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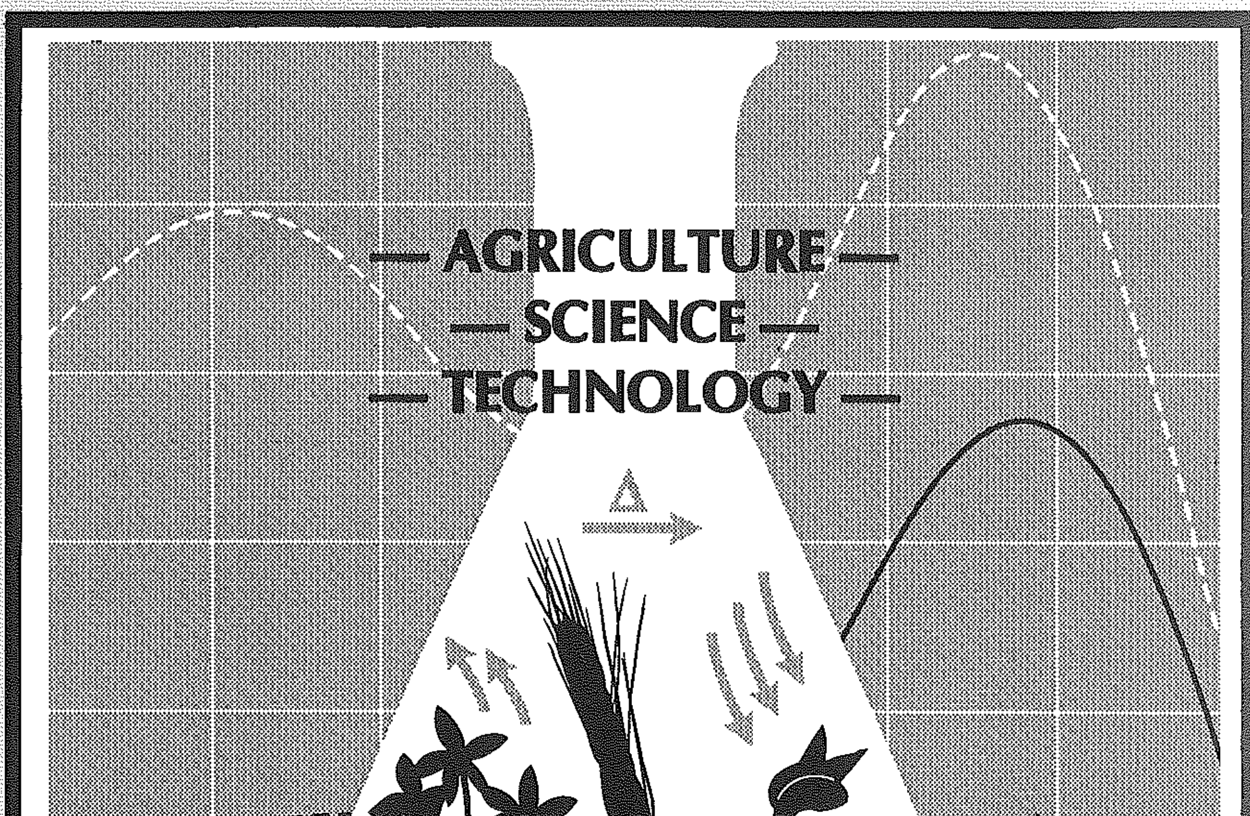

THEME: Agricultural Science

THE

AGRICULTURAL EDUCATION

MAGAZINE

January, 1991 Volume 63 Number 7

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ARTICLE SUBMISSION

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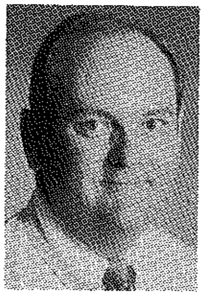
No Work, No Play



By Phillip R. Zurbrick, Editor and David E. Cox

(Dr. Zurbrick is Professor and Dr. Cox is Associate Professor, Department of Agricultural Education, The University of Arizona.)

The very title suggests the application of this policy must apply solely to educational programs and concomitant or subsequent recreational school activities. A student who is not expending enough effort academically to pass his or her classes should not be permitted to enjoy the fringe benefits of participating in (playing) extracurricular school activities (recreational events). This concept seems very sound and difficult to argue against! However, there are those who attempt to apply "No Pass, No Play" in situations different from that described above. When it is applied differently, argument is essential. When the "No Pass, No Play" policy is applied to only educational programs, it becomes illogical, counter-productive and results in poor educational practice. If for example it were applied to all educational efforts, it would mean that a student not passing a mathematics class could not participate in any other educational activity (class). Thus, the students would not be permitted to attend the English class, chemistry class or the social studies class, etc. It is equally illogical and felonious when it is applied to intra-curricular class activities which are of educational value. Its interpretation when applied in this instance would read as follows: "Unless the student passed all classes he or she cannot participate in or benefit from another educational experience." Instead of preventing students from active participation in educational class activities, schools need to encourage students to participate in and take advantage of every educational opportunity possible. For most students, the alternative to participation is not to study harder, but rather to either quit entirely (drop out) or to simply not try at all. As professional educators, either of these two alternatives is highly undesirable. Both alternatives reduce the effectiveness of the teacher and the school. Any teacher who has attempted to teach a group of students who did not care or would not try to learn understands the futility of such a situation. The professional educator must help students to learn, not punish them when they fail.

A major fallacy with the application of "No Pass, No Play" is the assumption that all students are equally endowed in academic ability. Such is not the case as can be noted by the number and diversity of special education programs and the number of students served by such programs. The strength of the educational system in this country historically has been its diversity and ability to deal with students of various academic abilities and educational interests. If educational programs of the future are to continue to serve all students as equally as possible, it is essential that students of lesser abilities be provided the opportunity to participate in all educational activities. Again, a "No Pass, No Play" policy discriminates against those students who may not have the ability to pass every course regardless of how hard they might try. Additionally, it is incumbent upon professional educators who apply a "No Pass, No Play" rule to be able to distinguish between activities in which students "play" intra-curricular educational enrichment activities.

A serious deficiency in academic programs is a tendency to undermine and pervert the work ethic of students. As a society intertwined with public education, it is essential to the survival of society for schools to develop individuals who can contribute to society in a productive manner. This certainly suggests the importance of helping students understand the essentiality of work and the need to value those individuals who are diligent and work hard. Too often, teachers and schools recognize and reward only those students who have academic ability and not those who work hard. In fact, it is not uncommon for teachers to punish individuals who do not perform well academically by assigning work and reward others through avoidance of work by reducing their assignments. Thus, students soon come to understand that if you are "smart" you can avoid work. Only the "poor" (unintelligent) student must work, while those who are "smart" get by without working. Students often brag to one another about a grade received without any study (work), while belittling the student who studies hard (works). Such attitudes must not be encouraged by educators and in fact must be refuted if society is to prosper.

A far more appropriate concept for the public school system would be a "No Work, No Play" policy. Public education would do well to consider, design and implement such a policy. A "No Work, No Play" policy is consistent with sound professional practice. A "No Work, No Play" policy would require academically talented individuals to "work" (perhaps at advanced levels) in order to "play." Students would not be able to simply pass the class without working and enjoy the rewards of participatory play. It is difficult to imagine the impact of such a policy if adopted and observed in every school. Students who work hard would be recognized and rewarded for their diligence. Graduates would soon develop a new and healthier attitude towards work and as such live healthier and more produc-

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THEME

Agricultural Science — Striving For Excellence

By Wesley E. Budke, Theme Editor

(Dr. Budke is Associate Professor, Department of Agricultural Education, The Ohio State University.)

In recent years there have been numerous forces challenging agriculture and agricultural education in America. The Committee on Agricultural Education in the Secondary Schools (1988) identified thirteen social, economic, and technical changes or advancements influencing the context of American agriculture including the following: demographics, urbanization, lifestyle changes, new biotechnological techniques, and public expectations about the role of schools. These forces are causing agricultural educators at all levels (instructors in local schools, state supervisory staff, and teacher educators) to re-examine the mission and purpose of agricultural education in the secondary schools. What is our purpose? Who are our clients? What are we preparing them for? The pressure for redirection of focus in local agricultural education programs becomes very real in the face of decreasing enrollment in agricultural education programs, the increasing emphasis on science in the school curriculum, the reduction in the number of people involved in production agriculture, an increase in the number of people involved in agriculture related occupations, and the increased scientific and technological nature of agriculture. This is good reason why the Committee on Agricultural Education in the Secondary Schools focused their recommendations on:

- Goals for instruction in agriculture.
- The subject matter and skills that should be stressed in curricula for different groups of students.
- Policy changes needed at the local, state, and national levels to facilitate the new and revised agricultural education programs in secondary schools.

A logical program change in agricultural education is toward increased emphasis on biological and physical science principles directly addressing the increasing scientific nature of agriculture and appealing to a broader audience of students who are interested in science oriented agriculturally related occupations. Agriculture provides an ideal setting for demonstrating and applying biological science and physical science principles. This is an opportunity for students to apply their classroom learning in a live setting. Along with this realism in learning comes stimulated interest, facilitated understanding, and increased appreciation of science and agriculture.

Agriculture teachers have always incorporated science principles into their curriculum and teaching. Agriculture provides a marvelous vehicle for teaching genetics, photosynthesis, nutrition, pollution control, water quality, reproduction, food processing where real live examples can become part of the classroom for experimentation and observation. In the agricultural mechanics instruction area, physical science principles applications abound. But now, it is more important than ever for teachers of agriculture to incorporate increasingly complex science applications into their teaching to reflect the state-of-the-art in agriculture; biotechnology being one example. Instructional programs in agriculture must be redesigned and presented to appeal to a broader audience of students, including those who may be college bound or interested in science oriented agriculturally related occupations. Teaching relationships must be developed between the agriculture teacher and the physics, chemistry, biology, earth science, and general science teachers in order to compliment each others expertise and share teaching environments, facilities, and equipment.

It is time for those of us involved in agricultural education to reaffirm our commitment to agriculture and to agricultural education. Agricultural educators at every level must realize that a change in educational programming is absolutely necessary to respond to changing client groups and their changing information needs. To do nothing is to fail and fade away. The recently published *Strategic Plan for Agricultural Education* provides the focus and the call to action.

But, where to begin! This seemingly overwhelming task requires simultaneous efforts by agricultural educators across America at all levels, addressing the many aspects and components of agricultural science programs. These program aspects or components include: curriculum development, laboratory activities, facilities, student recruitment, supervised agricultural experience programs, student recruitment, supervised agricultural experience programs, coordination with science teachers and in-service programs for agricultural education instructors and supervisors.

Agricultural instructors, state supervisory personnel, and teacher educators in every state are hard at work identifying which clientele are to be served, determining how these changing clientele groups will be served, evaluating existing agriculture curriculum and instructional delivery systems, and planning innovative and relevant educational programs to meet the needs of old and new clients. The following series of articles address several of the critical components of program and personnel development in agricultural science. The

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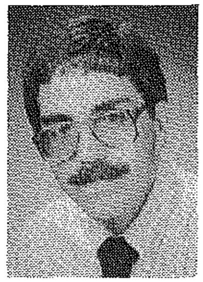
Computer Technology Resources
Putting A Handle on Computing Power



By Nat Jaeggli, Special Editor
(Mr. Jaeggli is Instructor, Department of Agricultural Education, University of Arizona.)

