Water Environment Federation®
Preserving & Enhancing the Global Water Environment

Aqua Venturer Teacher Guide

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Developed in partnership with the
Louisville and Jefferson County (KY) Metropolitan Sewer District

MSD

Founded in 1928, the Water Environment Federation (WEF) is a not-for-profit technical and educational organization with members from varied disciplines who work toward the WEF vision of preservation and enhancement of the global water environment. The WEF network includes more than 100,000 water quality professionals from 79 Member Associations in 32 countries.

For information on purchasing the *Aqua Venturer CD ROM* and/or WEF publications, membership and conferences, contact:

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To access a modified version of the *Aqua Venturer CD ROM* (corresponding to activities in the *Aqua Venturer Teacher Guide*), go to www.AquaVenturer.org.

Comments, suggestions, and questions about the *Aqua Venturer Teacher Guide* are welcome – contact WEF's Public Education program at 703-684-2400, or email PublicEducation@wef.org.

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Introduction

Aqua Venturer tells the remarkable multi-cultural story of human ingenuity that developed the technologies for collecting, distributing and treating water that allowed civilizations to flourish. The project including the *Aqua Venturer CD ROM*, the modified version website (www.AquaVenturer.org) and the *Aqua Venturer Teacher Guide,* was developed by the Water Environment Federation (WEF), an international, not-for-profit, technical and educational services organization representing the water quality field.

The *Teacher Guide* is designed to enhance usage of *Aqua Venturer* in the classroom. "Teacher friendly" and easy to use, the guide offers interdisciplinary, standards-based suggestions for using *Aqua Venturer* in middle-and high-school classrooms.

Although *Aqua Venturer* content is focused on science, technology and social studies, the guide activities and assessments also incorporate language arts, mathematics and the fine arts. The assessments correlate to Bloom's Taxonomy of Cognitive Skills, and offer opportunities to develop students' multiple intelligences.

Students - individually, in small groups, or as a class – may browse *Aqua Venturer*, and read or hear illustrated vignettes on important events spanning 40,000 BCE - 2080 CE. They may compete with themselves or classmates on their knowledge of those events. Students may also use *Aqua Venturer* to find interesting project or research ideas. Perhaps most valuably, *Aqua Venturer* can change the attitudes of students that believe they "don't like science," by making connections between science, social science and the real world.

WEF recognizes that today's students are tomorrow's leaders. *Aqua Venturer* will raise awareness of key water issues, the necessity of investing in infrastructure and the many opportunities for the future. It will encourage students to do their part to help preserve the water environment and may even inspire them to consider careers in water quality.

Major Focus

The 12-state education agency collaborative, State Education and Environment Roundtable, did a nationwide study of educational programs using the environment as an integrating context for learning and concluded that such programs have the following achievement-gap-closing benefits[1]:

[1] Closing the Achievement Gap: Using the Environment as an Integrating Context for Learning, Gerald A Lieberman, PhD, Linda L Hoody, MA, and the State Education and Environment Roundtable, 1998

- Better performance on standardized measures of academic achievement in reading, writing, math, science and social studies
- Reduced discipline and classroom management problems
- Increased engagement and enthusiasm for learning
- Greater pride and ownership in accomplishments

The *Aqua Venturer Teacher Guide* activities and assessments challenge students' to discover their local environmental history to make environmental education tangible.

Big Understanding

Municipal drinking water supply and wastewater treatment have contributed significantly – more than most medical break-throughs – to public health and human longevity.

Essential Questions

1. When did my community begin supplying citizens with municipal drinking water? What precipitated its introduction? What changed, for good or bad, as a result?
2. When did my community begin to treat its wastewater? What precipitated its introduction? What changed, for good or bad, as a result?

Performance Standards

The following national performance standards, itemized in Appendix B, can be addressed via the *Aqua Venturer Teacher Guide* activities and assessments:

Standards for the English Language Arts
Environmental Education Materials: Guidelines for Excellence
National Geography Standards – 1994
National Health Education Standard
National Standards in Historical Thinking
Principles and Standards for School Mathematics
National Science Education Standards
Curriculum Standards for Social Studies

After this water line was constructed in the late 1800s, it was covered with soil to protect it from freezing" (photo courtesy of Louisville Water Company.)

Learner Outcomes

1. Students will understand some ways in which social, technological, educational, governmental and economic institutions shaped history.
2. Students will understand the important role that municipal water and wastewater treatment played in public health, environmental protection and economic development of their communities.

