Assessing National Water Quality Education Needs for the Nonformal Youth Audience

Extension Service
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ASSESSING NATIONAL WATER QUALITY EDUCATION NEEDS FOR THE NONFORMAL YOUTH AUDIENCE

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BACKGROUND

The USDA Extension Service project to review youth water education needs was developed in support of youth and community water quality education goals of the National 4-H Environmental Stewardship Program and the USDA Cooperative Extension National Water Quality Initiative Team.

The Cooperative Extension Service is a national system which links state land grant universities to the United States Department of Agriculture and to each other. The system provides university research to every county in the country through county based faculty and a local outreach structure. Priority issues, such as water quality, are identified both through a process of consultation with the state land grant universities and through direction from federal government and congressional priorities.

NEED FOR PROJECT

In 1988, a national workshop for Extension Directors and Administrators identified water quality as one of the most significant of the national priority issues previously identified by the Cooperative Extension System.

Recognition of the significance of this issue prompted increased commitment to water education needs by Cooperative Extension nationwide. Extension leadership determined that the focus of this commitment must be "on people and what people do to enhance or protect water quality." Thus, youth and their families have a role in achieving the Extension water education goals. Involvement of youth is viewed as providing an opportunity for meeting youth leadership, career, and science education goals as well as conveying the importance of the role of youth in the welfare of the community.

To respond to the potential role for youth in water quality improvement, the National Water Quality Initiative Team of the Cooperative Extension Service identified two immediate needs:

- an assessment of youth water education needs and curricula, and
- establishment of a national review team of individuals representing private and federal organizations providing leadership to youth water education.

The 1991-92 "Water Curriculum Needs Assessment Project" was designed to meet these needs. The newly formed National Review Team was invited to advise the Water Quality Initiative Team on the assessment process and the need for further initiatives. Project outcomes were to include a policy guidance publication for the Cooperative Extension Service and a water curricula summary publication designed for use by water education leaders in national, state, and regional settings.

Assessing youth water education needs and curricula had several dimensions. Although a multiplicity of water education materials have been available, it has not been readily apparent to the educator what water topics should be emphasized to enable society to meet its water quality goals and which materials were available to teach these concepts. Another consideration was the increasingly recognized need to improve literacy in basic science processes and environmentally related critical thinking skills among our citizenry. Finally, the Cooperative Extension emphases on providing learning through experiential education strategies and on serving diverse audiences encouraged a review of youth water curricula for attention to sensitivity to these needs.

Because the Cooperative Extension Service provides education in the nonformal, or out of school/noncredit setting, project investigation design focused on providing information that would be useful for nonformal education programs. An underlying goal of the project was to gather impressions about how nonformal education strategies could complement youth water education needs and opportunities.

GOALS OF PROJECT

The goals of the Water Curriculum Needs Assessment Project could be summarized as follows.

GOAL I --Identify youth water quality learning objectives for the nonformal setting.
Products leading to this goal include:

1. Key water topics listing: water education needs identified by topic. (See Appendix H.)
2. Water topic concept outline: listing of subtopics that relate to each key water topic. (See Appendix H.)
3. Key environmental learning skills listing: a summary of skills identified as necessary to an ability to make decisions and take actions about the environment. (See Appendix H.)
4. Key instructional setting considerations listing: a listing of possible methods of providing learning materials and experiences. (See Appendix H.)
5. Proposed youth water quality learning objectives for the nonformal setting. These were developed in cooperation with the National Review Team as a listing of water education goal statements which would describe the water topics from a nonformal education point of view. (See Appendix J.)
6. Preliminary summary of community action strategies which have been used with youth or with the potential for youth involvement. (See Appendix G.)
7. Preliminary summary of key concepts for design of successful nonformal education materials and experiences. (See Appendix K.)

GOAL II --Select and categorize water quality curricula according to objectives developed under Goal I.
Products leading to this goal include:

1. A comprehensive bibliography of youth water curriculum materials, and a listing of water education bibliographies. (Listing of reviewed materials, see Appendix F. Detailed information about reviewed materials is available in companion guide, in development, for water education coordinators. Water education bibliographies, see Appendix D. A comprehensive bibliography of materials was not published as part of this project, but is available in photocopy version from Elaine Andrews, University of Wisconsin.)
2. Criteria for selecting water quality curricula to review for potential use in the nonformal setting. (See Appendix E.)
3. Summary of approximately 75 curricula according to water and environmental topics, and instructional setting considerations. (See Appendix I.)

GOAL III --Categorize relevant curriculum materials, delivery systems, and model programs in an easily understandable and accessible format.
Products leading to this goal include:

1. Publication for distribution to State Cooperative Extension offices, Federal and State agency education personnel. Publication will include:
   a. Brief explanation of background of Needs Assessment Project
   b. Youth water quality learning objectives for the nonformal setting.
   c. Water concept outline.
   d. Brief suggestions for choosing curricula for a particular nonformal setting.
   e. Quick look at selected curricula: in chart form according to key summary topics.
   f. Explanation of how curricula were selected for review.
   g. Brief summary of each curriculum reviewed.
   h. Summary of unique materials and strategies not reviewed as curriculum,with annotated source
   i. Brief summary of needs for the future.
2. Diskette listing categories of water topics, environmental education learnings and instructional setting present for each curriculum reviewed. Diskette to be accessed by word processing "text search" methodology.

GOAL IV --Identify and communicate priorities for meeting targeted objectives of 4-H and youth education about water quality. Products to include:

1. Draft document for review by National Team and Water Issues Team.
2. Final revised document.

THE NATIONAL WATER QUALITY EDUCATION NEEDS REVIEW TEAM

A number of government and private organizations have been involved in developing and promoting water education for many years. To benefit from their combined experiences, a National Review Team composed of individuals representing key institutions among these groups was formed. The group provided advice to the Cooperative Extension Service on youth water education resources, needs, and strategies for addressing unmet needs. Individuals and cooperating institutions that agreed to participate in this project are listed in the front of this publication and in Appendix A.

The National Review Team met twice during the scope of the needs assessment project. The proposed strategy for assessing water education needs was reviewed during the first meeting. The second meeting provided review of the results of the needs assessment process and final recommendations to the CES National Water Initiative Team. The recommendations found in this report are a result of the review process.

THE NEEDS ASSESSMENT PROJECT
Identifying Water Education Needs

In many cases, water curriculum has evolved to meet specific water education needs, such as education about the causes of groundwater pollution or the need to conserve water. In the Needs Assessment Project, an **overview** of education needs was sought to better determine the strengths and weaknesses of the scope of available materials.

Nine key water education topics were identified through review of a variety of national, regional and state resources and the recommendations of the national review team. The topics were:

- the science of water
- water related ecosystems
- drinking water supply: quantity and quality
- water use
- sources of water pollution/contamination
- water quality: risk assessment and reduction
- management and protection strategies for specific uses
- government and citizenship issues
- water related careers

Printed resources used to determine water education topics are listed in Appendix B.

Resources included a number of Federal Cooperative Extension studies and separate studies by five state Cooperative Extension systems. A sampling of Cooperative Extension state plans of work for the water initiative were also reviewed as a method of confirming CES identified needs.

Input from other Federal agencies was included through review of reports or products of the United States Department of Agriculture, the United States EPA Great Lakes National Program Office, and the United States Geological Survey. National Review Team members participating in the process from Federal agencies represented the United States Environmental Protection Agency, the United States Department of Fish and Wildlife, the United States Forest Service, the United States Geological Survey, the Soil Conservation Service, and the Tennessee Valley Authority.

The perspective of private organizations was provided through review of a report published by the Freshwater Foundation and members of the review team from the America's Clean Water Foundation, American Water Works Association, the Baltimore Aquarium, Project GREEN and Southern Illinois University's Nature Center.

Water education topics derived from curricula reviewed for this project were added to the water topics list as appropriate.

The overall water education topic list was reviewed by the National Review Team. Analysis of printed studies and discussion by the National Team resulted in a number of subtopics related to each major topic. Water education topics and subtopics are listed in Appendix H.

Identifying Science and Environmental Education Learning Goals and Objectives

Project Goal I specified that a project outcome would include youth learning objectives appropriate to nonformal education about water. Water education goals were to relate to the development of environmental problem solving skills, and to include science literacy and career components. This outcome required a search for relevant concepts about learning strategies.

Environmental education skills identified include five areas:

- ecological foundations
- conceptual awareness of environmental issues and values
- investigation skills
- evaluation skills
- environmental action skills.

Three of these five areas also describe skills to be developed as part of science literacy.

Curriculum format considerations identified include:
- indicated grade level of materials
- applicability to diverse audiences
- instructor materials: content and presentation style
- student materials: content and presentation style
- instructional environment: indoor or field
- lesson types: seatwork alternatives and action alternatives
- applicable subject areas (science, social studies, math, language arts, the arts)

Identification of materials which addressed disciplines other than science was deemed relevant to a holistic understanding of the importance of water in our lives.

The effort to gather ideas about appropriate learning goals and objectives was limited by targeting the review to a study of environmental education strategies and nonformal education format needs. The environmental education skills list used in the curriculum assessment process were based on internationally recognized efforts to identify needs (Tbilisi, 1978) and to develop a taxonomy of environmental education objectives (Hungerford, Peyton, Wilke, 1980; Roth, 1990). A previously designed evaluation tool for evaluating the environmental education component of curricula helped to verify environmental education skills chosen for the review process (Gardella, 1986).

A draft version of "Curriculum Development For Issues Programming" helped to provide a philosophical frame of reference for materials format considerations (developed by USDA Cooperative Extension; Joy Cantrell, 1991). This document is one of the few available that provides guidance on appropriate strategies for nonformal education. This comprehensive handbook stresses an experiential learning model. Ideas about practical goals for applying environmental education and experiential learning strategies were derived from materials by the Minnesota Department of Education (1991) and Cornell Cooperative Extension (1989).

A listing of environmental education skills and nonformal education format possibilities identified through the needs assessment process can be found in Appendix H.

Youth Water Curriculum Review Process

In order to compare available youth water education materials with the water topics, environmental education skills, and format choices identified through earlier steps of the project, a curriculum review process was developed. Each curriculum chosen for review was read in its entirety. The review process noted the presence or absence of particular concepts or skills listed in the checklists found in Appendix H. The quality of the educational processes provided by the materials was not rated in any way. However, subjective comments about apparent trends in material quality have been provided along with the statistical summary. Results of the review process were intended to improve our understanding of youth nonformal water education materials strengths and gaps.

Seventeen water education bibliographes and numerous individuals including members of the

National Review Team were consulted to identify appropriate materials to review. Bibliographic references are listed in Appendix D. Some of the bibliographies listed in Appendix D were discovered as part of the curriculum review process. Although there was a lot of repetition of well known materials in most bibliographies, each new bibliography contains some materials not listed in others. Not all potential materials discovered through bibliographies found during the study were reviewed due to time limitations. Additional materials and references continue to be collected as possible. (A proposed effort to personally interview Cooperative Extension state water and environmental education contacts to provide a more comprehensive picture of state and regional resources was not completed due to limited project time.)

A comprehensive, but not annotated, bibliography of youth water education materials was developed as part of the review process. The bibliography, a compilation of relevant materials listed in consulted water bibliographies and materials identified through other routes, includes over 1,500 references. There are no plans to provide the bibliography in a published form.

Because of the tremendous volume of materials available to support youth water education, it was necessary to find some method of limiting materials to be reviewed. Overall goals of the project plus specific water education, environmental education, and format goals were used to develop curricula review criteria. Criteria for choosing curriculum was reviewed by the National Review Team. Specific criteria are listed in Appendix E.

Identified criteria described characteristics of individual curricula and defined overall characteristics to be applied to the curricula as a group. If aspects of targeted overall criteria were not met through individually selected materials, other materials were sought out to meet those objectives. Every topic and subtopic determined to be significant to the goals of this project was present in at least one curriculum chosen for review.

