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Arid Arizona Not Lacking Water Education Programs

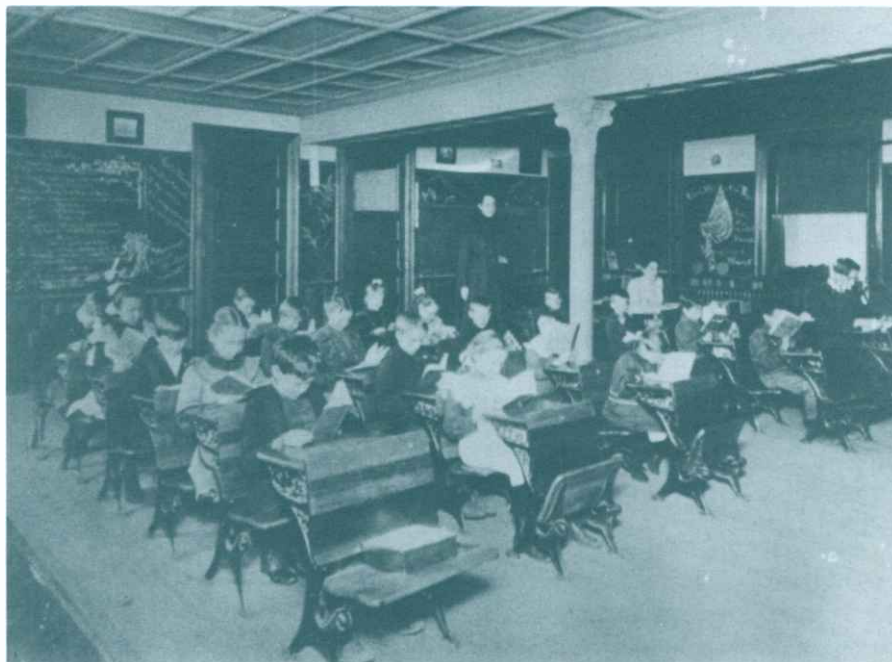
by Joe Gelt

Self-improvement is as American as apple pie, with wide ranging educational programs abounding throughout the land. The abundance and variety of such educational programs convey a mixed message. Obviously a sentiment is widely shared that there is room for improvement in many areas. At the same time, the existence of these programs represents a sense of optimism that education can remedy troublesome deficiencies and inadequacies.

The large number of water education programs within Arizona seems to indicate that residents have much to learn about water. Admittedly, living in a desert climate can itself be a water education, but despite this shared experience, and often because of it, Arizonans still can improve their water awareness and understanding. Water education encourages this deeper comprehension.

The Study of Water Education

Water education, if it is thought of at all, usually is considered a service performed, and is evaluated depending



Water education would be an unlikely subject in early Arizona school rooms. As knowledge and public awareness increased, water education gained importance

upon how well the service was delivered. Was the topic interesting, and was it presented so that the audience remained alert and attentive? Did people leave better informed about riparian areas? Do they now know how to install a drip irrigation system?

Water education, however, can be a topic unto itself, to be looked at apart from its content, whether irrigation efficiency, nonpoint source pollution, or a history of water use. Our knowledge about water affairs in the state broadens if, along with studying specific water concerns, we also learn about the educational programs that inform a wide range of Arizonans—

from ranchers to fisherman, from school children to homeowners—about those pertinent water issues.

Also, a review of water education in the state—the politics, philosophy and pedagogy—provides a valuable commentary about water attitudes and values that prevail in Arizona. Education involves choice, and water education programs are designed by deciding which information, ideas and concepts are of particular value, to be studied and passed on, presumably for the good of the individual and society. A study of water education, therefore, provides a commentary on society's relationship to this essential natural resource.

Water education is a very broad topic. It includes not just classroom instruction but also other efforts, such as workshops, exhibits and the distribution of various printed materials, including this newsletter. Water education is not limited to school children, but also benefits an adult population in its varied roles, as homeowner, gardener, business person, etc.

The water education offerings within the state are too abundant and varied to describe within the confines of a single newsletter. Instead, only some of the water education programs occurring within Arizona will be featured. They were selected because they represent different approaches to water education. At the same time, however, a discussion of these programs raises various issues and concerns shared by other water education programs in the state.

