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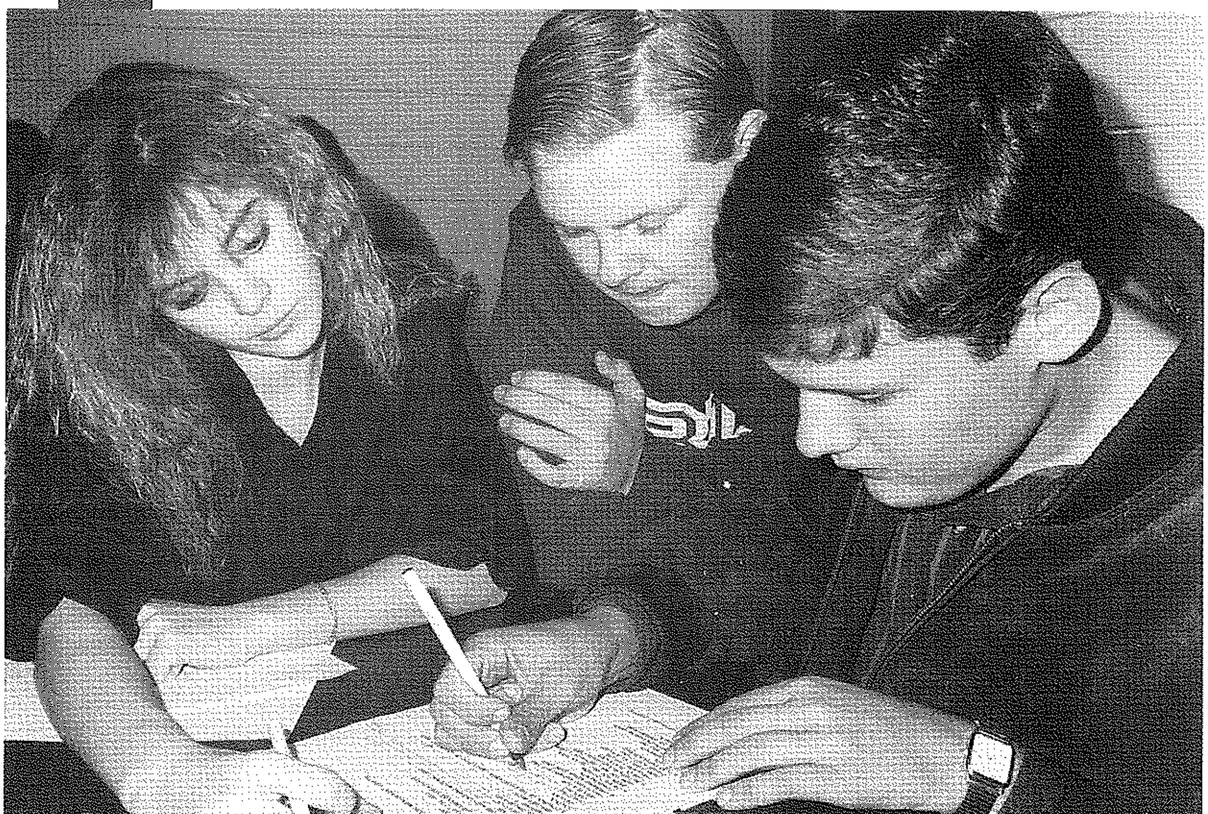

Innovative Curricula

Specialized Programs
Elementary Agriscience Curricula
Ties to the Community

THE
AGRICULTURAL EDUCATION
MAGAZINE

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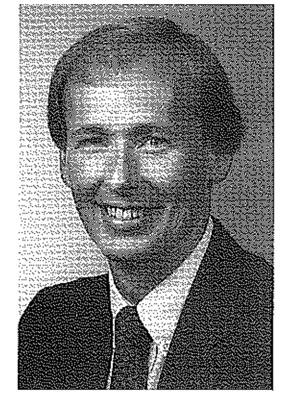
Locating Yourself on the Map



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

Since 1988 there has been a flurry of curriculum development activity in agricultural education. The agriculture curriculum in a secondary school of today could conceivably be drastically different from that of the late 1980s. Curriculum materials in agriscience, aquaculture, financial management, food science, marketing, international agriculture, and other areas have given teachers excellent new resources for updating and improving what they teach. Whereas the problem five years ago may have been a lack of innovative curriculum materials, today's teachers have more good materials than they can probably incorporate into their curricula. Many of these materials are truly innovative—they suggest new ways of teaching agriculture, from both a content and process standpoint.

So how do teachers decide whether or not they should incorporate innovative curricula into their instructional programs? A few guidelines, as suggested by the following questions, are in order.

- Do the innovative curricula complement the needs and interests of my students?
- What impact would the innovation have on my program?
- Are the new curricula compatible with my program objectives? If not, should my program objectives be modified?
- Do the new curricula align with objectives and activities in the specific courses that comprise my program? If not, should these objectives and activities be modified?
- Do I have the facilities needed to implement the innovative curriculum? If not, can (how can) they be put in place?
- Do I have the technical expertise to teach the innovative curriculum? If not, how can I acquire it?

Like any innovation, there are those who grab the new product almost as soon as it becomes available. Then there is a large group that gradually begins to use the innovation after a more thoughtful and delayed review. Finally, there are those who lag far behind, although they may eventually use the innovation. For example, I'll have to admit that we just bought our CD player this past Christmas, long after this technology was introduced. And my wife bought it, not me. (I'm not generally a quick adopter, in case you weren't sure.) Within these large groups, adoption of any innovation occurs in incremental stages. Each increment is, in turn, associated with a unique set of concerns held by the adopter (teacher). We can map out this adoption process and the stages of concern that teachers are experiencing. Locating yourself on this map can tell you and others much about what you need before you are likely to more fully implement an innovative curriculum.

"Adoption" is a relative term in the eyes of many. However, educators need to view adoption in terms of how the innovative curriculum was designed by its developers. For example, was the curriculum designed as a new course in itself or to supplement existing course materials and activities? Stopping short of full adoption as intended by the curriculum developers probably means that the full benefits of the innovation will not be realized. This is not to say that innovative curricula cannot be adjusted or modified to better suit a given situation. Rather, the focus needs to be on whether or not the key features and intents of the innovation have been adopted.

As teachers gradually move through the process of adopting innovative curricula, different concerns arise. These concerns are a good indication of where teachers are in the change process. According to Hall and Hord (1987), these concerns follow a predictable pattern as teachers move further into the change process. These researchers identified seven Stages of Concerns (SoC) that describe this process. They include:

Stage 0. Awareness of the innovation, but with little concern or involvement.

Stage 1. Informational, where teachers are generally aware of the innovative curriculum and desire to learn more about it.

Stage 2. Personal concern about the demands of the innovation, my role in implementation, and whether I can adequately perform my role.

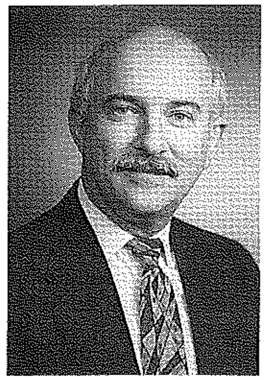
Stage 3. Management of the innovation with respect to organization, scheduling, efficiency, and time demands.

Stage 4. Consequences, as evidenced by the impact of the innovative curriculum on students.

Stage 5. Collaboration with others regarding

(continued on page 5)

Risking the Future



By David M. Coffey,
Theme Editor
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"Declining enrollment." "Costs too much." "Students from the 'city' who don't even know the color of a Hereford cow." "Not trained for teaching that." "Scheduling conflicts." "FFA contests." "SAE." "No textbook, lesson plans or materials." "Tech Prep will not work here." "Those teachers over in that other part of the building are in their own world." "The administrator says the facilities are under utilized." "The counselor really doesn't understand (or want to understand) our program." These are statements that are often heard when one discusses current deterrents to change in agricultural education.

Are you willing to change your program, or are you still riding the old talk-and-pontificate merry-go-round? Can you count the number of "Where are we going?" speeches you have tolerated, only to realize that you haven't gone anywhere? Does anything ever stay the same in education? Who would have thought that the Venn diagrams describing the balance of SAE, instruction and FFA are still applicable as we approach the 21st century? While the diagrams may have physically remained the same, change in the components has been significant. Agricultural education has changed from the initial need to train boys to become farmers, with the Smith-Hughes Act providing a basic framework for implementing curriculum that was community based. As population dynamics changed, curriculum changed to meet those changing times. Major innovations in agriculture, including hybrid corn, pesticides, fertilizers, oil seed crops and welding for farm machinery repair, reflected those curricular changes and were incorporated into the agriculture curriculum. Legislation in the 1960s and '70s broadened the scope of agricultural education to move beyond production agriculture to areas common today. Biotechnology, marketing and globalization have become major areas of emphasis as we teach in and about agriculture.

Educational reform both at state and national levels has stressed the need for integration and sequencing of courses, group problem solving, and practical application of curricula to the "real" world. The School to Work Initiative illustrates the current philosophy of education where educational reform is jobs driven.

Change, according to the Center for Research and Development for Teacher Education at the University of Texas, is "a process, not an event, made by individuals first, then the institution."[1] In his evaluation of the study by Ryan and Gross of the process of change in adopting hybrid corn among Iowa farmers, Everett Rogers identified five general groups according to the amount of the time they take to adopt new ideas. The first group was termed innovators. These change agents are thought of by the general population as "naive or a little crazy, not really integrated into social system, eager to try new ideas, willing to take risks, and open to change."[2] They are not thought of as the leaders of change but rather as those who may be a little different and possibly described as "ahead of their time."

Change in agricultural education usually is a planned, managed and slow process sometimes mandated by legislative involvement or state department guidelines. Perkins' grants, youth apprenticeship, Tech Prep, and career academies are examples of change being mandated through partnerships with industry and education.

While curricular innovations are often the result of hours of discussion after investigating changes in neighboring states, and especially changes in the FFA awards programs, innovators are ahead of the game. While administrative support and approval are necessary, innovators rarely worry about a required course number in state guidelines, their lack of technical training workshops, the lack of a state or national FFA contest(s), or lack of curriculum guides. They may move to other groups or educational organizations to procure supplies and equipment, as well as training. These unique individuals perceive their role as preparing a student for a different workforce than in the past and are willing to experiment with the instructional setting and procedure. They sometimes bypass teacher educators and state department and extension personnel, preferring to go directly to science and industry. They are ahead of the game.

