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December, 1994
Volume 67, number 6

# Environmental Education Programs

## *Teaching Agriculture and the Environment*

## *Community-Based Curriculum Development*

## *Teaching Resources*

THE
# AGRICULTURAL EDUCATION
MAGAZINE

December, 1994 Volume 67 Number 6



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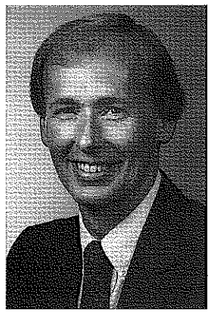
# Parting Shots



BY ED OSBORNE
*Dr. Osborne is associate professor and program chair of agricultural education at the University of Illinois, Urbana-Champaign.*

My last editorial! It's been a fast three-year term as Editor of *The Agricultural Education Magazine*. Preparing the monthly Editor's Comments has been challenging, to say the least. I hope my short articles have stirred some thought and action on the part of readers. And even if they haven't, I've learned a lot along the way. As a speaker once said, one of the keys to enjoying life is knowing what you believe in. Serving as your Editor has been invaluable in helping me decide what I believe about issues in agricultural education. Likewise, I challenge each of you to determine where you stand on these issues. Apathy and indifference are the worst enemies of growth and change. So even if we find that our position is wrong, it's better to have taken a position on an issue and later decide we were wrong than to ignore the issue altogether. While we need to determine our beliefs, we also need to keep these beliefs open to change as warranted by new information.

But I have one last opportunity to "get in the last word," and I cannot let it pass. The chosen themes for the past 36 monthly issues of *The Magazine* have reflected some of the most pressing issues in agricultural education today. These issues contain many unresolved questions that demand our continuing attention. Let me challenge you to address these issues in your personal philosophies and as you carry out your work in agricultural education on a daily basis.

## Some Challenges to the Profession

Tech Prep – What is the ideal level of integration and how can it be achieved? How can educators in all disciplines be brought to embrace Tech Prep?

Distance Education – What delivery methods are most effective? When and how should regional, cooperative delivery efforts via distance education be pursued?

Secondary Curricula – Should secondary agriculture curricula be balanced in agriscience, agribusiness, and agricultural management? What outcomes are we seeking in our students at the high school level?

Land Laboratories – How can maximum educational value be designed into our land laboratories? What role should land laboratories play in today's programs?

Teaming Up with CES – In what areas/programs should public school agricultural education collaborate with educational programs of the Cooperative Extension Service? How should preservice and inservice programs be designed to enhance collaboration?

Professional Diversity – How diverse should our professional corps be? How can we increase diversity?

Curriculum Change – How do we stay ahead of the change curve? How do we sustain our efforts at curriculum change and improvement?

Instructional Technology – What instructional technology should be used in our programs? What emphasis should be placed on instructional technology in preservice programs?

Complete Learning – How can we routinely take our learners through the complete experiential learning cycle, including active experimentation? To what extent are agricultural educators consciously providing full experiential learning for their students?

Using Research – How can research and practice in agricultural education be more unified? How can our research provide clearer, better direction for practice in agricultural education?

University Programs – What relative emphasis should be provided to teacher education? How can university programs become significantly broader than teacher education without weakening this critical role? What is the character of university level agricultural education that maximizes program strength and vitality?

Vocational Education – To what extent should secondary agricultural education be vocational in nature? Can secondary programs contain identifiable vocational and nonvocational components/courses?

Agriscience Instruction – How is hands-on science in agriculture different from hands-on science in biology, chemistry, and physics? What approaches should we use for teaching agriscience?

Lab Instruction – What are the goals of lab instruction? Should labs be less focused on psychomotor skill development and more focused on thinking and experimenting skills and processes? How can we move from

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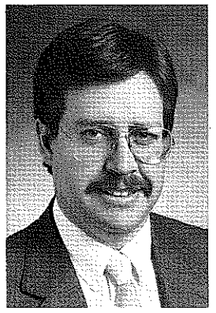
# Teaching Agriculture and the Environment



BY THOMAS H. BRUENING, THEME EDITOR

*Dr. Bruening is assistant professor of agricultural and extension education at The Pennsylvania State University, University Park, PA.*

As teachers, we can have a profound effect on the students we teach. All of us can remember that one teacher who, for us, was able to spark our interest on a specific topic. When it comes to environmental education, teachers and the approaches used can be dangerous! There is much information about this topic on both sides of the scale that is just not true. In addition, students can take extreme positions that border on hysteria when dealing with environmental issues. Some of these extreme positions can be found in the following statements: "Unfortunately, too many people believe that we need to wholeheartedly support production agriculture and all of its current practices, and to do any less is to remove farmers' freedom of speech." "In order to guarantee our food supply we should redistribute land and everyone should grow organic vegetables in their backyards."

Teachers of agriculture have the opportunity to teach students to understand the balance of nature, as well as the need for a reasoned approach to producing food. Using these strategies, teachers can find a variety of ways to teach so that a sustained food supply reaches the marketplace. In the following paragraphs and in this issue you will find a variety of approaches to teaching environmental education that will help you teach a balanced approach to this important topic in society today.

## Opportunities Abound

Opportunities to teach about environmental education abound. In some parts of the country the interest in environmental education is phenomenal. At The Pennsylvania State University, the Environmental Resource Management (ERM) undergraduate degree has by far the largest enrollment in the College of Agricultural Sciences. Current enrollment in the college is nearly 3,000 students, with more than 700 of these individuals enrolled in ERM. Students at the secondary level have also shown a great amount of interest in environmental education. In recent years Pennsylvania agriculture teachers were able to lobby the Department of Education to include environmental understanding as one of the state-mandated 53 outcomes all students will attain. Being "green" and understanding its importance in the lives of youth is critical to being an effective teacher in the 1990s.

## How Does Environmental Education Work in the Classroom?

Paul Hawkins in his book *The Ecology of Commerce* believes that we need to pass on the true cost of environmental degradation to the consumer. He believes we are postponing or deferring the true cost of environmental destruction. We've known for a long time the problems associated with siltation in agriculture. Siltation is the single largest cause of water pollution in the U.S. Hawkins believes that consumers and/or farmers should bear the responsibility of this pollutant through taxes to remove it from the environment. The argument is sometimes given that farmers by their actions create the possibility of soil loss and are actually taking away the capacity from future generations to grow food. We know that soybean production causes the soil to loosen, and the lack of ground cover further promotes soil erosion and sedimentation. According to Hawkins, since soybean production is a threat to the environment, all of the produce resulting from this crop should be taxed at a fair rate to either protect the environment or to put the soil back into a productive state.

That is Hawkins' position! Do you know what your students' position is regarding sedimentation? Think about the learning and the stimulating discussion that could follow. Students on both sides of the issue could discover as much as possible about the true costs of sedimentation, use of current tax dollars, legal ramifications, costs of terraces, how to meet soil tolerance levels, no-till farming, farmers' rights and responsibilities, the Conservation Reserve Program, benefits to society from food production, and who knows what else. It could be a class project! It could be a nine-week project! Students could go wild learning about sedimentation. Wait a minute . . . it's . . . it's too dangerous. The students might learn too much. I wouldn't try it. Stop, stop, don't throw me in the briar patch!

## Goals for Environmental Education in Agriculture

Students learning "true" information about the environment should be the goal of agricultural education. For too long we have promoted production practices because they were expedi-ently efficient. In the not too distant past, Midwest farmers plowed bean stubble in the

*(continued on page 23)*





# Zoos are a Natural Place to Learn: The Lincoln Park Story

BY MELISSA S. WIMER

*Ms. Wimer is a graduate student at Cornell University specializing in environmental education and has been a summer intern at Lincoln Park Zoo in Chicago.*

The lesson in biology is not progressing as smoothly as you had planned. The students seem to be preoccupied and uninterested in this exciting and relevant topic. The planet that we inhabit seems to have increasing problems of overcrowding, habitat loss, species decline and extinction, not to mention environmental problems like drought, ozone depletion, and pollution. You feel that children, as well as adults, need to be educated regarding environmental issues. The animals and plants that share this space with us are equally important, and each is fascinating. A zoo is an ideal place to study these concepts in an extremely engaging setting.

A trip to the zoo may be a bit different from what you were originally thinking. It's nice and pretty, but what can the kids learn? Many zoos have education departments that offer teacher training workshops, special tours, comprehensive science curricula, family activities, and camps that all focus on the issues of environmental education and conservation. Zoos are no longer primarily focused on exhibiting animals solely for entertainment. A zoo is an excellent place to learn. Zoo education departments are involved in many types of outreach, as well as programming at their site. Outreach programs are especially useful when there is limited opportunity to visit a zoo because of location, money, or time.

Lincoln Park Zoological Gardens, located in the heart of Chicago, offers many ways to correlate school studies with zoo resources. A program titled "Zoo to You" invites the teacher to the zoo for environmental education training. Upon returning to the classroom, the curriculum program is designed for four lessons. The first two lessons focus on the concepts of adaptation and habitat. The third lesson is a visit to the classroom by docents (specially trained volunteers) and live animals to demonstrate how animals adapt to their environments. The fourth lesson discusses positive human impact on wildlife. The personal attention given to the class and the opportunity to meet animals up close provides a lasting impression.