"If it were easier to take my computer with me I'd probably use it more often." You may have said that recently to yourself or to anyone who would listen. Moving your PC's system unit, keyboard and monitor can be a daunting experience. In my last article I talked about the perils of moving a computer, probably a desktop system, from one spot to another. In this installment I'm encouraging you to find a package which makes that a practical proposition.

Portable computers combine those separate system components into a hinged and compact package complete with handles, cases and straps. Like desktop computers, portables come in a variety of configurations, features and options. "Transportable or Luggable" computers are the heaviest version of the portables, weighing 15-25 lbs., and generally are AC powered only. These are sometimes characterized as "Lunch Box or Sewing Machines" because of their shape and size. "Laptops" are battery, as well as AC powered, may fit comfortably on your lap and weight 10-12 lbs. One of the fastest growing categories is the "Notebook" computer which is about the size of a three-ring binder, one to two inches thick and may weigh less than 8 lbs. The term "Clamshell" is used to describe notebook and laptop computers whose screen hinges up to reveal the keyboard. "Pocket or Handheld" computers are just a little larger than a calculator, and weigh between 2-4 lbs.

Determining which portable type is best depends primarily on the computing tasks, and budget. As new products are released and performance of older ones improved, it's expected that portables will become smaller and prices will continue to fall; currently prices range from $200-$8500.

If this computer is both traveling partner and deskmate, don't settle for "just a portable box." It must have the processing power capable of sorting your largest database, or crunching spreadsheet problems. Even if you're not doing them yet, give yourself room to grow. A processor capable of 16 mhz, and 2 meg of RAM expandable to 8 meg should be a minimum. Hard disk drives are no longer just "nice to have;" they are a must, and many portables come standard with 20-40 meg drives. An internal "floppy disk drive" (3.5", 5.25" or both in some luggables) adds to the flexibility of the computer. Some smaller portables lack "FDD's" and can only load additional programs to the hard disk from a special external drive or by cabling to the hard disk to a desktop computer.

"Displays" are often the weakest element of portable computers. Even some of the best displays are difficult to view unless seated directly in front, a distracting feature when instructing others. An external video port allows the use of a conventional monitor or an "LCD projection panel" when needed.

The keyboard of many portables is just adequate. There's no standard key arrangement like that found on full-size desktop computers; it's as if the manufacturers put the keys where there was room and not in any particular order. Although the keyboard is an integrated element of most portables and cannot be removed, an optional "standard" keyboard might be attached while working at your desk. Attention to keyboard detail, placement and feel of the keys could save you many hours of frustration in the future.

The type of battery power and how it is used varies greatly between manufacturers. When comparing portables, you should be aware of the expected battery life, recharge rate, and price of additional battery packs. While some portables use standard batteries, others use special batteries available from the manufacturer only. Batteries are also the heaviest part of a portable package; be sure they are included as part of the weight and price.

Portable computers add yet another dimension to a communication tool many are still learning to use effectively. Portables bring computing power directly to a problem, which can also mean more direct solutions.

REFERENCES

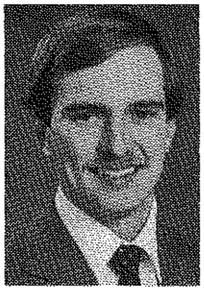
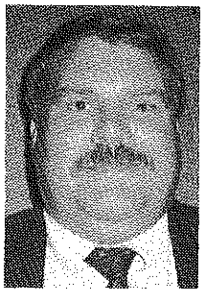
"The Portable: The Next PC You'll Buy," PC Magazine, March 13, 1990, pp. 97.

"Power Portables: The Next Wave," PC Magazine, October 16, 1990, pp. 99.

About the Cover

The illustration is a design created by Ed Osborne for the course development project "Biological Science Applications in Agriculture sponsored by Illinois State Board of Education through Facilitating Coordination in Agricultural Education (FCAE).

Agriculture and Science: Linkages For The Future

By Jack Elliot, Jim Connors and Al Steeby

(Dr. Elliot is Assistant Professor, Department of Agricultural and Extension Education, Michigan State University.)

(Mr. Connors is Graduate Assistant, Department of Agricultural and Extension Education, Michigan State University.)

(Mr. Steeby is Agriscience Educator, Caledonia High School, Caledonia, Michigan.)

As secondary schools increase graduation requirements, elective classes (including most secondary agricultural classes) continually battle for enrollment. In order to meet the needs of today's students and to transfer agricultural classes from an elective category, Michigan agriscience and natural resources educators have laid the groundwork for a new cooperation between agriscience and natural resources instructors and other high school science teachers.

The Michigan State Department of Education has initiated a total restructuring of the secondary agricultural curriculum. The new curriculum, titled Agriscience and Natural Resources Education, includes four core units: Natural Resources and Michigan Agriculture, Plant Science, Animal Science, and Business Management and Marketing. Each unit serves as a semester course.

These four units were developed through a unique interaction among teacher educators, agriscience and natural resources instructors, high school science teachers, Michigan Department of Education personnel, Michigan State University (MSU) faculty and representatives from business and industry. The primary goal of the curriculum project is to utilize agricultural content and experiences as a context for integrating principles and concepts from many disciplines. The curriculum focuses on utilizing content as a means for: developing critical thinking abilities; improving basic skills such as reading, writing, and arithmetic; making decisions; and solving problems. The application of these concepts and principles occurs in the areas of agriscience and agribusiness. The curriculum is cross-referenced with the Michigan objectives for science education, and is designed to meet local high school graduation requirements and university admissions' requirements.

Many agriscience and natural resources programs have been physically and administratively moved to science departments. Over ninety percent of Michigan's agriscience and natural resources educators are certified to teach science, and sixty percent of the educators have taught a non-agriscience science class. Team-teaching with other science teachers is a reality with many Michigan agriscience and natural resources educators. However, several distinct differences exist between agriscience and natural resources programs and classes traditionally taught in science departments. Unlike traditional science classes, this new curriculum reinforces classroom learning with participation in youth leadership organizations (FFA) and supervised experience programs.

To supplement the core curriculum, a total of seven advanced/specialized units are being developed. The advanced units include areas such as business management and marketing, horticulture, animal science, mechanics, plant and soil science, natural resources management, and advanced placement. The advanced placement classes will qualify as MSU credits. These advanced units, when taught in addition to the core units, serve as an option for high schools that desire a four-year agriscience and natural resources program. The new agriscience and natural resources curriculum is easily adapted to both comprehensive high schools and area career centers.

Comprehensive High School

The Agriscience and Natural Resources Education (ANRE) program at Caledonia, Michigan is in a state of transition. Upon completion of a new high school in 1989, the Caledonia district placed the ANRE program physically and administratively within the science department. The program uses one of the four labs in the new science wing, a greenhouse, shared storage rooms and a staff office. The science department has four full-time instructors, including the agriscience and natural resources instructor, who are working together to effect planned change in science instruction at Caledonia.

At present, the ANRE curriculum is realigned to reflect the orientation of the first two years of science instruction at Caledonia. Ninth graders take a full year of physical soil science, which corresponds to the earth science classes taught by other instructors. Tenth graders take a full year of plant and animal sciences, which corresponds to the biology classes. Eleventh and twelfth graders may choose between Advanced Plant and Animal Science or Agriscience: Business Management and Marketing.

The Caledonia ANRE program continues to emphasize personal leadership development through FFA, and occupa-

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Science In Agriculture

By Steven J. Gratz
(Mr. Gratz is State Supervisor, Agricultural Education Service, Division of Vocational and Career Education, Ohio.)

When I entered the teaching profession, I was considered a Vocational Agriculture teacher and I taught students production agriculture in courses called Vo-Ag I, Vo-Ag II, Vo-Ag III, and Vo-Ag IV. Within a few years I changed to become a teacher of Agricultural Education. I taught students Agriscience in courses called Agriscience 100, Agriscience 200, Agriscience 300, Agriscience 400 and Agricultural Options. By changing the name of the program and the curriculum I broadened the program to meet the needs of the young women and men who were pursuing careers throughout the agricultural industry. I try to think what it would have been like to teach in the 1930s and 40s, when the vocational agriculture teacher prepared young men for a future in farming, and when all students carried livestock and crop projects. As our clientele changes, so must our curriculum. Changing the name of the program or course work will not change the outcome of our students or increase enrollment. If it does, the change will only be temporary.

As an agriscience instructor I thought I was being progressive, on the cutting edge of the agricultural education profession, but I was criticized by neighboring vo-ag departments, parents, university personnel, and a few students for making changes that were considered in their eyes only superficial and cosmetic in nature. The superintendent even had a meeting with the principal and myself after several letters appeared in the editor's section of the local paper. All of this because of a name change. Fortunately, the curriculum supported the name change and the program better served the needs of the students and community.

Today, in agricultural education, we are encouraging our teachers to instruct students in agricultural science. In 1986, the U.S. Department of Agriculture issued the report, Employment Opportunities for College Graduates in the Food and Agricultural Sciences, that indicated there is a 10% shortfall of new college graduates with expertise in agriculture, natural resources, veterinary medicine, and closely allied fields. The report summarizes that today is still an exciting time to be involved in the food and agricultural system. The pursuit of scientific and technological developments offers impressive challenges to future graduates (Higher Education Programs, 1986). As a result, we have seen secondary agriculture education programs prepare students to enter the job market directly out of high school with an increased level of competencies learned and with the ability to successfully pursue postsecondary education.

As a supervisor of agricultural education, supervising schools has given me the opportunity to visit schools across the state that call their departments Vocational Agriculture or Agricultural Education. Some of their classes are entitled Vo-Ag, Production Agriculture, Agriscience, Agricultural Science and Technology, or Agriscience and Leadership Development. Of course, when I visit an Agricultural Education department with courses offered in Agriscience, I expect to see agriculture being taught that is influenced with science. The most science I have observed being taught this past year was in a Vo-Ag III/IV class. The teacher was teaching a unit on animal nutrition and was illustrating how protein contained in a ration was broken down into amino acids and how animals utilize the essential amino acids. The students were drawing chemical diagrams in their notes and realized the importance of the carboxyl group attached to certain amino acids.

Development. Of course, when I visit an Agricultural Educa-

As teachers change their courses they will need to identify resources to accommodate their new and improved program. In Ohio, the Curriculum Materials Service, located at The Ohio State University, has several new items along with previous materials that will aid with the instruction of agriscience. The Curriculum Materials Service is currently developing Agricultural Science Activity Sheets. The Activity sheets are demonstrations and laboratory exercises that assist teachers with the infusion of science into their lesson plans.

Applied Biology/Chemistry

I have the pleasure to be the consortium representative for Ohio on the development of the Applied Biology/Chemistry (ABC) course that is being developed by the Center for Occupational Research and Development (CORD). Within the ABC course, twelve separate units are being developed. Each unit will last approximately six weeks. The units come complete with a teacher's guide, lesson plan and student workbook. The units contain laboratories and demonstrations to apply the competencies being taught. The unit titles are: Natural Resources, Water, Plant Growth and Reproduction, Nutrition, Continuity of Life, Air and Other Gases, Disease and Wellness, Life Processes, Waste and Waste Management, Synthetic Materials, Community of Life, and Microorganisms. The first seven units will be developed in time for a field test during the 1990-91 school year. The last five units will be developed at a later date, as project funding permits.