Curricula chosen for review are listed in Appendix F. For easy reference, materials in Appendix F are separated into three lists: state/regional materials, national materials, and state Cooperative Extension materials. Unique materials which did not qualify for the curriculum review process, but could help to meet other goals of the project are listed in Appendix G. Materials listed in Appendix G may help provide the basis for new innovative water education programs for youth.

State and regional curriculum materials identified for review come from 25 states. The list includes materials developed by Cooperation Extension 4-H programs, state agencies, and regional agencies or groups.

State/regional materials reviewed were from the following areas:

Northeast: Massachusetts, New York, Vermont
Middle Atlantic: Maryland, Pennsylvania, Virginia
South: South Carolina, Tennessee
Midwest: Illinois, Indiana, Iowa, Kansas, Michigan, Missouri, Nebraska, North Dakota, Ohio, Wisconsin
Far West: Montana, Nevada, Utah
West Coast: California, Oregon, Washington
Southwest: Arizona
Non-Continental: no curricula reviewed

Reviewed 4-H materials are included in the state/regional listing, but are also summarized separately for convenience.

Fourteen of the reviewed materials were prepared by a national organization or business or could be appropriately used anywhere in the country. These materials were produced by groups such as the American Water Works Association, Water Pollution Control Federation, National Wildlife Federation, Project Wild, and the LaMotte Company.

All regions were represented with a curriculum from at least one state in that region. In addition, many curricula listed in this summary were designed with a regional scope and may adequately meet the needs of states not specifically represented.

The following states were not represented in the review process due to one or more of the following reasons: materials have not been

developed for that state, available materials do not meet curriculum review criteria, or curriculum examples were not readily available. However, many materials from these regions were identified and listed in the unique materials listing, Appendix G.

States **not** represented in the review process:

Northeast: Connecticut, Maine, New Hampshire, Rhode Island
Middle Atlantic: Delaware, New Jersey, Kentucky, West Virginia
South: Alabama, Arkansas, Georgia, Florida, Louisiana, Mississippi, North Carolina, Oklahoma, Texas
Midwest: Minnesota, North Dakota
Far West: Wyoming, Colorado, Idaho
West Coast: all states represented
Southwest: New Mexico
Non-Continental: Alaska, Hawaii

Each water curriculum chosen for review was summarized by noting the presence of topics, skills, or format choices listed on the three assessment checklists developed as a result of study of youth water education needs. The three checklists: water topics, environmental education goals, and curriculum format, are included in Appendix H.

Individual curriculum were reviewed by noting the presence or absence of a particular water topic, environmental education skill, or aspect of the curriculum format. If a particular topic was not addressed directly, but an understanding about the topic could be inferred from the curriculum content, it was noted as a minor emphasis, but not tabulated in the percentage summary.

YOUTH WATER CURRICULA SUMMARY FINDINGS

To allow evaluation of the curricula as a whole, findings from individual curriculum summaries were tallied by subtopic. Consideration of each subtopic by the curricula overall was identified by determining the percentage of mention, as either a major or minor emphasis, of that subtopic. The percent of the curricula that included a subtopic as a major component was also calculated.

Percentages of "mentions" and "major component" for each subtopic are listed in Appendix I.

The following summary represents findings about water topics and environmental education skills from reviewing 57 curricula which included 64 separate curriculum pieces.

Youth Water Curricula: Water Topics

An overview of how well available curricula cover the key water topics identified through review of published materials and discussion by the National Review Team is summarized in Table I. Curriculum that emphasized **any** water subtopic under a particular water topic were counted as addressing that topic. Table I makes it clear that the "science of water" is well covered throughout curricula materials and that "water careers" are poorly covered. Other topics deemed important by the needs assessment process were present in at least two thirds of the curricula.

TABLE I - Emphasis on Water Topics by Reviewed Curricula

Topic	*No. of curriculum pieces*	*Percent of curriculum*
Science of water	59	92%
Water-related ecosystems	46	72%
Drinking water supply	42	66%
Water use	44	69%
Pollution sources	45	70%
Water quality	40	63%
Management & protection	41	64%
Government & citizenship	40	63%
Water-related careers	5	8%

To assist understanding about the strengths and gaps of existing curricula, a summary of the percentage emphasis of each subtopic listed under the key water topics is provided.

The following tables, II through X, provide information about the emphasis of reviewed curricula on specific water topics. The percentage listed for each subtopic indicates the percent of all reviewed curricula which included an emphasis on that subtopic. To aid interpretation of the table for each topic, low and high emphases are reiterated and subjective commentary about the materials is provided. Review of individual curriculum provided an additional understanding of curricula strengths and gaps not readily apparent from statistical evaluation. A generally observable trend is that while materials reflect the results of this study as to which key topics to present, curriculum materials do not agree on what aspect of any particular topic is most important to convey.

TABLE II -Degree to Which "Science of Water" Subtopics are Represented by Reviewed Water Curricula

Science of Water Subtopics	*Percent of curricula*
Properties	43%
Importance to living things	52%
Hydrologic cycle	66%
Geology/hydrology dynamics:	69%
•surface water	38%
•groundwater	48%
•regional supply	12%

Although "science of water" topics are covered in 92% of the curricula, materials do not agree on what aspect of the science is most important to convey. The **properties of water** is the water science subtopic least emphasized, present in **43%** of the curricula. In general **geology/hydrology dynamics** was emphasized in **69%** of the curricula, but emphasis on specific sources of water ranged from **12%** for **regional supply** to **48%** for **groundwater.**

There is a lot of material about this topic. However, the emphasis is on the elementary level. Vocabulary used to describe water science is often too complex for elementary students leaving a question about what the appropriate age level for teaching water science should be. Efforts to bridge concepts about the properties of water and why it is important to understand the properties of water are minimal. A curriculum which stands out in its teaching of water geology/hydrology is the Missouri "Groundwater Protection Curriculum Guide."

TABLE III -Degree to Which "Water Related Ecosystem" Subtopics are Represented by Reviewed Water Curricula

Water Related Ecosystems Subtopicss	*Percent of curricula*
Types of Ecosystems	54%
•lakes	12%
•rivers	11%
•ponds	12%
•streams	23%
•wetlands	22%
•watersheds	20%
•oceans	14%
•riparian	2%
•estuaries	11%
•ephemeral systems (intermittent)	9%
Major regional resource	22%
Ecological concepts	48%

Major regional resources were the subject of curriculum in **22%** of materials, but this is not a measure of strengths or weakness. It is more an indication of particular regional water education needs. At least **one type** of water related ecosystem was emphasized in **54%** of the curricula. **Ecological concepts** were emphasized in **55%** of the curricula.

Although ecological concepts are addressed by many curricula, they are handled superficially by most materials reviewed. Individual ecosystems are viewed in isolation, not as part of the water cycle. Individual ecosystems are presented in a modular format rather than

integrating them for the student with other water concepts. Information and activities about estuaries and ephemeral systems were rarely provided. The Wisconsin materials, "Caring for Our Lakes," provides an example of a successful effort to teach about ecosystems.

TABLE IV -Degree to Which "Drinking Water Supply" Subtopics are Represented by Reviewed Water Curricula

Drinking Water Supply Quantity and Quality	*Percent of Curricula*
Delivery:	46%
•community/public	37%
•private	17%
Water quality control	22%
•well concerns	5%
•testing	18%
_public	11%
_private	8%
Treatment of drinking	34%
•public drinking water	26%
•home treatment	3%
Lifestyle impacts/conservation	49%

Home treatment of drinking water (3%) and **water quality control issues** (well concerns at 5%; private water testing at 8%) were least emphasized in the curricula. **Lifestyle impacts/conservation** was emphasized in **49%** of the curricula.

Materials about drinking water supply provide a good example of curricula which get at life style impacts of water use. However, this topic is most often addressed in its own curriculum and is not integrated with other water concepts. Very little material is available about well technology/concerns; water testing; or home treatment of water. Materials provided by the HachCompany most successfully address water testing and treatment.

TABLE V -Degree to Which "Water Use" Subtopics are Represented by Reviewed Water Curricula

Water Use Subtopics	*Percent of Curricula*
Use of water by many groups:	62%
•commercial	29%
•industry	32%
•agricultural	25%
•municipal	31%
•domestic	37%
•power production	15%
•recreation	6%
Conservation by user groups	9%
Issues/conflicts between user groups	9%

Recreational use at **6%** and **issues/conflicts between user groups** at **9%** were emphasized least in this category. The general concept of **use of water by many groups** was emphasized in **62%** of the curricula.

Water use concepts, especially issues and conflicts between user groups, were best taught in curriculum examples using role playing activities. The suggested role playing activities also provide a good avenue for development of evaluation skills. Curricula provided few water conservation activities other than those specifically about domestic conservation. Community water conservation was best covered in various curricula by suggesting invitation of a community water user as part of the education process. "Decision Making on the Chesapeake Bay" provided model strategies for handling this topic.

TABLE VI -Degree to Which "Pollution/Contamination Sources" Subtopics are Represented by Reviewed Water Curricula

Water Pollution/Contamination Sources	*Percent of Curricula*
Point source	51%
•agricultural sources	18%
•public and/or private wastewater	42%
•industrial & business hazardous wastes	35%
•energy production wastes	15%
Nonpoint source	51%
•agricultural	31%
•urban	32%
•forestry	6%
•mining	8%
•atmospheric deposition	12%

Nonpoint pollution source subtopics of **forestry (6%), mining (8%),** and **atmospheric deposition (12%)** were least emphasized in the curricula. The general topics of **point** and **nonpoint source pollution** were emphasized in **51%** of the curricula.

Under the point source pollution topic, most emphasis was on public and private pollution through improper wastewater and solid waste management. Industrial waste and energy production impacts received limited exposure. Only one curriculum mentioned radioactive pollution and thermal pollution. Nonpoint pollution was discussed in many curricula without any detail. Contamination from forestry and mining activities was rarely mentioned. Education about atmospheric deposition and acid rain issues must be derived from supplementary materials.

TABLE VII -Degree to Which "Water Quality" Subtopics are Represented by Reviewed Water Curricula

Water Quality: Risk Assessment and Reduction	*Percent of Curricula*
Curriculum addresses the concept of how risk decisions are made	2%
Impact of water quality on health	23%
Impact of water quality on human food sources	3%
Impact of water quality on plant and animal communities	25%
Understanding and reducing risks for specific contaminants	42%
•bacteria	17%
•pesticides	15%
•sediments	26%
•nitrates	18%
•salinity	8%
•other chemicals	28%
Water quality indicators	22%

Although 63% of curricula included this topic overall, particular subtopics did not get a lot of attention. Least emphasized subtopics were: addressing the **concept of how risk decisions are made,** emphasized in **2%** of the curricula and **impact of water quality on human food sources,** emphasized in **3%** of the curricula. **Understanding and reducing risks for specific contaminants** was emphasized in **42%** of the curricula. However, the percentage of curricula addressing a specific contaminant ranged from 8% for salinity to 26% for sediments.

Curricula included more emphasis on understanding chemical risks than how to reduce them. Hach Company materials were the only ones to provide education about how risk decisions are made. Even then, the topic discussion was limited, addressed through teaching about parts per million, etc. Few materials review the impact of water quality

on human food. Most education materials about water quality indicators specify stream studies. In general, lake and ocean materials do not provide activities about water quality indicators.

TABLE VIII -Degree to Which "Management and Protection" Subtopics are Represented by Reviewed Water Curricula

Management and Protection Strategies for Specific Uses	*Percent of Curricula*
Zoning strategies	32%
•shorelands/flood-plains	3%
•wetlands	3%
•wellhead/ground-water recharge areas	11%
Chemical storage	8%
Recreational use	3%
Wastewater treatment	42%
Solid waste management decisions	29%
Agricultural management practices	18%
Wildlife habitat/land stewardship management	15%
Natural disasters	5%
Chemical emergencies	6%
Development issues/pressures	14%

Zoning strategies for floodplains and wetlands (3%), recreational use (3%), natural disasters (5%), and **chemical emergencies (6%)** were least emphasized in the curricula. **Wastewater treatment** was emphasized by **42%** of the curricula.