Procedure

I. Begin with the following activity from the UN Environmental Program:

A. Ask students to bring buckets to school. Take the students and buckets to an outdoor water spigot. Organize the students into pairs, each with a full bucket of water. Instruct the pairs to carry the water to some place on campus, far enough to make an impression upon them without overtaxing them. (Afterwards, instruct students to use water on landscaping that needs it.)

B. Explain that children historically were responsible for collecting their families' water every day, year-round, typically carrying much more water for much longer distances than the students just did. Note that children in developing countries today still must haul their families' water.

II. Ask students to imagine having to carry water for all their family's needs:

A. Ask them to calculate how much water they'd need to carry daily:

1. They may make a quick mathematical calculation using a recent water bill. Keep in mind, that not all students have residences with water bills.

2. Ask older students to propose how they might measure their family's water consumption. Instruct younger students to use buckets, tape measures, watches, etc.

3. Ask them to state assumptions, explain measurement techniques and show computation. If they use calculators, require them to show their computation in terms of units to encourage them to catch mistakes.

B. Ask them if they know of a stream near their homes, from which they could safely take drinking water. Ask them what they know, see or smell about the stream or its watershed that tells them about its quality. Discuss the vulnerability of thirsty people whose communities are without laboratories to confirm the safety of their local streams.

C. Ask students what they do for drinking water and sewage disposal when on backcountry camping trips.

D. Ask students to reflect upon their water carrying exercise. Discuss the trade-offs between smaller and larger buckets, such as the extra work to carry larger buckets versus the greater number of trips to carry smaller buckets. After calculating how many buckets they would need to haul to meet their families

E. water demands, ask how long it would take them to carry it from wherever they might find it. Ask them if they think they would still have time for school, sports, etc.

Before piping was installed, children often had the burden of collecting and carrying water for the family. This sewer was installed in 1875 to deliver water from a river to an early drinking water treatment plant and the residents of that community (photo courtesy of Louisville Water Company.)

III. If you have projection equipment, use the *Aqua Venturer CD-ROM,* or the modified website version at www.AquaVenturer.org, to explore important events throughout environmental history. Otherwise, use it individually or in small groups.

IV. Define history as "change over time." Explain that historians ask more than just when? Which is the oldest? Or which was the first? Historians seek to learn the causes and effects of change.

V. Discuss what the students think "environmental history" means, until the class reaches an accurate consensus. (Environmental history includes natural history (weather patterns, soil type, plant and animal species, etc), technological history (tools, work, institutions, social relations, etc) and our environmental views (values, myths, laws, etc).)

VI. Explain – and discuss – the fact that before people in the developed world got municipal water service they were quite vulnerable to cholera, yellow fever and typhoid fever, diseases that we associate with the Third World. People did not understand Germ Theory and there were no antibiotics. Children were often left without one or both parents and commonly had to quit school and work long, hard hours, six days per week, to support their families.

VII. Explain that well into the 20th Century, most cities in the United States piped sewage to nearby creeks or rivers without treatment. Note that it wasn't until the passing

of federal legislation, the Clean Water Act in 1972, that municipalities were required to remove most wastewater and industrial pollution before discharging into waterways. Ask the class to imagine what would have happened if a child decided to go swimming in such a stream or river.

VIII. Show the students the "Plumbing: the Arteries of Civilization" video from the History Channel's Modern Marvels series. Lead a class discussion on which cause-and-effect aspects of plumbing they found most interesting and why. (see Appendix C, #5)

Assessment

Teachers are encouraged to use the following approach to enhance and assess what students have learned. The assessment can be adjusted to middle through high school, typical through gifted, students by the extent or depth of the inquiry. For example, younger students would be assigned fewer questions; older and more gifted students, more or all questions.

Lest local information sources be overwhelmed by too many students all calling for the same information, the assessment should be conducted as a whole class, broken into coordinated small-groups. Because it is interdisciplinary, a mix of intelligences or academic strengths should be included in the make-up of small groups.

Divide the students into one group for water and another for wastewater. Divide those two groups into four subgroups each, for addressing the questions below. (The order of the questions somewhat correlates to the level of thinking skills required to answer them. The a) questions require lower-order thinking skills compared to the b) questions, the c) questions, and so forth.)

