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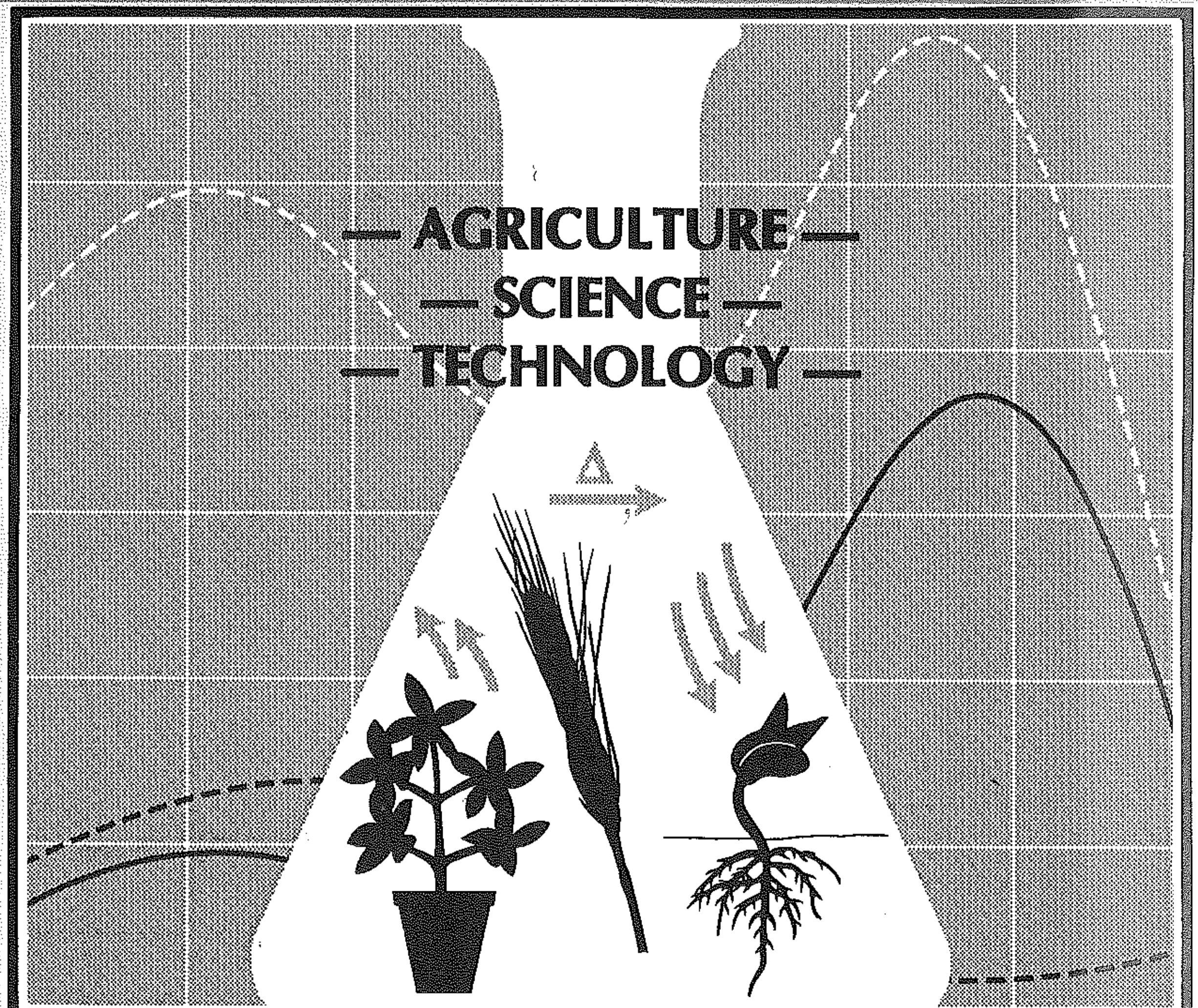

Physical Science in Agriculture — *The New Ag Mech*

THE

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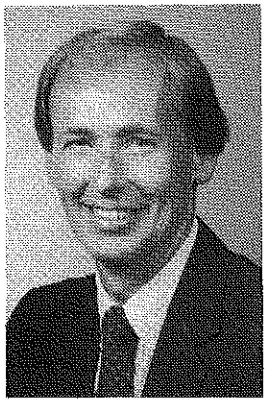
Reshaping Ag Mech



BY ED OSBORNE,
EDITOR

Dr. Osborne is associate professor and program chair of agricultural education at the University of Illinois.

Curriculum changes in agricultural education at the secondary level have been rapidly gaining momentum. Science and business-based courses and programs have become the standard. But what has happened to agricultural mechanics instruction? How has it changed? Has it been dropped from the curriculum in some schools? How should agricultural mechanics instruction be different as we head into a new era in agricultural education?

Many teachers and other agricultural educators have expressed a great concern that agricultural mechanics has been lost in the shuffle of curriculum reform. The current literature gives relatively little attention to agricultural mechanics instruction, supporting the concern that Ag Mech may be getting squeezed out of the curriculum. Some believe that agricultural mechanics contradicts rather than complements science-based curriculum revitalization efforts occurring nationwide. Are we unconsciously throwing out the baby with the bath water?

Agricultural mechanics has been a strong drawing card for secondary agricultural education since the 1920s. Dropping Ag Mech from the curriculum is not the answer. Practices in agricultural mechanics are derived from science foundations, just as crop and livestock management techniques are drawn from biological and physical science concepts and principles.

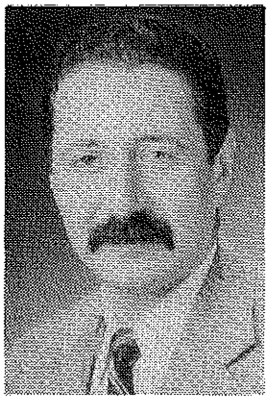
Instruction in agricultural mechanics should undergo the same science-based reforms that other parts of the curriculum have experienced. We can no longer afford to teach only skill development and project construction in secondary agricultural mechanics programs and courses. To continue such will widen the gap between the nature of instruction and the type of students enrolled in Ag mechanics and other specializations in agriculture. Agricultural mechanics in most schools should be primarily taught as an application of physical science and math concepts and principles.

Agricultural mechanics instruction must shift from a product focus to a process focus. The baseline question that should be addressed in all units of study is, "Why do we perform this practice or skill in this way?" Physics and chemistry concepts must be examined in an effort to explain practices in agricultural mechanics. Wiring, fastening, welding, cutting, tempering — all of these basic practices occur as a function of one or more scientific principles. All of this confusion over the place of agricultural mechanics in today's secondary curriculum reminds us to continue asking the all-important question: "What are my goals and objectives in Ag mechanics instruction, and what curriculum/course design will best allow me to accomplish those objectives?"

The incorporation of science into Ag Mech instruction can occur in two ways: blending into existing courses and offering new courses that primarily focus upon science applications in agricultural mechanics. Both strategies should be implemented in most schools, and several states have embarked on such a trail. In Illinois a recently revised Core Curriculum for vocational agriculture classes contains science-enhanced lesson plans for teachers. In addition, the Teacher's guide for a new one-semecter course entitled *Physical Science Applications in Agriculture* (PSAA) was disseminated to teachers last October. This course is designed as a nonvocational agriculture course having physical science and algebra as the preferred prerequisites. PSAA uses experiments as the means to the end — better understanding of the math and science affecting agricultural mechanics activities. This course has both agricultural and scientific literacy objectives. By contrast, vocational agriculture courses should use project activities as a means to two ends — skill development in agriculture and enhanced math and science literacy.

Agricultural mechanics should remain a major segment of instruction in secondary agriculture programs. But, the Ag Mech of today must be reshaped into a more scientifically sound enterprise that focuses less on skill development and more on basic understanding of *the way things work.* In specialized settings, intensive skill development should be sought, but in comprehensive settings, greater emphasis should be →

Filling The Gap In Agriculture



By PHIL BURIAK

Dr. Buriak is associate professor of agricultural engineering at the University of Illinois.

When invited to share my feelings about agricultural mechanics, I was somewhat hesitant to accept, even though I have given much time and thought to agricultural mechanics instruction. Today, many perceive agricultural mechanics to be a non-essential area with the move to science-based curricula in secondary agriculture programs. States are requiring less and less agricultural mechanics for teacher certification. Critics ask, "Are programs of agricultural mechanics viable in the 21st century?" In preparing my remarks I will attempt to answer this question based on my background and experiences. I invite you to read this introduction and the articles that follow and question what is said, so that together we may define a better future for agricultural mechanics.

I currently coordinate and teach in a university program of agricultural mechanization (internally we call it technical systems management). I have been involved with agricultural education and mechanics for only a dozen years; my undergraduate education was in biology and general sciences, my father is a mechanic by trade and a past vocational director, and my grandfather was a carpenter.

Are programs of agricutural mechanics viable with the move to science-based curricula in agricultural education? It depends on how we describe agricultural mechanics and how we define agriscience. Years past, agricultural mechanics was directed to preparing individuals to return to the farming enterprise. Students needed a broad range of knowledge and skills about machinery, electricity, structures for storage and livestock housing, environmental systems, and soil and water concerns. All of these areas were structured under the umbrella of production. Instruction was largely skill based and project oriented, with the product (the student) entering production agriculture upon completion of the program. The question of viability may be justified based on this description alone. I define agriscience as instruction in agriculture emphasizing the principles, concepts, and laws of science and their mathematical relationships supporting, describing, and explaining agriculture. Agricultural mechanics should be applied physics — the applications directed towards agriculture. Programs such as these are viable.

Agricultural education's move to agriscience gained momentum in Orlando at the Conference for Agriscience and Emerging Technologies (1988). Representatives from many states attended and returned home to lead local efforts to infuse more science into agricultural instruction. For the most part, many of the local efforts have been successful, but in my opinion unidirectional.

