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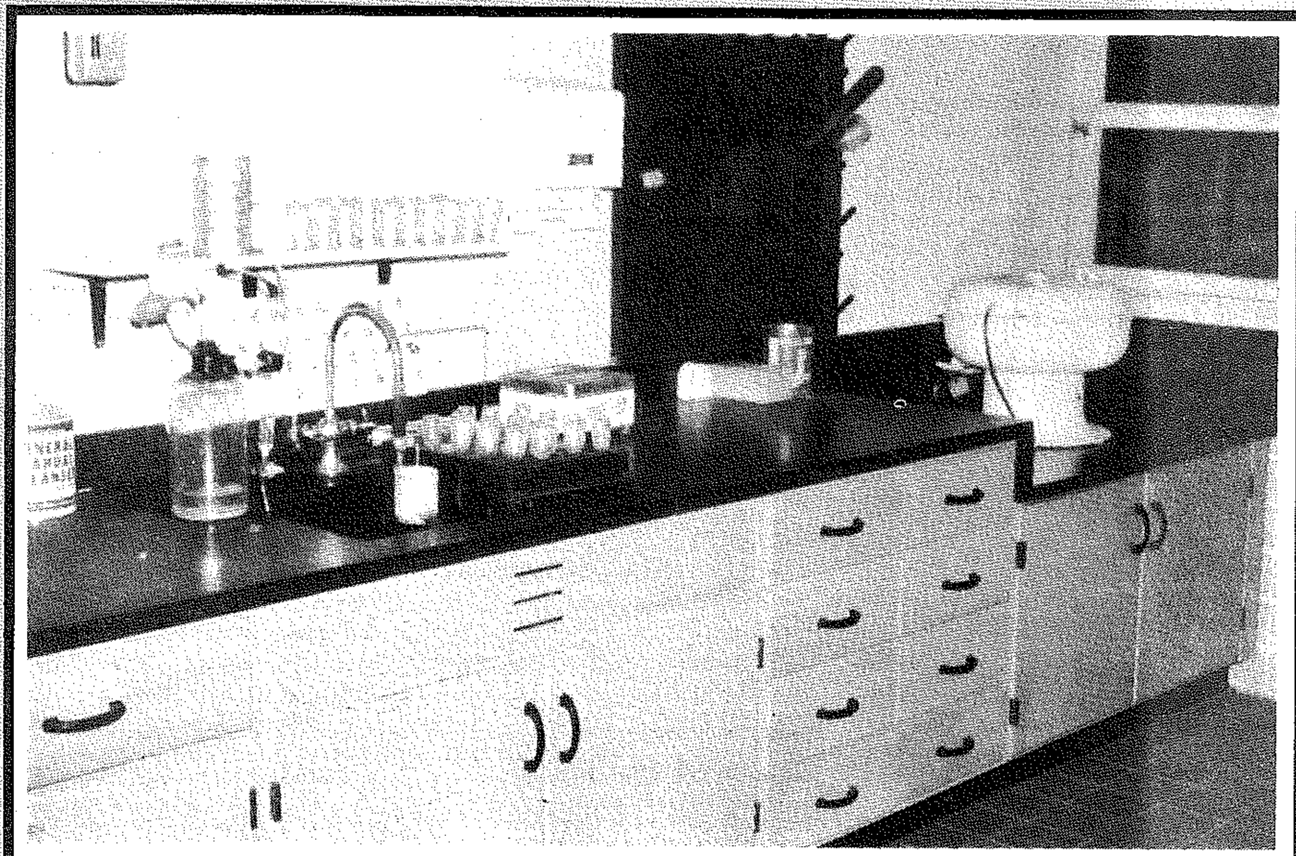

THEME: Facilities

THE
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ARTICLE SUBMISSION

Articles and photographs should be submitted to the Editor, Regional Editors, or Special Editors. Items to be considered for publication should be submitted at least 90 days prior to the date of issue intended for the article or photograph. All submissions will be acknowledged by the Editor. No items are returned unless accompanied by a written request. Articles should be typed, double-spaced, and include information about the author(s). Two copies of articles should be submitted. A recent photograph should accompany an article unless one is on file with the Editor.

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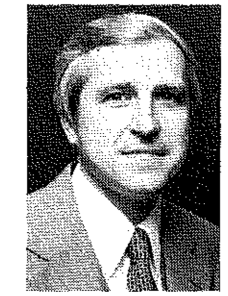
Facility Needs



JASPER S. LEE, EDITOR
(The Editor also serves as Professor and Head, Department of Agricultural and Extension Education, Mississippi State University.)

In vocational agriculture/agribusiness, the facilities include all of the buildings, sites, and furnishings which are used in the instructional program. The nature of the facilities should be shaped by the competencies which students need to learn, and not vice versa. Instruction should dictate facility needs rather than facilities dictating what is to be taught!

The facilities that are available are important in shaping the quality of the education to be provided. The arrangement of classrooms and laboratories and the equipment and furniture in them comprises the available facilities. These should be adequate for the number of students and kinds of learning activities to be provided.

Needed: Modern Facilities

The age of a facility is not as limiting to an instructional program as is the nature of the facility. Old facilities can be modern. New facilities can be out of date. The key is the instructional capability of the facilities. Some new facilities are not modern in terms of the kinds of competencies which can be taught. The reason some new facilities are not modern is that a modern instructional program was not planned before the facility was planned.

Individuals who are planning and designing facilities need to be modern in their approach. The first step in planning new facilities or facility renovation is to plan a modern instructional program. It is very difficult to have a quality agribusiness program, for example, in a facility designed for teaching farming and ranching.

Traditionally, vo-ag facilities have included classrooms and shops. We must move away from this tradition. We must think and speak in terms of educational laboratories and classrooms. The day when all that is needed in vo-ag facilities is a shop and classroom has passed.

One additional comment is in order. The notion that the facilities for a vo-ag department should be located behind the main school building or away from it must be changed. The position of an individual or a facility impacts prestige and respectability. There is no way vo-ag can have the high credibility it deserves when it is relegated to a physical location of low credibility. The facilities for a vo-ag program must be a prominent part of the overall school facilities.

Needed: Facility Maintenance

The taxpayers of our nation have invested tremendous sums of dollars in facilities. School administrators and teachers have the responsibility of maintaining the facilities in a clean, safe, and attractive condition. Facilities need routine cleaning and maintenance. Custodial personnel should be provided for vo-ag facilities the same as they are for other school facilities. Teachers need to supervise students in such a manner that the facilities are not abused.

The Editor has frequently seen facilities where students have smeared paint on the wall, broken windows, and left dirty laboratories. This affects credibility. It is well to remember that the physical appearance of facilities is an important evaluative criterion applied to a teacher and instructional program by many members of the general public.

Vo-ag teachers and students should not become involved in facility repair, renovation, and construction. Some individuals rationalize that such involvement provides good, practical experience. Such rationalizations are little more than a cop-out for lack of a systematic instructional program. It is unfair for teachers and administrators to expect vo-ag students to help maintain or construct a school facility, except in rare instances.

Needed: Assistance in Facility Planning

Individuals who are planning new or renovated facilities must be futuristic in their thinking. They must get the assistance of competent individuals and not be afraid to experiment with new approaches. Architects can be helpful but their knowledge of what vo-ag needs is very limited. Part of the problem with the newer facilities is that knowledgeable agricultural educators were not involved in the planning process.

Professionals in agricultural education need to carry out research and development activities to more accurately specify the facilities that are needed. These efforts must be based on the needs of agricultural industry today and anticipated future needs.

One of the best sources available on facility planning is BUILDINGS AND FACILITIES FOR VOCATIONAL AGRICULTURE/AGRIBUSINESS DEPARTMENT. This publication was prepared by George W. Sledge, Walter T. Bjoraker, Theodore J. Brevik, and Virgil Martinson. Additional information on this document can be obtained from Dr. Walter T. Bjoraker, Department of Continuing and Vocational Education, University of Wisconsin, Madison, WI 53706.

December, 1980

Dr. Elmer Cooper of the University of Maryland served as Theme Editor for this issue of the MAGAZINE. He has obtained several articles on facilities from various individuals. It was his hope that this issue would serve as a guide to individuals involved with facility planning.

THEME

Cooperative Planning — A Key To Effective Facilities

By Elmer L. Cooper, Theme Editor

Editor's Note: Dr. Cooper is Assistant Professor, Department of Agricultural and Extension Education, University of Maryland, College Park. His experience includes that of vocational agriculture teacher, state supervisor, and teacher educator.

The instructor in a vocational agriculture/agribusiness program stands first in the factors that contribute to the success of that program. However, the type, quality, and extensiveness of the facilities available to that instructor will, to a large extent, determine the long-term outcomes. There is a tendency for the innovative teacher to utilize more community resources when the tools, equipment, and laboratory facilities are limited or non-existent at the school. The phenomenon is a blessing on one hand, but can be a hindrance to good facility development on the other. Failure to have suitable facilities may sound the death knell of programs when teachers change.

This issue of The Agricultural Education Magazine was planned as a "handbook" issue. It is our hope that useful reference information will be provided for teachers, teacher educators and supervisors, and, through these groups, passed on to planners and administrators at state and local levels. Facility planning is so complex and the potential for errors so great, that cooperative planning is the most promising key to effective facilities. It is hoped that the material contained herein will provide practical information for improvement of facilities across the country.

Historical Perspective

Historically, vocational agriculture teachers have utilized community resources so effectively that, in some instances, school authorities have permitted programs to operate in school facilities that were inferior to other programs in the school. Many supervisors and teacher educators who had the opportunity to visit departments over the years could cite examples of "boiler room" or "under-the-stairs" classroom and shop operations.

The Vocational Education Act of 1963 and federal legislation for special areas, such as that to relieve poverty in the Appalachian Mountain areas, have done much to update facilities for vocational programs in agriculture. However, there is some evidence to suggest that many states used such funds to build new area vocational and technical centers, while facilities in many high schools were not updated. In some instances, facilities were built in accordance with inadequate program standards and specialized facilities suffered from plans developed by architects who were not familiar with effective program procedures.

Standards Are Needed

Unfortunately, many states do not have minimum building and equipment specifications for vocational programs in agriculture. Instead, such specifications are general in nature for applicability to all vocational programs or, even worse, to education in general. Thus, weak programs may be traced to unsuitable facilities which relegate the agricultural instruction to general education in content, form, and outcome.

The "Standards for Quality Vocational Programs in Agriculture/Agribusiness Education," as developed by Iowa State University under contract with the U.S. Department of Education, involved extensive input from supervisors, teachers, teacher educators, and agricultural industry representatives. This effort yielded a set of recommendations for facilities and other program components which has enabled movement towards more state standards across the nation. It is hoped that the current flurry of interaction between program specialists and those ultimately controlling the decision-making process will result in future facility modifications which enhance the prospects for superior program outcomes.

Facility specifications vary widely from state-to-state. In an effort to update guidelines in his home state, this writer examined the specifications for secondary vocational agriculture programs in several neighboring states. The variations in space requirements found in that tightly clustered group of states was amazing. Given such variations in facility specifications, one must wonder what the relationship is between the existence of state standards for facilities and program outcomes. This is a question which merits further study.

Research is Needed

Another problem that needs research is the relationship between facility design and the health of student and instructors. In the early seventies, there was research in Virginia to study the noise output of selected shop equipment and to design machine modifications to reduce such noise. More recently, research was completed in another state indicating that noise from equipment found in typical agricultural mechanics shops produced sufficient noise to be regarded as hazardous to persons operating the machines.

Some instructors report that, under certain conditions where exhaust systems are sufficient to remove fumes and dust, the noise is too loud to permit instructional communication. Others have observed situations where agricultural mechanics shop exhaust systems have been redesigned and reinstalled several times in a ten to fifteen year period. Here, the old systems were not worn out, but rather, simply not effective. Each successive system was installed in an effort to arrive at something that worked. Needless to say, such repetition is wasteful and irks the tax payer. Such errors may be prevented by (1) research to determine the most functional design of facilities, (2) dissemination of research results to facility planners, and (3) development of state standards to require that only effective facilities be installed.