Lincoln Park Zoo remains one of the last free zoos in the country and, therefore, has thousands of school and day camp groups visit throughout the year. Prior to each group's visit (which must be registered through the education department), the Zoo-cology Action Guide, a packet of age-appropriate environmental activities, is mailed to the supervising teacher. Each folder contains pre-visit and post-visit activities, as well as an activity to complete while visiting the zoo grounds. While the visit to the zoo is an exciting experience, the continuities of pre- and post-visit lessons help to better solidify the message of conservation.

Educational programming at the zoo includes after-school programs that are free to invited groups. These programs, "Zootrition" and "Animal Crackers," are each funded by corporate sponsors and are designed to meet the needs of children attending federally-funded after-school programs. Each group is invited to the zoo for two separate visits that include activity stations and hands-on experience with zoo animals. The curriculum includes pre-visit and post-visit activities to provide an introduction and closure to the topics presented. The after-school program staff is provided with the pre- and post-visit activities, as well as additional follow-up activities and places to visit or call for further information. The students are provided with a workbook of activities and letters to keep their families updated on the information presented during each of the visits to the zoo.

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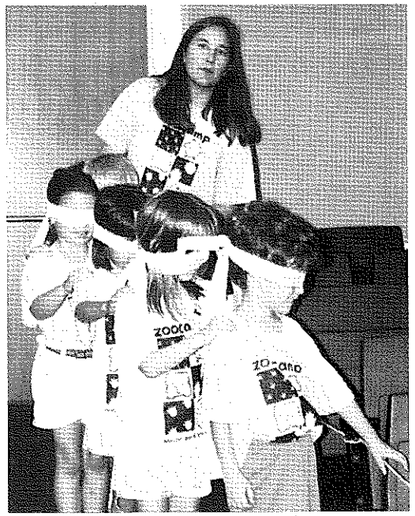


*"The Blind Trail" - children using their senses (other than sight) to determine where they had once been without blindfolds. (Photo courtesy of Lynne Yamaguchi, Lincoln Park Zoo.)*

*Firsthand experience with a tortoise. (Photo courtesy of Lynne Yamaguchi, Lincoln Park Zoo.)*

Environmental programs are offered at the zoo to meet a wide variety of interests and ages. Family workshops, film series, field trips, and an adult lecture series occur in the fall, winter, and spring. The topics of these programs range from a class and tour on one species to broader topics like habitat conservation for the lecture series. The family workshops include parents and children learning together, while the lecture series features internationally known conservationists discussing current environmental issues and conservation programs. Classes allow children as young as age three to begin to explore the world and exotic habitats from much closer to home.

The summer season at Lincoln Park Zoo is reserved solely for the implementation of ZooCamp. ZooCamp is an in-depth environmental experience allowing children a three- to five-day close up look at the zoo. Children that attend the various camp programs range in age from 5 to 14. The students are involved in hands-on experience with animals, touring behind the scenes and talking with zookeepers, and meeting other zoo staff, including curators and veterinarians. Challenging discussions regarding environmental problems and recent environmental successes, as well as the role of zoos, are discussed with each camp group in an age-appropriate manner.

Each camp focuses on a theme and involves the children in participatory activities and games that reinforce the message of conservation. Many times there is not one "correct" answer to the topics. Instead, children are asked to discuss and contemplate challenging issues. The parents and families of the children enrolled are encouraged to share the theme of conservation. Each day the children are sent home with a Parents' Guide that reiterates the theme and activities for that day. On occasion, children are given guidelines to recreate simple activities or are asked to complete an activity at home. Parents and families are invited to attend one additional hour of ZooCamp Open House on the final day of camp. During this hour, guests experience firsthand some activities, videos, and animals that had been a part of the previous camp days.

My personal experience at Lincoln Park Zoo, especially working with the ZooCamp program, illuminates the many benefits of including a zoo in an environmental education curriculum. A zoo offers a unique resource to observe animals and exotic landscapes throughout the world without the need to travel. Education departments at many zoos are involved in these programs, under different clever names, or programs similar to the ones described in this text. The resources available at a zoo enhance student learning. The motivation to learn is intrinsic and the enthusiasm is contagious. Why not contact a zoo in your area? Perhaps there is an opportunity for a joint educational experience with the science and agriculture teacher, or other combinations. ■





# Responsible Environmental Teaching in a Threatened Community

BY CLIFFORD L. NELSON
*Dr. Nelson is professor of agricultural education at Washington State University, Pullman.*

The spotted owl, old growth timber, the endangered salmon, the wetlands, and the wolf are examples of major environmental and endangered species concerns. These concerns impact communities and industries across the nation.

Agricultural education may find itself in the middle. On the one hand, it is important that students in agriscience and natural resource courses be well versed on environmental questions and possible solutions. In contrast, community concerns about disappearing agricultural lands, lost forest industry employment, or limited commercial fishing might trigger severe public reaction to any environmental education.

What is the solution? What can agriscience teachers do that will maintain their professional integrity and yet be sensitive to community concerns with policies perceived to threaten livelihoods, the economy, social structure, and individual families?

### Let Someone Else Do It?

A safe choice might appear to be to ignore sensitive community environmental issues in the curriculum and in interaction with students. Some might call this "burying our heads in the sand." Recent history has demonstrated that problems will not easily go away. A look at the early lack of public debate and action concerning the ozone layer and possible global warming because of the loss of rain forests and current major dialogue addressing these topics clearly makes the point. Gangs, teen violence, and assaults on tourists cannot be swept under a rug. The local chambers of commerce and political leaders are not able to "keep the lid on" these major problems.

Environmental issues, too, will not go away. Sustainable agriculture, integrated pest management, biological controls, and non-point source pollution are examples of increasingly important topics in agriscience education classes. There is both the ethical and professional responsibility to equip students with the tools to ascertain relevant current facts and to develop problem solving/decision making skills on any sensitive issue.

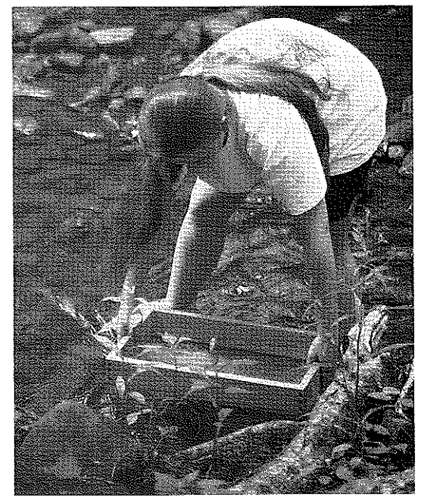
### Thinking About The Topics

Balanced community advisory input is as vital as it is to establish the need to study the topic(s) at this stage. A close relationship with school administration and awareness of established school policies is also a must. Potential community reaction should also be examined by these two groups. Criteria that must be met before going forward with the instructional program on sensitive community issues include: recognized importance of the subject matter to the education of youth; capacity to collect sufficient, scientifically-established support materials for balanced presentation; and the availability of community resources that can contribute to the educational program.

Commitment to publicly support the instruction of a sensitive subject is also needed from advisory and administrative personnel. This support will be needed if major community questions arise. It would also be very useful to have support from contentious individuals in the community. These individuals can assist in the accumulation of supporting materials and local resources appropriate to the teaching of the topics.

### Addressing the Topics

One recommended method of addressing sensitive topics is to determine limited objectives for the educational experiences. The objectives might deal with pollution of one stream or the endangerment of one habitat, and they should be addressed both academically and operationally. When students have a chance to apply their knowledge and see the →



*A student participating in the Pennsylvania Aquatic Resource Contest. (Photo courtesy of Thomas Bruening.)*

*The Aquatic Resource Contest is part of Pennsylvania FFA Activity Week. (Photo courtesy of Thomas Bruening.)*

results empirically, enduring, long-term learning often takes place. If the students assist a landowner to fence off and reseed a stream area that had been open to livestock, the improvement of water quality is often visible to the naked eye. Dramatic examples of environmental improvement are very important.

Learning projects for students should be relatively short-term. An academic quarter or semester would be best. A year-long project would also be good if evaluation of the results can be completed while students are still in school. Assistance of public groups such as SCS, fish and wildlife personnel, or Native American tribal councils has been very useful at both the identification and evaluation stages. They can be very helpful in identifying possible cooperators and sites within a reasonable distance of the school for the students to study, as well as evaluation criteria and methods.

### Topic Presentation

There are several ways controversial topics might be presented. Below are two strategies that have been used successfully.

1. Focus on the scientific facts (cognitive domain). This represents presentation of the accepted facts concerning a given topic. Reports of studies on the problem, stream or water quality guides and handbooks, extension bulletins and fact sheets, videotapes from interested organizations, or presentations in person or by phone are examples of how teachers may enrich their presentations. Agriculture students can often cite community examples of where some of the facts might be used or applied.