The rationale CORD used to begin the development of the ABC course came because of criticism that U.S. educa-

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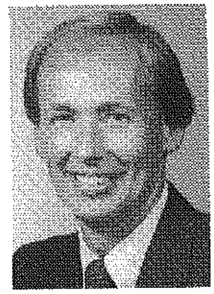
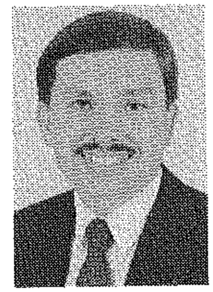
THEME

Biological Science Applications in Agriculture

Agriculture is an applied science. Effective management of agricultural enterprises requires a knowledge of basic concepts and principles drawn from the biological and physical sciences. Using science fundamentals to solve agricultural problems has resulted in astonishing new technologies for agriculture. These technologies are creating constant change in nearly all phases of the vast agricultural industry.

Still, teachers of today face two major problems. First, many Americans have little understanding and appreciation for the key role that agriculture plays in our daily lives. Our educational programs have been targeted primarily toward those with an interest in agriculture, often as a part-time or full-time wage earning occupation. Our delivery system in agricultural education has done little to educate the other 80% of Americans who will not be involved in agriculture in these ways. Secondly, the scientific literacy of high school graduates nationwide is perhaps even worse, especially given the amount of time devoted to science instruction in the secondary schools. At least in agriculture, we have not tried and failed. Instead, we have not yet attempted in most cases to take agricultural instruction to the entire student population in the secondary schools.





By Edward W. Osborne and Jeff Moss

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(Dr. Moss is Visiting Assistant Professor, Department of Agricultural Education, University of Illinois at Urbana-Champaign.)

A Proposed Response

High school agricultural curricula are becoming more science and business based. In teaching more science, greater attention is being given to why agricultural practices are done as they are. Traditionally, vocational agriculture has done an excellent job of teaching students the what and how in agriculture. The focus of our teaching has been on knowledge and skill development in the practices in agriculture. More recently, however, we have begun to recognize the importance of also teaching our students more about why certain management practices are performed.

The 1988 National Academy of Sciences report on agricultural education strongly recommended that applied science courses on agricultural topics be made available at the high school level. Similarly, the American Association for the Advancement of Science, in its recent publication *Science for All Americans — Project 2061*, stated that school curricula must pay more attention to the connections among science and technology, including agriculture. The report further stated that the teaching of science would start with questions rather than answers, engaging students in hands-on learning that stimulates students' curiosity and creativity.

In response to these trends and conditions in agricultural education and education in general, faculty at the University of Illinois pursued funding to develop course outlines and teaching materials for two new courses in secondary agricultural education. The Illinois Committee on Agricultural Education, a group of agribusiness and industry leaders appointed by the Governor to support improvement in agricultural education, approved funding for the project. The new courses were designed to: (1) be taught by agriculture teachers, (2) be approved for science credit at the local level, as well as for admission to colleges and universities, and (3) attract a broader student audience into agricultural education in all Illinois high schools by complementing the vocational agriculture portion of the secondary agricultural education program in a given school. The primary intent of the new courses is to serve as a solid starting point for developing a non-vocational, agricultural literacy component of agricultural education in the secondary schools.

Course Description

Two courses, each one semester in length, have been developed. A teacher's guide for the first course, Biological Science Applications in Agriculture (BSAA) — Plant Science, has been developed and distributed to secondary agriculture teachers. A companion course in Physical Science Applications in Agriculture has been outlined and will be fully developed in 1991. The BSAA course is designed to reinforce and extend students' understanding of science by associated basic scientific principles and concepts with relevant applications in agriculture. Students will consider major crop management decisions in light of specific biological science concepts that govern plant growth. The BSAA course will deepen students understanding of science as content and as process through exclusive use of experiments. The following objective have been developed for the BSAA course:

1. to reinforce and extend students' understanding of basic biological science concepts.
2. to illustrate agricultural applications of biological science concepts and principles.

3. to develop students' science process skills.
4. to stimulate greater interest in studying and working in science and agriculture.
5. to create greater awareness and understanding of the nature and importance of the agricultural industry to all citizens.
6. to develop leadership and entrepreneurial skills.
7. to inform students of the career opportunities in the food and agricultural sciences.
8. to contribute toward mastery of the four State Goals for Learning in the biological sciences.

Teaching Approaches

The BSAA course is designed to be taught totally through student inquiry and discovery learning. To accomplish this, problem-solving teaching is used as the teaching approach, with experiments, supervised study and group and classroom discussion used as the primary teaching techniques. Students will be active as learners. Teachers will use a process of uncovering rather than covering as they teach. Teaching and learning in the course will involve experimenting, questioning, problem solving, and researching. As a result, high potential exists for student gains in agricultural knowledge and practice, science concepts and principles, science process/research skills, creativity, thinking skills, motivation, and leadership ability.

Major areas of study in the BSAA course include scientific investigation, environmental relationships, initiating and managing plant growth, reproduction, and processing plant products. The Teacher's Guide for the BSAA — Plant Science course contains a total of 35 lessons. Each lesson plan includes a description of agricultural applications and practices, an interest approach, a set of "why" questions for investigation, teacher objectives, lab materials and equipment needed, experimental procedures, suggestions for data summary and analysis, anticipated findings, ideas for additional experiments, and underlying science concepts.

The experiment on herbicide applications raises many questions about the rate and degree of injury as the plant species and other factors are varied.

The lesson on herbicide application serves as a good example for illustrating the subject matter focus of this new course. Typically, an agriculture teacher would teach this topic by discussing types of herbicides, application equipment and methods, safety, and similar topics. In other words, the focus would be on developing basic knowledge of herbicides and how they should be applied. This emphasis on the what and how of herbicide use is very appropriate, given the purpose of instruction in vocational agriculture. However, in this new course, which has much broader purposes, the instructional focus is on why herbicides are applied as they are. For example, the science questions for investigation include such questions as (1) Why are some herbicides selective in their effects on plants?, (2) Why do climatic conditions affect herbicide effectiveness?, (3) How do plant characteristics and life processes affect herbicide activity within the plant?, (4) How do herbicides enter the plant?, and (5) How do herbicides work within the plant to cause injury and death? Relevant plant biology concepts include absorption, diffusion, metabolism, osmosis, selectivity, toxicity and translocation.

By clearly connecting agricultural practices with science principles, student interest and understanding in both agriculture and the sciences should increase. Further, if students understand why agricultural practices are done as they are, then they should be able to make sound management decisions as they work in agriculture, whether it be as an entrepreneur, manager, worker, or simply homeowner or hobbyist. The 35 labs contained in the BSAA — Plant Science Teacher's Guide have applications in a variety of agronomic and horticultural settings.

Who Should Enroll?

Enrollment in the BSAA course is open to all high school students who have completed one year of biology. This includes those with or without previous course work in agriculture. In practice, most students will be juniors or seniors. Whether or not students plan to pursue further schooling, this lab course should increase their interest and understanding of science and improve their overall agricultural and scientific literacy.

Course Implementation

All secondary agriculture teachers in Illinois received the BSAA — Plant Science Teacher's Guide through a series of statewide workshops in October. A group of 35 teachers were then identified to implement the new course during the 1991 spring semester. These "starter teachers" identified a biology teacher colleague in their school to assist with their teaching activities. Workshops were provided in November and December for those 70 teachers to help prepare them for teaching this new course. Pretest and posttest data will be collected from students and teachers in the 35 starter schools to examine the effectiveness of the course. Variables will include achievement in agriculture and biology; problem solving, research, and thinking skills; and overall satisfaction with the course.

During the 1991 spring semester, plans are to identify another set of starter teachers to teach the new course during the 1991-92 school year. In-service workshops are also planned for these teachers, focusing on both the content of the course and how the course should be taught.

Future Development

The Biological Science Applications in Agriculture — Plant Science course represents only a small, first step in developing a substantive agricultural literacy component in secondary agricultural education programs. During 1991, a companion course in physical science applications will be developed. Other courses in biological and physical science applications in agriculture are being considered.

These science application courses are only one type of agricultural literacy course. Other base areas include social science and communications. Certainly there is a limit to the amount of agricultural literacy instruction that a single school can provide, but we are just beginning to explore the possibilities. The science application courses developed in Illinois offer great potential for expanding the audience base to all secondary students, improving the image of agricultural education, and moving agricultural education closer to the center of the educational agenda in public schools. Secondary agriculture programs that have experienced growth in the last five years have modified their curricula in these directions. Future program growth and strength is assured if we continue to complement our successes of the past in agricultural education with creative programming for the future.

No Work, No Play

(Continued from page 3)

tive lives. Society would garner the rewards of a happy productive labor force. The Country would easily regain its status as a world leader.

A "No Work, No Play" policy would, of course, require careful monitoring and would be more difficult to quantify than the simplistic "No Pass, No Play" policy. The premise of the policy would apply only to educational efforts (classes) and extracurricular school activities, not intra-curricular class activities. Teachers would have to start recognizing students for the work they did and not just the scores they made on tests and assignments. For a sizeable number of students the opportunity to succeed by trying hard would encourage them where the current academic scheme has long since discouraged them to the point they do just enough to "get by." A difficulty with the "No Work, No Play" policy is the fact that it would require teachers and administrators to have enough strength of character to deal in a subjective way with students recognizing that what may be acceptable work for one individual may not be acceptable for the next student. This would require a sophisticated level of individualized planning, instruction and an environment in which professional judgments and decisions can be made and supported. Before the "No Work, No Play" policy idea is discounted by the reader, one must recognize the "No Pass, No Play" policy must also be closely and individually applied rather than blindly adopting the concept and attempting to apply it to all students and to all types of educational activities conducted in both school and class settings. The educational value of a well-planned field trip can significantly enrich the educational experience of students. The social studies teacher who does not take advantage of the opportunities to provide students with real life experiences through field trips is robbing the students of an educational enrichment opportunity. The logical extension of the above scenario would ask what difference it makes whether a field trip is arranged by a local teacher to the county courthouse to see how justice is administrated or whether it is an intra-curricular activity arranged by a State Vocational Student Organization Coordinator which involves several schools using the most talented and articulate members of the legal profession in the chambers of the State Supreme Court? A "No Pass, No Play" policy adopted and rigorously applied to all educational activities offered through the school is self defeating and does not make good students, but essentially encourages poor teaching. Teachers soon grow tired of arranging educational enrichment activities for their classes if students are not permitted to participate or if only a few of the more talented ones are involved.

Educators and parents must assess the outcomes of applying such policies prior to adopting and enforcing them. A cursory view and immediate adoption of policies such as "No Pass, No Play," and the simplistic application to extracurricular school activities and intra-curricular class activities equally will provide inaccurate and distorted results. More rational and empirical observations of outcomes must be made prior to any mass adoption of such a policy.

Science In Agriculture

(Continued from page 7)

tion in the 1980s produced high school graduates with fewer academic abilities (National Commission on Excellence in Education, 1983). In response to reports like A NATION AT RISK, many states have increased the academic credits required for high school graduation (Commission for Educational Quality, 1985). Currently Ohio is in the process of raising its requirements to 21 credits for graduation, including 100 hours of community service. The goal has been to upgrade high school graduates' competency levels in communication, computation, and applied science. Educators and employers agree that without these basic competencies high school graduates are ill-equipped to be lifelong learners (National Commission on Excellence in Education, 1983). Furthermore, those who employ high school graduates want higher entry-level competencies than they are receiving (National Commission on Excellence in Education, 1983). While it is true that people who enter the work force immediately after high school might later acquire the required competency levels with postsecondary training, half do not enter a postsecondary institution (Youth and America's Future, 1988). Therefore, producing a work force that is competitive in the global marketplace has become the responsibility of secondary education systems — particularly vocational education systems.