Tell the students that they will be discovering part of their local environmental history, by searching for the answers to the following questions:

1) Water

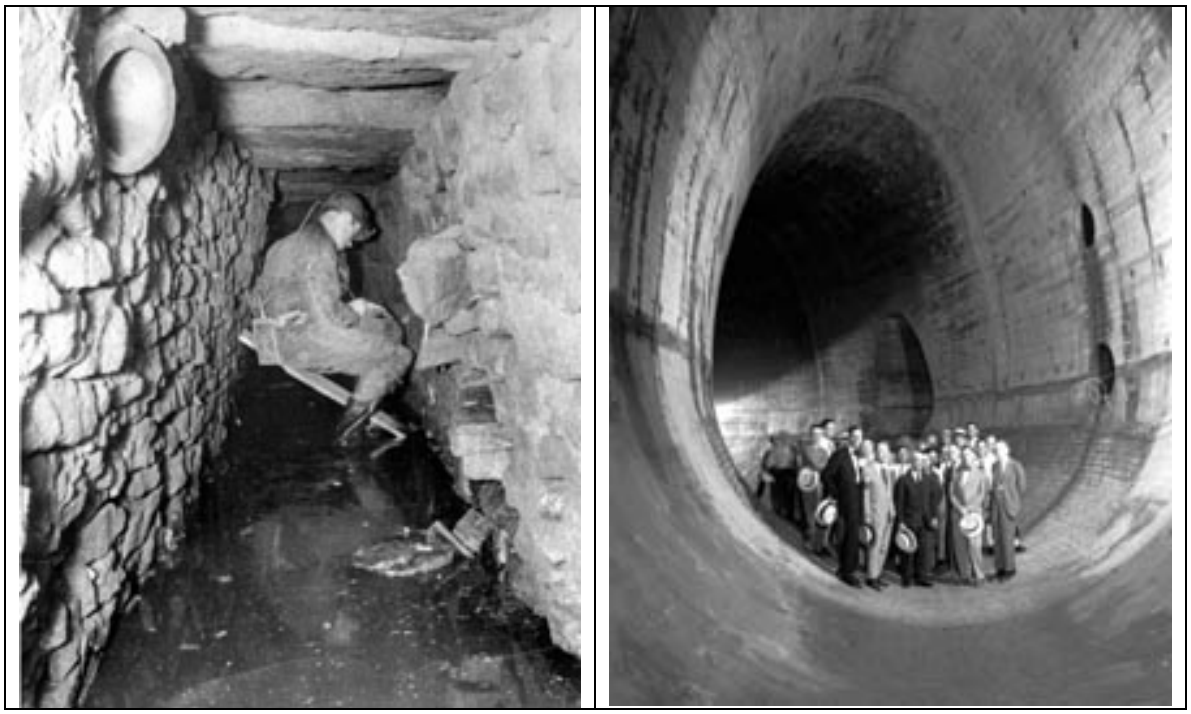
    a) When did my community begin supplying citizens with municipal drinking water? Why were the facilities sited where they were?
    b) What events precipitated its introduction then? Did any particular person or people lead the effort? What was their motivation? How did their motivation influence the outcome?
    c) What sort of treatment was constructed? How does the treatment technology used then differ from what is used in my community today?
    d) What changed, for good or bad, as a result? What could be done to increase the benefits and/or reduce the problems?

2) Wastewater

    a) When did my community begin to treat its wastewater? Why were the facilities sited where they were?
    b) What events precipitated its introduction then? Did any particular person or people lead the effort? What was their motivation? How did their motivation influence the outcome?
    c) What sort of treatment was constructed? How does the treatment technology used then differ from what is used today?
    d) What changed, for good or bad, as a result? What could be done to increase the benefits and/or reduce the problems?

Suggest students consider the appropriateness of the following entities as sources of the information required to answer their assigned questions:

City Hall
Engineering society
Historical society
Plumbing union
Public health department
Public library
University library
Water utility
Wastewater utility



Left - Sewers in the early 1800s were made of stone, narrow and rough (photo courtesy of Cort Best, 1949, Courier-Journal and Louisville Times.)

Right - A century later, they were smooth, poured concrete. Louisville Alderman inspect 16'x24' sewer in 1932 (photo courtesy of University of Louisville, Metropolitan Sewer District Collection.)

Require students to write and submit a proposed strategy for finding the needed answers. For example, will they assign one or two sources to each group member and contact all of them at once? Or will they rank the sources in priority order and work through them one-by-one, refining their questions as they go along, based on what they learn as they work?

Discuss why the latter approach is more appropriate and effective.

