9

Classroom and Laboratory Facilities

Lucy Stabler is teaching in a high school where student numbers are rapidly increasing. The original school building, including the agriculture facility, was constructed 40 years ago. Temporary classrooms are used for some classes. The board of education has obtained land for building a new, larger, modern school facility. The voters in the school district have approved the sale of bonds to finance a new building.

Planning for the building is underway by the superintendent, principal, and others. Ms. Stabler is delighted that a new agriculture facility will be included. She has been invited to a meeting at the superintendent's office with the architect so that she can share her ideas. Now, she is pondering how to prepare, what to take, and what to say. She is even wondering about the nature of the classroom and laboratory facilities that are needed to ensure all students have opportunities to develop and apply agricultural knowledge and skills.

For a teacher to have input into facility design is unusual. Most teachers are at established schools, and they work with what exists. To offer ideas on a facility is a wonderful opportunity, but the teacher must be prepared.

TERMS

agriscience laboratory
aquaculture laboratory
classroom
facility
inventory
laboratory
learning stop
safety
Safety Data Sheets (SDS)
storage facility

OBJECTIVES

This chapter addresses the National Quality Program Standards for Agriculture, Food, and Natural Resources Education (National Council for Agricultural Education, 2016), specifically Standard 1C: Program Design and Instruction—Facilities and Equipment. It has the following objectives:

1. Describe the role of facilities in teaching.
2. Identify the kinds of facilities needed for agricultural education.
3. Explain the organization and maintenance of facilities.
4. Develop a plan for the continual updating of facilities and equipment.
5. Maintain a complete inventory of equipment and supplies.
6. Practice safety in instructional environments.

FIGURE 9.1 This food science lab has workstations for students to work in groups and a demonstration bench for the instructor. Drop-down power cords are available above each workstation to allow for flexibility. (COURTESY OF RACHEL HOLDEN.)

ROLE OF FACILITIES IN TEACHING AND LEARNING

Agricultural education is a facilities-intensive program. A ***facility*** is a building, a specialized area within a building, an outside area, or a large item that is not movable or that is attached. Although students are capable of learning in any environment, facilities make a difference in the quality, breadth, and depth of instruction. It is very difficult to demonstrate, experiment with, and practice concepts without the proper facilities.

As you learned in Chapter 3, agricultural education has its roots in vocational education, but today utilizes a blend of training in specific agricultural skills and development of critical thinking and problem-solving skills to help students become agriculturally literate citizens prepared for life beyond high school. To accomplish these aims, agricultural education uses a combination of classroom and laboratory-based instruction in which students have opportunities to learn and apply new knowledge and skills. Agriculture teachers use a diversity of laboratory facilities and spaces to facilitate this approach to learning. Nationwide, access to agricultural laboratory facilities varies, depending on the needs and resources of the community. In a 2012 study, Shoulders and Myers identified the top five most frequently reported laboratory facilities available to study participants: mechanics/carpentry/welding facilities (76.8%), greenhouses (72.2%), landscaping areas, (51.0%), gardens (38.7%), and aquaculture tanks/ponds (33.0%).

Bear in mind that not all laboratory-based instruction occurs in school laboratory facilities. Teachers also utilize field trips to farms, businesses, and other locations in the community to provide students a learning laboratory experience. Considering a laboratory experience provides students the chance to apply their knowledge and skills in a practical way, involvement in various FFA activities also can be considered a laboratory for leadership skill development. In this chapter, we will focus on the laboratory facilities available through the school's campus.

Facilities and Program

Facilities must be matched to the type and size of program desired. The program plan, as discussed in Chapter 5, should guide the facilities planning process. Ideally, a program is planned first and the facilities are established afterward so that the program can be efficiently and effectively implemented.

Here are a few questions to consider: What is the program emphasis? What are the program goals? What are the needs of the community? What agricultural education courses will be offered? What is the expected student enrollment? How many agriculture teachers will the facilities need to support?

