AN ASSESSMENT OF RESOURCES FOR SOURCE WATER EDUCATION NEEDS

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BACKGROUND

Historically, the health of individuals and communities has been linked with the availability of a safe source of drinking water. Currently, advances in technology, population increases, changes in land development patterns, and lifestyle changes have impacted on both the quality and quantity of safe drinking water available for human consumption and needs.

In response to the increasing demands for safe sources of drinking water, decreasing water quality, and rising treatment costs; protection of the nation's surface and ground waters that serve as drinking water sources has been designated a national priority. The Safe Drinking Water Act (SDWA) requires that citizens be provided with information on their drinking water in order that they can learn how to help protect it, and can make individual health decisions about it. The 1996 Amendments to the Safe Drinking Water Act (SDWA), address this need through the funding of state Source Water Assessments (SWA) and the subsequent development of Source Water Assessment Programs (SWAP). SWA and SWAP will provide consumers with increased access to information about their drinking water, and furnish opportunities for involvement in drinking water issues. The completion of a state SWA and the development of a SWAP will result in:

- Identification of areas that contribute ground water or surface water (drinking water sources) to public water systems.
- Identification of land uses or facilities that may threaten source water quality.
- An inventory of source water contaminants.
- Assessment of the water systems susceptibility to contamination.
- Dispersal of the information to the public.

The overarching goal of state Source Water Assessment and Protection Programs is to protect public health by preventing contamination of a public water supply.

On a federal level, in an attempt to revitalize the nation's commitment to water resources, the Clean Water Action Plan (CWAP) was released on February 19, 1998. Included within the 111 key actions, or goals and objectives of CWAP, are actions designed to support and help create community-based watershed protection and restoration measures through information exchange and collaboration, in addition to measures designed to protect the sources of drinking water (surface and ground waters).

In recognition of the role of public education, and citizen participation, in water resource issues - and the concurrent need to expand existing education programs in source water protection and improvement - the National Environmental Education & Training Foundation (NEETF) in collaboration with the US Environmental Protection Agency (EPA) Office of Ground Water and Drinking Water (OGWDW), engaged Elaine Andrews, University of Wisconsin (UW) Cooperative Extension Service, to evaluate existing K-12 water education materials for topic areas related to drinking water sources (DWS). Gaps - areas where little or no curricula exist to address source water issues - would be identified and presented, as future source water education needs.

Completion and publication of the gap analysis of water resources curricula would provide the information to guide future development of new curriculum, or adaptation of existing curricula, to fill source water education needs.

PROJECT GOAL

To search the UW, *Educating Young People About Water* (EYPAW) resource database, and newly acquired water education materials to: 1) identify curricula that that could be used to meet source water education needs, and 2) to identify gaps that could be filled through expansion of existing materials, or creation of new source water education materials.

SOURCE WATER CURRICULA REVIEW PROCESS

In order to assess existing curricula for source water content, the EPA OGWDW developed a list of key topics and subtopics considered to be essential components of source water education materials (Appendix A). Key source water education topics, as identified by the OGWDW, were then correlated with the Water Quality Education Topics and Major Subtopics evaluation criteria utilized by the UW - Environmental Resources Center (ERC) for the *Educating Young People About Water* (EYPAW) database (Appendix B). Additional water education topics - relevant to source water education needs - not present in the original EYPAW checklist, were also identified and used as evaluation criteria for selected curricula (Appendix C). Source water concepts were realigned into six key source water topics and related subtopic areas based on the interrelationships of subject matter content, the dynamics of source water acquisition and distribution, and a curriculum-style progression of learning (Appendix D). The six key topics identified were:

- Identification of Drinking Water Sources
- Geohydrology: Dynamics of Drinking Water Sources
- Accessing, Storing, Treating, and Distributing Drinking Water Sources
- Contamination, Risk Assessment, and Remediation of Drinking Water Sources
- Protection and/or Prevention Activities and Programs of Citizens, Communities, and the Government
- Present and Future Needs for Safe Drinking Water Sources

As a preliminary step to the research process, information on one hundred twenty-two previously evaluated water resources curricula, originally in word processing format in the UW youth water education database, was converted into an electronic database in Paradox. The goal of the conversion was to facilitate the development of a list of curricula that mention source water topics. The list would act as a tool designed to identify curricula for further assessment.