For innovative curriculum in agricultural education to be effective, one must face reality. Student numbers are of utmost importance in deciding on courses to be taught, teachers to be hired or fired, and dollars to come to a school district. Successful innovative curricula must provide a better way to entice students than the current curricula. Again, in many cases, student enrollment numbers are the measurement of success, although some innovators argue that →

students will follow a quality curriculum. All faculty within the department, the school administration, and community members must feel "comfortable" with the situation for the curriculum to survive. Innovative curricula must sometimes be "spoon-fed," piece by piece, by making minor changes in existing facilities, programs, and contests and sharing them with appropriate personnel.

Innovative curricula are the result of countless hours of trial and error by unique individuals. Innovation should reflect the changing job market. Numerous thriving, innovative programs abound with the degree of change in different stages. Innovations may be in the mechanics or greenhouse laboratory, with group problem solving skills required on projects, or in presenting materials to include activities where students are actively involved in decision making, rather than taking notes for a true-false test. Certain programs have renovated and innovated at the same time by removing all mechanical equipment and utilizing the existing laboratory space for technology centers or modular stations to teach principles in agricultural science and technology. Most students are nonfarm oriented and think like consumers. Innovative curricula emphasize issues related to sustainable agriculture, globalization and marketing, maximizing profits, food quality, animal welfare and the environment. Industry is collaborating with departments to assist in skills training. Contests have been redesigned to stress both "hands-on" and "brains-on" activities in both individual and group performance. SAE has been broadened to include recognition for hours, as well as dollars, in areas beyond the traditional production project. Some departments which have been threatened with closure due to low student numbers are adding teachers. Collaboration with science, math, social science, and language arts teachers is beginning to break down walls of isolation as interdisciplinary, thematic units are planned and presented to make learning more relevant. Agricultural education instructors are utilizing professional organizations and curriculum materials to discover assistance awaiting in other disciplines. Community resources are being utilized in classrooms in a variety of non-traditional ways. Workshops are being sponsored by NVATA and the National FFA Foundation to provide incentives for change.

By utilizing changes made by those who dared to try something different, innovation in agricultural education curricula continues. Regardless of the type of innovation, curriculum planners and incorporators must focus on students as the ultimate benefactors. Change may come slow to the entire profession; however, persons involved in innovative curricula will always be taking risks. Are you willing to become an innovator in agricultural education curriculum? If not, please follow those innovators who lead the way.

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[1]Center for Research and Development for Teacher Education. (1992). Learning from the game: Assumptions of the concerns based adoption model (CBAM). Austin: CBAM Project.

[2]Rogers, Everett M. (1983). Diffusion of innovations. New York: Free Press. ■

Locating Yourself . . .

(continued from page 3)

use of the innovative curriculum.

Stage 6. Refocusing the innovation, with possible changes or alternatives identified.

Teachers will typically have concerns in a number of the stages at any given time. For example, in a recent study of Illinois agriculture teachers, Petrea and Osborne (1994) found that teachers' greatest concerns dealt with their personal involvement with the innovative curriculum (BSAA) and the impact of the curriculum on their students and program. Given the needed technical assistance at the appropriate times, teachers should gradually move from the lower to the higher stages of concern (Stages 5 and 6) over time. However, the time required for teachers to reach these higher SoC varies from teacher to teacher.

By being aware of your concerns about implementing a curriculum innovation, you may be better able to identify the roadblocks that must be dismantled before you can move further along in the change process. Our goal should be to fully implement innovative curricula, or consciously follow an alternate path of change. Although curriculum workshops for teachers are group-based, change is an individual process. Our profession must be concerned with that rate of change—the rate at which and the extent to which innovative curricula are adopted. As a profession, we are probably still in the early stages of modern curriculum change, but the results are promising. We must identify ourselves along this road map of change and the continue to focus toward fuller implementation of the many innovative curricula available today in agricultural education.

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Petrea, R.E. & Osborne, E.W. (February, 1994). An assessment of the stages of concern of teachers using the science applications in agriculture courses. Paper presented at the Central Region Agricultural Education Research Conference, St. Louis, MO. ■

Breaking Tradition-Innovation Through Small Animal Technology

BY KRISTA PAYNTON

Ms. Paynton is an animal science instructor at Bristol County Agricultural High School, Dighton, MA.

What do rats, rabbits, dogs and fish have in common? Everything, when you are a student at Bristol County Agricultural High School in Massachusetts, maybe even more if you are a faculty member who has been faced with declining enrollment and threats of closing the department.

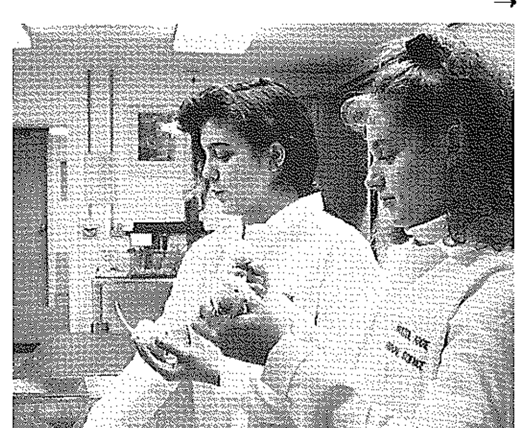
These animals and many other species are all part of the Laboratory Animal Technician Training Program within the Animal Science Department. Bristol County Agricultural High School is a state-approved secondary vocational school specializing in training for agriculture and related occupations. The 230-acre campus is located in southeastern Massachusetts and was established by legislation in 1912. Students from within the county, which includes 22 cities and towns, may apply for admission to the school. While the area is considered rural, few students are farm or production oriented. Major biotechnological and research industries have replaced the manufacturing base.

During the late 1980s, Bristol Aggie and the Animal Science Department were challenged with a variety of issues. Student enrollment had hit an all-time low of less than 200 students. Additionally, declining large animal production within the community and county budget problems threatened the school with closure. With these issues and our jobs at stake, instructors began assessing the current job opportunities at local hospitals, universities, and research companies. After the assessment was made and analyzed, time was spent developing a curriculum based on technologies relating to small animals. As a result, an innovative Laboratory Animal Technician Training Program began.

Initially, funding was limited for the program. Initiating the program involved many "friends" of the department donating surplus caging, equipment, and animals. The student response was impressive; enrollment in the Animal Science Department nearly doubled. In 1989 a pilot program emphasizing laboratory animal management was housed in a small room in the Poultry Science Center at the "Aggie." In 1990 the Poultry Science Department was closed and the Animal Science Department gained all of its buildings, including the Poultry Science Center, a modern 10,000 square foot building with two classrooms. Cooperation with instructors in the Carpentry Department resulted in the conversion of the former hen laying pens into a rabbit room, washroom, cage storage, laboratory animal room, pet shop, grooming room, and an aviary. Animal science students were excited to be involved in designing and planning the new facility.

At the beginning of this project, staff consisted of two full-time animal science teachers and an enrollment of approximately 20 majors (large animal production) in both the junior and senior years. Currently the department has four full-time animal science teachers and a full-time riding instructor with nearly 70 juniors and seniors majoring in Animal Science. The Laboratory Animal Program started a domino effect within the department and the community. The department has been able to equip and expand its offerings with the help of Perkins grants and donations from a variety of institutions and corporations.

The curriculum within the department offers students the opportunity to explore and receive in-depth training in laboratory animal management, pet shop management, pet grooming, equine management, equitation, dairy, and livestock management. The Laboratory Animal Technician Program started on a small scale and emphasized proper husbandry, handling, and restraint of a variety of animals. The curriculum has expanded to include topics such as aseptic technique, introductory cell culture, and laboratory animal facility design. Through the years the curriculum has been supplemented with many excellent teaching resources outside of traditional agriculture. (A list of some of these is included at the end of this article.) Essential is the need to retrain ourselves about the current advances and controversial issues →



Junior laboratory animal management majors sexing a litter of newly weaned rats.

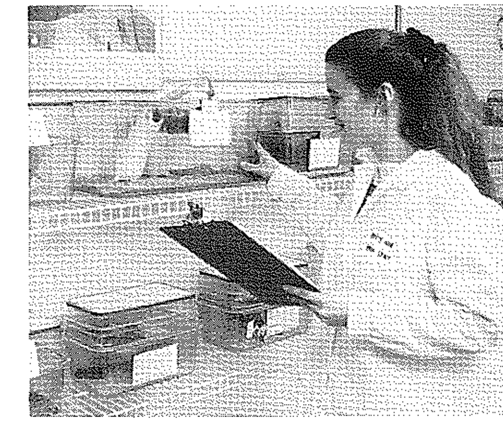
within animal science, including animal welfare vs. animal rights, transgenic animal production, and bio-engineered products from animals. Jobs abound for students who complete the program.

The laboratory animal program has been a tremendous success in many ways. It has provided increased enrollment in the department and job placement for graduates, which is above average for high school graduates. Students having graduated from the program are often sought after by area institutions, including hospitals, universities and private corporations, that are involved in medical research and biotechnology. Other graduates continue their education at various colleges and universities in animal science, cell biology, and wildlife biology.

Networking outside of traditional agricultural venues has proven to be very beneficial. Staff members of the Animal Science Department have joined various organizations, including the national and local branches of the American Association for Laboratory Animal Science (AALAS) and The Massachusetts Society for Medical Research (MSMR). Participation in conferences and classes sponsored by organizations such as The American Medical Association and the Massachusetts Biotechnology Research Institute has opened new avenues for informative field trips, equipment procurement, curriculum materials, and job and internship possibilities.

The future of the Animal Science Department is very bright. The current enrollment for the school is at an all-time high of 340 students. The Animal Science Department continues to attract additional majors every year. The Laboratory Animal Technician program currently has 30 percent more students than guidelines suggest. Demand from more students for fewer spaces than available has become the norm. The need for additional instructors is being discussed. Future planning focuses on new projects within the department, including an aquatic laboratory animal environment for amphibians and reptiles, expansion of housing for rodents, and development of a database for the entire facility.

The success of our program and the turnaround of our school's dire situation was the result of our innovative curriculum developed by assessing the area's agricultural opportunities and then acting to implement new programs, even with our limited resources. But with the teamwork of a devoted animal science staff focused on these new opportunities, we have always accomplished our goals. The future of the school, the Animal Science Department, and all of our graduates is very bright indeed.