The twelve units will be used differently in Ohio than most other states. The passage of SB 140 and HB 7 empowered the Ohio State Board of Education to prepare a plan of action for accelerating the modernization of vocational education. The Department of Vocational and Career Education has developed an action plan. The plan, "Ohio's Future at Work," contains eleven imperatives that were derived from environmental forces and trends. One of the objectives set forth by the plan states, "Applied academics (science, mathematics, and English/language arts) and technology will be implemented in all secondary occupational programs and will be recommended for full-time adult job specific programs."

Ohio will use the ABC course as: instructional material for applied science classes or students enrolled in programs relating to consumer and vocational home economics, diversified health occupations, and agriculture education; as a preoccupational course in comprehensive high schools for students enrolled in or planning to enroll in the vocational program; and as resource materials for teachers in consumer and vocational home economics, diversified health occupations, and agricultural education programs.

The ABC course should not be used as a replacement of the current agricultural education curriculum. All twelve units use agriculture in their applications. Because agriculture is so prevalent in each unit, it would be easy for teachers to purchase the units to replace their current lessons. The ABC units, which may be purchased separately, will best be utilized in agriculture if used as resource materials and not taught alone and labeled Agriscience. The CORD materials are some of the better materials I have reviewed that will help agriculture teachers infuse science into their programs.

Agricultural education across the country is changing. We as educators must maintain the high standards that we have placed upon ourselves to assure us that we do not fall subject to a cosmetic change in our programs. The CORD materials can ease the transition process of evolving from a traditional production agriculture program to that of agricultural science.

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Agricultural Science — Striving For Excellence

(Continued from page 4)

leadership demonstrated by these authors and their colleagues is indicative of the activities occurring across America. Agricultural educators should take advantage of every opportunity to describe their agricultural science programs, share their curriculum, and boldly provide leadership to build and expand relevant agricultural education programs.

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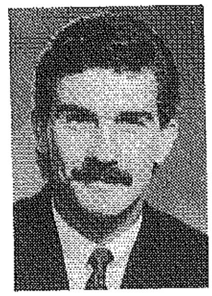
Agriscience Inside and Out



By J. Scott Vernon and Gary E. Briers

(Mr. Vernon is a Graduate Student and Dr. Briers is Professor, Department of Agricultural Education, Texas A&M University.)

When a significant event happens in our lives, we are often able to recount vividly what we were doing on that particular day. Such is the case when we recall the assassination of President Kennedy, Neil Armstrong's first step on the moon, or perhaps the day we watched in pride as our first student received his or her FFA American Farmer Degree. However, few people may recall December 18, 1984, as a day of any specific importance. This was the day the Secretary of Education, the Secretary of Agriculture, and the President of the National Academy of Sciences signed an agreement to sponsor a study of agricultural education (Case, 1986). That study resulted in a 1988 report of the National Research Council entitled *Understanding Agriculture: New Directions for Education;* the report has been one of the most significant writings in agricultural education's history. Serving as a catalyst for change, this report thrust agricultural education into the national spotlight. Agricultural education responded with a new and progressive emphasis — a shift to Agriscience.

In light of changes in contemporary agriculture, the term agriscience seems to fit nicely, but is it only a superficial name change? This along with other questions comes to mind — questions like: Are we really adopting a more scientific approach in teaching agriculture? Can we justify our place alongside the folks in the science departments across our nation's high schools? If we looked into today's agriscience classroom, would we see the products of change or simply a fresh coat of paint on the same old delivery systems?

The National FFA organization has recognized the importance of agriscience and has adopted programs to promote scientific agriculture in secondary agricultural education (Duval, 1988). One notable program is the Agriscience Teacher of the Year Award Program. Established in 1986, the program recognizes vocational agriculture teachers for their contributions in the area of agriscience education. Additionally, the National FFA has developed an award program to recognize students for their achievements in agriscience. These programs, along with a concerted professional focus, have had a significant impact on the way people look at secondary agricultural education. Yes, the picture has changed and it is more than just a new coat of paint.

Curriculum Changes

H. Ross Perot's 1984 story about the road weary show chicken is now classic. (Ask Jay Eudy of Texas if you have not heard it!) Almost at the point of extinction, Texas vocational agriculture teachers, teacher educators, and the Texas Education Agency went on the offensive in response to Perot's verbal attack. Developing 23 agriscience semester courses, Texas was not only able to save its program, but also enrollment grew by impressive numbers. Today these courses reflect a more contemporary agriculture. With room to grow and mature, these courses focus on the science and technology of agriculture.

During the early to middle 1980's, California vocational agriculture was experiencing the pressure of the educational reform movement. In a "pendulum swing" back to the basics, school districts began increasing high school graduation requirements to include more math, science, and English. And, not only were there increased graduation requirements, but also colleges and universities were increasing their enrollment requirements. Caught between the proverbial rock and a hard place, California vocational agriculture teachers launched a grassroots campaign to get approved science credit for agriculture classes. Working with the University of California, the State Department of Education, and local school boards, agriculture teachers cross-referenced the essential elements of the State Science Core curriculum with the State Agriculture Science Core curriculum. School boards found similar elements and competencies in science and agriculture, so they began granting science graduation credit to agriculture courses. Several schools have developed courses that meet college entrance requirements for the University of California.

How Do We Look and Act In An Agriscience Classroom?

As Malpiedi (1989) points out, we have to be cognizant of our skeptics. We cannot, in one broad sweep, change our name, but ignore changes needed in our methods and curriculum. If secondary agricultural education is going to position itself alongside "regular" science, should it not adopt some of the practices of science? Practices such as guided investigations in theory, the use of scientific concepts and principles, and planned laboratory exercises? One might argue that we've successfully employed problem solving methods, or that we've always conducted guided laboratory exercises. Granted that is true, but more often than not, they were probably labs that entailed common animal husbandry techniques or production-oriented seed trials.

Today's agriscience laboratories should be designed and used in a manner more parallel with science. This will mean

Agriscience laboratory parallel those found in science departments. (Photo courtesy California State Department of Education.)

developing a lab that looks like a lab — the kind with test tubes, microscopes, and chemical reagents. Vocational agriculture teachers, in our training, have experience in college science laboratories, but do we know specifically what is needed in a lab? The Fullerton High School Department of Agriculture, along with vocational agriculture teachers, science teachers, and teacher educators throughout California, have developed a list of items needed in today's agriscience classroom. This list should serve as a guideline in purchasing supplies and equipment.

Equipment

Animal cage
Artificial light
Triple beam scale
Beakers
Candlers Computer with Spreadsheet
Crucibles
Dissecting trays
Dissecting microscopes
Forceps
Funnels
Glass jar/lids
Graduated cylinders
Hand lens
Hot plates
Light microscopes
Plastic trays/lids (20x30x10 cm)
Probes
Rulers/meter sticks
Scalpels
Simplex soil testing kit
Test tube holders
Test tube racks
Thermometer
Bunsen burners

Chemicals

Alcohol
Benedicts solution
Blue stain
Crystal violet stain
Fungicidal powder
Iodine
Methyl blue dye
Multiple color dyes
Rooting hormone
Sulfur dioxide gas
Testosterone

Supplies and Materials

Acetate sheets
Cellophane tape
Cotton
Cover slips
Digestive tracts
Flowers & plants
Hypodermic needle/syringe
Lens paper
Medicine bottles
Medicine droppers
Microscope slides
Petri dishes
Petroleum jelly
Pins
Pipettes
Planting flats
Polyethylene bags
Potting soils
Poultry parts
Rubber cement
Test tubes
Wax pencils

Specimen Supplies

3 day old cockerels
Planaria
Preserved grasshoppers
Small rats
Vinegar eels
Yeast

Prepared Slides

Assorted animals/plants
Bacteria
Leaf
Mitosis/Meiosis
Root/Stem
Tapeworm/Trichina

These and other materials may be purchased from biological supply companies in your area. Companies handling these materials include:

Nasco Agricultural Sciences
1524 Princeton Ave.
Modesto, California 95352-3837
(209) 529-6957

Nasco
901 Janesville Ave.
Fort Atkinson, WI 53538
(414) 563-2446

Kimble Science Products
2640 Fountainview
Suite 240
Houston, Texas 77057
(713) 266-5780

Carolina Biological Supply
2700 York Ave.
Burlington, N.C. 27215
(800) 334-6957

Greg Beard and Sheila Barrett use the computer laboratory for agriscience students at Fullerton High School. (Photo courtesy of California State Department of Education.)

Safety Precautions

Like the agricultural mechanics laboratory, the new agriscience classrooms have inherent safety risks. Teachers should be aware of the appropriate regulations and safety procedures needed to conduct a safe and active agriscience laboratory. The following list outlines some essential rules and regulations for students in an agriscience laboratory:

1. Never horse around in the laboratory.
2. Never play with laboratory equipment or materials.
3. Always follow instructions and wait until you are told to begin before starting any investigation.
4. Never carry out any unassigned investigation.
5. Never eat, or taste anything in the laboratory. This includes food, drink, and gum as well as chemicals found in the lab.
6. Wash hands after every experiment.
7. Keep all books and non-essential items away from work area.
8. Keep your work area clean. Dispose of waste materials in appropriate containers.
9. Turn off any gas jets or electrically operated equipment when you have completed assigned investigation.
10. Report ALL injuries or accidents to your teacher immediately.

(Continued on page 23)

Agriculture and Science: Linkages For The Future

(Continued from page 6)

tional exploration and development through supervised experience. Both FFA and supervised experience at Caledonia are in a state of transition as well. The community is on the southeastern side of Grand Rapids and is one of the fastest growing areas in Michigan. Though production agriculture still plays an important role in the local economy, diversified opportunities in agribusiness, landscaping and recreation will assume a larger role in the future. Challenges to the ANRE program and instructor lie in accommodating the changing needs of both the Caledonia students and the community.

The Caledonia school district, with the aid of several restructuring grants from the State of Michigan, is planning change throughout its schools. Beginning in 1990, the science department at Caledonia will embark on an ambitious project. Using the National Research Council's UNDERSTANDING AGRICULTURE: NEW DIRECTIONS FOR EDUCATION (1988) and the American Association for the Advancement of Science's SCIENCE FOR ALL AMERICANS: A PROJECT 2061 REPORT (1989) as a base, the department will undertake curriculum revision to design a common two-year program of science instruction for all ninth and tenth graders. The program will be vertically integrated with the K-8 curriculum as the project progresses. Called Science, Technology and Society (STS), the project will seek to eliminate the current deficiencies in the science curriculum. A common core of elements including agriscience, natural science, physics and chemistry will be designed for all students. Currently, students may be exposed to one or two of these elements, but not all. The project will seek to include some form of appropriate supervised experience for all students, based on the success rate of students in supervised experience in the ANRE program. Courses for juniors and seniors will continue to be developed based on student and program needs.

The change in emphasis from the "how" of vocational agriculture to the "why" of agriscience and natural resources has made it possible for the Caledonia program to serve a wider population of students. "Together We Can" applies to more than just agricultural educators, it applies to collaboration with our colleagues in other disciplines. As Bob Moawad observes, "It's not who we think we are that holds us back, it's who we think we're not!"