This methodology also encourages field application of subject matter learned when feasible. This meets the criteria of the problem solving approach, where the problem is identified, facts are gathered, findings are synthesized and tentative solutions proposed, the tentative solution is applied, and the results are evaluated to determine if the solution attempted was the proper one. The application of solutions requires field trips and student activity to prevent problem solving from becoming an academic exercise.

2. A second approach focuses on attitudes and feelings (affective domain). This is the most difficult to present and to assure that the polarized feelings and commitments found in the community are dealt with fairly. It is in this area of sensitive subject matter that the controversy is most likely to rise. Studies of human behavior have shown that when someone plays the part of another or debates another's position, the participant often changes attitude in the direction of the role they played. Thus, role playing is one suggested way of presenting both sides.

Formal debate among students or one minute oral presentations of conflicting positions may also help. The goal is not to "brain-wash," but rather to give credibility to another's position. Viewing of videotapes of those representing different sides would also be useful, as would in-school forums of community members representing different attitudes. These can be used as part of in-school classes or as part of a program for a community group.

Evaluation immediately following the environmental presentations is very important. This should include evaluation of how well each student met the cognitive and affective objectives developed for the area. Testing of knowledge and demonstration of skills learned should be part of the process. Another very important part of the process is to determine students' attitudes toward the environmental areas covered. These can be collected by interview or open-ended queries.

Reports of the evaluation results should be immediately shared with the advisory committee(s), school administrators, and others in the community who show concern. If successful, other environmental and perhaps more controversial subjects might be tried. If the process didn't work as well as hoped, this is the time to examine and revise the teaching process in part or as a whole.

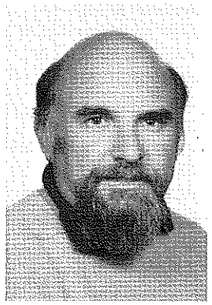
Teachers of controversial subject matter can be reassured that they are operating responsibly when the "bases are all touched." Have I involved the community? School administration? Advisory groups? Acquired all the latest scientific facts? Presented all sides? Developed a credible teaching approach? If yes, a teacher may rest easier as a responsible professional.

Sensitive issues are often the norm in the real world. Students must find out that there may be no one correct answer, and that a shade of gray rather than black or white might be the best alternative. Giving students the opportunity to develop analytical skills and apply their learning to benefit their community and environment should be central in any agricultural education program. ■





# Community-Based Curriculum Development: Partners in Teaching and Learning



BY ELLEN RILLA & RICHARD PONZIO

*Ms. Rilla is director of the University of California Cooperative Extension offices in Marin and Sonoma Counties and a former high school science teacher. Dr. Ponzio is 4-H science and technology specialist at the University of California, Davis.*

Public education is continually being asked to do more with less resources. To reverse Dickens: "It is the worst of times, and the best of times." The worst of times in that expectations of education far outstrip available resources; the best of times because when the situation becomes this serious, it forces people in education and other professions and the community to pull together and create programs in much the same way that the fabled "stone soup" was created. This article provides a sketch of how an educational program was developed by a consortium of stakeholders (parents, teachers, environmental and agriculture groups) to teach school-age children about agriculture.

### The Setting

With increasing frequency and urgency society is being called upon to make decisions about critical agriculturally-related issues, such as food safety, land use, and water policy. In order to make informed decisions the American public must have a basic understanding of agriculture and its role in our society and economy. Yet, several reports have found that most people's knowledge of agriculture is inadequate. The most prominent of these was a 1989 National Academy of Sciences report titled *Understanding Agriculture—New Directions for Education*, which concluded that most people do not have a clear understanding of agriculture. Authors of the report proposed the following definition of agricultural literacy:

> *An agriculturally literate person's understanding of the food and fiber system includes its history and current economic, social and environmental significance to all Americans. This definition encompasses some knowledge of food and fiber production, processing and domestic and international marketing.*

Ten years ago most thought and discussion about agriculture was confined to individuals and institutions directly involved in agriculture (Desmond et al., 1990). In the late '70s and early '80s public concern began to emerge which indicated a broader interest in food, fiber and land use related to the environment. These concerns, many with grassroots beginnings, spawned school-based curricula, such as Life Lab, Project Learning Tree, and Project WILD, that were soon recognized by agricultural institutions such as USDA and Farm Bureau. Another concern was that urban populations, particularly urban youth, were ignorant about how their food and fiber are produced and what factors are crucial to continued production. As a result, other programs, such as Agriculture in the Classroom, were developed to address this emerging educational need and interest in America's agriculture. Interest culminated in the National Academy of Sciences calling for a "national review of agricultural education" in 1989. One of the principal conclusions of the Academy report was, "Beginning in kindergarten and continuing through 12th grade, all students should receive some systematic instruction about agriculture." The report also went on to suggest that "much of this instruction could be incorporated into existing courses rather than taught in separate courses."

Subsequent research (Braverman et al., 1991) indicated that while most school administrators agreed agricultural literacy was important enough to incorporate into the school curriculum, they were in a quandary as to where to fit it into the school day. The placement of the responsibility for agricultural literacy was problematic. Should it be part of the social studies curriculum? General science? Biology? What grade levels should be responsible for presenting agricultural literacy materials? The elementary schools? Middle schools? There were certainly more questions than answers.

Researchers from the University of California began investigating the perceived need of California public schools by surveying school administrators (Braverman et al., 1991). The survey results indicated that California educators believe agricultural literacy is an important element of a complete education and that it can be best incorporated at the 4th through 6th grade levels by integration into the science and social studies frameworks. The survey results matched an important lesson learned from the environmental education movement—environmental concepts are best infused into science and social studies as the most practical way to reach educational goals (Disinger, 1986). "The survey results matched an important lesson learned from the environ- →

mental education movement—environmental concepts are best infused into science and social studies as the most practical way to reach educational goals." Other related studies (Pomerantz, 1990) indicated that educational programs have their greatest influence on developing attitudes toward environmental issues during childhood.

### A Successful Model for Theme Immersion?

In the summer of 1991 a local foundation agreed to fund the development of agricultural literacy curriculum materials focusing on agriculture in Marin County, a small county located directly north of San Francisco. The group's charge was to create and design materials "in" and "about" agriculture, while integrating science, technology, economic, societal, and environmental needs and concerns.

The project, conceived by a small group of local educators, environmentalists, and ranchers (the stakeholders), would create a set of educational materials in English and Spanish for use in the 80 public and private schools in the county, based on the educational needs identified in the agricultural literacy surveys.

The project organizers' primary goal was to "bring the community into the schools" with a focus on agriculture as a primary theme. (In Marin County 45% of the land base is tied to agriculture.) Titled the Marin Agricultural Literacy Project (MALP), the consortium of stakeholders included ranchers, organic farmers, private and public school teachers, bilingual specialists, a foundation officer, college professors, parents, environmental groups, teens, and community members. Each stakeholder had something to contribute to the product: money, time, talent, classroom experience, or subject matter knowledge. Each had an interest and commitment to its success. One of the greatest challenges facing this community-based group was how to best integrate experiences and activities that would promote agricultural literacy into classroom practices and do this in a manner that was unbiased, action-oriented, and in a format that teachers would use.

After reviewing several reports, including the Academy and Braverman reports, the group decided to use the California State Science and History-Social Science Frameworks as a basis to create effective and usable curriculum materials that would have the greatest chance of success in local schools. They also decided to follow the Braverman study recommendations and incorporate agriculture into a thematic approach. The group interpreted "theme" as:

- local agriculture, including topics students could consider important and interesting to their lives with controversial political issues, historical questions, and environmental problems;
- broad, with many opportunities for questions/subtopics that relate to the overall theme;
- extended to the community with regional, national, and worldwide implications;
- having opportunities for multicultural education and increased respect for others; and
- having a variety of printed materials and other media available for student research.

### Key Components for Success of the MALP Design Strategy

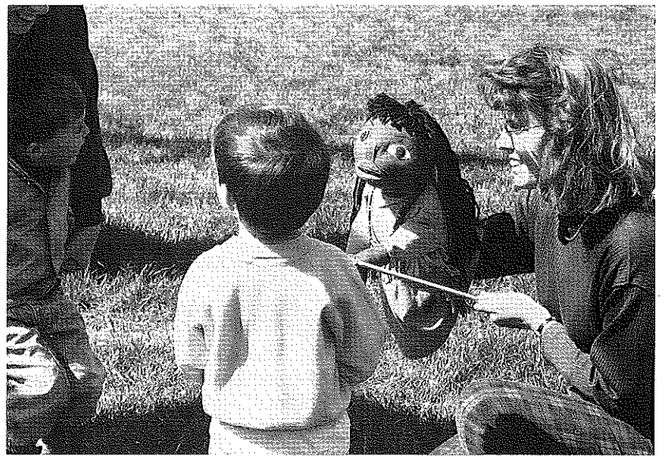
Checklists exist that define what is needed for a program to function as an effective instructional vehicle in schools, regardless of its theme or content area (Niedermeyer, 1992). However, the experiences gained from this project illustrate how a group of interested and knowledgeable individuals can go about creating and designing effective supplemental instructional materials. These guidelines are based on recent experiences of the MALP consortium and their evaluation of the process.