A search for new curricula materials potentially relevant to source water education was also initiated. Sources for new educational materials included, but were not limited to: 1) government agencies, 2) environmental organizations, 3) cooperative extensions, 4) topic searches of Internet search engines, 5) educational catalogs, and 6) national partners.

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Using the Paradox database as a research tool, curricula could be assessed for the presence or absence of source water topics. Curricula within the database were originally evaluated for topic mention without reference to quality of the materials. Therefore, one of the goals of the conversion was to create a list of curricula, which generally addresses the six key source water topics and subtopics. Analysis of the listed curricula further quantified the materials into a summary of curricula that mentioned 60% or more of the subtopics within one of the six key source water topic areas (Appendix E). A listing of topic areas mentioned by each curriculum can be found in Appendix F.

A further selection process of the Paradox identified curricula (Appendix E) was initiated using strength of correlation, a random sampling of both older and newer curricula, and previously published curricula summaries as a guide. Targeted curricula were then individually assessed for content and quality; in order to prepare a summary of selected curricula and associated activities that strongly addressed identified topics for source water education needs (Appendix G). A bibliography of sample curricula, which addressed source water education needs by way of information presentation, resource identification, and/or activities presented, was then generated (Appendix I). As a means of formulating future recommendations for source water education, in addition to subject matter content, selected curricula were also scanned for format and correlation with current philosophies of teaching and learning.

Through the Paradox research process and individual assessment, topic areas could be identified which were strongly or weakly addressed in the evaluated materials (Appendix H). Gaps in source water topics within the education materials were also identified through analysis of Paradox database search results, and by scanning hard copies in the Environmental Resources Library (Appendix H). Gaps in evaluated materials were to be identified and presented, as future source water education needs.

SOURCE WATER EDUCATION GOALS FOR YOUTH

Youth have an important role in source water protection. Individually, as members of a family and community, and as future citizens, the youth of today have the power to act as catalysts to initiate change and guide development of future activities to ensure the health of the nation's drinking water sources. To empower youth in this process, three key concepts need to be understood and applied:

1. Safe drinking water is essential for the health of individuals and communities.
2. Water is connected to everything else in nature. Thus, source water needs to be studied and protected in relationship to the physical and human environment.
3. Individuals and groups can identify potential sources of source water contamination and protect their water supply.

The organization and content of key source water topics, in conjunction with the sample education goals described below, are designed to facilitate the understanding of the above mentioned concepts. The sample goals are also designed to develop a youth's sense of ownership towards their community, personal health, and the health of their drinking water sources.

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SAMPLE EDUCATION GOALS

1. *Identification of Drinking Water Sources*

It's midnight; do you know where your source water is?

Previously, limited information has been available or distributed, to individuals and community members concerning the source(s) of their drinking water. Consequently, the first step in source water protection should be the **Identification of Drinking Water Sources** for the community in question. Due to the dynamics of water movement, and the relationship to soil composition and landscape topography, both ground and surface waters act as sources for most drinking water systems. In order to protect source water from contamination, ground and surface water potentially threatened by contamination must be identified and mapped. To accomplish this objective, within their community youth will:

- Recognize and define a drinking water source as an area from which water flows, (surface water, underground aquifers, or both) to an intake or well that supplies drinking water.
- Differentiate between ground and surface water ecosystems.
- Locate and describe the characteristics of the aquifer(s) in their area.
- Using topographic maps as a tool, identify and delineate the watershed.
- Describe the characteristics of, and locate the source(s) of the local drinking water supply.

2. *Geohydrology: Dynamics of Drinking Water Sources*

There is a lack of understanding about the science of source water.