Teachers teach best what teachers know. Curriculum planners and writers write best what they know. What science-based content do agriculture teachers and agricultural teacher educators (who were once agriculture teachers) know best? I'd bet my paycheck that the biological sciences are where most agriculture teachers

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Reshaping . . .

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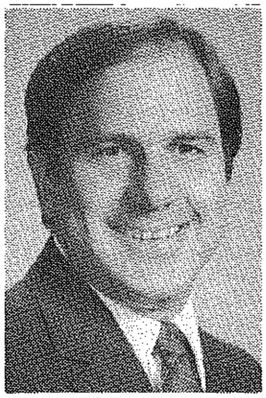
given to enabling students to acquire a basic foundation in agricultural mechanics and its science and math connections. The contributing authors in this issue share numerous examples of how this can be accomplished. As we continue to improve the secondary curriculum, agricultural mechanics must be reexamined and reshaped along with other curriculum specializations. When compared to other segments of the curriculum, agricultural mechanics may hold the greatest potential for addressing a blend of literacy, vocational, applied science, and basic study objectives. A new emphasis on physical science applications in agriculture will diversify agricultural mechanics instruction and appropriately maintain Ag Mech as an important component of secondary agricultural education. ■

Strategies and Techniques For Teaching How Things Work



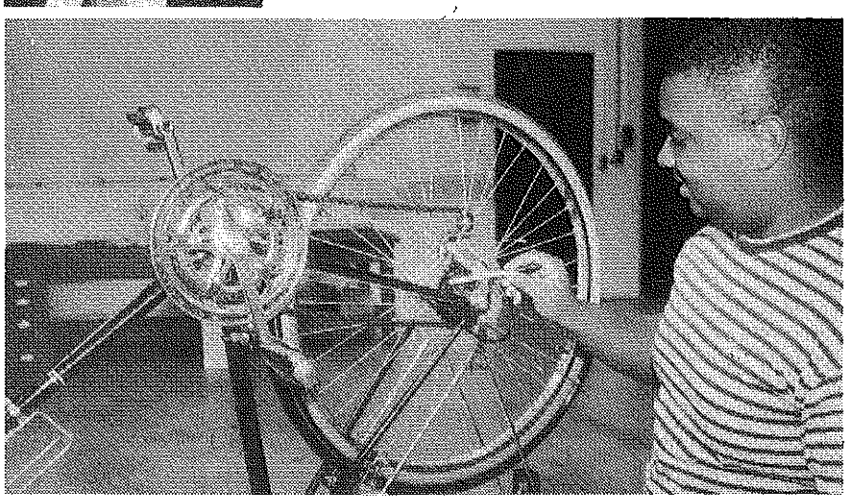
By JOE G. HARPER and MICHAEL S. MCMANUS

Dr. Harper is associate professor and Mr. McManus is a graduate teaching assistant in agricultural education at Clemson University.

What is it about the machines, structures, and technologies around us that fascinate some students? Simply put, it is the desire to know how things work. In education we have seen a shift from teaching students just how to fix things to being able to understand how things work. This fundamental shift has brought about instruction in the principles of technology. In order to teach students about technology in agriculture, we must also teach the basic principles of technology. The physical sciences provide the basic principles of technology for agricultural mechanics instruction.

Our goal should not be to convert agricultural mechanics instruction to a science curriculum, but rather to a technology curriculum. Therefore, in order to prepare students to work in a rapidly changing technology-based industry, our students must have a fundamental understanding of how things work in order to be able to adapt to technological change.

In education we have seen a shift from teaching students just how to fix things to being able to understand how things work.



Graduate student Michael McManus developing a student learning activity about gear ratios using a ten-speed bicycle.

Strategies

There are several fundamental strategies for teaching basic physical science principles in agricultural mechanics.

1. Keep the instruction simple. Emphasize the basic physical science principles and use basic tools and equipment. Effective instruction can be accomplished using basic equipment such as a volt-ohmmeter or a spring scale.
2. Provide visual examples. We know that most instruction occurs because of visual inputs, so be sure that students see what is going on.
3. Involve the students. Learn by doing! Active learning is the key to effective technology transfer.
4. Emphasize student understanding. Spend more time asking students how things work rather than relying on listing parts and pieces. Good strategies include getting students to draw diagrams, develop systems, and design flow charts.
5. Provide applications. Take the basic instruction to the machines and demonstrate the applications. The relative size of a tractor's axle compared to the transmission shafts provides an application of the relationships between speed and torque.
6. Utilize a variety of methods. Have your students perform experiments, have a science fair, use a lot of demonstrations, and be both a scientist and a teacher.
7. Incorporate the physical sciences into present instruction. Enhance your present instruction and do not get away from the practical hands-on instruction we presently do. Instead, get rid of some of those old passive techniques like fossil filmstrips and create new, active instruction.
8. Have fun. When teaching and learning are no longer fun, then it is time for change. Getting students to better understand how things work is worth the effort because it is fun to teach. →

Techniques

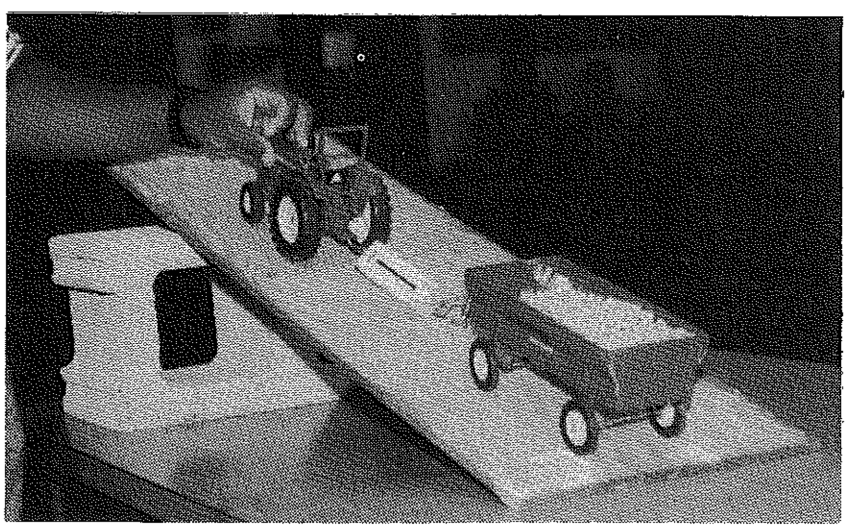
Based upon these strategies, here are just a few techniques and examples of learning activities which utilize the physical sciences in agricultural mechanics instruction.

Forces - A variety of techniques can be used to get students to better understand tractor pulling forces. A favorite technique is to use a 50 pound spring scale and a concrete block (it usually weighs about 36 pounds, which is easy to mathematically divide).

Have your students weigh the block and then drag the block across a sheet of plywood. Vary the surfaces, such as loose sand and an oily, smooth surface. The amount of force will vary quite a bit for various surfaces. Also, you can drag the block up an inclined plane. Furthermorre, an effective closure activity is to put the block in a small wagon and measure the force required. The next step would be to determine the speed and calculate the power requirement. You can go so far as to determine a series of coefficients of friction for the various surfaces.

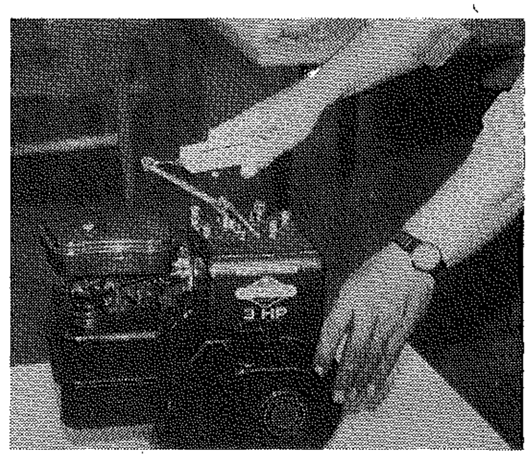
Torque - This is a fundamental concept which is easy to demonstrate. Use a beam or bar-type torque wrench to tighten a bolt, preferably in pounds-feet. Then measure from the center of the bolt up the torque wrench bar one foot, attach a spring scale which measures in pounds at that point. Students will see that when the spring scale is pulled the force will be the same as indicated by the torque wrench.

Horsepower - Have your students determine the amount of horsepower they can generate. A simple example is to have each student run as fast as they can up a flight of stairs or a steep slope, carrying a known weight over a measured distance and determining the time required. A set of football stadium seats works well. Be sure to determine the vertical rise. Based upon this information you can determine the amount of force (foot-pounds) and time (seconds) to determine the horsepower (1 hp = 33,000 lbs. ft./minute).



Close-up of a spring scale being used to measure the force required to pull a toy farm wagon load of soybeans up an inclined plane.

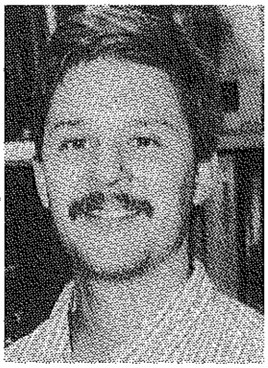
Lever - Another simple set of examples can be used to help students understand the basic principles of a lever. This is appropriate when teaching students about how front-end loaders and three-point hitches operate. The example we have used is a simple piece of steel bar stock that is 5 feet long and a spring scale. Drill holes at least every foot in the steel stock. Then use a known weight, like a ten pound bag of grass seed, and determine the forces used to support the weight at various points. Also you can move the fulcrum point from the center to other points to indicate second and third class levers.



A simple demonstration of a spring scale and a wrench being used to demonstrate the application of torque.

Viscosity - These examples demonstrate the flow rates of a liquid. This demonstration or experiment is very useful when teaching students about selecting lubricants. Hard plastic cups like you get at fast food restaurants work well. Drill a small hole in the bottom of several cups of equal size. Then have your students time the flow of various liquids, or two different viscosity oils through the cups. You can also use several holes of different sizes to determine various flow rates, gallons per minute. Another idea is to use liquids of different temperature. One time we tried to heat engine oil in a microwave oven, which turned into an interesting experiment in itself because the properties of the oil are such that after a long period of time the oil was still room temperature, but the plastic container became very hot. Putting 30 weight oil in a freezer for →

Physical Science in the Study of Foods



By GREGORY SCHRADER and J. BRUCE LITCHFIELD

Mr. Schrader is an instructor in agricultural engineering and Dr. Litchfield is an assistant professor of food engineering in the Agricultural Engineering Department at the University of Illinois.