Build coalitions. Identifying and recruiting potential coalition members to help "build" the project idea is critical. Since the release of *A Nation At Risk* in 1983, the number of coalitions and partnerships in schools has increased from a few dozen to thousands. The coalition approach promotes involvement of external groups and agencies in developing a sense of ownership in the educational process (Hadfield, 1992). The MALP advisory committee (consortium) is made up of teachers, environmentalists, local ranchers and farmers (from organic to dairy), students, county agricultural groups, and offices of education. Faculty members from departments of education at university campuses help to ensure relevance and bring content expertise to the process.

Feedback from the MALP advisory committee indicated that they appreciated the use of interactive meeting techniques such as:

- facilitating meetings with group memory clearly recorded; techniques like brainstorming and prioritizing helped clarify the most important elements of the project goals;
- following up with minutes from the group memory to group members with action tasks clearly delineated;
- creating and following group ground rules by bringing to each meeting and posting and obtaining explicit agreement from group members for the agenda or direction we created; and
- keeping group members informed between meeting dates with brief update memos on project's progress. Asking for group involvement in individual project tasks.

The above meeting process worked effectively, according to ongoing group feedback (verbal and written evaluations gathered after each session). All of the group management techniques described above are summarized in Doyle and Straus' popular book *How to Make Meetings Work* and are based upon years of study about group problem solving and decision making.



*Student teachers interact with preschool children at Greencastle Environmental Center. (Photo courtesy of Thomas Bruening.)*

Create clear goals and outcomes. Make sure that project goals, objectives and outcomes are clearly delineated from beginning to end and that goal statements are congruent with the activities content (Ramsey et al., 1992). For example, after our advisory group's initial meeting, we posted project goals, objectives and outcomes at every subsequent meeting so that group members could refer to them.

Integrate current educational instructional strategies. Do your homework! Classroom teachers can easily see the difference between promotional and educational viewpoints when scanning materials. A neutral, non-biased viewpoint is essential. A great deal of time in MALP was spent reviewing the current state frameworks for science and social studies and reviewing other related regional and state educational frameworks, such as Project Food, Land and People; Life Lab; and Ag in The Classroom. A subcommittee of the advisory group spent two full-day sessions creating an organizational matrix and guidelines for MALP materials. The California State Science Framework provided guidance for the "constructivist" model of learning, which considers direct, hands-on experience of the learner to be of prime importance. Many of the MALP processes follow concepts and learning elements described in Chapter 6 of the Framework.

Hire or enlist a credentialed teacher or education consultant to write your basic lesson plans if you can afford it. In our experience it was easier to use a subcommittee of volunteers from the full advisory committee to act as designers of ideas and have a consultant articulate the ideas in a lesson plan format. Our most creative activities were brainstormed in our design team sessions, followed by the writer articulating them in a consistent educational format. Another model is to conduct a teacher's "writing workshop," where several teachers get together to write activities. This will work as long as there is one style of writing that emerges, or someone is responsible to edit the various activities and styles into a single, consistent format.

Include a realistic timeline of events and product due dates. MALP took two years to create 29 lesson plans, a teacher's resource directory, loan library, and accompanying videotape teaching aid. Because we had multiple products, we needed four separate but integrated timelines for each product. For example, the videotape consultant was a member of the lesson plan design team so that the resulting tape would integrate concepts and ideas from the activities guide. Since repeated field-testing is essential to the project's success, project timelines should be planned around the school year. We found ourselves writing and field-testing in the middle of the summer when many of our best classroom teachers were on vacation.

Use teacher input throughout. We found that involvement of teachers in every phase of the curriculum development project was a major factor in successful dissemination and use in local schools. From planning and writing, to field testing and evaluation, to inservice and distribution, teachers should drive the project. In MALP it was the teachers in the group who consistently acted as our reality check when activities became too expensive to carry out or were difficult to understand.

Build a small substitute teacher fund into your project budget. This allows you to make arrangements with the school principal to let a teacher become involved on a regular basis in your project. Remember, it will take at least one school year, if not two, to complete the process. Teacher continuity is critical. The process of involving teachers all along the way pays off a hundred fold as they become excited about "their" project, tell others of its progress, and build anticipation of its imminent arrival. By the time we had gone to press and had organized teacher workshops through the local teachers inservice cooperative, we had a long list of teachers who were eager to sign up for workshops.

Actively provide teacher training and distribution of materials. Research by Mayer and Fortner (1987) indicated that short, frequent workshops for teachers with frequent follow-up contacts to share experiences keep teacher interest high and lead to greater use of the materials. Work through your local office of education to offer teacher inservice workshops. Place materials in every school resource library in your area.

### Epilogue

Has this style of supplemental curriculum development and dissemination been successful? So far, the results are promising. Field test-

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ing of materials indicate good receptivity by students and teachers to lesson plan content and format. The teacher workshops have been well attended by enthusiastic participants who praise the materials upon first use. Several other regional consortiums of teachers, school districts, agricultural support groups, and environmental activists are interested in replicating the materials, and one county to the north raised $20,000 to initiate its own version of materials.

Did agriculture work as a theme to teach science and social science processes? The jury is still out on this area. Once the dissemination and workshop phase is over, the authors are planning to conduct a follow-up survey of all teacher participants to determine long-term effectiveness of materials. Only then will we be able to better analyze our overall success.

Were there enough resources available to develop and disseminate materials? We were fortunate in having adequate foundation support to do a thorough job. Other groups may not and will have to improvise. Response from other groups wanting to develop their own local materials has been phenomenal, and this article is intended to share some key ingredients that helped this consortium successfully create and disseminate supplemental teaching materials in an effective and collaborative manner.

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■

## Parting Shots

*(continued from page 3)*

"shops" to "labs," both in terminology and content?

Collaboration – Can agricultural education (at all levels) break out of its traditionally independent, isolated mode into one of greater teamwork and collaboration? Does greater collaboration mean significant changes in methods and programs?

Problem Solving – Is problem solving teaching (PST) as effective or more effective in agriculture than other teaching approaches? Why don't teachers use PST more? How should PST be taught? To what extent do agricultural educators use problemsolving to improve their programs?

Agricultural Literacy – What should agricultural literacy programs look like at the elementary, middle school, and high school levels? What staffing and other resource changes are needed to meet the huge opportunities for agricultural education in the early and middle grades?

SAE Programs – How should SAE programs be modified to best serve our changing students? Should SAEs be required of all agriculture students? What are our expectations from students?

Special Needs Populations – What is our role? What is our unique advantage? What is our responsibility? What methods and programs are most appropriate?

Professionalism – What are our biases? Do we offend colleagues and others by our actions and/or our words? Do we "go along" with comments and situations that are unprofessional, or do we express our dissatisfaction and encourage positive change? Do we, both as individuals and as organizations, present a positive image for agricultural education?

All of these issues will continue to challenge us. Likewise, responses and solutions must continually be developed and revised as circumstances change. I look forward to working with colleagues in agricultural education to enthusiastically address issues in our profession. Thank you for the opportunity to serve as Editor. ■





# Agricultural Education and Environmental Education: Collaboration for Global Sustainability


BY GEORGE R. VAHOVIAK & ARLEN W. ETLING

*Dr. Vahoviak (top) is an instructor in agricultural and extension education at Penn State University and co-director of the Penn State Conservation Leadership School. Dr. Etling is associate professor of agricultural and extension education at Penn State.*


When plans are made for shuttle flight into space, preparations for food, air, water, and waste management are made for a finite number of people for a finite period of time. In other words, technicians in the space program maintain sustainability for the crew members while they are in flight. The planet Earth is essentially a spaceship, with the inherent ability to provide its inhabitants with a degree of food, water, air, and waste absorption. In the space shuttle, population never changes. Inhabitants all have equal access to the food, water, and air. Additionally, the waste produced by its inhabitants does not contaminate any of the shuttle's life support systems. The tragedy with the metaphor is that on spaceship Earth, sustainability is continually sabotaged.

