

Table of Contents



RESOURCES for Youth Water Education Planning and Evaluation



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Water Quality 2000 Report — Challenges for the Future	49
National Geographic Society sample water quiz	49
Water topics and subtopics	50
Environmental education topics and subtopics	51
Questions adapted from Bennett's Hierarchy	52
Common evaluation strategies	53
Sample questions for evaluating participant impacts	54
Agencies with an interest in water issues	55
Private groups with an interest in water issues	55
Bibliography of sources for criteria to evaluate nonformal youth water education programs	56



Water topics and subtopics

In developing water education programs or reviewing materials for the likelihood that they will help meet water education goals, these topics should be considered.

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
 - wetlands
 - rivers
 - watersheds
 - ponds
 - streams
 - oceans
 - riparian
 - estuaries
 - ephemeral systems (intermittent)
- Major regional resource: _____

- Ecological concepts

3. Drinking water supply: quantity & quality

- Delivery
 - community/public
 - private
- Water quality control
 - well concerns
 - testing
 - public
 - private
- Treatment of drinking water
 - public drinking water
 - home treatment
- Lifestyle impacts/conservation

4. Water use

- Use of water by many groups
 - commercial
 - municipal
 - recreation
 - industry
 - domestic
 - agricultural
 - power production
- Conservation by user groups
- Issues/conflicts between user groups

5. Sources of water pollution/contamination

- Point source
 - agricultural sources
 - public &/or private wastewater
 - industrial & business hazardous wastes
 - energy production wastes
- Nonpoint source
 - agricultural
 - forestry
 - atmospheric deposition
 - urban
 - mining

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

- Agricultural management practices
- Chemical storage
- Chemical emergencies
- Development issues/pressures
- Natural disasters
- Recreational use
- Solid waste management decisions
- Wastewater treatment
- Wildlife habitat/land stewardship
- Management
- Zoning strategies
 - shorelands/floodplains
 - wetlands
 - wellhead/groundwater recharge areas

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
- _____

Environmental education topics

In developing water education programs or reviewing materials for the likelihood that they will meet water education goals, the following environmental education goals should be considered.



1. Ecological foundations

(program focuses 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

(program encourages 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

(program provides 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

(program provides 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 with new information

5. Environmental action skills

(materials guide development of:)

- Skills to work towards ends consistent with personal values
 - persuasion
 - legal action
 - community problem solving
 - consumerism
 - ecomanagement
 - 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

Recent thinking by experienced environmental educators includes socio-political knowledge as a component to environmental education.¹¹ While socio-political themes have been woven into the previous listing, program planners/evaluators may wish to further emphasize the following education goals:

6. Socio-political knowledge

(program provides opportunities to:)

- Improve awareness of economic, social, political and ecological interdependence in urban and rural areas
- Study and communicate how human cultural activities influence the environment
- Study the relationship between beliefs, political structures, and environmental values of various cultures
- Study the basic components of societal systems
- Develop geographic understanding at the local, regional, and global levels
- Study patterns of change in society and culture
- Understand structure and scale in societies and culture

11. Summarized by the NAAEE Standards project. See reference below.

For more detail about environmental education goals, review the following references:

Tbilisi Intergovernmental Conference on Environmental Education. 1978. "Toward an Action Plan: A Report on the Tbilisi Conference on Environmental Education." A paper developed by the FICE Subcommittee on Environmental Education. Washington, D.C., U.S. Government Printing Office, Stock No. 017-080-01828-1.

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.

NAAEE background papers on environmental education standards. 1995. North American Association of Environmental Education, Washington, D.C.

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

Resources



Questions adapted from Bennett's Hierarchy

One strategy¹² which has been used effectively to evaluate natural resource based programs uses Claude Bennett's hierarchy of program outcomes.

A wide variety of outreach programs use Bennett's program evaluation methodology to measure effectiveness.

Bennett's Hierarchy

-
- 1: Inputs: time expended, staff qualifications
-
- 2: Activities: educational methodology
-
- 3: People involvement: number and characteristics, continuity and intensity
-
- 4: Reactions: interest in activities, acceptance of leadership
-
- 5: Knowledge, attitude, skills, and aspirations change (KASA): direction and extent, duration
-
- 6: Practice change: individual innovation, structural change
-
- 7: End result: ultimate objectives, side effects

Because evaluation can be difficult, samples from the Bennett Hierarchy are regrouped here according to the sections of this publication's *Water Program Evaluation Checklist*. This should help by giving another set of words to consider. Questions listed after each of Bennett's topics were adapted from Bob Steelquist.¹² Most have also been integrated into the Evaluation Checklist in this guide. See the checklist for more details about these topics.

Evaluation Checklists 4 and 7: Program support, partners, and networks; Program evaluation

1: INPUTS

- what costs will be required to conduct this program including employees and materials?
- what is the source of the funds?
- how do you know if you have chosen the most cost effective approach to solving the water problem addressed in your program?

4: REACTIONS

- how do program participants view your organization and its leaders?
- how will you find out how program participants evaluate your instructors, organization, or water issue after involvement in the program?

Evaluation Checklist 3: Why do this program?