The food industry is the largest industry in the U.S. and the world, employing people from a wide variety of disciplines. Since most foods require preservation, storage, or processing before consumption, about 95% of the foods and beverages purchased in the U.S. come from commercial processors (Survey of Manufacturers, 1990). These companies hire a large and increasing number of scientists and engineers. Creative human resources are needed to deal with important issues such as insuring food safety, minimizing packaging and additives, developing safe waste product disposal, and improving efficient use of water and energy for processing.[1] Studying foods is exciting and helps expand interest in agriculture. Most of us have an interest in food, and creative teaching in this area will gain the attention of your students.

[1]Food engineering is the application of engineering principles to produce, preserve, process, package, and distribute foods. Food engineers develop, design, and construct new machinery, processes, and plants; they develop and test new products; they preserve and distribute foods; and they manage environmental factors, waste products, and energy. Food engineers participate in nearly every phase of food processing. Graduates are prepared for positions in a variety of industries, including food, pharmaceutical, and biotechnology industries. Job opportunities also exist with the government, universities, and consulting firms. Career possibilities include: (1) research and development, (2) project, process, and plant engineering which can include design, optimization, and construction, (3) technical sales and service, and (4) supervision and management.

In a recent issue of this journal (October, 1991), Joe Gliem called for a better physical science framework in the field of agriscience, including better teaching and student understanding of physics and mathematics. We submit that an excellent topic for a marriage of the biological and physical sciences is the study of foods. It is obvious that the biological sciences are important in the food industry, but a thorough understanding of areas such as chemistry, mathematics and physics is required as well.

We submit that an excellent topic for a marriage of the biological and physical sciences is the study of foods.

Consider the selection of a pump for a new line in a food plant. Does it matter whether orange juice or molasses will flow through the pump? Of course. An understanding of the physical flow properties (rheology) of the material is required →

Strategies and Techniques . . .

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several hours provides a very dramatic demonstration of viscosity.

Gear Ratios, Torque, and Speed - A very good teaching aid for presenting these principles is a ten-speed bicycle. Phil Buriak provided an excellent series of problems in the March 1989 issue of *The Agricultural Education Magazine.*

Batteries - Each of us has used a hydrometer to teach students how to test a liquid cell battery. Another approach which can supplement this instruction is to make a simple battery from a lemon. Take a penny (this does not deface the penny) and a galvanized nail (because of its zinc coating) and stick each partially into the lemon. Use a voltmeter to measure the electrical pressure. The copper penny will be the positive terminal and the galvanized nail will be the negative terminal. A decent lemon will produce about one volt of electrical pressure.

These are just a few of the examples of how we can apply the physical sciences in our present agricultural mechanics instruction. Here are two references which can assist you in the development of physical science instructional activities:

Macaulay, David. (1988). **The Ways Things Work.** Boston, MA: Houghton Mifflin Company.

Tippens, Paul. (1985). **Applied Physics.** New York: McGraw-Hill Book Company.

Summary

These are a few ideas you can use to more effectively teach agricultural mechanics by applying the physical sciences. The rapid development of new technologies has placed greater demands upon education to provide stronger technology-based curricula for the work force of the future. Therefore, it is increasingly important that we provide learning experiences for our students which apply the basic principles of the physical sciences to real world applications. ■

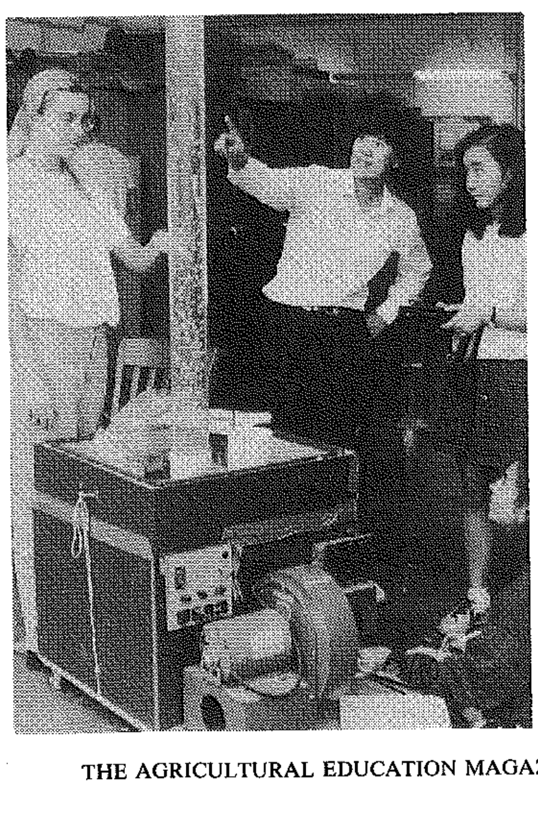
to determine the power requirements of the pump. And often such flow properties are dependent upon factors such as temperature and may even change with time. The study of the physical properties of food is extensive and includes some of the following topics:

- Structural and physical properties
- Rheological properties
  - — fluids (flow)
  - — solids (deformation)
- Optical properties
- Thermal properties
- Particle and frictional properties
- Aero- and hydrodynamic properties

Any company that works with food products must have a thorough understanding of the physical properties of their specific materials in order to design, operate and maintain their process. Some measurements of physical properties require specific (and sometimes costly) equipment. A spectrophotometer or colorimeter may be necessary to get accurate measurement of color properties, and a viscometer may be necessary to measure viscosity with accuracy. But it is hardly necessary to obtain such specific pieces of equipment to conduct good classroom experiments with food materials. There is a multiplicity of experiments possible that require only limited equipment. We would like to suggest several experiments for the classroom.

Aerodynamic Properties

Air is often used as a transport or cleaning medium in the handling of food materials. Pneumatic conveying of raw materials and some finished products is common in the food industry, and air is often used to separate or suspend materials. An understanding of the aerodynamic properties of such materials is necessary for the design or selection of the machinery used for these processes. One such property is *terminal velocity.* Terminal velocity is the velocity at which the gravitational force on an object is equal to the resisting drag force. A person jumping from an airplane will not continue to accelerate as the law of falling bodies would predict, but will reach a terminal velocity of approximately 120 miles per hour due to resistive drag force. Materials have different terminal velocities dependent in part on their shape and density. This explains why an airstream can be used to separate foreign materials such as dust or straw from food materials. If the material has a terminal velocity less than the air stream, it will rise; if it has a terminal velocity greater than the airstream it will fall. Instead of dropping materials out of airplanes, a laboratory setup using an air column will also work to measure terminal velocity. Consider using a tall plexiglass column supplied from the bottom with a fairly strong air flow (a leaf blower works well). Control of the air →



Students use an air column to determine the terminal velocity of corn kernels and associated corn trash. Air velocity is adjusted by controlling the input to the fan.

A hot-wire anemometer is used to measure the airflow at different points within the air column.

velocity is necessary, as is some method of measuring airflow. Air velocity can be controlled by adjusting the amount of air intake into the air supply (most leaf blowers have some type of variable intake). To measure the airflow, holes can be drilled in the side of the plexiglass column to accommodate a hot-wire anemometer, a water manometer, or other such instruments. Airflow should be measured at different distances from the side of the tube, since airflow will not be uniform. Increase the airflow until the study material (puffed what, corn kernels, etc.) is lifted. This is the terminal velocity for that material. The airflow within the column can then be measured, and the results can be compared to values for other materials.

Particle Flow Studies

In the food industry there are large amounts of bulk ingredients such as corn grits, flour, sugar, and spices that are held in temporary storage and then delivered by gravity flow. Besides the food industry, other areas of agriculture also have applications of gravity flow. Two examples are the storage of fertilizer and grain. The laws of fluid dynamics do not apply to the flow of solid particles, and therefore, experiments are necessary to determine the actual flow rates of different materials through an orifice. Factors such as orifice shape and size, size and shape of the particles, surface roughness, and particle density may all affect the flow rate. A simple laboratory experiment can be designed to test the effect of one or more of these factors on the flow rate of different materials through an opening. Flow rate can be measured by weighing the amount of materials that flows through the orifice in a given amount of time. An equation has been proposed to model granular flow through a circular orifice (Gregory and Fedler, 1987):

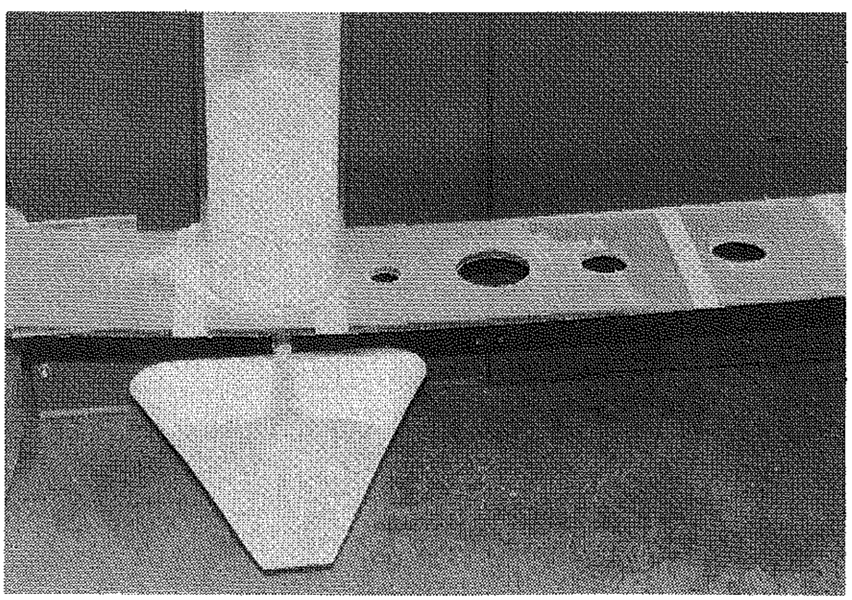
$$Q = \frac{\pi}{16} \frac{gD_b}{k} D^3$$

where,

Q = mass flow rate (g/s)
g = gravitational constant
D_b = bulk density of the material (g/cm^3)
D = diameter of the orifice (cm)
K = coefficient of drag (cm-g/s)

The coefficient of drag, k, is unique for each material and depends upon the physical properties of the flowing material, such as internal friction, surface roughness, and granule shape. Consider testing a number of materials (sugar, rice, soybeans, puffed wheat) through circular openings of different size. Graph the mass flow vs. the orifice diameter cubed for each of the materials. The drag coefficient, k, can be determined for each material.