Arizona's Environmental Education Program

A review of the history of Arizona's environmental education program provides a good introduction to water education within the state. Such a review could appropriately be titled "The Rise and Fall of Environmental Education." The passage of the Environmental Education Act (ARS 15-706) in 1990 represents a milestone in the rise of environmental education, while 1995 legislative action can be interpreted as environmental education falling from political grace. The 1990 act mandated environmental education in Arizona; 1995 legislative action repealed the mandate and placed restrictions on optional environmental education efforts.

The 1990 Environmental Education Act required that all public school districts teach environmental education in grades K through 12, a segment of Arizona's population that

is young and impressionable. Water is one among many topics within the environmental education curriculum.

The act declared that "all public schools, community colleges, state universities and state agencies provide a continuing awareness of the essential mission to preserve the earth's capacity to sustain a quality of life in the most healthful, enjoyable and productive environment possible." With the act's passage, Arizona became one of 30 states to require environmental education.

The law established the Governor's Task Force on Environmental Education. Its responsibilities included developing a state comprehensive plan for environmental education. This plan then guided the Arizona Department of Education (ADE) in establishing the Environmental Education Framework, a 378-page document of general guidelines for teachers to follow voluntarily to comply with state environmental education requirements.

As defined by ADE, environmental education was not intended as a new subject area, to be taught independently of other established disciplines, such as history or language arts. Instead, environmental concepts were to be integrated or worked into the entire school curriculum, thus enriching such traditional subject areas as history and language arts, as well as science, math, etc., and deepening their relevance to today's world.

For example, the guidelines note that environmental problems often transcend both political boundaries and cultural differences. The guidelines go on to suggest that the environmental concepts underlying this situation could be explored as part of a social studies lesson describing physical geography and its impact upon people's culture.

Even the study of dance can be taught with an environmental message. To stress the importance of physical factors such as energy,

climate, geology, the water cycle and the sun on ecological systems, the guidelines suggest that dances be improvised to create movement showing the water cycle and energy flow.

The framework is intended as a flexible tool or starter document, for use by school districts as they design their own environmental education programs, responsive to their student and community needs. For example, communities with CAP allocations might work in information about this water resource.

Thus, environmental education, mandated and with a devised instructional strategy, became an established state educational program. It did not maintain that status for very long.

That environmental education arose from the political process was both an advantage and a disadvantage. The advantage was that the program could be broadly applied and public funds were available to develop and support it. Disadvantages, however, also accrued.

Located within the political arena, environmental education was vulnerable to the critical scrutiny of a

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variety of political interests. Further, political trends come and go. Having rode the wave of a relatively friendly or supportive period, environmental education later confronted a less favorable climate. Support or backing of the program diminished, as critics first called for changes, then termination.

Critics complaining of various flaws in the legislation were heard and heeded. Some critics claimed the law overlooked important scientific and economic principles, to the disadvantage of a fuller understanding of environmental concepts. Further, some critics feared that environmental education politicalized children. As a result, environmental education became a politically charged topic in Arizona.

The situation was sufficiently unsettling to prompt the 1994 Arizona Legislature to amend the 1990 Environmental Education Act. Various changes were made to the wording of the act to reflect a shift in political thinking that resulted in a revised view of environmental education.

For example, the 1990 act required programs to "be designed to help pupils develop an understanding of the importance of the environment." This passage was amended by deleting "importance of the environment" and inserting in its place, "scientific and economic concepts which impact on environmental and natural resource issues." Other such changes were made. If, as some educators maintain, the changes did not significantly affect environmental education goals, they did portend an emerging sense of political dissatisfaction with the program.

The 1994 legislation also created the Environmental Education Curriculum Review Committee, composed of legislators, environmentalists, scientists, economists, teachers and business leaders. The committee's goal was to revise current state environmental education guidelines

to reflect the amended changes in the 1990 Environmental Education Act.

The committee's work halted because legislative action was underway to rescind the state environmental education mandate. This, in fact, occurred, possibly making moot any further committee action. The political dust is still settling.

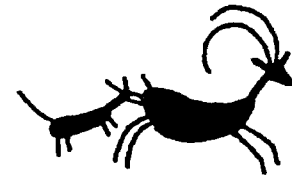
Environmental education is no longer a required topic, and if a school district chooses to provide it, certain directives must be followed. For example, the program must be based on the most current scientific data and must address economic and social implications of environmental actions. Many educators do not believe these directives preclude presenting sound environmental education. In fact, many believe that to be well rounded, environmental education needs to include scientific, economic and social concepts.