Planning is Needed

The rising cost of energy, the public mood to hold down taxation, and the current down turn in school enrollments have placed school planners in a different ball game. Such factors will increase the need for effective planning in the future. At the same time, the teacher must be given an increased role in deciding what does and what does not work, and what should and should not be included in the new or renovated facilities for agricultural programs. As architects and administrators plan new facilities and replacement or renovation of existing ones, they must seek the advice of program specialists, the teacher being one.

Carefully conceived and validated state standards should be in place to assure essential features for effective programs. Similarly, instructional settings must be free of hazards to the health and well-being of students and instructors. Here, government agencies, agricultural engineers, teachers, supervisors, teacher educators, architects, and others can collectively contribute to a cooperative process that results in facilities that really work. Such facilities must be energy efficient, safe, functional, affordable, and engender the pride and support of local patrons and tax payers.

We are indebted to those who prepared the materials on facilities contained herein. The content includes ideas and recommendations useful in planning nearly every type of facility for education in agriculture. We dedicate these ideas to more deliberate facility planning and to more effective agricultural programs in the future.

The Cover

Classrooms and laboratories are needed to provide specialized instruction. The cover photograph shows a laboratory for instruction in milk testing. Good laboratory facilities enable students to learn important skills for success in agricultural industry. (Photograph courtesy of Walter T. Bjoraker, University of Wisconsin.)

THEME

From Wisconsin — Planning Building Layouts For Basic Vo-Ag Programs

By George W. Sledge and Walter T. Bjoraker

Editor's Note: Doctors Sledge and Bjoraker are Professors of Agricultural Education at the University of Wisconsin in Madison.

There are many factors which should be considered in providing optimum buildings and facilities for departments of vocational agriculture/agribusiness. An agriculture instructor has an important responsibility in working with school officials to assess the needs for buildings and plan facilities. A primary consideration is that buildings and facilities must be appropriate to meet the educational program needs of the local community. The authors recently published a 107 page bulletin entitled "Buildings and Facilities for Vocational Agriculture/Agribusiness Departments." An extensive number of agricultural instructors have indicated an interest in the departmental layouts in the publication. For this reason, a variety of selected plans is used to illustrate the possible organizational layouts for vocational agriculture/agribusiness educational departments.

Curriculum Dictates Facility

It is important to keep in mind that the educational objectives and the basic curriculum will determine the need for buildings and facilities. Therefore, one must keep in mind that rather than simply following departmental layouts which are already in existence, the planning for adequate educational facilities must include a total assessment of program needs and be adapted to the local community. This process must necessarily include or should include citizen participation involving the local school administrator, instructors of vocational agriculture/agribusiness, citizen committees, local advisory committees, FFA alumni, students, and other interested groups served by the school system. Counsel can also be secured from any state leaders involved in agricultural education and from agriculture teacher educators.

In the accompanying departmental plans, it should be noted that some of the facilities are integrated with the existing school system, while others might in fact be separate. However, it is the authors' belief that integrated school building facilities are highly desirable. These plans should be studied carefully for their desirable features, as

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From Wisconsin — Planning Building Layouts For Basic Vo-Ag Programs

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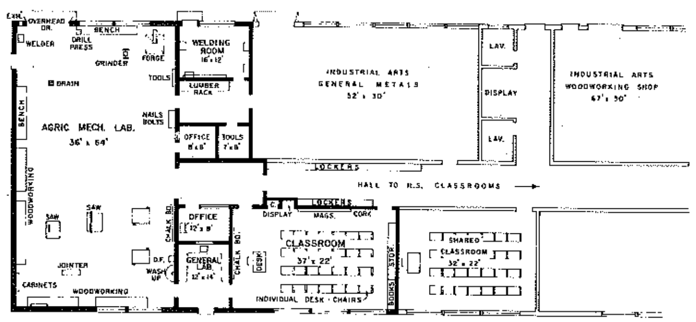
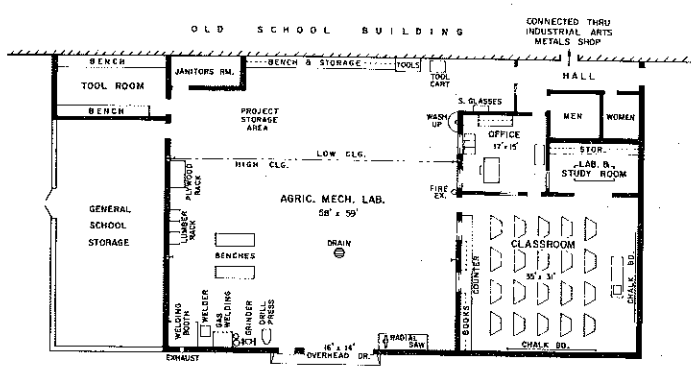
well as an understanding of the features which can be improved upon.



MULTIPLE INSTRUCTOR
VOCATIONAL AGRICULTURE DEPARTMENT RICE LAKE HIGH SCHOOL

Rice Lake

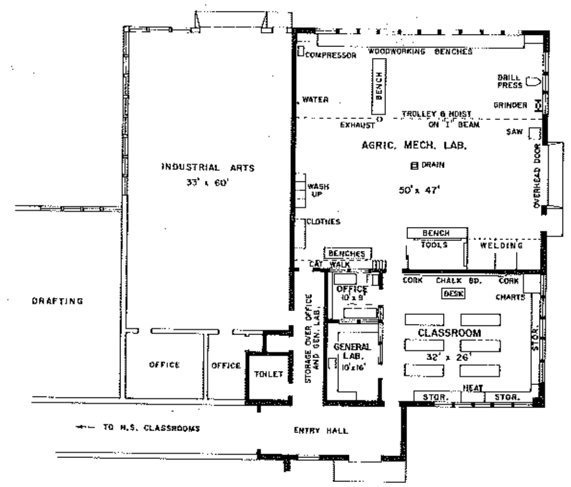
The Rice Lake (Wisconsin) High School Plan is one to accommodate multiple instructors. There are two classrooms, with the second classroom being a shared one which might be utilized by other vocational-technical departments. The plan provides individual offices with access to a common corridor and to a general laboratory from the primary classroom. The agricultural mechanics laboratory has an adjacent welding room, a lumber rack, and tool storage room. With adequate planning, use of shared facilities can be accomplished in a multiple teacher department. Preferably, one of the instructors in a multiple instructor department should be designated as the chairman to facilitate overall planning and coordination of space utilization.



ADAPTED FROM -
VOCATIONAL AGRICULTURE DEPARTMENT DARLINGTON HIGH SCHOOL

Darlington

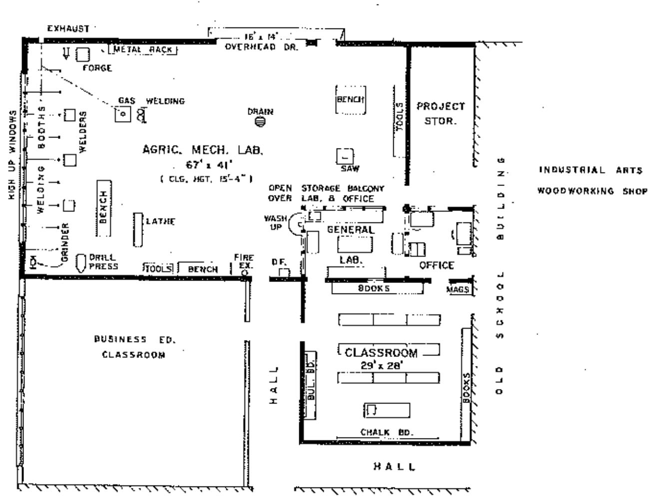
The Darlington (Wisconsin) High School Plan depicts several features which should be considered. There is a large outdoor project area adjacent to the building for repair of large agricultural equipment and machinery. The agricultural mechanics laboratory has a drain near the overhead door. One feature of the Darlington High School Plan includes a laboratory and study room adjacent to the classroom. It should also be noted that the instructors' teaching station position at the chalkboard provides the instructor visual observational capability into the agricultural mechanics laboratory by the inclusion of a door at the rear of the classroom, as well as two windows in the rear of the classroom. Facilities for washup are provided in the plan, as well as area for project storage.



VOCATIONAL AGRICULTURE DEPARTMENT WISCONSIN DELLS HIGH SCHOOL

Wisconsin Dells

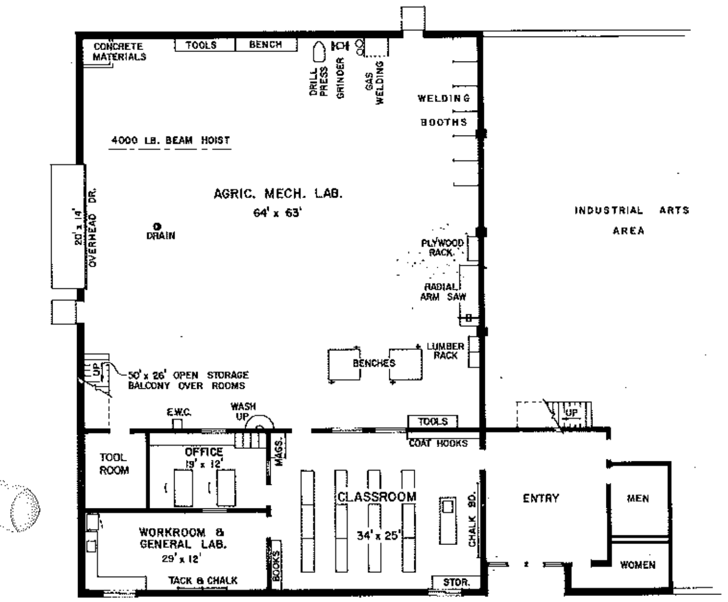
The Wisconsin Dells High School Plan shows storage over the office and general laboratory, which provides for some supplementary storage to that which is in the agricultural mechanics laboratory. This particular plan shows welding booths in the immediate vicinity of the overhead door. It should be noted that adequate ventilation and adequate lighting should be provided in any buildings for vocational agriculture/agribusiness education. Also, adequate storage for books, bulletins, periodicals, posters, and other audiovisual aids should be available. The general laboratory in the Wisconsin Dells High School Plan is one of satisfactory size and provides for general use by students at all grade levels.



VOCATIONAL AGRICULTURE DEPARTMENT HIGHLAND HIGH SCHOOL
(PLAN SLIGHTLY REVISED)

Highland

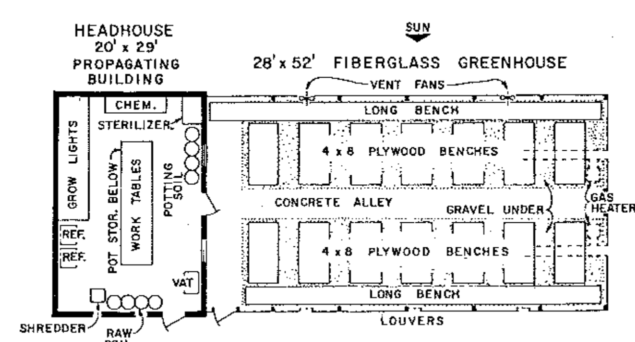
The Highland (Wisconsin) High School Plan shows a separate facility for project storage which can be shared both by vocational agriculture/agribusiness and industrial arts. It should be noted that the window areas in the office and in the general laboratory provide for observational capability by the instructor, should he or she be in the office. Also, access is provided both from the office into the classroom and into the laboratory, as well as into the agricultural mechanics laboratory. It should be noted that in the agricultural mechanics laboratory, the grouping of various pieces of equipment is by work areas. For example, machinery work area versus woodworking versus metal and welding. With large agricultural machinery and equipment, the overhead door must be of sufficient size to allow passage.