Authors such as Brown (1994), Daly & Cobb (1989), Ehrlich & Ehrlich (1991), Hawken (1993), Meadows, Meadows, & Randers (1992), Orr (1992), Sachs (1992), and Young (1990) have written about global sustainability and the elements of humanity which are important factors in today's unsustainability. Population growth (5.5 billion and growing exponentially), environmental degradation, consumption of resources (industrial, private, and municipal), loss of wildlands and species, and agriculture are repeatedly indicated in the above body of literature as the critical variables in the sustainability equation. Traditionally thought of as an issue of interest to environmental education, worldwide environmental impacts of agriculture and population growth make global sustainability equally vital to agricultural education. Agriculture's role in this scenario simply cannot be understated:

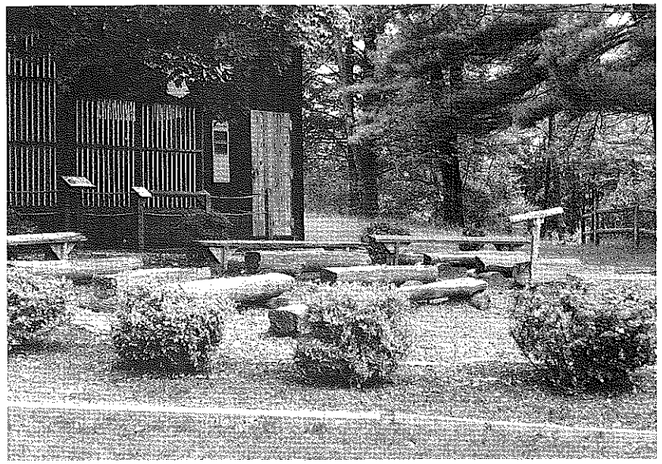
> *Humanity's struggle both to feed the poor and overfeed the rich constitutes one of the principal causes of environmental degradation, one that perhaps will be the most difficult to correct. But it must be corrected if Earth is to be healed. Because of the size of the human population, the nature of many diets, and the way most agricultural systems are run, eating is one of the most ecologically destructive of all human activities (Ehrlich & Ehrlich, 1991, p. 193).*

Global sustainability implies a population that lives off the "interest" rather than the "principal" of the resources which planet Earth affords us. Referring to the space shuttle metaphor, humanity must learn to continually provide food, water, air, and waste absorption in ways which are sustainable. Like the shuttle, we are carrying a finite amount of resources, but we are supporting an exponentially growing population.

The point of this discussion is to emphasize the argument that agricultural education, with linkages to environmental education, could foster an educational philosophy with global sustainability as its focus. This concept is beautifully described in David Orr's book, Ecological Literacy (1992). The concept of ecological literacy and a discussion of its application to agricultural education was reported in Vahoviak, Adams, and Bruening (1994). The purpose of this article is to detail some specific linkages between agricultural education and environmental education for those educators wishing to expand current agricultural education programs into programs which embrace sustainability as its goal.

### Ecological Literacy: Shared Goals for Agricultural Education and Environmental Education

Agricultural education and environmental education represent a potential coalition of disciplines from which to begin developing ecological literacy education. Kirts (1990) claimed that agricultural education and environmental education exist separately in our schools, but they should be linked by incorporating environmental concepts into the vocational nature of agricultural education. This claim is supported by Orr's (1992) notion that ecological literacy requires education for both the head and the hands. Additionally, Kirts (1990) argued that agricultural education and environmental education share many interests in terms of subject matter, (e.g., soils, forests, water, wildlife, pesticides, and food production). There is a mutual interest of natural resources and agriculture in both disciplines, and stewardship is the common link between the two disciplines. Noting that environmental education was originally intended for application across the curriculum, Kirts (1990, p. 34) drew upon the North American Association for Environmental →



*An outdoor classroom may become a vital component in an environmental education land laboratory used collaboratively by agricultural education students.*

Education (NAAEE) for 10 guiding principles to link agricultural education and environmental education.

Environmental education should:

1. consider the environment in its totality—natural and human made, biological and physical phenomena and their interrelations with social, economic, political, technological, cultural, historical, moral, and aesthetic aspects;

2. integrate knowledge from the disciplines across the natural sciences, social sciences and humanities;

3. examine the scope and complexity of environmental problems and, thus, the need to develop critical thinking and problem solving skills and the ability to synthesize data from many fields;

4. develop awareness and understanding of global problems, issues, and interdependence—helping people to think globally and act locally;

5. consider both short- and long-term futures on matters of local, national, and international importance;

6. relate environmental knowledge, problem solving, values, and sensitivity at every level;

7. emphasize the role of values, morality, and ethics in shaping attitudes and actions affecting the environment;

8. stress the need for active citizen participation in addressing environmental problems and preventing new ones;

9. enable learners to play a role in planning their learning experiences, and provide an opportunity for them to make decisions and accept consequences; and

10. be a life-long process—it should begin at the preschool level, continue throughout formal elementary, secondary, and postsecondary levels, and use nonformal (e.g., extension) modes for all ages and educational levels.

Kirts (1990) noted methodologies and skill areas such as problem solving, decision making, community development, citizenship, and student project activities as examples of the common ground for agricultural education and environmental education and urged teachers in both disciplines to work cooperatively. This list of guidelines illustrates how environmental education and agricultural education could cooperate to form a basis for ecological literacy.

An analysis of David Orr's (1992) definition of ecological literacy provides a framework for creating ecological literacy from the existing structures of agricultural education and environmental education. Orr's position that ecologically literate persons should be competent with respect to where they live and how to live in their place is consistent with the present capabilities of agricultural education to teach both mental and psychomotor topics. The diverse competencies required for ecological literacy are best characterized through the following goals for ecological literacy. Orr (1992) asserted that no student should graduate from any educational institution without a basic comprehension of: (1) the laws of thermodynamics, (2) the basic principles of ecology, (3) carrying capacity, (4) energetics, (5) least-cost, end-use analysis, (6) how to live well in a place, (7) limits of technology, (8) appropriate scale, (9) sustainable agriculture and forestry, (10) steady-state economics, and (11) environmental philosophy and ethics.

### Application of Environmental Education Activities in Agricultural Education

The broad array of program areas comprising agricultural education offers promise of encompassing contemporary activities of environmental education. Such a collaboration is evidenced with the incorporation of sustainable agriculture in agricultural education as cited by Cooper & Gamon (1991) and Marshall & Herring (1991). Regardless of what the incorporation of agricultural education and environmental education is called, environmentalizing the agricultural education curriculum may be accomplished in part through the inclusion of the following types of environmental education activities:

1. Leadership: Group dynamics, team building, and action socialization experience (ASE) are some of the leadership activities used in environmental education with exciting potential for agricultural education.

2. Natural History: Forestry, water study, wildlife, ecology, geology, and soils are all areas of interest to both agricultural education and environmental education.

3. Geologic Time Walk: By converting time into distance (e.g., one step equals one million years) the study of local history, evolution, population growth, and agriculture can become an exciting and dynamic activity.

4. Simulations: A simulated public hearing on a locally relevant environmental/agricultural issue, with students adopting opposing viewpoint roles, provides a dynamic, integrative activity. Agricultural, environmental, social, political, economic, and even ethical issues arise allowing students to discover how interrelated these issues actually are. The key to success with any simulation is to have students apply real information to a simulated problem.

5. Interpretive displays and programs: Modeled after activities typical of environmental education centers, the concept of environmental interpretation has many applications in agricultural education. Students may research, design, and build interpretive displays on virtually any environmental/agricultural concept for use in the school, local environmental education center, fairs, and other appropriate settings. If the school has the resources for one, students might even develop an environmental education center on the school grounds. They can then become environmental interpreters for elementary and middle school programs.

6. Mechanics: Small gas engines play an important part in many forms of environmental management practices. Forest thinning, soil conservation projects, and wildlife habitat management all rely on the use of machinery usually powered with small gas engines. By having students construct various nesting and feeding devices, woodworking and metal working have dynamic applications. Additionally, construction of alternative energy demonstrations (methane digesters, solar water heaters, stream-powered water pumps, and so on) is appropriate through traditional agricultural mechanics techniques.

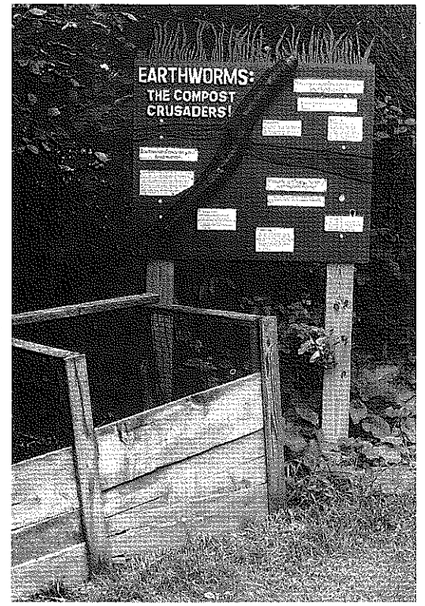
7. Greenhouses: A practice of sustainable agriculture known as "permaculture" incorporates plant and fish production in greenhouses. Contemporary interest in recirculation systems for aquaculture and hydroponics supports this concept.

8. Land Labs and Trails: Dependent upon school facilities, students may become actively involved in designing, developing, using, and maintaining outdoor classrooms, environmental interpretation trails, and demonstration areas. Organic agriculture, composting, plantation management, wildlife habitat management, pond construction, fencing, grazing, and soil conservation methods are some examples of practices which may be developed as demonstration areas.

9. FFA Contests: The national forestry and land judging contests are examples of mutual interest areas between agricultural and environmental education.

In Pennsylvania, state level aquatic resource and wildlife contests add to this collaboration. The Envirothon at county, state, and national levels offers yet another exciting potential for agricultural students to become involved in environmental education.