The legislation, however, goes beyond pedagogical matters, to affect funding. Funds derived from the sale of Arizona environmental plates no longer will go to ADE to support environmental education. Instead, the State Land Commission will receive the funding.

Some environmental educators feel other threats, as well. Many question state school chief Lisa Graham's commitment to environmental education. They complain of Graham's strategy of distributing \$630,000 that had accumulated from the sale of environmental license plates. Graham decided to distribute the funds on a per-pupil basis which amounts to about \$1 per pupil. Critics complain that by spreading the money so thin, funds are not available to support ambitious and innovative environmental education projects. Graham also is discontinuing the ADE environmental education specialist position.

The Arizona experience demonstrates that environmental education is a potentially controversial topic. Broadly interpreted, en-

vironmental education is concerned with our relationship to the natural environment. This covers a wide area, from the scientific to the economic, from the materialistic to the spiritual. Issues are likely to arise that reflect



Petroglyph, Coso Range, California

on choices we make as individuals and as a society. Inevitably, values are involved. Discussion of personal and political preferences may be difficult to avoid, with controversy not far off.

The Nogales Wellhead Protection Program

Despite difficulties at the state level, other water education efforts continue within Arizona. For example, efforts are underway in Nogales, Arizona to establish a water education program for public school students and adults in the community. Unlike the state environmental education program, with its broad, state-wide coverage, the Nogales Wellhead Protection Program operates within a single community. It is intended, however, to have broad application, able to be used in other border and non-border cities, as well.

Further, the Nogales program is concerned with wellhead protection, not the larger environmental picture addressed by the state program. With much of Nogales' drinking water coming from shallow wells, wellhead protection is an important topic.

A local or community approach to water education has various benefits. Being mainly concerned with Nogales provides geographic focus to the program and enables it to concentrate

more on local issues; in this case, wellhead protection. A local perspective also can be more flexible and responsive to local needs and concerns.

The Environmental Protection Agency's (EPA) Office of International Activities, which is concerned with protecting environmental conditions along the U.S.-Mexico border, funded the Nogales program. EPA intends to fund the project for two years, through October 1996.

The intent of the project is to encourage Nogales citizens to be better informed about their drinking water supplies. A technical committee and an education committee were formed to guide and develop the project. The education committee's responsibilities include developing educational strategies and materials.

The education committee consists of two subgroups, each with a specific assignment. One group is working on a curriculum for students attending the Nogales public school system, with the other group developing a general educational strategy for reaching adult members of the community.

Teachers from the Nogales School District make up the group developing the water education curriculum. Plans originally called for a K-12 curriculum, but initial efforts are focused on working out a curriculum for grades K-8. The teachers' strategy was first to examine what water education materials presently are available, both in Arizona and other states.

As a community education project, the Nogales program also needed materials that reflected local conditions and issues. For example, the material needed to be in both English and Spanish. More than just being bilingual, however, the curriculum materials were to provide a community focus to water quality problems.

The curriculum therefore is to in-

clude presentations such as "Who pollutes? Is 'Who' You?" This lesson includes profiles of various individuals who could represent a cross section of a community such as Nogales. For example, characters include owners of a gas station and a meat packaging plant and a high school student who changes her own motor oil and discards the used oil in her backyard. The lesson includes descriptions of the activities of each of these people.

Students also receive a fact sheet describing how groundwater becomes contaminated. After reviewing the fact sheet and related materials, students discuss whether the featured community members are contributing to groundwater pollution. The conclusion is that all are contributing in some way to the problem.

The curriculum also is to consider specific Nogales issues. For example, it discusses the closure of some Nogales schools because of microbiological contamination. The removal of downtown lead pipes was a success story that was included within the curriculum.

A strategy for providing water education to the general public also is being developed. The plan proposes a range of activities, from involving school children in developing a program slogan and logo to a community water festival. As an initial step, area residents would be surveyed to determine their awareness and knowledge of water issues.

Four "train-the-trainer" pamphlets are to be developed devoted to priority program topics. The purpose of the pamphlets and the accompanying instructional sessions is to train community members to become "trainers" in certain water topics. For example, a pamphlet might be prepared on drinking water and related public health issues. A public instructional or training session then would be scheduled.

People attending the session will become acquainted with the informa-

tion in the pamphlet. After successfully completing the training session, a person will receive a button, with slogan, logo and a message to the effect, "Ask me about drinking water and public health." That person will then become an authority or "trainer" in that topic, qualified to inform or train family, friends and other community members about the issue.