ADAPTED FROM - VOCATIONAL AGRICULTURE
DEPARTMENT LODI HIGH SCHOOL

Lodi

The Lodi (Wisconsin) High School Plan shows the vocational agriculture/agribusiness department as a part of a vocational building. Access to the high school building which is nearby is provided by a covered walkway. This particular facility shows an entryway which is shared by industrial arts and by vocational agriculture/agribusiness. Basically, the location of the classroom provides passage of students into the classroom and then, subsequently, into the workroom and general laboratory which is large enough for small meetings, as well as for laboratory work. An overhead storage balcony provides for additional needed space in the agricultural mechanics laboratory.



HORTICULTURE VO. AG. FACILITY VERONA HIGH SCHOOL

Verona

The horticulture facility at Verona (Wisconin) High School shows one possible arrangement for a greenhouse and headhouse. Any school contemplating the addition of a greenhouse to its laboratory facilities must, in addition to meeting a needs assessment for this phase of the program, take into consideration the staff resources needed as well. Greenhouses need care Saturday and Sunday as well as on school days. Desirably, a greenhouse should be in the immediate vicinity of the total vocational agriculture/agribusiness buildings.

Factors to Consider

There are many factors to consider in departmental building and facility layouts. Adequacy of space associated with the curricular and program requirements is primary. Also, the consideration of flexibility, as well as supervisional capability, by the instructor(s) is highly desirable. Such features as safety, availability of support utilities, and environmental factors, including adequate lighting, ventilation, dust, and gaseous pollution control, must be given consideration. A composite arrangement of internal and external space areas, as well as a cohesiveness achieved by adequate planning and location of equipment internally, must be considered.

In addition to the physical buildings and facilities normally associated with the school campus, one should give consideration to use in the educational program of land laboratories. Such laboratories may encompass a wide variety of uses, including conventional school farms, school forests, wetlands, study areas, horticultural gardens, arboretum areas, orchard plots, landscape areas, turf plots, nature studies areas, plant material beds, experimental crop production plots, and similar types of laboratories. Such land laboratories might be used for a variety of educational purposes involving the production of crops for nonfarm and urban background students, demonstrational teaching, and/or for production sales to help support other departmental functions. The scope and size of such land laboratories will be determined by the availability of land and the utilization of such spaces for learning activities. The extent of use of such land laboratories can be enhanced by nearness to the school campus.

In the final analysis, the effectiveness of buildings and facilities depends upon the instructor and his or her willingness to utilize facilities in a top-quality educational program. Instructors of vocational agriculture/agribusiness have a unique opportunity educationally, in that instruction of students occurs in a variety of locations and facilities. All buildings and facilities are, in essence, educational resources that are extremely important in the conduct of a broad, basic educational program in agriculture and agribusiness. It is incumbent upon instructors, therefore, to plan curricula which meet the educational needs of students and use resources wisely.

The Hereford Story . . .
Using Community Influence to Get a New Facility

BY STEEN G. WESTERBERG

Editor's Note: Mr. Westerberg is Instructor of Vocational Agriculture at Hereford Jr.-Sr. High School in Parkton, Maryland.

In teaching agricultural mechanics, you may find yourself faced with the same problem as the vo-ag teachers at Hereford Junior-Senior High School in Parkton, Maryland, in 1971. I was one of the teachers. We felt that our agricultural mechanics instruction should be strengthened and brought in line with the broadening needs of the community. It became apparent that our facility was inadequate and that there was no hope on the horizon for additional facilities funded by local or state boards of education.

As is the case so many times in education, we had to create an excessive need before authorities recognized a basic one. I recall at the time an increase in enrollment wasn't anticipated when we expressed fears of strain on the existing shop facility. At no time did our supervisor or principal disagree with the course we pursued, although both were apprehensive.

Our Program

Briefly, our agricultural mechanics program is designed to cover a three year period. The content of the three years is broken down as follows:

Agricultural Mechanics I — includes sketching and drawing, woodworking and carpentry, tractor safety and operation, tool fitting and sharpening, metalworking (cold and hot), sheet metal fabrication, paint and preservatives, arc welding and cutting, small gas engines, and developing a farm or home shop.

Agricultural Mechanics II — includes machinery repair shop practices; minor services and periodic maintenance; engines (gasoline and diesel); electrical systems; hydraulic systems; the power train; drive lines; braking systems; gas shielded welding; operation, calibration and repair of machinery; and use of processing equipment.

Agricultural Mechanics III — includes masonry and concrete construction; farm and home plumbing; heating and ventilation; soils and water management; fencing; structures (wood and metal); agricultural surveying; agricultural electrification; electric motors; and automatic controls.

The first course must preceed the other two. Both class I and class II meet five periods per week, while class III meets ten periods per week.

Initially, the intent was to give students a program that would better serve their needs as well as the needs of the community. Little was it realized that almost instant growth would occur when an updated curriculum was implemented. By 1974, two years after implementation, enrollment had increased from 50 to 150 students.

Our Facilities

The agricultural mechanics laboratory being used in 1974 was constructed in 1952. It was out-of-date and limited the curriculum. A self-propelled combine and other modern equipment could not be moved through the door. If we had been able to bring in a twelve-foot-cut combine, it would have taken up half of the floor space. The problems brought on by increased enrollment, small shop size, and the new curriculum were not limited to space concerns, but included safety.

Our Strategy

Public relations and community involvement were important in this strategy. In the community there are two very strong and influential farmers clubs. The chairman of the vo-ag department belongs to one of the clubs and the school principal belongs to the other. Our school draws its students from a large school district from within a county school system which surrounds the City of Baltimore, Maryland. The school district encompasses about 75-80% of the agriculture in the county, but would still have to be characterized as suburban.

In the summer of 1975, the farmers clubs became aware of the fact that our mechanics program could no longer handle the number of students electing to enter. That year we turned away 40 students. The fact that critical parts of our curriculum were being hampered and safety practices were deteriorating was also discussed.

With this information available, a representative from each of the farmers clubs and our school principal talked with the County Board of Education and requested immediate action. A new agricultural mechanics facility, separate from the existing school and of a pre-engineered metal-type construction, was discussed. The answer from the Board of Education was blunt. Even if such a structure was found to be necessary, the time required to get it would be greater than we wanted. Their estimate was around eight to ten years. In addition, they could not foresee the funds being available for at least five years. They further told us that the type of structure we wanted was not acceptable.

Our proponents came out of this meeting with a united conviction. They would not allow a program that was trying to meet the needs of the community to suffer at the hands of an unresponsive central school administration and county bureaucracy. (In our state, the county unit is the "local education agency.")

Within a month, a Citizens Committee had been formed. This committee consisted of two state legislators, the President of the County Farm Bureau, the President of the County Young Farmers, ten farmers (four of them former students), a veterinarian (also a friendly member of the lay Board of Education), two of our county agents, two leaders from the agribusiness community, the President of the school's Parent-Teacher-Student Association, and several students. The five agriculture teachers were asked to act in an advisory capacity to the group.

The first meeting of the Citizens Committee was held in November, 1975, and by December cost estimates had been obtained on the type of facility we felt would be adequate. In February, 1976, the Committee appeared before a meeting of the lay Board of Education and convinced them of need. Funds, time, and type of structure were still a roadblock.

In April, 1976, the Committee and our FFA Chapter invited the Baltimore County Executive to attend and speak before our annual FFA Senior Luncheon. We also had a commitment from our vocational supervisor that, if the building were to become a reality, the outfitting of the structure would not be a problem.

After the luncheon, the County Executive was taken on a tour of the total vocational agriculture facility. The agricultural mechanics curriculum needs were explained and, after surveying the mechanics laboratory, he and his aide admitted the facility was not acceptable and was unsafe. That same day he tentatively agreed to make money available out of the county budget. The type of structure was acceptable to him, as long as it would meet the existing county and state codes.

By June, 1976, the "Educational Specifications for the Proposed Hereford High School Vocational Agribusiness Mechanics Facility" had been submitted to the Office of Architectural Planning for the Board of Education.

In January, 1977, final plans had been presented and the project was put to bid in April. Ground was broken in December, 1977, and completion was to occur in one year. On December 1, 1978, a skeleton crew of students and the author started placing equipment, outfitting tool panels and cabinets, and putting together benches. On February 1, 1979, our classes officially started to meet in the new facility.

Total time involved from the initial contacts until completion — three years and three months. This time table was four to seven years less than that estimated by the Board of Education, even if they could get the funds. I might add, that during the 3¼ years this project covered, there were probably not more than a total of six weeks that the committee allowed the phones to become silent at the Board of Education offices.

Now

We now have two full-time agricultural mechanics instructors and two teachers that devote a portion of their teaching time to mechanics. Total enrollment in the senior high agricultural mechanics program has increased to 207 students. We now have a staff of six teachers and an aide. Both the old (but renovated) laboratory and the new agricultural mechanics building are used seven periods per day and for night adult classes.

Our new facility has 6,000 square feet of floor space with an additional paved area outside the building that is secured by a ten-foot fence giving an additional 4,300 square feet. We have additional unsecured parking areas and storage space.

We owe a great deal to a very responsive community with interested and vocal agricultural leaders. Community involvement worked for us, and it will work for you.

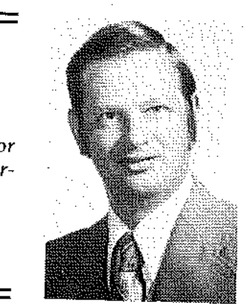
Would you believe that this year we had to turn away students who wished to enroll?

THEME

Minimum Facility Standards

BY VICTOR A. BEKKUM

Editor's Note: Dr. Bekkum is Assistant Professor of Agricultural Engineering at Iowa State University.



Planning a new facility or evaluating an existing facility is an exciting time in a vocational agriculture department. It is a time for involvement of the teacher(s) and advisory council. Good input is needed whether a new building is to be constructed or an existing one renovated.

A recent study at Iowa State University provided updated recommendations for facilities for production agriculture programs. The minimum recommendations in this article were derived from data collected from a teacher educator panel who were primarily responsible for teaching and consulting regarding vocational agriculture facilities in the central region of the United States. These guidelines will be helpful in planning new facilities and evaluating present facilities to determine future facility improvement plans.

Classroom

The classroom is the center of learning activities. Items to consider and minimum recommendations for each are presented in Figure 1. In the largest classroom of a multiple-room facility or a single-room facility, a floor space minimum of 910 square feet is recommended. This

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Minimum Facility Standards

(Continued from Page 9)

will accommodate classes of 24 students (42 square feet per student). Multiple teacher departments should provide additional area for each teacher.

Eighty-four linear feet of storage space for text books and other teaching materials should be provided. It should be easily reached by students. The chalkboard, bulletin board, and magazine rack should be included from the beginning rather than added on later. Electrical considerations include lighting at a minimum of 75 foot candles at the table tops and duplex receptacles spaced around the room perimeter at a maximum interval of eight feet. A ceiling with acoustical type tile will improve sound conditions in the classroom.

Figure 1. Classroom facility items and minimum recommendations.

Room size (total)	910 sq. ft.
Area per student	42 sq. ft.
Table space per student	2.5 linear ft.
Storage space	84 linear ft.
Magazine rack	22 linear ft.
Chalkboard area	60 sq. ft.
Bulletin board area	40 sq. ft.
Entrance doors	2 (number)
Entrance door width	3 feet
Lighting (on tables)	75 foot candles
Ceiling height	10 feet
Electrical outlets — 120V	8 feet max. intervals
Windows (dist. above floor)	5 feet
Floor tiles or carpeted	
Acoustical treated ceiling	

Classroom Storage Area

A separate storage area of 140 square feet minimum should be provided in addition to the storage space located in the classroom. This will provide space to store audiovisual equipment and teaching materials not being used at the time. At least 110 linear feet of shelves are recommended within the storage room.

Classroom Laboratory Area

A classroom laboratory area included as a part of the classroom is preferred over a separate room. This would require a minimum additional area of 285 square feet and 20 linear feet of counter work space in the classroom. A folding accordian-type partition is an optional item if the teacher prefers to separate the laboratory area from the classroom. This additional area without a permanent wall provides extra room for larger group activities, such as FFA meetings and night classes. Utilities including gas, water, air, and electrical outlets should be included in the plan for the classroom laboratory area.