When planning your agriculture program, it is helpful to use the National Quality Program Standards (NQPS; National Council for Agricultural Education, 2016) to ensure the program facilities and equipment support the implementation of the curriculum so that all enrolled students have opportunities to develop agriculture skills and knowledge. The following statements are NQPS (2016) indicators of quality program design and instruction as it relates to facilities and equipment available in the agricultural education program:

- Facility and layout provides for effective delivery of all programs of study (POS) offered.
- Facility is in compliance with existing local, state, and federal safety and health standards.
- Training and evaluation are in place so individuals using the facility create a safe working environment.
- Facility is clean, organized, and maintained to provide an environment conducive to learning.
- Facility is designed to be accessible and accommodating to all students.
- Storage space is sufficiently sized and organized for both student and teacher materials, supplies, and equipment.
- An inventory of equipment, tools, consumable items, and instructional technology is completed and includes a plan for new purchases and replacements.
- Equipment, tools, and instructional technology are safe, adequately maintained, and current to industry standards.
- The quantity of tools, equipment, and consumable supplies is adequate for equipping all students enrolled at all times.
- Equipment, tools, and instructional technology are current, available, and used effectively for delivering instruction.

The Teacher's Role

When a new school building or new agricultural education facilities are being planned, the agriculture teacher must inform planners, decision makers, and architects of the needs of the agricultural education program. Along with the local advisory committee and the state agricultural education specialist (state supervisor), the agriculture teacher should give input on items of which the others may not be aware. Information to be provided includes type and size of facilities needed; layout of rooms and equipment; special electrical, ventilation, or plumbing needs; and agricultural considerations, such as optimal location for a greenhouse. Input given before construction begins will save time and money and will enhance teaching effectiveness for the life of the facilities.

Building codes, state and local standards, and safety and fire codes must be met when any facility is being constructed. In addition, facilities must be accessible to persons with

disabilities. In some states, facilities must meet state education standards if state funds are to be available for construction and equipment.

KINDS OF FACILITIES NEEDED FOR AGRICULTURAL EDUCATION

Agricultural education facilities are typically in two major areas: classroom and laboratory. Classrooms often have many similar qualities. Laboratories vary widely based on the instruction to be provided and the needs of the local community served by the school. Storage and work areas are parts of each.

Facility Location

Agricultural education facilities are typically found in one of four locations.

In a separate building A school may have the agricultural education facilities as a separate building or complex close to the main school building. This arrangement has the advantages of providing space for the program to expand, removing noise and odors from the main school building, and providing program visibility to the community.

Within the main building A school may locate the facilities within the main school building, usually within a wing housing other career and technical education programs. This arrangement has the advantages of efficiently utilizing the building infrastructure, involving agricultural education students and teachers in the total school, and providing for sharing of space between programs.

Within other departments A school may sometimes place the agricultural education facilities within other school areas, such as the science wing. This has the advantage of providing for sharing of space between programs, viewing the agricultural program as an integral part of the school, and recruiting students who might never see the program otherwise.

Off school grounds Some programs have laboratory facilities or school farms off the school campus, within a short drive from the school. Locating laboratory facilities off-campus has the advantage of being embedded within the community, and may allow for expansion of facilities if the school grounds have no additional space for expansion. Using laboratory facilities that are off-campus does mean that agriculture teachers need to plan for how students will be transported from the main campus to the off-campus site, which may prove to be costly in both time and money.

• • •

A teacher who has input into design should promote a location that enhances instruction. Access is very important for some instructional areas, such as farm machinery, livestock, and horticulture. Location can also enhance student participation by convenience of access as related to locations of other classes at a school facility.

Categories of Facilities

There are four broad categories of agricultural education facilities: classroom, laboratory, storage, and office/teacher workroom. Within each of these categories can be specialized areas for different agricultural emphases.

Classroom

A ***classroom*** is a facility designed for group instruction. It typically has individual student desks or tables and chairs. It is important for the agricultural education program to have its own classroom(s). Experiments may need to be left in place for several days. The room may contain specialized equipment, such as GPS units, microscopes, aquariums, or food processing machines. FFA activities, student projects, and supervised experience records all require special room arrangements or storage places within the classroom.

An agricultural education classroom should have a minimum of 33 square feet of floor space per student. Ideally, the largest agricultural education classroom should have 45 square feet of floor space per student to allow for special activities. This translates into 825 to 1,125 square feet of floor space for a classroom designed for 25 students. Tables and chairs are preferable to tablet arm desks because they provide space and flexibility for experiments, student presentations, and group projects.