Each material has a minimum size opening that it will flow through without arching or clogging, so some testing by the instructor is necessary in advance to get a good range of orifice sizes. Have the students discuss alternative designs to prevent clogging. As a second experiment, students can test their own designs on a variety of materials.

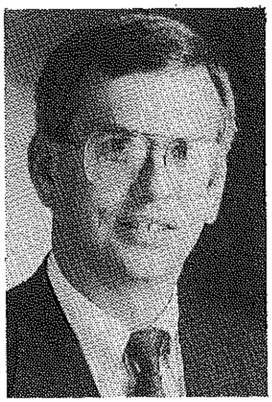


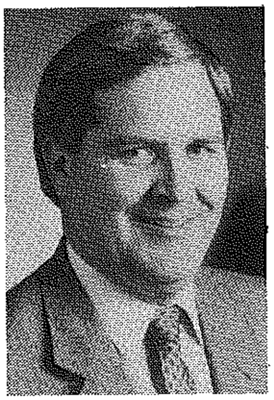
Measuring the particle flow rate of corn grits through an orifice.

Variation in Biological Materials

Unlike other materials, biological materials such as food are usually not ideal in their behavior. This will be obvious in almost any experiment conducted. Data will often not result in a perfect curve, and variation will be obvious. Instead of making the teacher nervous about the data, such results provide an opportunity to discuss variation, probability, and "real world" science, which is often far from ideal. Here's a final, quite simple experiment which demonstrates the need for understanding food materials and shows the variability in biological materials. Set up an experiment to drop apples from different heights onto a hard surface. A few days later, measure the effects of bruising either qualitatively (bruising or no bruising) or quantitatively (measure bruise size). →

agriSCIENCE in Agricultural Mechanics?





By DAVID E. LAWVER
and STEVE FRAZE
Drs. Lawver and Fraze are assistant professors in the Department of Agricultural Education and Mechanization at Texas Tech University.

Change, Change, Change!!! Future Farmers of America, production agriculture programs to non-traditional programs, vocational agriculture to agricultural education, vocational agriculture teacher to agricultural science teacher. As we witness and participate in these changes in agricultural education, one of the most exciting has been a trend toward incorporation of so-called academic subject matter into agricultural education. In fact, much of the subject matter taught in the secondary agriculture classroom is founded in the academic basics. For instance, a great deal of time in animal and plant science courses is devoted to biological subject matter such as genetics, reproduction, anatomy, and physiology.

Students will undoubtedly benefit in agriculture programs where the teacher reinforces academic subject matter. Such students are able to see direct application of concepts taught in their academic classes. It can also be argued that these students are better prepared to perform at the collegiate level.

The biological sciences are not the only subject area where agriculture teachers are able to teach and reinforce scientific curriculum in agricultural education. There are also ways to provide instruction and reinforcement in the physical sciences. Upon careful examination, it becomes evident that agricultural mechanics is applied physical sciences, just as the study of animals and plants is applied biological sciences. Even the most traditional and routine instructional areas such as welding, agricultural power and machinery, agricultural structures, and others can become new and exciting simply by recognizing the fact that agricultural mechanics is applied science and then teaching in the appropriate manner.

Welding has been taught for many years in our agricultural education programs. However, it was and maybe still is taught primarily for skills attainment and project construction for application of those skills. Welding skills and project construction remain important in our agricultural mechanics programs, but why not teach physical science concepts which are associated with those skills?

The biological sciences are not the only subject area where agriculture teachers are able to teach and reinforce scientific curriculum in agricultural education. There are also ways to provide instruction and reinforcement in the physical sciences.

Chemical reactions are routinely taught in high school chemistry courses. Chemical reactions occur when one welds. For instance, what happens to the flux coating on an electrode during the welding process? Why does this occur? As heat is applied to the flux on an electrode, a gaseous envelope is formed around the arc. The purpose of this gaseous envelope is to shield the arc so that unwanted →

Physical Science . . .

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Is there a critical height at which apples will bruise if dropped?

Will all apples dropped from the same height bruise?

Does the orientation of the apple when it hits the hard surface have an effect on bruising?

Is bruising the same for peaches?

Is this information important in designing and selecting equipment for harvesting and processing fruit? You bet it is.

The study of foods requires understanding of both the physical and the biological sciences. A strong foundation in math, chemistry and physics is a necessary foundation for the student to go on to study physical properties, microbiology, equipment design, process design, and plant scale-up.

References

Gregory, J.M. and C.B. Fedler, (1987). Equation describing granular flow through circular orifices. *Transactions of the ASAE,* 30 (2): 529-532.

oxygen is not introduced to the weld. In effect, arc welding involves one chemical reaction (formation of the gaseous shield) to prevent another chemical reaction (oxidation of the weld). This is but one example of the many scientific principles which can be taught or reinforced through a unit of instruction as traditional as welding. Other scientific principles which the teacher may incorporate during the instruction in welding are:

- Electricity - circuits, duty cycles, alternating current, direct current
- Chemistry - properties of metals, chemical reactions
- Mechanics - expansion and contraction of metals

With a little creativity and ingenuity, one can identify scientific principles in each of the units of instruction which are taught in the agricultural mechanics curriculum. It only seems proper, since agricultural mechanics is applied science, to identify and teach these basic principles.

It should require little effort to make the transition from teaching skills and project construction to that of reinforcing and enhancing the science instruction that students already receive in their general education courses. Most importantly, it is the student who benefits from this teaching approach. First, once students understand the scientific principles behind a particular skill, the acquisition of the skill may prove easier. Second, students may develop a greater interest in their academic studies once they witness a practical application.

With a little creativity and ingenuity, one can identify scientific principles in each of the units of instruction which are taught in the agricultural mechanics curriculum.

So how do agriculture teachers who want to help students incorporate scientific applications in their agricultural mechanics classes accomplish this?

- ***Develop an attitude that science is a component of agricultural mechanics.*** Agriculture teachers must exhibit a commitment to the idea of teaching agricultural mechanics as a science in addition to being a hands-on skills class.

- ***Look for commonalities in agricultural mechanics and physical sciences curricula.*** By comparing curricula, the agriculture teacher can identify scientific principles which are appropriate to the particular agricultural mechanics area being taught.

- ***Identify scientific principles which are currently being taught.*** Undoubtedly, agriculture teachers are already teaching some scientific principles. Teachers need to be aware of those principles.

- ***Incorporate additional scientific principles which should be taught.*** After identifying the appropriate scientific principles as well as those principles being taught already, teachers can incorporate the principles which have been overlooked up to now.

- ***Emphasize these scientific principles when teaching.*** The agriculture teacher can now emphasize these principles just as teachers normally emphasize important ideas and concepts in their instruction.

- ***Reinforce these principles when working in the agricultural mechanics laboratory to ensure the transfer of knowledge to application.*** As students perform skills in the laboratory or observe demonstrations, teachers should remind students of the appropriate scientific principles.

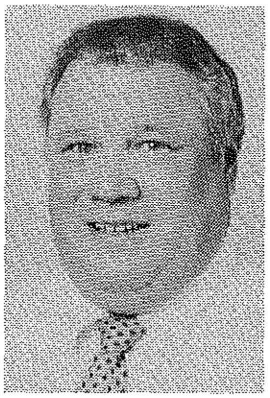
Science in agricultural mechanics? Yes! Of course, there is science in agricultural mechanics! But, it is the responsibility of the agriculture teacher to take advantage of the opportunities which exist. Agriculture teachers are in a unique situation. It is a situation in which they can teach the subject matter for which they are responsible and reinforce and/or enhance the science instruction student are receiving. A positive approach to incorporating scientific principles will encourage greater student interest and diversity in agricultural mechanics in the future. ■

How do we approach the enormous opportunity of teaching agriculture in the elementary schools?

Look for ideas in the May issue.

THEME ARTICLE

Are You Teaching Science Principles On Just Skills In Your Agricultural Mechanics Program



By JOE GLIEM

Dr. Gliem is professor of agricultural education and agricultural mechanization at The Ohio State University.

In my last article entitled, "Agriscience: Good for Students or Just a Charade," my desire was to cause you to critically evaluate your agricultural science program. If you are already teaching agriculture from a science and mathematical base, I applaud you and encourage you to continue because this is one of agricultural education's important needs today. However, if you tend to be doing the same old thing, I would strongly advise you to change the focus of your program so it is truly an agricultural science program.

In this article, I would like to focus on the agricultural mechanics or applied physics component of the agricultural science curriculum. In the October, 1991, issue of *The Agricultural Education Magazine,* my colleagues very ably presented some of the physical science principles involved and how they are applied through agricultural mechanics. I wonder how many of us are applying these scientific principles in our agricultural mechanics instruction? Are we just teaching skills to our students and hoping that somehow, maybe through osmosis, students will learn the application of these principles? Now before you get too upset, I firmly believe in skill development in our high school agricultural education programs. (I would prefer, however, to call skill development the application of learning.)