Office Area

An office area separate from the classroom is strongly recommended. A minimum area of 115 square feet per instructor should be provided. General lighting in the office should be a minimum of 80 foot candles. Pre-wiring for a telephone is an absolutely essential item to include in the office plan. Careful consideration should be given to the location of the office. It should be readily accessible from the classroom and laboratories with windows between the classroom and laboratories. An access corridor should be provided directly to the laboratories from the classroom area.

Basic Agricultural Mechanics Laboratory

As the largest and most costly teaching facility area, the basic agricultural mechanics laboratory requires extra consideration. Minimum recommendations for facility items related to the agricultural mechanics laboratory are presented in Figure 2.

Figure 2. Minimum recommendations for a basic agricultural mechanics laboratory.

Room size	3000 sq. ft.
Area per student	150 sq. ft.
Open floor space	1700 sq. ft.
Width to length ratio	1:1 5-2 ratio
Width	40 feet
Ceiling height	17 feet
Overhead door width	14 feet
Service doors	2 (number)
Lighting (at work areas)	80 foot candles
Electrical outlets (120V)	8 foot max. intervals
Electrical overhead bus ways	
Tool storage cabinets	140 sq. ft.
Bench space	100 linear ft.
Dust collection	
Exhaust-welding, monoxide	
Sump type drain	12 lineal ft.
Compressed air outlets	5 number
Floor sealed concrete	
Concrete apron to overhead door	
Hoist	
Fire alarm system	
G.F.C.I. (outdoor outlets)	
Safety zoning	
Non-skid (around machines)	

A minimum of 3,000 square feet of floor space is needed in the laboratory used for instruction in basic agricultural mechanics, not including supply and tool storage rooms. Allowing for placement of stationary equipment, welding booths, benches, and so forth should leave a minimum of 1,700 square feet of open space.

With the large modern machinery of today, it is necessary to provide an overhead door of similar proportions. A minimum height of 14 feet and width of 17 feet are recommended for the overhead door. A service door and sump-type drain in the immediate vicinity of the overhead door should be provided.

Electrical service includes lighting of 80 foot candles at the work areas and 120 volt receptacles spaced no more than 8 feet apart are recommended. Overhead bus ways should provide convenient electrical access for stationary power tools.

A high priority item in the agricultural mechanics laboratory is the exhaust system for the welding engines areas. Although it was not within the scope of the study to determine air quality standards or cost considerations for exhaust systems, it is evident high energy costs will necessitate selection of ventilation systems that considerably reduce the heat losses from the area. All applicable safety laws and regulations must be met by the facility.

Tool Storage Area

Tool storage cabinets located in the agricultural mechanics laboratory and organized by subject matter area are highly recommended. Providing additional storage space in a separate room is a good idea, especially for portable power tools. An area of 100 square feet is the minimum recommendation for a tool room with 25 linear feet of shelves. Identification of the shelves with labels or tool silhouettes will help the instructor and student to account for each tool each class period with minimal effort. Also, bench space should be provided in the tool room for storing specialized tools and as an area to perform tool maintenance work.

Supply Storage Area

Planning for the storage of metal, wood, projects, and supplies (including paint and fasteners) is of importance. Provide 340 square feet for supply storage, with a minimum length of 22 feet to accommodate metal stock in 20 foot lengths. An entrance door for the outside provides a convenient access to unload incoming supplies. Two-level storage is an option to consider which utilizes overhead laboratory space that otherwise might not be used.

Locker Area

Student lockers should be located near the wash area. A separate locker room is not considered necessary as it may add to supervision problems.

Restrooms for both boys and girls must be provided if the vocational agriculture facility is located away from the main school building. If restrooms are provided, a logical location is near the lockers and wash area, since water and sewer lines will be closeby.

Outdoor Area

An outdoor area adjacent to the agricultural mechanics laboratory can provide space needed for activities such as construction projects. Figure 3 shows the minimum recommendations for the outdoor area.

Provide a minimum of 2,100 square feet of outdoor space adjacent to the agricultural mechanics laboratory. The area should adjoin the overhead door for supervision purposes. Hardsurfacing of at least a portion of the outdoor area will provide a more satisfactory work area. A roofed area of at least 500 square feet will offer some protection from the elements. A fence or wall eight feet high will improve the aesthetics of the area and the security. Also, provide a sump-type drain to allow for cleaning of tractors, small engines, and other equipment brought into the laboratory for service and repair demonstrations. When properly planned, the outdoor area can furnish substantial usable area for teaching.

Figure 3. Outdoor area

Space provided	2100 sq. ft.
Hardsurfaced area	1500 sq. ft.
Roofed area	500 sq. ft.
Fence or wall	8 ft. high
Sump type drain	
Loading ramp	10 ft. wide
Entrance gate	23 ft.
Lighting	35 foot candles

Use Recommendations

Planning a new facility or evaluating an existing facility requires involvement and direction by the teachers and advisory council. Up-to-date recommendations should be used as guidelines in preparing facility specifications. Consult with facility specialists at your university or state department of education during the preliminary planning steps.

The recommendations in this article are minimum. Individual situations may warrant additional space, especially as related to the teaching areas, the classroom, classroom laboratory, agricultural mechanics laboratory, and outdoor area.

An office area separate from the classroom is needed for the teachers. Storage areas for classroom materials, tools, and supplies are absolutely essential. Locate the agricultural mechanics storage areas for convenient access from outside doors. Locate the locker and wash areas in the laboratory as opposed to a separate room. The outdoor area adjacent to the laboratory can be a productive and aesthetically pleasing area if properly planned. A good motto with vocational agriculture facilities is to plan ahead.

BOOK REVIEW

FARM MANAGEMENT MANUAL, by Kenneth C. Schneeberger and Donald D. Osburn, The Interstate Printers and Publishers, Inc.: Danville, Illinois, 1978, 127 pages, $4.95.

THE FARM MANAGEMENT MANUAL utilizes numerous real life problem situations to emphasize the application of basic economic principles and management analysis techniques.

The book contains only problem situations, therefore, students will probably need some classroom instruction prior to or in combination with the use of the manual. Students who have had some experience in farm management classes may use the manual as a self-instruction unit.

The manual will require the student to interpret data from tables and budgets and use basic math skills in finding problem solutions.

Answers to the problems and solution logic are given for most problems at the end of the chapters. These answers provide students with immediate knowledge as to their success in reaching problem solutions and increase the feasibility of using the manual as a self-instructional unit.

The chapter on cost analysis covers the various types of fixed or ownership costs and variable costs. The credit chapter has problems on interest rates, cost of loans, and loan payment comparisons. Chapter eight on commodity prices includes problems related to forward contracting and the future market. Other chapters on records and investment analysis are helpful.

The manual is primarily directed toward use in high school or junior college level farm management classes.

William H. Adams, Jr.
Lexington, North Carolina

Getting The Greenhouse Laboratory You Need

The construction of an educational greenhouse laboratory is a costly undertaking. Whether it be a part of an overall new building or an addition to an existing building, proper safety and design considerations are essential to insure against later problems with greenhouses.

The impulse to select the least expensive greenhouse structure may turn out to be a costly mistake. By depending solely on the advice of an "anxious" salesman, what may appear to be a low initial investment, could grow into an overburdening expense. Regretably, most architects have little understanding of the features needed in an educational greenhouse.

Some educational greenhouses have been designed by heating and cooling engineers who have no practical experience with the unique problems encountered in greenhouses. Many of these have functioned perfectly, whether by design or by luck. Others have been plagued with problems since completion. Even some of the well established brands in greenhouse structures have been disasters because of cost-cutting options offered to an unknowing educator-administrator.

Unfortunately, the expert design on paper may turn out to be different in reality. Construction of any facility involves cost cutting. All too often the cost of cutting is done without consultation as to what the effect might be on the proper operation. The effects usually aren't readily apparent until the greenhouse is put to the test, often in midwinter. It is then that one realizes that the most inexpensive heating system was not necessarily a good choice. Mistakes like this are difficult to correct. Expensive plants may die, students cannot learn proper growing techniques, and the school will have additional expense.

A greenhouse that functions properly is an important and essential facility for effective programs in horticulture. It should be designed to serve not only regular daytime

Educational greenhouses must be safe, functional, and roomy to permit effective student use. (Photograph from Walter T. Bjoraker, University of Wisconsin)

By Michael A. Sedlak
Editor's Note: Mr. Sedlak is Associate Professor of Horticulture at The Williamsport Area Community College in Williamsport, Pennsylvania.

students, but others in the community including senior citizens, members of local garden clubs, and adult horticulture workers. Allotting space for such programs could increase public support and meet the needs of groups that are often overlooked.

Needed Safety Features

Far too many greenhouse laboratories do not meet the needs of the students and teachers in terms of design and safety. Safety in the school greenhouse should not be overlooked. The safety requirements of the educational greenhouse differ from those of the commercial greenhouse. Some important questions about safety include:

Are the electrical outlets weatherproof covered?

Are the outlets located at a height to prevent water entry?

Is there an electrical "panic" button in the headhouse?

Is there a clearly visible fire extinguisher of the appropriate size and type nearby?

Are there any emergency exits in the greenhouse and are they marked as such?

Is there a fire alarm in the greenhouse?

If steam is present, are the steam valves clearly marked as to their danger?

If CO^2 cylinders are used, are they located safely outside the greenhouse?

Is the black photoperiod control cloth of a fire retardant fabric?

If it is a fiberglass greenhouse, is the fiberglass covering a flame retardant type?

Are all fan blades covered with a protective screen?

Experienced teachers can add to this list as they scrutinize their facilities and seek to improve safety.

Facility Versus Equipment

Contrary to some opinions, the educational greenhouse is a facility and should be subject to the same scrutiny given all other educational facilities. It is unfortunate that many states consider them "equipment," avoiding inclusion of the important safety specifications required of other buildings.

Planning the Educational Greenhouse

With increased emphasis on beautification and ecology has come a growth in horticultural education programs in the public schools and junior colleges. Often the person responsible for planning the accompanying greenhouse facilities does not have sufficient experience to adequately design or select the structure, environmental equipment, and support systems. The result is a less than satisfactory facility which does not function well in the educational program.

Proper prior planning, including technical assistance from experienced persons in local grower associations, the Cooperative Extension Service, and greenhouse manufacturers or reputable dealers, can eliminate many of the problems before the facility is built. Modification after construction is inconvenient, costly, and restricted due to budget constraints.

This article will show some of the mistakes that have been observed and point out some of the considerations that should be given to the development of a greenhouse facility for educational purposes. Topics covered are selecting the site and structure, creating and maintaining the proper growing environment with heating and ventilating equipment, using the facility space efficiently, and incorporating safety considerations. The discussion will be most useful to the architect or planner not familiar with greenhouses. However, the horticulture instructor should benefit from the article and bibliography listed and may wish to seek out the planner to provide the types of recommendations contained herein.

Selecting the Site

The purpose of a greenhouse is to provide a suitable environment for plant growth, particularly during the fall-to-spring period when crops are not grown outside. A sunny location which avoids the long winter shadows cast by buildings and evergreen trees is a primary requirement for growing flowering or fruiting plants which need high light levels. Remember to note where the winter shadow falls. It is longer than the summer shadow. Shade loving plants can be grown in a heavily shaded greenhouse but the total variety of plants is reduced. Afternoon shading by deciduous trees in the summer is acceptable and often desired; in winter the leaves are gone.

For security purposes an institution should consider large courtyards or other partially enclosed areas between buildings. Fences and lighting may be necessary for security, but night lighting can affect the plant photoperiod. Shield security lights so they do not shine directly onto the greenhouse.

Other important considerations include the relative locations of the horticultural classrooms, the work and storage space requirements, and the central heating plant. A good teaching arrangement would have the classroom, work tables, and storage facilities in a conventional building adjacent to the greenhouse, as illustrated in Figure 1.