Many materials provide information about wastewater treatment and solid waste management. But few materials provide education about zoning strategies, or management of natural disasters and chemical emergencies.

TABLE IX -Degree to which "Government and Citizenship" Subtopics are Represented by Reviewed Water Curricula

Government and Citizenship Issues	*Percent of Curricula*
Policy issues	26%
•water quality	32%
•water quantity	17%
Role of local government in developing protection strategies	20%
Citizen involvement & participation	45%
Legislation, regulation, incentives/disincentives	31%

Water quantity policy issues were least emphasized, present in **17%** of the curricula. However, policy issues in general were emphasized in 26% of the curricula. **Citizen involvement and participation** was emphasized in **45%** of the curricula.

About half of the materials had some focus on these issues. Water quality was emphasized twice as much as water quantity as an issue. "Local Watershed Problem Studies" (Wisconsin) materials included an excellent appendix discussion of citizen action opportunities with local government.

TABLE X -Degree to Which "Water Related Careers" Subtopics are Represented by Reviewed Water Curricula

Water Related Careers	*Percent of Curricula*
Technical	6%
Professional	9%

Technical water related careers were emphasized in **6%** of the curricula. **Professional water related careers** were emphasized in **9%** of the curricula.

Clearly, few materials are available in this area. "Always A River" (Ohio) and "Los Marineros" (California) were notable exceptions. Materials developed by EPA and the National Aquarium may fill this gap to some extent. Those are listed in Appendix G, unique materials.

Youth Water Curricula: Environmental Education Goals

An overview of how well available curricula cover environmental education skills identified through review of published materials and discussion by the National Review Team is summarized in Table XI. Curriculum that emphasized any environmental education subtopic under a particular skill were counted as addressing that skill. All five environmental education skills were well covered throughout curricula materials. However, opportunities to develop evaluation skills and environmental action skills were less consistently available in the curricula than ecological foundations, conceptual awareness, and investigation skills.

Institutions which have chosen to develop water education materials seem to recognize the need for opportunities to develop environmental education skills as part of this topic, but differ in the degree of emphasis and in the instructional format provided for learning the opportunity.

TABLE XI -Degree to Which Environmental Education Subtopics are Represented by Reviewed Water Curricula

Subtopics	*Percent of total curricula*	*No. of curricula*
Ecological foundations	91%	58
Conceptual awareness: issues & values	88%	56
Investigation skills	95%	61
Evaluation skills	73%	47
Environmental action skills	73%	47

To assist understanding about the strengths and gaps of existing curricula, a summary of the percentage emphasis of each subtopic listed under the key environmental skill topic is provided.

As with the water topics, tables XI through XV, provide information about the emphasis of reviewed curricula on specific environmental education skills. The percentage listed for each subtopic indicates the percent of all reviewed curricula which included an emphasis on that subtopic. To aid interpretation of the bar graph for each topic, low and high emphases are reiterated and subjective commentary about the materials is provided. Review of individual curriculum provided an additional understanding of curricula strengths and gaps not readily apparent from statistical evaluation.

TABLE XII -Degree to Which "Ecological Foundations" Subtopics are Represented by Reviewed Water Curricula

Ecological Foundations	*Percent of Curricula*
Individuals & populations	46%
Interactions & interdependence	60%
Environmental influences & limiting factors	66%
Biogeochemical cycling	65%
Community & ecosystems concepts	46%
Homeostasis (balance of nature)	9%
Succession	9%
Humans as ecosystems components	20%
Ecological implications of human activity	62%

Homeostasis (9%) and **succession (9%)** were emphasized least in the curricula, with the lack of attention to these subtopics contrasting sharply with the presence of this general skill in 91% of water education curricula. **Environmental influences (66%), biogeochemical cycling (65%), ecological implications (62%),** and **interactions/interdependence (60%)** were fairly well covered in the curricula.

Few materials included education about homeostasis, succession or human ecosystem components. The most common exposure to concepts about succession occurred in discussions of eutrophication. The most popular ecological foundation topic addressed was the water cycle.

TABLE XIII -Degree to Which "Conceptual Awareness" Subtopics are Represented by Reviewed Water Curricula

Conceptual Awareness: Issues and Values	*Percent of Curricula*
Ecological impact of human culture on environment	71%
Ecological impact of individuals on environment	52%
Ecological& cultural implications of environmental issues	38%
Alternative alolutions	63%
Cultural implications of alternative solutions	32%
Investigation as prerequisite to decision making	32%
Role of human values & need for personal values clarification in decision making	34%
Need for responsible citizen action in environmental issue remediation	65%

Cultural implications of alternative solutions and **investigation as a prerequisite to decision-making** were least emphasized, present in **32%** of the curricula. **Ecological impact of human culture on the environmental** was emphasized in **71%** of the curricula. While overall attention to this topic was high, 88%, in the curricula, two thirds of reviewed curricula did not provide attention to half of the subtopics.

Examination and exploration of personal values received remarkably low emphasis in curricula reviewed. Attention to personal values was most likely to appear in activities for elementary students who were encouraged to talk about how they feel about water as they play with it, or to remember times they used water. The skill of recognizing alternative solutions for various concerns was taught by offering alternative solutions rather than by

having youth suggest alternative solutions. Most materials did not discuss the cultural implications of chosen alternatives.

TABLE XIV - Degree to Which "Investigation Skills " Subtopics are Represented by Reviewed Water Curricula

Investigation Skills	*Percent of Curricula*
Shape questions	22%
Formulate hypotheses	52%
Make observations and measurements	95%
•Natural science settings	83%
•Social science settings	46%
Perform tests	71%
Analyze results with respect to:	71%
•Ecological implications	58%
•cultural implications	29%

Shaping questions was least emphasized, present in **22%** of the curricula. **Making observations and measurements** was emphasized in **95%** of the curricula. Investigation skills are clearly valued as an important part of water education, present in 95% of the curriculum, but use of the skills in curriculum activities seems to rely on observation and measurement opportunities.

In addition to a low emphasis on the skill of shaping questions before developing an hypothesis, few curricula encourage youth to design their own experiments or focus on questions they might have about natural or political phenomena. The emphasis was on repeating previously identified relationships. Another weakness in the materials is a lack of specified discussion of the link between the investigation activity and its application to a practical situation. "Discover Wetlands," "Sensing the Sea," "WOW, the Wonder of Wetlands," and "Living in Water" each provide good examples of strategies for teaching investigation skills.

TABLE XV -Degree to Which "Evaluation Skills" Subtopics are Represented by Reviews Water Curricula

Evaluation Skills	*Percent*
Identify alternative solutions	62%
Identify values associated with alternative solutions	32%
Evaluate alternative solutions with respect to cultural & ecological implications	40%
Identify & clarify personal values & positions as they relate to issues & solutions	52%
Change personal values & positions given new information	57%

Identifying values associated with alternative solutions was least emphasized, present in **32%** of the curricula. **Identifying alternative solutions** was emphasized in **62%** of the curriculum.

Opportunities to evaluate information and values was mostly **implied** in the curriculum. Few materials emphasized the development of this skill, which is crucial to responsible citizen participation in policy issues. Few materials provided an opportunity for youth to think about **how** a person changes their values. Pre- and post- value measurements are an example of how this can be done. "A Hidden Treasure" and "Nevada In School Curriculum" both provide opportunities for developing evaluation skills.

TABLE XVI -Degree to Which "Environmental Action Skills" Subtopics are Represented by Reviewed Water Curricula

Environmental Action Skills	*Percent of curricula*
Skills to work towards ends consistent with individual values	62%
•persuasion	20%
•consumerism	43%
•political action	9%
•legal action	3%
•ecomanagement	35%
•education	17%
•community problem solving	20%
Decision-making regarding environmental action strategies	38%
Opportunities to apply environmental action skills	55%
Evaluate influence of actions taken to effect balance between quality of environment	31%

Evaluating the influence of actions taken to affect the balance between quality of life and quality of the environment was emphasized in **31%** of the curricula. Several **skills used to work towards ends consistent with individual values** were lacking in most curricula. Overall, **skills used to work towards ends consistent with individual values** were emphasized in **62%** of the curricula.

Environmental action skills are taught primarily through individual actions appropriate to the home or school setting. When addressed at all, communication action skills are taught primarily through role play and simulation activities. Behaviors suggested for environmental action include: composting, recycling, conserving water, and letter writing. Explicit discussion of the balance between the quality of life and the quality of the environment is limited.

Youth Water Curriculum: Curriculum Format

Curricula emphasis on different types of curriculum format choices was also tabulated and summarized. However, a discussion of the percentage of use of different techniques is not useful for the most part. While information about the curriculum format of individual curricula will be useful to practitioners, it does not help develop a sense of overall water curricula needs. Tabulation details are present in Appendix I.

A few topics present an exception to this general conclusion and can provide some data useful for understanding youth water education needs.

One topic of importance to USDA Cooperative Extension goals was the extent to which water education materials are applicable to diverse audiences. Curricula summary tabulations showed that **58%** of the curricula provided materials that were relevant to both genders. Though many of these continued to use universal masculine words such as "man" for "humans," "mankind" for "humankind," and "man-made" for "human-made." Only **23%** provided materials relevant to ethnically diverse audiences and **6%** provided materials relevant to audiences from diverse socio-economic classes. No materials provided strategies for special learning needs. Some materials were clearly inappropriate to one or more aspects of diversity.

Presentation of instructional materials is another format choice made by curriculum developers. Most materials seemed to have instructors' and students' needs in mind. **Stated goals and objectives** were present in **86%** of the curricula, **lesson plans** in **82%**, and **further study suggestions** in **60%**. Student materials included **activity instructions** in **65%** of the materials and some type of **worksheet** in **86%** of the curricula. Keeping costs low, but perhaps more difficult for the nonformal setting, **80%** of activities relied on instructor-made photo copies.

Instructional setting requirements are important for nonformal education strategies. **82%** of the

curricula provided **indoor activities which could be conducted at home.** 74% of the curricula provided some type of activity or ideas about activities which could be conducted as **community action. Natural sites** were employed in 43% of the curricula, **community facilities or agencies** in 48% of the curricula, and **neighborhoods** in 32% of the curricula.

Because of the need to emphasize experiential education, lesson types were reviewed for their emphasis on different types of seatwork and action activities. **Most** curriculum reviewed included some type of **action activity. Experiments** were emphasized in 72% and **drama/artwork/models** were emphasized in 77% of the curricula. **Field observation/measures** was emphasized in 66%. **Individual work** was provided in 85% of the materials while **team work** was emphasized in 77%.

A diversity of subject matter was represented in the curricula ranging from a **science** emphasis in 100% of the curricula to an **art** emphasis in 49%.

CONCLUSIONS ABOUT WATER EDUCATION NEEDS

Several general needs have been identified through the curriculum review process. These are listed below. Some conclusions are addressed through recommendations for future efforts by the USDA Cooperative Extension. Other needs are best met through the efforts of other national or regional groups.

- Water education instructors, be they volunteer leaders, 4-H agents, or teachers, will need preparation time to learn about the provided materials. For best application of water education, there will be a continued need for training workshops for teachers and volunteer leaders. Training should focus not only on content, but on the process of leadership and instruction. Some curricula, such as Los Marineros, provide good guidelines on instructor training.

- There is a need for supplemental materials for the youth themselves, such as booklets, video tapes, software, etc. Reviewed curricula included much more material for instructors than for students. Student materials were typically photo copied from the teachers' materials.

- There is a need to develop educational strategies to address a progressive exposure to water topics. Some water topics, such as the water cycle, are repeatedly emphasized at every age level. Some, such as the science of water, may be emphasized with children who are too young to appreciate its importance and connection to more immediate, environmental concerns.