7: END RESULT

- what environmental condition will your program help correct?
- how will you know if the condition has been corrected?
- how will your program contribute to correcting the condition?

Evaluation Checklists 5, 6 and 7: Program goals, design, and access; Program delivery; Program evaluation

In Bennett's Hierarchy, goals, program design and delivery, and evaluation are integrated into the following themes.

2: ACTIVITIES

- what activities have you planned and what will you have to do to prepare?
- what factors will affect the success of these activities?

3: PEOPLE INVOLVEMENT

- what are the characteristics of your participants and how many participants are you planning for?
- how will you reach your participants?
- how will participants perspective be represented in program planning?

5: KASA

- does change in behavior require new knowledge or skills that can be learned? attitudes or awareness that must be developed? what information is required?
- how will information be transmitted to participants?
- how will you find out if participants received, understood, or used the knowledge, attitudes, skills or awareness that they are exposed to during the program?

6: PRACTICE CHANGE

- what current behavior (or lack of behavior) contributes to the condition?
- what changes in behavior do you hope will occur as a result of your project?
- how will you know if the behavior of participants has changed as a result of your program? short term? long term?

12. Materials developed by Bob Steelquist. Public Information Education grant program, Puget Sound, Washington, 1993.



Common evaluation strategies

How you evaluate your program depends on what you want to know about it. Here are seven program areas you might want to review along with a list of evidence you could collect and examine for each.¹²

Resources

Financial audit, tracking expenses, timesheets, letters of commitment of funding, in-kind contributions, donations

Activities

Project timelines, work plans, activity reports, status reports, final reports

Participants

Sign up sheets, participant lists, audience counts, product counts, contact lists, audience characterization

Participant reactions

Self-report evaluation form, instructor evaluation form, program audit, exit interview, instructor logs, correspondence files, news clipping files

Knowledge, attitudes, skills, awareness

Peer review of materials, pretest - posttest, certification exam, self-reflective writing, portfolio review, instructor logs, student journal, group self-assessment, polling, focus groups, informal consultation, skills demonstration, exit interview

Behavior change

Pledge, peer or participant rated exercise, incentive award, informal followup, polling, focus groups, direct observation, photo documentation, measuring indicators

Environment or resource condition

Ambient monitoring, hasty reconnaissance, population survey, mortality reports, creel census, incident reports, measuring indicators

For a more complete guide to identifying strategies for evaluating specific program outcomes, see *Program Evaluation Kit*, second edition, edited by Joan Herman. Available from SAGE Publications, the kit includes nine separate publications. You may want to begin with *Evaluator's Handbook*, the first in the series.

12. Adapted from presentation handouts developed by Bob Steelquist, Puget Sound, Washington, PIE program, 1993.



Sample questions for evaluating participant impacts

Questions to ask in a self report evaluation:

1. How did participants find out about the program?
2. What did participants hope to learn?
3. What was the most important idea or skill that participant gained from the program?
4. How will participant use the information he/she learned?
5. How would participants improve the program?

Other evaluation ideas:

1. Pre and post questions related to specific goals, i.e. can you identify the boundaries of your local watershed? Can you think of five ways to reduce your use of water at home? etc.
2. Pre and post skills observation, i.e. did participant identify information needed to understand a particular water issue and successfully interview a public official to acquire that information? Do parents report that participant remembers to turn off the water while brushing teeth? etc.
3. Problem solving ability, i.e. participant must plan a way to find the answer to a relevant problem. Try the same or similar problem before and after the activity or program. For example, the participant is asked to develop a plan to find out how to insure that home water is good quality? Can the participant figure out what to do first, second; who to call for help in designing the plan, etc.?
4. Pre and post environmental conditions observation, i.e. participant decided that the stream needed to have trash removed to improve fish and wildlife habitat. Was the habitat improved as a result of this activity according to accepted criteria?
5. Informal group discussion about topics such as: what do you remember the most about what we did? How do you know you learned something new? what would you do different now that you experienced this activity? What would make this activity more fun? why did we do (activity A) before we did (activity B)?



Agencies with an interest in water issues

Government agencies

National Oceanic and Atmospheric Administration (NOAA)

No contact available at present

US Cooperative Extension Service

Check your local phone book under County Government for the Cooperative Extension office in your county.

US Environmental Protection Agency

EPA Resource Center
202/260-7786

EPA Public Information Office
202/260-7751

EPA Region 5
Education Computer Programs
312/353-6353

US Fish And Wildlife Service

Office of Training and Education
Publications Unit
4401 North Fairfax Dr.
Mailstop webb 304
Arlington, VA 22203
703/358-1711

US Forest Service

Natural Resource Conservation
Education Program (NRCEP)
14th and Independence Ave., SW
Washington, DC 20090-6090
202/205-1545

US Geological Survey

Check your local telephone book under US Government, Department of the Interior for the office nearest you.

US Natural Resources Conservation Service

Check your local telephone book under US Government, Department of Agriculture for the office nearest you.