This strategy is similar to the use of *promotoras* in South American countries. A *promotora* is a community member, usually a woman, who receives training in a field, often public health. The *promotora* then provides information to other community members.

The general education plan also proposes a water festival. The water festival would be conducted in conjunction with two sporting events, with competing teams from both sides of the border. Water information would be worked into the program.

AMWUA, Serving a Region

The Arizona Municipal Water Users Association's (AMWUA) water conservation education program has a regional focus. As such, its scope of operation lies somewhere between a local or community effort, e.g., the Nogales Wellhead Protection Program, and the statewide environmental education program.

AMWUA's program mainly serves nine member cities: Phoenix, Mesa, Glendale, Tempe, Scottsdale, Chandler, Goodyear, Peoria and the Town of Gilbert. This area or region includes the largest population cluster within Arizona.

Membership in AMWUA, a non-profit organization, is voluntary, with member cities joining for mutual benefit. As a result, a shared sense of purpose prevails among member cities and generally ensures interest and support for AMWUA's projects,

including water education activities.

Like the Nogales program, AMWUA's water education effort has a specific focus. Whereas the theme of the Nogales project is wellhead protection, AMWUA's program stresses water conservation or water use efficiency. This focus reflects the concern of an organization serving a large urban population.

AMWUA's water education program is serving the population of a large metropolitan area. In a broad sense, all area water users are the intended beneficiaries of the association's educational message. AMWUA provides educational services and materials to a range of target groups, from school children within various public school systems to adults in their different roles, from homeowners, gardeners, and landscapers to persons involved in different businesses.

AMWUA's public water education efforts consist of eight programs. These programs include the Conservation Publicity Program; Xeriscape Program; Turf Irrigation Program; Industrial, Commercial and Institutional Program; Conservation Research Program; Middle School Education Program; and Coordinated Water Resource Planning.

Many and varied types of educational activities are conducted as part of these programs. For example, AMWUA conducts an annual xeriscape conference for water conservation specialists, landscape architects, facility managers, golf course superintendents and nursery personnel. AMWUA also conducts a xeriscape award program to acknowledge people who have made an outstanding effort to achieve water conservation and promote xeriscape.

AMWUA often works with cooperating agencies or cosponsors to present many different types of workshops, events and materials. For example, AMWUA, along with six cosponsors, supports the Smartscape

program, a statewide educational endeavor. Smartscape is a training program for nursery and landscape professionals, and targets mainly small scale independent landscapers. AMWUA's cosponsors include Tucson Water, Pima and Maricopa County branches of the University of



Petroglyph, Coso Range, California

Arizona Cooperative Extension Program, the Arizona Nursery Association, the Arizona Certified Landscape Professionals, and Arizona Landscape Contractors Association.

AMWUA recently published a school curriculum, "Water in Our Desert Community," for grades 6-9. Funded by the Arizona Department of Water Resources (ADWR) through a conservation assistance grant, the curriculum provides a broad review of water resource issues in the state. Issues covered include water supply, historical development of water resources, water quality and water uses, food production, xeriscape, and plant and animal adaptation to the desert. Valley schools can adopt the curriculum or use it to supplement their own programs and materials.

Curriculum activities were developed for coordination with Arizona Department of Education's essential skills, and an index is provided to facilitate cross-referencing. For example, water cycle activities can be worked into the teaching of dramatic arts, language arts, and science. Teachers thus know what state objectives they are achiev-

ing when using the AMWUA curriculum.

AMWUA's programs or presentations stressing low-water use plants convey a statement about desert aesthetics. Through careful planting, whether at a home or a golf course, a pleasing vegetative effect can be achieved that preserves the beauty and openness of the desert.

In other words, to conserve water is to be in harmony with the desert, a region of limited rainfall and water resources. AMWUA stresses this message, without commenting on what water uses then would benefit from conservation, whether environmental or commercial applications. Controversy thus is avoided.

A regional approach to water education has various benefits. For one, duplication of efforts is avoided. Also, broader public visibility results if one program covers an extensive geographical area than would be the case if smaller entities acted independently within the same region. Broader visibility in turn encourages a sense of regional consistency.

With nine cities pooling resources more funding is available for developing educational materials. For example, AMWUA member cities publish a series of colored xeriscape booklets. The high quality of the materials would have been unlikely without the cities' combined resources and expertise.

