resource development, and implementation of research-based instructional practices (Minnesota Department of Education, n.d.).

Leaders' Guide, identify future partnership opportunities, and give partners an opportunity to provide feedback if they desired.

For the partner reviews, MinnAqua identified the organizations they wanted to review the Leaders' Guide and gave suggestions of individuals within these organizations. Suggested reviewers were individuals who would most likely be responsible for utilizing the Leaders' Guide with their organization. (Table 5 lists the educational outreach partner reviewers.)

Table 5: Educational Outreach Partner Reviewers

| Partner Organization | Reviewer's Title |
|---|---|
| Junior Girl Scouts | • Director of Council Services, Girl Scouts Peacepipe Council |
| Cub Scouts | • Cub Scout Leader, Indianhead Council |
| 4-H | • Extension Educator, University of Minnesota Extension Center for 4-H Youth Development |
| University of Minnesota's Water Resources Center | • Water Resources Education Coordinator, University of Minnesota Water Resources Center & Sea Grant Program |
| Great Lakes Aquarium | • Director of Education, Great Lakes Aquarium |
| Sporting Goods Stores | • Aquarium Curator, Cabela's<br>• Retail Marketing Coordinator, Gander Mountain |
| Recreational Boating and Fishing Foundation | • President, Recreational Boating and Fishing Foundation |
| Minnesota Department of Natural Resources Education | • DNR Education Coordinator, Minnesota Department of Natural Resources |

Reviewer tasks varied depending on the stakeholder. MinnAqua created correlation matrices for Junior Girl Scouts, Cub Scouts, and 4-H which identified correlations between MinnAqua lessons and the organizations' activity requirements. The intent was that MinnAqua would be used as a supporting tool, not a replacement for their educational materials. To

understand the utility of the matrices and provide data to answer the second evaluation question, individuals from these organizations were asked to review their organization's matrix for ease of use, comprehension, and accuracy. (See Appendix I for reviewing instructions for all educational outreach partners.) Great Lakes Aquarium, Cabela's, Gander Mountain, and the University of Minnesota's Water Resources Center all reviewed the Leaders' Guide and provided documentation on how it could be used to strengthen both their outreach efforts and future partnerships with MinnAqua. Feedback from these educational outreach partners gave insight into how useful the Leaders' Guide might be in these unique education settings, again providing data for the second evaluation question. The individual from the University of Minnesota's Water Resources Center also reviewed the water stewardship chapter (Chapter 3), because it included lessons MinnAqua had adapted from the Water Resources Center's lessons. In addition, MinnAqua wanted to use the Water Resources Center's expertise to verify that aquatic information was presented with fairness and accuracy, one of the rewrite guidelines.

The rewrite guidelines were created taking into consideration the RBFF's Best Practices and state of Minnesota education plans. To ensure that the Best Practices and state plans were sufficiently addressed by the Leaders' Guide, individuals from educational outreach organizations representing each entity reviewed the guide. The president of the Recreational Boating and Fishing Foundation reviewed the Leaders' Guide and provided supporting documentation of how MinnAqua addressed the Best Practices throughout the Leaders' Guide. Approval and support of the Leaders' Guide was sought from DNR staff outside of the Division of Fish and Wildlife by identifying how MinnAqua supports *A GreenPrint for Minnesota: State Plan for Environmental Education* and meets DNR education goals outlined in the *2000 Cornerstones Report* and *A Strategic Conservation Agenda 2003-2007*[13].

## Accessibility Expert Review

The Best Practices state that effective programs strive to be inclusive of individuals with disabilities by decreasing constraints to involvement (Seng & Rushton, 2003). To address these Best Practices and make MinnAqua lessons inclusive of all intended users, an expert familiar with making environmental education and outdoor recreation activities accessible was contacted.

[13] *A Strategic Conservation Agenda 2003-2007*, the DNR's strategic plan, demonstrates accountability to Minnesota's citizens and lays out indicators and targets for continued improvement (Minnesota Department of Natural Resources, 2005).

He reviewed the Leaders' Guide and determined how best to address accessibility in individual lessons and/or the Leaders' Guide as a whole. The accessibility expert's participation addressed the second evaluation question by ensuring educators could be inclusive of all students when carrying out MinnAqua lessons.

## Data Analysis and Reporting For Stage Two

### *Instructional Design Experts*

Each instructional design expert provided feedback specific to his or her educational content area, so data were not compiled for each lesson as in Stage One. Instead, the data from each lesson were given directly to the MinnAqua Education Specialist responsible for incorporating comments for specific educational content areas. (For example, one Education Specialist was responsible for reviewing and incorporating feedback from the instructional design expert looking at K-2 options.) After reviewing feedback from their assigned experts, MinnAqua Education Specialists scheduled one-on-one follow-up meetings to clarify suggestions and ask any additional questions. The Education Specialists also asked some of the experts for ideas on how to disseminate the Leaders' Guide and structure workshops, since most instructional design experts were also involved in professional development activities for educators.

### *Educational Outreach Partners*

Two types of feedback were received from educational outreach partners: feedback on matrices and letters of support. Some partners provided feedback on correlation matrices developed for their organization. Again, after the individual MinnAqua Education Specialist responsible for a particular matrix reviewed the feedback, they had one-on-one meetings to discuss the utility of the matrix for the partner organization. During these meetings, educational outreach partners were also asked for ideas on how to disseminate the Leaders' Guide to their organization.

Other educational outreach partners provided letters of support for the Leaders' Guide and future partnership efforts. This feedback was given directly to MinnAqua for follow-up with the organizations to identify ways to strengthen partnerships. With reviewers' permission,

MinnAqua may also include excerpts from the letters of support in the Leaders' Guide to help strengthen the value of the guide for various stakeholder groups.

### *Accessibility Expert*

The accessibility expert had extensive experience in adapting lessons to be inclusive of individuals with physical disabilities in informal education settings. Based on this experience, he created planning documents for the Leaders' Guide that aid educators in adapting any MinnAqua lesson for use with individuals with physical disabilities. MinnAqua reviewed the documents and set up a follow-up meeting with the accessibility expert to discuss any questions and proposed changes before including the documents as an appendix in the Leaders' Guide.

## STAGE TWO: RESULTS

### Feedback From Instructional Design Experts

As stated earlier, comments from each instructional design expert were specific to his or her area of review and were given directly to the appropriate MinnAqua Specialist upon being received. Provided below are overviews of the type of feedback obtained from each of these experts.

#### *Service-Learning Components and Resources*

The service-learning expert was impressed with the service-learning section created for the Leaders' Guide. Suggested revisions were minor, mainly focusing on changes in wording. However, the expert did suggest content to add that would make the service-learning section of the Leaders' Guide more useful for educators. These additions included a list of student literature for introducing service-learning projects and curriculum mapping ideas to illustrate how service-learning projects can cross the content areas of language arts, social studies, physical education, visual arts, theater, music, science, and technology.

#### *K-2 Options*

Overall, the K-2 instructional design experts felt most of the lessons could be adapted to use with younger children. Feedback included suggestions on how to make options more developmentally appropriate by providing additional and/or alternative methods on how to teach a certain concept based on the knowledge and skills of this age group, bringing to light safety concerns when angling with young children, and pointing out advanced vocabulary with suggestions on alternative terms to use. There were a small number of lessons in which experts felt concepts presented and issues addressed were too advanced to try to adapt for younger children so they suggested not including K-2 options for those lessons. For options they felt were developmentally appropriate, the experts provided positive feedback by pointing out certain lessons they were particularly interested in teaching and felt their students would enjoy.

*Objectives, Assessments, and Rubrics*

While reviewing the objectives, assessments, and rubrics, instructional design experts pointed out instances where they felt these features were done well. They also offered detailed feedback on how to strengthen objectives, assessments, and rubrics. Experts provided suggestions so that all objectives were measurable and could be adequately met by doing the lesson. In some cases, experts advised removing, altering or adding objectives. Feedback for assessments included ideas to make assessments more authentic, means to address various learning styles in assessments, changes so assessments demonstrate what students have learned in relation to the objectives, suggestions for assessments to remove, and ideas for additional assessment options. In some cases experts felt a lesson's extension ideas worked better as assessments. Instructional design experts provided suggestions on how to ensure rubrics adequately measured the objectives of the lesson, clearly described what students were expected to do to obtain a certain score for the various criteria, and included developmentally appropriate activities. They also indicated certain criteria to add or remove from a rubric. Experts felt some rubrics simply required educators to count errors, so they provided changes so the rubrics would more adequately evaluate a student's ability. During the review, the science and language arts experts also expressed concern about the overall grade appropriateness of the fisheries management concepts and vocabulary presented in a few of the lessons.

*Minnesota Science Academic Standards*

During the initial meeting with one of the science experts, the expert suggested indicating the extent to which the lesson addressed a benchmark, instead of simply listing the standards and benchmarks the lesson aligned with. MinnAqua liked the suggestion, and incorporated it into the instructions for all experts who reviewed the various disciplines of the Minnesota Academic Standards.

The science experts provided positive feedback on lesson content and noted activities they felt their students would enjoy. One of the experts particularly liked how lessons tie classroom activities to life outside of school. Both experts provided extensive reviews beyond simply looking at the extent to which standards and benchmarks were addressed. They provided suggestions on how to more fully address certain benchmarks; make lessons more inquiry-based; strengthen the science instruction to better incorporate various learning styles; and ensure lessons

were in line with the prior knowledge, abilities, and concepts appropriate for students in grades 3-5. Both experts felt the complete text for the standards and benchmarks should be written out on each lesson so educators do not have to look them up. One expert suggested creating a matrix of lessons connected by certain standards or topics. The other expert suggested including student checklists along with the rubrics for each lesson. This expert also had a background in editing and provided many formatting suggestions related to lesson layout.