Traditionally, water resource protection activities have focused on either a ground water approach, whereby public water utilities use wells to pull water from aquifers, or a surface water approach directed at source water accessed from lakes, streams, rivers, and other surface water bodies. In reality, both ground and surface water influence most drinking water systems. In order for youth and citizens to protect and prevent contamination of local drinking water sources, it is therefore crucial to understand the often interconnected, dynamic relationship between ground and surface waters.

Since contaminants usually move in the direction of water flow, by understanding ground and surface water movement, youth can determine whether land use activities and development within the watershed will pose a threat to the quality of local drinking water sources.

To reach this goal, within their community youth will:

- Describe the hydrologic cycle, recognizing that ground and surface water are integral components of the cycle.
- Investigate the porosity and permeability of different soil types as it relates to source water and pollutant containment and movement. Compare to soil types within their watershed; predict the impact on contamination within the watershed.

- Explore the effects of landscape topography on source water movement within the watershed.
- Design and construct a watershed model illustrating the hydrologic cycle, the interrelationship between soil characteristics and landscape topography, and ground and surface water interactions.

3. *Accessing, Storing, Treating, and Distributing Drinking Water Sources*

Approximately 85% of U.S. citizens consume water from public systems or supplies.

In order to empower youth, and facilitate comprehension of public water management issues, educators need materials that will identify and illustrate the progression of activities starting with collection of source water at its point of origin, storage, identification and treatment of contaminants, through distribution, wastewater treatment, and disposal.

Based on this need, within their community youth will:

- Illustrate the movement of source water from its place of origin, through collection, storage, pretreatment, distribution, wastewater treatment, and return to the environment.
- Identify where, and how, source water is stored before treatment and distribution.
- Summarize the treatment(s) used to purify local source water. Investigate and cooperatively design a treatment system for polluted water.
- Describe the method of drinking water distribution.
- Describe and illustrate a septic system. Explore the relationship between septic system placement, design, and maintenance; correlate to possible ground water contamination.
- Summarize the wastewater treatment procedure for the community. Explore alternative strategies for treating wastewater.
- Identify the local water body where treated wastewater is discharged.

4. *Contamination, Risk Assessment, and Remediation of Drinking Water Sources*

Is it safe to drink?

A dichotomy in water resource issues exists. People are aware that there are problems with our water resources; but yet, generally perceive that water is safe to drink. The public needs more information about health problems associated with water. They need to know what contaminants exist in their drinking water, and how it can affect them.

The ultimate goal of a state SWAP is to protect source water against contamination by sediment, certain chemicals, and microorganisms. In some cases, contamination may lead to costly and difficult remediation techniques; in others, affordable technologies are nonexistent. It is easier, and less costly, to stop the pollution problem at its source by preventing contamination of drinking water. As community members, youth can help drive and focus pollution prevention activities through investigation, discussion, and dissemination of information.

To aid this process, youth will:

- Investigate and trace the movement of a pollutant in surface and ground waters.
- Predict how, when, and why source water is susceptible to contamination.
- Assess the health of a local body of water based on biological and chemical parameters.
- Identify and analyze land use practices and/or present and future land development issues that may impact on the quality and/or quantity of their source water.
- Research and develop a list of point and nonpoint sources of pollution. Compare with different kinds of land use in the community; develop a summary of possible contamination issues to investigate.
- Explain the link between watersheds and human health; correlate with local source water health.
- Acquire a copy of the Consumer Confidence Report (CCR) from the local water supplier. Analyze the CCR and identify contaminants in their source water.
- Explore and discuss the consequences of source water contamination.

5. *Protection and/or Prevention Activities and Programs of Citizens, Communities, and the Government*

Only you can protect your source water!

The issue of drinking water safety is both a health and environmental concern. Water is connected to everything else in nature; what enters our environment will ultimately be passed on to humans in one form or another.