- Teaching of water science concepts to elementary youth needs to be handled in a different way. Most water chemistry concepts are presented without adequate student preparation. In many examples, the suggested age range for these materials is too young. Macro concepts such as turbidity and pH are better handled.

- Education about water related ecosystems needs to be approached in a more integrated way. There is a need for materials which help youth understand how different ecosystems are related to each other and how ecosystem concepts relate to the other water education topics.

- None of the reviewed curricula integrated ecology and science study with everyday life needs. Drinking water and conservation concepts provide opportunities where this could happen. In general reviewed water curricula have not provided an integrated look at ecosystems, but are modular in approach. For example, a curriculum which focuses on drinking water quality or conserving a particular source of water, such as groundwater, may not provide activities which would allow the youth to integrate what they have learned about that topic with an overall understanding of

their personal role in protecting water and the components of its regional ecosystem.

•Development of a packet of educational materials on chemical risk assessment and reduction would fill a gap in the water education materials and is appropriate to education needs identified by Cooperative Extension.

•There is a need for materials which address the following concepts: water testing, home water treatment, water emergency prevention strategies, and water careers.

•There is a need for materials appropriate to the following audiences: special learning needs audiences, diverse socioeconomic classes (upper middle class is well represented), ethnically diverse communities. Some currently popular materials need to be rewritten to take these needs into account.

•Specific actions which would improve attention to diversity in water curriculum include: consultation with educators who work with socieconomically and ethnically diverse populations while any new curriculum is under development; field testing of curricula with ethnically and socioeconomically diverse populations; when using examples in education materials use gender-equitable scenarios and names relevant to diverse socioeconomic and ethnic groups; avoidance of stereotyped role expectations in examples and illustrations; recognition in language examples and illustrations that the "nuclear family" is only one of many alternative forms of family lifestyles.

•In general the achievement of environmental education goals seems to require a partnership between the school and the Nonformal setting. Gaps in the curriculum indicate that there is a need to highlight how investigation and evaluation skills can be transferred to personal life decisions.

•Curriculum which addressed environmental action skills emphasized home and school based actions. There is a need for model community based youth activities or an adaptation of citizen monitoring materials for the youth, nonformal setting. Project GREEN provides a structure which could be adapted for the nonformal setting, but additional attention to evaluation and environmental action skills in the community and/or political setting is needed.

•There is a need to make nontraditional learning choices more accessible. Hands on, community action, and other experiential learning choices are most often located in the "further activities" section of curricula, a section least used by most educators because of time constraints and because it is not featured.

•There is a need to evaluate learning outcomes as they relate to curriculum structure. This is particularly needed for use of these materials in the nonformal setting.

•In general, water curriculum is not an availability problem, but a publicity problem. Instructors need help identifying what they need to do and how they can find materials suited to educating about that need.
With respect to existing materials, an ideal water curriculum package might include: a general curriculum, like Aquatic Wild or another well rounded curriculum, to provide a general overall choice of activity topics, levels, and types; accompanied by materials which provide education about a regional water resource and materials which provide information about drinking water education. Where possible, these choices should be made with a sensitivity to gender equity, awareness of the socioeconomic and ethnic characteristics of the intended population and consideration of special learning needs.

•Unique approaches to providing education about water need to be further identified. A review process for evaluating the

potential success of different approaches should be established and tested.

•The lack of water education materials reviewed in this study from the northeast and southeast portions of the United States should be further investigated. Are materials available, but not listed in standard bibliographies or do those regions lack regionally based support materials?

•There is a potential need to reprint high quality water education materials which are no longer available.

WATER EDUCATION GOALS

Goal I of this project specified the development of water education objectives. Project time limitations did not allow for development of water education objectives, but concepts were developed as a way to describe identified water topics more completely and to summarize water education needs from the perspective of the National Review Team. Goal III of this project specified that relevant curriculum materials, delivery systems, and model programs would be summarized in an easily understandable and accessible format for use by water education coordinators in various settings. As part of providing water education information in an accessible format, water quality education concepts identified through this needs assessment project were described in the form of goals.

The second meeting of the National Review Team focused on development of water education goals. The National Team based their work on the water topics listing which had been finalized at a previous meeting, the goal of improving access to appropriate water education for the nonformal setting, the needs assessment results, and their experience as part of the institutions they represent. Goals from all reviewed curricula were provided for their review and revision.

The Team agreed that it was important to convey the following overall water education theme as part of the goals statements. "To become a part of our national effort to protect and enhance water, youth need opportunities to develop and apply an understanding of water as vital to natural processes, human activities and the health of all living things."

As an avenue for developing this understanding, the National Review Team provides the water education goals found in Appendix J. Goals are organized by the general water categories identified through a process described earlier. Environmental education strategies are incorporated into the goals. These goals could be considered as an endpoint of a youth's education leading into their life as a citizen. Educators will need to develop objectives for each goal relevant to the age of a particular youth group.

Listed goals are intended for use in nonformal education circumstances, which are those educational experiences conducted outside of the time and location restrictions of the daily school program. Nonformal education about water can be coupled with a school program, provided as school enrichment, or can be offered with independent learning goals and activities.

In a nonformal setting, the personal or community life of the youth forms the foundation of the water education experience. Activities provide opportunities to learn and apply investigation skills, evaluate alternative solutions to problems, and apply what is learned in real life situations. Nonformal education events will also contribute to a youth's general understanding of water science, aquatic ecology, and human water systems, but the formal school setting may be best place to focus education about the principles underlying those disciplines.

A Wisconsin team of Extension educators also reviewed the water curricula and provided a preliminary summary of criteria which might be useful in choosing curricula for the nonformal setting. The listing of preliminary criteria is found in Appendix K.

RECOMMENDATIONS TO USDA COOPERATIVE EXTENSION FOR ACTION ON YOUTH WATER CURRICULUM NEEDS

Projects Suggested for Completion in the Near Future:

- Disseminate water curriculum needs assessment study. Provide hard and data base copy of curriculum chart and annotated information about reviewed curricula. Publish results of study in appropriate literature.

- Continue the National Review Team, to provide a national forum for discussion of youth water education needs, resources, and strategies to meet needs. Identify collaborative partnerships where possible.

- Consider and coordinate the following suggested future activities for the National Team:
  - -improve diversity of group and identify other groups who should join
  - -continue to collect and summarize curricula; publicize recommended/reviewed curricula
  - -examine data base options for continued management of information
  - -team review of USDA/EPA actions to establish Water Education Action Centers in cooperation with other interested parties to enable regional training, research,
  - -development, and improved communication about water education materials
  - -develop or identify resources to develop monographs on evaluating curricula for gender, etc.
  - -provide an ongoing effort to coordinate with other interested agencies and groups
  - -continue and support Cooperative Extension use of land grant facilities for team meeting and train the trainer opportunities

- Develop a system to ensure that all Cooperative Extension materials are sensitive to and meet Federal standards for gender, class, ethnicity, and learning disabilities.

- Encourage the development of water education support materials on:
  - -water related careers. Work with professional water related association to develop these materials.
  - -home water testing
  - -home water treatment
  - -chemical risk assessment and reduction

  Materials should be gender neutral and suitable for use in diverse socioeconomic and ethnic settings. Materials should be developed for educationally challenged youth including physical, cognitive and emotional concerns.

- Identify technologies and opportunities for distance training about water education materials for youth education providers.

- Demonstrate and evaluate the successful application of water education in school enrichment and nonformal settings. A suggested strategy would:
  - -identify 3 - 5 successful examples of application of water education in both the school enrichment and the nonformal setting.
  - -evaluate why these programs are successful and develop an evaluation tool based on structures which make these programs successful for use in testing new materials and strategies.
  - -using USDA CES water demonstration project settings, apply two examples of each strategy: school enrichment and nonformal. Use newly developed evaluation tool to establish demonstration programs. Evaluate results.

- Determine at what level USDA CES would like to recommend involvement of 4-H clubs in citizen monitoring programs. Provide national communication on decision. Related recommendations include:
  - -development or identification of additional education materials for low technology monitoring of local water quality

-make connections between 4-H groups and adult citizen monitoring organizations

•Identify and publicize materials developed for disabled/learning impaired. Review curriculum examples in development: Oregon Fish and Wildlife materials; "Adventures of a Water Drop" sponsored by America's Clean Water Foundation.

Long Term Recommendations:

•Encourage any new curricula under development to:
-include discussions on different perspectives on ethical issues
-include a sense of hope/improvement

•Create a multicultural consultation network of education specialists to provide leadership in developing, implementing, testing and training leaders in water education materials that are sensitive with respect to gender, ethnicity, socioeconomic status, and special learning needs.

•Examine the definitions of successful nonformal education as it applies to USDA CES state network opportunities. Identify or create curriculum models which best exemplify a strategy for high quality educational outcomes in the nonformal setting.

•Define and distinguish between formal and nonformal water education curriculum materials. Provide a listing of materials appropriate for nonformal use. Evaluate use of these materials in varied nonformal settings with the aim of identifying missing materials and sample model curricula.

•When nonformal education goals and models are better defined, identify the best curricula for each of the nine water subtopics described in the initial needs assessment study, and what goals are met by each curriculum.

•Develop and institute a national train the trainer program, using distance learning technologies where appropriate, to improve leader understanding of water concepts and recommended educational strategies.

•Create a 4-H version of citizen water monitoring programs with accompanying support materials possibly including a computer network. Provide leader training and dissemination.

•Examine opportunities to make nontraditional learning choices, such as community based learning or "school without walls," more accessible. Focus on availability of community action and other experiential learning choices. Investigate the environmental education evaluation and action skills present in these choices to understand the potential for improving educational opportunities in these areas.

•Create a national forum for youth competition related to water issues.

APPENDIX A

YOUTH WATER CURRICULUM NATIONAL REVIEW TEAM

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Kim Knox, American Water Works Association
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Bob Pfeiffer, America's Clean Water Foundation
Gordon Stuart, United States Department of Agriculture Forest Service
Steve Vandas, United States Geologic Survey

APPENDIX B

SOURCES OF WATER ISSUES TOPICS IDENTIFIED FOR EDUCATION

Abdalla, Charles W., editor. 1990. "Proceedings of a Meeting of the Policy Working Group on Groundwater Quality." Pennsylvania State University. Northeast Regional Center for Rural Development. Publication Number 59.

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George, Gail. 1988. "Iowa Groundwater Education Strategy." Iowa Department of Natural Resources.

Glanville, Tom. 1985. "Water Quality for Home and Farm." Iowa State University, Cooperative Extension Service, Ames, Iowa 50011.

Smith, M. F., Beth Eason, Mary Ellen Waltemire, Norris Diefenderfer, Kenneth Couture. 1989. "CES Water Quality/Quantity Program for Youth." University of Maryland Cooperative Extension Service.

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Oceanic and Atmospheric Administration, united States Geological Survey, Fish and Wildlife Service, Army Corps of Engineers, and the Tennessee Valley Authority.

Rockwell, S. K., D. R. Hay, A. Ziebarth, S. M. Meyer. "Major Findings and Implications of a Survey About Nebraska Residents' Perceptions of the State's Water Quality." Cooperative Extension and the Water Center. University of Nebraska.

Vandas, Steve. 1991?. "Water Resources Poster." US Department of Interior including: US Geological Survey, US Bureau of Land Management, and US Bureau of Reclamation; and the American Water Resources Association. USGS Books and Open File Reports Section, Box 25425, Denver, Colorado 80225-0425.

Vaughn, Gerald F. 1989. "Water Quality as an Issue: What Does This Mean?." Journal of Extension: Winter 1989, 23-24.

APPENDIX C

SOURCES OF ENVIRONMENTAL EDUCATION AND OTHER LEARNING GOALS

Cornell Cooperative Extension Service, Water Wise

Gardella, Ronald. 1986. "Environmental Education Curriculum Inventory Forms A and B." Northern Kentucky University, Highland Heights, Kentucky 41076.