Area Career Centers

Area career centers in Michigan also reflect the new linkage between agricultural education and science. Area center agriscience and natural resources instructors who have traditionally prepared students for entry-level jobs in certain vocations currently emphasize the need for students to understand science principles related to their areas of specialization. Programs such as horticulture, floriculture, and production agriculture rely heavily on science principles.

In Michigan, most career centers offer two sessions each day, lasting from 2 to 2½ hours. In many programs, students are instructed in science principles during the first hour of class time, and a laboratory exercise is conducted during the remainder of the period. This procedure allows students an opportunity to receive both formal instruction in the classroom and experiential learning in the laboratory.

Students in specialty areas such as horticulture or floriculture usually cover the entire plant science curriculum and supplement their training by covering one of the other curriculum areas. Supplemental areas include Natural Resources and Michigan Agriculture, Business Management and Marketing, or one of the other advanced/specialized units. These units offer students a well-rounded knowledge of the scientific principles and business skills needed to succeed in tomorrow's agriculture and provide science credits toward graduation requirements.

As in the past, change remains an ongoing occurrence in agricultural education. New curriculums, programs, and activities are needed to meet the challenges that agriscience demands. It is through change that the linkage between agriculture and science was born. It is only through change that agriscience and natural resources education will continue to grow and prosper.

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Hydroponics On A Budget

Hydroponics is one aspect of horticulture which has aroused the interest of many people, including agriculture instructors. I was no different. I was intrigued by the potential to raise plants without having the usual concerns most gardeners have: soil tilth and fertility, weeds, watering, insects, hot dry winds and so on. I also felt hydroponics could supplement classroom experiences in horticulture, plant science, and the use of fertilizers. The limiting factor for me, probably for other instructors, was financing.

BY DALE R. CARPENTIER

(Mr. Carpentier is Graduate Assistant in Agricultural Education, The University of Georgia.)

Many people think of hydroponics as a new technology that uses large greenhouses and huge tanks of water to "grow tasteless vegetables." According to Bridwell (1989), " . . . modern hydroponics is a revival and development of methods that go back almost 300 years" (p.16). Bridwell (1989) also states, "Hydroponics is a principle. It can be applied on simple or complex levels" (p. 18). One of the more complex hydroponic greenhouse operations in a vocational agriculture program is described by Queen and Iverson (1989) in the October 1989 issue of *The Agricultural Education Magazine.* They described the Georgia school's year round hydroponic system of producing Bib lettuce for the restaurant trade in Atlanta. Handwerker and Neufville (1989) described a simpler "hydroponic garden," but one that was still cost prohibitive for my situation.

While reading Bridwell's book, *Hydroponic gardening* (1989), I came across an idea for a small hydroponic system and modified it to suit my situation. The text and pictures which follow describe how I construct a small hydroponic lab for use in the classroom with a minimum investment of time and money.

The materials needed for this project consisted of the following.

1. Two one gallon or #10 cans that were designed to hold a liquid worked best for this project. Coffee cans did not work well because they were prone to rust.
2. A six inch piece of .030" copper refrigerator tubing was purchased at a local hardware store at a cost of $.29 per foot.
3. Non-toxic flexible tubing to slip over the copper tubing was purchased at the same store at a cost of $0.07 per foot. Three feet of 1/8" ID x 3/16" OD x 1/32" wall was needed.

One can was used for the growing container, the other contained the nutrient solution. The cans were free, thus the total cost of materials for this project was approximately $0.36 plus tax.

The procedure to construct this project included the following tools and supplies.

1. A tubing cutter was used to cut the copper tubing into three inch lengths. The ends were reamed out to prevent the restriction to the flow of liquids.
2. A pliers was very useful for holding the tubing when cutting, reaming, and soldering.
3. A hole was drilled approximately one inch from the bottom of each can, the same size as the copper tubing.
4. After drilling the holes, the area around the holes and the copper tubing was cleaned thoroughly and then soldering flux was applied to both surfaces.
5. The copper tubing was inserted approximately one-and-one-half inches into the holes in the cans and heat was applied to the copper tubing. Solder was applied to the joint carefully so as not to apply too much solder. The copper tubing was checked after soldering to insure it was not plugged with solder.

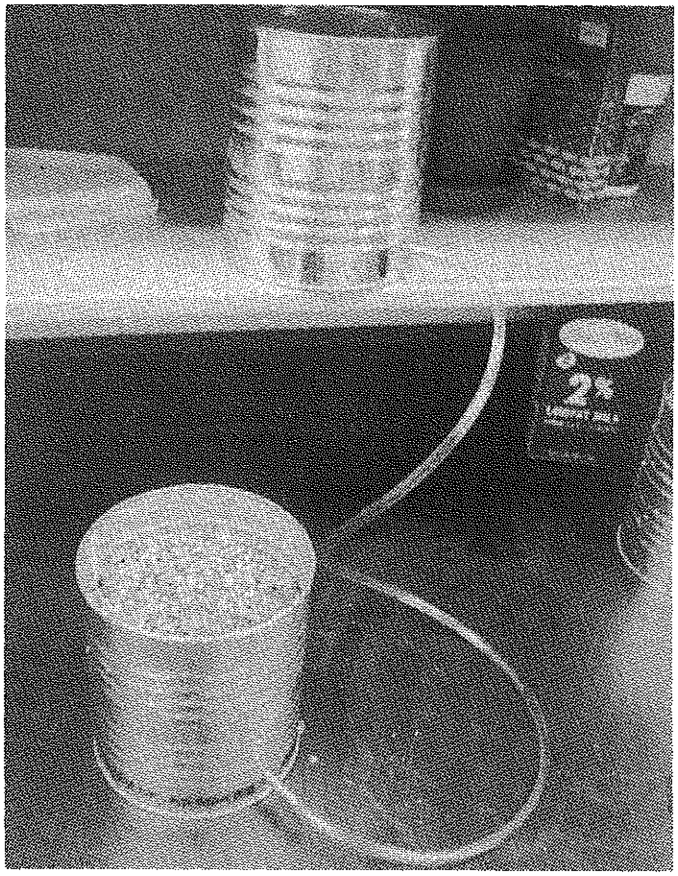
When the cans cooled they were washed thoroughly and then sterilized. The clear tubing was also cleaned and sterilized. Sterilization was accomplished by washing in hot sudsy water followed by a rinse in hot water and bleach and one final rinse in hot water. When the sterilization process was completed, the clear tubing was slipped over the copper tubing. This produced a leak-proof seal; however, clamps should be used if leakage occurs.

There are a wide variety of growing mediums which can be used in a hydroponic system. The medium I chose was small gravel, 3/16" diameter. Gravel is an excellent growing medium because it allows water, air, and roots to move through it very easily. It provides good support for plant roots and plants are easily removed from it which facilitates cleaning and sterilization of the used growing media. In addition it is easy to find and is usually free or of little cost.

A large grain sieve worked well for screening the material. After the material was screened it was rinsed, washed, and sterilized to remove any disease and foreign material.

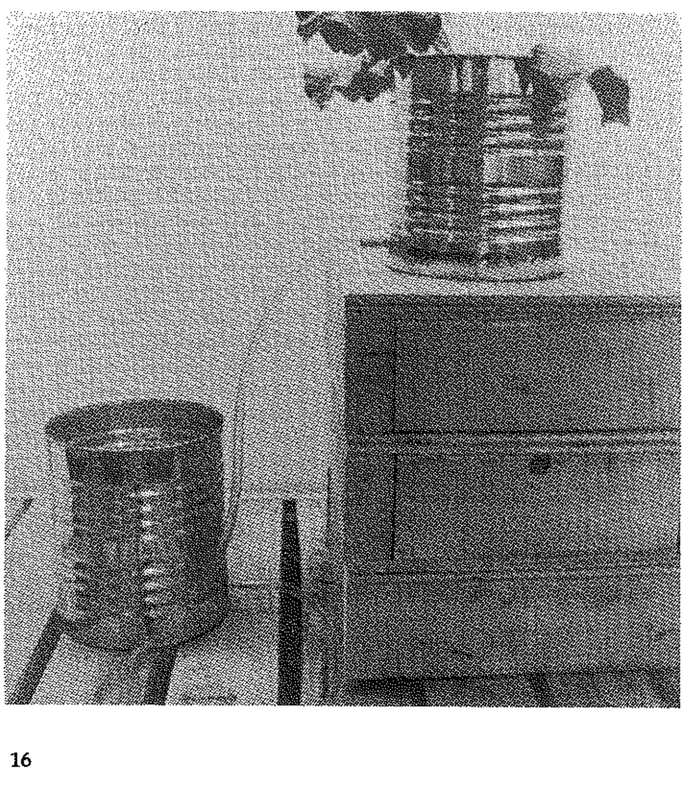
One of the cans was filled to within one inch of the top with the growing medium. Water was added to this can until the liquid covered the growing medium; then the water was allowed to drain into the reservoir can. The height of the water in the reservoir can was marked to indicate when additional water was needed. A final check for leaks was also carried out.

The system was then ready for seed or transplants. Large seeds were sown directly into the gravel. Floral foam, which is used in florist shops for flower arrangements, was used with small seeds. The floral foam was put directly into the gravel and the small seeds sown into the floral foam. Small



seeds can also be started in soil and then transferred after the plant develops true leaves and a root system.

Watering was accomplished by elevating the reservoir can above the growing container. When the reservoir can was through draining, the cans were reversed. When I was in a hurry the nutrient solution was poured into the growing container and then allowed to drain back into the reservoir can.



This process of watering the plant was done 4 times per day. When the plant began to wilt between waterings the frequency was increased during the day. It is recommended that plants **not** be watered during the night when the lights are out. According to Bridwell (1989), "If the root is too wet at night, you interfere with plant metabolism" (p. 182).

Hydroponically grown plants require the same nutrients as plants grown in soil, however, all of the nutrients must be applied with the water. There are a number of water soluble fertilizers which can be used in the system to supply the macronutrients. The micronutrients which are needed can be purchased from a hydroponics supplier.

The nutrient solution was changed every 4 to 7 days. This kept the nutrient level at an acceptable level. As the plants take nutrients from the water and water evaporates, the concentration of nutrients changes. It is easier to simply change the solution than to purchase a parts-per-million meter to detect the changes. After three or four nutrient changes, distilled water, or tap water low in salts, should be used to flush the system of salts which may be accumulated.

Temperature, day length, and light quality must also be considered. An effort must be made to match the plants to the environment in which they will be growing.

I discovered that warm season plants responded best in areas where the temperature was maintained at or above 70 degrees F. Areas which had more temperature variation, especially cooler night temperatures, favored the cool season plants. Experimenting is the best way to discover which plants work best in your situation.

Temperature is often hard to change in a school but the day length and light quality can be modified. I controlled day length by using fluorescent lights with an electric timer. Keeping the plant next to a sunny window or by placing the light within 12 inches of the plant will insure proper light quality.

This is a small and simple hydroponic system but it demonstrates well the principles of hydroponics. Students can build their own system for a minimum cost in time, labor and materials. This system could be expanded to use a 5 gallon bucket for the nutrient reservoir and several growing containers connected to it. If a larger, low-cost system is desired which is more automated, one could construct a hydroponic garden like the one described by Handwerker and Neufville (1989).