Instruct students to draft their first set of interview questions for your review.

After you believe they are adequately prepared, instruct students to take careful notes of what responses they get, from whom, as they conduct their interviews.

The variety of suggested assessment products allow emphasis of the visual, oral, written and/or kinesthetic intelligences. Teachers may assign products individually or to small groups, on the basis of which intelligences students need to further develop, or allow students to choose themselves.

The strategies for assessment below are correlated to Bloom's taxonomy of cognitive thinking skills [2], from following lower- to higher-order thinking skills:

Knowledge

Define environmental history?

Possibilities for completing this assessment include writing an essay or a dictionary entry and presenting an oral definition.

When did my community begin supplying citizens with municipal drinking water? When did my community begin to treat its wastewater?

Possibilities for completing this assessment include simple fill-in-the-blank and writing an essay or performing a skit on life in the students' community that year.

Comprehension

Why was the community's drinking water or wastewater treatment plant located where it is (or originally was)?

Possibilities for completing this assessment include writing an explanation, conducting a mock interview of a decision-maker and drawing a map with explanatory notes.

Application

What events precipitated the introduction of municipal drinking water or wastewater treatment in the community? Did any particular person or people lead the effort? What was their motivation? How did their motivation influence the outcome?

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[2] Bloom, Benjamin, editor, Taxonomy of Educational Objectives: The Classification of Educational Goals: Book 1 Cognitive Domain, Longman, 1956.

Possibilities for completing this assessment include writing a school newsletter article or illustrated comic book and writing and performing a play.

Analysis and Critical Thinking

What sort of treatment was constructed? How does the treatment technology used then differ from what is used in my community today? (For a generic schematic of wastewater treatment, see Appendix C, #11).

Possibilities for completing this assessment include making diagrams with explanatory notes, creating models and writing a compare-and-contrast essay.

Synthesis and Creative Thinking

What changed, for good or bad, as a result?

Possibilities for completing this assessment include writing an essay or mock newspaper story, writing and performing a play and graphing the installation of water pipes and/or sewers and the incidence of a disease (see examples in Appendix A) using historical records from sources listed in the Procedure section.

If the disease rate rose before it fell, ask students to analyze why. (Large waves of immigration caused severe crowding thereby degrading sanitary conditions.)

Evaluation, Critical Thinking and Using Criteria

What could be done to increase the benefits and/or reduce problems?

Possibilities for completing this assessment include writing an essay, letter to the editor or mock engineering proposal, creating mock city plans, and giving a mock political speech.

Extension Activities

1. Take field trips to one or more of the following locations, if available in your community:

    - Tour the local drinking water and/or wastewater treatment plants
    - Paddle a stream or ride a boat on a river
    - Visit a museum with exhibits on river life, life in the 17th or 18th Centuries, indigenous cultures, etc.
    - Hike a greenway along a stream or river, preferably where your community was settled for more than 100 years.

2. Ask students to draw a map, write and perform a play or write a school newsletter article, portraying the relationship between people and their environment during assigned or self-selected eras in history, the presence or the future.

3. Ask students to choose an event vignette from the *Aqua Venturer CD ROM* or website www.AquaVenturer.org (perhaps specifying a time frame to coincide with other class studies), and research what caused it, its impact on society and the environment, etc.

4. Assign students to react to "Plumbing: the Arteries of Civilization" video by performing a play, writing an essay, or writing and conducting a mock interview on a topic within the video, or creating posters to encourage other kids to watch the video. (See Appendix C, #5.)

This photo of infrastructure installation in the late 1930s shows improved understanding of safe construction practice. This trench is shored with heavy lumber, unlike the trench in the 1875 project on page 6, to protect the workers from the risk of a deadly collapse
(photo courtesy of Charley Darneal, Courier-Journal and Louisville Times.)

5. Ask students to write an essay or school newsletter article or deliver a speech defending their conclusions on what event they believe had the greatest impact, positive or negative, in U.S. environmental history.