With the growing dropout problem and the associated societal concerns, it is critically important that we develop technical skills in our agriculture students. However, agriculture graduates also need a solid grounding in science and mathematics to ensure their employability. My concern is that we too often, many times unintentionally, are not educating our students about agricultural mechanics, but rather are turning out robots that can't think or apply the scientific principles involved to other situations.

Let's look at two examples to illustrate my thinking along this line. Most of the agricultural mechanics programs that I am familiar with teach some aspect of power through their small engine and/or multi-cylinder engine subject matter areas. I would guess that sometime during the course of this instruction the term horsepower is mentioned. How may of us at this time make sure that students know and understand the concepts and relationships of such terms as energy, force, work, power, horsepower, torque, and kilowatt. If students don't understand these concepts and relationships, they are not seeing the application of scientific principles. Likewise, how many of us use the horsepower formulas as shown below to discuss with students the variables that contribute to theoretical horsepower, where:

Four-cycle Theoretical Horsepower Formula:

$$HP = \frac{PLANn}{33{,}000 \times 2}$$

Two-cycle Theoretical Horsepower Formula:

$$HP = \frac{PLANn}{33{,}000}$$

HP = Horsepower
P = Pressure, lbs./sq. in.
L = Length of stroke, ft.
A = Area of the cylinder, sq. in.
N = Revolution per minute
n = Number of cylinders
33,000 = 1 Horsepower
2 = Correction factor

As you look at the formulas, do you discuss and show students why the four-cycle engine has half the theoretical output of the two-cycle engine if all the variables are equal? Do you discuss why a student's car has more horsepower available on a damp, cool fall evening as compared to a dry, hot summer evening? Do you discuss why water injection can increase horsepower? Do you explain to students the →

easiest and the most difficult ways to increase engine horsepower? If not, you are missing a golden opportunity to get students excited about the physical sciences as well as demonstrate the application of scientific principles.

But, how many of you have discussed the variables that affect sprayer output and have shown students how the formulas were developed? If students understand the variables involved and the relationship of the variables to sprayer output, they will ultimately be able to calibrate sprayers without the benefit of formulas. In fact, they will see that sprayer calibration is actually nothing more than collecting and determining the volume of spray output over a given area.

The previous example also raised the question as to whether you are teaching the unit factor method as a logical approach to solving problems in agricultural mechanics. This approach to problem solving provides a road map as to where we want to go in relation to where we are. It also provides for both a dimensional and unit analysis of the problem at hand. Let's look at the following example:

In many calibration problems in agricultural mechanics, tractor speed in MPH is needed. However, many times the tractor speedometer is not working or even worse is not accurate, so this means that we have to determine tractor speed by calculation. We also know that speed is really nothing more than distance divided by time. Thus, if we travel between two telephone poles that are 60 feet apart in 10 seconds we have speed, but it is not in the units that we need. This is where the unit factor method of instruction becomes so valuable. We don't have to memorize formulas, nor do we have to measure time over a set distance so as to use a particular table. We simply do the following:

1. Write down the wanted answer in the units desired.

$$\underline{\quad}\ \frac{\text{Miles}}{\text{Hour}} =$$

2. Use the information that we know.

$$\underline{\quad}\ \frac{\text{Miles}}{\text{Hour}} = \frac{60\text{ ft}}{10\text{ sec}}$$

3. Use conversion or unit factors to convert to the desired units.

$$\underline{\quad}\ \frac{\text{Miles}}{\text{Hour}} = \frac{60\text{ ft.}}{10\text{ sec}} \times \frac{60\text{ sec}}{1\text{ min}} \times \frac{60\text{ min}}{1\text{ hr}} \times \frac{1\text{ mile}}{5280\text{ ft}}$$

4. Calculate the problem, making sure that all units cancel each other and that only the units desired remain in the problem.

$$\underline{4}\ \frac{\text{Miles}}{\text{Hour}} = \frac{60\ \cancel{\text{ft}}}{10\ \cancel{\text{sec}}} \times \frac{60\ \cancel{\text{sec}}}{1\ \cancel{\text{min}}} \times \frac{60\ \cancel{\text{min}}}{1\text{ hr}} \times \frac{1\text{ mile}}{5280\ \cancel{\text{ft}}}$$

The need for an understanding of the concepts and the relationships of the different variables and how they affect the end result is also determined by the sprayer calibration problem. It does one very little good to know how to calibrate a sprayer if you don't know how much material should be applied in the first place. Likewise, how can you teach troubleshooting to students if they don't understand how the machine works? It is only through the teaching of scientific principles, concepts, and the relationships of these that one can really understand what is happening.

The importance of being competent in basic mathematics becomes obvious. It is basically impossible to understand the concepts and relationships involved in any of the sciences, and particularly the physical sciences, without competence in basic mathematics. Research has shown this to be an area that is weak not only with students, but with teachers and the general population as well. However, lack of competence in mathematics should not be an excuse for not teaching the application of scientific principles. It simply means that students have to be taught this material by the agriculture instructor or already have it upon entering the agriculture curriculum.

It is basically impossible to understand the concepts and relationships involved in any of the sciences, and particularly the physical sciences, without competence in basic mathematics.

I tend to prefer a two-pronged approach. I think it is extremely important to have prerequisites in mathematics and science for our upper division agriculture courses. At the same time, the agriculture instructor needs to teach students math and science as applied to agriscience. However, this is where a potential problem exists in the agricultural education profession. Research by the author and others has shown that many agriculture teachers are not competent in mathematical problem solving in agricultural mechanics. →

THEME ARTICLE

Physical Science and Environmental Issues in Agriculture:

By MICHAEL C. HIRSCHI

Dr. Hirschi is associate professor of agricultural engineering at the University of Illinois.

In the recent past, one of the only criteria for success in agricultural ventures was productivity, i.e., maximum yields. Agribusiness needed only to point to yield benefits to sell their products in the marketplace. However, the view of success in agriculture today is moving more and more to a balance of maximum profitability with minimal adverse effect on the environment. This shift also dictates a shift in our education goals for students interested in serving agriculture as a career. We must recognize the needs of agriculture and expose our students to environmental issues and processes in our curricula.

There are several directions that environmental awareness education can take. One strategy might be that students simply be exposed to the environmental questions facing agriculture, and society in general, through survey courses or modules. These would simply attempt to heighten a student's awareness of the issues being raised, but not necessarily give the student the tools to analyze those questions critically, or to attempt their solution. Unfortunately, this mode of education provides educators with credit for adding these issues to their courses, but does very little to serve the agricultural industry in problem solution.

In my view, students working toward careers in agriculture need formal course work in the physical science of contaminant interaction with environmental processes. Only then can the student recognize and begin to understand the root cause for a specific environmental problem, be it sediment in the lake or diesel fuel in well water. The overall objective of this educational thrust is to move the student's awareness of hydrologic and atmospheric processes to the point that they will recognize potential problems while they develop services, products and procedures for agriculture. Given that we can provide this formal course work, where will it take the student? Does it open new career opportunities? Of course it does.

Consider a traditional agribusiness career for an agricultural mechanization graduate, that of sales representative for a major equipment manufacturer. If such a student was unaware of the environmental impact of excessive tillage, could he or she deal with the issues of conservation compliance? If such a sales representative were asked by a producer about flotation tires for one of his or her company's tractors, wouldn't the client be well served by someone who might caution them away from cropping wetland areas that might jeopardize their USDA benefit eligi- →

Are You Teaching Science . . .

(continued from page 13)

Many teachers are not at the competence level needed to teach the mathematics and science that is needed. The question then becomes, how can we teach students what we do not know? The answer lies in bringing ourselves up to a competence level in mathematics and science so that we can adequately teach our students. Let's not feel ashamed, embarrassed, threatened, or humiliated to admit that we might be deficient in an area. But rather, let's ask for help in obtaining the continuing education needed for us to excel in these areas. Let's be working with our universities and our State Department of Public Instruction to provide education in those areas in which we are deficient. Only through a cooperative effort by all of us in the agricultural education profession can we successfully accomplish this task and fully implement a true agricultural science curriculum.

In summary, let's keep the momentum as we continue to move our agriculture programs toward an agricultural science base. Let's keep the application of learning (skills), but at the same time increase our emphasis on the concepts and relationships of scientific principles as they relate to the agricultural science curriculum. We also should not be afraid to ask for help in those areas in which we are deficient. Together as a family we can succeed and accomplish whatever we want. This is good for the profession, but more importantly, it is good for the thousands of students with whom we come in contact. ■

bility, or might cause excessive soil compaction that could jeopardize yields in the long-term? It is physical process understanding that leads to these insights and their potential benefits.

Another traditional career might be as a representative of a fertilizer/chemical distributor. Proper handling and application of these products is crucial if we are to continue our high level of production and protect the environment. Recognizing potential contamination scenarios on farms while preparing to apply materials is necessary to avert costly mistakes. Environmental understanding is the only way to develop these recognition skills.

. . . students working toward careers in agriculture need formal course work in the physical science of contaminant interaction with environmental processes.

Knowlege of environmental issues also opens totally new career opportunities. For example, environmental engineering firms are recognizing the multiple talents of agricultural mechanization graduates. These graduates are hired to perform technical duties that don't require the constant attention of a professional engineer, but do require knowledge of environmental processes. These firms are also discovering that Ag Mech graduates have talents in instrumentation and computers that are helpful in environmental engineering work.

There are many other examples that could be discussed, but the key to all of them is a basic understanding of physical science and environmental processes. A suitable curriculum would need to include modules on at least the following:

- The hydrologic cycle, including rainfall/runoff processes, infiltration and subsurface flow, stream flow and evapotranspiration,
- Soil erosion and sedimentation processes,
- Soil/water/plant relationships,
- Basic atmospheric processes, including particulate transport and microclimatology,
- Water management, including concepts of drainage, irrigation and storm water management, and
- Basic Integrated Pest Management (IPM) concepts.