Private groups

American Forests

1516 P St., NW
Washington, DC 20005
800/8-RELEAF

American Water Works Association

Public Affairs Department
6666 W. Quincy Ave.
Denver, CO 80235
303/794-7711, EXT. 4114

The Blue Thumb Program A consortium of public and private groups

National Drinking Water Week
Headquarters
6666 W. Quincy Ave.
Denver, CO 80235
303/794-7711

Earth Force

1501 Wilson Blvd., 12th floor
Arlington VA 22209

Global Rivers Environmental Education Network (Green)

721 East Huron St.
Ann Arbor, MI 48104
313/761-8142

The Groundwater Foundation

PO Box 22558
Lincoln, NE 68542-2558
402/434-2740

Izaak Walton League of America

707 Conservation Lane
Gaithersburg, MD 20878-2983
301/548-0150
1/800/BUG-IWLA

National Association of Conservation Districts

408 E. Main, PO box 855
League City, TX 77574
713/332-3402

National 4-H Council

Environmental Stewardship
Program
301/961-2866 or 2833

National Marine Education Association

Dauphin Island Marine Lab
PO Box 369-370
Dauphin Island, AL 36528
205/861-7558

Project Wet

(Water Education For Teachers)

National Project WET
201 Culbertson Hall
Montana State University
Bozeman, MT 59717-0057
406/994-5392

River Network

PO Box 8787
Portland, OR 97207-8787
503/241-3506

Trout Unlimited

1500 Wilson Blvd., #310
Arlington, VA 22209-2310
703/284-9409

Water Environment Federation

601 Wythe Street
Alexandria, VA 22314-1994
703/684-2487

Western Regional Environmental Education Council (WREEC)

4014 Chatham Lane
Houston, TX 77027
713/520-1936



Bibliography of sources for criteria to evaluate youth nonformal water education programs

Bibliography

Strategies for evaluating programs

Strategies for evaluating programs

USDA Cooperative Extension. 1976.
Analyzing Impacts of Extension Programs.

This paper describes a program evaluation methodology developed by Claude F. Bennett which is used by a wide variety of outreach programs to measure effectiveness. The hierarchy of evidence for program evaluation includes the following steps:

1. Inputs: time expended, staff qualifications
2. Activities: educational methodology
3. People involvement: number and characteristics, continuity and intensity
4. Reactions: interest in activities, acceptance of leadership
5. Knowledge, Attitude, Skills, and Aspirations change: direction and extent, duration
6. Practice change: individual innovation, structural change
7. End result: ultimate objectives, side effects

Remaining discussion focuses on: selection of evidence for evaluation, evaluation criteria, and study types.

The Extension evaluation model was recently applied to an evaluation of project WILD by Margaret Tudor of the Washington Department of Wildlife in 1992. Her study combined Washington State data with a 1990 survey by Standage Accureach to provide information for each category suggested by the Bennett model. Tudor was not able to demonstrate any direct linkages between use of Project WILD and behavior changes that would meet Department of Wildlife goals. However, the materials were widely used with a high level of teacher satisfaction. Tudor recommends the development of measurable action outcomes to enhance the use of these materials.

Bennett, Dean B. 1988-89. *Four Steps to Evaluating Environmental Education Learning Experiences.* **Journal of Environmental Education, 20(2):14-2.**

Bennett urges the need to evaluate environmental education (EE) programs in order to convince the educational community that EE can be an integral aspect of the curriculum and actually improve the learning experience. He states some reasons why educators avoid evaluating their programs, e.g., time, expense, complexity, fear of being evaluated, and criticism of being too subjective. Bennett then suggests a simplified four-step evaluation method to assist environmental educators to become better evaluators. Bennett describes the variety of evaluation measures which could be used including: performance tests, questionnaires, interviews, observations, artifact examination, and unobtrusive measures.

McCrea, Edward J., and Glenn D. Weaver. 1984. *Nonformal Environmental Education : An Overview and Methodology for Evaluation.* **In Monographs in Environmental Education and Environmental Studies, Vol I, edited by Arthur B. Sachs, ERIC, Ohio State University College of Education, School of Natural Resources, 1200 Chambers Rd., 3rd Floor, Columbus, OH 43212.**

Authors summarize the nonformal EE history, i.e., early educational materials, agency involvement, and historical events that led to strengthening the EE movement. Since the 1980s, many nonformal educators have focused on issue-oriented programs hoping to directly affect positive social behavior and problem-solving. Traditional practitioners question the effectiveness of this narrow focus as truly beneficial in increasing public awareness. Authors then address the key points of the learning theory as the first step in predicting the potential effectiveness of nonformal programs. Nonformal education programs should possess the following attributes in order to maximize learning potential: (1) learning is

based on past learning; (2) learning occurs best when it is multisensory; (3) learning should build on the reality principle and use concrete examples; (4) learning should be non-threatening and reinforcing; (5) educational activities should be as enjoyable as possible and be structured to provide challenges; (6) educational activities should be structured to facilitate concepts building; (7) learning should be demonstrated by a change in behavior; (8) specific attempts should be made to teach for transfer (from knowledge to action).

Nonformal EE evaluation procedures differ from the cognitive testing process of conventional education. Authors discuss setting standards by creating a hypothetical average or an optimum program against which to compare EE programs. However, this process also creates difficulty due to the subjectivity of setting standards and measuring adherence to those standards. Finally, the authors point to an evaluation tool designed by themselves for the U.S. Fish and Wildlife Service programs. Program attributes are identified, then used as the basis for developing standards. Standards are specific, concrete statements intended to identify presence or absence of program elements.