When schools are in the midst of a budget crisis they often restrict instructors from buying equipment and implementing new curricula. However, teachers don't have to be limited by finances. This project is very economical and its uses can be incorporated into existing curricula. If sufficient interest is generated, the curriculum can be expanded without making a large investment. This project will provide students and instructors the opportunity to gain a better understanding of hydroponics. If interest is high, more extensive systems can be developed.

To obtain more information about hydroponics write to the Hydroponic Society of America and request their Directory of Hydroponic Supply Companies and Books on Hydroponics. The cost of this directory is $7.00. Send requests to:

(Continued on page 23)

Teaching Tips
Plant Tissue Testing

By Ed Osborne, Special Editor

(Dr. Osborne is Associate Professor and Chair, Department of Agricultural Education, University of Illinois, Urbana-Champaign.)

Maintaining the nutrient levels of crops is a critical element in plant growth and management. Traditionally, soil nutrient levels have been used to estimate the actual nutrient availability and uptake by plants. However, scientists realize there is a difference in soil nutrient levels and the amount of nutrients actually taken in by plants during growth stages.

Two methods for determining the amounts of essential nutrients contained in plant tissues have been developed in recent years. Plant tissue *analysis* is a procedure now conducted by many soil testing labs which gives an accurate indication of plant nutrition levels. Sophisticated equipment is needed for conducting this analysis. Plant tissue *testing* (or sap analysis) is another procedure which has been developed for *estimating* plant nutrition levels. Unlike plant tissue analysis, plant tissue testing can be performed in the field or greenhouse using a simple kit which contains nutrient extractants.

Plant tissue testing can be done to monitor plant nutrition levels during the growing season and diagnose nutrient deficiency problems. When used in combination with soil fertility tests, plant tissue tests can provide feedback on crop conditions and fertility needs.

Materials and Procedures

For this lab all you need is a plant tissue testing kit, leaf and stem samples, and some paper towels. People on our agronomy faculty at the University of Illinois believe that one of the best tissue testing kits on the market is the NPK Kit, available from Soil Chem, Box 54, Rossville, IL 60963. Each kit costs $14.95 and contains enough material for 50-100 tests for each major nutrient. Phone orders are accepted at (217) 748-6794

As an interest approach, show students samples of growing plants (horticultural or agronomic species) that exhibit nutrient deficiency or health problems. Some plants in good condition should also be included. Ask students to describe each plant, and name possible problems in plants where present. Challenge their observations and diagnosis. How can their diagnosis be verified?

Arrange students in groups of two or three, and provide each group with a tissue testing kit and growing plants from which samples are to be taken. Conduct nutrient tests, carefully following the directions provided with the kit. Have every group record their results on the board or in chart form. Have students use the interpretation guide in the kit, along with soil test results if available, to determine if adjustments in soil fertility levels are needed.

Have students run tissue tests on more than one part of the same plant to check for consistency of results. For multiple tests on a single plant, combine the test results and calculate an average nutrient level for N, P, and K.

A number of follow-up experiments are appropriate using the plant tissue test kit. Results can be compared from various parts of the plant and with soil test results. Results are also likely to vary under different soil conditions and various stages of plant growth. If you have a hydroponics unit, the concentration of nutrients supplied in the nutrient solution can be varied, with tissue testing performed to examine effects on growing plants and nutrient levels present in the plant tissues.

Science Connections

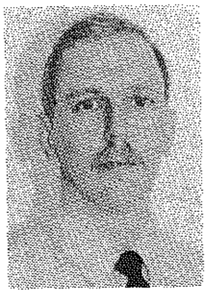
This lab provides a great opportunity to connect plant science concepts/principles to the agricultural practice of maintaining adequate nutrient levels for plant growth. Essential terms, such as macronutrient, essential element, translocation, and fertilization should be addressed. Students should also investigate the functions of N,P, and K in plant growth and development. This lab also provides an excellent context for examining how plants take in nutrients and how nutrients are diffused throughout plant tissues. This connection to basic plant science principles will allow students to better understand why we design soil fertility programs as we do in agriculture and why certain deficiency symptoms occur when macronutrients are in short supply.

A Final Tip

This simple and inexpensive tissue testing kit provides a great opportunity for agriculture students to investigate and seek out answers themselves. This lab works well when teachers provide the framework for student inquiry and then guide students as they ask and answer relevant questions about plant nutrition. While this could be set up as a demonstration lab, its effects will be much greater if it is designed as a lab *experiment*, by challenging students to question and research the topic themselves.

ARTICLE

The Curriculum Guides The Way



By Alan P. Whetzel

(Mr. Whetzel is Agricultural Mechanics Teacher, Mineral County Vocational-Technical Center, Keyser, West Virginia.)

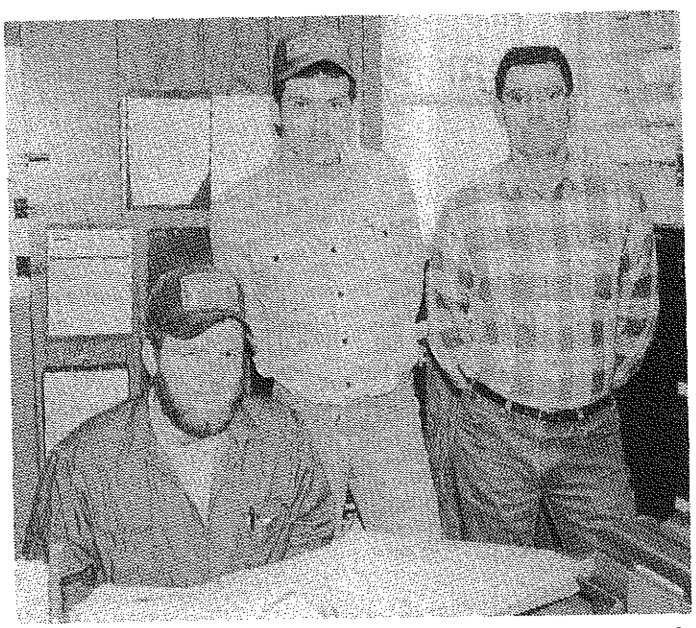
Curriculum plays a major role in soliciting students into the agricultural program. The agricultural teacher is charged with developing a curriculum that is highly motivating and teaches the skills necessary to make students employable in business and industry. Coordinating the curriculum with a local entrepreneur is extremely important and can easily be accomplished.

First, the agriculture teacher must visit local area business and industry to see first-hand the type of equipment presently being used and to talk with plant managers in order to identify the type of skills they are needing in new employees. Developing a relationship with industry is like working on a two-way street. Our agricultural program is furnishing industry with a product and they in turn may furnish the laboratory with the type of equipment and materials which they want employees to be able to operate.

Secondly, field trips to local businesses will promote rapport with former students employed in the work place. It is important to reinforce the success of former students who are presently employed in business and industry, as well as, those who went on to post-secondary and higher education institutions.

The development of a highly technical curriculum must integrate two theories of thought. The first thought is that of making students employable in business and industry, as well as outside of the local community, and the second thought of assisting in the academic preparation of those students wanting and needing additional education beyond the secondary level.

There are several important components which facilitate a successful curriculum. Those components are individuals who put in time, effort, energy, supervision and financial dollars to see that the student is going to be successful upon completion of the program. These groups must work together in unison like the spokes of a wheel. Students today need the support and encouragement from not only secondary agricultural teachers, but from the parents, employers, and the high school administration.



These gentlemen play an important role in connecting the classroom with the local industry. The success of former students certainly is a motivator in the classroom.

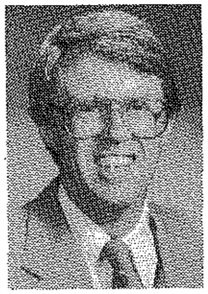
A demanding state of the art curriculum must be supported with motivational and reward mechanisms. Motivation is easily accomplished when the students can visualize the benefits of his/her efforts. Motivation starts with a detailed syllabus. The syllabus provides direction for the student to follow in pursuing his or her goals. Motivation is contagious. The more dedicated the teacher, often the more dedicated the student. Other motivational methods which students and parents find stimulating are: personal letters, interim reports, positive phone calls to the parents during the school year, outstanding students of the month publicized in local papers, pictures and descriptions of major laboratory projects published in the newspapers, special FFA participation rewarded with bonus points, the development of peer pressure concept with integrating laboratory days on Fridays, recommendations for jobs and the development of a reward system which encompasses personal items designed specifically for the student by the instructor. Needless to say, the ultimate reward that a student could receive would be placed in a job in which he or she is interested. A successful job will enable the student to progress through life giving something back to the community in which he or she works.

Agricultural teachers need to be continually aware of high quality opportunities available to assist agricultural mechanics students in gaining experience in their chosen field. In addition to traditional placement of students with business and industry, thoughts should be given to paid apprenticeships during and following high school. In both cases with placement and paid apprenticeships, extreme care must be given to the selection of the individual to be placed. As we all know, students placed with business and industry, not only represent themselves, but also the school, the administration, the teacher and the community. Detailed ar-

(Continued on page 22)

Assistantships and Fellowships in Agricultural Education 1991-1992

The 1991-92 survey of institutions offering assistantships and fellowships in agricultural education is provided by the Publications Committee of the American Association of Teacher Educators in Agriculture. This survey is published annually to assist those in the profession who are seeking information about graduate studies. Over twenty institutions responded to a request for details concerning assistantships and fellowships.



BY JOHN HILLISON
(Dr. Hillison is Professor and Program Area Leader, Agricultural Education, Virginia Polytechnic Institute and State University.)

Key To Understanding

The information is provided in the following order: nature of assistantships (number available); number of months available during the year; beginning month of employment; amount of work expected; monthly remuneration and other considerations such as remission of fees; whether aid is for master's, advanced graduate program, or doctoral students; source of funds; the 1991 deadline for application; and the person to be contacted. Slight variations in this pattern are due to the nature of the data provided by reporting institutions.

University of Arkansas

Research Assistantship (1); July 1; one-half time, 20 hours/week; $550-700 per month; full tuition and fees provided; master's or doctoral; May 1; Dr. Nolan Arthur, Department Head, Department of Agricultural & Extension Education, Agriculture Building Room 301-B, University of Arkansas, Fayetteville, Arkansas 72701, Telephone (501) 575-2035

Teaching Assistantship (1); September 1; one-half time, 20 hours/week; $550-700 per month; full tuition and fees provided; master's or doctoral; May 1; contact same as above.

University of Arizona

Teaching Assistantship (1); 12 months; July; one-half time, 20 hours week; $708.75 per month; out-of-state tuition waived; department budget; March 1 or 6 months prior to enrollment; Dr. Roger Huber, Department of Agricultural Education, The University of Arizona; Tucson, Arizona 85721, Telephone (602) 621-1523.

Fellowship (6); 12 months; immediately (3) and July 1, 1991 (3); Max $4,000; $2,000 gift and $2,000 low interest loan; sponsored by Dougherty Foundation; recipients must major in international development program; U.S. citizenship required; must plan to work in international development, contact same as above.

Clemson University

Graduate Teaching Assistantships (3); 10 months; August through May; one-half time; $650-850 per month plus remission of out-of-state tuition and one-half fees; master or doctoral; SDE and/or instruction funds; April 15 or until filled, Dr. Glen C. Shinn, Head, 112 Poole Agricultural Center, Clemson University, Clemson, SC 29634-0356. Telephone (803) 656-3300, FAX (803) 656-3608.