Senior laboratory animal management major updating records in the rodent room.

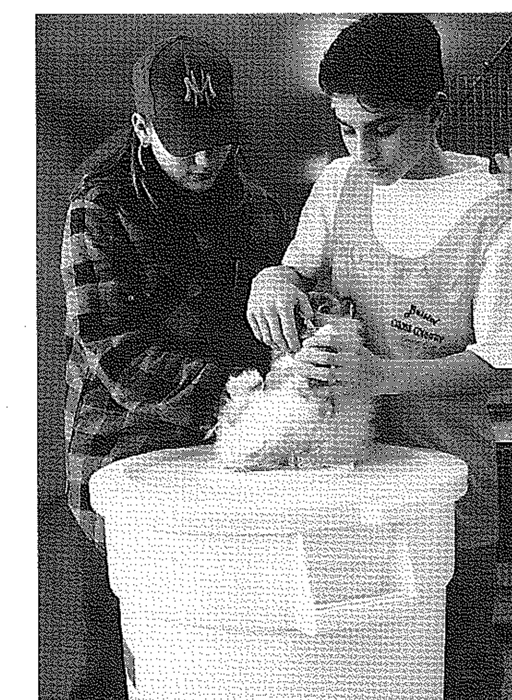
Suggested References for Small Animal Technology

American Medical Association Group on Science and Technology. Medical progress: A miracle at risk. 515 North State Street, Chicago, IL 60610.

Bennet, B. Taylor, D.V.M., Ph.D. Scientific editor, and Nancy Addcox, M.B.A., editors. Instructional guide for technician training: Assistant laboratory animal technician and laboratory animal technician. 700 Timber Creek Drive Suite 5, Cordova, TN 38018. (901) 754-8620

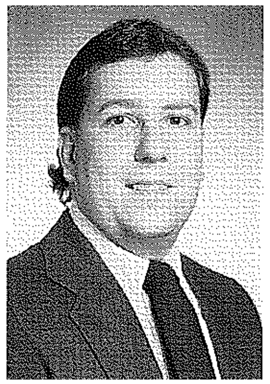
People and animals: United for health—A comprehensive curriculum on biomedical science. Developed and produced by the Massachusetts Society for Medical Research, 1440 Main Street, Waltham, MA 02154-1649. (617) 891-4544 FAX: (617) 893-7934

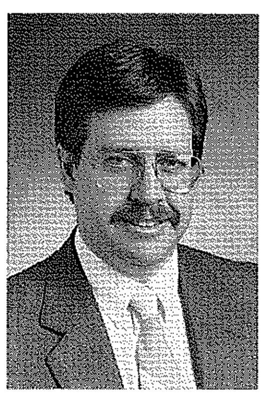
Science for life: Exploring animal models in basic research. An instructional curriculum developed by the Department of Biological Science at Florida State University. For information contact: Kevin Vidergar, 237 Conradi Building, Department of Biological Science, Florida State University, Tallahassee, FL 23306-2043 (904) 644-1142 ■



Sophomore small animal science majors clipping nails for rabbits.

A Sustainable Farm Plan Activity





BY GEORGE R. VEHOVIAK, PHYLLIS F. ADAMS, & THOMAS H. BRUENING

Mr. Vehoviak is an instructor in agricultural and extension education at Penn State. Dr. Adams and Dr. Bruening are associate professors in agricultural and extension education at Penn State.

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).

Agriculture and Population: Pressures on the Planet

Agricultural education is concerned with both education in and about agriculture (NRC, 1988). Paraphrasing Ehrlich and Ehrlich's (1991) quote, feeding an exponentially growing population, catering to luxurious diets, and environmental degradation from certain forms of agriculture have become self-defeating partners in the nonsustainability of the planet. But in the United States the study of such issues has been compartmentalized into specific disciplines. Studying and experiencing agriculture has been the role of agricultural education. Investigating environmental degradation has been the focus of environmental education. And finally, analyzing population, industrialization, development, and sustainability have become major foci of Science, Technology, and Society (STS) programs throughout colleges, universities, and high schools worldwide.

Meanwhile, agricultural education as a discipline of study has operated outside the realm of global sustainability. Its traditional role was to provide agricultural literacy, agricultural science, agricultural production, youth development, and distance education. In light of demands on the whole educational system to provide for the diverse needs of today's "youth at risk," it may seem inappropriate to incorporate yet another philosophy. Education for sustainability, the focus of this article, ultimately addresses the entire nature of today's industrialized society which yields "youth at risk" and industrialized agriculture. It is not easy for industrialized minds, approximately 20 percent of the world's population, to face the costs that our comfortable level of living has had upon indigenous cultures and the environment.

Worldwide soil erosion and salinization, water depletion and contamination, deforestation, and overgrazing symbolize the destruction industrialized agriculture bears on the planet in its effort to feed an exponentially growing world population presently totaling 5.5 billion. Similarly, for a growing number of authors (Brown, 1994; Ehrlich & Ehrlich, 1991; Hawken, 1993; Meadows, Meadows & Randers, 1992; Orr, 1992), the critical issue is how can humankind feed itself while protecting planetary resources. Meadows, Meadows, and Randers (1992) believe we have already pushed certain areas of the planet's capabilities beyond its limits. In their sequel to *Limits to Growth* (1972) titled *Beyond the Limits to Growth*, they comprehensively describe the relationship of planetary systems and population in very simple terms. Within the entire global ecosystem, they describe a three-phase model (Figure 1) which forms the foundation of their thesis (p. 45). Within the biosphere, the "planetary sources" provide the materials, biomass, and energy which are processed through the "economic subsystem." This subsystem is the sum total of all human activity: agriculture, industry, and housing. The wastes produced from the economic subsystem are then absorbed into the "planetary sinks" and wasted heat loss is dispelled into space.

Figure 1 illustrates the basic premise of finite limits to both ends of the continuum, namely the sources and sinks. It is the human economic system, existing between the planetary sources and sinks, which must be based on sustained economic growth. Overall, the model incorporates the impacts of resource extraction, waste disposal, and direct impact of the human economic subsystem on a global scale. At this scale, Meadows, Meadows, and Randers conclude that we are pushing the planet beyond its limits of growth.

The sustainable farm planning activity described in this paper focuses on the sources, use, and sinks involved at a local level in an agricultural setting. It allows students to study sustainable alternatives by planning an organic, sustainable farm. In order for students to plan a sustainable farm, they must understand the concepts of carbon and nitrogen cycles, hydrologic cycles, and biological diversity. A full understanding of these concepts will ultimately lead to more sustainable farm planning methods and a better understanding of sustainable agricultural systems. →

Agricultural Education and Global Sustainability: The Sustainable Farm Plan

Educating for sustainability requires a new approach for education. Rather than breaking education into smaller, more discrete parts, studying issues and ways to satisfy human needs requires a holistic and integrative approach to education. The sustainable farm activity was developed by the author on a foundation of sustainable agriculture and living as described by Berry (1977); Orr (1992); and Meadows, Meadows, and Randers (1992). The goal of the activity is to integrate tenets of sustainability—diversity, organic farming, knowledge of one's place, and sustainable lifestyles—into one activity. This activity plunges students into the process of examining agricultural inputs and outputs, sustainability, and appropriate technology. This approach ultimately leads to an in-depth study of the many facets of agriculture in an integrated, holistic fashion. Too often in the past, students learned only the "parts" of agriculture. Their understanding of agriculture was limited to solving production problems within a very narrow context. The form of agriculture known as sustainable agriculture collectively embodies the tenets of regenerative agriculture (Rodale Institute, 1993) and organic agriculture.

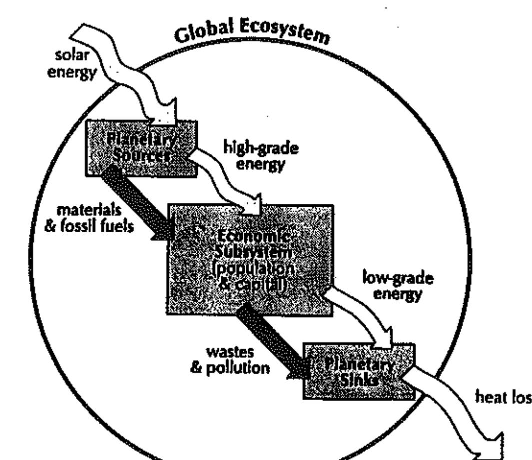


Figure 1. Sources, Human Economic Subsystem, and Sinks in a Global Ecosystem Model. (Source: Meadows, Meadows, & Randers, 1992, p. 45)

Before planning the sustainable farm, students must know and understand the guidelines for achieving sustainability identified by Meadows, Meadows, and Randers (1992). Students would then be able to describe sustainable limits of "through-put" of planetary sources to planetary sinks in the following terms:

1. The rate of use of renewable resources (soil, water, fish, forest, etc.) must be less than or equal to their rate of natural regeneration;

2. Replacement rates of non-renewable energy sources (fossil fuels) with renewable sources (solar, geothermal, wind, etc.) must equal or exceed current use of non-renewable sources;

3. Emission of pollutants and waste must be less than or equal to the rates at which these can be recycled, absorbed, or rendered harmless naturally within the environment (1992, p. 46).

These tenets not only guide the planning of the sustainable farm, but also the analysis of inputs to the farm and the lifestyles of those involved in working the farm.

Students at Penn State work with a local 80-acre farm known as Gettys Ridge Farm and must base their plan on its existing features. After studying the philosophic foundation of sustainability, students visit the farm and are exposed to its capabilities and limitations. They then begin to focus on various sources of information from which the many facets of the sustainable farm plan are derived. Because of the various individual interests and preferred learning styles among members of the class, the farm plan accommodates many types of agricultural interests and ways in which to actually present the plan.

The following information describes the scenario and planning guidelines given to students as they begin their individual research for the final farm plan.

Scenario

Students are a team of private consultants hired to prepare a plan for an 80-acre sustainable agriculture farm. The current yield is solely Christmas trees. However, the Christmas trees present will be cut (or dug) and sold within the next few years. Students are asked to view the farm as an open piece of land. Their plan should closely conform to the following objectives.