10. Sustainable Agriculture: Making agriculture sustainable while maintaining maximum yields provides a direct application of environmental concern in agricultural production. Sustainable agriculture is represented by a continuum of alternative practices, from the USDA definition of sustainable agriculture through organic agriculture to Rudolph Steiner's "biodynamic agriculture." Extending this concept of sustainable agriculture into the food distribution system incorporates the philosophy of "community supported agriculture (CSA)." Donahue (1994) demonstrates the application of CSA to environmental education. This application is also appropriate for agricultural education. Whether incorporated into demonstration areas in a land lab, student supervised agricultural experience programs, or practiced on a school farm, sustainable agriculture offers an exciting potential for collaboration between agricultural and environmental education.




*After considerable research, construction of interpretive displays can be tailored to individual student interests and be displayed in multiple settings.*

### Conclusion

Agricultural education has adopted various goals, including education both in and about agriculture. Similarly, environmental education has multiple roles involving both learning about the environment and how humans impact the environment. The issues of sustainability discussed by Brown (1994) and others involve pop-

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ulation, food production and distribution, environmental degradation, and industrialization.

Environmental education has been actively involved in teaching students about this wide array of topics for decades. Existing as separate entities in our educational system, agricultural and environmental education fail to address sustainability separately. Incorporating some environmental education activities into an agricultural education program does not make an environmentalized program. A new philosophy of education for sustainability, as detailed in Orr (1992), requires a collaboration between all existing disciplines, especially agricultural and environmental education. As agricultural education evolves, teaching both in and about agriculture must begin to recognize the global context our agricultural system exists within.

**Teacher Resources**
**Resources on environmental education include:**

*Aquatic Project Wild Activity Guide.* Western Regional Environmental Education Council, P.O. Box 18060, Boulder, CO 80308-8060, (303) 444-2390.

*Catalog of Information Products on Environmental Science & Methods.* U.S. Government Printing Office, Supt. of Documents, Washington, D.C. 20402.

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***Project Learning Tree: Supplementary Activity Guide for Grades 7-12.*** **American Forest Foundation,** 1250 **Connecticut Ave., NW, Suite 320, Washington, D.C.** 20036.

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*State of the World 1994* (plus many other manuscripts on diverse agricultural and environmental issues). **1776** Massachusetts Ave., NW, Washington, D.C. 20036-1904, (202) 296-7365.

*World Resources; People and the Environment* (plus many other teaching materials). World Resources Institute Publications, P.O. Box 4852, Hampden Station, Baltimore, MD 21211, (800) 822-0504.

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## About the Cover. . .

Susan Hammond (student teacher) is showing pre-school students a Native American puppet. This puppet is part of the "Earth Keepers" curriculum program for elementary students. Suzanne student-taught at a comprehensive agricultural high school and at Tayamentasuchta, an environmental center in Waynesboro, Pennsylvania.
(Photo by Thomas Bruening.)





# Environmental Science Teaching Materials


BY BRYAN L. GARTON & ROBERT J. BIRKENHOLZ

*Dr. Garton (top) is assistant professor and Dr. Birkenholz is associate professor and program chair of agricultural education at the University of Missouri, Columbia.*


The environment and its protection has been referred to as a major issue in the 1990s. Americans have become increasingly conscious and concerned for the conservation of our environment (Heimlich, 1992). Increasing numbers of people have become aware of the limitations of our natural resource base and the long-term implications of environmental deterioration (Trisler, 1993). Furthermore, one state Senate has passed legislation for the establishment of a comprehensive environmental education program that includes the development of environmental curricula (Water Impacts, 1994).

Agriculture has not been immune to environmental concerns. The agricultural industry directly affects and is affected by the environment through the use of natural resources in the production of food and fiber. Consequently, almost on a daily basis the media alleges misuse of our natural resources by agricultural enterprises.

While there are instances of environmental wrong-doing, corporate America and the agricultural industry have a vested interest in the conservation of the environment and are becoming more proactive in addressing concerns about the environment. Persons employed in agriculture should develop a full appreciation for the interrelationship between agriculture and the environment. They should also employ a sense of stewardship reflecting a positive attitude toward maintenance of the natural resource base for future generations.

The interests of future generations will best be served by conscientious members of the present generation. Production policies and practices should reflect the long-term goal of environmental conservation, as opposed to the short-term goal of economic gain. Although economic viability is an important factor in the decision-making process of any business enterprise, for the security of our nation, and indeed our world, economic gain must be balanced with the objective of environmental conservation and preservation. Americans should be encouraged to develop: (a) a broad knowledge of the interrelationships between agriculture and the environment; (b) an attitude of environmental conservation in conjunction with


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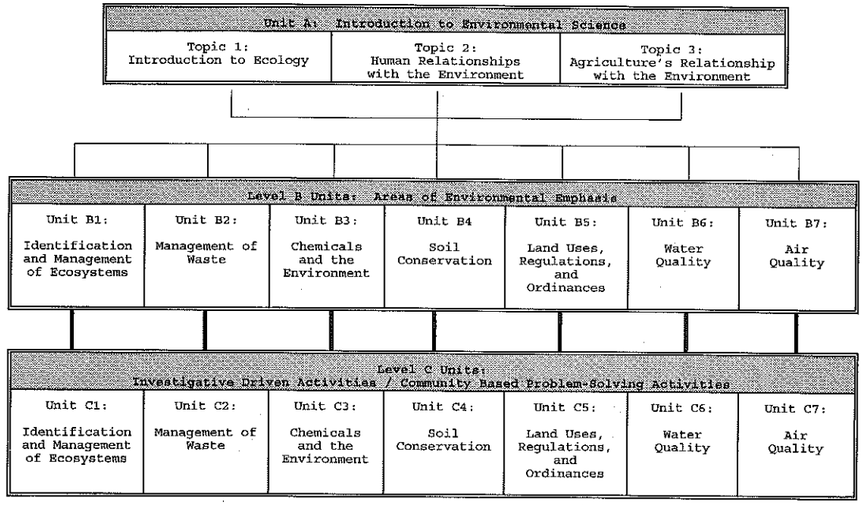
Figure 1.

ENVIRONMENTAL SCIENCE TEACHING MATERIALS



acceptable food and fiber production policies and practices; and (c) personal habits which conserve the use of natural resources in the United States and other countries.

Specific attention should be directed toward the development of an environmental consciousness among all citizens. As we increase our recognition of the growing interdependence among different regions and countries of the world, we should also acknowledge the "environmental overlap" which occurs among nations in a given geographic area. Global residents of the future should be prepared to address complex environmental issues. They should also be cognizant of the environmental influence on world neighbors now and in the future. In consideration of these issues the National Council for Agricultural Education has funded a project to develop a set of instructional materials to assist agriculture and science instructors in teaching about environmental science.

### Purpose of the Project

The purpose of the Applied Environmental Science project is to develop a set of instructional materials to assist teachers who seek to enhance the environmental consciousness of their students. The primary audience for the materials consists of students enrolled in courses taught by the nearly 12,000 secondary agricultural education and natural resource teachers in the United States. In addition, secondary and middle school science teachers will be encouraged to use the materials with their students.

The teaching materials are designed to be used: (a) to supplement existing instruction in agricultural education and natural resources courses; (b) as independent units of instruction on environmental concerns and issues in agricultural education, natural resources, and science courses; and (c) as practical, hands-on activities and experiments to enliven the educational experience for students and teachers. As a result of teaching the Applied Environmental Science materials, students should be able to:

1. explain the significance of environmental issues;
2. specify recommended practices for the conservation of the environment;
3. identify the basis for practices related to the environment which may appear to be controversial;
4. analyze and evaluate environmental issues; and
5. identify and develop plans to address local environmental issues.

### Development of the Project

A national task force consisting of agriculture teachers, science teachers, teacher educators, and business/industry representatives met in St. Louis in July of 1993 to begin the process of developing the structure and delineating the content of the Applied Environmental Science instructional materials. During the succeeding months, a working document and conceptual model (see Figure 1) were produced to guide the development of the project. The plans are for the Applied Environmental Science instructional materials to consist of an introductory unit (Unit A) and seven additional units (each consisting of two levels, B and C) in specified areas of environmental science.

The objective of Unit A, "Introduction to Environmental Science," is to introduce students to the concepts of environmental science, encourage students to be conscious and concerned about the environment in which we live, recognize the need to conserve our environment and its resources, and begin to understand the interrelationships between agriculture and the environment. The introductory unit is comprised of a total of nine instructional plans in three topic areas.

Each instructional plan will include desired student outcomes, study questions, a content outline, possible teaching procedures, student activities, and a sample evaluation. The three topic areas are: Introduction to Ecology; Human Relationships with the Environment; and Agriculture's Relationship with the Environment. Unit A can be taught as an independent unit or be followed with one or more of the level B and C units. The nine instructional plans were field tested during the fall of 1994 by selected secondary agriculture and science teachers across the country.

The level B units are currently under development and are being structured to encourage students to investigate seven environmental areas. The seven environmental areas are: Identification and Management of Ecosystems; Management of Waste; Chemicals and the Environment; Soil Conservation; Land Uses, Regulations, and Ordinances; Water Quality; and Air Quality.