Graduate Research Assistantships (2); 12 months; July; one-half time; $650-850 per month plus remission of out-of-state tuition and one-half fees; masters or doctoral; instruction and/or experiment station funds; April 15 or until filled; Dr. Glen C. Shinn, Head, 112 Poole Agricultural Center, Clemson University, Clemson, SC 29634-0356. Telephone (803) 656-3300, FAX (803) 656-3608.

Cornell University

Teaching Assistantship (1) September; 15 hours/week; $8,250 ($434.22 bi-weekly); waiver of tuition and fees; doctoral, state funding, April 15, 1991. Dr. Arthur L. Berkey, Department of Education, 418 Kennedy Hall, Cornell University, Ithaca, NY 14853, Telephone (607) 255-2197.

Research Assistantships (1); 9 months; September 15; 15 hours/week; $8,250 for 9 months; ($434.22 bi-weekly); waiver of tuition and fees; master's and doctoral; Hatch Act and other research funds; April 15, 1991; contact same as above.

University of Florida

Research Assistantships (2-3); 9-12 months; July 1, 1991; 14-20 hours/week; out-of-state fees waived; Master of Science; remuneration varies depending upon position; April 1; Dr. Carl E. Beeman, Department of Agricultural and Extension Education, 305 Rolfs Hall, University of Florida, Gainesville, Florida 32611, Telephone (904) 392-0502.

University of Georgia

One Ed.S. (Specialist of Ed.D. (Doctoral level; 10 months; September 1 to June 30; one-third time (approximately 13 hours per week); $838.00 per month; Waiver of Registration fees; Department of Vocational Education Funds; deadline for application June 1, 1991; Dr. M.J. Iverson, Head, Agricultural Education, The University of Georgia, 628 Aderhold Hall, Athens, Georgia 30602, Telephone (404) 542-1204.

One M.Ed. (Masters) level; 10 months; September 1 to June 30; one-third time (approximately 13 hours per week); $785.78 per month; Waiver of Registration fees; Department of Vocational Education Funds; deadline for application June 1, 1991; contact same as above.

University of Illinois

Graduate Research Assistantships (3-5); 9-10 months; August; one-half time; $900 per month doctoral, or $685 per month masters; in- and out-of-state tuition and nearly all fees waived; April 1 or until filled; Dr. Ed Osborne, Chair, Agricultural Education, University of Illinois, 124 Mumford Hall, 1301 W. Gregory Drive, Urbana, IL 61801, Telephone (217) 333-3166.

Graduate Teaching Assistantships (1); 9 months; August; one-half time; $900 per month doctoral; in- and out-of-state tuition and nearly all fees waived; April 1 or until filled; contact same as above.

Iowa State University

Research Assistantships (4); 9 months; September; one-half time; 20 hours/week; $950 per month; fee reduction; master's or doctoral; Agricultural Experiment Station; March 1; Dr. David L. Williams, Head, Department of Agricultural Education, Iowa State University, Ames, Iowa 50011, Telephone (515) 294-0241.

Fellowships (3); 12 months; September; 20 hours/week; $1000 per month; full fees paid; master's or doctoral; March 1; USOE for minorities and women; contact same as above.

University of Maryland

Graduate Assistantships for minority students; 9½ months; approximately August 15; 20 hours/week; remission of tuition for 10 credits per semester; $9,200-10,300 per year (1989-90 rates); aid for qualified graduate students (M.S., AGS, Ph.D) March 15; Dr. Merl E. Miller, Professor & Chairman, Department of Agricultural and Extension Education, University of Maryland, College Park, MD 20742, Telephone (301) 454-3738.

Michigan State University

Graduate Teaching and Research Assistantships (2); 9 months in duration September 15 through June 15, (summer extensions possible); 20 hours per week, $910 MS, $1002 PhD; waiver of out-of-state tuition fees; additional graduate fellowships available for prospective candidates. Funds are from projects with Agricultural Experiment Station, Cooperative Extension Service, and General Education. Deadline for applications May 1; Dr. Carroll H. Wamhoff, Chairperson, Department of Agricultural & Extension Education, Michigan State University, East Lansing, MI 48824-1039, Telephone (517) 355-6580.

University of Minnesota

Research Assistantships (2-5); 9-12 months; July or September 15; 10-20 hours; $884-1,086 per month (50%); tuition reduced by two times % time appointed; master's and doctoral students; University; April 15; Dr. Edgar Persons, Head, Division of Agricultural Education, 320 Vocational and Technical Education Building, University of Minnesota, 1954 Buford Avenue, St. Paul Minnesota 55108, Telephone (612) 624-2221.

Graduate School Fellowships in Vocational Education (2); 9 months; September 15; none, but full-time students; $1,500-2,000; master's or doctoral students of outstanding potential; Graduate School; April 15; Director of Graduate Studies; Department of Vocational and Technical Education Building, University of Minnesota, 1954 Buford Avenue, St. Paul, Minnesota 55108, Telephone (612) 624-2258.

Mississippi State University

Research Assistantships (2); 9 or 12 months; July or August; $600-1,200; tuition waived; doctoral; March 1; Head, Department of Agricultural and Extension Education, Post Office Drawer AV, Mississippi State University, Mississippi State, Mississippi 39762, Telephone (601) 325-3326.

Research Assistantship (1); 9 months; August; $600-1,000, tuition waived; master's educational specialist, or doctoral; March 1; contact same as above.

University of Missouri-Columbia

Research Assistantships (2-4); 9-12 months; July and September 1; 20 hours/week; $700 per month; fees waived; doctoral; May 1; Dr. Bob R. Stewart, Agricultural Education, 121 Gentry Hall, University of Missouri-Columbia, Columbia, Missouri 65211.

Teaching Assistantships (1-2); 9 months; August 20, 20 hours/week; $700 per month; fees waived; doctoral; May 1, contact same as above.

University of Nebraska

Graduate Teaching Assistant/Graduate Research Assistant (1); 9-12 months; July 1; 20 hours/week; $500-700 per month plus remission of tuition; master's candidate; department budget appointment; April 1 or until filled; Dr. Allen G. Blezek, Telephone (402) 472-2807.

Graduate Project Assistant (1); 9-12 months; July 1; 20 hours/week; $500-700 per month plus remission of tuition; master's or doctoral candidate; grant budget appointment and/or department budget appointment; April 1 or until filled; Dr. Allen G. Blezek, Telephone (402) 472-2807.

University of New Hampshire

Approximately 4 fellowships for females for 2 semesters and possible summer funding beginning September 3 with 8 hours/week of work expected. Students receive in-state tuition and mandatory fees plus a stipend of $1,200. Total value $5,000. Provides teacher certification as a part of the Master's program. Source of funds - Federal Equal Access grant for State of New Hampshire for Preservice Teachers of Agricultural Education. Deadline is February 15, 1991. Contact Dr. David L. Howell, (603) 862-1760.

North Carolina Agricultural and Technical State University

Research and Graduate Assistantships (5); 9 months; August; 20 hours per week, $600 per month, Master's Degree, deadline July 1. Contact: Dr. A.P. Bell, (919) 334-7711.

North Dakota State University

Graduate Research Assistant (1); 12 months; July 1; one-half time; $660 per month; master's; School of Education; May 1; Dr. Michael Swan, Assistant Professor, Ag Education, 155 home Economics Building, North Dakota State University, Fargo, North Dakota 58105, Telephone (701) 237-7436.

Graduate Research Assistant (1); 12 months; July 1; one-half time; $660 per month; master's; grant funds (number and salary dependent upon funding); March 1; Dr. Michael Swan, Assistant Professor, Ag Education, 155 Home Economics Building, North Dakota State University, Fargo, North Dakota 58105, Telephone (701) 237-7436.

The Ohio State University

Teaching Associateships (2); 12 months; July or later; one-half time; $930 per month; in- and out-of-state fees waived; doctoral; February 1, Dr. Kirby Barrick, Acting Chair, Department of Agricultural Education, The Ohio State University, Agricultural Administration Building, 2120 Fyffe Road, Columbus, Ohio 43210-1099, Telephone (614) 292-6321.

Research Associateships (4-6); 9-12 months; July or later; one-half time; $785-930 per month; master's or doctoral; February 1; contact same as above.

Administrative Associateships (2-3) with emphasis in Extension Education (same as above).

Teaching Associateships (1); 12 months; July or later; one-half time; $930 per month; in- and out-of-state fees waived; doctoral; March 1; Dr. Joe Gliem, Department of Agricultural Engineering, 590 Woody Hayes Drive, Columbus, Ohio 43210, Telephone (614) 292-9356.

Research Associateships (3-6); 9-12 months; July or later; one-half time; $760-865 per month; in- and out-of-state fees waived; master's or doctoral; February 1; Dr. Ray Ryan, Center on Education and Training Employment, 1960 Kenny Road, Columbus, Ohio 43210, Telephone (614) 292-4353.

Oklahoma State University

The Oklahoma State University Agricultural Education Department is seeking qualified applicants for assistantships within our department. The assistantships are available to individuals wishing to pursue the Doctoral Degree in Agricultural Education.

The following assistantships are available:

(1) Teaching assistantship; 9 months; starting September 1, 20 hours per week; remuneration, beginning at $880 per month and possible increase second year; out-of-state fees waived, partial fee waiver scholarships and competitive college fellowships available; application deadline August 1; duties would include: teaching undergraduate professional courses, working with state vocational technical staff, assisting with undergraduate student advisement.

(1) Teaching assistantship; 9 months; starting September 1, 20 hours per week; remuneration, beginning at $880 per month and possible increase second year; out-of-state fees waived, partial fee waiver scholarships and competitive college fellowships available; application deadline August 1; duties would include teaching undergraduate professional courses, working with state vocational-technical staff, assisting with undergraduate student advisement, serving as assistant director of student teachers, supervising of student teachers in the field.

(1) Research assistantship; 12 months; starting September 1, 20 hours per week; remuneration, beginning at $880 per month and possible increase second year; out-of-state fees waived, partial fee waiver scholarships and competitive college fellowships available; application deadline August 1; duties would include: assistance in writing RFP's, computer programming, conducting literature searches, developing literature reviews for staff research, and assisting with a research design course.

Persons interested or requiring additional information concerning these assistantships should contact: Dr. Robert Terry, Professor and Head, Department of Agricultural Education, 448 Agriculture Hall, Oklahoma State University, Stillwater, OK 74078, Phone (405) 744-5129.

The Pennsylvania State University

Teaching and Research Assistantships in Agricultural Education and Extension Education (4); 12 months; August 20; 20 hours/week; $4,360 per semester; remission of fees; out-of-state; master's and doctoral; applications due February 1; Dr. Samuel M. Curtis, Head, Department of Agricultural and Extension Education, 102 Armsby Building, University Park, Pennsylvania 16802. Telephone (814) 865-1688.

Purdue University

Teaching Assistantships (2); 10 months; August; one-half time; $720 per month; tuition and fee waiver; doctoral or master's; February 1. Dr. James P. Greenan, Chairman, Vocational Education, Purdue University, South Campus Courts F-25, West Lafayette, Indiana 47907, Telephone (317) 494-7290.

Research Assistantships (3-5); 10-12 months; August; one-half time; $720 per month; tuition and fee waiver; doctoral or master's; February 1; contact same as above.