The protection of source water is unique to each system's potential or existing threats to its sources, policies and procedures of the local government, local economic conditions, and other

local environmental or community concerns. As a result, source water protection strategies require an integrated, holistic approach tailored to the local situation.

Youth need to understand how their individual and/or collective choices and actions can affect the quality and quantity of locally available safe water. Studies have shown that public education has changed consumer behavior and attitudes. Yet, few people have any knowledge about specific laws or regulations that require water to be safe. The Safe Drinking Water Act, Clean Water Act, Source Water Assessments, and Source Water Assessment Programs, all address the health of drinking water sources. As citizens and community members, youth can support drinking water protection programs through investigation, analysis, and action; education; personal lifestyle changes; partnerships with the community and local water supplier; or input at the local, state, and national levels of government.

Examples of source water protection programs which youth/community members could

participate in may include:

- zoning or land use planning
- identification of activities that may potentially contaminate source water
- reservoir, or river, stream, and lake protection
- protection of wellhead and ground water recharge areas
- emergency response
- best management practices
- public education campaigns and workshops
- land acquisition and conservation easements

As active participants in source water protection, youth will:

- Recognize the role of lifestyle and personal choice as related to water quality and quantity.
- Tabulate and analyze their personal and household consumption of water. Differentiate between required water consumption and optional water consumption. Reflect on, discuss, and create a product illustrating methods of reducing consumption.
- Inventory their households for potentially polluting substances and practices. Research and evaluate alternative products and pollution prevention strategies.
- Explore and tabulate the quantity of water consumed in the manufacture of a consumer product from acquisition of raw materials, through manufacturing and distribution. Explain the link between consumerism and water use.
- Research and summarize legislation to protect source water.
- Research local policies relating to land use and water resources. Identify steps they can personally take to prevent source water contamination.
- Explore youth action opportunities in local implementation of the SWAP.

6. ***Present and Future Needs for Safe Drinking Water Sources***

Water; water everywhere, but...

As land development patterns change, technology continues to advance, and populations grow; what are the drinking water source concerns in relationship to adequate supply and safety? How will the needs of different user groups be balanced and mediated? What strategies can be initiated now to protect future water supplies?

To explore these questions, youth will:

- Investigate, compare and contrast, land development patterns of the past with the present.
- Compare and contrast water usage in the past with the present. Correlate with lifestyle, population, changes in land use and technology advances. Based on the water usage patterns presented from past to present, predict future needs for source water.
- Explore the actions and perspectives of different user groups through simulation of a water emergency.

- Develop a summary of pollution prevention and resource conservation practices that could be implemented in the community.

SOURCE WATER CURRICULA STRENGTHS AND WEAKNESSES

There is an abundance of curricula available to the educator for water resources education. A large percentage of the source water key topics covered in the evaluated curricula are addressed in activities that can be incorporated into a classroom or nonformal setting for source water education needs (Appendix F).

Through the Paradox identification and evaluation process, in conjunction with individual assessment of selected materials, the following strengths and gaps were noted for the six key source water topics (Appendix H).

Identification of Drinking Water Sources

Strengths:

Although not incorporating the term source water, numerous curricula covered surface and ground water systems as they related to drinking water use by humans. Information on the ecology and geology of ground water systems and ground water protection, as represented by the *H20 Below* curriculum, was well documented in the materials evaluated. Frequently, the need to understand both surface and ground water was covered in curricula and activities centering on the watershed concept such as *Watershed Science for Educators* and *From Ridges to Rivers: Watershed Explorations.*

Determination of the land area defined by a watershed is integral to the study and understanding of drinking water issues. Watershed mapping, often centered on the interpretation or construction of a topographic map, was covered in a number of the curricula such as *Give Water A Hand* and *Watershed to Bay: A Raindrop Journey.*

Gaps:

Notably absent in all but one curriculum evaluated, was a definition and description of source water. Few people are aware that source water describes the original source of water acquired from a water ecosystem in order to fill the public's need for drinking water. In many cases, individuals have not envisioned their water source beyond the tap or local water tower. One newer curriculum, *That Magnificent Ground Water Connection*, addressed this topic in a student activity, "Track Down and Protect Your Critical Ground Water Resources". The goal of the activity was for students to research and develop a ground water resource protection strategy for their community. Through reading materials which discussed reasons why a community might want to protect its ground water resources, students were introduced to the 1996 Safe Drinking Water Act Amendments, and the concept of source water protection through Source Water Assessment Programs (SWAP).