At least one wall of the classroom should be equipped with a writing surface (chalkboard or whiteboard). In some classrooms, the writing surface has been replaced or supplemented with a digital interactive whiteboard, such as a SMART Board or Clevertouch. This should be paired with a digital video projector and internet-connected computer capable of playing Blu-ray and DVDs. While the interactive nature of these digital whiteboards allows teachers to more easily integrate tech-savvy lessons into their instruction, they may not be ideal for classrooms that may have dust and debris (such as in a shop facility) or which have excessive sun glare. Having a physical chalkboard or whiteboard allows for instruction to continue even when experiencing temporary network or power outages. If a classroom does not have an interactive whiteboard, then a projection screen should be located so all students can easily see it from wherever they are seated. Natural light through windows is desirable in the classroom, but blinds or other means must be available to control light level for audiovisual use. If applicable, stations with water, electricity, and gas are important additions to the classroom.

Other walls of the classroom can be equipped with bulletin boards and storage cabinets. Inclusion of useable counter space above these storage cabinets can allow the teacher to set up manipulatives as part of a demonstration or stations for students to rotate through. Sometimes an agricultural education classroom is equipped with a few desktop computers or classroom sets of laptops. These computers should be networked to a printer and other peripherals such as scanners. With the rise in one-to-one device use, desktop computers or classroom sets of laptops may not be as common anymore, but are still in use in some districts.

Laboratory

Some classrooms may have built-in ***laboratory*** facilities. Possible examples are those for food processing, small-animal care, computer technology, hydroponics, or aquaculture. However, most laboratory facilities are separate rooms or buildings. With either arrangement, an agricultural education facility should have restrooms, sinks for cleaning up, and a water fountain. For all facilities applicable National Electrical Code (NEC) requirements (National Electrical Installation Standards, 2021), National Fire Protection Association (NFPA) codes and standards (2021), and Occupational Safety and Health Administration (OSHA) laws and regulations must be met. Agricultural education programs require several types of laboratory facilities. A laboratory is an area for individual or group student experiments, projects, or practice in agriscience, food science, aquaculture, agricultural mechanics, horticulture, plant and soil science, animal science, and natural resources. Each of these will be discussed in further detail.

Agriscience An *agriscience laboratory* is a facility used in teaching the science and math principles and concepts associated with agriculture. This type of facility should have 160 square feet of floor space per student. For a 25-student class, this would mean 4,000 square feet. This amount of space allows for bench-type experiments, demonstrations, and projects. The agriscience laboratory may need water, electricity, and gas at each workspace. Ventilation and floor drainage must be provided.

Equipment storage is a necessity. Microscopes, measurement devices, and other equipment need storage cabinets, ideally with the ability for the teacher to lock them. Depending on the community, the laboratory will need cages for small animals, aquaculture tanks, hydroponics units, grow lights, soil-erosion experiment tables, and other agriscience-related equipment.

Food science Food science laboratories are becoming increasingly popular. One type of food science laboratory includes the equipment and facilities for processing meat and other foods. The other type of facility provides for experiments, cooking, and preparation of food products. State guidelines should be followed when designing and equipping food science laboratories. Food safety, sanitation, and processing regulations vary by state and locality and must be followed.

Aquaculture An *aquaculture laboratory* is a facility used for providing learning experiences in fish farming and related areas. The laboratory may be inside, using tanks or vats, or outdoors, using ponds or raceways. Some programs pair the production of edible fish with the production of vegetables using a variety of aquaponics systems. Still other programs have aquaculture facilities to raise fish for the pet or research industry.

Agricultural mechanics An agricultural mechanics laboratory should have 150 to 200 square feet of floor space per student. For a 25-student class, this would mean 3,750 to 5,000

FIGURE 9.2 This indoor aquaculture facility allows for the production of a variety of species of fish.
(COURTESY OF LEDYARD AGRI-SCIENCE & TECHNOLOGY PROGRAM.)