Texas A&M University

Assistantships: teaching (4), non-teaching (6), research (2); 9-12 months; generally July 15 or September 1 or January 15; 20 hours/week; $900/1,000 per month for doctoral, $550-650 per month for master's; out-of-state tuition waived for teaching or research assistantships; public (state) and private; April 1 for September appointment; Dr. Don R. Herring, Graduate Coordinator, Department of Agricultural Education, College of Agriculture and Life Sciences, Texas A&M University, College Station, Texas 77843-2116, Telephone (409) 845-2951.

Fellowships: doctoral (2), master's (2); 12 months; generally September 1 or January 15; 20 hours/week; $900-1,000 per month for doctoral, $550-650 per month for master's; public (state) and private; April 1 for September appointment; contact same as above.

Texas Tech University

Assistantships; teaching (2), research (2); 9-12 months; generally September 1; 20 hours/week; $600-700 per month; waive non-resident tuition and certain fees; master's; state and private funding; April 1; Dr. Paul Vaughn, Chairman, Department of Agricultural Education and Mechanization, College of Agricultural Sciences, Texas Tech University, Mail Stop 2131, Lubbock, TX 79409-2131. Telephone (806) 742-2816.

Utah State University

One assistantship available for MS student. Responsible for Agricultural Mechanization laboratory instruction and/or departmental research. Twelve months possible employment beginning August 1. Requires 20 hours per week and 12 credit hour course load per quarter. Stipend of $700 per month and waiver of out-of-state tuition. Send a letter of application to Dr. Gary Straquadine, Agricultural Education, Utah State University, Logan, Utah 84322-4805. Telephone (801) 750-2230 by May 1.

One assistantship available, MS and EdD students. Responsible for design and implementation of computer-aided instruction in secondary agricultural science courses. Twelve months possible employment beginning August 1. Requires 20 hours per week and 12 credit hour course load per quarter. Stipend of $800 per month and waiver of out-of-state tuition. Send a letter of application to Dr. Stephen E. Poe, Agricultural Education, Utah State University, Logan, Utah 84322-4805. Telephone (801) 750-2230 by May 1.

Virginia Polytechnic Institute and State University

Graduate Assistants (2); 9 months; August 16; 20 hours/week; $960-1,030 per month; one Groseclose Fellowship available for summer; master's or advanced degree; March 1; contact Dr. John Hillison, Agricultural Education, Room 223 Lane Hall, Virginia Polytechnic Institute and State University, Blacksburg, Virginia 24061-0254, Telephone (703) 231-8187, FAX (703) 231-3292.

University of Wisconsin-Platteville

Graduate Assistantships; (3-5) 9 months; September 1; (3-5) 12 months; July 1; 15-18 hours/week; $450-650 per month; limited out-of-state waivers; master's only, in either Agricultural Industries or Education; University of Wisconsin System Grant; March 15; Dr. Ralph Curtis, Director of Graduate Studies, 303 Brigham Hall, UW-Platteville, Platteville, Wisconsin 51818, Telephone (608) 342-1262.

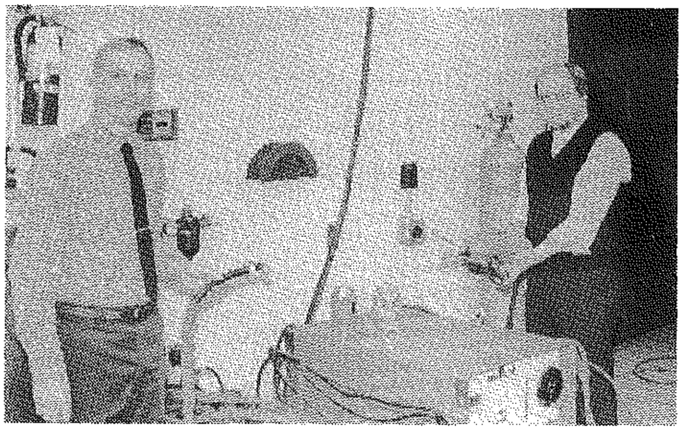
University of Wisconsin-River Falls

Graduate Assistantships (1-2); 9 months; September; 15-20 hours/week; $580-620 per month; remission of out-of-state fees; master's; state funding; April 1; Dr. Richard A. Jensen, Chair, Department of Agricultural Education, University of Wisconsin-River Falls, River Falls, Wisconsin 54022, Telephone (715) 425-3555.

The Curriculum Guides The Way

(Continued from page 18)

ticulation agreements and placement work plans are essential in assisting the student in gaining all the skills, knowledge, and attitudes necessary to be successful.



Administration support in purchasing up-to-date welding equipment plays a major role in placement of students from the Agriculture Machanics curriculum in local business. The Plasma Arc Cutting Torch on the left gives students experience in cutting stainless steel, mild steel, and aluminum.

It is obvious that team work is vital. Cooperation among parents, administration, business and industry, the teacher and the student is essential if he/she is to be successful. The parents' encouragement and support is necessary for their child to become more dedicated and successful. The teacher must provide motivation, basic knowledge, initial training, and supervision in all cases. The administration plays a very major role in fulfilling the needs and requisitions of the agricultural mechanics teachers. Administrators make it possible in helping them to purchase supplies and equipment necessary for students to gain hands-on experience with the type of equipment and materials presently existing in business and industry. Business and industry not only provide an opportunity for our students to train, but in many cases assist programs by providing consumable supplies, as well as equipment for students to be trained on at the high school level. Employers realize that they are the beneficiary of the students' effort, the parents' support, and the teacher's training which in turn makes the student a valuable resource for their business.

Yes, there are many components that make up the spokes of the wheel of success for the students of agricultural mechanics programs. Teachers must never forget that the initial start of any great program starts with a state of the art curriculum.

Agriscience Inside and Out

(Continued from page 13)

11. Never use broken or cracked glassware.

12. Always wear shoes in the lab. Avoid sandals or other opened-toed footwear.

13. Tie back long hair and restrict loose clothing.

14. Wear safety goggles, lab aprons, and gloves when instructed to do so.

Conclusion and Summary

Challenged by the National Research Council, diligent by nature, and supported by industry, secondary agricultural education is adopting a new and progressive image. If the profession continues to recognize the diverse needs of a changing society and student clientele, we can look forward to a strong, reputable position in the educational system.

As the old agricultural classroom changes and improves, we will see the fruits of our labor — a new, well-equipped, progressive, agriscience learning laboratory!

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1803 Rural Point Road
Mechanicsville, VA 23111

Editor *(Name and Complete Mailing Address)*: Dr. Phillip Zurbrick
University of Arizona
232 Forbes Building, Tucson, AZ 85721

Managing Editor *(Name and Complete Mailing Address)*: Dr. Blannie Bowen
102 Armby Building, Dept. of Ag. and Extension Education
Pennsylvania State University, College Park, PA 16802

7. Owner *(If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding 1 percent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a partnership or other unincorporated firm, its name and address, as well as that of each individual must be given. If the publication is published by a nonprofit organization, its name and address must be stated.) (Item must be completed.)*

Full Name	Complete Mailing Address
The Agricultural Education Magazine, Inc.	1803 Rural Point Road Mechanicsville, VA 23111

8. Known Bondholders, Mortgagees, and Other Security Holders Owning or Holding 1 Percent or More of Total Amount of Bonds, Mortgages or Other Securities *(If there are none, so state)*

Full Name	Complete Mailing Address
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The purpose, function, and nonprofit status of this organization and the exempt status for Federal income tax purposes *(Check one)*

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(2) [ ] Has Changed During Preceding 12 Months
(If changed, publisher must submit explanation of change with this statement.)

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2. Mail Subscription *(Paid and/or requested)*	4631	4658
C. Total Paid and/or Requested Circulation *(Sum or 10B1 and 10B2)*	4631	4658
D. Free Distribution by Mail, Carrier or Other Means Samples, Complimentary, and Other Free Copies	51	54
E. Total Distribution *(Sum of C and D)*	4682	4712
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2. Return from News Agents		
G. TOTAL *(Sum of E, F1 and 2—should equal net press run shown in A)*	5000	5000

11. I certify that the statements made by me above are correct and complete

Signature and Title of Editor, Publisher, Business Manager, or Owner: Glenn A. Anderson BUS. MGR.

PS Form 3526, Feb. 1989 *(See instructions on reverse)*

Hydroponics On A Budget

(Continued from page 16)

Hydropoincs Society of America
P.O. Box 6067
Concord, California 94524
(415) 682-4193

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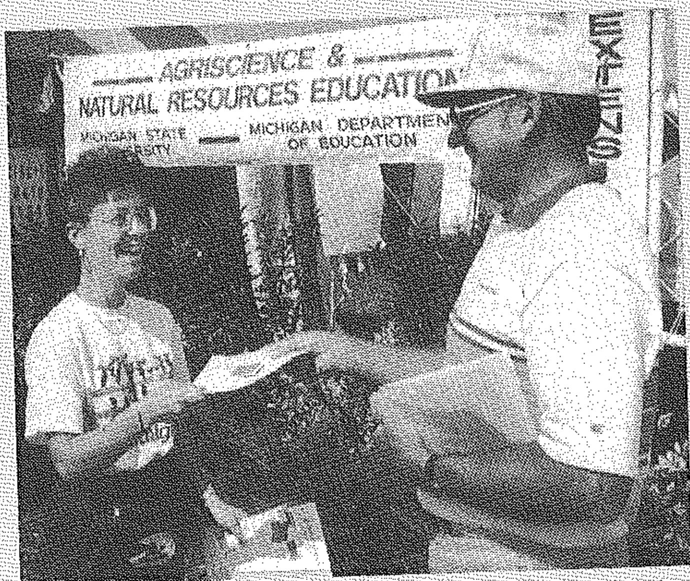
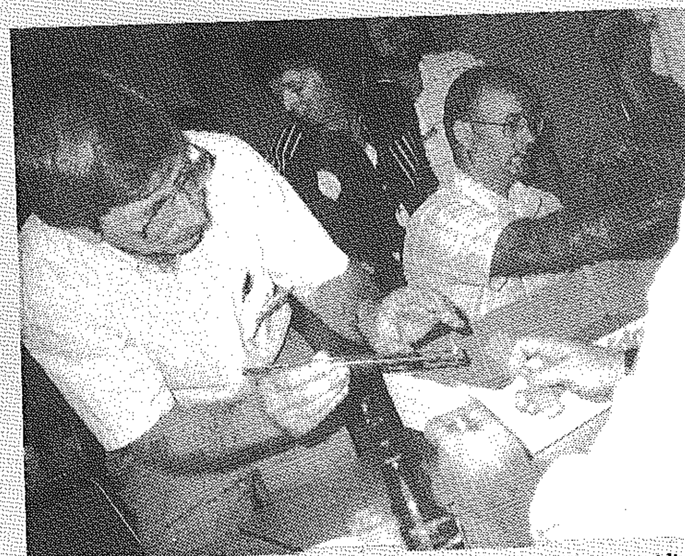
Stories in Pictures



Informing the public about the new directions in agricultural education is a vital part of the Agriscience and Natural Resources Education programs in Michigan. Photo courtesy of Jim Connors, Michigan State University.



Understanding agriscience laboratory techniques is essential to providing students with the latest skills needed for employment in the industry of agriculture. Photo courtesy of Jim Connors, Michigan State University.

Agriscience and Natural Resources instructors receive updated inservice training in the latest agriscience principles such as tissue culture. Photo courtesy of Jim Connors, Michigan State University.

The Michigan Agriscience and Natural Resources Curriculum provides opportunities for experiential learning of agriscience principles by students as well as adults. Photos courtesy of Jim Connors, Michigan State University.