By David S. Ross
Editor's Note: Dr. Ross is an Extension Agricultural Engineer and Associate Professor, Department of Agricultural Engineering, University of Maryland, College Park.

Access to utilities may determine the greenhouse site. Heat, water, and electricity must be provided and the distance to their sources will influence building costs. The site must be well drained, accessible to delivery trucks, and protected from cold winter winds.

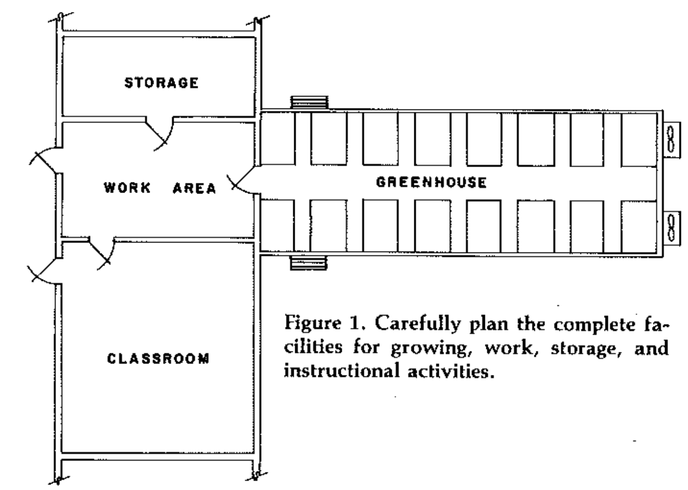


Figure 1. Carefully plan the complete facilities for growing, work, storage, and instructional activities.

Selecting the Structure

A stock model greenhouse with the necessary environmental equipment should be purchased from a reputable manufacturer or supplier. A stock greenhouse has an operational history behind it. That experience dictates the environmental equipment, such as heaters, ventilation fans, circulation fans, evaporative pads, and thermostats, that make it functional.

One of the biggest pitfalls in institutional greenhouses is allowing the architect to design a custom greenhouse to fit the lines of the rest of the building. The architect is generally inexperienced with greenhouse functional design and the contractors who follow are inexperienced in heating and ventilating greenhouses. The result is a greenhouse in which the environment may be difficult to control.

A second pitfall is letting of contracts for equipment and installation to companies which have no experience with greenhouses. The full package contract should be given to the greenhouse manufacturer or reliable supplier. If this is not practical or economical, adequate instructions and review of the plans should be made by a capable person.

(Continued on Page 14)

Planning The Educational Greenhouse

(Continued from Page 13)

Ideally, experienced supervision should be given to prevent problems from developing regardless of the contractor.

Choice of a structure includes style, framing and cover materials, type of heating and ventilation, and type of benches or growing beds. The top-of-the-line greenhouse is glass on a steel or aluminum frame. Glass is pleasingly transparent so the plants inside can be seen from outside and the structure is durable and easy to maintain. Fiberglass is often used to provide better protection against thrown objects and does diffuse the light to lessen shadows. The best grades of greenhouse fiberglass and glass are competitive in price and light transmission qualities about the same for both. Low cost facilities can be built using film plastic over a quonset pipe frame. Appearance, durability, and low maintenance are traded for low initial cost and higher annual maintenance cost.

Space requirements and the site will influence the style of the structure. A lean-to greenhouse provides low to moderate space by using the side of a building as one wall. The lean-to style appears to be one-half of a conventional greenhouse. A freestanding or end-attached greenhouse can be used for low to high space requirements.

Energy conservation practices should be incorporated into the design from the beginning. Techniques for saving up to 50 percent of the energy formally used are available. Thermal blankets or curtains are drawn at night to enclose the crop zone and reduce heat loss. Air-inflated double film plastic covers reduce heat loss by 30 percent over single covers. On old glass greenhouses the double plastic cover also reduces air infiltration, thus increasing the savings. Perimeter insulation, floor heating, reduced night temperatures, and other practices should be considered. Retrofitting the new greenhouse is more costly and the building budget will likely have been depleted, so incorporate conservation practices into the initial plan. Supplemental solar collection and storage should be considered as a step beyond the energy conservation techniques discussed, not as a substitute for them.

Creating the Environment

Sunlight, temperature, humidity, and carbon dioxide are major factors in plant growth. The greenhouse must provide a reasonable balance of these for best results. Nature provides the sunlight for greenhouses. However, artificial lighting can be used for germination and propagation in other buildings. Solar radiation provides part or all of the mid-day heating. Nature is supplemented by providing heating, ventilation, cooling, and humidifying equipment to maintain conditions suitable for good plant growth. Carbon dioxide is replenished by ventilation air or by other means.

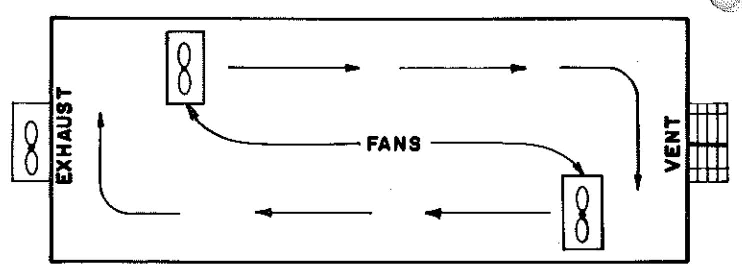
Institutional greenhouses must house a wide variety of plant materials, so thought might be given to dividing the structure into two temperature zones with a temporary barrier. If this is desired, the heating and ventilating equipment should be sized and located for this purpose during the planning stage. Energy conservation may be a motivating factor toward the two-zone greenhouse.

The translucent greenhouse differs from the conventional building because its response to solar radiation and change in outside temperature is much quicker. This difference dictates the greenhouse must be handled separately for both heating and cooling.

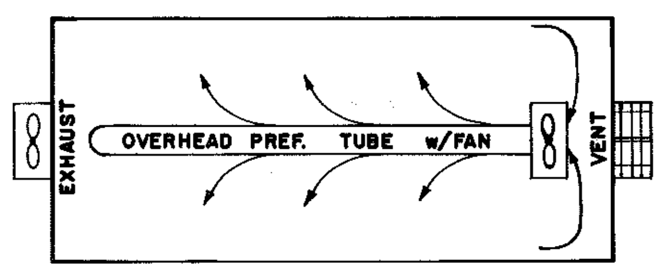
Providing Uniform Heating in Cool Seasons

The greenhouse heating system should be independent of another building's influence and control. In the past, a greenhouse was often added to the end of a heating line controlled inside the classroom building. With reduced night, weekend, and holiday temperatures in the classroom for energy conservation, the greenhouse was left without sufficient heat to maintain safe temperatures. A separate heating line from the central heating plant to the greenhouse with a thermostat in the greenhouse is highly desired. Alternate heating systems such as propane, fuel oil, or electric heaters in the greenhouse can be used for total heating needs or as backup low temperature protection to a central heating system which is not controllable in the greenhouse.

Continuous air circulation within the crop zone of the greenhouse is recommended during the heating season to maintain a uniform temperature. Air movement also helps to maintain carbon dioxide and to remove excess moisture from the foliage. For this purpose, the overhead fan and perforated tube or the horizontal air flow sytem is suggested. In the horizontal air flow system fans are placed on the sidewalls to move air around the greenhouse. Suggested configurations for air flow control in greenhouses are shown in Figure 2.



Horizontal air flow fans develop rotational circulation.

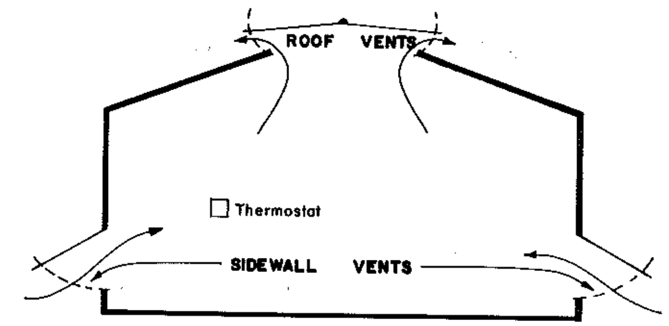


Overhead fan and perforated tube maintains air circulation.

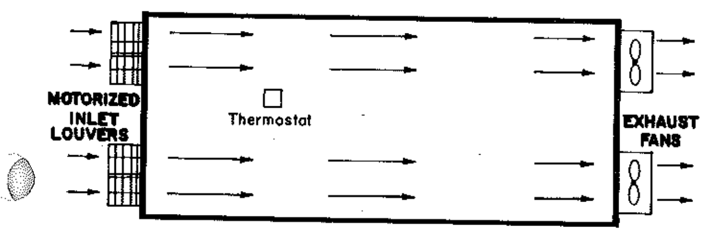
Meeting Ventilation and Cooling Needs

The need for exchanging air to the outside varies seasonally and daily to maintain the desired temperature, replenish carbon dioxide, and remove excessive moisture. Solar radiation provides more than enough heat on cool, sunny winter days and the excess must be exhausted. Winter ventilation is an example of a low ventilation rate that is equal to exchanging 20 to 30 percent of the greenhouse air volume (in cubic feet) per minute. Full ventilation during warm sunny weather requires 0.75 to 1 air change per minute in medium to large greenhouses and 1.2 to 1.5 air changes per minute in small greenhouses (under 5000 cubic feet of volume, for example, a 20 by 30 foot house).

Ventilation can be accomplished by natural convective air movement using sidewall and roof vents or by mechanical means using exhaust fans and intake louvers, as illustrated in Figure 3. Either way, automatic control via thermostats and motors is recommended. Thermostats should be at crop height, away from sidewalls, and shielded from the sun.



Natural convective ventilation.



Mechanical ventilation

Year-round ventilation can best be accomplished by staging the fans. Staging means the low speed of a two-speed fan can serve winter-time needs, while the high speed and perhaps additional fans are activated as the greenhouse temperature continues to rise. Thermostats set at successively higher temperatures (2 to 5 degrees F. intervals) activate fans, in sequence, as the temperatures rise until sufficient fan capacity is functioning to meet cooling needs.

Evaporative cooling can be used in most areas to provide better temperature control in the summer time. Water evaporated from wetted fiber pads at the inlet louvers to cool the air and raise its humidity. Inside temperatures can be kept near or below the outside temperature depending on outside relative humidity and the solar radiation load.

Using Facility Space Effectively

The greenhouse is most economically used for growing plants with, as much as possible, the supporting work, storage activities, and classroom space located in the classroom building or an adjacent insulated headhouse. Where the greenhouse is to be used for group instruction, try to separate the exhaust fans and other noisy equipment from the instructional area.

Instructional greenhouses need to provide more space for students to move about, so aisles should be 3 to 4 feet wide. Peninsular benches perpendicular to the length of the greenhouse provide individual growing spaces. Aisles between benches need to be at least 2 feet wide; benches can be up to 4 feet wide. Provisions for handicapped students in wheelchairs must be considered, so main aisles about 5 feet wide and aisles between benches about 4.5 feet wide must be provided somewhere in the greenhouse layout.

Water for plants should be provided by faucets each 25 feet or less apart along each main aisle. Watering hoses must be convenient to use without dragging them over benches and stored off the floor. Provisions should be made during the plumbing for installation of automatic watering systems. Electrical services will then be needed for automatice timers, solenoid valves, and other controllers needed for watering, misting, and lighting systems.

Incorporating Safety Considerations

For safety purposes, waterproof electrical outlets should be placed overhead so supplemental lighting or other equipment can be plugged in conveniently while accidental contact is less likely. Ground fault interrupters may be required by the electrical code. Electrical equipment and outlets should be properly protected by cover plates, shields, ground wires, and cut-off switches, as appropriate. Cut-off switches on fan and pump housings permit the power to be positively turned off at the unit while maintenance is being performed, for example. Concrete walks should slope to the sides for rapid drainage. Exits should be well marked and readily opened from the inside. Pesticides must be stored in a dry, secure, locked cabinet with toxic steps to take in case of an accident.