Geohydrology: Dynamics of Drinking Water Sources

Strengths:

Curricula activities were plentiful to address this topic. In *Hands On Save Our Streams,* students' design and construct a watershed to illustrate the effects of land use on surface water systems, and the benefits of using Best Management Practices (BMP). Student construction of a simple aquifer, and the effects of well pumping on water movement, were easily demonstrated in the activity "A Groundwater Drink" found in the curriculum *Investigation H20.*

Many of the laboratory activities and demonstrations in evaluated curricula were designed to simulate the movements between source and ground waters, thus demonstrating the strategic role of ground and surface water interactions within the watershed. Students were able to create visual representations of the processes, analyze the effects on water movement of landscape topography and different soil types, and predict contamination movement. Curricula addressing the topic with hands-on activities were numerous and thorough in covering this topic; a good example being *The Ways of the Watersheds: An Educator's Guide to the Environmental and Cultural Dynamics of New York City's Water Supplies.*

Accessing, Storing, Treating, and Distributing Drinking Water Sources

Strengths:

Distribution of treated drinking water sources to the public, and wastewater treatment, are included in the key topics in order to complete the man-made source water cycle starting at acquisition from a water ecosystem, through storage, treatment, distribution, wastewater treatment, and return to the environment. A number of curricula describe wastewater treatment processes such as *Water Sourcebook;* often recommending a field trip to the local wastewater treatment facility as an additional method of study. An interesting approach to the study of a distribution system can be found in *That Magnificent Ground Water Connection.* Students' work cooperatively to design and construct a model water delivery system from well to user. Overall, both source water delivery and public wastewater treatment were covered adequately in materials evaluated.

Gaps:

In general, there is limited information available on accessing and storing source water. Some of the curricula address ecologically appropriate well placement, such as *Ecological Citizenship: Precious Water* and a number of curricula cover contamination and overdraft through a lab-based well simulation activity. A very limited number of curricula cover well water testing, an example being *Investigation Groundwater: The Fruitvale Story*. In addition, private well testing, discussion and description of surface source water intakes, and wellhead protection are rarely mentioned.

Treatments used to purify source water before distribution are specific to the community in question. Several curricula demonstrate an overview of source water treatments such as *Streets*

to Stream and *Always a River;* however, to correlate treatments with actual contamination problems, information is needed on the health of the drinking water sources in question. Although not commonly mentioned in evaluated curricula, an activity illustrating natural filtration systems can be found in each of the following curricula: *Investigation H20, Discover Wetlands,* and *Ecological Citizenship: Precious Water.*

It should be noted that only a very limited number of the curricula evaluated addressed septic systems as both a means of private wastewater treatment, and as a source of ground water contamination, one exception being the activity "How Septic Systems Work" in the *Groundwater Study Guide.*

Contamination, Risk Assessment, and Remediation of Drinking Water Sources

Strengths:

Essential to source water study and protection is the determination of "where, why, and how" source water is contaminated. A number of curricula pose this question through simulation of a water contamination emergency. In *Investigating Groundwater: The Fruitvale Story* and the activity "A Grave Mistake" in the *Project Wet* curricula, students' analyze local land uses to determine a probable contamination source.

The majority of curricula examined explored contamination identification through either biological or chemical water quality indicators. The presence or absence of different macro-invertebrates as pollution level indicators was a common theme in numerous curricula such as *Watershed Science for Educators.* Chemical tests, such as pH and dissolved oxygen, were also well represented, an interesting twist being the analysis of snow in *Local Watershed Problem Studies.*

Gaps:

Risk assessment was rarely explored, an exception being the "Risk Assessment" activity in *Water Politics, which* examined students' attitudes toward the value of life. The effects of water quality on human health were weakly covered, although *Project Wet* contained several activities exploring health issues both past and present.