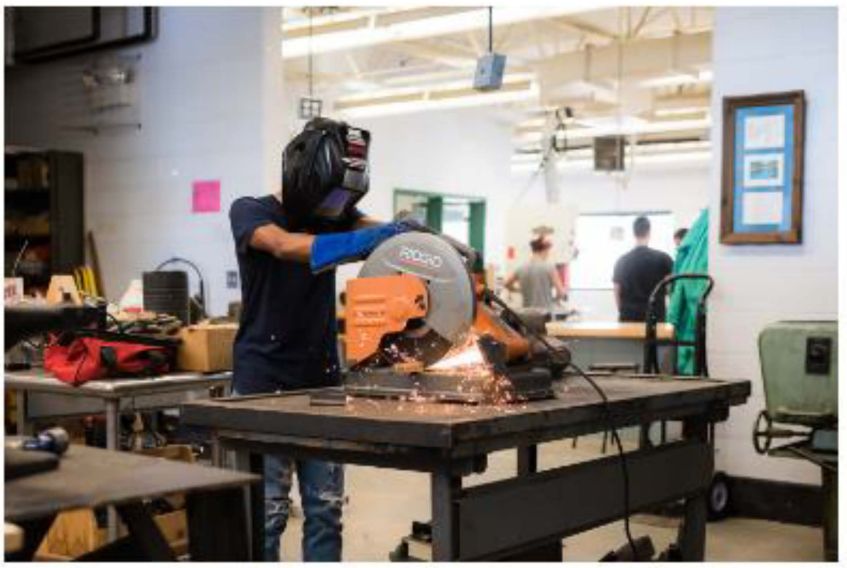

FIGURE 9.3 Agricultural mechanics laboratories should be designed to allow for students to work safely in various stations, using appropriate personal protective equipment. (COURTESY OF LEDYARD AGRI-SCIENCE & TECHNOLOGY PROGRAM.)

square feet. The type of agricultural mechanics program needed by the community will determine the design of the facility. Possible types include woodworking and construction, metals and welding, large engines and hydraulics, small engines, electricity, plumbing, concrete, and paint and bodywork. Each type requires a different layout and different equipment and tools. Adequate storage for projects, tools, and supplies is a necessity. An agricultural mechanics laboratory must be designed with student safety in mind. Building and fire codes must be adhered to strictly. Student health considerations are important when designing agricultural mechanics facilities. Dust, welding fumes, volatile organic compounds, exhaust fumes, and other contaminants must be properly handled.

Phipps and Osborne (1988) provided useful guidelines for designing an agricultural mechanics laboratory. The central portion of the laboratory should be clear to allow space for large projects. An overhead door at least 24 feet wide and 18 feet high will permit tractors and such to be brought into the facility. A regular-sized entrance door should be provided so people can enter and exit without having to open the overhead door. The ceiling should be 20 to 24 feet high. Concrete floors provide for numerous uses of the space. The electrical wiring should provide for both 110- and 220-volt current. Depending on the equipment needs, three-phase current will also need to be provided. An outside, fenced-in patio can provide both work and storage space. Inside and outside water service, including appropriate floor drains, is needed for many projects.

Horticulture Horticultural laboratories include greenhouses, headhouses for preparation and sales, indoor or outdoor landscaping areas, floriculture areas, and aquaculture/hydroponics areas. (*Note:* Depending on purchasing regulations, greenhouses are sometimes designated as equipment rather than facilities.)

A primary greenhouse should be well constructed of glass or hard plastic and have 60 square feet per student, but no less than 1,600 square feet total. The headhouse should have

FIGURE 9.4 A headhouse with plenty of workspace allows students to easily arrange flowers. (COURTESY OF LEDYARD AGRI-SCIENCE & TECHNOLOGY PROGRAM.)

30 square feet per student, but no less than 1,150 square feet total. The agriculture teacher must decide on bench arrangement, drainage, walkways, the watering system, and the temperature regulation system. Cost is almost always a limiting factor, but in all decisions, functionality as a teaching facility must take priority.

Floriculture can be taught using a classroom or the headhouse but requires some special equipment. Various-sized coolers and display cases are necessary to maintain the flowers and plants. Storage cabinets are important for the care and maintenance of tools and equipment.

Landscaping facilities can be both indoors and outdoors. Indoor facilities can be used for water garden displays, displays of landscaping materials, and construction of items such as gazebos. Ideally, an outdoor landscaping laboratory will be at least one acre in size. The area can be sectioned into smaller plots as needed. For many agricultural education programs, the school grounds or a town park becomes the outdoor landscaping laboratory. With this arrangement, care must be taken that tasks and projects conducted are for educational purposes.

Plant and soil science Land laboratories may be located on the school grounds or a distance from the school. These may range in size from as little as one acre to 100 acres or more.