The level B units will consist of instructional plans similar to the Unit A instructional plans; however, more student activities are being included. The student activities are being developed as independent activities that will allow teachers to use them separately from the instructional plans. The level B units will be field tested by secondary agriculture and science teachers during the fall of 1995.

The level C units will be structured as student investigations and will involve community-based, problem solving activities. Instruction will focus on identifying factors that affect the local environment and an analysis of what students can do to become better stewards of their

→ *(continued on page 21 )*





# The Crossword Puzzle as a Teaching Examination Tool

BY GLENDA BORCHER, JOHN HALLMAN, AND EDD CLEMENS

*Ms. Borcher and Mr. Hallman are former graduate students in animal science and Dr. Clemens is professor of animal and veterinary sciences at the University of Nebraska, Lincoln.*

The following is a descriptive study, initially intended for the sole purpose of assessing for our own interest the value of using a crossword puzzle as an examination tool. The decision to publish this information came as an afterthought when it was learned that similar studies had not been published.

The crossword puzzle, although not a traditional tool for examination, may possess some unique qualities. It would appear as though students, and instructors alike, are challenged by crossword puzzles and may pursue answers to questions beyond the scope of their available knowledge. It might further be assumed that information about the length of the word and the presentation of one or more letters from words that intersect the answer provide incentives to attempt questions that may otherwise go unanswered. Students are also aware of the importance of accurate spelling when solving crossword puzzles. In addition, from responses derived from this study and from previous use of the crossword puzzle in exams, crossword puzzles are often viewed more favorably than are the more traditional methods of examination.

### Procedures

The objective of this study was to compare student's success on exams presented as crossword puzzles (XWP) versus the more traditional fill-in-the-blank (FIB) exam format. In addition, attempts were made to determine the reason(s) for incorrect answers (i.e., misspelled word, wrong word, or no attempt at answering the question) relative to each exam format. Two studies were conducted.

Study one involved 107 undergraduate students enrolled in an introductory animal science course. These students were given an hour-exam consisting of five parts, two of which pertained to the XWP study. For this, approximately half (54 students) received an exam in which part A consisted of 22 questions presented as a XWP, and part B consisted of 21 questions as FIB. The other half (53 students) received an exam containing the exact same questions; however, for these students, part A was presented in the FIB format and part B as a XWP. Thus, each student received questions in both the XWP and FIB exam format. The remaining three parts of the exam were identical for both groups. However, each student was give the option of completing any four of the five parts of the exam. A record of students not electing to do the XWP or FIB was kept.

For the purpose of this study the XWP and FIB were scored as to: (a) percent correct answers and (b) percent incorrect answers. Furthermore, the incorrect answers were identified as to: (c) incorrect spelling, (d) wrong word, or (e) no attempt at answering the question. Note: the students were not graded on or informed of the assessments made for misspelling, wrong word, or no answer. Statistical comparisons were made between exam formats using a completely randomized design (SAS, 1986).

Study two involved 41 undergraduate students enrolled in an upper level animal science anatomy/physiology course. The study was conducted within the laboratory section of the course throughout the semester with each student receiving eight laboratory exams. For each weekly laboratory, approximately half the students received exam questions in the form of a XWP, while the other half received the same questions as FIB. Weekly exam formats were randomly distributed.

To further inform us of the value of the XWP as a teaching/learning instrument and to assist the students in preparation for each weekly exam, XWP study guides were given to approximately half the students the week prior to the exam. Students receiving the study guide, or no study guide, were randomly selected such that approximately half of each of these groups received the subsequent weekly exam in the XWP or FIB format.

Each exam was scored according to the methods presented in study one.

### Results and Discussion

Students receiving the exam in the form of a XWP had significantly more correct answers than those receiving the same exam questions presented as FIB (Table 1). The study further indicated that less than three percent of the questions were answered incorrectly as the result of misspelled words, with differences not being detected between exam format. However, statistical differences were observed for exam format for the frequency of wrong answers due to the use of an incorrect word and for no attempt at answering the question. Students receiving the exam in the form of a FIB had a lower percentage of unattempted answers, but were more likely to give the wrong answer than those receiving the XWP.

→

Table 1. Student performance relative to percent correct or incorrect answers on the crossword puzzle versus fill-in-the-blank exam format.

| | | | Reason Answer Incorrect | | |
|---|---|---|---|---|---|
| | Correct Answer | Incorrect Answer | Misspelled | Wrong word | No attempt |
| Study One | | | | | |
| Crossword puzzle (n=84) | 78.6* (1.9) | 21.3* (1.9) | 1.2* (1.6) | 7.8* (1.6) | 11.4* (1.5) |
| Fill in the blank (n=96) | 47.6 (1.8) | 52.2 (1.8) | 0.3 (0.2) | 48.1 (1.5) | 4.1 (1.4) |
| Study Two | | | | | |
| Crossword puzzle (n=160) | 72.1* (5.1) | 27.9* (5.1) | 2.3 (0.8) | 4.7* (1.4) | 20.9* (4.5) |
| Fill in the blank (n=157) | 59.8 (4.1) | 40.2 (4.1) | 1.7 (0.4) | 24.3 (4.1) | 14.2 (2.0) |

Note: Values expressed as mean and standard error. Crossword puzzle values with asterisk (*) are statistically different (P<0.05) from their fill-in-the-blank counterpart.

Student performance on the weekly exams was consistently better throughout the semester when the exam was presented as a XWP. Furthermore, students tended to improve their success rate (percent correct answers) with the repeated exam format (i.e., exams 2, 3, and 4), whether the exam was presented in the form of a XWP or FIB. However, while the percent correct answers for FIB remained below that of the XWP throughout the semester, students receiving the FIB format tended to improve their mean score to a greater extent than when receiving the XWP (i.e., 16.4 versus 5.7 percentage units over the four-exam period, respectively).

Students given a XWP as a study guide to assist them in preparing for the next week's exam had a mean percent correct score slightly better than those not given the study guide (70.6% versus 65.9%, respectively). The reasons for incorrect answers were not markedly different between those receiving the study guide and those who did not (i.e., misspelled words, 1.4 vs. 2.1; wrong answer, 17.2 vs. 18.4; and no attempt, 10.8 vs. 13.6, respectively).

A number of different instruments is typically used to assist students in the learning process and to assess their level of understanding of subject matter. While homework assignments, quizzes, term papers, group projects, class participation and oral reports are all commonly used, a major part of the students' grades is based on exams (Deiter & Pierce, 1991). Unfortunately, most exams are not viewed with favor by the student. The results of the present study suggest that students taking exams in the XWP format are significantly more successful at deriving the correct answer. The study further suggests the reasons for incorrect answers relative to each format. Misspelled words were not a major source of error with either format. However, students taking the exam as FIB are five to six times more likely to give the wrong answer, than are students of the XWP. However, students taking the exam as FIB are more willing to attempt the answer.

One might conclude that several features of the XWP enhance student success at deriving the correct answers. Such features as knowing the size of the word gives direction as to the possible correct answer. In addition, after determining the correct answer to one segment of the XWP, the student is given insight as to another correct answer via intersecting letters from previous answers. The end result is more incentive to pursue the answer, resulting in more correct answers. However, if the student has no clue as to the possible answer, knowing the size of the word and/or specific letters within the word apparently did not encourage, and may have discouraged, the attempted answer. This was evident by the increased number of unattempted answers with the XWP format. Also, in the introductory course, 23 of the 107 students chose not to do the XWP, compared to 11 who elected not to do the FIB.

It might be concluded that the XWP can be →



effectively used as a teaching/learning instrument. This may be a result of many factors, including clues given by knowing the size of the word and/or by intersecting answers. Furthermore, the XWP format allows students to rely on a combination of verbal, visual and kinesthetic skills to recall answers, while the FIB relies on verbal memory alone (Minninger, 1984; Banset, 1993). It is suggested that kinesthetic memory associated with the horizontal or vertical placement of words and the act of entering letters one square at a time may help in triggering the recall process. A report on student temperament/learning style and the use of the XWP has been published (Hallman, et al., 1992).

Throughout the course of the semester several students indicated that they enjoyed the challenge the XWP exams provided them. Thus, because the students found this exam format more enjoyable, they may well have experienced less test anxiety (Tryon, 1980) and greater success. Furthermore, several of these students actively pursued receiving, and possibly sharing, the XWP take-home study guide as a means of improving their exam scores. The obvious lack of control in the distribution and use of these XWP study guides leads to the difficulties in assessing their value.

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## *Environmental Science...*

*(continued from page 18)*

environment. Teachers will be provided with activities that will enable them to lead students through an analysis and evaluation of local environmental issues. In addition, students will be presented with environmental problems from their local communities and encouraged to develop possible solutions to the problems.

### Dissemination of the Project

After the instructional materials have been developed and field tested, a "train the trainer" workshop will be conducted. Workshop participants will be expected to network with teachers in their respective states and conduct teacher workshops on the effective use of the instructional materials. In addition, agriculture/natural resources teachers will be encouraged to network with biology and earth science teachers in using the instructional materials, therefore expanding the potential impact of the project.