Hungerford, Harold, R. B. Peyton and R. J. Wilke. 1980. "Goals for Curriculum Development in Environmental Education," Journal of Environmental Education, 11(3):42-47.

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Roth, Charles. 1990. "Definition and Clarification of Environmental Literacy, a working paper." ASTM Environmental Literacy Project, 1916 Race St., Philadelphia, PA 19103-1187.

Cantrell, Joy, ed. 1991. "Curriculum Development For Issues Programming. A national handbook for Extension youth development professionals - DRAFT." Extension Service, US Department of Agriculture.

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APPENDIX D

WATER EDUCATION BIBLIOGRAPHIES

The following water education bibliographies were used in addition to unpublished resources to identify available water education materials.

Catalog of Water Quality Educational Materials (Tennessee Valley Authority)
CONTACT: TVA Water Quality Branch
270 Haney Bldg.
Chattanooga, Tennessee 37402-2801

Directory of Great Lakes Education Material (International Joint Commission United States and Canada)
CONTACT: International Joint Commission
Great Lakes Regional Office
100 Ouellette Avenue, Eighth Floor
Windsor, Ontario N9A 6T3
or PO Box 32869
Detroit, Michigan 48232-2869

Educational Videos for Children About Our Precious Water Resources! (US EPA, #430/09-91-016(B)
CONTACT: EPA's Video Lending Library
1-800/624-8301

Environmental Education Compendium for Water Resources (California Department of Education, California Department of Water Resources, Sonoma State University)
CONTACT: California Department of Water Resources
ATTN: Public Information and Education Branch
1416 9th St., Rm. 1104-1
Sacramento, California 95814
916/653-6192

Environmental Education Materials For Teachers and Young People (Grades K - 12) (#OPA 87-022, US EPA)
CONTACT: Office of Community and Intergovernmental Relations (A-108 EA)
U.S. Environmental Protection Agency
401 M Street, SW
Washington, DC 20460
202/382-4454

Florida Marine Education Resources Bibliography (SGR-51, Florida Sea Grant College)
CONTACT: Pine Jog Environmental Sciences Center
College of Science
Florida Atlantic University
West Palm Beach, Florida 33406

The Freshwater Foundation
CONTACT: The Freshwater Foundation
2500 Shadywood Rd.
Box 90
Navarre, Minnesota 55392
612/449-0092

Ground Water Education in America's Schools. A Catalog of Resource Materials for Elementary and Secondary Education Professionals (The American Ground Water Trust)

CONTACT: The American Ground Water Trust
6375 riverside Drive
Dublin, Ohio 43017
614/761-2215

Marine Education. A Bibliography of Educational Materials Available from the Nation's Sea Grant College Programs

CONTACT: Sea Grant program in local state or region, OR
Sea Grant Marine Education Bibliography
Gulf Coast Research Laboratory
J. L. Scott Marine Education Center and Aquarium
PO Box 7000
Ocean Springs, Mississippi 39564-7000
601/374-5550

1990 Nebraska Environmental Education and Information Resources Directory

CONTACT: Nebraska Natural Resources Commission
PO Box 94876
Lincoln, Nebraska 68509-4876
402/471-2081

Save Our Streams Resource List (Izaak Walton League)

CONTACT: The Izaak Walton League of America, Inc.
1401 Wilson Boulevard, level B
Arlington, Virginia 22209
703/528-1818

Streams, Lakes and Wetlands. A Collection of Curriculum and Reference Materials (City of Everett Department of Public Works)

CONTACT: City of Everett Department of Public Works
Storm and Surface Water Management
Community Involvement Program
Everett, Washington
206/259-8863

Water Education 101 (American Water Works Association)

CONTACT: Youth Education Manager
American Water Works Association
6666 W. Quincy Ave.
Denver, Colorado 80235
303/794-7711

Water Education Foundation resources listing (Water Education Foundation)

CONTACT: Water Education Foundation
717 K Street, Suite 517
Sacramento, California 95814
916/444-6240

The Water Quality Catalog. A Source Book of Public Information Materials (Water Environment Federation)

CONTACT: Water Environment Federation
601 Wythe Street

Alexandria, Virginia 22314
703/684-2400

Water Quality Education Bibliography (Cooperative Extension Washington State University)
CONTACT: Christopher F. Feise
Washington State University
7612 Pioneer Way E.
Puyallup, Washington 98371-4998
206/840-4556

Youth Water Quality Resources (USDA, Cooperative Extension Service)
CONTACT: Cooperative Extension Service, 4-H and Youth Development
United States Department of Agriculture
3861 South Building
Washington, D.C. 20250
202/447-5516

APPENDIX E

WATER QUALITY CURRICULUM REVIEW: INCLUSION CRITERIA

In choosing materials to be reviewed in the Water Quality Curriculum Needs Assessment Project, we were guided as closely as possible by the following inclusion criteria. With an upper limit target of approximately 75 curricula, we designated two sets of criteria: the first set describes the characteristics we seek in each individual curriculum, while the second set describes the overall characteristics of the designated group of curricula. We begin by applying individual criteria, and make subsequent amendments in order to meet our group criteria.

Curriculum for Issues Programming:

A September 1991 draft of "Curriculum Development for Issues Programming - A National Handbook for Extension Youth Development Professionals" by the 4-H Curriculum Task Force provides a basic definition of curriculum and guidelines for its development which offer a standard for reviewing curriculum proposed for use in the nonformal setting.

4-H curriculum is defined as "the sum of all *planned* experiences of participants in 4-H."

The "Handbook" recommends that five essential components be considered:

- characteristics of learners
- the changes one hopes to facilitate in learners (outcomes/objectives)
- the important and relevant content
- methods which enable learners to accomplish the outcomes
- evaluation strategies to measure outcomes

In overview, the needs assessment will consider materials which provide or guide the delivery of planned experiences with attention to the five essential components outlined by the "Handbook."

Individual Criteria:

- Materials that have been often used or have met with previous success in Nonformal educational settings will be given special attention.

- Comprehensive curricula will be given priority over single activities. Single activities will be included for review where there is an identified omission in the literature.

- Materials should attend to a variety of environmental education objectives as described by the Tbilisi Conference, including ecological foundations, conceptual awareness, investigation and evaluation skills, and environmental action.

- Curricula should include both instructor and student activities.

- Unique educational materials will be sought out and reviewed.

- Materials that are oriented towards personal action and community issues will receive priority over those emphasizing academic skills alone.

•An effort will be made to avoid review of materials that are repetitive of those found in another curriculum, although popular materials will be noted.

Group Criteria:

•Materials should, overall, represent attention to all four environmental education objectives as described by the Tbilisi Conference, including ecological foundations, conceptual awareness, investigation and evaluation skills, and environmental action.

•Materials should, overall, represent a regional cross-section of water quality-related issues.

•Materials should, overall, represent a topical cross-section of water quality-related subjects, including science of water, water-related ecosystems, drinking water supply quality and quantity, water pollution and contamination, water quality risk assessment and management, use management and protection strategies, government and citizenship issues, and water-related careers.

•Instructional materials will be given priority over purely informational materials.

APPENDIX F

REVIEWED CURRICULA LISTINGS

STATE/REGIONAL REVIEWED CURRICULA LIST

Following is a list of materials, referenced by state, that were reviewed for the purpose of this study. Items marked by an asterisk (*) have been deleted and/or replaced by more recent publications in the companion guide developed to publicize information gleaned during the review process, *Educating Young People About Water: A guide to goals and resources with an emphasis on nonformal and school enrichment settings.*

ARIZONA
A Sense of Water (Southern Arizona Water Resources Association)

CALIFORNIA
Los Marineros (Channel Islands National Marine Sanctuary)
Water Quality: A Water Education Program (Metropolitan District of Southern California)

ILLINOIS
Water: The Liquid of Life (Illinois EPA)

INDIANA
Water Riches (Indiana Cooperative Extension Service; Nebraska version reviewed)

IOWA
G.R.E.A.T. (Groundwater Resource Education Activities for Teachers; Iowa DNR)

KANSAS
Water Education for Teachers (Kansas Cooperative Extension Service)

MARYLAND
*The Chesapeake Bay: For Elementary Teachers; For Secondary Teachers
Decision Making: The Chesapeake Bay (University of Maryland, Sea Grant; includes issues for all states directly affected by the Bay)
Living in Water: An Aquatic Science Curriculum (also listed on national list)

MASSACHUSETTS
Water Watchers (Massachusetts Water Resource Authority)
Water Wizards (Massachusetts Water Resource Authority)

MICHIGAN
Groundwater Education Program (East Michigan Environmental Action Council)
Gee-Wow (Ecology Center of Ann Arbor)

MISSOURI
Missouri Dept of Natural Resources Groundwater ProtectionCurriculum Guide
Water Riches (Univ. of MO-Columbia Extension Service; Nebraska version reviewed)

MONTANA
Water Education for Teachers (WET; different content from Kansas version)

NEBRASKA
Stop Look & Learn About Our Natural World (Nebraska Natural Resources Commission)
Water Riches (Nebraska Cooperative Extension Service; Indiana version reviewed)
Children's Groundwater Festival Teaching Packet (Nebraska Groundwater Foundation)

NEVADA
Water Conservation In-School Curriculum (University of Nevada Cooperative Extension)
Wise Water Ways (University of Nevada Cooperative Extension Service)

NEW YORK
4-H Sport-Fishing Aquatic Resources Education Program (Cornell Cooperative Extension Service)
Water Resource Education (Cornell Cooperative Extension of Nassau County)
Water Wise: Lessons in Water Resources (Cornell Cooperative Extension Service)
Water Worlds (Cornell Cooperative Extension Service)

NORTH DAKOTA
Water Education for Teachers (North Dakota State Water Commission; different content than the Kansas Cooperative Extension WET; Montana version reviewed)
North Dakota State Extension Service Water Activities (North Dakota State University Cooperative Extension Service)

OHIO
Always a River (US EPA)
The Great Lakes in My World (Lake Michigan Federation and University of Ohio Sea Grant)

OREGON
The Stream Scene: Watersheds, Wildlife and People

PENNSYLVANIA
Instructor's Guide To Water Education Activities (Pennsylvania Department of Environmental Resources)

SOUTH CAROLINA
Teaching Aquifer Protection (Clemson University Cooperative Extension Service)

TENNESSEE
Groundwater: A Vital Resource (Tennesee Valley Authority)

UTAH
Water Education

VERMONT
Environmental Education For Youth: Groundwater, Surface Water, Water Around Us (University of Vermont Cooperative Extension Service)

VIRGINIA
Be Water Wise (Virginia Water Resources Research Center, also listed in national materials section)
Sensing the Sea (Virginia Institute of Marine Science)
Virginia CES/4-H Marine Project: What is Water? A Stream Becomes An Ocean. What is An Ocean?
Marine Resources (Virginia Cooperative Extension Service)

WASHINGTON
Discover Wetlands

WISCONSIN
Caring For Our Lakes (University of Wisconsin Institute of Environmental Studies)
Groundwater: Wisconsin's Buried Treasure (Wisconsin Department of Natural Resources)
Local Watershed Problem Studies (University of Wisconsin Water Resources Center)
Our Great Lakes Connection (University of Wisconsin Cooperative Extension Service)

REVIEWED CURRICULA FROM NATIONAL ORGANIZATIONS OR WITH NATIONAL APPLICATION

Items marked by an asterisk (*) have been deleted and/or replaced by more recent publications in the companion guide developed to publicize information gleaned during the review process, *Educating Young People About Water: A guide to goals and resources with an emphasis on nonformal and school enrichment settings.*

A Hidden Treasure (National FFA Foundation)

Aquatic Wild (Project Wild, Boulder, CO)

Be Water Wise (Virginia Water Resources Research Center)

Investigating Streams and Rivers (Project GREEN, Ann Arbor, MI)

Living in Water (the National Aquarium; also listed on state list)

Naturescope: Diving Into Oceans (National Wildlife Federation)

Project Water Works (American Water Works Association)

Ranger Rick's NatureScope - Wading Into Wetlands (National Wildlife Federation)

*The Story of Drinking Water - Primary, Secondary, Advanced (American Water Works Association)

The Tapwater Tour (LaMotte Company)

Wally the Water Molecule ("Chem Kids," Moreno, CA)

Water in Your Hands (Soil and Water Conservation Society)

Water Quality Curriculum: Surface Water Unit, The Groundwater Adventure (Water Environment Federation, formerly Water Pollution Control Federation)

Water, Water Everywhere (Hach Company)

WOW, The Wonders of Wetlands (Environmental Concern Incorporated)

REVIEWED CURRICULA FROM THE COOPERATIVE EXTENSION SERVICE

INDIANA
Water Riches (Nebraska version reviewed)

KANSAS
Water Education for Teachers (WET)

MISSOURI
Water Riches (Nebraska version reviewed)

NEBRASKA
Water Riches

NEVADA
Water Conservation In-School Curriculum
Wise Water Ways

NEW YORK
4-H Sport-Fishing Aquatic Resources Education Program
Water Resource Education (Nassau County Cooperative Extension)
Water Wise: Lessons in Water Resources
Water Worlds

NORTH DAKOTA
North Dakota State Extension Service Water Activities

SOUTH CAROLINA
Teaching Aquifer Protection (Clemson University Cooperative Extension Service)

VERMONT
Environmental Education For Youth: Groundwater, Surface Water, Water Around Us

VIRGINIA
Virginia CES/4-H Marine Project: What is Water? A Stream Becomes an Ocean. What is an Ocean? Marine Resources.