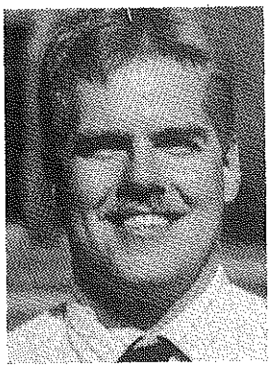
The aim of these modules is to 1) provide exposure to many of the management techniques that seek to protect our environment and 2) to provide a solid background in the basic processes. The latter aim helps the student to understand the success or failure of environmental protection strategies, and the "whys" of the management techniques.

So, what do we take out of our curricula to accomplish these goals? Unfortunately, the immediate reaction might be to throw up our collective hands and exclaim "we can't add anything else." Fortunately, even if full treatment is not possible immediately, there are opportunities to utilize environmental concepts throughout our curricula. For example, let's assume you are developing a computer instruction laboratory on Lotus 1-2-3 graphics. Why not provide data on residue cover and erosion reduction and have the students plot the results? The students work with curvilinear data that require little extra explanation as long as they are familiar with the general concepts of agricultural production. And if they are required to interpret their finished work, they learn a well-established soil conservation concept while they learn Lotus 1-2-3.

Another example of adding environmental concepts to a curriculum without taking much additional time is in gravitational physics. Instead of the time-worn "cannon ball dropped from the Tower of Pisa" problem, use raindrop impact velocity. The problem can be made as simple or as complex as appropriate for the class. For example, simple gravitational kinetics would have an object accelerate to some terminal velocity in air, or continue to accelerate forever in a vacuum. While the former may be approximately true for a raindrop falling in calm air, the problem can be made more complex with the addition of the deformability of the raindrop. The concepts of shape affecting drag, etc., can be introduced, given the student a much fuller exposure to real world problems and approximations. Additionally, if energy is also a concept to be explained, the calculation of annual raindrop impact energy over an acre of ground and its conversion to familiar units, such as equivalent sticks of dynamite, enlightens the student to the erosive energy in simple raindrops.

More examples could be developed, but the point of this discussion is to put forth the idea that future leaders of our society, especially those serving agriculture, need a basic understanding of environmental processes, and our curricula can provide that understanding, if we just work to fit in. ■

Developing Scientific Principles In Agricultural Mechanics



By DAVE KRUEGER
and JIM JOHNSON
Mr. Krueger is a graduate assistant in agricultural and extension education at Michigan State University and Mr. Johnson is agri-science educator at Alcona Community High School, Lincoln, Michigan.

According to Project 2061: Science for all Americans, *Technology has been a powerful force in the development of civilization, all the more so as its link with science has been forged. Technology — like language, ritual, values, commerce, and the arts — is an intrinsic part of a cultural system and it both shapes and reflects the system's values. In today's world, technology is a complex social enterprise that includes not only research, design, and crafts but also finance, manufacturing, management, labor, marketing, and maintenance* (AAAS, 1989, p. 39).

It is absolutely essential to America's cultural well-being that 21st century workers not only continue to invent and improve these technologies but maintain them as well. The importance of this observation is underscored by the rapid changes in agricultural technology and in agriculture programs that prepare the next century's workers. These changes are inevitable because, "agriculture has evolved rapidly at the national and state levels, a transformation fueled by advances in technology, greater efficiency, and a more accessible global marketplace" (Whaley & Lucero, 1991, p. 6). These industry-driven changes, coupled with more stringent high school graduation requirements, have prompted programs to adopt new agri-science curricula. These curricula, developed to meet changes in agriculture and technology, incorporate applied scientific concepts and principles.

To meet the challenges of the future, students are expected to think critically, communicate clearly, solve problems effectively, and be proficient in both science and math. To accomplish these tasks, agriculture curricula have been modified and course titles altered to include names such as applied biology, ecology, zoology, environmental science, and natural resources.

The Challenge

These curricular innovations have positively affected enrollments, but they are based predominantly on the biological sciences. Have the applied physical sciences been neglected? Does a biologically-based curriculum exclude student preparation for careers in agricultural and chemical engineering? Would a further rejuvenation occur in programs if the applied physical sciences were similarly strengthened?

. . . curricular innovations have positively affected enrollments, but they are based predominantly on the biological sciences.

In agricultural education a proven vehicle that can provide experiential learning in applied physical science is agricultural mechanics. It provides a context for direct, systematic application of scientific knowledge in developing and applying technology. It encourages student development of collaboration skills — the ability to be a team player, a person who can cooperate on a task. Students will also begin to display a "can do" attitude as well as show adaptability in a "learning by doing" environment. Sounds good, but is there time in an already full class schedule? Please read on! →

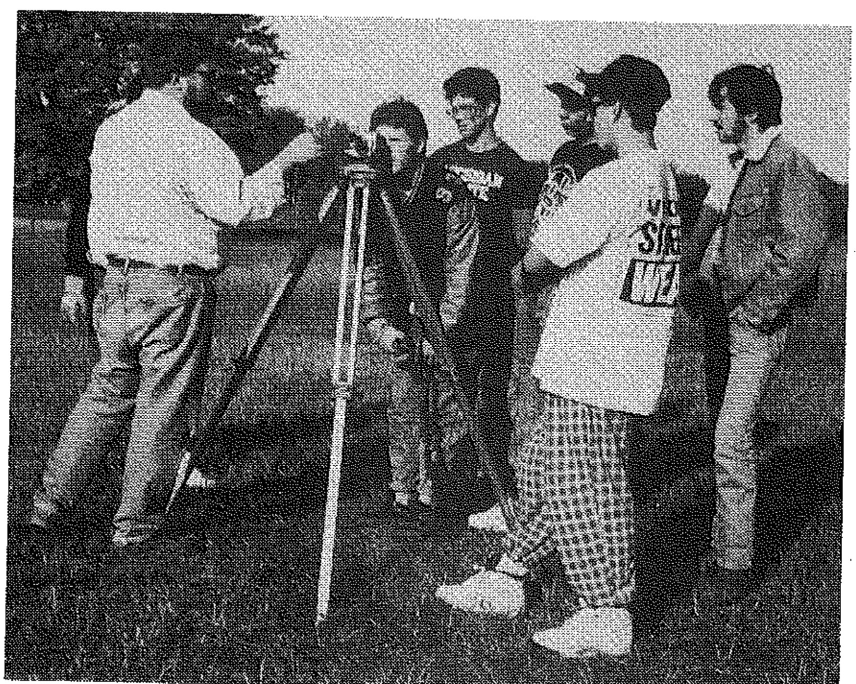
As students harvest sugar beets, application of mass, volume, gravity, levers, forces, and other scientific concepts should be examined.

Scientific Principles In Action

Preventive maintenance is an ongoing process in the agriscience department at Alcona, Michigan. The Alcona agriscience education department emphasizes that preventive maintenance is something important that can be taught not only in Alcona, but nationwide. A good example of this became evident last fall when students chose to become involved in a marketing exercise with sugar beets. Trailers, tractors and trucks were needed to transport beets from the field to the lab area. Bags and a weighing apparatus had to be located. As a result, early planning was needed to assure that equipment was ready for use. The master plan included a unit of instruction called preventive maintenance. Prior to making the decision to become involved with this enterprise, there were, of course, opportunity-solving processes being practiced. (The word "problem" was not used because it carries such a negative connotation.)

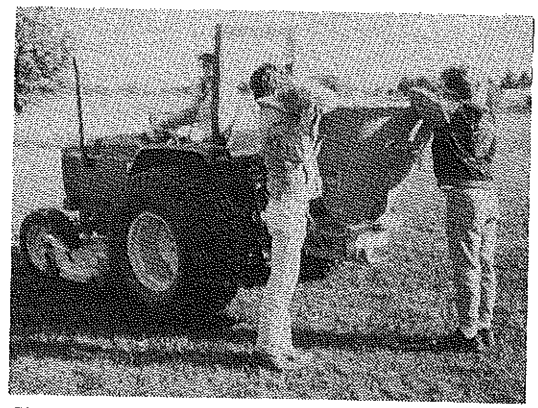
Doesn't sound like much science being practiced with this activity! Take a closer look: "Billie, you're in charge of the truck. The battery, air pressure, oil, water, anti-freeze and fuel level all need to be checked." Acid-base relationships, units of pressure, temperature, viscocity, solvents, solutions, and ratios are all concepts that come to mind with the truck preventive maintenance exercise.

The sugar beets were hauled with a gravity box. Talk about science! What is gravity? What is the weight of the box? How can it be weighed? What is its volume? How many sugar beets will it hold? What unit of measurement should be used? How are sugar beets sold? How are they bagged? What is the weight of each bag?



A soil conservation district specialist works with students to apply scientific concepts to surveying procedures.

The tongue of the old trailer needs straightening. Is there any science involved? Simple machines, force and work, forms of energy, properties of gases and metals, temperature and heat, expansion, changes of state, fuels, structure of atoms, color, light,and sound all become relevant.



Simple application of fertilizers involves use of concepts such as calibration, flow, speed, and friction.

As technology becomes more sophisticated, its link to science becomes even stronger. This link is not only implicit in the formation of specific lesson plans, it needs to be made explicit as students are taught the underlying scientific principles that govern their activities in the classroom.

A Practical Lesson

A common classroom activity such as testing a battery can be an opportunity to provide students with critical thinking and problem solving, scientific concepts that were both alluded to earlier. What an excellent way to transmit important information to students while simultaneously performing a basic preventive maintenance task.

Agriscience is an excellent medium where students learn and practice scientific principles. Agriscience offers the opportunity to relate theoretical concepts to practical concrete experiences. Perhaps what is needed is to recognize that in each agriscience or technology unit there are many hidden concepts and processes of science.

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According to Newton's First Law of Motion, every body at rest or in uniform motion in a straight line will remain at rest or in uniform motion unless some outside force is applied to it. It is imperative to create forces to place those who are at rest in motion and allow those in a straight line to deviate, by recognizing that the most relevant educational opportunity for youth exists in agriscience and technology.

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Battery Testing

Interest approach: Provide an automobile battery for the class. Ask students to describe any incidence where a poor battery caused automobile trouble. Ask students to list reasons for the trouble.