Summary

Greenhouses are essential for effective vocational horticulture programs. Experience has shown that the adequately and carefully planned and constructed facility is a real asset. Professional assistance should be sought by the architect or building planner where a greenhouse is being considered. The greenhouse is structurally and environmentally different from a classroom building and should be given careful attention.

Among the planning considerations are: a sunny location; well constructed structure; independent heating control; adequate and properly-staged ventilation and cooling; well designed work, storage, and growing areas; and designed with safety and energy conservation in mind. Careful planning prior to building will result in a facility with a minimum of problems for the instructor and of hazards to the students.

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NRAES is the Northeast Regional Agricultural Engineering Service, a regional Extension activity.

Efficient Storage For The Agricultural Mechanics Laboratory

The request was to design a mechanics laboratory storage facility that would eliminate supplies and materials in the laboratory, provide storage of mechanics roller tool cabinets, and have a security cabinet for specialty tools, a safety storage cabinet, and dead storage for off-season components. Challenge? No! "Surprise and pleasant task" is a better description of my response to the Board of Education.

By W. Forrest Bear

Editor's Note: Dr. Bear is Professor of Vocational and Technical Education and Agricultural Engineering at the University of Minnesota - St. Paul.

Better Space Utilization

The agricultural mechanics laboratory work space is not sacrificed when adequate storage is provided. In the past, supplies were obtained at an economical delivery cost. Therefore, the storage of equipment, hardware items, fasteners, and building materials was not considered essential. The cost of petroleum products has sparked the need for better storage facilities in the school mechanics instructional areas. The present cost of construction materials also encourages an efficient inventory system and better security of materials whether school or student owned.

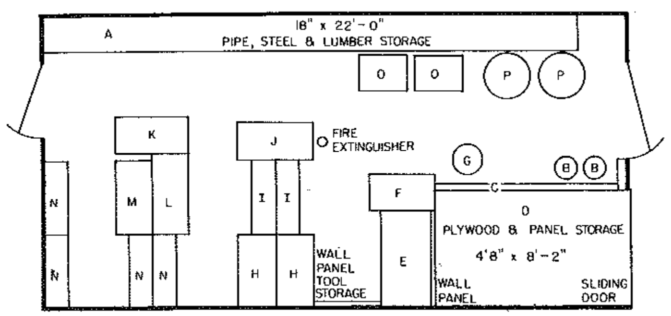


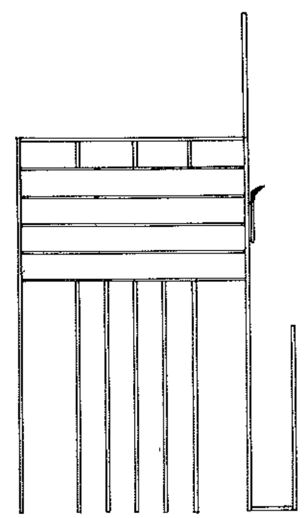
Figure 1. AGRICULTURAL MECHANICS LABORATORY STORAGE FACILITY 12' x 24'

Size and Doors

The storage area, Figure 1, is 12'x24'. The 24-foot dimension was dictated by standard lengths of pipe and steel. A more economical utilization of space could be obtained with vertical storage but a 22-foot ceiling is more difficult and expensive to achieve in building design! The 12-foot dimension was determined by the need to store plywood and panels plus accommodate a quantity of other supplies. A sliding door covers the plywood and panel storage, and a four-foot swinging door completes the other end. The three-foot door in the opposite end could service a second mechanics laboratory. These swinging doors could be the "dutch type" which could be utilized as a check-out point for tools and supplies.

Fabrication of Storage Units

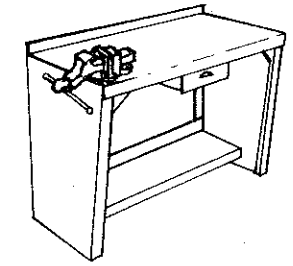
Storage unit (A) for lumber, steel, and pipe will probably need to be fabricated locally. Remember to provide 6-10 uprights with narrow spacings, 6-12", between the projected supports. The more uprights and storage supports, the greater the flexibility provided for storage of shorter lengths of material.



PLYWOOD & PANEL STORAGE (D) SHEET METAL STORAGE (C)

Figure 2. Detailed sketch of C and D.
Letters refer to locations in Figure 1.

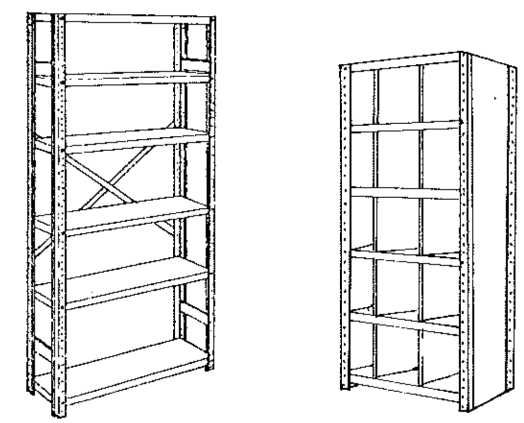
Combustible waste receptacles (B) are provided for both clean and dirty rags or clothes. Sheet metal storage (C) will be fabricated to provide 4-8" of storage which is 30 inches high. The sheets of metal can be lifted up and out of the receptacle. The plywood and panel storage unit (D) is also designed to provide vertical storage of thick panels and flat storage of thinner materials. Off-season storage for lightweight materials can be provided above this storage unit of a railing with kick board is provided. Forty square feet of wall storage space can be provided above the sheet metal rack. This location can be for shovels, rakes, brooms, surveying equipment, and other long items. Design the holders to eliminate the risk of tools falling down.



HEAVY DUTY WORKBENCH (E)

Figure 3. Sketch of Workbench.

A workbench (E) is provided with a machinist vise. The location of the vise will depend whether the file cabinet (F) is a two- or four-drawer unit. Wall panels for storage can be placed at the back of the workbench and on the wall. The workbench is to be used as a repair station for tools and equipment but will probably be used more frequently for inventory control, cost analysis, and ordering of supplies. The file cabinet can have one drawer devoted to storage of operator's manuals for all tools and equipment. The waste receptacle (G) is essential for good housekeeping.



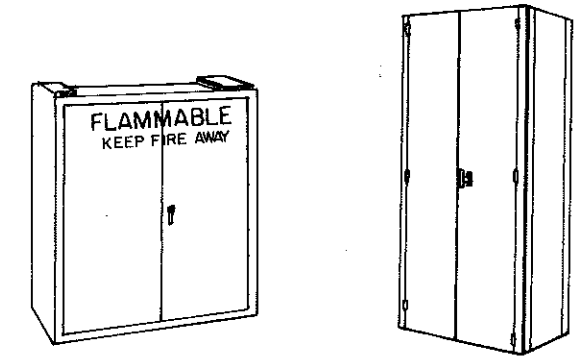
OPEN TYPE SHELVING UNIT (N) CLOSE BIN UNIT (M)

Figure 4. Types of shelving.

Open-shelf units, 18" deep (H) and 12" deep (N) will have adjustable shelves which can be personalized for specific items. Shelf edges can be marked with a tapewriter to identify desired location for items. Some teachers may want to construct these units as student projects. The instructor's time should be too valuable for fabrication. Analyze the convenience and economics between purchase and fabrication. The closed bin unit (M) has sides and back with the shelves in a fixed location.

Movable Units

The location and use of mechanics roller tool cabinets (O), and castered barrels (P) for steel storage will depend upon the instructional program. Project storage space has not been designated because a separate room should be provided for this. The shelves for project storage will be of different design and special security should be provided away from normal student traffic flow.

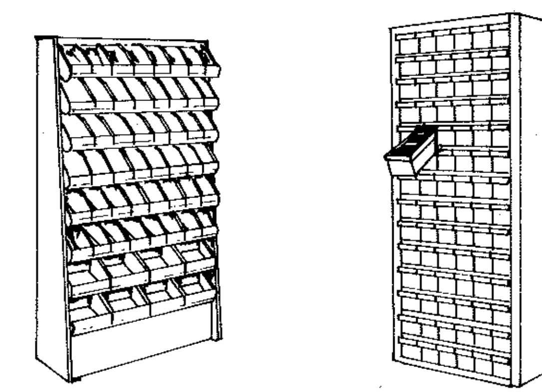


SAFETY CABINET (L) LOCKING DOOR SHELVING UNIT (K)

Figure 5. Cabinets.

Security and Safety Storage

The security cabinet (K) has six shelves and a locking door. The safety storage cabinet (L) is rated for 45 gallons and is to meet the OSHA requirement for storage of petroleum products, paint, chemicals, and similar materials.



SMALL PARTS STORAGE UNIT (I) 84-DRAWER STORAGE UNIT (J)

Figure 6. Storage Racks.

Small Parts Storage

To accommodate the multitude of small parts, fasteners, and hardware items, two open storage racks (I), with 56 bins each, have been recommended. The closed component parts unit (J) has 84 drawers. Providing a fire extinguisher in this storage area is desirable and the end of (J) is convenient for this purpose.

Cost

Whether this storage facility costs too much depends upon your priority for an efficient instructional program and efficient use of funds for storage equipment and supplies. Many commercial firms have these or similar units for sale. Cost within or beyond your budget may be an issue, but few will question the necessity for providing adequate, efficient, and economical storage of supplies used in the agricultural mechanics laboratory.

THEME

Arc Welding Exhaust Systems

Getting fumes out of the arc welding area is a difficult job. The need for a safe and healthful environment is a primary concern for the instructor and the school administration because of the health hazards from fumes and gases generated by the welding process.

Ventilation Needs

Ventilation specifications which have been published by the National Occupational Safety and Health Administration established the following standards for safety of the employees in the welding occupations:

1. A minimum ventilation air flow of 2,000 cu. ft. per minute per welding station, or

2. A capture air velocity of 100 lineal feet per minute air flow away from the worker.

These standards are designed to protect the employee from exposure to excessive inhalation of particulates as the result of the welding process.

By Clinton O. Jacobs

Editor's Note: Dr. Jacobs is Professor of Agricultural Education at the University of Arizona.

Airborne particulates are classified into four groupings as follows:

1. Dust — A solid particle which has been broken loose and is being propelled through space (such as sawdust).

2. Fumes — Gases which have resolidified in the air and become a solid particle (such as smoke).

3. Vapor — A liquid droplet suspended in the air (such as steam).

4. Gas — Lacking substance of a liquid or a solid (such as air).

The relative size of airborne particles may range from .001 microns (gas) to 10,000 microns (dust). Particles larger than 10 microns are visible to the eye. An electron microscope is necessary to see particles less than .1 micron. The visible smoke that is generated from welding is composed of metals and chemicals which were heated to the gaseous state and resolidified. These particles include oxide of metals, vaporized oils, and smoke generated by compounds and chemicals in fluxing agents.