WISCONSIN
Our Great Lakes Connection (University of Wisconsin Cooperative Extension Service)

APPENDIX G

UNIQUE PROGRAMS OR PROGRAM SUPPORT MATERIALS

The following materials could not be considered as youth water education curricula, but do provide an important resource for those developing youth water education programs. Items are included in this list if:

a. they provided a unique strategy for educating youth about water;
b. provided a unique water education resource not easily repeated locally;
c. or are cited frequently in water education bibliographies.

Computer based educational programs were not investigated in this study. A few are mentioned here, but should not be considered as the only materials of this type available.

Information about how to acquire these materials will be available in a companion publication to this report.

UNIQUE PROGRAM STRATEGIES

Angler Education leader training and programs (sponsored by US Fish and Wildlife, available through state conservation agencies)

Aquatic education materials being developed/adapted for the hearing-impaired (Federal Aid Division, U.S. Fish and Wildlife Service)

Field Manual for Water Quality Monitoring: An Environmental Education Program for Schools (University of Michigan, School of Natural Resources, Thomson-Shore Printers)

GEM. The Groundwater Education In Michigan Program. Provides summaries of projects developed through annual grant funds and sources of products which were created. (The Institute of Water Research, Michigan State University)

National Directory of Citizen Volunteer Environmental Monitoring Programs (US EPA and Rhode Island Sea Grant College Program, EPA 503/9-90-004)

Public Involvement and Education Model Projects Fund. 47 Success Stories from Puget Sound. (Puget Sound Water Quality Authority)

Save Our Streams. A Citizen Action Program (Izaak Walton League of America)
Save Our Streams Kit
Wetlands Watch Kit

Tennessee Valley Authority Teacher/Student Water Quality Monitoring Network (Tennessee Valley Authority, Water Quality Branch, Chattanooga, Tennessee)

The Western Watercourse. A Regional Adult and Youth Water Education Program (Montana State University, Bozeman, Montana; national WET, Water Education for Teachers, program development in process)

USGS Water Resources Education Initiative Program notebooks for water resource specialists visiting classrooms (USGS with Bureau of Land Management, Earth Science Education, Project US Fish and Wildlife, US EPA, the National Science Teachers Association, and the American Water Resources Association)

UNIQUE SUPPORT MATERIALS

Water Education Activities

Acid Rain Curriculum, grades 4 - 8
Acid Rain Curriculum, grades 6 - 12
(Acid Rain Foundation, Inc.)

AIMS, Activities Integrating Mathematics and Science. Grades K-4 Series. Grades K-6 Series. Grades 5-9 Series. (AIMS Education Foundation)

Ask the Aquarium Fact Sheet Packet (National Aquarium, Baltimore, Maryland)

BARK, Backyard Acid Rain Kit (Public Focus, Toronto, Ontario)

The Changing Chesapeake, an introduction to the natural history and history of the Chesapeake Bay for upper elementary and middle school children (National Aquarium in Baltimore and U.S. Fish and Wildlife Service)

Fisheries Education Units #16 - 18 (Maine Department of Marine Resources)
"Estuarine Studies. An Activities Text for Maine Schools"
"Field Trip in the Classroom"
"Field Testing Manual for Water Quality"

Fishing for Fun and Learning (University of Wisconsin Cooperative Extension Service)

Fishing . . . Get in the Habitat (Minnesota Department of Natural Resources, MinnAqua and University of Minnesota Cooperative Extension, 4-H Youth Development)

Friends: Special Water Edition. A Magazine for Young Readers From Georgia 4-H Clubs. (University of Georgia Cooperative Extension Service)

Investigating Your Environment Series (Forest Service, United States Department of Agriculture, new water education materials in development)

Jefferson County 4-H Water Quality Project (Washington State University, Jefferson County Cooperative Extension)

KARE, Keystone Aquatic Resource Education. "Water Resources in Pennsylvania. An Earth Science/Biology Unit" (Pennsylvania Fish Commission, Bureau of Education and Information)

Lacustrine Lessons newsletter (Minnesota Sea Grant, discontinued in 1988)

Lines on the Land - A "hands-on" soil and water conservation learning package for 6th-8th grades (National Association of Conservation Districts)

My Wetland Coloring Book (US EPA, Region 6)

OBIS, Outdoor Biology Instructional Strategies packets: Aquatic Animal Behavior; Breakwaters and Bays; Desert; Ponds and Lakes; Seashore; Streams and Rivers (Delta Education, Inc., Hudson, New Hampshire)

OEAGLS, Oceanic Education Activities for Great Lakes Schools. 23 interdisciplinary investigations for grades 5-9 (Ohio Sea Grant and The Ohio State University)

Project Earthcare. Soil and Water Stewardship Activities (St. Louis County, Missouri Soil & Water Conservation District)

Project Mayfly. Guide to the Determination of Water Pollution in Local Waterways (National Audubon Society, Mid-Atlantic Regional Office)

Ranger Rick's NatureScope - Pollution: Problems and Solutions (National Wildlife Federation)

Responsible Angling. The Oregon Angler Education Manual (Oregon Department of Fish and Wildlife, Oregon State University Extension Service, Outdoor Empire Publishing, Inc.)

Stream Sampler Tour. MacIntosh based computer software (Thames Science Center, Connecticut)

Terrene Institute nonpoint source curriculum for fifth and sixth grade (Terrene Institute in cooperation with US EPA, Washington DC; in process)

Toward A Sustainable Agriculture: A Curriculum (University of Wisconsin Center for Integrated Agricultural Systems)

University of Minnesota 4-H Youth Development, youth fact sheet series: "Wetland Restoration," "Water Stewardship," "Well-Water Testing," and "Household Hazardous Wastes." (University of Minnesota)

Water Can Be Fun. How to Create A Successful Science Fair (American Water Works Association)

Watercard: A Hypercard Stack and Manual for Calculating Water Quality (University of Wisconsin Cooperative Extension Service, Environmental Resources Center)

Water Ecology Topics. K-8 Group Outdoor Activities for Stream, Pond and Schoolyard (Youth Science Institute, Los Gastos, CA)

Water Quality and Aquatic Resources Protection Activities. A packet of 20 4-H activities, community service and fair projects. (Washington State University, Thurston County Cooperative Extension)
Water Fun For You (American Water Works Association)

Wavelets, Marine Schoolhouse Series No. 1 - 27 (Virginia Institute of Marine Science, Sea Grant Marine Advisory Services)

"Wetlands and Wildlife" curriculum materials (Alaska Department of Fish and Game and U.S. Fish and Wildlife Service)

Wild Louisiana. Aquatic Activities for Environmental Science (Louisiana Sea Grant, Louisiana State University)

Educational Program Idea Sources

Many state University Cooperative Extension Services and state Conservation Departments provide water education materials and resources specific to that state. Some of these materials are youth education pieces and have been listed elsewhere in this study when possible. Other materials were designed as resources for the general adult audience or professionals and interest groups serving the

general public. No effort was made to list all of those materials here. Materials listed in this section are high quality examples of available materials. Individual state agencies can provide more information.

Angler Ethics Program (National Wildlife Federation, in process)

Citizens Guide to Clean Water (Izaak Walton League)

Classrooms Without Walls. A Guide for Developing Aquatic Education Trails
(Alaska Department of Fish and Game)

Clean Water Resource Packet for Youth and Youth Educators (University of Minnesota Extension Service, a compilation of materials to be photo copied at cost)

The Conservation Handbook (Boy Scouts of America)

Drinking Water Week annual packet (USDA Cooperative Extension Service, Washington, DC)

Drinking Water: A Community Action Guide (Concern, Inc.)

Drinking Water Education Programs, A Guide for County Faculty (University of Wisconsin Cooperative Extension Service, Central Wisconsin Groundwater Center)

Environmental Software Programs (EPA Water Education, Region V)
"Agricultural Pollution Prevention"
"Groundwater Education System '91"
"Principles and Design of Onsite Waste Disposal with Septic Systems '91"
"Private Water Systems Education System '91"
"Residential Water Conservation Techniques '91"

Getting to Know Your Stream: Stream Habitat;
Getting to Know Your Stream: Water Quality and Stream Biology
(University of Wisconsin Cooperative Extension of Dane County)

Groundwater: A Community Action Guide (Concern, Inc.)

Handle With Care. Your guide to preventing water pollution (Terrene Institute)

Investigating the Marine Environment: A Sourcebook. Volumes 1 - 3 (Project Oceanology, Groton, Connecticut)

Marine Science Methods for the Classroom, fact sheets #1 - 9 (Virginia Institute of Marine Science Sea Grant Marine Advisory Services)

Manual for Use of the Sand-Tank Groundwater Flow Model (University of Wisconsin Cooperative Extension)

Nontraditional Marine Education Activities: a planning guide (Virginia Sea Grant College Program, Educational Series Number 32)

Puget Soundbook (Puget Sound Water Quality Authority; also see Maryland's and Green Bay, Wisconsin's "Baybooks" available from their state conservation agencies)

Reaching Tomorrow's Consumers Today. Youth Education Programs for Utility Managers (American Water Works Association)

Salt Marsh Manual, an educator's guide (San Francisco Bay National Wildlife Refuge)

Sandcastle Moats and Petunia Bed Holes. A book about groundwater. (Virginia Water Resources Research Center)

Washington Post, "The Mini Page," October 28, 1990. Treat Water Well

Water Quality Field Guide (USDA Soil Conservation Service)

Water Quality Indicators Guide: Surface Waters (USDA Soil Conservation Service)

Water Quality Series, Booklet 1: Water Quality Sampling Equipment
Water Quality Series, Booklet 2: Homemade Sampling Equipment
(Tennessee Valley Authority, Water Quality Branch; to accompany TVA's Teacher/Student Water Quality Monitoring Network)

Wetlands and Water Quality: A Citizen's Handbook for Protecting Wetlands (Lake Michigan Federation)

APPENDIX H

YOUTH WATER CURRICULUM SUMMARY: CHECKLISTS

TOPICS INCLUDED IN CURRICULUM

1. **Science of Water**
   - ___Properties
   - ___Importance to living things
   - ___Hydrologic Cycle
   - __Geology/hydrology dynamics
     - __surface water
     - __groundwater
     - __regional supply