Objectives

1. All agriculture practices must be sustainable (i.e., organic).

2. Plants and animals must be used together to form natural organic cycles.

3. Equipment may include small gas engine machines and one small tractor.

4. Existing topographic features, including streams, forests, ponds, and hillsides, must be accounted for in the plan.

5. The farm should provide most of the food (meats, vegetables, fruits) needed for a family of four.

6. Supplementary feed may be brought in from outside sources.

7. Enough livestock, fish, and vegetables may be produced for sale each year to help defray feed and other operating costs.

8. Diversification in production is critical. A →

Sample Research and Planning Elements

Planning Area:	Plan and Presentation Elements:
Vegetables, Fruits, Herbs:	culturing: direct seeding, cuttings, etc. soil preparation cultivation and weed control planting schemes (spacing, rows, companion planting, etc.) when to plant, seed, etc. harvesting storage, preserving
Animals, Grazing:	uses types of animals numbers of each type: carrying capacity of the land housing fencing feeding, grazing
Wildlife	species present habitat management—brush piles, nesting devices, den trees
Integrated Pest Management (IPM):	natural predators (bacteria, birds, insects, etc.) traps
Forest Management:	present stocking rate types of trees—map of stand types silvicultural practices—intermediate cutting sugar maple
	Composting: use of compost
	Carbon:nitrogen ratio contents: sources and amounts of various materials devices to compost in

wide variety of vegetables and fruit is desired.

9. Animals to be considered include dairy, beef, sheep, goats, poultry (meat and eggs), horses and hogs.

10. A greenhouse is desired to house an aquaculture and hydroponics system. Additionally, it may be used to produce bedding plants and vegetable seedlings.

The following highlights possible areas of concern to be researched and presented during the final farm plan presentation. These lists are not exhaustive but serve to roughly guide the work in individual planning areas. During the farm planning class, mutual interest in certain land areas and interrelationships between planning areas will be resolved. Examples of these include cropping and grazing, animal-manure-soil preparation processes, and wildlife, forestry, and pond aquaculture. These interrelationships must be evident throughout the final plan.

Developing the Sustainable Farm Plan

After the first farm visit and studying information on the soils and geology found in the county soil survey, students begin to work at their discretion either individually or in small groups. Sources of information suggested for their use include New Farm Magazine, Mother Earth News Magazine, Organic Gardening Magazine, various texts from the Rodale Research Institute, and the Penn State library. Students are advised their research need not be exhaustive, but rather representative of their topic, integrative, and tied to a given place.

Working with a large map of the farm (scale 1' = 100"), students work cooperatively in locating various practices in relation to soil types and topographic features of the land. Discussions follow on interrelated practices and human involvement on the farm, which forms the bulk of the learning that occurs.

Conclusion

Recognizing that global sustainability begins with local action, ecological literacy about one's particular place is the essence of this activity. Holistic approaches and integrative

(continued on page 13)

Curriculum Integration and Ornamental Horticulture

BY ROBERT W. CLARK
Dr. Clark is assistant administrative director at the Dauphin County Technical School, Harrisburg, PA.

Introduction

From the outside, the Dauphin County Technical School appears to be a traditional 9-12 high school with a traditional curriculum, traditional students, traditional scheduling, and other characteristics associated with a traditional high school setting. But remember, assumptions about a book's cover may not always accurately reveal its contents, and this is no exception! The "cover" of the Dauphin County Technical School looks very traditional, but step inside and you'll discover something radically different.

During a typical day, you might visit, vocational laboratories and observe students' work on projects that extend over a week or more. You could visit a classroom and see horticulture students writing technical reports in English class detailing their poinsettia projects. You may also encounter carpentry students calculating stress capacity of roof trusses using geometrical concepts taught in math class. Should you investigate further, you'll find no conventional academic departments, no conventional vocational departments, and throughout the school, you'll see traditionally isolated academic subject instruction being transformed into a fully integrated instructional approach to teaching. What's going on here? If you think this sounds like a major shift in the belief of what and how students learn during high school, then you're right on target.

Professional Staff and Clustering

Drawing from six school districts in the Harrisburg area, Dauphin County Technical School offers 20 vocational programs and supporting academic programs to over 800 students in grades 9-12. Several years ago, an unprecedented organizational shift occurred that focused on the relevance of a student's vocational education training to the world beyond high school—whatever that world may hold, including work and/or postsecondary education. Essentially, conventional curriculum and instructional practices were abandoned in favor of academic/vocational curriculum integration centered on student performance, thus providing students wide-ranging opportunities to make the school-to-work transition upon graduation.

Clustering and Curriculum Integration

Fully committed to restructuring and curriculum integration, the Dauphin County Technical School staff teaches competency-based vocational education programs complemented with rigorous academics relating directly to students' occupational subjects. To facilitate the curriculum integration, traditional academic and vocational departments were restructured into a new and unique organizational approach—occupational clustering. As a result, the school consists of four occupational clusters with each cluster composed of related occupational teachers and an academic teacher from each discipline. Included are: 1) the Communication and Transportation Cluster; 2) the Construction Cluster; 3) the Technical Cluster; and 4) the Service Cluster. Teachers work together in their cluster, discussing curriculum integration projects, strategies, and subject matter collaboration; sharing instructional materials; and planning team teaching activities. In other words, the cluster format makes the integration process come alive. Since the horticulture program belongs in the Service Cluster, the horticulture teacher, along with other vocational teachers, collaborates directly with the Service Cluster academic teachers to integrate the curriculum. Therefore, instructional modules differ for 11th grade English students in horticulture and 11th grade English students in food service. Once teachers decide what will be taught and what outcomes students are expected to perform, integration becomes the real and dominant →

DCTS Service Cluster teachers Bob Eisenhower (math), Ron Fite (horticulture), and Karen Skovrinski (English) discuss curriculum integration, specifically the cross-curricular skills required in wedding floral design.

DCTS seniors Suzette Best and Angie Smith collaboratively organize, plan, and assign production responsibilities to students in grades 10 and 11 to complete a wedding floral arrangement project. They will also order inventory, project cost estimates, and write a final production report on the project.

focus of learning. After all, once students graduate, they must apply what they learn to an integrated, synthesized world. Here's how integration actually happens in the classroom.

I. Horticulture and English

In English, potential writing and communication aspects of the horticultural industry represent an important part of language arts instruction. Through instructional modules that emphasize content, competence, and performance within contexts of the horticultural industry, students actually do what they may be expected to do as an employee in the horticultural industry. Students study resume formats, compose resumes, write job application letters, and participate in mock interviews to hone interview skills. Students may write technical and collaborative reports on topics learned in horticulture, such as a poinsettia project that includes lighting time, fertilization schedules, and results of climate controls. Students must also work on and continually revise business plans.

II. Horticulture and Mathematics

In the horticultural industry, mathematics and horticultural integration might occur in many contexts. Students calculate fertilization ratios for different horticultural crops, use data collected in the lab to correctly determine calibration settings on chemical sprayers, or determine germination rates of certain hybrids being considered for commercial usage. Additionally, students may work on interrelated math and English financial projects where students calculate financial ratios, compile spreadsheets for cash flow and income/expense analysis, and write a complete business plan. On a broader scale, students design and report on a greenhouse, giving appropriate consideration to square footage, internal volume, ventilation, and climate control.

III. Horticulture and Science

Opportunities abound for integrating science and horticulture. Students learn about plant and cell structure in science and biology while discovering the physiological effects of fertilization and chemicals on cells. To exemplify how bacteria and other microorganisms impact on larger forms of life, students demonstrate soil sterilization, study the effects of bacteria and soil nodules on certain types of plants, and discover possible biological pest control measures in place of traditional chemical usage. Students may also learn about geotropism and phototropism in science class, but actually observe the effects of light on a control sample of poinsettia crop in the horticulture greenhouse. Students may synthesize physiological information learned in science with economic and structural content from horticulture to design a pest management system for a nursery that relies on biological control instead of chemical intervention.

IV. Horticulture and Social Studies

Students should be aware of how dynamic local and national economies affect the horticultural industry. Supply and demand concepts, along with production management, are actually applied in the entrepreneurial section of social studies, so students make firsthand observations on the business skills and acumen needed by individuals planning to start their own horticultural business. Through integration projects between horticulture and social studies, students engage in activities that directly cause them to consider these economic variables in making business decisions in horticulture.

Results

The Dauphin County Technical School's curriculum integration efforts provide students an excellent environment for learning. Students exhibit greater enthusiasm for their vocationally related academic classes. Curriculum linkages allow students to explore their interests →

Angie Smith and DCTS horticulture instructor Ron Fite review the final project plan including cost, production schedules, and a time frame for project completion.

and aptitudes further in occupational areas, while simultaneously meeting performance requirements in academics. Not surprisingly, parents wholeheartedly endorse instructional integration. But perhaps most importantly, industry representatives who employ our graduates extol the virtues of curriculum integration because students make the school-to-work transition better equipped to handle the unpredictably diverse work world. Graduates display better communication skills, a better understanding of mathematical concepts in their trade area, and for the most part, acquire scientific and technical skills faster and better than before.

Recommendations and Curricular Integration Strategies

Agriculture teachers, and more specifically horticulture teachers, have ample means and opportunities to facilitate curriculum integration. It's a good way to let other teachers know about your program while also assisting them in teaching their classes. This could prove a vital asset for groundbreaking program modifications and obtaining administrative support. Although school scheduling and organization may lie beyond the agriculture teacher's scope and jurisdiction, curriculum integration may still be a fascinating possibility for all students. The following suggestions are offered to assist in promoting curriculum integration among agriculture teachers and their academic colleagues.

1. Review your existing curriculum to decide how different academic components could be integrated into your program. Discuss your interests with several interested academic teachers and invite them to assist you with the curriculum review.

2. Plan a lesson that focuses on the real-world relevance of a traditionally academic centered concept and show students how agriculture relates to the academic concepts. (e.g., sprayer calibration relates to proportions, rate, and volume.)

3. Invite interested academic teachers to observe and give you feedback on your integration of the mathematics concept into agriculture. Here, they will get a chance to critique you, and you should let them!

4. Attempt to cultivate other teachers' interests in integrating their instruction by offering your assistance through curriculum materials, periodicals, texts, or lab exercises.

5. Offer to team teach an integrated lesson that concentrates on the relevance between agriculture and the academic subject.

6. Continue working with other interested teachers and promote integration by modifying your curriculum to promote student achievement, enabling students to effectively make the transition from school to work.