### *Minnesota Social Studies Academic Standards*

The social studies expert provided clarification on topics the social studies standards were meant to address, and how MinnAqua lessons aligned with the standards. In some cases MinnAqua had interpreted the standards from a different perspective, and the expert pointed out instances where the lesson did not contain enough historical content or adequately describe the environment's influence on humans, and thus failed to address a benchmark and standard indicated on the lesson. In order to make it easier for educators to see what standards were addressed, the expert felt standards and benchmarks should be written out completely on each lesson. The expert also pointed out areas where social studies concepts were well covered and provided suggestions of potential areas where concepts could be strengthened or integrated into a lesson.

### *Minnesota Language Arts Academic Standards*

The language arts experts appreciated the integration of language arts into many of the MinnAqua lessons, making them interdisciplinary. One of the experts also commented that she found the Leaders' Guide easy to use and teacher friendly. The language arts experts did not provide much additional feedback beyond indicating the level at which the benchmarks were addressed in the lessons and how a lesson could possibly be altered to more fully address a benchmark.

### *Minnesota Math Academic Standards*

The math expert appreciated that lessons provided opportunities for students to see how math and science are connected. There were instances in which the expert felt the connection could be strengthened and provided suggestions on how to make it easier for teachers to bring

out the math in a lesson. In some cases the expert felt certain math standards and benchmarks listed on the lesson were not addressed so she provided suggested changes so the lesson would address the indicated benchmarks and standards.

### *Minnesota Environmental Literacy Scope and Sequence*

The individual reviewing Minnesota's *Environmental Literacy Scope and Sequence* provided feedback on the Key System Concepts and Supporting Concepts addressed by each lesson. While doing the review, she felt the preK-5 Environmental Literacy Benchmarks should be addressed in lessons instead of the Key System Concepts and Supporting Concepts. The reviewer pointed out that the Key System Concepts and Supporting Concepts help to understand the preK-5 Environmental Literacy Benchmarks, whereas the preK-5 Environmental Literacy Benchmarks actually define what students should understand at the end of certain grade levels. She clarified that the preK-5 Environmental Literacy Benchmarks build on prior knowledge, and if a student does not have certain basic knowledge the educator would need to begin at concepts from a lower level (preK-2) so the student can understand more advanced concepts. With this in mind, the reviewer provided MinnAqua with a list of which preK-5 Environmental Literacy Benchmarks each lesson addressed. The reviewer praised MinnAqua for creating a user-friendly Leaders' Guide and aligning it with the *Environmental Literacy Scope and Sequence* Environmental Literacy Benchmarks. She also felt the background information would be valuable in giving educators the confidence to carry out lessons.

## Feedback From Educational Outreach Partners

As stated earlier, comments from each educational outreach partner were specific to their organization's educational outreach activities and were given directly to the appropriate MinnAqua Specialist upon being received. Provided below are overviews of the type of feedback obtained from each of these partners.

### *Junior Girl Scouts*

The representative from Girl Scouts was impressed with the comprehensiveness of the correlation matrix and said it was above and beyond what she had expected. She felt incorporating MinnAqua lessons into Junior Girls Scout activities provided opportunities for

creating family scouting events related to angling. To help strengthen the matrix, she pointed out areas where MinnAqua lessons and Junior Girl Scout badge requirements did not align and provided an explanation of why the lesson did not fulfill a requirement.

### *Cub Scouts*

The Cub Scouts reviewer provided assistance during the initial development of the matrix to help MinnAqua understand the variety of Cub Scout requirements and how they may align with MinnAqua lessons. Overall, the Cub Scout representative had positive feedback about the completed matrix and provided various suggestions to make it easier for Cub Scout leaders to use. The reviewer suggested changes to wording within the matrix and introduction so they used correct Cub Scout terminology, such as "rank achievements" and "electives". The reviewer also pointed out additional areas of alignment between Cub Scout requirements and MinnAqua lessons.

### *4-H*

The individual reviewing the 4-H correlation matrix felt it illustrated well how MinnAqua and 4-H activities compliment each other. The reviewer thought MinnAqua lessons would be useful for providing ideas for fair projects, although he was unsure of the usefulness of the matrix itself and felt it might be more beneficial for 4-H to just use the MinnAqua Leaders' Guide in place of other 4-H activities instead of using lessons to complement 4-H activities. However, the reviewer did provide suggestions on how to change the matrix to make it more useful for 4-H if MinnAqua decided to keep it as part of the Leaders' Guide. Suggestions included aligning 4-H project requirements with MinnAqua chapters instead of with individual lessons and adding certain 4-H materials to the matrix.

### *University of Minnesota's Water Resources Center*

The individual from the University of Minnesota's Water Resources Center reviewed the water stewardship lessons in Chapter 3. Some were adapted from lessons developed by the Water Resources Center, so the reviewer provided feedback on changes to these lessons along with suggestions of other ideas and activities to integrate. Throughout Chapter 3, the reviewer pointed out aquatic concepts and related activities she felt were too advanced from her

experience doing aquatic education with grades 3-5, and offered suggestions to make them more developmentally appropriate. The reviewer also commented on accuracy of the aquatic resource and stewardship information included in the lessons.

### *Great Lakes Aquarium*

The Great Lakes Aquarium has a partnership with MinnAqua that involves housing a MinnAqua intern at the Aquarium each summer. For this reason, a MinnAqua intern has been responsible for most of the angling education programming at the Great Lakes Aquarium. The reviewer thought the Leaders' Guide would be beneficial if the Aquarium decides to lead their own angling programs in the future. The reviewer also noted that the Leaders' Guide contained many topics covered in their educational programming and in the future plans on using the Leaders' Guide as a source of ideas, activities, and information. He felt the depth of background information would be especially useful for training new staff.

### *Sporting Goods Stores*

Representatives from Cabela's and Gander Mountain were included in the review because they sponsor community events with MinnAqua at their retail sites and have an interest in expanding educational outreach with their customers. Representatives from these stores provided limited feedback. They said they did not have time to complete a thorough review and provide written feedback, so MinnAqua staff spoke to them on the phone to at least gain insight into their impressions of the Leaders' Guide. The representative from Cabela's was unsure if they would use the Leaders' Guide and felt the background information was overwhelming. The reviewer from Gander Mountain was impressed with the Leaders' Guide and felt it could be used in the efforts to build mentoring opportunities related to angling.

### *Recreational Boating and Fishing Foundation (RBFF)*

The president of RBFF wrote a letter of support praising MinnAqua's educational efforts, which he believes has made it one of the leading aquatic education programs in the country. He acknowledged MinnAqua's participation in the development of RBFF's Best Practices and the use of these Best Practices throughout the development of the Leaders' Guide. He also

commented on how evaluation is a critical element of the Best Practices and applauded MinnAqua's commitment to evaluation throughout the Leaders' Guide development process.

*Minnesota Department of Natural Resources*

The reviewer from the Minnesota DNR provided evidence of how the MinnAqua Leaders' Guide supported various state plans. The reviewer felt the Leaders' Guide supported the third outcome of *A GreenPrint for Minnesota: State Plan for Environmental Education,* "focus on out-of-classroom environmental education programs for K-12 students" (Ledermann, 2000). She also noted that the Leaders' Guide could be used with pre-K-12 students and teachers, two of the GreenPrint's priority audiences. The reviewer felt the Leaders' Guide fulfilled needs addressed in A *Strategic Conservation Agenda 2003-2007* through collaboration with various education entities, bringing natural resource education to every student, creating informed citizens, and helping individuals develop a lifelong stewardship ethic. In relation to the *2000 Cornerstones Report,* the reviewer saw the Leaders' Guide supporting three of the six recommendations in the report including (1) build an effective, coordinated, DNR natural resources stewardship education effort with consistent messages and measurable outcomes; (2) expand DNR's working relationships with preK-12 audiences and providers; and (3) collaborate with other natural resource agencies and organizations to provide natural resources stewardship education (Minnesota Department of Natural Resources, 2000). The reviewer thought MinnAqua addressed these recommendations by looking to national standards, educators, and organizations to help guide development of the Leaders' Guide, and by evaluating the Leaders' Guide through the use of a variety of methods and intended users.

Documents Created By Accessibility Expert

The accessibility expert created a series of documents to ensure accessibility for all intended users of the Leaders' Guide. These documents included an overview on adapting MinnAqua lessons for individuals with physical disabilities, a needs assessment for identifying the physical abilities and limitations of an individual, a lesson analysis record for analyzing a lesson based on its physical activity requirements, and an adaptation guide to help educators think about accommodations which might be necessary for an individual to participate.