In general, contamination sources were identified through reading materials, although few were given in-depth treatment through investigation and/or analysis.

The consequences of source water contamination, whether through additional treatments which may be costly, the building of supplemental or new treatment facilities, or purchase of uncontaminated water, was rarely covered in the materials assessed. *Water Politics* was one of the exceptions, utilizing a decision-making activity to explore the possibility of upgrading or closing a reservoir. Remediation stratagies once drinking water sources have become contaminated was also poorly covered. *Investigating Groundwater: The Fruitvale Story* examined this issue through the simulation of a town meeting to choose a clean-up plan.

Protection and/or Pollution Prevention Activities and Programs of Citizens, Communities, and the Government

Strengths:

Protection of source water through individual actions and choices within the home environment was a topic area covered in depth in numerous curricula. Activities requiring an examination of both the quantities of water consumed, and the potentially polluting substances stored and used within the home, were strongly represented. Home-based remediation strategies for reducing water consumption were covered extensively in evaluated materials; "Xeriscaping – Seven Steps to Water-Wise Landscaping" in the *Water Sourcebook* was a unique activity in this area.

Gaps:

Factors beyond domestic usage such as consumer product choice and lifestyle decisions were absent from evaluated curricula. The effect of population increases, as a factor in water quality and quantity issues, was not addressed.

Relatively little curricula content was devoted to zoning or legislative actions on a community, state, or federal level. Although a number of curricula contained simulation activities for a hypothetical community issue; for the most part they concerned personal, economic, or social issues from the perspective of the individuals affected by a contamination situation. A gap in materials exists in the area of documentation of source water protection programs and laws; concurrently, youth action opportunities in the form of support, input, or community education were absent also.

Present and Future Needs for Safe Drinking Water Sources

Gaps:

Will there be enough safe water available 25 years from now to meet the needs of individuals and communities? In order to explore the answer to this question, present needs must be documented. A gap exists in this area, with few curricula addressing the topic on a concrete basis. One exception, evaluating world and U.S. water use, can be found in *E2: Environment & Education - Water Conservation.* Along similar lines, comparison of present day methods of using and obtaining water are compared to Native American usage of the past in *A Child's Place in the Environment: Caring for Aquatic Systems.*

DISCUSSION

Teaching and Learning

Although not representative of all older water education curricula evaluated; in general, the format of older curricula, such as *GREAT – Groundwater Resources and Education Activities,* placed a greater emphasis on paper/pen and seatwork as a means of acquiring knowledge. Information was frequently presented in reading or lecture format, with subsequent classroom discussion of concepts and data presented. Hands-on laboratory activities and field work were

well represented in many of the curricula evaluated; although generally older materials, such as *Clean Water, Streams and Fish: A Holistic View of Watersheds,* stressed teacher presented demonstrations or directed lab activities. The use of technology in the classroom was rarely addressed.

In contrast, newer curricula, such as *Ecological Citizenship: Precious Water,* often emphasized an inquiry approach into students' preexisting knowledge base as an means of introduction to a new concept or topic. In some newer curricula, the classroom collective knowledge base was used to prepare an informational overview of the topic. Some of the newer materials reflected current educational theories of teaching and learning; cooperative learning was stressed, students were active participants in the construction of knowledge, and process was stressed over product. As indicated by more recently published curricula, philosophies of teaching and learning have changed in the last decade. Teachers are no longer seen primarily as a means of dispensing information; rather the teacher becomes the facilitator of science learning. In this capacity, the teacher's role is determining if students are making sense of the learning experiences provided. Increasingly, the classroom emphasis is on student-centered learning, and cooperative learning strategies are utilized as students actively construct knowledge utilizing inquiry-based problem solving. It is recommended that newly developed education materials be designed to meet current philosophies of teaching and learning in order to address current needs in the education community.