Murphy, Nancy. 1993 draft. *Innovative Student Assessment in Environmental Education*. Presented at the 1993 annual conference of the North American Association of Environmental Education. Paper available from Nancy Murphy at Antioch University, Seattle.

This paper summarizes authentic assessment resources available to evaluate environmental education. The author focuses on assessment relevant to instructional decision making only. To that end, she recommends that instructors evaluate: preconceptions, conceptual change, ability to apply concepts in new contexts, participation in group construction of shared meanings, personal behavior changes, and attitude change. An assessment model is provided for use of the learning cycle model which includes: engagement, exploration, discovery, experimentation, and extension. Examples of generic assessment tools as applied to environmental education are also provided. Generic tools include: concept mapping; prior

knowledge charts; rubrics such as checklists, Likert scales, and scoring scales, analytical trait tools, and holistic scales. Further information and example tools using generic evaluation strategies are provided on how to assess preconceptions, how to assess conceptual change, how to assess group skills, how to assess behavior change, and how to assess attitude change.

Thomas, Ian G. 1990. *Evaluating Environmental Education Programs Using Case Studies*. *Journal of Environmental Education* 21(1): 3-8.

Addresses the difficulty of evaluating programs which involve students in citizen action. Proposes a case study approach which would answer "how" and "why" questions and would lead to "understanding" rather than "knowledge." References other evaluation experts who verify that case descriptions can be useful when no theoretical data model exists. Reminds users that validity and reliability concepts must be considered in developing the case study model. One example described questionnaires and interviews which sought to gain information about program features, especially those perceived to be of interest and/or worthwhile.

Evaluation criteria that could be adapted for youth nonformal water education programs

Bennett, Dean B. 1989. *Four Steps to Evaluating Environmental Education Learning Experiences*. *Journal of Environmental Education* 20(2):14-21.

Bennett suggests a simplified four-step evaluation method to assist environmental educators to become better evaluators: set expectations; plan the evaluation; determine results; use the results. Expectations include: knowledge and understanding objectives, thinking skills objectives, values and attitudes objectives, action skill objectives; and allowing for unanticipated outcomes.

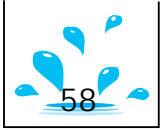
Resources



Bibliography

Strategies for
evaluating
programs

Adaptable
evaluation
criteria



Bibliography

Adaptable
evaluation
criteria

Important
skills for
success

Dwyer, William O., Frank C. Lemming, et al. 1993. *Critical Review of Behavioral Interventions to Preserve the Environment: Research Since 1980.* **Environment and Behavior, 25(3): 275-321.**

Authors note that from 1970-1990, behavioral intervention studies that focus on environmentally relevant behavior peaked in 1977 and then steadily declined into 1990. The research was restricted to behavior-change interventions and obtained 54 intervention studies with antecedent and consequence strategies. They concluded that over the past decade, much of the research did not allow for meaningful comparisons among other interventions while few studies included critical follow-up procedures. Without follow-up, techniques that produce long-term behavior change may be overlooked. Authors note some accomplishments from the 1980s research.

The techniques that have resulted in consistent behavior change are antecedent conditions, commitment, modeling, and goal-setting strategies. The authors then offer several specific suggestions to address the methodological problems and general research.

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

Translation of 1978 Tbilisi definition of environmental education and 1980 Hungerford, Peyton and Wilke goals for environmental education into a checklist useful for reviewing curriculum materials for their environmental education components.

Hungerford, Harold R., and Trudi L. Volk. 1990. *Changing Learner Behavior Through Environmental Education.* **Journal of Environmental Education 21(3): 8-21.**

Research into environmental behavior has not been able to show that increased knowledge will change human behavior. To achieve responsible citizenship behavior, individuals must be given the opportunity to develop the sense of "ownership" and "empowerment." Individuals who act have "expressed an intention to take action" and "possess a desire to act". Authors also found that to change learner behavior, strategies should be imple-

mented across all grade levels. The cooperation of nonformal education agencies as well as local and regional educational resources would maximize this opportunity for success.

Lisowski, Marilyn, and John F. Disinger. 1991. *The Effect of Field-Based Instruction on Student Understandings of Ecological Concepts.* **Journal of Environmental Education, 23(1): 19-23.**

Authors assess comprehension and retention of selected ecological concepts when using field study instruction techniques. Results showed that students learned effectively through field-based instruction in conceptual development. Used the Student Ecology Assessment (SEA) for evaluating concept development.

Niedermeyer, Fred C. 1992. *A Checklist for Reviewing Environmental Education Programs.* **Journal of Environmental Education, 23(2):46-50.**

Increasingly, various forms of environmental education materials are reaching schools. The author provides educators a checklist to identify the technical characteristics when reviewing or developing EE programs. These characteristics are those which instructional developers determine as highly desirable, e.g., clearly stated objectives, student opportunities to practice objectives, and field-tested programs.