## Summary of Stage Two Results

Feedback was received from three types of reviewers during Stage Two. Instructional design experts verified the educational content specific to their area of expertise. Content areas reviewed included service-learning components and resources; K-2 options; objectives, assessments, and rubrics; Minnesota Academic Standards in science, social studies, language arts, and math; and Minnesota's *Environmental Literacy Scope and Sequence*. In addition to content verification, instructional design experts offered suggestions to improve the quality of the educational content and thus strengthen the extent to which the corresponding content area rewrite guidelines were addressed. A variety of educational outreach partners reviewed the Leaders' Guide with their specific educational outreach efforts in mind. Reviewers from Junior Girls Scouts, Cub Scouts, and 4-H provided feedback to increase the utility of correlation matrices for their organization. Great Lakes Aquarium and Gander Mountain provided documentation of how they might use the Leaders' Guide to strengthen their educational outreach efforts, while Cabela's was unsure of the Guide's utility for their educational purposes. The reviewer from the University of Minnesota's Water Resources Center commented on the accuracy of the aquatic stewardship and resource information in the lessons as well as the changes made to lessons adapted from Water Resource Center activities. The Recreational Boating and Fishing Foundation wrote a letter of support for MinnAqua's educational efforts and use of RBFF's Best Practices during the development of the Leaders' Guide. A reviewer from the DNR commented how the Leaders' Guide supported various state plans. The third type of reviewer, an accessibility expert, created a series of documents to guide educators in adapting lessons so they were inclusive of individuals with physical disabilities.

## STAGE TWO: DISCUSSION

### MinnAqua Leaders' Guide Addressing the Rewrite Guidelines

The first evaluation question was, "To what extent are MinnAqua's rewrite guidelines addressed in individual lessons and the Leaders' Guide as a whole?" Discussed below are the major findings and recommendations from Stage Two, which describe the extent to which the rewrite guidelines were addressed in the Leaders' Guide and suggested changes that could be made to more fully address the guidelines.

#### *Major Findings*

The rewrite guidelines were created to ensure a quality educational product. One of the resources reviewed while creating the guidelines was the Recreational Boating and Fishing Foundation's "Best Practices in Fishing, Boating, and Aquatic Resources Stewardship Education". The president of the Recreational Boating and Fishing Foundation praised MinnAqua for utilizing the Best Practices throughout the development of the Leaders' Guide. The rewrite guidelines were also used to support various Minnesota state plans. A reviewer from the Minnesota DNR confirmed that the incorporation of the guidelines and the use of intended users throughout the evaluation process helped to address these state plans.

Each of the instructional design experts reviewed the lessons based on one of the rewrite guidelines. Their positive feedback provided evidence for the successful incorporation of the guidelines, with some reviewers also offering suggestions to further address them. The service-learning expert was impressed with service-learning resources and components included in the Leaders' Guide. K-2 experts felt most of the lessons could be adapted to younger grade levels and provided a variety of suggestions on how to appropriately adapt the lessons. They also expressed interest in teaching some of the lessons and felt their students would enjoy them. Instructional design experts pointed out objectives, assessments, and rubrics they felt were done well, and offered detailed suggestions to strengthen these features and thus the extent to which the corresponding rewrite guidelines were addressed. The variety of instructional design experts reviewing the Minnesota Academic Standards appreciated the interdisciplinary nature of the lessons, while the science experts' provided suggestions to make lessons more inquiry-based. This feedback provided evidence that the rewrite guideline, "incorporating interdisciplinary,

hands-on, and inquiry-based lessons", was addressed during the instructional design expert review. The experts reviewing the standards also suggested changes so lessons would more fully address benchmarks and standards. The instructional design expert reviewing the *Environmental Literacy Scope and Sequence* praised MinnAqua for aligning their lessons with this document. However, she pointed out that MinnAqua lessons were incorrectly aligned with the Key Systems Concepts and Supporting Concepts instead of the preK-5 Environmental Literacy Benchmarks. The expert clarified this difference for MinnAqua and provided suggestions to align lessons with the preK-5 Environmental Literacy Benchmarks.

*Recommendations*

Based on Stage Two feedback, recommendations were generated to more fully address the rewrite guidelines. These recommendations will also help to address the second evaluation question by increasing the extent to which educators' needs are met. Recommendations included:

1. Revising a variety of lessons where the reading level and concepts were found to be too advanced for students in grades 3 – 5. This revision would help to more fully address the rewrite guideline, "ensuring activities and concepts are developmentally appropriate and build on students' prior knowledge". This recommendation was based on concerns from both instructional design experts and the educational outreach partner from the University of Minnesota's Water Resources Center, who echoed educator feedback received during pilot tests. It was also recommended to use the assistance of instructional design experts to revise the lessons so they were appropriate for grades 3 - 5 and then pilot these revised lessons to confirm new versions were age appropriate.
2. Removing K-2 options where instructional design experts felt the concepts addressed in a lesson were too advanced to appropriately adapt for younger ages. This would help to more accurately address the rewrite guideline, "including ideas on how to adapt lessons for use with grades K-2", since instructional design experts felt it would be inappropriate to try to adapt every lesson to a younger grade level.
3. Aligning lessons with the *Environmental Literacy Scope and Sequence* Benchmarks instead of Key Systems Concepts and Supporting Concepts. Lessons were aligned with the *Environmental Literacy Scope and Sequence* per the rewrite guidelines, but as the

instructional design expert from the Minnesota Office of Environmental Assistance pointed out, lessons were aligned incorrectly. This recommended change would ensure the Leaders' Guide accurately reflects the intended use of the *Environmental Literacy Scope and Sequence.*

## MinnAqua Leaders' Guide Meeting the Needs of Intended Users

Various intended users were consulted during Stage Two to provide data for the second evaluation question, "To what extent does the Leaders' Guide meet the educational needs of intended users in both formal and informal education settings?"

### *Major Findings*

Instructional design experts were also practicing educators or former educators so they often offered feedback about the usefulness of the lessons in addition to reviewing the accuracy of the lesson's instructional content. Their suggested changes specific to the rewrite guidelines will also help increase the utility of the lessons for classroom educators.

Educational outreach partners provided overall positive feedback about the utility of the Leaders' Guide. The reviews of the Junior Girl Scouts, Cub Scouts, and 4-H confirmed the utility of the Leaders' Guide and the value of the correlation matrices for their organizations' activities. In addition, they provided suggestions to better align their organizations' requirements to MinnAqua lessons in order to strengthen the usefulness of the matrices. The Great Lakes Aquarium saw value in the lessons' information and activities and recognized a variety of ways the Leaders' Guide could be useful to their setting. Representatives from sporting goods stores gave mixed reactions about the usefulness of the Leaders' Guide; with one unsure of its utility and the other excited about the possibility of using the Guide to build mentoring opportunities.

The accessibility expert's involvement increased the extent to which the Leaders' Guide will meet the needs of intended users with disabilities. Lesson features, such as hands-on and group activities, were mentioned by educators during Stage One as ways to address the learning needs of students with disabilities. However, the use of the expert's documents will further increase the extent to which these students' needs are met.

*Recommendations*

MinnAqua also received recommendations to more fully address the needs of intended users. Recommendations included:

1. Writing out the Minnesota Academic Standards and associated benchmarks addressed by a lesson, instead of using letter and number indicators. This will save educators the time of having to cross-reference standards themselves.
2. Building on the Great Lakes Aquarium's interest in the Leaders' Guide by providing trainings and support so Aquarium staff can conduct their own angling education programming year-round.
3. Working with sporting goods stores to identify how the Leaders' Guide can be used to address their unique educational needs.

## Changes to Leaders' Guide Before Publication

MinnAqua used the raw data, major findings, and recommendations from Stage Two to guide final revisions before publication of the Leaders' Guide. As in Stage One, the expertise of the individual providing the feedback, MinnAqua's mission, and the MinnAqua rewrite guidelines were all taken into consideration when deciding on changes to lessons. During Stage Two, MinnAqua compared a reviewer's expertise with their feedback. Instructional design experts were chosen to review content related to one of the rewrite guidelines so their comments were often incorporated to help strengthen the extent to which rewrite guidelines were addressed. If a reviewer provided feedback unrelated to their area of expertise, MinnAqua compared their feedback to comments from individuals with that expertise before being incorporated. Additionally, instructional design experts did not pilot test lessons so any comments they gave related to the usability of a lesson with students were mostly inferential. In instances where instructional design experts provided this type of feedback, MinnAqua considered experts' comments in relation to feedback from educators who actually piloted the lessons before they made any revisions.

All lessons underwent some form of revision. Most revisions were minor and did not significantly alter the lessons, but helped to strengthen the extent to which the rewrite guidelines were addressed. Revisions included removing K-2 options when necessary, making activities more inquiry-based, adding student checklists for assessments, increasing the clarity of

objectives, indicating the extent to which Minnesota Academic Standards and Benchmarks were addressed, and ensuring all lessons included authentic assessments which adequately measured objectives and addressed a variety of learning styles.

MinnAqua tried to limit the number of major revisions to avoid creating lessons drastically different than what was piloted, although there were a number of lessons that underwent significant changes because they did not sufficiently address the rewrite guidelines or meet educators' needs as originally written. Instructional design experts echoed concerns heard during Stage One about concepts covered in "The Lake Game" and their appropriateness for grades 3 - 5. The role cards were rewritten once again and some role-playing scenarios revised. Similar concerns about age appropriateness were addressed with the role-playing cards for the board game in "Fisheries Management and You". The lessons "Tackling Your Tackle Box", "Design a Habitat", and "Habitat Hideout" had activities added to them to help enhance the learning opportunities in the lesson following instructional design experts' suggestions. These lessons were not pilot tested a second time, so as Beyer (1995) notes, it cannot be assumed the revisions resolved the problems noted by reviewers.

After Stage Two, MinnAqua created the appendix pieces for the Leaders' Guide. Some of the items included in the appendix were matrices based on feedback from educators who piloted the lessons and instructional design experts. The matrices were included to assist educators in finding lessons appropriate for their educational needs, to provide guidance for creating instructional units, and to more fully address the rewrite guidelines by ensuring lessons could stand alone or be used as part of a larger unit. The various matrices categorized lessons based on Minnesota Academic Standards, academic skills, academic subjects, topics, activity time, location and setting, seasons, and units. The correlation matrices for Cub Scouts, Junior Girl Scouts, and 4-H were also revised per suggestions to increase their usability.