2. **Water Related Ecosystems**
   - ___Types of Ecosystems
     - __lakes
     - __rivers
     - __ponds
     - __streams
     - __wetlands
     - __watersheds
     - __oceans
     - __riparian
     - __estuaries
     - __ephemeral systems (intermittent)
   - ___Major Regional Resource: _____
   - ___Ecological Concepts

3. **Drinking Water Supply: Quantity & Quality**
   - ___Delivery
     - __community/public
     - __private
   - ___Treatment of drinking water
     - __public drinking water
     - __home treatment
   - ___Water Quality Control
     - __well concerns
     - __testing
       - __public
       - __private
   - ___Lifestyle impacts/conservation

4. **Water Use**
   - ___Use of water by many groups
     - __commercial
     - __industry
     - __agricultural
     - __municipal
     - __domestic
     - __power production
     - __recreation
   - ___Conservation by user groups
   - ___Issues/conflicts between user groups

5. **Water Pollution/Contamination Sources**
   - ___Point source
     - __agricultural sources
     - __public &/or private wastewater
     - __industrial & business hazardous wastes
     - __energy production wastes
   - ___Nonpoint source
     - __agricultural
     - __urban
     - __forestry
     - __mining
     - __atmospheric deposition

6. **Water Quality: Risk Assessment & Reduction**
   ___Curriculum addresses the concept of how risk decisions are made
   ___Impact of water quality on health
   ___Impact of water quality on human food sources
   ___Impact of water quality on plant & animal communities
   ___Understanding & reducing risks for specific contaminants
      __bacteria __nitrates
      __pesticides __salinity
      __sediments __other chemicals:_____
   ___Water quality indicators

7. **Management & Protection Strategies For Specific Uses**
   ___Zoning strategies
      __shorelands/floodplains
      __wetlands
      __wellhead/groundwater recharge areas
   ___Chemical Storage
   ___Recreational Use
   ___Wastewater Treatment
   ___Solid Waste Management Decisions
   ___Agricultural Management Practices
   ___Wildlife Habitat/Land Stewardship Management
   ___Natural Disasters
   ___Chemical Emergencies
   ___Development Issues/Pressures

8. **Government & Citizenship Issues**
   ___Policy issues
      __water quality
      __water quantity
   ___Role of local government in developing protection strategies
   ___Citizen involvement & participation
   ___Legislation, regulation, incentives/disincentives

9. **Water-Related Careers**
   ___Technical: _____
   ___Professional _____

Other Comments:

YOUTH WATER CURRICULUM: ENVIRONMENTAL EDUCATION GOALS

1. **Ecological Foundations (materials focus on...)**
   - __ Individuals & populations
   - __ Interactions & interdependence
   - __ Environmental influences & limiting factors
   - __ Biogeochemical cycling
   - __ Community & ecosystems concepts
   - __ Homeostasis (balance of nature)
   - __ Succession
   - __ Humans as ecosystem components
   - __ Ecological implications of human activity

2. **Conceptual Awareness: Issues & Values (materials encourage recognizing...)**
   - __ Ecological impact of human culture on environment
   - __ Ecological impact of individuals on environment
   - __ Ecological & cultural implications of environmental issues
   - __ Alternative solutions
   - __ Cultural implications of alternative solutions
   - __ Investigation as prerequisite to decision-making
     - __ Role of human values & need for personal values clarification in decision making
     - __ Need for responsible citizen action in environmental issue remediation

3. **Investigation Skills (materials provide opportunities to...)**
   - __ Shape questions
   - __ Formulate hypotheses
   - __ Make observations and measurements
     - __ Natural science settings
     - __ Social science settings
   - __ Perform tests
     - __ Analyze results with respect to:
     - __ ecological implications
     - __ cultural implications

4. **Evaluation Skills (materials provide opportunities to...)**
   - __ Identify alternative solutions
   - __ Identify values associated with alternative solutions
     - __ Evaluate alternative solutions with respect to cultural & ecological implications
     - __ Identify & clarify personal values & positions as they relate to issues & solutions
     - __ Change personal values & positions given new information

5. **Environmental Action Skills (materials guide development of...)**
   - __ Skills to work towards ends consistent with individual values

__persuasion	__legal action	__community problem solving
__consumerism	__ecomanagment	
__political action	__education	

   - __ Decision-making regarding environmental action strategies
   - __ Opportunities to apply environmental action skills
   - __ Evaluate influence of actions taken to effect balance between.quality of life and quality of environment

YOUTH WATER CURRICULUM: CURRICULUM FORMAT

1. **Grade Level(s)** _____

2. **Applicability to Diverse Audiences**

Materials are relevant to diversity with respect to:

___Gender
- __language
- __illustrations
- __examples

___Geographic region
- __national audience
- __regional audience: _____

___special learning needs: _____

__Socioeconomic class
- __vocabulary
- __illustrations
- __examples

__Ethnicity
- __language: _____
- __illustrations
- __examples

3. **Instructional Materials**

Instructor Materials

**Content:*
- __background information
- __stated goals & objectives
- __lesson plan/teacher script
- __answer keys
- __resource list
- __further study suggestions
- __glossary

**Presentation Style:*
- __booklet: # pages=___
- __computer software
- __videotape
- __other: _____

**Quality of Printed Materials*
- __clearly organized
- __typed

Student Materials

**Content:*
- __activity instructions
- __worksheets
- __tests
- __text
- __game materials

**Presentation Style:*
- __booklet: # pages=___
- __teacher-made photocopies
- __comic book
- __magazine or newspaper
- __other: _____

**Quality of Printed Materials*
- __age-appropriate visual layout
- __clearly organized

4. **Instructional Environment**

___Indoor
- __home
- __classroom
- __laboratory

___Field
- __natural site
- __community facility/agency

___Neighborhood

5. **Lesson Type(s)**

___Seatwork	___Activities
__discussion/debate	__field observation/measures
__worksheet	__laboratory experiment
__demonstration observation	__drama/artwork/models
__reading text	__community project
__instructor/guest lecture	__fairs & festivals
__audio/visual material	__home project/observations
__letter writing/essays	__student presentations
__individual work	__individual work
__team work	__team work
__computer software	__games/puzzles
__special equipment needed:	__special equipment needed:
----------	----------

6. **Subject Area(s)**

__Science __Social Studies __Math __Language Arts __Art

APPENDIX I

YOUTH WATER CURRICULUM SUMMARY: PERCENTAGE PRESENCE OF SUBTOPICS

The **first number** is the percent mention, as either a major or minor emphasis on that subtopic in the curricula.
The **second number** is the percent of the curricula that included that subtopic as a major emphasis.

TOPICS INCLUDED IN CURRICULUM

1. Science of Water

49%/43% Properties
55%/52% Importance to living things
71%/66% Hydrologic Cycle

80%/69% Geology/hydrology dynamics
- 54%/38% surface water
- 58%/48% groundwater
- 18%/12% regional supply

2. Water Related Ecosystems

Types of Ecosystems 54%
- 17%/12% lakes
- 17%/11% rivers
- 15%/12% ponds
- 26%/23% streams
- 25%/22% wetlands
- 25%/20% watersheds
- 15%/14% oceans
- 2%/ 2% riparian
- 12%/11% estuaries
- 11%/ 9% ephemeral systems (intermittent)

24%/22% Major Regional Resource
74%/48% Ecological Concepts

3. Drinking Water Supply: Quantity & Quality

55%/46% Delivery
- 46%/37% community/public
- 23%/17% private

29%/22% Water Quality Control
- 11%/ 5% well concerns
- 28%/18% testing
  - 15%/11% public
  - 8%/ 8% private

40%/34% Treatment of drinking water
- 31%/26% public drinking water
- 6%/ 3% home treatment

52%/49% Lifestyle impacts/conservation

4. Water Use

72%/62% Use of water by many groups
- 48%/29% commercial
- 46%/32% industry
- 40%/25% agricultural
- 47%/31% municipal
- 42%/37% domestic
- 23%/15% power production
- 9%/ 6% recreation

11%/9% Conservation by user groups
14%/9% Issues/conflicts between user groups

5. Water Pollution/Contamination Sources

63%/51% Point source
- 23%/18% agricultural sources
- 51%/42% public &/or private wastewater
- 38%/35% industrial & business hazardous wastes
- 17%/15% energy production wastes

68%/51% Nonpoint source
- 42%/31% agricultural
- 43%/32% urban
- 8%/ 6% forestry
- 11%/ 8% mining
- 17%/12% atmospheric deposition

6. Water Quality: Risk Assessment & Reduction

2%/2% Curriculum addresses the concept of how risk decisions are made
40%/23% Impact of water quality on health
5%/ 3% Impact of water quality on human food sources
40%/25% Impact of water quality on plant & animal communities
49%/42% Understanding & reducing risks for specific contaminants
- 20%/17% bacteria
- 18%/15% pesticides
- 26%/26% sediments
- 20%/18% nitrates
- 8%/ 8% salinity
- 31%/28% other chemicals

28%/22% Water quality indicators

7. Management & Protection Strategies For Specific Uses

46%/32% Zoning strategies
- 6%/ 3% shorelands/floodplains
- 5%/ 3% wetlands
- 14%/11% wellhead/groundwater recharge areas

12%/ 8% Chemical Storage
14%/ 3% Recreational Use
49%/42% Wastewater Treatment
34%/29% Solid Waste Management Decisions
23%/18% Agricultural Management Practices
20%/15% Wildlife Habitat/Land Stewardship Management
11%/ 5% Natural Disasters
8%/ 6% Chemical Emergencies
18%/14% Development Issues/Pressures

8. Government & Citizenship Issues

31%/26% Policy issues
- 37%/32% water quality
- 20%/17% water quantity

26%/20% Role of local government in developing protection strategies
48%/45% Citizen involvement & participation
37%/31% Legislation, regulation, incentives/disincentives

9. Water-Related Careers

8%/ 6% Technical
11%/ 9% Professional

ENVIRONMENTAL EDUCATION GOALS INCLUDED IN YOUTH WATER CURRICULUM

1. Ecological Foundations (materials focus on...)

55%/46% Individuals & populations
74%/60% Interactions & interdependence
74%/66% Environmental influences & limiting factors
75%/65% Biogeochemical cycling
58%/46% Community & ecosystems concepts
15%/ 9% Homeostasis (balance of nature)
12%/ 9% Succession
28%/20% Humans as ecosystem components
72%/62% Ecological implications of human activity

2. Conceptual Awareness: Issues & Values (materials encourage recognizing...)

80%/71% Ecological impact of human culture on environment
57%/52% Ecological impact of individuals on environment
43%/38% Ecological & cultural implications of environmental issues
68%/63% Alternative solutions
43%/32% Cultural implications of alternative solutions
43%/32% Investigation as prerequisite to decision-making
45%/34% Role of human values & need for personal values clarification in decision making
74%/65% Need for responsible citizen action in environmental issue remediation

3. Investigation Skills (materials provide opportunities to...)

25%/22% Shape questions
54%/52% Formulate hypotheses
95%/95% Make observations and measurements
- 83%/83% Natural science settings
- 46%/46% Social science settings

71%/71% Perform tests
80%/71% Analyze results with respect to:
- 66%/58% ecological implications
- 32%/29% cultural implications

4. Evaluation Skills (materials provide opportunities to...)

63%/62% Identify alternative solutions
34%/32% Identify values associated with alternative solutions
48%/40% Evaluate alternative solutions with respect to cultural & ecological implications
58%/52% Identify & clarify personal values & positions as they relate to issues & solutions
63%/57% Change personal values & positions given new information

5. Environmental Action Skills (materials guide development of...)

65%/62% Skills to work towards ends consistent with individual values

20%/20% persuasion	3%/ 3% legal action	20%/20% community problem solving
43%/43% consumerism	35%/35% ecomanagment	
9%/ 9% political action	20%/17% education	