Skills important to success in youth nonformal water education programs

Berger, Ida, E. and Ruth M. Corbin. 1992. *Perceived Consumer Effectiveness and Faith in Others as Moderators of Environmentally Responsible Behaviors.* **Journal of Public Policy and Marketing, 11(2), 79-89.**

The authors use a 1989 environmental opinion poll of the Canadian population to examine the influence of perceived consumer effectiveness and faith in the efficacy of others on the relationship between environmental attitudes and consumer behaviors. Results support the concept that "Consumers need to be empowered to rely on their own capabilities to achieve valued environmental outcomes."

Berman, Shelley. 1991. *Thinking in Context: Teaching for Open-mindedness and Critical Understanding in Developing Minds: A Resource Book for Teaching Thinking*, ed. Arthur Costa. **Educators for Social Responsibility, Alexandria, VA.**

Educators for Social Responsibility claim that students lack the necessary thinking skills to understand complex social issues. Under the whole-language approach, thinking is an integrative process that is enhanced when placed in the context of real, meaningful situations. Berman lists nine strategies that enrich students' thinking abilities through empowerment and confidence including: creating a safe environment, collaborative thinking, teaching interconnectedness, multiple perspectives, and providing opportunities to act on their thinking. If youth are to become active participants in society, they must feel confident that others value their thinking and that their thinking makes a difference by improving their own lives or influencing others.

De Young, Raymond. 1989. *Exploring the Difference Between Recyclers and Non-Recyclers: the Role of Information.* **Journal of Environmental Systems, Vol. 18(4), 341-351.**

This study found no difference between the attitudes of recyclers and non-recyclers. Those who did not value recycling (as demonstrated in attitude studies six months prior to the initiation of community recycling) participated in recycling activities as often as those who did value recycling. As a result, the author recommends that environmental education focus on how to turn intentions into actions, rather than on changing attitudes.

De Young, Raymond. 1993. *Changing Behavior and Making It Stick: The Conceptualization and Management of Conservation Behavior.* **Environment and Behavior, 25(4): 485-505.**

Due to the complexity and ubiquity of environmental issues, the need to find strategies to change conservation behavior while minimizing the need for repeated intervention continues to challenge EE program developers. Environmental education professionals have used the following techniques of intervention: informational techniques, positive motivational techniques and coercive techniques. Five

evaluation techniques should be used to measure the impact of the intervention technique on behavior change: reliability, speed of change, universality, generality, and durability. Under these criteria, positive motivation techniques produce the best results, especially if they focus on intrinsic motivation. Commitment strategies provide this opportunity reliably producing both quick and durable behavior change.

Disinger, John F. 1990. *Teaching Creative Thinking Through Environmental Education.* **In ERIC/SMEAC Environmental Education Digest, Columbus, OH 43212 (614) 292-6717. EDO-SE-90-33.**

Creative thinking has been defined as one aspect of higher-order thinking necessary for problem-solving, invention and achievement. If teachers are to teach creative thinking in students, they must first develop their own creative talents. Authors point to several techniques to foster creative thinking, such as storytelling, brainstorming, guided imagery, and reflective writing. Environmental education can act as a mode for learning how to think creatively by identifying alternatives, using multiple resources, and identifying real and potential impacts of existing problems and potential solutions.

4-H National Program. National 4-H Criteria for Curricula Development. National 4-H Program Leader, USDA Room 3860 S. Building, Washington, DC 20250-0900.

A resource developed specifically for those creating curriculum materials to be used by 4-H clubs.

Gigliotti, Larry M. 1990. *Environmental Education: What Went Wrong? What Can Be Done?* **Journal of Environmental Education, 22(1):9-12.**

The author argues that although environmental education has been successful at producing ecologically concerned citizens, people are generally unwilling to change their personal lifestyles in ways which are necessary to solve some environmental problems. Citizens who have learned misconceptions or myths about the environment have criticized the behavior of others, but lack the knowledge and conviction to change their own behaviors. Gigliotti states that every citizen needs a basic understanding

Resources



Bibliography

Important
skills for
success



Bibliography

Important
skills for
success

of ecological principles, information on the alternatives and consequences of actions, and information on possible individual action. To help change the myth that people are separate from the environment, environmental education messages must make the connection between environmental information and individual actions and solutions to environmental problems.

Howe, Robert W., and John Disinger. 1988. *Environmental Education That Makes A Difference —Knowledge To Behavior Changes.* In **ERIC/SMEAC Environmental Education Digest, Columbus, OH 43212 (614) 292-6717. EDO-SE-90-12.**

Students who are given the opportunity to engage in long-term, realistic environmental issues tend to demonstrate responsible environmental behavior. Authors describe several variables involved in developing this accountability. Such individuals exhibit: (1) knowledge of relevant environmental concepts, (2) knowledge of environmental problems and issues, (3) concern for the quality of the environment, (4) knowledge of action strategies that may be used for resolving an issue, (5) belief that their action can make a difference, (6) commitment to take action, and (7) experience in action-based activities. Authors then list three sets of materials shown to have a significant effect on student learning and behavior: (1) *Conservation and Children* (National Diffusion Network, 1988); (2) *Investigating and Evaluating Environmental Issues and Actions: Skills and Development Modules* (Hungerford, 1988); and (3) *Decisions for Today and Tomorrow: Issues in Science-Technology-Society* (Iozzi, 1987).