# CONCLUSION

## Using Evaluation to Improve the Leaders' Guide

Formative evaluations are an integral part of the development of new educational products. The formative evaluation was designed to answer the questions: (a) To what extent are MinnAqua's rewrite guidelines addressed in individual lessons and the Leaders' Guide as a whole?, and (b) To what extent does the Leaders' Guide meet the educational needs of intended users in both formal and informal education settings? The two-stage evaluation design provided the opportunity for lessons to receive multiple reviews from a variety of intended users and stakeholders. The diversity of reviewers provided the depth and breadth of feedback necessary to adequately address the evaluation questions by verifying the incorporation of the rewrite guidelines, identifying ways to strengthen the extent to which the guidelines were addressed, and ensuring the Leaders' Guide met educators' needs.

### *Addressing the Rewrite Guidelines*

The diversity of reviewers and the varied focus of their reviews provided evidence for the first evaluation question. The evaluation was designed to verify that the guidelines were incorporated and strengthen the extent to which they were addressed, thus helping to increase the overall quality of the Leaders' Guide.

Educators provided first-hand evidence of how the lessons, based on the rewrite guidelines, worked in the intended educational settings. Educator feedback confirmed that many of the guidelines were successfully addressed and their integration resulted in engaging lessons that were easy to use. Educators also provided suggestions that increased the extent to which guidelines were addressed, as well as increased the utility of the Leaders' Guide. Suggested changes included the revision of lessons where concepts, vocabulary, and overall reading level were not developmentally appropriate for grades 3 – 5 and the creation of matrices to make it easier for educators to design instructional units out of MinnAqua lessons.

DNR Fisheries staff and instructional design experts provided feedback related to specific rewrite guidelines. With the extensive fisheries management and aquatic ecology information included in the lessons, it was important to have Fisheries experts confirm the accuracy of this information and identify any necessary changes. Instructional design experts verified lessons'

instructional content specific to a particular rewrite guideline and provided suggestions to increase the extent to which the guideline was addressed. Suggested changes included strengthening authentic assessment ideas and making lessons more inquiry-based.

### *Meeting Intended Users' Needs*

Feedback from a variety of intended users in both formal and informal education settings provided evidence for the second evaluation question. The evaluation examined if the Leaders' Guide, developed following the guidelines, adequately met all educators' needs and if any features needed to be strengthened to increase the Guide's utility.

Overall, the individuals involved in the evaluation had a favorable impression of the Leaders' Guide. Most formal and informal educators said they would use the lessons they piloted again in the future and felt the lessons would fit into their regular curriculum. Fisheries Liaisons thought they could use most of the lessons they reviewed in their fisheries outreach activities. Educational outreach partners either confirmed the utility of correlation matrices or identified how the Leaders' Guide could support their outreach efforts. The accessibility expert created planning documents to increase the extent to which the Leaders' Guide meets educators' needs of creating an inclusive learning environment. The flexibility provided by the Leaders' Guide's three-ring binder format will allow MinnAqua to further respond to intended users' and stakeholders' needs once it is published.

## Recommendations For Formative Evaluations of Future Leaders' Guides

The evaluation was successful in providing the breadth and depth of information necessary to address the evaluation questions, and thus improve the Leaders' Guide during its development. However, formative evaluations of future Leaders' Guides could be improved upon by implementing the following recommended changes.

A few measures are recommended in order to help recruit a larger number of educators to pilot the Leaders' Guide. Incentives should be clearly defined in recruitment materials. The information for pilot testing stated that educators would receive materials to teach MinnAqua lessons in their classroom, but did not specify the exact materials because MinnAqua wanted educators' input on what materials would be most useful. However, deciding on incentives beforehand and indicating the exact materials and their estimated value in recruitment

information might have gained the interest of more educators. In addition to clearly defining incentives, advertising should begin much further in advance for informal educators. Recruitment materials for informal educators were sent out two months in advance. Informal educators pointed out that late spring is a busy time, and many informal education institutions already have programming schedules in place. If recruitment materials had been sent out further in advance, informal educators could have planned accordingly to accommodate piloting MinnAqua lessons. To prepare for future recruitment efforts, it is recommended to speak to various informal educators to gain an idea of the deadlines they have for incorporating new programs into their schedules. This will help to ensure informal educators are not excluded because of scheduling conflicts.

A second recommendation is to extend the timeframe for educators to pilot lessons. The pilot testing period was three months. However, there were educators who would have liked more time, especially to pilot lessons intended for a particular season. In future evaluations, piloting should span across all seasons so lessons can be tested in the ideal conditions. Extended time for piloting will also make it easier for educators to incorporate materials into their regular curriculum. This is especially true for informal educators who may need to create a program in which to test lessons if they don't normally cover angling and aquatic education topics.

A third recommendation is to budget for personal meetings with all of the reviewers. This will help ensure all reviewers understand their role, are engaged in the process, and provide useful feedback. Funding limited the number of personal meetings with reviewers during Stage Two of the Leaders' Guide evaluation. A more thorough review might have been received from partners at sporting goods stores if someone had met face-to-face with them to make sure they had a clear understanding about the program, the evaluation, and the intended use of the Leaders' Guide in their educational setting.

A fourth recommendation to consider when planning future evaluations is to include a second round of pilot testing. During the evaluation of the Leaders' Guide, some lessons underwent significant changes to more fully address the rewrite guidelines and meet educators' needs. However, lack of time and funding prevented additional pilot testing. Instructional design experts provided a second review of the lessons, but without an additional round of piloting with students it cannot be assumed that the changes sufficiently addressed the problems. Future evaluations should include a second round of piloting after instructional design experts

review the lessons. This will allow educators to pilot a more finalized version of the lessons. If time and financial restrictions exist, additional piloting could be limited to only the lessons that undergo significant changes.

A fifth recommendation is to examine educators' pilot testing experiences based on their prior angling experience. During the focus groups, educators were not directly asked how their angling experience affected their use of the lessons they piloted. However, discussions related to angling experience came up in focus groups, specifically in relation to offering extended trainings to increase non-anglers' confidence in teaching angling-related lessons and providing contact information for individuals willing to help teach angling lessons with educators lacking angling knowledge. For future evaluations, it is recommended to target recruitment efforts to include educators with varying angling experience. Additionally, the questionnaire and focus group should include questions about how educators' prior angling experience helped or hindered piloting lessons. Non-anglers could also provide suggestions of additional information or training opportunities necessary to increase their confidence in teaching lessons that focus heavily on angling skills and knowledge.

The final recommendation is to include the accessibility expert in the Leaders' Guide development process. This will allow the planning documents to be pilot tested along with the lessons to make sure they are easy to use and meet educators' needs for creating an inclusive learning environment for students with physical disabilities.

## Implications

The formative evaluation has value beyond the improvement of the MinnAqua Leaders' Guide. MinnAqua staff has come to understand the importance of evaluation as a result of being involved in the evaluation process. They have since focused evaluation efforts on other aspects of the MinnAqua program. Additionally, some of MinnAqua's staff have participated in evaluation courses to further increase their evaluation knowledge and skills.

The evaluation of the Leaders' Guide also has value outside of the MinnAqua program. This paper adds to the literature another example of how the formative evaluation of an educational product can be designed and carried out. Professionals can review the Leaders' Guide formative evaluation, along with the evaluations of similar educational products cited in the Literature Review, to gather ideas of what methods may or may not be appropriate for their

evaluation design based on the goals of their evaluation, the characteristics of their product, and the time and budget available for the evaluation.

## Future Directions

Future evaluation efforts to continue to improve the Leaders' Guide include tracking educator use of the Leaders' Guide and the impact MinnAqua activities have on student learning and behaviors. MinnAqua plans to disseminate the Leaders' Guide through workshops and track its use by educators. This will provide an understanding of how lessons are being utilized and aid in future revisions. MinnAqua also intends to carry out a longitudinal study to track student involvement in both MinnAqua activities and angling in general. The study would focus on MinnAqua's ability to reach their long-term student outcomes of aquatic stewardship, participation in angling, and purchase of a fishing license upon turning sixteen.

This evaluation solicited educator feedback about student learning and engagement, but did not directly measure outcomes related to student learning. To understand the true impact of the Leaders' Guide, a summative evaluation will be carried out to measure the effect of MinnAqua lessons on student achievement. The summative evaluation could become formative if it is discovered that student outcomes are not met and the Leaders' Guide needs further revisions.

MinnAqua plans to continue their outreach to various audiences by creating Leaders' Guides for additional grade levels. During the development of any future educational materials, it is recommended that formative evaluations similar to the one described in this report are carried out to ensure the creation of quality instructional materials that will meet the needs of intended users.

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# APPENDICES

## APPENDIX A: OUTLINE OF MINNAQUA LEADERS' GUIDE

From MinnAqua Leaders' Guide Draft, December 2005

Table of Contents

Acknowledgements, Contributors, Reviewers

Introductory Material

The MinnAqua Program

Introduction to the New MinnAqua Leaders Guide: Get in the Habitat! -Goals

Organization and How to use this Leaders Guide

Fishing in Minnesota

Chapter 1: Aquatic Habitats

1:1 Design a Habitat
Experience signs of pond life on a "virtual field trip" or an actual field trip to a pond, and construct a fish habitat diorama that demonstrates the four basic habitat needs of fish.