40%/38% Decision-making regarding environmental action strategies
55%/55% Opportunities to apply environmental action skills
37%/31% Evaluate influence of actions taken to effect balance between quality of life and quality of environment

CURRICULUM FORMAT OF YOUTH WATER CURRICULUM

1. Grade Level(s) _____

2. Applicability to Diverse Audiences

Materials are relevant to diversity with respect to:

69%/58% Gender
- 69%/60% language
- 18%/15% illustrations
- 18%/18% examples

Geographic region
- 40%/40% national audience
- 54%/54% regional audience
- 0%/ 0% special learning needs

9%/ 6% Socioeconomic class
- 0%/0% vocabulary
- 0%/0% illustrations
- 9%/6% examples

23%/23% Ethnicity
- 8%/ 7% language
- 18%/18% illustrations
- 17%/17% examples

3. Instructional Materials

Instructor Materials

**Content:*

92%/92% background information
88%/86% stated goals & objectives
92%/82% lesson plan/teacher script
58%/51% answer keys
63%/63% resource list
62%/60% further study suggestions
58%/58% glossary

**Presentation Style:*

98%/98% booklet
3%/3% computer software
9%/9% videotape
11%/11% other

Quality of Printed Materials

83%/80% clearly organized
94%/92% typed

Student Materials

**Content:*

66%/65% activity instructions
88%/86% worksheets
29%/28% tests
43%/40% text
17%/17% game materials

**Presentation Style:*

18%/18% booklet
80%/80% teacher-made photocopies
8%/ 8% comic book
2%/ 2% magazine or newspaper
3%/ 3% other

**Quality of Printed Materials*

38%/38% age-appropriate visual layout
57%/57% clearly organized

4. Instructional Environment

98%/98% Indoor
- 96%/96% home
- 91%/91% classroom
- 39%/39% laboratory

75%/74% Field
- 43%/43% natural site
- 49%/48% community facility/agency
- 32%/32% neighborhood

5. Lesson Type(s)

95%/95% Seatwork
- 92%/92% discussion/debate
- 82%/82% worksheet
- 78%/78% demonstration observation
- 68%/68% reading text
- 92%/92% instructor/guest lecture
- 32%/32% audio/visual material
- 42%/38% letter writing/essays
- 89%/89% individual work
- 58%/58% team work
- 5%/ 5% computer software
- 29%/25% special equipment needed

92% Activities
- 66%/66% field observation/measures
- 72%/72% laboratory experiment
- 77%/77% drama/artwork/models
- 23%/23% community project
- 3%/ 2% fairs & festivals
- 55%/55% home project/observations
- 52%/52% student presentations
- 85%/85% individual work
- 77%/77% team work
- 45%/45% games/puzzles
- 28%/23% special equipment needed

6. Subject Area(s)

100% Science
69%/62% Language Arts
77%/69% Social Studies
58%/49% Art
83%/78% Math

APPENDIX J

YOUTH WATER EDUCATION GOALS

To develop and apply an understanding of water as vital to natural processes, human activities and the health of all living things, youth will:

Science of water

Youth will:

•explore observable physical and chemical properties of water and relate how those properties work together in the hydrologic cycle.

•identify where and in what conditions water is stored on the earth, recognize local water storage formations, explain the hydrology of any local formations, and recognize their interconnections. (For example, youth should be able to describe sources of water for a local estuary and identify characteristics that make an estuary a unique water storage area.)

•practice using observation, measurement, data recording, prediction, and inference skills in studying the science of water

Water related ecosystems

Youth will:

•investigate and evaluate the environmental characteristics of a given water ecosystem, describe the plants and animals that inhabit the ecosystem, and research the importance of that ecosystem to those living things and to humans.

•identify sites in their community where the "natural" clean water cycle, including dissipation, biodegradation, and filtration, is functioning.

•locate areas in their community where natural or human influences have changed a local water ecosystem for better or worse and document changes that have occurred. (Change can include anything from beaver dams or floods to pollution discharges or improvement from pollution prevention techniques.)

•practice using observation, measurement, data recording, prediction, and inference skills in studying a water related ecosystem

Drinking water supply: quantity and quality

Youth will:

•trace the path that water travels in order to serve humans in the local community. Steps include its origin in surface and ground sources, movement to home wells or public storage facilities, to home treatment systems or public treatment plants, to home and industry uses, and eventually to its return into the natural environment.

•acquire and apply the skills needed to investigate the relationship between drinking water quality and human health and explain why private and public drinking water supplies must be tested for quality.

•view residential or public drinking water facilities and explain how treatment techniques help meet regulatory standards applied to water before its use.

•demonstrate their awareness of personal water use habits and provide leadership to involve their families and community in water conservation efforts.

Water use

Youth will:

•identify water related products and recreation experiences that are part of their lives.

•experience the aesthetic impact of a water resource on their life.

•analyze how local water use decisions affect human lifestyles, quality of life, and standard of living.

•summarize the evolution of a local use of water, and interpret the impact of that evolution on the environment. Investigation of the local water use should identify any local doctrines of water ownership that apply to water use in their area and local use conflicts caused by changes in water demand. (Water uses which could be considered include; the historical increase in an urban population, evolution of commercial fishing or textiles industry, or use of water in food production processes over time.)

Sources of water pollution/contamination

Youth will:

•identify categories and sources of information about human actions which affect water quality in their community with special attention to those which provide major sources of pollution.

•view residential or public wastewater treatment facilities and explain how treatment techniques help meet regulatory standards applied to water after its use.

•list local environmental factors which affect the potential of pollution sources to contaminate groundwater and predict land uses appropriate to protecting those factors. (Environmental factors might include soil types, geologic formations, proximity of water sources, height of water table, potential of flooding, climate factors, etc.)

•demonstrate their awareness of products used in home life which can contribute to water pollution if managed inappropriately and provide leadership to involve their families and community in efforts to protect water from contamination by those products.

Water quality: risk assessment and reduction

("Risk assessment" is used here according to its broadest definition, not the scientific assessment process used to develop pollutant regulations. However, understanding of the risk assessment process is an important education goal.)

Youth will:

•meet with representatives of regulatory agencies to learn about likely causes and effects (on humans, fish, and wildlife) of pollutants found in their community that exceed advisory levels.

•investigate how people measure water quality changes over time and summarize what those measurements have indicated about local water quality. Understanding about change should include the impact of human behavior on degradation as well as historical improvement of local water quality.

•assess the relative environmental quality of a local body of water based on water quality parameters and the diversity of living organisms.

•demonstrate their understanding of Best Management Practices which minimize the risk of water contamination from crop protection chemicals through farm visits and farm management simulations.

Management and protection strategies for specific uses

Youth will:

•identify local and regional agencies which monitor and control human caused pollution; and observe the strategies and equipment they use to identify water quality problems and sources in their community.

•identify local and regional agencies which monitor and control natural disasters; interview professionals from these agencies to learn how to prepare for and prevent natural disasters related to water.

•evaluate the effects of different kinds of land use on water habitat, then describe and evaluate lifestyle change and community planning options to minimize damaging effects.

Government and citizenship issues

Youth will:

•identify steps that they can personally take to prevent water pollution.

•identify appropriate questions and sources of information for evaluating a local water issue. practice using observation, measurement, data recording, prediction, inference, classification and problem solving skills to enhance their understanding of the science, community values, and policies of a local water issue.

•develop their own ideas about solutions to a local water issue by investigating and analyzing the science, community values, and policies that relate to that issue.

•demonstrate that they understand how, when, and where to communicate what they have learned about any positive or negative impacts of changing local conditions on the water resource.

•practice skills that enable them to act in direct response to what they have learned about water.

Water related careers

Youth will:

•identify and describe at least five careers related to the water resource and explain what they would need to do to prepare themselves for at least one of the careers.

APPENDIX K

CHOOSING CURRICULUM FOR THE NONFORMAL SETTING

Educating youth about water in a nonformal, or out of school setting, can contribute to the youth's opportunity to experience and apply water concepts. The nonformal setting might include: an after school ecology club, a summer camp, a visit to a nature center, a church youth group meeting, or an organized youth program such as Boy Scouts, Girl Scouts, or 4-H.

With few exceptions, water curriculum and support materials have not been designed for the nonformal setting. However, several can be adapted to the nonformal setting relatively easily. Still others would be useful in the nonformal setting with minimal preparation and modification. A few provide good models for development of a comprehensive nonformal program.

The following questions can be used as a guide to deciding whether a particular curriculum could be easily adapted to the nonformal setting. These questions were suggested by nonformal education practitioners. The applicability of these questions has not been subjected to a formal evaluation.

- Does the format:
  - provide instructions in a brief form?
  - allow easy separation of instructions from the activity?
  - provide appropriate packaging to ensure that instruction materials are portable and long wearing?

- Are concepts taught through an activity?

- Does the activity provide a "hook" or appeal to a "teachable moment"?

- Does the activity relate to the "world" of the youth who will do the activity? Is it appropriate to the interests, age, sophistication, gender, culture, socioeconomic status, and learning needs of the youth?

- Can activities be provided independent of each other, i.e. can they stand alone?

- Is the time requirement for the activity appropriate to the attention span of the age group and the time available in the nonformal setting?

- Does the activity produce a product or result that enables the youth to communicate the concept that is learned?

- Is the activity fun? Is there a reward for the learner, tangible or intangible?

- Does the activity have a good probability of changing or influencing behavior?

- Are materials easily available to most people? Are special required resources packaged with the materials? Do the materials assume ownership of special equipment such as a video cassette recorder, tape recorder, or computer?

- Are the instructional methods easy to understand, organize, and carry out? Can they be conducted without any special training or knowledge on the part of the leader?

- Is the language used to describe the activity "user friendly," without educational jargon?

- Does the activity actually work?

•Is the purpose for any support items, such as charts, graphs, or illustrations, self explanatory and clearly related to the activity?

•Is the activity appropriate to the setting where the activity will be used, e.g. the best use of a computer based learning program would be in a setting with low distractions and the opportunity to spend time with the materials?

To help narrow the search for curriculum materials which could be adapted to the nonformal setting, the following materials are offered as examples. This list is not intended to be exclusive nor have these materials been tested for their effectiveness in that setting. Details about the topics included in each curriculum are available in the Curriculum Summary Table.

The following curricula, are examples of curriculum which could be adapted to the nonformal setting:

Aquatic Wild
Be Water Wise
Local Watershed Problem Studies
Our Great Lakes Connection
The Story of Drinking Water
Water Resources Education. Critical Issue: Water. You Can Make a Difference!
Water Riches, Indiana version
Water Magic
Water Wizards

Activities from these curricula could be adapted to the nonformal setting with some effort:

4H Sportfishing Aquatic Resources Education Program
Groundwater: A Vital Resource
The Groundwater Adventure
Instructor's Guide to Water Education Activities
Stop, Look, and Learn
Surface Water
Teaching Aquifer Protection
Water Wise
Water Worlds

These curricula provide a unique resource to the nonformal setting:

Nebraska Groundwater Foundation: *Groundwater Festival* and *Children's Groundwater Festival Outreach* packet - provides an easily transferred model of a regional or state wide Nonformal

Ranger Rick's NatureScope, "Wading Into Wetlands" and Diving Into Oceans" - some of these activities are ideal for self learning; others provide an excellent basis for design of a nature center or summer camp experience.

The following materials listed under "Unique Programs or Program Support Materials" were either designed for the nonformal setting or could be adapted with minimal effort:

The Changing Chesapeake
Fishing for Fun and Learning
Fishing . . . Get in the Habitat
Friends - Special Water Edition, A Magazine for Young Readers From Georgia 4-H Clubs
My Wetland Coloring Book
Project Earthcare
Responsible Angling. The Oregon Angler Education Manual
Ranger Rick's NatureScope. Pollution: Problems and Solutions
Water Can Be Fun! How to Create a Successful Science Fair
Water Fun For You

Printed on recycled paper.

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