Objectives: Upon completion of this activity, students will be able to:

1. Take a specific gravity reading with a hydrometer.
2. Determine the charge of a battery at different temperatures.
3. Explain hydrometer readings indicating types of battery failures.
4. Fill a battery with distilled water.
5. Explain a scientific concept related to this practical application.

Materials:

1. Automobile battery.
2. Hydrometer.
3. Distilled water.
4. Battery syringe.

Procedure:

1. Remove the cell caps.
2. Squeeze rubber bulb and insert into cell holding hydrometer vertical with the battery.
3. Release bulb and draw electrolyte into the tube.
4. Without removing nozzle, record specific gravity reading at eye level.
5. Squeeze electrolyte back into cell.
6. Make correction for termperature differences, if needed.
7. To make correction for temperature add .0004 to the reading for every 10°F above 80°F or subtract .004 for every 10°F below 80°F.
8. Test and record the remainder of the battery cells.
9. Determine charge of battery (Table 1).
10. Evaluate battery condition on chart.
11. Add distilled water if needed.

Table 1.

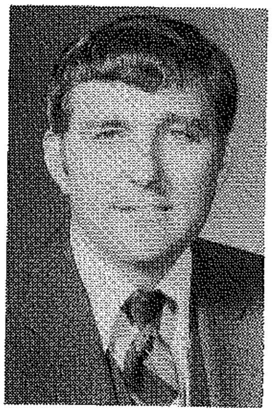
% of Charge	Specific Gravity	Freezing Point
100	1.260-1.280	-90
75	1.230-1.250	-62
50	1.200-1.220	-16
25	1.170-1.190	- 4
very little	1.140-1.160	+ 5
discharge	1.110-1.130	+19

Clean Up: The job may vary depending on the facility.

Questions for Investigation:

1. Explain specific gravity. How can the discharge of a battery affect specific gravity?
2. Why is it important to use distilled water?
3. What is an electrolyte?
4. Why is it important to maintain a specific temperature?

Tools for Time Management



By GARY MOORE
Dr. Moore is professor of agricultural education at North Carolina State University.

It is frustrating trying to do a job without the proper tools. Removing sparkplugs, oil filters and flywheels without the proper tools is frustrating if not impossible. It is also exasperating trying to use the right tool but having the wrong size tool for a job; such as using a small Phillips head screwdriver to remove a large Phillips head screw. For best results, the tool needs to match the job. This is also true in time management.

There are a variety of tools available to help manage time better. These time management tools range from the simple daily to-do list to sophisticated day planners to hand-held electronic time schedulers to complex computerized time management systems. In this article we will examine what features to look for in time management tools and will examine a sampling of paper-based time management systems. In the next article in this series, electronic time management systems and computer software will be examined.

What Features Should Be Found In A Time Management System?

One general characteristic of a good time management system is that it is all contained in one device. Having three to four different devices (an appointment book, a to-do list, address book, note pad for keeping notes) to help get organized is counterproductive. Some of the specific features to look for in a system are:

Daily Task List — A section is needed where tasks that need to be done each day can be listed by some type of priority order.

Daily Appointment Schedule — A place to record appointments and scheduled meetings for each day is essential.

Daily Notes — During a typical day a teacher may agree to do something and need to record the details, make notes regarding specific students, record information from a meeting, etc. Instead of placing this information on note cards or note pads, one central location is needed so the information can be retrieved quickly in the future. Putting this information with the daily appointment schedule and daily task list makes sense.

Goals and Values — Before one can manage his or her time effectively, it is crucial to identify the values and long range goals for the individual. After the values and goals have been identified and recorded, they will help provide the foundation for determining what should be done daily. Several time management devices are deficient in this area. They start with a daily to do list and forget about long range personal goals. This approach leads one to do superficial tasks that are needed for day-to-day survival at work but rarely lead to the planning or major personal tasks that are not work related.

Address and Phone Directory — A good time management system will have a section for phone numbers and addresses.

Yearly Calendar — There should be a section showing the next three to five years at a glance.

Flexibility — Since each individual may have unique concerns or needs in regards to time management, the system used should have some flexibility. Loose-leaf notebook-type time management planners that can open up to allow pages to be inserted provide this flexibility.

Paper-Based Time Management Systems

Paper-based time management systems range from the simple to the sophisticated. For people with limited discretionary time and minimal responsibility a simple paper-based system may be all that is needed. The simplest system will not have many of the features described above but will be small enough to fit into a pocket and will cost less than $10. It will be better than no system. However, as responsibility and need for control of time, events and information becomes more important, the system will need to become more sophisticated and larger in size and cost. The most sophisticated time management planners are about the size of a book and may cost in the neighborhood of $50. Agriculture teachers who use the more sophisticated larger systems agree they are worth the cost and yes, even the inconvenience of carrying them around. Several of the paper-based systems ranging from the →

simple to the sophisticated are described in the following paragraphs.

Day-at-a-Glance — This appointment scheduler is just that, an appointment scheduler. It has no features other than having one page per day divided into 15 minute increments for scheduling appointments. It costs less than $10 and can be found in most office supply stores.

E-Z Planner — This simple device resembles the Day-at-a-Glance and is primarily an appointment book except that it comes in a loose-leaf ring-binder and has a limited assortment of forms that can be added in an effort to gain more flexibility and customization. It is sold in stores such as Office Warehouse and ranges in price from $12-25, depending on what you want to add. For more information write E-Z Industries, Inc., P.O. Box 829, Westminster, MD 21157.

Day Runner — The Day Runner comes in two basic sizes, one about the size of a standard book (5½″ × 8½″) and one about two-thirds that size. The system consists of a loose-leaf ring binder, a filler insert containing a page for each day of the year, and a large assortment of forms than can be added. An assortment of binders is available, depending upon how much you want to spend. This is a good middle-of-the-road system that allows for considerable flexibility. It is sold over the counter at most office supply stores and can range in price from $30-$80. It is manufactured by Day Runner,Inc., 3562 Eastham Drive, Culver City, CA 90232.

Day-Timer — This is one of the most widely used systems in America. It comes in several different designs. One design, called the Pocket Day-Timer, consists of a series of wire-bound pocket size booklets, one for each month of the year. There is also a pocket size booklet for addresses and phone numbers, a six year planner booklet, and a work organizer booklet. While it is no problem to get the monthly booklet in your pocket, the other booklets won't all fit at the same time. After each month the booklet is stored in a special filing box with the other monthly booklets. There is a limited variety of extra forms and several nice covers that can be used with the Pocket Day-Timer. The basic set sells for around $15, but when you add a cover and some optional forms, the cost can go up to $75.

A second Day-Timer design is a loose-leaf notebook binder that comes in four different sizes — junior (2¾″ × 5″), senior (3¾″ × 6¾″) and desk sizes (5½″ × 8½″ or 8½″ × 11″). There are several different styles of filler sheets that go into the binders. Some styles have an entire week spread out on two pages; another style has one day per page, and yet another has two pages per day - one page for appointments and "to be done" items with the opposite page being used to record notes and information. You can select a style that fits in best with your level of activity. The cost for the basic contents is around $25, but you have to pay extra for the binder, which runs from $12 for the smallest, least expensive binder to over $100 for the fanciest binders. There are many binders at prices between these two. There are also numerous extra forms and accessories available for purchase. One of the most helpful extras is a computer software program to use for maintaining the address and phone directory. A sample pocket Day-Timer and a catalog may be obtained by writing Day-Timers, Inc., One Day-Timer Plaza, Allentown, PA 18195-1551.

Franklin Day Planner — This time management system was developed in 1984 by a person who had considerable experience with the Day-Timer and who thought improvements could be made in the original Day-Timer. This system is used in many American corporations including such companies as Dow, Citibank, Merrill-Lynch and Exxon. The system consists of a loose-leaf ring binder that has two pages for each day (three months of pages are normally carried in the book) plus six additional sections (addresses, goals, finances, key information, ready reference, and planning). One of the notable features of this planner is the sophisticated system for keeping track of tasks and information; things just don't fall through the cracks. The section for values and goals is identified as the most important component of the planner. In most of the other time management systems, value and goal sheets are not included in the basic filler set, but generally can be purchased separately. The main disadvantage of the system is the size; it comes in two sizes 5½″ × 8″ and 8½″ × 11″). Neither size will fit in a pocket but a booklet call the Satellite has been developed to be used in conjunction with the system when it is left in the office or at home. The basic set, including a ring binder, the filler sheets and a storage binder, can be obtained for around $40. The price rises to over $100 if a genuine leather binder is desired. A recent →

FEATURE COLUMN

Experiments and Demonstrations In Soils

By LYNN COERS
Mr. Coers is the agriculture teacher at Midwest Central High School, Manito, Illinois.

Most of the experiments or demonstrations I am going to share with you are far from original. This does not make them any less fun or less educational. I also use demonstrations that are easy and require little building and buying, but maybe some borrowing. The greatest thing about demonstrations and experiments is that some students will do things they are not used to doing, like think and ask questions.

When I teach soils I have several fun experiments or demonstrations for the students to try.

A. Controlling soil erosion with good cover.

Objectives: To show students how cover crops will control erosion and improve water absorption.

Materials: Two small boxes about 16″ x 12″ x 4″ deep. This can be built instead of saw horses or tool boxes. To make them water tight you can line them with plastic. On one end of the box cut a v-notch 1 to 1½ inches deep. Sprinkling can, bucket, two sticks to prop up one end of the boxes.

Procedure:

1. Fill one box with a piece of sod and the other with bare soil. (I even had one student try terraces.)
2. Set the boxes on a table with the boxes propped up with boards of equal size.
3. Put a bucket or jar under the end of the slot to catch the runoff.
4. Pour the same amount of water on the two boxes and watch the results.
5. You may try different kinds of soil, using crop residues or mulch and note the results.

B. Water penetration through sand, silt and clay.

Objectives: To observe how fast water penetrates through different soil particles.

Materials: Three Pringles potato chip cans with holes in the bottom, sand, silt, and clay, glass of water and a can to catch water.