1:2 Food Chain Tag
Observe a food chain in action by role-playing: becoming minnows, perch, northern pike, bacteria and anglers.

1:3 Run For Your Life Cycle
Travel the migration route of a northern pike to discover some of the challenges these fish face during their life cycle.

1:4 Water Habitat Site Study
Explore a local water body and discover a variety of organisms that live there.

1:5 Habitat Hideout
Identify preferred fish habitat to find where the fish are likely to be and where to cast your line when fishing.

1:6 From Frozen To Fascinating
Scoop bottom sediment from an icy lake, pond, or wetland to discover what causes some tiny aquatic organisms to emerge in spring after quietly surviving through the cold Minnesota winters.

Student Reading List

Resources

Chapter 2: Minnesota Fish

2:1 Fish Sense
Explore the six senses of a fish and print its image using the ancient Japanese art form called Gyotaku.

2:2 Fins: Form and Function
Learn the names and test the function of different fin types; determine that fin adaptations help fish survive in their habitat.

2:3 Fish Families
Learn how scientists classify fish into groups called families. Find out how many fish families are in Minnesota.

2:4 Using a Key for Fish ID
Identify Minnesota fish species by looking closely at their physical characteristics and using a dichotomous key.

2:5 Diving Into Diversity
Explore fish diversity in Minnesota. Create a grouping system that helps answer a question about fish.

2:6 Adapted for Habitat
Dress two fish with adaptations, one a predator and one a prey species, then, design a fish with adaptations suited to habitat in the year 4000.

2:7 Fish Tales
Discover that fish stories have a long history in Minnesota. Write a tall tale using exaggeration, similes and metaphors to increase entertainment value.

2:8 Fish in Winter
Discover how winter conditions can affect dissolved oxygen levels in the water and learn what this means for fish in winter.

2:9 Fish Bowl
Play a knowledge bowl game show to review and reinforce concepts learned about fish identification, habitat, fish management, and other topics covered in a unit.

Student Reading List

Resources

Chapter 3: Water Stewardship

3:1 Incredible Journey
Participants simulate the movement of water within the water cycle.

4:5 Fisheries Management and You
Play a game to become familiar with fisheries management tools and techniques.

Service-Learning Component

Student Reading List

Resources

Chapter 5: Fishing Equipment and Skills

5:1 Freshwater Rods and Reels
Examine different types of freshwater rods and reels, learn what fishing conditions each is suited for, and practice casting.

5:2 Casting a Closed Face Rod and Reel Combo
Practice basic rod and reel rigging and fishing skills.

5:3 Pop Can Casting
Use common materials at hand to make fishing gear that will catch fish like native Indians and early Minnesota settlers.

5:4 Tackling Your Tackle Box
Shop in a virtual tackle store for basic lures and baits, identifying the best items for catching a particular fish species.

5:5 Flashy Fish Catchers
Use knowledge about fish senses to design you own fishing lure.

5:6 Fool Fish with Flies
Learn the life stages and body parts of various aquatic insects and play a game of Go Fly Fish.

5:7 Making Ice Fishing Jiggle Sticks
Students make and rig their own jiggle stick.

Service-Learning Component

Student Reading List

Resources

Chapter 6: Safety and Fishing Trip

6:1 Safety and Fishing at the Waters Edge

Choose a safe fishing site and participate in creating a safety plan by writing a safety rap, song, or poem with safety rules and tips for the trip.

6:2 Ice Fishing and Winter Safety

Learn about dressing in layers, about ice rescue, and how to ice fish while having fun.

6:3 Planning a Fishing Trip

Gather information from the Minnesota Department of Natural Resources website and other sources to plan a fishing trip.

6:4 Piscatorial Palate

Let your creativity run wild by suggesting common foods to try as alternatives to traditional baits when trying to catch "the big one!"

6:5 Omega 3s and PCBs

Explore how toxins can accumulate in aquatic predators, the benefits and potential risks of cooking and eating fish.

Service-Learning Component

Student Reading List

Resources

Appendices

i. Glossary

ii. Conceptual Framework

iii. Minnesota Academic Standards Matrix

iv. Service-Learning Resources

v. Cub Scout Correlations Matrix

vi. Junior Girl Scout Correlations Matrix

vii. 4-H Project Correlations

viii. Academic Skills Matrix

ix. Academic Subjects Matrix

x. Topics Matrix

xi. Activity Time Matrix

xii. Location and Setting Matrix

xiii. Seasons Matrix

xiv. Units Matrix

xv. Minnesota Fun Fish Facts

xvi. Minnesota Water Facts

Bibliography

## APPENDIX B: CONSENT FORM

### Evaluation of the MinnAqua Leaders' Guide

You are invited to be in an evaluation study of the MinnAqua Leaders' Guide. You were selected as a possible participant because you are an educator working with grades 3, 4, or 5. We ask that you read this form and ask any questions you may have before agreeing to participate in this study.

This study is being conducted by Amy Grack, Graduate Research Assistant from the University of Minnesota's College of Natural Resources - Extension, in affiliation with the Minnesota Department of Natural Resources - Fisheries Division.

**Background Information:** The purpose of this study is to improve the MinnAqua Leaders' Guide during its development and before the publication of a new educator's guide. This evaluation will attempt to answer the following questions: "To what extent are MinnAqua's rewrite guidelines addressed in individual lessons and the Leaders' Guide as a whole?" and "To what extent does the Leaders' Guide meet the educational needs of intended users in both formal and informal education settings?"

**Procedures:** If you agree to participate in this study, you will be asked to attend an initial review team meeting, pilot test six lessons in your educational setting, fill out a questionnaire for each lesson, critique each lesson, and participate in a focus group. The review team meeting will last six hours. It will cover the MinnAqua program, rewrite process, new Leaders' Guide, evaluation project, and your role on the review team. Pilot testing will take approximately one hour for each lesson. This time will vary between lessons. You will then provide feedback by filling out a questionnaire describing your experience pilot testing the lesson and critiquing the lesson content. The questionnaire has 22 questions for formal educators and 29 questions for informal educators regarding lesson content and the pilot testing experience. The questionnaire will take approximately 10 - 15 minutes to complete. The lesson critique involves reviewing each component of a lesson and providing suggestions, corrections, and comments. The lesson critique will take approximately 30 – 45 minutes for each lesson. Focus groups will also be held after all review team members have completed pilot testing. The focus groups will be two hours long. The focus groups will provide an opportunity for you to discuss with other educators your thoughts about the Leaders' Guide and experiences using it in your educational setting.

**Risks and Benefits of being in the Study:** There are no known risks associated with participating in this study. The incentives to participating in the study include: recognition in the MinnAqua Leaders' Guide for your participation in the review team, a complete MinnAqua Leaders' Guide, and a kit with materials to do one of the MinnAqua lessons. You will be compensated for mileage to the initial review team meeting at the rate of $0.36/mile as well as the full cost of one night's lodging if you travel further than 100 miles. Lunch will be provided by the DNR at the initial meeting. You will also be compensated for mileage to the focus group meeting.

**Confidentiality:** The records of this study will be kept private. In any sort of report we might publish, we will not include any information that will make it possible to identify a subject. This form will be on record at the University of Minnesota – Center for 4-H Youth Development.

**Voluntary Nature of the Study:** Your decision whether or not to participate will not affect your current or future relations with the University of Minnesota, Center for 4-H Youth Development, MinnAqua, or the Minnesota Department of Natural Resources. If you decide to participate, you are free to withdraw at any time without affecting those relationships.

**Contacts and Questions:** The researcher conducting this study is Amy Grack. If you have questions, you may contact her at the Minnesota Department of Natural Resources at (651)-215-1470. You may also contact her University of Minnesota advisor, Dr. Stephan Carlson, at (612)-624-8186. If you have any questions or concerns regarding the study and would like to talk to someone other than the researcher, contact Research Subjects' Advocate line, D528 Mayo, 420 Delaware Street S.E., Minneapolis, Minnesota 55455; telephone (612) 625-1650.

***You will be given a copy of this information to keep for your records.***

**Statement of Consent:** I have read the above information. I have asked questions and have received answers. I consent to participate in the study.

Signature: _____ Date: _____

Signature of Investigator:_____ Date: _____

## APPENDIX C: CHARACTERISTICS OF PILOT TESTING SAMPLE

Table 6: Characteristics of Formal Educators

| Education Setting | Location | Grade(s) Piloted Lessons With |
|---|---|---|
| Public School | Metro/Suburban | 5th |
| Public School | Metro/Suburban | 3rd |
| Public School | NW MN | 4th |
| Public Fine Arts School | Metro/Inner City* | 5th |
| Homeschool | NC MN | 5th |
| Public School | Metro/Suburban | 3rd |
| Private School | Metro/Suburban | 3rd (for one lesson), 5th |
| Public Montessori School | SE MN | 4th, 5th |
| Public School (Reservation) | WC MN | 3rd |
| Public School | NW MN | 3rd |
| Public School | NW MN | 3rd |
| Private School | NE MN | 3rd – 5th (depending on lesson) |
| Public School | NE MN | 3rd |
| Public School | NW MN | 3rd |
| Public School | NW MN | 4th |
| Public School | NE MN | 5th |
| Public School | NE MN | 5th |

*Inner city defined as Minneapolis or St. Paul. All other cities in the seven county metro area were considered suburban.