Curricula Content

Overall, background information that is needed by students and educators in order to comprehend the scientific concepts integral to learning about source water, are well represented in the evaluated curricula. Background topics include:

- the physical and chemical properties of water
- the hydrologic cycle
- the percentage of fresh water on the Earth available for drinking
- types of water related ecosystems
- soil composition and structure

In order for youth to visualize and understand the complete picture, there is a need for curricula materials that follow the natural and man-made course of source water from the water ecosystem(s) of origin, through collection, treatment, and distribution, to local and home-site treatment of wastewater generation. Although there are several curricula which address this progression of topics, such as *The Ways of the Watersheds: An Educator's Guide to the Environmental and Cultural Dynamics of New York City's Water Supplies,* and *Watershed to Bay*: *A Raindrop Journey;* the materials are centered around a specific, regionally based, water ecosystem within the United States. Much of the background information and activities are adaptable to various water-related ecosystems throughout the U.S., but an educator would be required to pull resource materials from other sources in order to adapt the materials to local conditions.

Curricula Scope and Sequence

On a community level, there has been a lack of information available to the public on the safety of their drinking water. As part of the 1996 Safe Drinking Water Act Amendments, by October 1999, all community water systems will be required to develop and publish a Consumer Confidence Report (CCR), or water quality report. Publication of a local CCR will provide some of the required background and technical information needed by educators in order to develop a locally based teaching unit on source water. The CCR can be used as an organizational tool, providing a sequential structure for source water topics, in addition to defining the scope of information studied.

The information available in a CCR can also be correlated to the six key source water topics and the source water sample education goals for youth presented in a previous section of this report. Each CCR must include, but need not be limited to:

- Identification of the sources of local drinking water.
- Susceptibility to contamination of the sources of local drinking water.
- The level of contaminants in the local water supply, and a comparison with EPA's health-based maximum contaminant level.
- Potential health effects if a violation has occurred.
- The probable source of a contaminant.
- If detected in the water, information on radon and *Cryptosporidium.*
- Information on any completed Source Water Assessments (SWA), and the means in which to obtain a copy.
- Phone numbers of the local water utility, and EPA's Safe Drinking Water Hotline (800-426-4791).

At their discretion, water utilities may choose to enhance their reports with additional information, such as the treatment used to purify local drinking water sources, present needs for drinking water, and projected future needs. Additional report requirements may be developed and enacted by each state after public notice and consumer input. The reports will be mailed to all customers of the water utility, or published in the local newspaper.

By providing easily accessible and locally based information on the origin and safety of a community's' water supply; publication of a water utilities Consumer Confidence Report will provide the background information necessary for formal and nonformal educators, individuals, and/or the community to investigate and address the issue of source water protection and contamination prevention by:

- Heightening awareness about contaminants that cannot be seen, smelled, or tasted. Water that looks, tastes, and smells good is almost always considered to be safe by consumers.
- Prompting them to think about the origin of their source water, what can be in it, potential health effects of contaminated source water, and where they can access more information on the consumer's role in source water protection.

- Encouraging reflection on their personal activities, which may threaten source water.
- Providing locally relevant scientific knowledge necessary for the understanding of local source water protection and contamination prevention issues.

Therefore, it is recommended that newly developed curriculum materials for source water education needs include incorporation of a CCR in the curriculum structure in order to provide: 1) an educational resource for locally-based source water background information, and 2) an organizational tool for content presentation and study.

Curricula Format

Increasing pressures are being placed on formal educators to adapt and correlate materials to education standards, select or modify materials to engage students with different learning styles, and to provide inquiry-oriented and interdisciplinary education materials. In 1996, the average workweek of teachers was 49 hours, the highest the figure has been since records were first collected in 1961. In order to assist teachers with limited time; it is recommended that any newly developed curriculum materials pull together the necessary background information, resources, activities, and assessments. In addition, newly developed materials should be aligned with National Science Education Standards and current theories of student learning.