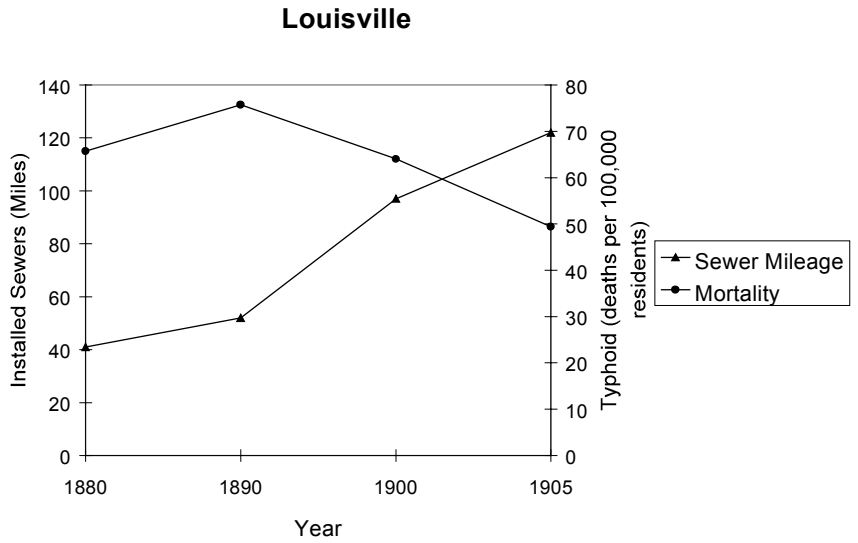
6. Take water samples from various locations, some relatively clean and some relatively polluted, measure for various parameters (temperature, dissolved oxygen, pH, biochemical oxygen demand, etc); compare and contrast the results.

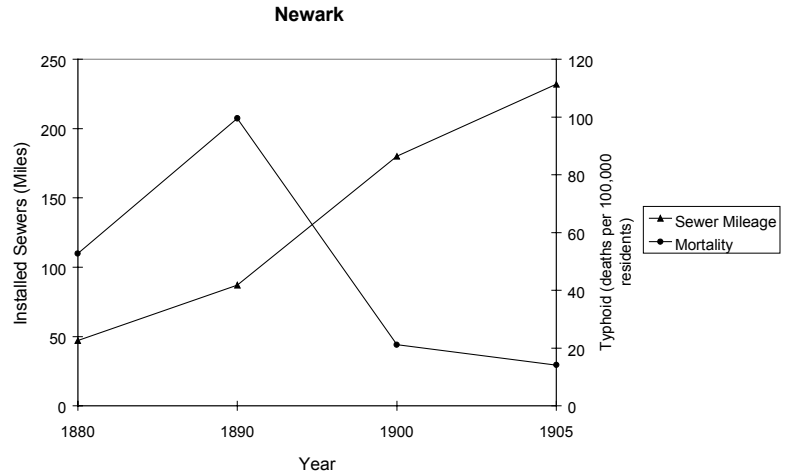
7. Discuss with students whether homeless Americans are more likely to get infections since they have limited access to clean water.

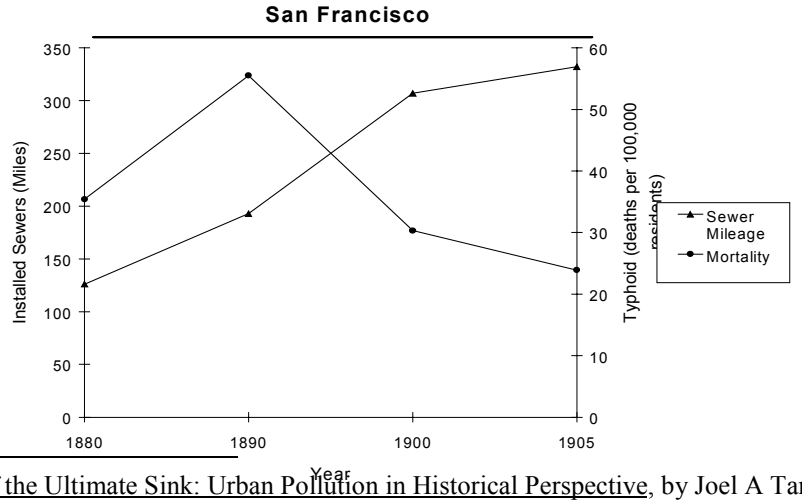
8. If students live in an area lacking municipal water or sewers, have students employ strategies similar to the ones above to determine whether any efforts to install them have been tried in the past, why those efforts failed, the impacts of doing without that infrastructure on public health, property values, economic development, etc.

9. Use the activities of the non-profit organization, *Water for People,* to help students learn that many people still lack adequate clean drinking water, but that volunteers are organizing to help. (Water for People supports locally sustainable drinking water, sanitation, and hygiene education projects worldwide.) Request a free copy of the Water for People lesson plan, focused on Bolivia, from the Louisville Water Company (see Appendix C, #8). If your school has a Spanish instructor, consider asking him or her to get involved. Assign beginning students to complete the work sheets, and the advanced students, the open-response question, in Spanish.