Academic and vocational integration offers agriculture teachers a unique opportunity to broaden their program, increase student interest, and make learning fun. The Dauphin County Technical School implements this integration strategy with resounding success, and many aspects of this strategy may benefit a variety of educational efforts. Just remember, the true beneficiaries of your efforts will be your students when they learn the integrated skills that keep them on the job! ■

A Sustainable Farm . . .

(continued from page 13)

processes dominate the development of the sustainable farm plan. This activity is suitable for secondary through college-level classes. It may be designed to last for varying amounts of time with various components emphasized, based upon the skill level of students. The activity focuses on local conditions and should consider plant and animal species indigenous to that area. By being involved in planning a sustainable farm, students discover how all things are related, that one cannot actually throw anything away (but merely move it from point A to point B), all human actions will produce some changes in the environment, and each individual is responsible for our environment and global sustainability.

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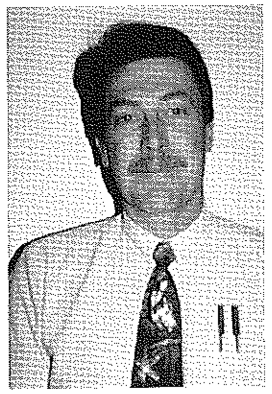
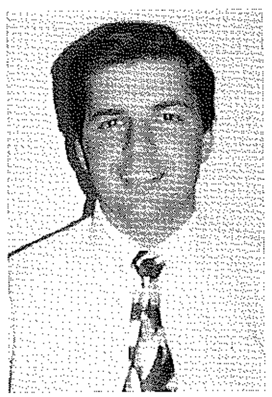
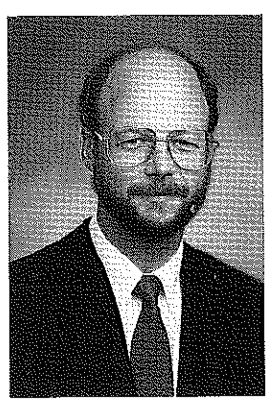
Ties That Bind: Linking the Classroom and Community







By Jerry Barden, Mark Kokes, & David Whaley

Mr. Barden (top) and Mr. Kokes are agriculture teachers at Fort Morgan High School, Ft. Morgan, CO. Dr. Whaley (bottom) is associate professor and program chair of agricultural education at Colorado State University, Ft. Collins.

Agricultural educators often regard the local community as the most important resource they possess. Yet, to many teachers this valuable asset remains untapped. At Fort Morgan High School we have developed a unique program, *Ties That Bind*, that helps maximize community involvement in our educational system. This program encompasses a variety of broad-based, community opportunities. These include a) industry tours, where businesses are explored firsthand and company personnel expectations are explained to students; b) guest instructors who work individually with a few students or an entire class on technical skills; c) Chamber of Commerce forums, where students are allowed to express points of view and influence members of the community; and d) major classroom projects in farm management or agri-marketing, where students invite local farm production and agribusiness experts to advise them on specific areas of project design and marketing.

This interaction between students and community volunteers is essential in formulating a real-world experience for agriculture students. As well though, community volunteers have opportunities to interact with each other. The major goals of *Ties That Bind* are to provide community support and offer ownership in the local educational system. Ultimately the quality of education that we give to our students improves through these vital connections.

Students at Fort Morgan High School plan a minimum of 15 formal instructional seminars each year with industry and guest instructors. These seminars generally lead to many more informal meetings between community business leaders and interested students.

Objectives

Six simple objectives were used to develop the *Ties That Bind* program.

A. Give community ownership in our educational system.

Critics become supporters when they feel ownership in the system. When faced with the knowledge of educational challenges, they may help to address and solve these problems.

B. Develop more competent employees.

The program allows students to become knowledgeable of employers' needs in new employees. This further enhances familiarity between the students and community leaders.

C. Nurture a strong working relationship with the community.

When asked to share their expertise, community leaders have responded enthusiastically.

D. Enhance communication between the students, business community, and the school system.

Too often, friction between groups can be traced to inadequate or incomplete communication. It is easy to form negative opinions when one has incomplete facts.

E. Increase the amount of exposure and accountability of educational programs to the community.

Exposure to the local community is important in strengthening good educational programs. This exposure also increases program accountability. *Ties That Bind* is a program that provides essential reinforcement needed for good programs.

F. Shift the focus from students leaving our community to encouraging their retention.

Students are often under the assumption that the "road to success is the road out of the community." Through *Ties That Bind*, students are exposed to the abundance of opportunities that lie within our community.

Benefits

Benefits to the Student

In this program, students make all contacts and arrangements with local community leaders. The instructor serves only as advisor and facilitator and neither initiates nor directs the contacts. The student must make all phone and written contacts, coordinate all scheduling with the businesses and school, and make all introductions at the start of the program. *Ties That Bind*:

1. Allows the student to view community business operations;
2. Gives students opportunities to meet prospective employers;
3. Facilitates communication between adults on a business and professional level;
4. Improves the student's understanding of the community;
5. Helps the student identify career paths; and →

Local business owner Howard Wickham discusses with students everyday employer/employee relations.

6. Stimulates new ideas, concepts, and personal goals.

Benefits to the Business and Community

The community generally has a great desire to feel ownership in the educational system. Through *Ties That Bind*, community participants:

1. Have the opportunity to "try out" prospective employees;
2. Influence the technical content being taught in school and participate in the development of students' personal skills;
3. Become more comfortable in communicating with the educational system; and
4. Benefit from good public relations.

Benefits to the School

Benefits to the school from the *Ties That Bind* program are:

1. Builds good public relations between the school and community;
2. Sensitizes the business community to the challenges found in education today;
3. Bonds the community to the school (increases support); and
4. Makes programs more accountable to the community. Accountability encourages excellence.

Competencies

In a program such as this, the competencies learned are unlimited. Some examples include:

1. **Phone communication skills**—The students have to make all of the original and follow-up telephone contacts with the business manager or owner.
2. **Brainstorming and decision making**—A brainstorming session is initially held to assist the students in selecting a community business or leader that they want to involve in the program.
3. **Written communication**—All students are required to make written confirmation of the dates of their program activities and send written thank-you letters afterwards.
4. **Organizational skills**—The students have to arrange scheduling with the school and business.
5. **Professionalism**—The students must conduct themselves at all times with the greatest amount of professional courtesy.
6. **Effective questioning and listening skills**—The students must be able to ask questions that will help the business professional know the areas of interest relevant to the program. Students must also listen effectively.
7. **Technical skill awareness**—During this program, the students will become aware of technical skills that they need for employment with the company.
8. **Career opportunity awareness**—Students become aware of the many different career opportunities in their community.

Beginning the Program

Following are a few suggested steps in beginning the program.

A. Establish your own guidelines and boundaries; make sure they are comfortable for you (the teacher), the community, and the students.

B. Have a brainstorming session with students and allow each student to present two possible programs for consideration.

C. After programs are defined, have students allocate the different programs to individual student managers. (This is an activity that will require a monitor to assure equity between students.)

D. Request possible dates and times for programs.

E. Have students finalize dates with instructor and presenter(s).

F. Post a master list of programs, leaving room for alternate dates in case of conflicts or cancellations.

G. Require students to make all initial phone contacts and scheduling, followed up by a written confirmation to the presenters.

H. Seek verbal confirmation one week in advance to make sure all plans are complete.

I. On the day of presentation, students are required to make all formal introductions.

J. Formulate key questions ahead of time.

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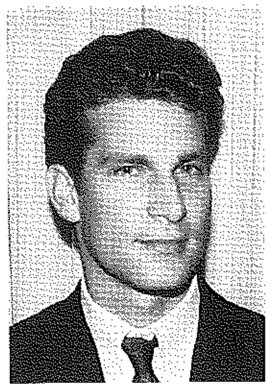
THEME ARTICLE

Building Capacity for an Innovative Elementary Agriscience Curriculum



BY CARY J. TREXLER

Mr. Trexler is coordinator of the ABC in Science program at Sanilac Intermediate School District, Peck, MI.

Agricultural literacy programs have not deeply penetrated institutional walls to become firmly ingrained into classroom culture. External educational efforts generated by the National FFA, agricultural commodity groups, Farm Bureau's Ag in the Classroom, and various universities impact only a handful of teachers and students. Agricultural promoters often become narrowly focused and fail to realize that most non-agriculture teachers cannot justify teaching new materials unless they directly meet mandated learner outcomes.

Agricultural education's challenge is to make inroads into formalized, non-agriculture school curricula. To accomplish this, systems for integrating existing agricultural literacy materials into the established school curriculum must be explored. Models are now emerging that accomplish this task. One model is the Agriculturally Based Curriculum (ABC) in Science program of the Sanilac County Intermediate School District (SISD), an educational service agency serving seven local school districts in rural Michigan. This innovative elementary agriscience curriculum development program, initially funded by the W.K. Kellogg Foundation, is developing a systematic process for institutionalizing agricultural themes into existing school culture, thereby bringing a real-life context to science education.

Why Integrate Agriculture with Formalized Science Curricula?

Elementary school science lays the foundation for all science education. However, according to a Council for Educational Development and Research report published in 1993, ED TALK: What We Know About Science Teaching and Learning, "studies show that lecturing and discussion are far and away the dominant mode of science education, comprising 75 percent of teaching time in kindergarten through third grade and nearly 90 percent in the upper elementary grades" (Kober 1993, p. 36). As a result, students are bored and disinterested in science. Today, the nation's schools aspire for science teaching that is more interdisciplinary, authentic, and hands-on. Agricultural education can now, as it has in the past, serve as a vehicle to meet these ends.

Since February 1992, the SISD has helped teachers connect agriscience curricula with *Michigan Essential Goals and Objectives for Science Education* (1991). The program's conceptual foundation is based upon recommendations from both science and agricultural education. Specifically, program architects recognized the value of the recommendation made in the 1988 landmark publication *Understanding Agriculture: New Directions for Education:*

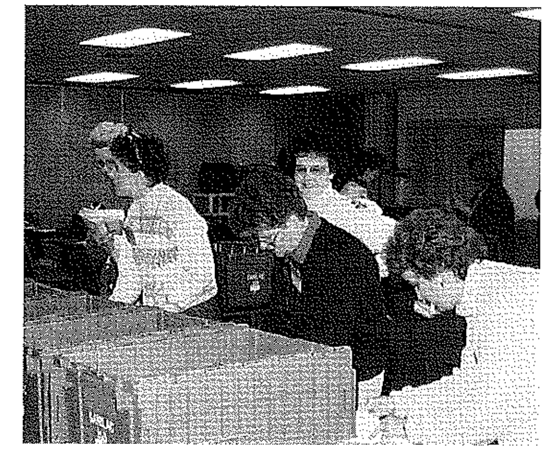
> *In elementary school, the most realistic way to infuse science and agriculture [into the curriculum] is to introduce hands-on modules, or units of instruction, that supplement and eventually replace existing curriculum and textbooks. Each module would focus on a particular science topic and provide teachers with the instructional materials and apparatus to investigate the topic in the classroom* (NRC, 1988, p. 13).