Technology in the Classroom

In this decade, schools are also striving to incorporate, and increase, the use of technology in the classroom. In 1995, only one-fourth of teachers used calculators or computers in the classroom. In today's classroom and in the future, teachers will be expected to use technology to provide educational alternatives and choices that augment and stretch opportunities for learning. It is therefore recommended that any new source water education materials either correlate with currently available technological tools, such as the *Surf Your Watershed* web-site developed by the EPA, or incorporate technology as an additional learning tool.

RECOMMENDATIONS FOR NEW SOURCE WATER EDUCATION MATERIALS

There is a need for source water education materials designed to identify, assess, prioritize, and address local needs in the area of source water protection and contamination prevention. Numerous activities are available to cover many of the key topics identified for source water education. However, there are gaps in existing curricula that need to be addressed in newly developed materials in order to complete the source water "big picture" for educators and the community. Suggested format, concepts and content to include in a teacher/leader packet are summarized in the recommendations below. Ideas are presented in response to evaluation results and comments in previous sections of this report.

Goals for New Source Water Materials

To support EPA's source water initiative by: 1) identification of existing curricula which meet source water education needs, and 2) creation of new materials designed to fill gaps within existing materials.

Context

A local, community-based inquiry-oriented source water education experience.

Format and Content Areas

Creation of a progressive, sequential source water education teacher/leader packet. The following should be included in the packet:

- Background information, goals and objectives, activities and associated timeline, materials list for activities, resource identification, glossary, and assessment strategies.

- A curriculum template which describes the source water "big picture" through identification of the six key source water topics:
  1. Identification of drinking water sources.
  2. Geohydrology: Dynamics of source water.
  3. Accessing, storing, treating, and distributing source water.
  4. Contamination, risk assessment, and remediation of source water.
  5. Protection and/or prevention activities and programs of citizens, communities, and the government.
  6. Present and future needs for safe source water.

- Sample source water education goals (refer to p. 4 in the curricula assessment report).

- Resource identification of previously evaluated source water activities in the areas of:

  1. The physical and chemical properties of water.
  1. The hydrologic cycle.
  2. The percentage of fresh water on the Earth available for drinking.
  3. Types of water related ecosystems.
  4. Soil composition and structure.

- Student activities focusing on the following themes:

  1. Identifying and defining source water, and source water areas.
  2. Identification of the watershed(s) in which the community is located.
  3. Identification of storage areas for local source water.
  4. Identification of contaminants in the local water supply.
  5. Methods of treating contaminated source water.
  6. A survey of possible sources of source water pollution in the community.
  7. An investigation into the effects of water quality on food sources and human health.
  8. Environmental and economic costs of creating new or supplementary municipal water systems.
  9. Action strategies for a source water contamination emergency.

10. An exploration into the interrelationship between personal lifestyle, socioeconomic status, culture, population growth, and accessibility as they relate to source water availability and contamination.
11. The role of legislation in source water protection.
12. Individual opportunities for source water protection actions on a community, state, or federal level.

- An activity simulating the "big picture" of the source water cycle from acquisition through treatment and consumer consumption to discharge of treated water back into a water ecosystem.

- Information on accessing the local Consumer Confidence Report. Incorporation of CCR information into the structure and knowledge base of the information and activities in the education packet.

- Incorporation of technology through activities and information acquisition, and/or resource identification.

- Correlation of activities with National Science Education Standards.

- Student assessment through a home, school, or community based source water action project.

Philosophy of Teaching and Learning

- Materials are inquiry-based and hands-on.

- Emphasis on student-directed teaching and learning.

- Recognizes that student knowledge and understanding are rooted in experience. As a result, learning consists of continual or active construction of meaning by the learner.

- Recognizes and responds to student diversity and different learning styles.

- Integrates the subject matter with other disciplines.

- Supports collaborative learning within the classroom.