Appendix A: Sewers versus Typhoid Fever [3]







[3] In Search of the Ultimate Sink: Urban Pollution in Historical Perspective, by Joel A Tarr, University of Akron Press, 1996, ISBN= 1-884836-06-2 (soft cover), p 189

Appendix B: National Performance Standards

The following national performance standards can be addressed via the activities and assessments in the *Aqua Venturer Teacher Guide*:

Standards for the English Language Arts [4] (all grades)

Standard 2: Students read a wide range of literature from many periods in many genres to build an understanding of the many dimensions (e.g., philosophical, ethical, aesthetic) of human experience.

Standard 5: Students employ a wide range of strategies as they write and use different writing process elements appropriately to communicate with different audiences for a variety of purposes.

Standard 6: Students apply knowledge of language structure, language conventions, (e.g., spelling and punctuation), media techniques, figurative language, and genre to create, critique, and discuss print and non-print texts.

Standard 7: Students conduct research on issues and interests by generating ideas and questions, and by posing problems. They gather, evaluate, and synthesize data from a variety of sources (e.g., print and non-print texts, artifacts, people) to communicate their discoveries in ways that suit their purpose and audience.

Standard 8: Students use a variety of technological and informational resources (e.g., libraries, databases, computer networks, video) to gather and synthesize information and to create and communicate knowledge.

Environmental Education Materials: Guidelines for Excellence [5] (all grades)

Key Characteristic 1 — Fairness and Accuracy: Environmental education materials should be fair and accurate in describing environmental problems, issues, and conditions, and in reflecting the diversity of perspectives on them. (Guideline 1.3, Openness to inquiry.)

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[4] Standards for the English Language Arts, National Council of Teachers of English and International Reading Association, 1996, p 25.
[5] Environmental Education Materials: Guidelines for Excellence, North American Association for Environmental Education, 1996.

Key Characteristic 2 — Depth: Environmental education materials should foster awareness of the natural and built environment, an understanding of environmental concepts, conditions, and issues, and an awareness of the feelings, values, attitudes, and perceptions at the heart of environmental issues, as appropriate for different developmental levels. (Guidelines 2.1, Awareness, 2.2 Focus on concepts and 2.3 Concepts in context.)

Key Characteristic 3 — Emphasis on Skills Building: Environmental education materials should build lifelong skills that enable learners to prevent and address environmental issues. (Guidelines 3.1, Critical and creative thinking, 3.2 Applying skills to issues and 3.3 Action skills.)

Key Characteristic 4 — Action Orientation: Environmental education materials should promote civic responsibility, encouraging learners to use their knowledge, personal skills, and assessments of environmental issues as a basis for environmental problem solving and action. (Guidelines 4.1, Sense of personal stake and responsibility and 4.2 Self-efficacy.)

Key Characteristic 5 — Instructional Soundness: Environmental education materials should rely on instructional techniques that create an effective learning environment. (Guidelines 5.1, Learner-centered instruction, 5.2 Different ways of learning, 5.3 Connection to learner's everyday lives, 5.4 Expanded learning environment and 5.5 Interdisciplinary.)

Key Characteristic 6 — Usability: Environmental education materials should be well designed and easy to use. (Guidelines 6.3 Long-lived, 6.4 Adaptable and 6.7 Fit with national, state or local requirements.)

National Geography Standards – 1994 [6] (all grades)

The World in Spatial Terms: The geographically informed person knows and understands how to use maps and other geographic representations, tools, and technologies to acquire, process, and report information from a spatial perspective.

Human Systems: The geographically informed person knows and understands the patterns and networks of economic interdependence on Earth's surface.

Environment and Society: The geographically informed person knows and understands how human actions modify the physical environment, how physical systems affect human systems and the changes that occur in the meaning, use, distribution, and importance of resources.

[6] Geography for Life: National Geography Standards, 1994, Geography Education Standards Project, Washington, DC, 1994, pp 34-35.

The Uses of Geography: The geographically informed person knows and understands how to apply geography to interpret the past and how to apply geography to interpret the present and plan for the future.