FIGURE 9.5 An outdoor landscaping laboratory can include both landscapes and hardscapes to allow students opportunities to develop skills related to planning, installation, and maintenance. (COURTESY OF LEDYARD AGRI-SCIENCE & TECHNOLOGY PROGRAM.)

Land laboratories can be used for a variety of purposes including production of hay or corn, serving as a test plot for seed trials, a school garden, or agriscience research projects. Larger land laboratories may also serve as moneymakers for the agricultural education program, as supervised experience for students, or as demonstration plots for agricultural producers in the community. Some programs own the planting, tillage, and harvesting equipment themselves, while others contract with community farmers for these services. Land laboratories are most useful when used for year-round agricultural education instruction. Best utilization requires summer employment for the agriculture teacher and extended class periods, such as in block scheduling, during the school year.

Animal science Animal science laboratories range in size from what is needed for housing small animals indoors, to barns for animals, to several acres for livestock grazing. Some programs even include small animal grooming and boarding facilities, offering students the opportunity to run a "doggie daycare" business from the school. Animal facilities must follow health and safety guidelines in addition to humane animal-care guidelines. Provisions must be made for food and water, medical care, waste disposal, odor control, and dispersal of the animals at the end of instruction. Note that when housing animals in the classroom or indoor laboratory, any state or local indoor air quality regulations must be followed. Working closely with area veterinary professionals can help teachers develop facilities and management plans to account for the health and well-being of the animals housed in program facilities. Consideration should be given to external access to the animals for feeding on weekends, holidays, or inclement weather days, so the students or staff responsible for feeding can do so without needing access to the entire school building.

For more detailed guidance on appropriate housing, husbandry, health care, and biosecurity for agricultural animals, please see the *Guide for the Care and Use of Agricultural Animals in Research and Teaching*, published in 2020 through a collaborative effort of the American Dairy Science Association, the American Society of Animal Science, and the Poultry Science Association (available at https://www.asas.org/services/ag-guide). If you are teaching in a facility that uses small animals commonly used in laboratory animal research, please consult the National Research Council's *Guide for the Care and Use of Laboratory Animals*, 8th ed. (2011; available at https://www.aaalac.org/the-guide/).

FIGURE 9.6 This chicken coop not only served to help students develop skills in an animal science class, but also was utilized as part of the Ledyard Regional FFA's Living to Serve project in which they raised laying hens to produce eggs for a local food bank. (COURTESY OF LEDYARD AGRI-SCIENCE & TECHNOLOGY PROGRAM.)

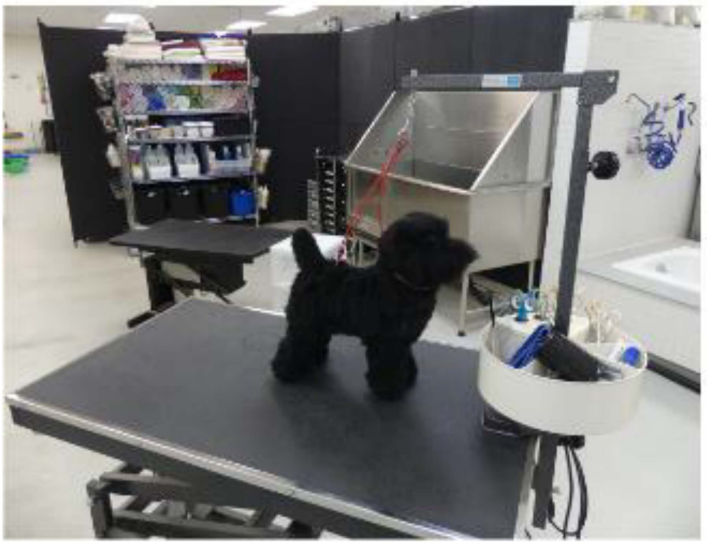

FIGURE 9.7 Some animal laboratory facilities focus on the care and grooming of companion animals as part of a veterinary science course. This dog grooming facility, pictured at a Connecticut high school, allows students to connect with animal science concepts that are relevant to the urban and suburban communities served by the program.