Time to Build Capacity for Change

To "re-form" Sanilac County's science curriculum into an elementary agriscience program, the county's school staff capacity must be enhanced. Capacity-building helps teachers and principals create school organizations and cultures that support reform. Lack of these services translates into a lack of support for change. Michigan's school principals state that three of the top six most important staff development needs are: assessing student learning, interdisciplinary approaches, and teaching content (Friedman, et al. 1993). These needs can be specifically met through agricultural education.

For Sanilac County to institutionalize an agriscience curriculum, educators must agree upon cross-curricula interdisciplinary connections, gain scientific and agricultural knowledge, learn to use new curriculum and hands-on activities, and develop supportive networks. All of these objectives require tremendous effort, input, and cooperation from teachers, administrators, and the community. ABC in Science realizes that developing an articulated science curriculum is an arduous process and provides coordination of capacity-building opportunities (see figure 1).

To build capacity for change, teachers meet quarterly during school hours in half-day or day-long inservices. Substitutes are provided by funds from the W.K. Kellogg Foundation, the federally funded Dwight D. Eisenhower Math and Science Program, and the Michigan Math and Science Challenge Grant. Few agricultural literacy initiatives provide the time required for capacity-building, and that is their downfall. SISD's experience shows that when teachers are directly involved in curriculum development, they are more prone to use agriscience curriculum materials.

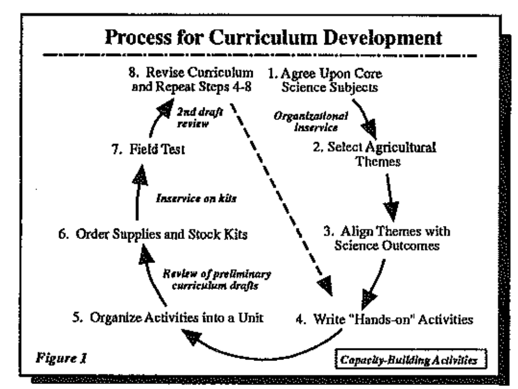


Sanilac County kindergarten teachers take inventory of their agriscience kits.

ABC in Science Curriculum Development Process

1. Agree Upon Core Science Subjects

All county teachers meet by grade level, and with the help of ABC in Science staff, identify and select common science subjects taught in each district. For example, third grade teachers agreed upon several major science topics to be covered each year: matter and its changes, ecosystems, food chains and webs, water cycle and basic botany. District science curriculum scope and sequence are referred to, but teachers paint a realistic picture of what can actually be taught in their classrooms.



2. Select Agricultural Themes

After selecting science subjects, teachers hammer out common agricultural themes to serve as umbrellas under which to place science subjects. Initially, kindergarten through third grade teachers selected themes of indigenous crops and agricultural products (sugar beets, corn, milk, and soybeans). As understanding of the food and fiber system grew, upper elementary teachers in grades four through six selected more complex topics, such as agriculture's impact on the environment, its place in the human food web, and the risks and benefits of pesticides in production. These agricultural themes lend themselves to hands-on exploration by the students.

Third grade teachers organized one of their three units around students' questions about milk: Where does it come from? How do cows make milk? What is milk made of? How is milk made into butter, yogurt or ice cream? These questions became the basis for student and teacher exploration in agriscience.

3. Align Themes with Science Subjects

After initially involving teachers, the program's elementary science curriculum specialist and coordinator (formally a secondary agricultural and biological science teacher) align science topics and agricultural themes with Michigan's science core curriculum. To do this, they look for logical connections between the themes and science subjects (see Figure 2). For example, third grade teachers selected using a hand crank freezer to make ice cream as an activity for the milk theme. From this one activity, students explore traditional physical and life science, while acting as food scientists. These science outcomes are touched upon through this ice cream activity: measuring temperature (cream solution before and after using the freezer), observing common physical changes in matter (liquids to solids), using simple devices to make metric measurements (mixing specified amounts of cream, sugar, vanilla, etc.), and using simple machines to make work easier (the freezer).

> **Milk Theme Umbrella's Science Subjects**
>
> - cells
> - food chains
> - simple machines
> - changes in matter
>
> ***Figure 2***

4. Write "Hands-on" Activities

There is a wealth of agricultural literacy materials available to educators. To gather these curriculum resources, the ABC in Science coordinator regularly participates in the National Agriculture in the Classroom (AITC) Conference sponsored by the U.S. Department of Agriculture. At the conference, agricultural literacy materials from throughout the country are easily and efficiently acquired. In addition to these resources, the program relies upon educational materials distributed by various commodity groups. Some of these materials are →

exemplary, innovative, and thought provoking, while others are propagandized to the point of serving little educational value.

With the science-agricultural unit relationships identified, the curriculum writer refers to the program's voluminous library of agricultural and scientific literacy materials. After reviewing materials, the writer judiciously selects exemplary models and modifies them to meet teacher selected themes. Once lessons are developed, teachers review preliminary curriculum drafts. To promote curriculum advocacy, the county's seven schools select one teacher for the review team.

5. Organize Activities into a Unit

After teacher review, lesson plans are edited and organized into teaching guides. Background information on practical agricultural applications of specific scientific principles is an essential part of the guide. In addition, a kit containing student laboratory sheets and all manipulatives and consumables needed for hands-on learning is supplied.

6. Order Supplies and Stock Kits

An ABC in Science staff member is responsible for purchasing and stocking kit materials (Figure 3 lists supplies found in the Milk kit). All county elementary teachers receive one kit for each unit containing approximately $75-worth of materials. Much thought is given to include only hands-on activities that effectively and simply help students build a deep and fundamental understanding of scientific principles, while keeping costs to a minimum.

The preparation of materials for hands-on science is new to most elementary school teachers. By prepackaging classroom materials for the teachers, they can now concentrate on teaching, rather than on scavenging for materials, such as corn stalks, guppies, or raw milk.

7. Field Test

Teachers participate in full-day inservices prior to receiving the curriculum unit and kit. Common scientific misconceptions inherent to the unit are identified by ABC in Science staff. Teachers are assisted in reconstructing naive understandings about these science concepts. Further, teachers review agricultural theme connections to the unit's essential scientific concepts.

Experience shows that teachers who review curriculum and experiment with materials are much more likely to use these same materials in their classrooms. This concentrated, uninterrupted review is essential for curriculum implementation. Therefore, the ABC in Science program only delivers kits to teachers who have attended inservice training. Thus far, of the over 200 eligible teachers, only two have opted not to participate.

After the inservice, program staff deliver kits in the ABC in Science van. Teachers are provided everything needed to teach the curriculum to a class of 30. They then use the curriculum and supporting materials to teach experiential agriscience. To document curriculum implementation progress, teachers write down their impressions and student reactions on a kit →

Milk Kit Supplies

- agar plates
- baby food jars
- book, Dairy Cows
- book, Milk Makers
- bowls, small
- brass paper fasteners
- chart paper
- chicken bones
- clock
- copy paper, blue
- dairy foods
- dowels
- glue
- grease pencil
- hand mixer
- heavy whipping cream
- jars with lids
- lined paper
- meat trays
- plastic knives
- plastic spoon
- poster: Milk From Cow to You
- rubbery bones, chart
- rubber bands
- sponge shape sterile swabs
- straws, small
- supermarket fliers
- tablespoon
- vinegar
- lab sheet, A Glass of Milk
- lab sheet, Butter 'Em Up
- lab sheet, Cells are Living Things

Figure 3.

At a capacity-building workshop first grade teachers discuss using agricultural themes as a context for science instruction.

assessment form.

Teachers contact the ABC in Science warehouse when finished with the unit. It is then retrieved for restocking.

8. Revise Curriculum

Based upon teacher comments detailed on the kit assessment form and additional anecdotal information, changes are considered, and if warranted, made by the curriculum writers. When second drafts are created, teachers review the updated material and provide feedback.

Next Steps

Sanilac County Intermediate School District's next step is to continue the teacher capacity-building process essential for the development of an articulated agriscience curriculum. Teachers are systematically being brought into the program. Kindergarten, third and sixth grade teachers are now beginning their third year, while those teaching first and fourth grades await their second. In the program's third year, second and fifth grade teachers are scheduled to begin curriculum development. When the W.K. Kellogg Foundation's support ends, the program's efforts will not stop; Michigan's legislature has granted the program a stable funding base for years to come.

Agricultural education's next step in expanding its audience is to work with school districts to use agriculture as a unifying theme for curriculum development. To do this, educational leaders (e.g., principals and curriculum coordinators) should be targeted for awareness programs. These programs must feature schools successfully moving toward development of interdisciplinary curricula using the food and fiber system as a context for instruction. The most logical and realistic place to begin the integration of agricultural themes is in the elementary science curriculum.

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Ties That Bind

(continued from page 15)

K. Follow-up with a written thank-you note from the individual or group.

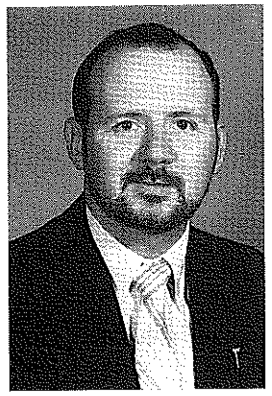
L. Have a class discussion on the presentation the following class day.

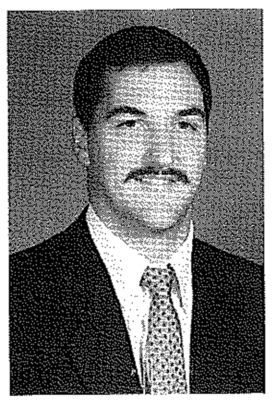
M. Don't forget the tremendous resources you have just created; continue to involve them in the program.