National Health Education Standard [7]

Standard 4: Health is influenced by a variety of factors that co-exist within society. These include the cultural context as well as media and technology. A critical thinker and problem solver is able to analyze, evaluate, and interpret the influence of these factors on health. The health-literate, responsible, and productive citizen draws upon the contributions of culture, media, technology, and other factors on family and community health.

Grades 5-8

Students will analyze the influence of technology on personal and family health.

Grades 9-11

Students will evaluate the impact of technology on personal, family, and community health.

National Standards in Historical Thinking [8] (all grades)

Standard 2. Historical Comprehension

A. Reconstruct the literal meaning of a historical passage.
B. Identify the central question(s) the historical passage addresses.
C. Read historical narratives imaginatively.
D. Evidence historical perspectives.
E. Draw upon data in historical passages.
F. Utilize visual and mathematical data presented in charts, tables, pie and bar graphs, flow charts, Venn diagrams, and other graphic organizers.
G. Draw upon visual, literary, and musical sources.

Standard 3. Historical Analysis and Interpretation

A. Identify the author or source of the historical document or narrative.
B. Compare and contrast differing sets of ideas, values, personalities, behaviors, and institutions.

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[7] National Health Education Standards: Achieving Health Literacy, Joint Committee on National Health Education Standards, 1995, p 20.
[8] National Standards for History, Basic Edition, National Center for History in the Schools, Los Angeles, CA, 1996, pp 60-61.

C. Differentiate between historical fact and interpretations.
D. Consider multiple perspectives.
E. Analyze cause-and-effect relationships and multiple causation, including the importance of the individual, the influence of ideas and the role of chance.
J. Hypothesize the influence of the past.

Standard 4. Historical Research Capabilities

A. Formulate historical questions.
B. Obtain historical data.
C. Interrogate historical data.
D. Identify the gaps in the available records, marshal contextual knowledge and perspectives of the time and place, and construct a sound historical interpretation.

Standard 5. Historical Issues – Analysis and Decision-Making

A. Identify issues and problems in the past.
B. Marshal evidence of antecedent circumstances and contemporary factors contributing to problems and alternative courses of action.
C. Identify relevant historical antecedents.
D. Evaluate alternative courses of action.
E. Formulate a position or course of action on an issue.
F. Evaluate the implementation of a decision.

Principles and Standards for School Mathematics [9] (all grades)

Numbers and Operations: understand numbers; understand meanings of operations and how they relate to one another; compute fluently and make reasonable estimates.

Algebra: understand patterns, relations, and functions; represent and analyze mathematical situations and structures using algebraic symbols; use mathematical models to represent and understand quantitative relationships; analyze change in various contexts

Geometry: analyze characteristics and properties of two- and three-dimensional geometric shapes and develop mathematical arguments about geometric relationships; specify locations and describe spatial relationships using coordinate geometry and other representational systems; apply transformations and use symmetry to analyze mathematical situations; use visualization, spatial reasoning, and geometric modeling to solve problems

[9] Principles and Standards for School Mathematics, National Council for Teachers of Mathematics, Reston, VA, 2000, pp 32-54, 60-70.

Measurement: understand measurable attributes of objects and the units, systems, and processes of measurement; apply appropriate techniques, tools, and formulas to determine measurements.

Data Analysis and Probability: formulate questions that can be addressed with data and collect, organize, and display relevant data to answer them; select and use appropriate statistical methods to analyze data; develop and evaluate inferences and predictions that are based on data; understand and apply basic concepts of probability.

Problem Solving: build new mathematical knowledge through problem solving; solve problems that arise in mathematics and in other contexts; apply and adapt a variety of appropriate strategies to solve problems; monitor and reflect on the process of mathematical problem solving.

Communication: organize and consolidate their mathematical thinking through communication; communicate their mathematical thinking coherently and clearly to peers, teachers, and others; use the language of mathematics to express mathematical ideas precisely.

Connections: recognize and use connections among mathematical ideas; understand how mathematical ideas interconnect and build on one another to produce a coherent whole; recognize and apply mathematics in contexts outside of mathematics.

Representation: create and use representations to organize, record, and communicate mathematical ideas; select, apply, and translate among mathematical representations to solve problems; use representations to model and interpret physical, social, and mathematical phenomena.

National Science Education Standards [10]

Content Standard G – History and Nature of Science: The standards for the history and nature of science recommend the use of history in school science programs to clarify different aspects of scientific inquiry, the human aspects of science, and the role that science has played in the development of various cultures.