Table 7: Characteristics of Informal Educators*

| Education Setting | Location |
|---|---|
| Tribal Community Waste Management | NE MN |
| Nature Center | Metro/Suburban |
| Cub Scouts | SE MN |
| 4-H | NE MN |
| 4-H | WC MN |

* Grades taught varied for each lesson piloted.

## APPENDIX D: DIRECTIONS FOR CRITIQUING LESSONS

*For each lesson you pilot test, we ask that you fill out a questionnaire as well as provide a written critique directly on the lesson. Below are instructions on how to do the lesson critique. These are the minimum critique parameters. Please feel free to provide additional feedback and suggestions.*

*For each of the lesson component headings below, carefully read through the critique instructions. If you have a change, comment, or suggestion, write it directly on the Checklist for that lesson. If you need more room attach a sheet of paper along with the lesson you have critiqued. There are check boxes directly on the lesson next to each component. When you have completed critiquing that component, please put a check in the box. If you think that component of the lesson is fine how it is, check the box and move on to the next lesson component. Throughout the lesson, also note any spelling errors, grammar errors or suggestions.*

**Title**

- Does the title accurately describe the activity? If you feel it should be changed, indicate why and how it should be changed.

**Grade Level**

- Do you feel this lesson was appropriate for the grade levels listed? If not, please indicate for which grade levels this lesson is appropriate and why.

**Subject Areas**

- Do you feel the lesson fits the subject areas listed? Should any subject areas be added? If you add or cross out a subject area, please explain your reasoning.
  The subject areas include the following:
  - Expressive arts (art, theater, dance)
  - Health and safety
  - Language arts
  - Math
  - Physical education
  - Science
  - Social studies

**Duration**

- Look at the time requirement for the lesson. Is this accurate? If it took more or less time to complete the lesson (including warm up, lesson, and wrap up), note that on the lesson. Identify what segment(s) of the lesson took more or less time than anticipated.

**Group Size**

- Some activities can be used with any size group, whereas other activities work best with a minimum or maximum number of participants. Look at the group size listed and comment if you think the activity is inappropriate for the group size listed. Suggest what group size should be listed instead and why.
  Group size listings can be:
  - Any
  - Minimum of
  - Maximum of

**Setting**

- The setting indicates the location requirements for the lesson. Look at what settings are listed for the lesson. Would it work in those settings? If not, cross off that setting and explain why. If you think a setting should be added, note it with your reasoning.
  Settings listed in the Leaders' Guide include:
  - Gym or large open area
  - Gathering area with tables
  - Gathering area
  - Water's edge
  - Computer lab

**Academic Skills**

- Do you feel the lesson fits the academic skills noted on it? Should any other academic skills be added? If you add or cross out an academic skill, please explain your reasoning. (The academic skills list is located on the last page of these instructions.)

**Vocabulary**

- Here you will find all vocabulary words introduced in the lesson, which will also be defined in a glossary in the appendix section of the Leaders' Guide. Please note if you feel any of the words are too advanced for the students with whom you piloted the lesson, not defined adequately, or not crucial for understanding the material covered in the lesson.
- As you read the lesson, note if any other terms should be defined and included in the vocabulary list.

**Internet Search Words**

- Look at the Internet search words. Did you use any words or phrases, other than the ones listed, to find information in relation to the lesson? If so, list the word or phrase exactly how you typed it into the search engine.

**Minnesota Academic Standards**

*(Science and Social Studies Standards are from the most current rough draft of standards)*

- Listed are the academic standards that are supported by doing the activity. Please look at the standards listed and determine if any of them are not supported by the activity. If you find any you think should not be included, cross them out with an explanation of why you feel they should not be included.
- Glance through the standards and note if there are any standards not listed on the lesson that should be included. Explain your reasoning for including the concepts.

**Minnesota Environmental Literacy Scope and Sequence Concepts**

- Here you will find the MN Environmental Literacy Scope and Sequence concepts correlated to the lesson. Do you feel the concepts listed are covered in the lesson? If not, please explain why.
- Glance through the Scope and Sequence document and note if there are any concepts for grades 3 through 5 not listed on the lesson that should be included. Explain your reasoning for including the concepts.

**Snappy Introduction**

- This introduction is a short, catchy statement or two to introduce the lesson. It should relate to the topic the lesson is covering. If you feel the snappy introduction should be changed, does not relate to the lesson, or could be "snappier" please make a suggestion and justification for the change

**Summary**

- Here you will find a brief summary of the lesson. This is the first description of the lesson the educator will see in order to decide if they want to continue reading more about the lesson. For this reason, the summary should include the main points of what the lesson is about and the activities included. Does the summary do that for the lesson? If not, what should be changed or included?

**Objectives**

- The objectives describe what students will do to acquire further knowledge and skills, as well as what students will be able to do as a result of participating in the lesson. The objectives also function to describe under what conditions students' performance will be accomplished. After reading the lesson, look at the objectives. Are the objectives met by completing the lesson? If not, please explain which objectives are not met by doing the lesson. Give any suggestions on how an objective could be changed to more accurately describe what the student should be able to do as a result of participating in the activity.
- Are the objectives measurable? From the objectives, can the educator determine the criterion which satisfactory attainment of the objectives will be judged? Could you use an assessment technique to measure if the objectives have been met? If you feel an objective is not measurable, please explain your reasoning. Also include a suggestion of how the objective might be changed so that it can be measured.

**Materials**

- Does the lesson list all materials necessary to do the activity? Add any additional materials you used with a note of how they were used.
- Did you make any substitutions to materials listed? If so, comment on how well they did or did not work.
- If you did not use any of the materials listed, cross them out and explain why they are unnecessary.
- Do any of the materials listed require more explanation or suggestions for where they can be obtained? If so, please jot down which materials need more explanation or information on where to acquire them.

**Background Information**

- Read the background information. Was adequate information provided for you to feel comfortable teaching the lesson? If not, note what information should be included or explained in more detail.
- Was there any information in the background that you feel was not needed to do the activity? If so, cross it out with an explanation of why you think the information is unnecessary.
- The background information should be easy to understand for educators with varying science backgrounds. The Education Specialists writing the Leaders' Guide have done extensive work with aquatics and sometimes a concept that seems basic to them may be unfamiliar to someone else. Please note if there is any background information you do not understand, why it is difficult

to comprehend, and any other suggestions you may have to improve the background information section.

**Procedure: Preparation**

- Listed here are things the educator needs to prepare ahead of time in order to do the activity. Think about what you had to do to prepare to teach the lesson. Are all of those steps listed here? If not, what should be included? Please note on the lesson what should be included and why.
- Is there anything listed in the preparation that you feel could be taken out? Please cross it out with an explanation of why it could be deleted.

**Procedure: Activity**

- Is any part of the activity unclear? If so, please note where it is unclear and why.
- Does the activity portion of the procedure (warm up, lesson, wrap up) include all steps necessary to carry out the activity? If not, include what steps are missing and why they should be included.
- Is there any part of the activity that could be left out or reworded? If so, please note and explain why it should be taken out or changed.

**Assessment**

- Look at each assessment idea of the lesson. Is the assessment activity a good way for students to demonstrate they have learned and understood the objectives of the lesson? If not, explain why the assessments do not relate to the objectives and what could be done to strengthen the assessment activities.
- Are the assessment activities authentic? Do they present students with real-world challenges that require them to use higher order thinking skills and apply a range of knowledge? If not, provide suggestions on how to make the assessments more authentic.
- If you have other assessment ideas, please write them on the lesson.
  *Note: Some of the lessons do not have detailed assessments. This is where we would like your help in coming up with possible assessment activities.

**Extensions**

- Extensions activities can provide students an advanced or enriched opportunity for further exploration into a topic or concept covered in the lesson. Look at each extension activity. Provide suggestions you have on how to improve an activity or comments on why an activity should be removed.
- If you have any additional ideas for extension activities, please add them here.

**K-2 Option**

- The intent of the K-2 options are not to "dumb-down" the material for a younger audience but to provide suggestions to help educators of younger children adapt the lessons to best support the emerging and developing abilities of these students. Do the options seem appropriate for that age level? In not, explain why an option is inappropriate and offer suggestions to make it suitable for K-2.
- If you have any other ideas for K-2 options, please add them here.

**Academic Skills**

- Analysis
- Application
- Calculation
- Classification
- Communication
- Comparison
- Computation
- Construction
- Computer Skills
- Debate
- Description
- Demonstration
- Drawing
- Drawing Conclusions
- Estimation
- Evaluation
- Experimentation
- Gathering
- Generalization
- Graphing
- Hypothesizing
- Identification
- Inference
- Interpretation
- Interviewing
- Inquiry
- Invention
- Kinesthetics
- Large Group Skills
- Listening
- Listing
- Mapping
- Matching
- Measuring
- Media Construction
- Modeling
- Observation
- Organization
- Prediction
- Presentation Skills
- Problem Solving
- Public Speaking
- Reading
- Recognition
- Recording Data
- Reporting
- Researching
- Role Playing
- Self/Peer Evaluation
- Simulation
- Small Group Skills
- Synthesis
- Using Time and Space
- Visualization
- Writing

**As a result of their initial review of educational resources to determine what was needed to create a quality educational product, MinnAqua decided to include in each MinnAqua lesson the academic skills the lesson addressed so educators could identify which skills they were teaching with each lesson or identify which lessons address a certain skill they want to cover with their students. The above list was compiled as a result of reviewing the *National Science Education Standards*, the American Association for the Advancement of Science's *Benchmarks for Science Literacy*, biology and earth science text books available from the MDE, educational products similar to the Leaders' Guide such as Project WET, Project WILD, and Project Learning Tree, and a variety of other curriculum development and science educator resources.