Summary

The *Ties That Bind* program has been most beneficial at Fort Morgan High School. The more we involve the community, the more the community wants to get involved. We invite parents and community leaders into our classroom on a daily basis. They are not there to observe, but to participate. We currently have two adults that guest instruct in our Ag II class on a daily basis. Kathy Barthlama and Steve Taylor are helping the class build two sheds as a group project. Kathy is a parent of one of the Ag II students, and Steve is a retired businessman in the community. The presence of several adults also changes the attitude of many students. Individual accountability increases because the students desire to be remembered as quality individuals. Parents and local business leaders are not only excellent instructors, but when a budget crisis occurs, teachers will have a cadre of knowledgeable individuals that can speak in support of their organizations. After all, through their participation in the *Ties The Bind* program, they have become knowledgeable educational partners. ■

Aquaculture is Agriculture: The High School Experience





By David Mooring and Joel Hoyle

Mr. Mooring is an agriculture teacher at North Lenoir High School in La Grange, NC. Mr. Hoyle is an agriculture teacher at Wayne Community College in Goldsboro, NC.

At North Lenoir High School located in La Grange, North Carolina, agricultural educators David Mooring and Joel Hoyle have this year begun to teach aquaculture as a part of a developing agriscience curriculum. Agriculture students are obtaining knowledge on how to raise a variety of fish species through closed/recirculating systems, pond production, and caged pond production.

Nationwide, educators are being told that our high school graduates need more math and science knowledge. As agricultural educators, we realize that the study of agriculture includes an abundance of science and math. We have found that aquaculture study is no exception. However, we have observed that our agriculture students are more excited about their science study and are easily motivated to learn.

Science and Math Competencies

Our students are finding that it is possible to have a hands-on working knowledge of chemistry without becoming a chemist or majoring in chemistry. Within any aquaculture production method, water chemistry analysis is an important observation. We are producing fish species in ponds, cages, and recirculating systems, with each requiring a variety of analyses.

Our students learn to chemically test water for dissolved oxygen, pH, ammonia, nitrate, nitrite, alkalinity, hardness, and other qualities. Instrumentation is also used to test for dissolved oxygen and pH. Our students learn normal tolerance and ranges for water quality, and when errors occur, they chemically correct them. For example, our students have applied lime to a pond to bring the pH up to 7.0 for increased fish production. In our recirculating system they have found that one method to reduce ammonia levels is to increase alkalinity with sodium bicarbonate, which in turn promotes the growth of nitrosomonas and nitrobacter ammonia-eating bacteria.

In addition to the identification of a variety of fish species, our students are studying fish anatomy. This expanded science study utilizes computer programs and the dissection of yellow perch to learn the internal, external, and skeletal anatomy and physiology of fish.

Mathematical computations are frequently used. Our students calculate how many pounds of lime per acre are needed to raise the pH in a pond by one point. They randomly collect fish samples and weigh them to convert to cage and tank quantities. The pounds of fish present will be multiplied by a percentage to determine daily feed requirements.

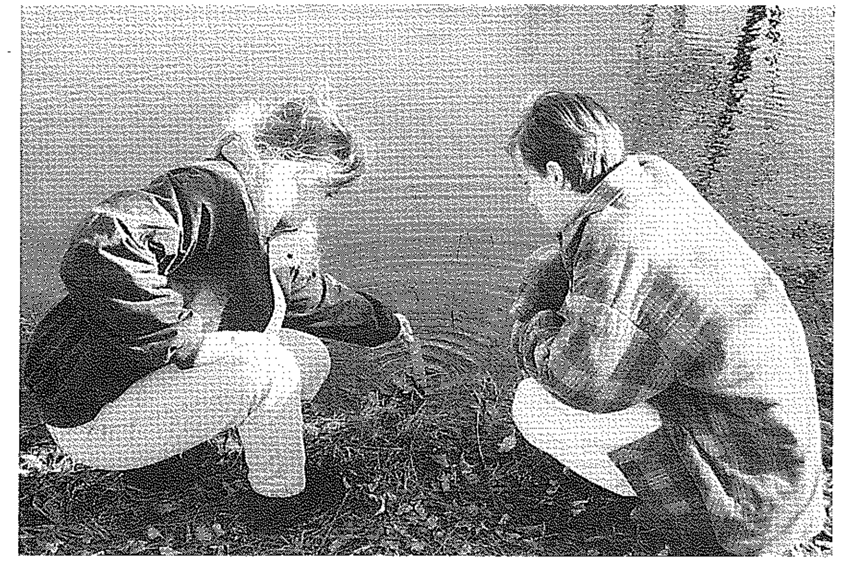
Aquaculture production has proven to be an exciting program of study that has motivated our students to expand their knowledge of chemistry, biology, and math. Their curiosity has promoted the testing of waters in determining if aquaculture production opportunities exist for them at home.

Closed Recirculation System Production

Our closed-system production at this point consists of two separate 550-gallon tanks with vertical screen filter systems. In both tanks we are growing tilapia. Last year we produced one tank of hybrid bluegills and one tank of tilapia. The bluegills were stocked in a local pond and the tilapia marketed. Tilapia were chosen because of their hardiness and ability to grow in tanks. Our purpose in the production of these two species is to provide students an opportunity to practice the competencies learned in stocking ponds and marketing products.

Our current success in closed-system production has not occurred without sacrifice. Our first production attempt was with rainbow trout. Within 24 hours of acclimation, all 200 fish had expired. We tested our water and received consultation from a North Carolina Wildlife Resources Commission Fisheries technician and an extension aquaculture specialist. We found no error in our water quality. Our probable cause of expiration must have been improper acclimation. Cautiously, we restocked the tank with hybrid bluegills. They did well. →

Alkalinity is important as a buffering system in fish production. Here students are chemically conducting an alkalinity test in the fish house.



Students are using a hand-held pH meter to take a recording in one of the fish ponds.

After a couple of weeks of successful hybrid bluegill production, the fish were removed and the next day 100 more rainbow trout were placed in the tank. Within two hours 50 percent were dead. We decided that our error must be our water temperature of 65° F. We had placed 250 rainbow trout of the same shipment in a cage in a pond that were surviving well at a water temperature of 55° F.

In desperation we dumped ice in the system lowering the water temperature to 55° F and were able to save only two. Our resources tell us that rainbow trout do well in 65° F water; however, our experience is that acclimation from 50° F to 65° F will not provide satisfactory results.

Students learn many competencies and practice many skills in closed-system tank production. In addition to complete water analysis at least twice weekly, other system checks are required. Each day, including weekends, the fish are fed and water levels checked. Water loss occurs due to evaporation and splatter by fish when feeding. Vertical filters are periodically cleaned of debris. Growth rates are recorded by random sampling. Our tanks are enclosed in a 30' x 30' hoop-type greenhouse, and room temperature adjustments are necessary.

Pond Production

Approximately one mile from the school a landowner is allowing our students to grow channel catfish in a 100' x 30' pond. Our first year we stocked 300 fingerlings in the fall. In the spring and summer our students were responsible for feeding, maintaining water quality, and taking dissolved oxygen readings. We found that in July when water temperatures and feeding rates were at their highest, we had an oxygen problem. We corrected this by purchasing an aerator and placing it on a timer. In the fall our students used a seine to harvest the fish, which were fed to our advisory committee, local business leaders, and students. We have since restocked the pond and are awaiting our second season.

Caged Pond Production

In a two-acre farm pond about one-half mile from the school, the landowner has allowed us to install a dock and four 4' x 4' round fish cages. In these cages we are raising rainbow trout.

Immediately after obtaining the opportunity to raise fish in this pond, we investigated several possibilities. We determined that this pond, already stocked with largemouth bass and bluegills, had an uneven and debris-covered bottom and would be best utilized for caged production. The water quality was clear and excellent; however, the water temperature was about 10 degrees lower than other ponds in the area. Further investigation noted that the pond water supply is from many underground springs that apparently exit a cold water aquifer.

With our resource being cold, clear water, we elected to try rainbow trout in one of the cages. Rainbow trout are not native to eastern North Carolina. Our principal, a strong supporter of our aquaculture expansion, has allowed us to supply electric power at the site so that we can aerate the water. Aeration allows us to increase oxygen in the water and periodically supply a small flow through the cage. We stocked 250 rainbow trout, which grew well and were harvested in May, when the water temperature reached about 72° F.

In the other cage we tried channel catfish, with our intention being to produce trout in the winter and catfish in the summer. During the summer, however, the water temperature never reached a level high enough to sustain catfish. The fish didn't feed well and didn't grow. We moved the cages to another pond in August where the temperature was warmer, and the fish began growing. As the water temperature began falling again, we used the fish to restock our catfish pond.

In our second season we have stocked 250 trout per cage for a total of 1,000 fish. These fish will be raised until the water temperature reaches about 70° F. Our plans are to then sell the fish locally.

Each day our students feed the fish in the cages and record the water temperatures and pH. Periodically other tests and adjustments are made. For example, we added lime to increase the pH when we elected to stock rainbow trout. Caged fish production has a lot of potential in eastern North Carolina. Cages are low-cost equipment. Our students ordered kits, assembled them, and experienced no complications. Cages may be placed in ponds already stocked

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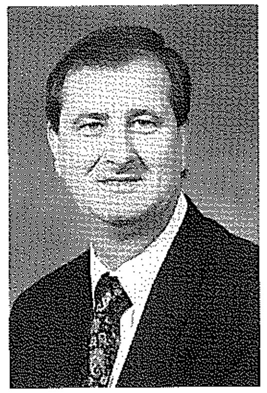
THEME ARTICLE

Agricultural Technology: Fertilizer for an Innovative Program



BY SYLVESTER DUNN AND TONY BRANNON

Mr. Dunn (top) is an agriculture teacher at Bell County High School, Pineville, KY. Dr. Brannon is an associate professor of agricultural education at Murray State University, Murray, KY.

"If you always do what you've always done, always say what you've always said, and always think what you've always thought, then you'll always get what you've already got."