> Grades 5-8
>
> The introduction of historical examples will help students see the scientific enterprise as more philosophical, social and human. Middle-school students can thereby develop a better understanding of scientific inquiry and the interactions between science and society.

[10] National Science Education Standards, National Academy Press, Washington, DC, 1996, pp 107, 170-171 and 200-201 and 204.

To develop understanding of the history and nature of science, teachers of science can use . . . historical vignettes.

In historical perspective, science has been practiced by different individuals in different cultures. In looking at the history of many peoples, one finds that scientists and engineers of high achievement are considered to be among the most valued contributors to their culture.

Tracing the history of science can show how difficult it was for scientific innovation to break through the accepted ideas of their time to reach the conclusions that we currently take for granted.

Grades 9-12

Teachers of science can incorporate other historical examples that may accommodate different interests, disciplines, and cultures – as the intention of the standard is to develop an understanding of the human dimensions of science, the nature of scientific knowledge, and the enterprise of science in society – and not to develop a comprehensive understanding of history.

Usually, changes in science occur as small modifications in extant knowledge. The daily work of science and engineering results in incremental advances in our understanding of the world and our ability to meet human needs and aspirations.

Curriculum Standards for Social Studies [11]

Strand II – Time, Continuity, and Change: Social studies programs should include experiences that provide for the study of the ways human beings view themselves in and over time, so that the learner can:

Middle School

b. identify and use key concepts such as chronology, causality, change, conflict, and complexity to explain, analyze, and show connections among patterns of historical change and continuity;

d. identify and use processes important to reconstructing and reinterpreting the past, such as using a variety of sources, providing, validating, and weighing evidence for claims, checking credibility of sources, and searching for causality;

f. use knowledge of facts and concepts drawn from history, along with methods of historical inquiry, to inform decision-making about action-taking on public issues.

[11] Curriculum Standards for the Social Studies: Expectations of Excellence, National Council for the Social Studies Bulletin 89, 1994, pp 22 and 34.

High School

b. apply key concepts such as time, chronology, causality, change, conflict, and complexity to explain, analyze, and show connections among patterns of historical change and continuity;

d. systematically employ processes of critical historical inquiry to reconstruct and reinterpret the past, such as using a variety of sources and checking, validating, and weighing evidence for claims, and searching for causality;

f. apply ideas, theories, and modes of historical inquiry to analyze historical and contemporary developments, and to inform evaluate actions concerning public policy issues.

Appendix C: Background Resources

1. Alibrandi, Marsha, Steven Anderson, Lucy Lafitte and Cheryl Oakes, "Environmental History: If Trees Could Talk," Green Teacher, Volume 67, pp 29-31, Toronto, Ontario, Canada, ISSN = 1192-1285.
2. Cook, Gillian E and Marian L Martinello, Interdisciplinary Inquiry in Teaching and Learning, 2nd ed, Merrill (Prentice-Hall), 2000, ISBN = 0-13-923954-5.
3. Cumbler, John T, PhD, Reasonable Use: The People, the Environment and the State, New England 1790-1930, Oxford University Press, 2001, ISBN=0-19-513813-9.
4. Eskin, Sarah S, Public Works and Public Health: Reflections on Urban Politics, 1880-1925, Public Works Historical Society's Essays in Public Works History, #19, 1999, ISBN=1047-5257.
5. History Channel's Modern Marvels video series, "Plumbing: the Arteries of Civilization," http://store.aetv.com/html/catalog/s03.jhtml?search=plumbing.
6. Jacobs, Heidi Hayes, editor, Interdisciplinary Curriculum: Design and Implementation, Association for Supervision and Curriculum Development, 1989, ISBN = 0-87120-165-8.
7. Katz, Phyllis, editor, Community Connections for Science Education, Vol II: History and Theory You Can Use, NSTA Press, 2001, ISNB = 0-87355-192-3.
8. Louisville Water Company, Adventures in Water curriculum, (Chapter 11 about *Water for People* includes work sheets, fact sheets, a rubric and other resources). http://www.lwcky.com/funzone/people/curriculum.htm.
9. Nye, David, Consuming Power: A Social History of American Energies, MIT Press, 1998, ISBN=0-262-64038-4.
10. Tarr, Joel A, In Search of the Ultimate Sink: Urban Pollution in Historical Perspective, University of Akron Press, 1996, ISBN= 1-884836-06-2.
11. Water Environment Federation, "Be in the Know, Go with the Flow" (schematic of wastewater treatment process), www.wef.org.