## APPENDIX E: MINNAQUA LESSON REVIEW QUESTIONNAIRE

**Directions:** **After you have read through the lesson and pilot tested it with students, answer the questions below. Please fill out one review sheet for each lesson. If you need more space, you can write your comments to questions on another sheet of paper and attach it to the questionnaire.**

**Reviewer ID Number:**

**Name of Lesson:** **Grade(s) Lesson Used With:**

*Questions 1 - 10: To what extent you agree or disagree with the following statements about the lesson you pilot tested?*

| | Strongly Disagree | Somewhat Disagree | Somewhat Agree | Strongly Agree |
|---|---|---|---|---|
| **1. I could easily understand the entire lesson the first time I read it.** | ☐ | ☐ | ☐ | ☐ |
| **2. The length of the lesson would turn me off from doing the lesson.** | ☐ | ☐ | ☐ | ☐ |
| **3. The lesson format was easy to follow.** | ☐ | ☐ | ☐ | ☐ |
| **4. The lesson accommodates different learning styles.** | ☐ | ☐ | ☐ | ☐ |
| **5. The lesson makes connections to students' daily lives.** | ☐ | ☐ | ☐ | ☐ |
| **6. The lesson builds on students' prior knowledge.** | ☐ | ☐ | ☐ | ☐ |
| **7. Students were interested in the lesson.** | ☐ | ☐ | ☐ | ☐ |
| **8. The lesson would fit into my regular curriculum.** | ☐ | ☐ | ☐ | ☐ |
| **9. I enjoyed teaching the lesson.** | ☐ | ☐ | ☐ | ☐ |
| **10. I would use the lesson again in the future.** | ☐ | ☐ | ☐ | ☐ |

*Questions 11 – 22: Think about your experience testing this lesson in your educational setting as you answer the following questions. Use the back of the questionnaire if more space is needed.*

**11. What did you like best about the lesson?**

**12. What did you like least about the lesson?**

**13. Did you encounter any obstacles while teaching the lesson?**

☐ Yes
☐ No → (Skip to Question 15)

**14. (If Yes) Describe the obstacles you encountered and how you overcame them.**

**15. Did you have any safety concerns while teaching the lesson?**

☐ Yes
☐ No → (Skip to Question 17)

**16. (If Yes) Explain your concerns and provide suggestions for making the activity safer.**

**17. Did you make adaptations to any part of the lesson?**

☐ Yes
☐ No → (Skip to Question 19)

**18. (If Yes) What adaptations did you make?**

**19. Did you use any resources other than the background information while preparing or teaching the lesson?**

☐ Yes
☐ No → (Skip to Question 21)

**20. (If Yes) Please list the resources you used with an explanation of what they were used for. Be as detailed as possible when describing the resource.**

**21. Please list or sketch any illustrations or diagrams you feel would be helpful to add to the lesson.**

**22. Overall, what do you feel students learned from the lesson?**

*Question 23 –29* ***(Asked of informal educators only)****: The following questions are to get a clear picture of the group with which you tested the lesson and the setting in which you carried out the pilot test.*

**23. Which of the following grades did you test the lesson with? (Check all that apply)**

☐ Grade 3
☐ Grade 4
☐ Grade 5
☐ Other grades (please specify):_____

**24. What was the total number of participants in the group you pilot tested the lesson with?**

**25. How many of these participants were in grades 3 – 5?**

**26. Where were the participants from? (Specify the town(s) and if applicable group name(s) – school, club, etc)**

**27. Was the lesson appropriate for this group?**

☐ Yes →(Skip to Question 29)
☐ No

**28. (If No) Explain why the lesson was not appropriate.**

**29. How would you describe the setting in which you tested the lesson?**

☐ Indoors at an informal institution (nature center, museum, park, etc.)
☐ Outdoors at an informal institution
☐ Indoors at a school
☐ Outdoors at a school
☐ Other (please explain)_____

**Additional Comments (please use the back of this sheet if necessary):**

***Thank you for taking the time to review this lesson!***
***Your input is very valuable.***

## APPENDIX F: QUESTIONS FOR FOCUS GROUPS

1. Please introduce yourself. Tell us your name, where you teach, the grade you teach (asked of formal educators only), the lessons you tested, and your overall impression of the lessons you tested.
2. Now think about the experience participants had with the lessons you tested. Begin by describing the group of kids you tested the lesson with - specifically the ages you tested the lessons with, the diversity of the children, and if you know if you had any English as a Second Language or special needs kids. Then describe how these students reacted to the MinnAqua lessons.
3. (Asked of formal educators only) We've designed these lessons to help support the new Minnesota Academic Standards. In what way do you feel these lessons are useful in supporting the standards?
4. Imagine you are one of the writers for the MinnAqua Leaders' Guide and could make changes so the Leaders' Guide is easier for educators to use. If you could make three changes to the Leaders' Guide, what would they be and why? Take a moment to jot down your responses and then we will discuss them. Changes can be anything, specific or general changes. (Probe them for why they listed something if they do not give a reason).
5. Many educators mentioned on their critiques that they had a hard time finding materials and that materials cost more than anticipated. Did you encounter this? How might this hinder teachers in doing the lesson? What can the DNR do to address the issue with materials for the lessons?
6. This Leaders' Guide will be made available in the future to educators who attend a MinnAqua workshop. What types of information and activities are important to include in a workshop so educators feel comfortable implementing this Leaders' Guide in their setting?
7. (Asked of formal educators only) One idea that the DNR has is to have a contact teacher for teachers who go to the workshops. There would be contact teachers possibly set around the state. The contact teachers would have direct contact with the MinnAqua Education Specialist in that region. The contact teachers would deliver support and answer questions for other teachers about lesson supplies, instructional best practices, standards alignment, assessment methods, subject content, and any other questions, concerns or ideas the

individual teachers would have about using the MinnAqua Leaders' Guide after they have attended the workshop. They could possibly have supplies that teachers could check out. How helpful would this teacher contact be for educators?

8. Have you shared your experience with other educators? If so, how have you shared that experience?
9. Did you utilize your DNR office or anyone from DNR to do the lessons?
10. Have you personally learned from doing the lessons?

## APPENDIX G: INSTRUCTIONS FOR FISHERIES LIAISONS

Your Name:

Name of Lesson:

1. Look at the Background Information and Activity sections of the lesson for their scientific accuracy. Please make any changes or suggestions directly on the lesson.

2. We've created these lessons to work in a formal, classroom setting, but we would still like most of them to be useful in an informal setting. Is this a lesson you feel you could do with participants you work with?
   ___Yes
   ____No

3. Please explain why you could or could not do this lesson with participants you work with.

## APPENDIX H: INSTRUCTIONS FOR INSTRUCTIONAL DESIGN EXPERTS

Instructions for Expert Review of Service-Learning Section

The MinnAqua Leaders' Guide has a service-learning section located in the Appendix that will include a brief description of service-learning, a list of service-learning resources for teachers and service-learning project ideas related to the content of Chapters 3 through 6. The project ideas are meant to give students the opportunity to apply the skills and knowledge they acquire from MinnAqua lessons to real world problems and community action through service-learning.

Review the service-learning section in the appendix. Also read through and become familiar with the lessons in Chapters 3 through 6. This will enable you to provide comments on the service-learning project ideas. Provide answers and comments in relation to the following questions on a separate document. Your feedback will be used to revise the service-learning section in the appendix.

1. The Minnesota Department of Education web site provides the following descriptions of service-learning.
    - "Service-learning is a form of experiential learning whereby students apply content knowledge, critical thinking and good judgment to address genuine community needs. Service-learning is a way of teaching and learning that engages all learners in hands-on academic projects in the community to meet learning objectives and strengthen communities."
    - "Service-learning provides the context in which learners can gain organizational, team and problem-solving skills, and other attitudes and capabilities necessary to succeed in learning and work."
    - "Service-learning in Minnesota seeks to increase the number of learners in service experiences that provide immediate relevance to academic studying as well as opportunities for learners to demonstrate how to solve real life problems."

    Are the service-learning project ideas appropriate based on the Minnesota Department of Education's definition of service-learning? If not, explain why a project idea is inappropriate and offer suggestions on how it can be changed to make it more appropriate for service-learning.

2. In the service-learning section there is a description of service-learning for educators who may not be familiar with service-learning. It was written so that it is clear what an authentic service-learning experience is and how it differs from other experiences such as community service. Does the description provide a clear, accurate definition of service-learning for educators? If not, what should be changed or added so the description of service-learning is clear and accurate?
3. The service-learning section includes various resources for educators wanting to learn more about service-learning and how their students can implement a project. Resources listed in the service-learning section include information regarding:
    - Funding sources for service-learning projects
    - Where to find more information on how to carry out service-learning projects including step-by step service-learning guides
    - Places to find community partners in service-learning
    - Local service-learning organizations that work with schools in Minnesota
    - Local, state and national organizations that have multiple resources and provide support to groups doing service-learning
    - Ways to link service-learning projects to larger efforts and programs such as National Youth Service Day

    Review the list of service-learning resources. Comment in relation to how this list might be used by educators. Is it a good resource for service-learning? Is the list comprehensive? If not, what could be added to the list so it is comprehensive? Can any of the resources be eliminated, changed or updated? If there are any resources you feel should be removed from the list, please indicate why you feel they should be removed.
4. The service-learning project ideas for a chapter are meant to incorporate the knowledge and skills students acquire by completing lessons in that chapter. Are any of the projects not related to resulting knowledge and skills obtained from doing activities in the indicated chapter? If not, indicate which project ideas do not relate to the chapter and why they do not relate. If possible, suggest ways in which the project idea could be revised so that it relates to the chapter activities.
5. What else would make the service-learning section more useful to teachers as a tool for engaging students in service-learning projects?