Table I — Welding Fumes & Gases Health Hazards

CHEMICAL AGENT	SOURCE	ROUTE OF ENTRY	HEALTH HAZARD(S)
Antimony	Alloy element	Exposed skin Breathing fumes	Inflammation of hair follicles — metallic taste — stomach distress
Arsenic	Metal painted with arsenic compounds Alloying element Hardening agent	Breathing fumes Exposed skin	Inflammation of mucous membranes; Skin irritation
Asbestos	Electrode coating (some)	Breathing fibers	Long term exposure causes asbestosis of lungs
Beryllium**	Alloying element w/copper	Breathing fumes	Acute exposure — chemical pneumonia; long term effect accumulative; fatigue and weakness
Cadmium*	Rust preventative on steel Alloying element	Breathing fumes	Severe lung irritant — long term exposure causes emphysema and kidney damage
Chlorinated Hydrocarbon Solvents	Engine degreaser Cleaning compounds	Breathing fumes	Heat and ultraviolet radiation from arc form highly toxic phosgene gas
Chromium	Alloying element, stainless steel	Breathing fumes	Extremely toxic and irritant to skin, eyes, mucous membranes
Fluorides*	Electrode coatings Welding flux	Breathing fumes	Irritant and accumulative effect — bone damage and fluid in the lungs
Iron Oxide*	Principle element in steel	Breathing fumes	Irritant to nasal passages, throat and lungs — Long term effect not dangerous
Lead* (Lead Oxide)	Alloying element Painted surfaces	Breathing fumes and Ingestion	Metallic taste in mouth — long term effect lead poisoning
Mercury*	Rust preventative	Breathing vapors	Kidney damage; respiratory failure — long term exposure - tumors, emotional and hearing problems
Nitrogen Oxides*	Atmosphere	Breathing fumes	Irritant — hard to detect; dangerous concentration can injure lungs
Ozone*	Gas produced by arc action on air	Breathing fumes	Very irritating to mucous membranes — excess produces fluid on the lungs
Silicon Dioxide	Electrode coating (some)	Breathing free Silica	Long term exposure leads to silicosis
Zinc*	Metal coating	Breathing fumes	24 hour metal fume fever

**Require mechanical local exhaust ventilation with sufficient air flow to maintain a capture velocity (away from worker) of at least 100 lineal feet per minute*

***Above plus NIOSH approved air-supplied respirator*

Classes of Gases

The classification of hazardous gases includes ozone, nitrogen oxide, and fluorides. These particulates in quantities of more than .1 part per million are considered hazardous to the health. The immediate effects of poor ventilation identified by both instructor and student are burning eyes and nostrils, nausea and headaches. The instructor is more likely to be exposed to the accumulative effect of hazardous fumes and gases. A summary of the elements associated with welding which constitute a health hazard is presented in Table 1.

Systems of Ventilation

A common system of ventilation used in many agricultural mechanics laboratories is to open the doors and to turn on a large exhaust fan to bring in outside air and evacuate the room air. This causes a tremendous loss of heating or cooling energy.

Another method is to equip the arc welding instruction area with a common intake hood mounted over permanently located arc welding booths. A single exhaust fan with sufficient volume to achieve the 2,000 cu. ft./min. air flow at each station is connected to the hood to remove the smoke and fumes. This type of system has several disadvantages. The welding fumes move upward toward the hood and into the welding helmet of the student or instructor. In the process, some of the fumes enter the face shield where they are confined and breathed. The high discharge rate of the exhaust fan removes considerable heat from the building which may be more than economically desirable. The high cost of the materials and machinery is often a deterrent to installation.

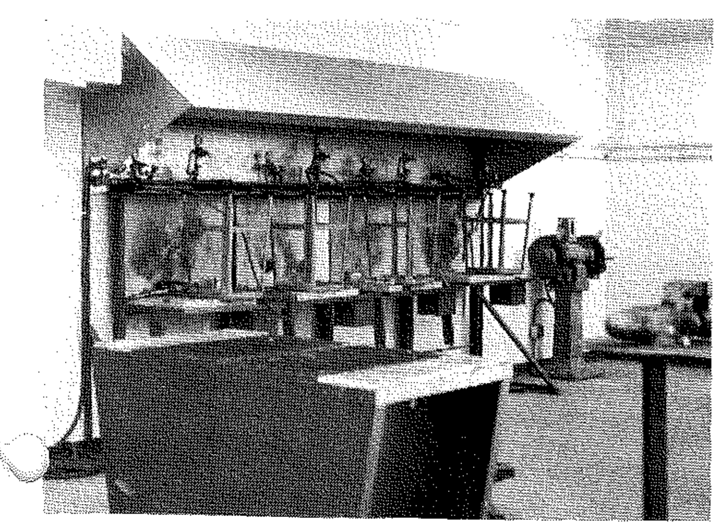


Figure 1. A Suspended Recirculating-Type Filter — removed dust but not hazardous gases.

The energy crunch has caused many schools to investigate the recirculation of filtered air in agricultural mechanics and other school laboratories to reduce the heating and cooling cost. Recirculating systems may be the electronic precipitator or the bag type filtering methods, Figure 1. The installation cost of these units is approximately $1.50 per cubic foot of air movement. When properly maintained, they are effective for removing dust and some fumes. They are not capable of filtering hazardous gases unless equipped with activated charcoal elements.

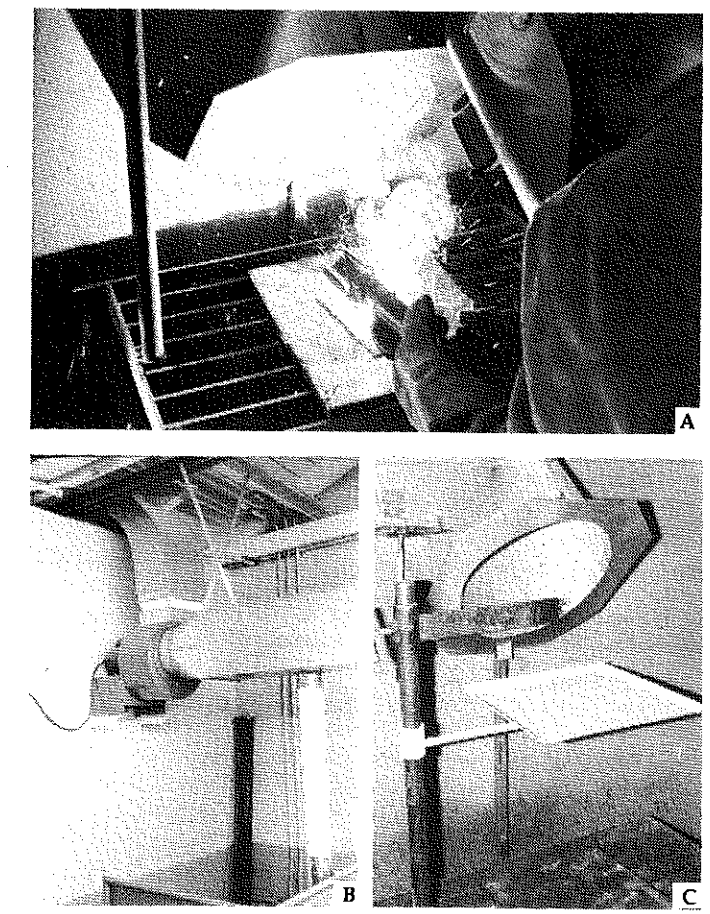


Figure 2. Cross-flow ventilation (A). Removes fumes and gases at the source exhausting it to the atmosphere (B). Intake hood raised for out-of-position welding (C). System should provide an air movement of 100 lineal feet per minute.

Cross-flow ventilation systems are designed to pick up and exhaust the fumes and gases that are developed at the point of generation. In this system, Figure 2, a small volume of air moves at a velocity of approximately 2100 lineal feet per minute in a 45 degree angle away from the student welder. The intake hood is adjustable to permit the pick up of materials to be exhausted when performing out-of-position welds. Hazardous gases and most of the fumes are evacuated to the atmosphere with a greatly reduced chance of inhalation. The design of this sytem may include

(Continued on Page 20)

Arc Welding Exhaust Systems

(Continued from Page 19)

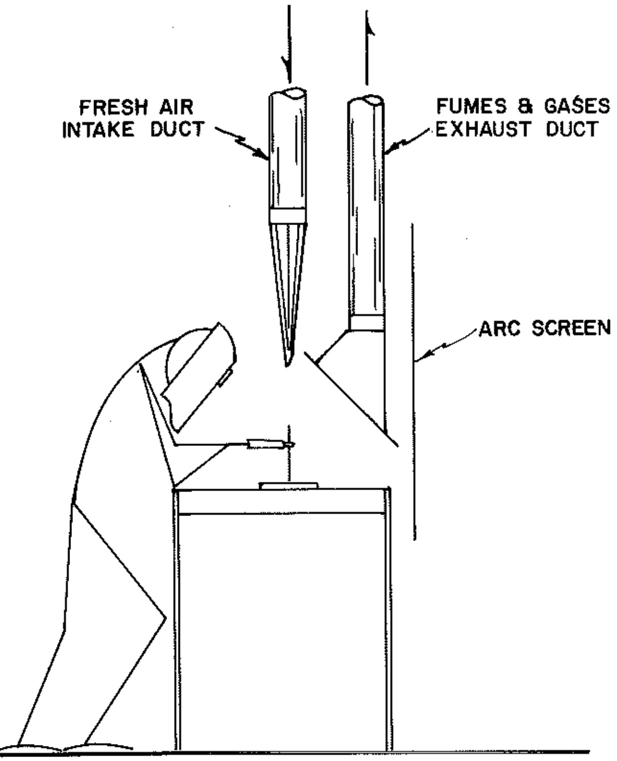


Figure 3. Conceptual fresh air recharge for a cross-flow welding area exhaust system. Outside air is moved into the flow pattern of the exhaust duct thus reducing the loss of room heat/cooling energy. (For detailed plans of a cross-flow ventilation system, contact Agricultural Education Department, University of Arizona, Tucson, 85721, and ask for Guide No. 30.)

provisions to allow the recharge intake of fresh air from the atmosphere in the vicinity of the student welder or welding station at a volume less than that displaced by the exhaust. As illustrated in Figure 3, a recharge duct provides outside air and projects it into the air flow pattern of the cross-flow ventilation system. The combined system will provide fresh air at the welding station with a reduction in evacuation of previously heated or cooled air within the laboratory.

It is recommended that the cross-flow evacuation and recharge system be used in combination with the recirculating filter units to reduce the hazards from fumes and gases and maintain a healthful environment in the agricultural mechanics laboratory.

Protection is Essential

In conclusion, the problem of providing adequate ventilation for exhausting fumes and gases from arc welding areas is quite complex. However, students and instructors must be protected from these hazards. A study of recommendations by the National Occupational Safety and Health Administration and other safety promoting agencies should be helpful in this regard.

School authorities are encouraged to consider the energy saving advantages of recirculating systems such as the electronic precipitator and/or the bag-type filtering methods. In view of hazards from toxic gases which cannot be removed by such devices, appropriate provisions for introduction of fresh air must be considered. This may include the cross-flow evacuation and recharge system. Such a combination is recommended over the traditional systems which introduce huge volumes of fresh air to the building and result in excessive energy consumption for heating or cooling.

BOOK REVIEW

THE SCIENCE OF ANIMAL HUSBANDRY, 2nd Edition, by James Blakely and David H. Bade, Reston Publishing — A Prentice Hall Company: Reston, Virginia, 1979, 516 pp., $14.95.

This book describes in considerable detail the elementary aspects of animal husbandry. Numerous photographs, charts, and diagrams add a measure of authenticity as well as completeness somewhat rare in current beginning text books. Topically arranged to include all the major livestock species, including poultry, the book is adequate for classroom or home-farm library.

By including reproduction, feeding, and management of each species, sections of the book are complete within themselves and provide a great deal of flexibility for use as a text and/or reference book. The addition of the section on dairying adds greatly to the usefulness for high school beginning livestock studies. Current findings and recommendations abound in this book which will add immeasurably to the value it holds for the serious student. Study questions at the close of each chapter allow the student an opportunity to conduct a self-test.

Analysis tables for commonly grown feedstuffs provide a ready source for ration adequacy and add a dimension all too often inaccessible in one text. Perhaps one of the book's greatest strengths is the treatment of new vocabulary words. Each new term is defined afer being identified in italics the first time it appears in the book.

Dr. James Blakely, professor of Animal Science at the University of Missouri, has spent over 14 years teaching and conducting research. Mr. David Bade, of Texas A & M University teaches at Wharton Junior College and manages the Hutchins Research Farm in Wharton County, Texas.

Having used the first edition in my beginning classes in vocational agriculture, I feel this edition expands on the material and should find ready acceptance. High school students in vocational agriculture, students in junior colleges, farmers, and teachers of animal science should find this an easy to read source of important information. Persons not well acquainted with some of the technical and modern findings in livestock production should be well satisfied. Persons involved in any phase of livestock production should find a ready source of information for intelligent decision making.