Procedure: Pour equal amounts of water through the three types of soils. Record the time required for water to begin and stop draining from each soil type. Water holding capacity and other characteristics of various soil types can also be examined with this experiment.

C. Fine particles settle to the bottom.

This is an extremely (but enjoyable) way to enable students to visualize physical properties of particle material. This demonstration can be tied to flow properties, as well as settling, packaging, and handling procedures with food and agricultural products.

Objectives: To observe that finer or smaller particles settle to the bottom.

Materials: Plastic bag with unpopped popcorn and salt.

Procedure: You have to explain soil particle size and relate it to the popcorn and salt.

1. Pour the popcorn in the bag.
2. Pour the salt in the same bag.
3. Shake and watch the salt settle to the bottom.
4. Cook the popcorn and eat it. ■

Tools For Time . . .

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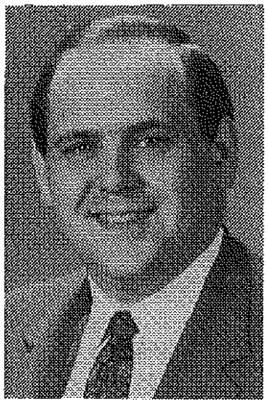
addition to the system is ASCEND, a computerized version of the Franklin Day Planner. A catalog of Franklin products can be obtained by writing Franklin International Institute, Inc., P.O. Box 25127, Salt lake City, UT 84125-0127 or by calling (800) 654-1776.

Summary

Space limits describing all the different paper-based time management tools available. There are many more quality systems that could be described. Ben Franklin observed that "To love life is to love time. Time is the stuff life is made of". The use of a good time management system can make a big difference in the quality of life and productivity of an individual. ■

Actions Speak Louder Than Words: A Response to The Strategic Plan



By JOHN POPE

Mr. Pope is Executive Director of The National Council for Agricultural Education, Alexandria, Virginia.

In the late 1980s and early 1990s much has been written about visions, missions, and goals for agricultural education. With the release of the Strategic Plan for Agricultural Education, much attention was given to this "revolutionary" document which would lead our community into the final decade of the twenty-first century. Many within our community praised the plan for its visionary approach, while others criticized the plan with vigor, saying that we as agricultural educators were trying to be "all things to all people" and that we were abandoning our traditional responsibilities in preparing students for entry level jobs and occupations.

The purpose of this article is not to debate whether or not the strategic plan is the right plan for everybody in agricultural education; the community has endorsed it. Rather, it is to discuss how the words in the plan have come alive and have been put into action.

Many have lauded the plan for its eloquent verse. They have applauded the plan for saying, in simple terms, exactly what the mission of agricultural education is and for describing seven national goals to accomplish the mission. Though many have complemented the plan on its composition, others have questioned whether the plan is just a written document or is truly a plan that will mobilize the entire agricultural education community.

Let's take a look at some of the progress that has begun as a result of the strategic plan. All fifty states and national agricultural education organizations were asked to develop tactical plans to meet the national mission statement and seven national goals. A tactical plan is defined as objectives and specific action steps to accomplish the goals and mission. As of today, 46 states and all national organizations have reported their commitment toward developing or having developed a tactical plan.

Although it would be impossible to list the many accomplishments of various states and national organizations in the implementation of specific programs related to the plan, this author feels confident The Council is an example of an organization whose programs are driven by this document.

I believe it would be safe to say that the very early years of The Council were not the smoothest of sailing. Many people within the community had various ideas as to what the purposes of The Council should and would be. Many viewed what was supposed to be an umbrella leadership group for agricultural education as a "bureaucratic, super board" that did not accomplish very much. Since the development of the plan, The Council has been able to develp the following programs. Listed in parentheses are the goals of the strategic plan, which have driven these programs.

- Infusing International Agriculture into the Curriculum — a program where 35 local agricultural educators each spent two weeks in Japan, experiencing Japanese agriculture, culture, education and international trade in order to develop 35 unit lessons on the importance of global agriculture. (Goal 1, 2, 4, 7)
- Agriscience Institute and Outreach Program — a program where 20 top agriculture teachers and 20 top biology and science teachers develop unit lessons on plant science and bottle biology, pilot test materials by team teaching, and inservice to all states in the summer of 1992 and 1993. (Goal 1, 4, 6, 7)
- Aquacultural Education — a four-phase program consisting of an assessment of materials, study and resource guide, development of a core aquaculture curriculum, pilot testing of the curriculum, and inservice education to all states in 1992 and 1993. (Goal, 1, 4, 5, 7)
- Food Science and Safety — a program designed to develop instructional materials around the areas of food safety, health, and nutrition. The project began in the Fall of 1991. (Goal 1, 4, 7)
- Competitive Grants in Environmental Education — a program designed to give local programs money to carry out innovative projects to improve the enviroment. (Goal 1, 4, 6, 7)
- **Marketing: Reaching Today's Consumer** — a series of lesson plans designed to teach agrimarketing. This document was sent to all local programs in Spring 1990. (Goal 1, 4, 5, 7)
- **Water Quality Indicators Guide: A Teachers Handbook** — a series of unit →

lessons and transparency masters to teach surface waters. This document was sent to all local programs in Summer 1991. (Goal 1, 4, 6, 7)

- Financial Records Program — a series of instructional materials designed for teachers to better teach proper financial and accounting principles in agriculture. This project began in Fall 1991. (Goal 1, 4, 5, 7)
- No-Till Agriculture Instructional Materials — a series of unit lessons to assist teachers in better teaching conservation practices using the concept of no-till farming. This project to begin in Fall 1991 (Goal 1, 4, 5, 7)
- Ag Issues Curriculum and Forum — a mini-curriculum of hot topics in agriculture such as ground water, biotechnology, genetic engineering, and others designed for teachers to instruct students on the pros and cons of each area in order that the student may better articulate each topics area. (Goal 1, 3, 4, 7)
- Supervised Agricultural Experience — a new handbook, video, and brochure developed for teachers in working with students and businesses for identifying and developing SAE programs. (Goal 1, 5, 7)
- Together We Can System — a new system to inservice teachers locally on new instructional materials developed nationally, also designed to gather input on the needs of local instructors. (Goal 1, 2, 3, 4, 5, 6, 7)

Judge for yourself. Is the strategic plan just a document of eloquent verse and professionally written sentences, or is it truly a document to mobilize the community for future successes in the years ahead? Only time will tell. Someone once said, "when you fail to plan, you plan to fail." Well, agricultural education did not fail to plan, and I believe that our plan will provide us with many successes in the days ahead. Only our actions will speak louder than these written words. ■

Filling the Gap . . .

(continued from page 4)

have acquired an expertise or at least a degree of comfort with the subject. It's only logical that the lion's share of the curricula, lessons, laboratories, texts, and other materials developed to assist our emphasis on science, have been biologically based. It's no wonder agricultural mechanics has been ignored or worse, considered unnecessary. Biological science does not govern or control or explain how and why things work, and therefore, agricultural mechanics does not fit into the agriscience schema. BUNK!

The physical sciences and mathematics serve as the foundation for all instruction in agricultural mechanics. Physical sciences also explain many of the biological phenomena we teach in agriculture. Unfortunately, most of us have little or no formal education and training in physics and often less in mathematical applications. Herein lies the problem and the HOLE in agricultural education's move to agriscience. We have inadvertently ignored the physical sciences due primarily to our lack of understanding of the role of the physical sciences in agriculture. I must say, however, that some of us are beginning to fill in the hole.

Critics might ask, "Is agricultural mechanics (physical science agricultural applications) important to the understanding of agriculture?" I answer this way. The agricultural industry is increasingly tecnologically based. As the technology becomes more sophisticated, the links to science become stronger. If we are to prepare future agricultural leaders for the world society, our product needs to be literate in the science controlling and explaining the technology, and how it interfaces with agriculture, not just the biological side to agriculture. Agricultural mechanics is where students should master the body of knowledge encompassing the physical sciences, mathematics, and agriculture. This represents the new agricultural mechanics; physical science applications in the agricultural industry.

The articles in this special issue of *The Agricultural Education Magazine* further explain the role of agricultural mechanics in agriscience and offer examples of how we might strengthen the connections between the physical sciences and agriculture. Other examples and guidelines for curriculum development can be found in the February 1989 issue of *The Magazine.* ■

About The Cover

Agricultural mechanics blends concepts, principles, and laws of physical science and mathematics with technology and management practices in agriculture. (Illustration from PSAA Teacher's Guide, University of Illinois)

Physical Science Applications in Agriculture

Agricultural Practices and Science Concepts*

*From sample lesson plans contained in the Teacher's Guide for Physical Science Applications in Agriculture (PSAA), developed in 1991 by faculty at the University of Illinois.

Agricultural Production Systems

Agricultural Practices	Science Concepts
applying pesticides/fertilizers	acid
calibrating sprayers	adsorption
planning tillage operations	base
mixing recommended concentrations	buffering capacity
controlling metering devices	calibration
conducting soil tests	cation exchange
identifying nutrient deficiencies	concentration/dilution
planning irrigation schedules	consistence
classifying soils	density
interpreting soil test results	exchange capacity
determining soil pH	hydrolysis
selecting suitable crops for pH	metering
applying lime to soils	permeability
testing groundwater for nitrates	pH
using best management practices	
maximizing economics yields	

Environmental/Natural Resource Systems

Agricultural Practices	Science Concepts
designing drainage systems	adhesion
controlling erosion	capillary flow
applying conservation practices	cohesion
using microirrigation systems	hydraulic conductivity
analyzing sites for irrigation	infiltration
evaluating drainability of soils	porosity
	saturation
	slope
	suspension
	velocity

Agricultural Processing Systems

Agricultural Practices	Science Concepts
measuring viscosity of food products	electrolytes
handling fluid foods	non-electrolytes
handling solid food	Raoult's Law
processing fluid foods	rheology
processing solid food	solute
chilling meat products	solvent
	strain
	stress
	viscosity