MinnAqua is looking for an endorsement stating how the Leaders' Guide can be used as a tool or resource for educators interested or doing service- learning projects. Please write a statement describing how you see educators utilizing the MinnAqua Leaders' Guide to support service-learning. Portions of your statement will be included in the Leaders' Guide. You will be given the opportunity to see and approve any quotes from your review prior to inclusion in the Leaders' Guide.

Instructions for Expert Review of K-2 Options

For every lesson there is a K-2 option. The intent of the K-2 options are not to "dumb-down" the material for a younger audience but to provide suggestions to help educators of younger children adapt the lessons to best support the emerging and developing abilities of these students.

Look at the K-2 option for each lesson. Were any of the options inappropriate for K-2 students? Explain why an option is inappropriate and offer suggestions to make it more suitable. You can write your comments directly on the lessons and/or create a separate document with your feedback. Your feedback will be used to revise K-2 options.

Instructions for Expert Review of Objectives, Assessments, and Rubrics

*Objectives*

Each lesson has objectives that are met by doing the Activity section of the lesson. The Activity includes the Warm Up, Lesson, and Wrap Up sub-sections of the lesson. For each of the lessons, read the activity and look at the objectives listed. Answer the following questions for each lesson. You can write your comments directly on the lessons and/or create a separate document with your feedback.

1. Are any of the objectives unclear or immeasurable? If so, describe what is unclear or immeasurable about them and suggest how the objectives could be revised to make them more clear or measurable.
2. Would any of the objectives listed not be adequately met by doing the lesson? If so, please indicate why the objective would not be met and make any suggestions on how the objective or activity may need to be changed.

3. What objectives may need to be added and why?

*Assessments*

Each lesson has assessment ideas based on the objectives of the lesson. For each of the lessons, read the assessment ideas and answer the following questions. You can write your comments directly on the lessons and/or create a separate document with your feedback.

1. Are assessment ideas authentic? If not, how could the assessment be changed so that it is authentic?
2. Does the assessment activity allow students to demonstrate they have learned and understood the objectives of the lesson? If not, explain why the assessments do not relate to the objectives and what could be done to strengthen the assessment activities.
3. Are assessments providing multiple ways to meet objectives to accommodate various learning styles? If not, offer suggestions on how assessments could be changed to address multiple learning styles.

*Rubrics*

Each lesson has a rubric that corresponds to one of the lesson's assessment ideas. For each of the lessons, look at the rubric and answer the following questions. You can write your comments directly on the lessons and/or create a separate document with your feedback.

1. Does the rubric address the objectives for the lesson? If not, what objectives are not being addressed? Is there a way to address them in the rubric?
2. Is it clear what students need to do to achieve a certain score for the various criteria? If anything is unclear, provide suggestions on how that part of the rubric should be changed to make it clearer.
3. Is the rubric appropriate for grades 3 – 5? If not, what changes need to be made so that it is appropriate?

Your feedback will be used to revise objectives, assessments and rubrics.

Instructions for Expert Review of Minnesota Academic Standards

(Same instructions for Math, Language Arts, Science, and Social Studies Standards)

Each lesson has Minnesota Academic Standards listed that are supported by doing the Activity section of the lesson. The Activity includes the Warm Up, Lesson, and Wrap Up sub-sections of the lesson. Standards are not listed based on assessment ideas because educators may not do the assessment piece and in some cases there may be more than one assessment listed.

For each of the lessons, read the Activity section and answer the following questions. You can write your comments directly on the lessons and/or create a separate document with your feedback.

1. For each benchmark listed, indicate to what extent the benchmark is addressed using the three levels below. Next to each benchmark, you can simply write the word "introduces", "partially", or "fully" to indicate the level.
    - Activity introduces the benchmark: The benchmark is mentioned or touched on, but not addressed in any depth.
    - Activity partially addresses the benchmark: Some of the benchmark is addressed, but not all of it. This may mean part of a benchmark is addressed in a rigorous way, but some other part of the benchmark is not covered completely (for example, the concept might be addressed in the activity but all of the vocabulary words stated in the benchmark are not used).
    - Activity fully addresses the benchmark: All parts of the benchmark are addressed. The activity is taught in such a way that students will have a complete understanding of the concepts and terms stated in the benchmark.
2. Are any of the standards and/or benchmarks listed not supported by the activity? If so, indicate which standards and/or benchmarks are not supported and include a brief note as to why they not supported.
3. Are there any standards and/or benchmarks missing that should be listed? For missing standards and/or benchmarks, list the standard and/or benchmark and a brief note of why it should be included.

Your feedback will be used to revise the standards listed on the lessons.

Instructions for Expert Review of

Minnesota's *Environmental Literacy Scope and Sequence*

Each lesson has scope and sequence concepts listed that are supported by doing the Activity section of the lesson. The Activity includes the Warm Up, Lesson, and Wrap Up sub-sections of the activity. Scope and sequence concepts are not listed based on assessment ideas because educators may not do the assessment piece and in some cases there may be more than one assessment listed.

For each of the lessons, read the Activity section and answer the following questions. You can write your comments directly on the lessons and/or create a separate document with your feedback.

1. Are the scope and sequence concepts listed supported by the activity? If so, indicate which concepts are not supported and describe why are they not supported.
2. Are there any scope and sequence concepts missing that should be listed? If so, list the missing concept and why it should be included.

Your feedback will be used to revise scope and sequence concepts listed on lessons.

## APPENDIX H: INSTRUCTIONS FOR EDUCATIONAL OUTREACH PARTNERS

Instructions for Review of Scouting Matrix

(Same instructions for Junior Girl Scouts and Cub Scouts)

MinnAqua has created a correlations matrix that illustrates how lessons and service-learning projects can help meet various requirements for scouting badges.

1. Look at the matrix to ensure that correlations identified in the matrix are correct. If you find any lessons listed that you feel would not work for the badge requirement indicated, explain why the lesson does not fulfill the badge requirement.
2. If you feel there are any badge requirements or lessons not listed that should be, indicate which badge requirement is addressed in a particular lesson along with an explanation of how that lesson fulfills that activity requirement.

You can make changes directly on the matrix, as well as type up a document where you can explain any changes/additions in more detail. Your feedback will be used to revise the correlation matrix.

Instructions for Review of 4-H Sportsfishing Correlation Matrix

MinnAqua has created a correlations matrix that illustrates how lessons can help meet various 4-H sportsfishing project area requirements.

1. Look at the matrix to ensure that correlations identified in the matrix are correct. If you find any lessons listed that you feel would not work for the requirement indicated, explain why the lesson does not fulfill the requirement.
2. If you feel there are any requirements or lessons not listed that should be, indicate which requirement is addressed in a particular lesson along with an explanation of how that lesson fulfills that activity requirement.

Your feedback will be used to revise the 4-H correlation matrix.

Instructions for University of Minnesota's Water Resources Center

1. The Lake Game has undergone changes based on teacher feedback, specifically related to the readability of the situation cards for third graders. Look over The Lake Game to ensure there are no glaring problems with the lesson. If you find anything you feel should be changed, indicate it on the lesson with an explanation of why it should be revised. Your feedback will be used to revise The Lake Game.
2. Review the lessons in Chapter 3, the Water Stewardship chapter. Comment on whether or not these lessons would be useful in delivering the mission of the Water Resources Center (WRC). Include an explanation of why the lessons would or would not be useful. Also comment on how the lessons could be utilized by the WRC staff. Your feedback will be used to continue to strengthen MinnAqua's partnership with the Water Resources Center.

Instructions for Identifying Outreach Possibilities

(Same Instructions for Great Lakes Aquarium, Cabela's, and Gander Mountain)

This Leaders' Guide was designed so it could be useful in both formal (school) and informal education settings. As an organization that does educational outreach, MinnAqua would like feedback on the potential to use the MinnAqua Leaders' Guide in your setting, outreach or training efforts. Look at the Leaders' Guide with this in mind. Answer the following questions by creating a separate document with your feedback.

1. As an informal education setting, how could you incorporate MinnAqua lessons into your current activities and outreach efforts?
2. How could the Leaders' Guide be useful in training your interpretive staff?

Your feedback will be used by MinnAqua to determine ways to work more closely with your organization to provide training to your staff and strengthen partnerships.

Instructions for RBFF Best Practices for Program Development

The Leaders' Guide was designed with the Recreational Boating and Fishing Foundation's Best Practices for Program Development in mind. Look at the Leaders' Guide and provide feedback of how the MinnAqua Leaders' Guide addresses the best practices. Your feedback will be used in the Leaders' Guide as reference for other educators wanting to develop programs based on the best practices.

Instructions for Review of

DNR 2000 Cornerstones and DNR Strategic Conservation Agenda

The MinnAqua Leaders' Guide was created to help meet the needs addressed in the DNR 2000 Cornerstones and DNR Strategic Conservation Agenda (Section 6). Both of these documents discuss the goal of reaching DNR's target audiences by providing them with environmental and natural resources stewardship education. Look at the Leaders' Guide. Report on how the MinnAqua Leaders' Guide fits into these two documents and addresses their goals and recommendations. Your feedback will be used as supporting documentation of the value of the new MinnAqua Leaders' Guide in helping meet the educational goals of DNR.