William W. Stewart
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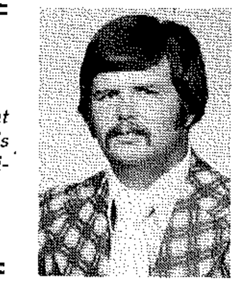
THEME

The Russell Story . . . Land Laboratories for Rural and Urban Students

BY DAVID A. MCCARTHY

Editor's Note: Mr. McCarthy formerly taught vocational agriculture in Russell, Kansas. He is currently a doctoral student at Iowa State University.



The Russell, Kansas, vocational agriculture department set out to re-establish a land and livestock laboratory in 1976. Justification was based upon program trends in the late 1970's and 1980's. Half of the vocational agriculture students were urban students with limited means for anything more than simulated supervised occupational experience programs. Several of the students had vocational interests. They deserved experiential training as much as those students with definite vocational interests. The ranches and farms in the school district were continually increasing in size and becoming fewer in number. Year-round educational opportunities were discussed with the continued importance of program justification.

A successful "school farm" had existed for years, and it needed complete renovation due to urban expansion and changing program needs. With the advice and support of the school administration, local advisory committee, and school board, plans for renovation were finalized. The laboratory now provides the resources necessary to meet the needs of a diversified group of students.

Establishing the Laboratory

Renovation of the laboratory offered a multitude of learning experiences for rural and urban vo-ag students alike. The value of experiential learning and the concept of "learning-by-doing" became immediately evident. Junior and senior students were assigned to separate groups to tour numerous livestock handling facilities and to develop a workable plan for a livestock laboratory. A final plan was developed using ideas gained from the farms and ranches visited. Freshman and sophomore students spent several weeks removing fences, salvaging lumber from old buildings, testing soil, and clearing the area for construction of the livestock laboratory.

Working cooperatively with the local county Extension agent, fifteen different wheat varieties were obtained from the Fort Hays Experiment Station and planted. Freshmen and sophomore students constructed and painted metal signs identifying each of the individual wheat variety plots. These same students carefully measured and staked out the one-tenth acre wheat plots and located the signs. A young farmer and former vocational agriculture student was hired to disk the wheat ground and a wheat drill was used for drilling the seed. Students carefullly seeded the variety plots and an additional 12 acres of wheat.

Fencing the cow-calf area and seeding brome grass were two activities accomplished. Materials were secured from the local cooperative and a tractor and post hole digger were brought in by a vo-ag student. The area was laid out using a farm level, and the fence was constructed in less than a week.

In the spring, students accomplish a variety of learning activities. These include seeding plots, landscaping the area, installing livestock waters, and constructing and hanging gates.

Activities for the Laboratory

These is obviously an insurmountable number of activities for which the facility could be used. Safety must be kept foremost in mind. SOE livestock and enterprises should be kept to a minimum with greater emphasis placed on teaching basic skills in animal production. Cooperative SOE projects with livestock and crops have great potential. Providing plots for town students is still another potential.

The following is a partial list of the activities and the experiential learning opportunities that the laboratory provided.

BOAC-State Gold Emblem — Governor's Citation (1978)
Food for America Program
Livestock Judging Contest
Kiddie Barnyard
Land Judging Contest
Parent-Greenhand Watermelon Feed
Display Area for Projects Constructed in Agricultural Mechanics Lab.
Cooperative Livestock Projects for Urban Students
Cooperative Crop Projects for Urban Students
Wheat and Grain Sorghum Variety Plots
Chemical Test Plots
Gardening Area for Urban Students
Concrete, Welding, Plumbing, Carpentry, and Electrical Skills
Livestock, Agronomy, and Farm Management Skills
Landscaping and Natural Resources Management
Soil Conservation, Tillage Alternatives, and Energy Conservation
Landscaping and other Horticultural Activities
Career and Occupational Development
Decision Making Skills

Summary

A land and livestock laboratory is very useful. Several obstacles must be overcome before a laboratory becomes a reality. Careful consideration should be given to size, distance and transportation problems, financing, safety, and instructor supervision. In vocational agriculture at Russell, Kansas, the laboratory became a reality. Urban and rural students have access to a school-owned and chapter-operated facility that provides tremendous experiential learning experiences.

LETTERS

"Letters to the Editor" is a feature to encourage dialogue among readers of the **Magazine.** *Selected letters will be printed without comment or editing. Your letter will be welcomed! (Send letters to: Editor,* **The Agricultural Education Magazine,** *P.O. Drawer AV, Mississippi State, MS 39762.)*

Editor:

As authors of the article entitled "Why Use Realia," Vol. 53, No. 2, August, 1980, pp. 4-6, we must clarify an omission in your printing of Dale's Cone of Educational Experiences (Figure 2, p. 6). We incorporated the cone to show the greater learning effectiveness and increasing directness as one uses the realia "down" the cone and increasing abstraction "vertically up" the cone.

We hope this point of clarification makes the figure more useful to those who plan to increase their use of realia. Our best wishes to you as editor.

— Floyd G. McCormick, Head, Agricultural Education Department, and David E. Cox, Lecturer, The University of Arizona.

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BOOK REVIEW

AGRICULTURAL BUILDINGS & STRUCTURES, by James H. Whitaker. Reston Publishing Company — A Prentice Hall Company: Reston, Virginia, 1979, 530 pp., $14.95.

This book in agricultural construction is well written and easy to read. It is intended for those interested in farm structures.

The book is divided into two parts: Part I deals specifically with planning and construction, fasteners, concrete and masonry construction, building tolerances, foundations, cost estimation and others. Each chapter includes a list of references and problems.

The principles outlined in Part I are applied to specific examples for livestock housing in Part II. Housing needs for dairy and beef cattle, poultry, sheep, swine, and horses are discussed with special attention paid to requirements for heating, cooling and ventilation.

A chapter on solar energy is presented with different energy-saving designs and alternatives discussed. The information available in this chapter is potentially useful for the farmer interested in energy efficiency.

Part II concludes with a look at greenhouse construction, food storage structures, and machine and shop construction. The section on machine and shop construction could be useful to vocational agriculture instructors.

Mr. Whitaker is a past officer for the North Atlantic Region of the American Society of Agricultural Engineers. He has held numerous research positions abroad in addition to serving as Agricultural Engineering Advisor in Bihar State, India. He is a graduate of Cornell University and is presently Professor Emeritus of Agricultural Engineering at the University of Connecticut.

This book is suitable for courses in agricultural mechanics and agricultural engineering at the college level. Because of its technical nature, it would be inappropriate for high school students. The book would be a good reference text for vocational agriculture instructors, especially those involved in adult education.

John G. Cowan
University of Idaho
Moscow, Idaho

Themes For 1981
The Agricultural Education Magazine

Time Management	January
Community-Based Programs	February
Keeping Up to Date	March
Programs in Agricultural Supplies and Services	April
Energy Education	May
Adult/Young Adult Education	June
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Using Research	November
Relationships with Agricultural/ Educational Agencies	December

FFA PAGE

Preserving FFA Heritage

By KIRBY BARRICK

Editor's Note: Dr. Barrick is Assistant Professor of Agricultural Education at The Ohio State University.

"A Golden Past - A Brighter Future" . . . the theme for the fiftieth anniversary of the FFA has been tucked away with other momentos of the celebration into time capsules and file cabinets, to be revived in the year 2003. While the national organization and many state associations and local chapters have moved to thoughts of tomorrow, each year FFA chapters across the nation are celebrating histories of one to 50 years long. Now is the ideal time to start preserving that history.

During the Golden Anniversary Celebration in 1978-79, this author set out to preserve the 50 year heritage of a local FFA chapter in Johnstown, Ohio. Hopefully, this discussion of how it can be done will encourage others to make an attempt to secure information that leads toward a written documentation of their local FFA chapter's history.

Who Should Take the Lead?

In every local FFA chapter there is a person who should take the lead in compiling the FFA history. That person is the local teacher of vocational agriculture and FFA advisor. The teacher's knowledge of the community and FFA program and access to records and files are essential to starting the project. The teacher can serve throughout the project as director and coordinator, lending support and assistance as other interested persons locate information.

Who Can Help?

Since the local teacher may not be a native to the community or an alumnus of the local chapter, other community residents should be called upon to assist in compiling the history. The local FFA Alumni affiliate is obviously a key group to get involved. Alumni interest and knowledge cannot be equaled by any other group. Alumni may be called upon not only to collect information but perhaps to do the actual writing of the history.

What Resources Are Available?

Once the decision has been made to start the project and the required help has been secured someone will ask, "Where do we begin?" This list of resources in not exhaustive, but it should provide a beginning for securing historical data.

1. Former FFA members — In compiling the history at Johnstown, key alumni were contacted at the beginning. Those former members, including two chapter officers, were helpful in laying the groundwork of information and providing old pictures of chapter activities.

2. High school yearbook — Class rosters helped match people to years and group pictures of the FFA and officers (some were not captioned!) were invaluable.

3. FFA record — Secretary, Treasurer, and Reporter books, if available, and other department records are helpful.

4. High school alumni records — Current addresses are kept for all alumni at Johnstown-Monroe High School by year of graduation.

5. Local newspaper files — Reading newspaper microfilms isn't much fun, but several news articles were very helpful. Articles about the annual banquet were beneficial. Even articles about starting vocational agriculture at Johnstown and building facilities in the "new" high school in 1927 were located.

6. State records — Files on the vocational agriculture department in the state office provided an accurate list of teachers and major changes in the program. State FFA records identified chapter ratings and awards.

7. Former teachers — Records and recollections of former teachers can help fill in voids. For the Johnstown history, the family of the second local advisor, who is deceased, provided pictures of the early years.

8. Others — There are others in each local community who can provide information, such as parents of former members, chapter queens and honorary members. It was interesting to locate, almost by accident, the man who was superintendent of Johnstown schools when vocational agriculture was started there in 1925.

What Should be Included?

In addition to the narrative tracing the history of the vocational agriculture department and FFA chapter, a comprehensive appendix may be utilized to serve as the official record for years to come. Items in the appendix may include.

— List of teachers and advisors
— List of former members by graduation year
— State and American Degree recipients by year
— State and National officers by year
— Chapter officers by year and office held
— State and area chapter and individual awards
— Honorary members by year
— Chapter queens
— Top local awards

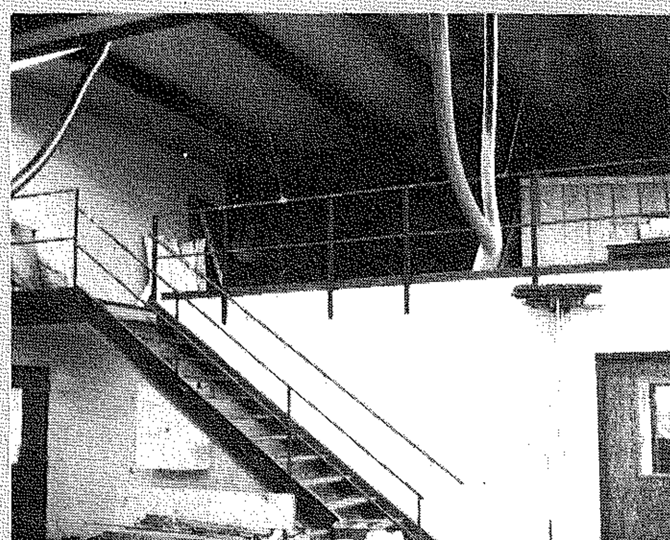
Start Now

Whether your chapter is 50 years old or just getting started, the opportunity for preserving the rich heritage of the FFA is before you. Start now to enlist help and support in preparing the FFA Chapter's history, and then keep it up-to-date through good records of the chapter's success.

Stories in Pictures

Open spaces for student projects and see-through windows to office and classrooms are important features of a modern agricultural mechanics laboratory.

A well-organized magazine and chart display and storage area. (All photographs courtesy of Walter T. Bjoraker, University of Wisconsin.)



Many departments have effective storage by utilizing overhead spaces. Permanent stairs, railings and kick-boards are essential for safety in such areas. Care must be taken to provide appropriate lighting and to manage such areas carefully to avoid hazards to students.