The environment and concerns over its conservation are major issues facing citizens about to enter the 21st century. Individuals, organizations, corporations, and government agencies are calling for educational programs to increase awareness and knowledge of the environment and the conservation of its resources. It is the intent of the agricultural education profession, through the Applied Environmental Science Instructional Materials project, to provide materials to help teach students about the environment as we enter the 21st century.

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# Using Problem Solving Teaching

BY BRYAN L. GARTON

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## Teaching Using The Forked-Road Problem

Agriculture students, and students in general, need to learn decision making and problem solving skills to effectively live and work in our changing society. Crunkilton (1988) stressed this importance by stating that it is more critical today for students to learn problem solving skills than it has been in the past.

Teaching students using a problem solving approach is not a new concept to agricultural education. However, from time to time there is a need to discuss, evaluate, and recommit ourselves to using problem solving as a way of teaching. The purpose of this article is to discuss one of the most widely used problem solving techniques.

Stewart (1959), and more recently Hedges (1991), concluded that teaching using problem solving should be no different than the manner in which we solve problems and make decisions in our daily lives. Therefore, the way in which we teach students to make decisions and solve problems should model the decision making skills used in everyday life.

Have you ever made a decision in which you had to choose between two alternative courses of action? What about making the decision to purchase an IBM or Macintosh computer system for your home or school? Agriculture teachers through the years have classified this type of problem or decision as a Forked-Road problem.

For years teachers have used the Forked-Road problem solving technique in their teaching. Examples include teaching students to select the appropriate welding electrode; to decide between using artificial insemination or natural breeding in a cattle herd; to select the type of grass to grow for a lawn; to select a construction project, to select between different livestock or crop enterprises; to select the best company for supplies; and to determine which FFA project the chapter should undertake. The examples that could be listed are unlimited. However, the main criterion in a problem of this nature is that students have two alternatives to choose from in solving the problem.

In guiding students in solving a Forked-Road problem, the teacher must first lead students to a clear definition of the problem. In addition, the teacher and students should identify the two alternative solutions to the problem (see diagram of Forked-Road chart).

After the problem is clearly defined and the two alternative solutions have been selected, the "factors to consider" in choosing between the two alternatives need to be identified. In making decisions, managerial or otherwise, certain factors must be considered to make the decision. These factors should be identified with the help of students. Students may need time to gather and use resources in identifying these factors.

After identifying the "factors to consider," the facts and relevant information for each factor should be identified. This process is usually completed using the supervised study teaching method. It is during this process that students are actively using resources to seek the necessary data and information to make the decision (solve the problem) between the two alternative solutions.

In the final step, students should be guided in analyzing and evaluating the facts and related information to come to a conclusion to the problem. Based on the analysis and evaluation of the information collected, students should select the best possible choice between the two alternative solutions. While situations of students and the decisions to make (problems to solve) will differ, the procedures for selecting the most appropriate course of action can be transferred to similar situations and other topics.

The Forked-Road problem solving technique is not a new idea. It has been used by teachers as a teaching tool and by individuals in everyday life for years. One of our goals as agriculture teachers should be to teach students how to think, learn, and make decisions. The Forked-Road problem is but one of many tools in our teaching methodology toolbox that can assist us in achieving that goal.

→

**Forked Road**
Problem-Solving Technique

| **Define the problem:** | | |
|---|---|---|
| **Factors to Consider** | **Choice One** | **Choice Two** |
| | | |
| | | |
| **Decision/Recommendation:** | | |

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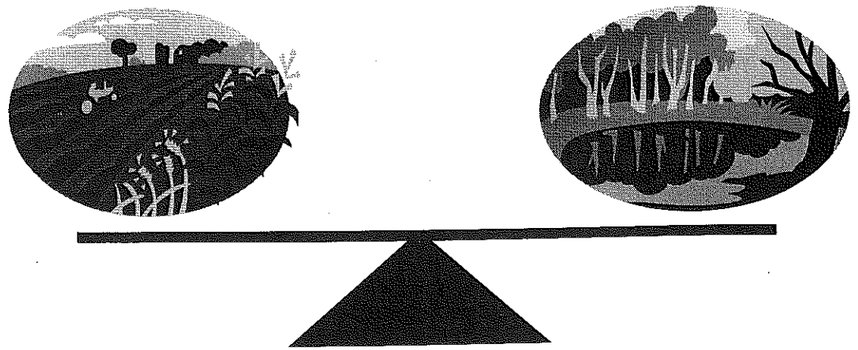
## Teaching Agriculture...

*(continued from page 4)*

fall and then made a number of passes over this same field in the spring because more corn could be produced per acre. Only a few still make this mistake. This process is too costly, not only because of fuel and time, but also because of the destruction to the water systems of this country. We are continually learning how to do a better job of producing food in a more appropriate way. Therein lies the opportunity for our students. America's farmers are doing a better job of producing food in a more sustainable way. Does this mean that we sacrifice a crop because of a severe pest infestation? No, of course it doesn't. Our students need to understand the difference between measured, step-by-step approaches to resolving our environmental problems and economic suicide. We need to view environmental education on a continuum. Today it is nearly impossible to pick up a farm magazine without seeing articles, advertisements, editorials, and farmers writing about a better environmental approach to production agriculture. This was not true five or ten years ago. Educators are making a difference! Ultimately, our students need to understand that agriculture and the environment are not two separate issues, but they are one in the same. In order to do a good job of producing food and fiber, collectively we all need to do a good job protecting the environment for ourselves and future generations. ■



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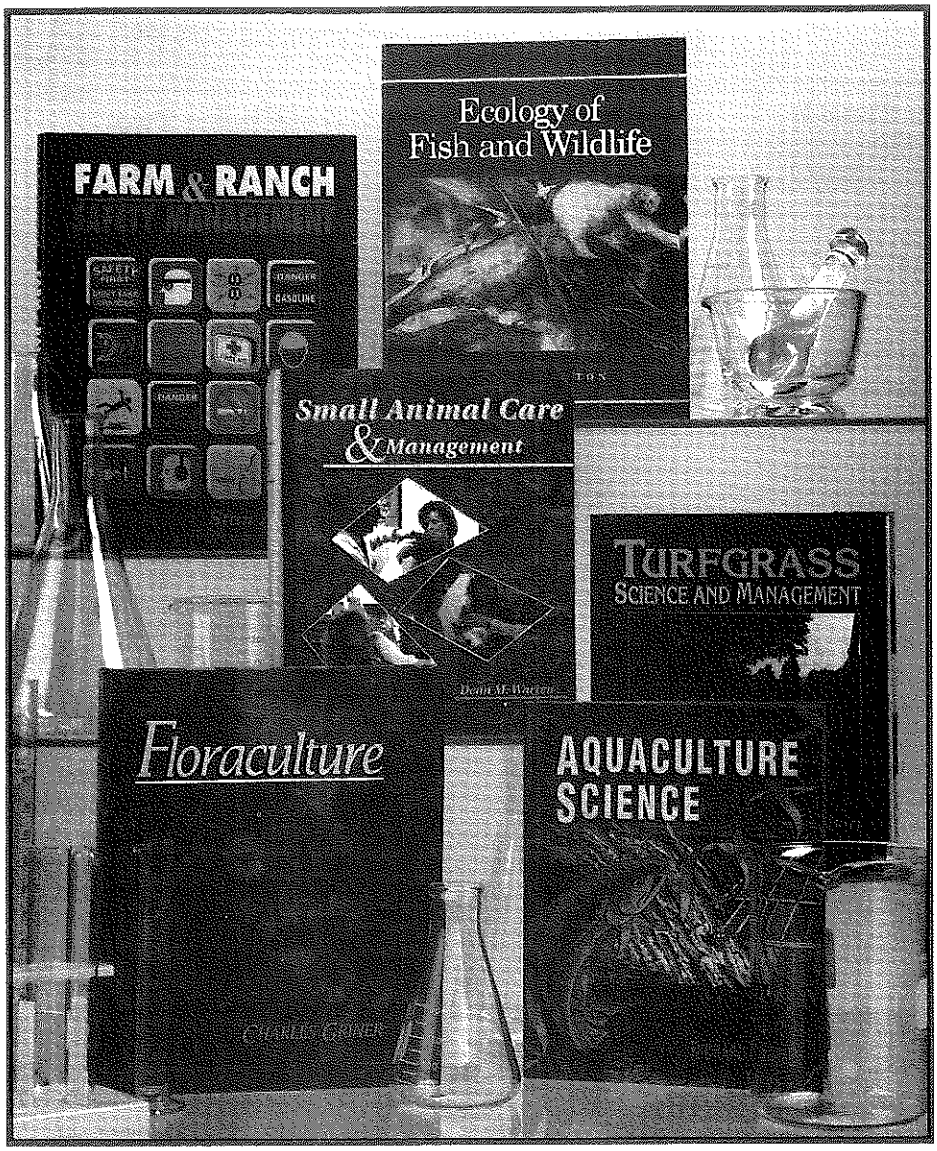


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