Howe, Robert W., and Charles R. Warren. 1989. *Teaching Critical Thinking Through Environmental Education.* In **ERIC/SMEAC Environmental Education Digest, Columbus, OH 43212 (614) 292-6717. EDO-SE-89-22.**

Critical thinking skills are an intricate part of daily life. Students are asked and expected to make complex choices, judgements and evaluations everyday. Authors list several critical thinking skills definitions, including Ennis' (1987) definition: the process and skills involved in rationally deciding what to do or

what to believe. Business and industry continue to report that many employees are not able to think critically in job situations. Authors argue that schools need to re-evaluate how and what they are teaching and how to better prepare students for various societal situations. EE is thought to be a good mechanism in teaching critical thinking skills due to the scope, breadth and reality of environmental issues.

Jones, Jo, and R. Dale Safrit. 1992. *Critical Thinking: Enhancing Adolescent Decision-Making.* **Journal of Home Economics, 84(3): 4-7.**

Critical thinking skills involve problem-solving, decision-making, and evaluating one's position on issues. Key elements in the critical thinking process are dialogue, reflection, and questioning. These elements underlie the authors' 13 "effective strategies" to foster critical thinking in teens. Such strategies include debate teams, dramatizations, journal writing, listening teams, and considering alternatives. Each strategy presents teens with realistic situations in which they are asked to consider the points of view of those involved in the conflict.

Katzev, Richard D., and Anton U. Pardini. 1987. *The Comparative Effectiveness of Reward and Commitment Approaches in Motivating Community Recycling.* **Journal of Environmental Systems, 17(2): 93-113.**

This study investigated the value of commitment to an environmental action. Various study components compared commitments vs. monetary incentives, single request vs. multiple requests for commitment, and verbal commitments vs. written commitment. Another study by Theodore Wang and Richard Katzev explored the individual vs. group commitment option. (1990. Group Commitment and Resource Conservation: *Two Field Experiments on Promoting Recycling.* *Journal of applied Social Psychology, 20(4): 265-275.*) Results showed that commitments work better than monetary incentives for their ability to produce short term involvement and enduring behavior change. Commitments must be explicit for a specific action. They are enhanced if they are individual, public, written, and voluntary. Commitments to a specific act may lead to a more generalized commitment.

Monroe, Martha C., and Stephen Kaplan. 1988. *When Words Speak Louder Than Actions: Environmental Problem-Solving in the Classroom.* **Journal of Environmental Education, 19(4): 38-41.**

Authors promote using case studies to teach environmental problem-solving skills in place of action-oriented projects. Encouraging discussion of actual problems and presenting examples of successful solutions increases students' familiarity with optional solutions. Authors argue that action-oriented environmental projects may actually discourage students from future environmental action. They support this claim stating that projects are challenging to carry out and do not guarantee a positive experience for all students. Action projects also impose classroom constraints and require a very special commitment from the teacher. Authors further state that future studies should directly test the students' knowledge rather than rely on the teachers' impressions.

Neilson, Allan R. 1989. *Critical Thinking and Reading: Empowering Learners To Think and Act.* **ERIC Clearinghouse on Reading and Communication Skills, Smith Research Center, Indiana University, Bloomington, IN.**

Neilson argues that students' lack of critical thinking skills reflects our current educational system and the assumptions it holds about the nature of knowledge, teaching and learning. Educators place an overwhelming emphasis on teaching and considerable faith in direct instruction (lectures, readings, drill exercises) as the primary means of transferring facts and skills. When students have little active involvement in their education, compliance, rather than independence, in students' thoughts and actions tend to be valued. Neilson addresses the question "How to better prepare our children for the world beyond the classroom?" by suggesting application of an alternative framework that encourages personal independence.

Newhouse, Nancy. 1990. *Implications of Attitude and Behavior Research for Environmental Conservation.* **Journal of Environmental Education, 22(1):26-32.**

Most environmental attitudes are formed as a result of life experiences vs. a specific program designed to change attitudes. One explanation

for the discrepancy is the possibility that attitudes being taught do not correspond well to behaviors which are being measured. Attitudes have been found to be changed through certain types of experiences. A sense of loss, repeated exposure to a stimulus, hands-on contact, information, and modeling by a respected or liked person are perceived as having the potential to promote attitudinal change. Yet, in order for persons to take action, they must believe in their ability to bring about change through personal behavior. Additionally, change is accompanied by individual sense of responsibility, a clear understanding of the issues, and a supportive atmosphere.

Renner, John W., and Edmund A. Marek. 1986. *The Learning Cycle and Elementary School Science Teaching, chapters 4-7 and 9-10.* **Heinemann, Portsmouth, NH.**

These chapters summarize key components and philosophy of the learning cycle as developed by Robert Karplus based on education principles described by Jean Piaget. The learning cycle focuses on development of the ability to think rather than memorization of knowledge. The learning cycle approach includes three stages: exploration, conceptual invention, and concept implementation. Programs designed around the learning cycle strategy have been demonstrated to produce students as knowledgeable about content as students in a traditional course of study, but more able to apply what they have learned in a new situation.