Project WET

As noted, water education programs are active in Arizona at different levels, from community-based to statewide. Other water education programs operate in the larger national arena, but with affiliated state projects designed to address the particular water issues of individual states. Such a program is Project WET (Water Education for Teachers)

The national Project WET began when the U.S. Bureau of Reclamation provided funds to The Western Watercourse (WW) to develop a national water education program called Project WET. WW decided to distribute the funds to individual states to develop K-12 WET programs. WW's home state Montana was the first to apply and provided the format that other states needed to adopt as they applied for WET monies. Arizona applied for project funds and then adapted the program to be relevant to Arizona. Project WET now operates in 30 states.

WW later decided that the various state Projects WET would benefit if they also included a national curriculum common to all projects. State projects therefore are to use both their state curriculum, along with a National Project WET curriculum. Work continues on the national curriculum, however, and it has not yet been introduced in any state.

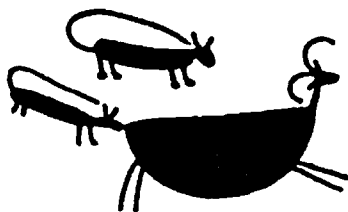
Project WET Arizona is a state affiliate of National Project Wet. The University of Arizona's Water Resources Research Center and the College of Agriculture Cooperative Extension 4-H Youth Development jointly administer the program. Grants from WW and the Lower Colorado Region Bureau of Reclamation support the project.

Project WET serves Arizona educators by providing water education resources and assistance. Educators are defined broadly to include public and private school teachers, 4-H leaders, Boy and Girl Scout leaders and others in teaching or leadership positions. WET resources are appropriate for all ages, although the project's priority is to provide teaching aides for K-12.

The goal of Project WET is to increase students' awareness, appreciation, and knowledge of Arizona water resources. As a result, much of the project information specifically relates to Arizona issues. Information

about surface water and groundwater is provided, and contemporary water issues are discussed; e.g. water conservation, water pollution, and water rights.

WET provides varied resources including an activity and reference guide for grades K-12; water resources maps, films, videos and slide presentations; and brochures, research reports and documents. Two of the more popular resources include a chest called Liquid Treasure that contains artifacts, each relating to an "old fashioned" water use; e.g., ice tongs, a washboard and a canvas canteen. Another popular WET resource is a groundwater flow model education package that includes a working model demonstrating the movement of groundwater.



Petroglyph, Coso Range, California

Recent Program WET projects include completion of a K-6 nonpoint source pollution curriculum funded by the Arizona Department of Environmental Quality (ADEQ). Also, Project WET developed Water Conservation Time Mazes for the Tucson and Santa Cruz AMAs. Funded by the Arizona Department of Water Resources (ADWR) through its conservation assistance program, a maze is an interactive exhibition for classroom and community use. The exhibit enables a person to travel through a physical maze that focuses on past, present and future water use.

Project WET is a resource available to tap. Its materials and expertise are accessible to individuals or or-

ganizations either planning or conducting an event in which water information is presented, whether workshop, in-service training seminar, or science or county fair.

The Verde Watershed Watch Network

A group of private and public high schools within the Verde River watershed are involved in a water education program to establish water quality monitoring sites along the Verde River and its tributaries. The Verde Watershed Watch Network (VWWN) is designed to provide an important community service, i.e., help protect the Verde River, and involves eight high schools, as well as local, state and federal agencies and a university, all working together to achieve program objectives.

The eight schools are Mingus Union High School in Cottonwood, Red Rock High School in Sedona, Chino Valley High School in Chino Valley, Flagstaff High School in Flagstaff, Oak Creek Ranch School in Cornville, Camp Verde High School in Camp Verde, Verde Valley School in Sedona and Prescott High School in Prescott.

The water quality monitoring sites to be established by VWWN along the Verde River will develop water chemical and biological baseline data for the Verde watershed. Also, specific water quality pollution threats to the watershed will be identified. A database will be established to help formulate and test Best Management Practices (BMP) for responding to identified water quality impacts. Chemical and biological quality changes in the Verde River due to BMP implementation also will be documented.

Three teachers from each school will be involved in the project, including a science teacher and a social

science teacher. Each participating school also will choose a third teacher from an academic area it wants emphasized as part of the project. The interdisciplinary teaching team is to ensure that project learning experiences are integrated into various areas of the school curriculum. For example, the social science teacher might present information about the geography, history and political governance of the Verde watershed.