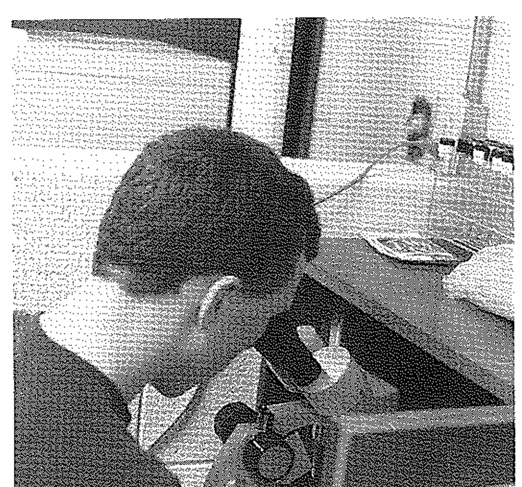
This wise adage is applicable to many of our secondary agriculture programs. The past history of vocational agriculture speaks for itself, and in many cases, is the envy of all of education; however, just as the "green revolution" led to an unbelievable boost in production agriculture, the "technology revolution" can provide a stimulus for a great boost in the production of our agriculture programs. Yet, to change what we've already got, we have to begin to do, say, and think differently than we have in the past.

One such agricultural education program which has begun to "think, say, and do" differently can be found at Bell County High School in rural southeastern Kentucky. In the late 1980s, the Bell County agriculture program faced a plight all too common with many programs—declining enrollments and location in a county with limited agricultural opportunities. Simultaneously, in 1990 the Kentucky General Assembly passed the Kentucky Education Reform Act (KERA), which called for all programs to contribute to six desired goals. Concurrently, the State Agricultural Education Program of Studies was changed to include a total of 29 semester or year-long courses. Rather than depend upon the laurels of the past to justify its existence, this program decided to turn the key to the future and unlock a positive change in education to help make students more competitive and better equipped to succeed.

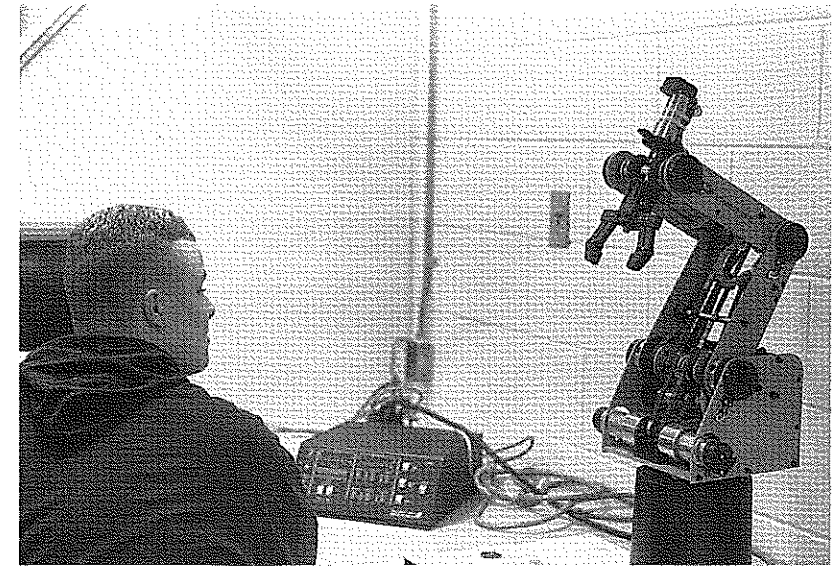
Changing What We Had

Beginning with the 1992-93 school year, a pilot experimental course in Agricultural Technology was offered for the first time. The Agri-Tech program was developed as a modular technology program and has proven to be an ideal vehicle for the integration of academic and vocational education. The traditional agricultural mechanics shop was renovated and divided into instructional modules to accommodate the following areas: biotechnology, electricity and electric motors, structures and design, applied mechanisms, Autocad/Landcad, environmental technology, pneumatics, hydraulics, small engines, welding, robotics, floral design, hydroponics, tissue culture, and computer applications. Two sections of the Agricultural Technology class are offered for freshmen or sophomores as a one-semester course in a block scheduling system of 90-minute classes. Students select areas in which they are interested and work in teams of 2-3 to accomplish the objectives of each module. Self-paced curriculum has been written in each area to guide students in a step-by-step approach. Students spend 10 days on each module and then rotate to the next area. The role of the agriculture teacher in this class is to serve as a facilitator for students and other instructors. This type of approach provides an interesting avenue to incorporate the current movements toward integration of vocational and academic education, school-to-work transition, Tech Prep and High Schools That Work (HSTW).

This approach has served as a major catalyst for the restructuring effort by opening the door for team teaching and joint projects that cross discipline lines and bring a unity to the educational process. Integration activities and team teaching have been conducted with AP biology, math, science, English, and American history classes. Industry is requiring that students be able to participate in group or team learning environments; this class is teaching both. Students participate in activities such as DNA fingerprinting and bacteria transformations that stress the science needed in agriculture. Traditional agriculture units, such as hydraulics and small engines, emphasize the math skills needed in a world class workplace. →



Tissue culture is a vital component of agricultural technology.



Principles can be learned "hands-on" with little space consumed.

The Results

Fantastic.... This year there were 404 applications to take this one class (out of a total school population of 1100). Unfortunately, there was room for only 180 students—90 per semester. Many of these students are quality students who would not have enrolled in a traditional agriculture program. However, as a result, many may go on and enroll in a more in-depth traditional semester class in agriculture. The change in methodology has brought about integrated and multi-disciplinary learning that has raised the expectations of the teacher and the level of learning for the students. The community, administration of the school system, and guidance departments have endorsed this process, and everyone has gained from the program, especially the students. The program has placed the student once again as the major player and allows him/her to learn responsibility and accountability, as well as a broad base of workplace skills. This concept has also received interest and scrutiny from outside, as there continues to be a steady stream of superintendents and administrators from other school systems visiting and observing.

What We Can Become

While this type of program will not fit all situations under all conditions, it has definitely been of benefit to Bell County High School. The greatest challenge of education is to make students more responsive and the curriculum more relevant to the demands of today's workforce. The Agri-Tech program has opened the door for creative thinking by the teacher while meeting the needs of the students. The class has brought about significant changes in enrollment and has increased the quality of students now enrolled in agriculture. Changes are required if we are to produce students that are successful and productive in this new era of technology.

The goal of agriculture teachers must be not only the desire to meet the needs of educational reform, but also to be on the cutting edge of learning for life. Agriculture has always had an important role in history and in the development of industry, which serves as the foundation for many things we now have. The standards that are the basis for the restructuring of education nationwide support that foundation and prove that our thinking has been in the right direction. We, as agriculture teachers, must continue to modernize our thinking and our methods of instruction, especially in the area of technology.

Now is the time for agriculture to once again accept the challenge to lead the way for major changes in education that will be felt for years to come. When students become so engaged that they want to try and are willing to take a risk in this climate, then we have unlocked the door to life-long learning. Technology is the fertilizer for a crop of innovative classes which will make our students "grow" and our programs become even better than "what we've already got." ■

Aquaculture Is Agriculture ...

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with other species, and fish can be easily monitored, fed, and harvested. We have noted much interest in caged pond production in our project by our students and members of our school community.

Continued Expansion

Our opportunity to expand into aquaculture study at North Lenoir High occurred when we obtained a grant to provide Tech Prep vocational education. Our agricultural education program used this funding to purchase the closed systems. Our local education agency and community support provided funding for Agricultural Engineering Technology students to construct the facility, systems, cages, and docks. We have recently received a grant from the North Carolina Rural Economic Development Center to construct a tilapia fish hatchery, which will be used to supply other agriculture programs with fish. We are also working with several area farmers on the possibility of growing fish in tanks.

Our aquaculture study has generated a high student interest in the science of fish production. It has provided an exciting course of study for the instructors, students, and interested members of the community. But most importantly, we expect expanded aquaculture production to occur in eastern North Carolina in the next few years, and we are training quality students for work in that exciting field. ■

1995 THEMES

Issue/Theme	Due to Theme Editor	Theme Editor(s)
January *The Public's View of Agricultural Education*	October 1, 1994	Dr. David E. Krueger Agricultural and Extension Education 410 Agriculture Hall Michigan State University East Lansing, MI 48824-1039 (517) 355-6580
February *The Profession's View of Agricultural Education*	November 1, 1994	Dr. Gary E. Briers Dr. James E. Christiansen Dr. Don R. Herring Agricultural Education Texas A&M University Room 107 Scoates Hall College Station, TX 77843-2116 (409) 845-2951
March *The Participants' View of Agricultural Education*	December 1, 1994	Dr. Joe G. Harper Ag. Ed. And Ag. Eng. 112 Poole Agricultural Center Clemson University Clemson, SC 29634-0356 (803) 656-3300 Dr. Phillip Buriak Agricultural Engineering 107 AESB University of Illinois Urbana, IL 61801 (217) 244-8324
April *The Future for Agricultural Education*	January 1, 1995	Dr. Douglas A. Pals 223 Morrill Hall University of Idaho Moscow, ID 83844-3012 (208) 885-6358
May *Using the Information Highway*	February 1, 1995	Dr. Michael K. Swan 155 Home Economics Building North Dakota State University Fargo, ND 58105 (701) 237-7439
June *Business/ Industry Partnerships*	March 1, 1995	Dr. Joe W. Kotrlik South Stadium Drive Louisiana State University Baton Rouge, LA 70803 (504) 388-5748
July *The Changing Workplace*	April 1, 1995	Dr. Carl L. Reynolds College of Education University of Wyoming Laramie, WY 82071 (307) 766-3267
August *Promoting Integrity in Students and Instructors*	May 1, 1995	Dr. David C. Whaley Agricultural Education 235 Education Building Colorado State University Fort Collins, CO 80523 (303) 491-6884/6317
September *Innovations in Teaching*	June 1, 1995	Dr. John P. Mundt Agricultural and Extension Education University of Idaho—Boise Center 800 Park Blvd. - Suite 200 Boise, ID 83712 (208) 334-2999
October *Rural Education*	July 1, 1995	Dr. W. Wade Miller Agricultural Education and Studies 201 Curtiss Hall Iowa State University Ames, IA 50011 (515) 294-0895
November *Collaboration in Agricultural Education*	August 1, 1995	Dr. Roland L. Peterson Agricultural Education and Extension 320 Vocational Technical Building University of Minnesota St. Paul, MN 55108 (612) 624-2221
December *Cognitive Levels of Teaching and Learning*	September 1, 1995	Dr. M. Susie Whittington Agricultural and Extension Education 223 Morrill Hall University of Idaho Moscow, ID 83844-3012 (208) 885-6358