Spinner, Nancy R. 1992. *Using Learning Styles to Empower Youth and Families.* **Journal of Home Economics, 84(3): 8-11.**

Learning reflects our response to environmental, social, emotional, physical, and psychological stimuli. Spinner describes studies comparing American and Asian student family situations. These studies suggested that American mothers tend to believe that school success results from an innate ability, whereas Japanese and Chinese mothers believe more in the relationship between hard work and success. Spinner also notes various learning styles: visual, auditory, manipulative (kinesthetic), and global learning. The style that suits a child's interest can best be determined by the parents. Determining a child's learning style

Resources



Bibliography

Important
skills for
success



Bibliography

Programs and recommendations

and encouraging parental involvement in the child's education may lead to higher achievement. Through greater parental expectations, a child may express him/herself through positive learning attitudes, self-confidence, curiosity, initiative, and persistence.

Wals, Arjen E., Almut Beringer, and William B. Stapp. 1989-90. *Education in Action: A Community Problem-Solving Program for Schools*. *Journal of Environmental Education*, 21(1):13-19.

The Action Research and Community Problem-Solving (ARCPS) model is adapted from a social science model (1940s) used to resolve disputes with a group. Under this model students isolate and thoroughly explore one environmental problem for study. ARCPS applies a systematic approach to learning that aims to equip students with the self-esteem and skills necessary for them to become confident and capable participants of society.

Water education programs and recommendations

Brody, Michael J. 1993. *A Comparison of Maine and Oregon Students' Science Knowledge Related to Marine Science and Natural Resources*. Presented at the annual meeting of the American Educational Research Association, Atlanta, Georgia.

Approximately 160 4th, 8th, and 11th grade students were interviewed in each state to determine knowledge about marine environments. The study demonstrated that while most students had some understanding of marine environment principles, most learning took place in the elementary grades. Overall, understanding of the concepts and principles related to marine ecosystem dynamics, resource utilization, management, and decision-making processes was low.

Brody, Michael J. 1993. *Student Understanding of Water and Water Resources: a Review of the Literature*. Presented at the annual meeting of the American Educational Research Association, Atlanta, Georgia.

The author investigated education literature about water topics in the areas of physics and chemistry education, biology education, earth

systems education, and water resource education. In general, studies showed that student understanding of science terms related to water and water resources is superficial. Students are not able to apply concepts which should underlay a particular term to other situations. Students showed particular difficulty explaining evaporation, diffusion, osmosis, etc. even when they had been introduced to appropriate molecular concepts. Students prefer explanations of common phenomena that they have acquired through personal experience. Models of water-related phenomena are too abstract and do not seem to relate to the everyday experiences of children. Although individual subject areas such as physics, chemistry, and biology address water topics, little effort is made to connect concepts taught in one subject with those in another. Research about student understanding of historical and cultural contexts of water does not exist.

A resource of note identified by this literature review is the Water Resource Knowledge Assessment (WRKA) described in *Water Resource Knowledge Assessment of College Bound High School Graduates*, by T. Mills, in *Proceedings of the Oklahoma Academy of Science*, 63: 78-82.

Fortner, Rosanne W., and Thomas G. Teates. 1980. *Baseline Studies for Marine Education: Experiences Related to Marine Knowledge and Attitudes*. *Journal of Environmental Education*, 11(4), 11-19.

This study summarizes the results of a marine awareness measure, The Survey of Oceanic Attitudes and Knowledge (SOAK). Results for Virginia's 10th grade students were compared with marine related experiences by the same students. Statewide average on the knowledge section was 49%. Those who scored higher also had more positive and less variable attitudes toward marine issues. Since ocean preservation does not make personal demands, positive attitudes were not interpreted as a measure of depth of commitment to improvement of ocean resources. A comparison of ocean awareness activities such as watching National Geographic TV specials, class activities, recreation activities, aquarium visits, indicated that students with the greatest access to these opportunities had the most knowledge and most positive attitudes. This suggested to the

authors that socio-economic status was a factor, leading them to recommend improved access for all youth to a variety of marine learning experiences.

Symposium on Water Resources Education: A Lifetime of Learning and Changing Roles in Water Resources Management and Policy. June 1993. Proceedings of the American Water Resources Association annual conference.

This conference included eight papers about water education. They are summarized below.

—*Symposium on Water Resources Education. Bixby, R. O. 1993. Environmental Education Initiative.*

Describes a watershed tutorial module using a graphical user interface (Arc View, a GIS program). Target audiences for the program were: decision makers, junior and senior high school students, and undergraduate college students. The project was initiated by the South Two River Watershed District which has an aggressive policy of public education. The environmental education initiative includes partnerships with a variety of local resource agencies, a state university, and two school districts. The effort is part of a comprehensive local water plan. One of the plan steps included working with two local school districts to provide curriculum materials on local geology and the impact of human habitation on water concerns. The resulting interactive computer module uses an existing data base on surface and ground water quality and quantity.