The teachers will be trained in sampling techniques, chemical analysis, macroinvertebrate sampling and analysis, and computer-based data management. Also, ADEQ will train the teachers in water quality and macroinvertebrate sampling.

The purpose of the program is to provide an alternative to the classroom science lab with its textbook experiments. Instead, the project "lab" will be a community natural resource, the Verde watershed, and students will be involved in establishing and maintaining a database for regulatory and management agencies, such as ADEQ and EPA. Students also will be asked to help solve identified water quality problems by devising management practices to mitigate such problems.

Each school will monitor at least two fixed sites located in its area. In addition, participating schools may choose to sample additional sites depending upon known or suspected pollution threats.

Various funding sources helped establish the project. The American Chemical Society provided a concept grant and a curriculum development grant. A Wal-Mart Environmental Education Grant to Schools also provided support. The EPA provided funds for needed equipment including water chemistry sampling equipment, computers and networking software. Funds from the Eisenhower Math and Science Act sponsored teacher training sessions.

VWWN has a more specific focus

than previously discussed water education programs. Not only does the project concentrate on an identified geographical area—the Verde watershed—but it also is concerned with a specific task, water quality monitoring along the Verde River. This represents a hands-on assignment, with immediate and practical application to an ongoing environmental concern.

The Beaver Environmental Education Project

The Beaver Environmental Education Project (BEET) is another locally initiated environmental program. Established by the South Beaver Elementary School of the Flagstaff Unified School District, BEET includes water studies, as well as other environmental topics.

The program originated with South Beaver School's participation in a Northern Arizona University program establishing Teacher Network Teams (TNT). TNT's goal was to develop innovative ways to conduct science education, beyond its traditional reliance on textbooks and classroom presentations. A hands-on, field based approach to science education was stressed.

The South Beaver's TNT efforts evolved into BEET. With funding provided by the Arizona Education Association, teachers developed environmental curriculum for grades 1-3. The school currently is working on writing curriculum for grades 4-6. A grant has been submitted to Arizona Game and Fish for Heritage monies to support the effort.

The curriculum, which focuses on Lake Mary and other local ecosystems, integrates math and science with other subject areas, and educational outcomes are referenced to Arizona Science Essential Skills. The curriculum places students in the field to take samples and measure-

ments and collect data.

For example, the curriculum calls for first grade students to visit Lake Mary to take water and soil temperatures. The information from the field trip is recorded on a large classroom graph, and students discuss possible variables to explain the differences in data collecting by groups of students. The experience is integrated into other subject areas by having the students paint a mural about their Lake Mary field trip and by developing a story.

Second grade students learn how water affects the types of plants and animals that exist in an environment. A field trip to Beaver Creek is arranged, and the students first observe natural conditions 100 yards from the creek. They note the distribution of plants, height of trees and collect leaf and soil samples. The students record their observations in field booklets. The students then study conditions along the creek and compare and contrast plants and soil from these two ecosystems. Such experiences teach South Beaver Elementary students to gather facts and data for careful, scientific analysis.

Conclusion

The types of water education programs within the state vary greatly. Despite this variety, certain concerns seem common to many of them. For example, such programs need to devise suitable strategies for attracting a targeted audience to the educational activities being offered. This involves locating suitable resources or materials. Program organizers, therefore, benefit from knowing what already has been developed and whether it is available for their use.

If materials are not available, a program may need to develop its own. Other programs that went through the same process could offer advice and assistance. Perhaps

cooperative arrangements could be worked out. The handling of politically sensitive topics often is a common concern, as is attracting funding to support the educational endeavors.

Water education programs in the state, therefore, would benefit from a service that enabled them to establish closer contact with each other. People involved in water education then would be more aware of the broader picture of what is happening in Arizona. Considerable cross fertilization could occur as programs share ideas, information and materials with others in the field, as well as providing inspiration and comfort when needed.

Computer and telecommunications technologies could help provide the common meeting ground for water educators to exchange information and ideas. For example, through electronic mail, bulletin boards and services available via the Internet, Nogales teachers could search for resources to complement their curriculum development efforts. If such materials were on-line, they could examine AMWUA's water education

resources for useful information.

The Internet is rapidly being transformed from a tool for university researchers into a popular medium for groups and individuals to reach a large audience. Teleconferencing is another communications technology that has become much more affordable and widely available. Such strategies would help organize a community of Arizona environmental educators.

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