—*Symposium on Water Resources Education. Brown-Babcock, M., and J. Zilligen. 1993. Marine Debris Curriculum: Awareness to Action.*

Describes “Save Our Seas,” a comprehensive marine debris education program for grades K-12. The program includes curriculum materials, a teacher training network, and local events. The curriculum seeks to develop a sense of stewardship and instill a commitment to take personal responsibility to protect natural resources. It provides practical approaches to restoring the environment. Each unit includes a “cleanup” activity. At the secondary school level students design a model for cataloging and measuring the amounts of debris found during their cleanup. Data is analyzed, then students brainstorm solutions. If possible, they implement one of the solutions.

—*Symposium on Water Resources Education. Dyckman, Claire, N. Hansen, A. Murphy, K. O’Laughlin, and W. Scherrer. 1993. Watershed Education: Lessons from the Northwest.*

Watershed education efforts in the Pacific Northwest have led to a number of conclusions about what it takes to provide successful programs. Programs focus on adult audiences, including adults who work with children. Programs include stream teams, adopt-a-stream, wild Olympic salmon (a 25 ft. fiber-glass walk-in salmon), field based environmental education for schools with an interdisciplinary focus. All programs:

- focus on understanding the entire watershed
- provide information specific to a particular basin
- conduct most instruction in the field
- limit programs to small groups
- promote long-term action and environmental problem-solving
- cooperate with different interest groups and agencies
- integrate school and community activities
- address scientific, technical, political, and individual aspects of watershed management
- employ a variety of interactive teaching methods
- furnish models for participants to teach to others

Program planners have been challenged by the need to educate so that individuals develop a long-term commitment and so that individual commitments are supported by local institutions. They recommend long-term funding for the best results. They also suggest proceeding slowly, including as many groups as possible, and addressing controversy. To make complex watershed topics manageable to audiences, they recommend keeping education as simple and concrete as possible.

—*Symposium on Water Resources Education. Handley, S. M. 1993. Streamwalk: A Dynamic and Successful Education and Public Involvement Project.*

Developers of the Streamwalk program attribute its success to the fact that it provides the lay person with an opportunity to become involved in environmental protection.





Bibliography

Programs and recommendations

Participants answered 11 stream description questions and several questions about land use and stream bank condition. Explanations of significance of each question are described in the materials. Results are entered into an EPA Region 10 data base. In each major geographic area, a lead agency or consortium of agencies has assumed responsibility for local Streamwalk programs. Local groups, students, and individuals can be involved in the program. Other support materials include a Streamwalk game for young children and a campaign to involve state workers into the program. The Streamwalk activities were also successfully integrated into the Boise River Festival.

— *Symposium on Water Resources Education*.
Higgins, Susan H. 1993. *Trends in Water Education: Results of the Western Watercourse Adult Education Needs Survey.*

The Western Watercourse conducted a study in 1992 to determine the water education needs of citizens in 17 western states. Survey participants (300 out of 900 water-related professionals responded) identified nine water topics as fundamental water education components. Topics include: (1) water conservation, (2) how to become personally involved in water quality protection, (3) where does water come from? how we harness and allocate water? (4) the basics of water science and the public process, (5) groundwater: take the mystery out and tell us what it really is and how to protect it, (6) water rights, (7) science and protection of wetlands and riparian areas, (8) integrated resource management: how planning and land uses in a watershed impact water quality and quantity, and (9) water and economics: what is the value of water? In order to increase public participation and commitment in water science and water use issues, it was determined that these nine topics should be addressed in a public water education program. Respondents stated they believe the general public receives most of their information about water resources from television programming, newspapers and magazines, or newsletters. In response, survey respondents view the challenge as lying in developing new communication media about water resources and management.

— *Symposium on Water Resources Education*.
Hoening, E. 1993. *Public Involvement and Education: A Framework for Local Government in Urbanizing Communities.*

Describes Public Involvement and Education (PIE) strategies for Olympia, Washington.

Olympia has integrated the conventional functions of public information, involvement, and education into its staff team for the Water Resources Program. This allows staff to be involved in all elements of public involvement and education. The Olympia program is based on the Puget Sound Water Quality Authority planning process. Key policies emphasize public involvement and education. A watershed, or basin, approach is an important element in all water resource programs. Major projects were: Stream Teams — short and long term projects for citizens; Operation Water Works — for businesses; and Project GREEN — for schools.

Recommendations were that a municipal unit begin its education program by identifying a geographic unit of planning. Second, a needs assessment should be completed. Goals should be developed based on this need. Program elements should include: community grants, education and training for a variety of audiences, public information and outreach, coordination and evaluation, technical assistance, data management.

— *Symposium on Water Resources Education*.
Koenings, J., and J. Mountjoy-Venning. 1993. *Comprehensive Water Resources Education Techniques in Thurston County, Washington.*

Outreach methods for public education include: springs tours by bus, restaurant table talkers, low tide beach tours, septic system homeowner workshops, beach booths, volunteer monitoring.

— *Symposium on Water Resources Education*.
Mercer, M. 1993. *Forging School Partnerships in an Era of Change.*

Seattle's water utility has chosen to develop school partnerships as a means of connecting with the community. Steps for a successful relationship include: determining whether a partnership is compatible with agency needs and goals, gaining administrative support, developing a familiarity with the school environment, selecting a school, developing mutual goals and levels of involvement, developing a final budget, setting a time line, recruiting and training volunteers, tracking activity levels, and communicating results.