Natural resources Natural resources laboratories include Christmas tree farms, maple sugar bushes, wildlife areas, ponds, rivers and streams, nature areas with trails, and timber production areas. These laboratories are excellent for teaming with other high school teachers and with middle school and elementary school teachers. These laboratories, more so than others, require signage and learning stops. A ***learning stop*** is a location in a lab where students stop and read information, do a task, or observe some phenomenon. Students can be included in the creation of learning stops as one way of sharing responsibility for curation of laboratory facilities in the agriculture program. Land laboratory facilities should be designed using a master plan to build in as many learning experiences as possible.

Storage

Agricultural education programs need an assortment of tools, equipment, textbooks, audiovisuals, resource materials, and consumables. When not in use, these items must be properly stored. A ***storage facility*** is a secure location where materials and equipment can be inventoried, organized, and protected from loss and damage. Storage facilities in agricultural education include separate rooms, as well as cabinets, bookcases and racks, lockers, and various types of shelving.

The agricultural education classroom should have storage for textbooks and other resources, FFA materials, student supervised experience record books, and student notebooks. If the classroom is dedicated to a specific function, such as agriscience, then locking storage for frequently used tools, equipment, and consumables should also be provided in the classroom.

A separate storage room is best for tools and equipment that are valuable, used infrequently, or bulky. A guideline is to have 10 to 16 square feet of storage space per student. Wall and cabinet storage should have tool silhouettes so the agriculture teacher can easily see if any tools are missing.

If possible, planning for an area for students to store a change of clothing and shoes is helpful in the agriculture program. Given that students may frequently be outdoors or getting dirty through the planned learning activities, providing students locker space to store a change of clothing and shoes can ensure students are prepared for a variety of hands-on learning activities at a moment's notice.

Office/Teacher Workroom

Dedicated office space allows the agriculture teacher to be organized, professional, and responsive to student and community needs. Each agriculture teacher should have a minimum of 120 square feet of office space. Teachers can share office areas when a school has more than one agriculture teacher. The office can be combined with a workroom or conference room.

In a teacher office, each agriculture teacher should have, at a minimum, a desk, a desk chair, a worktable, computer with internet access, and a filing cabinet. The office should have at least one telephone with an outside line. A telephone on each desk is preferred. An agriculture teacher is required to communicate with employers, adult agricultural education students, suppliers, and others. This justifies an agriculture teacher having an outside line when other teachers may not.

ORGANIZING AND MAINTAINING FACILITIES

Facilities should be properly organized and maintained to assure their efficient use and long life. A neat facility represents the agriculture teacher(s) and program well with the public who sees it.

Organization

Agricultural education facilities should be organized for effective and efficient instruction. In addition, they should be attractive and professional in appearance. Agricultural education facilities may be used by the community more often than other school instructional facilities and can be good public relations tools.

The state supervisor of agricultural education in each state will likely have sample facility plans for various curriculum offerings. Safety is a major concern in establishing facilities. Plan doors, windows, ventilation systems, and other features to promote student and teacher safety.

Maintenance

Equipment and tools must receive both daily and periodic maintenance. Daily tasks, such as cleaning, checking for wear and tear, and storing properly, help maintain appearance and functionality. Periodic maintenance schedules should be followed for replacing parts, lubricating, making adjustments, and cleaning thoroughly. Well-maintained equipment and tools will provide years of quality service. Often the maintenance of tools and equipment is included as a component of curriculum, but sometimes agriculture teachers will need to conduct maintenance activities outside of classroom time for efficiency and student safety.

UPDATING FACILITIES AND EQUIPMENT

A replacement and updating plan should be developed for the facility and equipment. This will extend the life of the facility and equipment while preventing them from becoming completely outdated. Local, state, and federal funding sources will have various requirements for documenting the need for new or replacement facilities and equipment. The agriculture teacher should develop one-, three-, and five-year plans.

The one-year plan should include items needed immediately and included in the budget. It is good to have additional items in the one-year plan in case more funds become available during or at the end of the school year. Safety equipment, such as eye, hearing, and

body protection, should be replaced annually. The three-year plan should include replacement items as well as items needed for new curricular thrusts. The five-year plan should be a capital improvements plan that will give school administrators and the school board time to budget for larger-expense items.

ACCOMMODATING ACCESS TO FACILITIES

It is important to ensure laboratory facilities can be made accessible to all students. This may require updating facilities to include ramps, widening door openings, or more spacing between tables or equipment to allow for increased maneuverability. According to federal law, learning activities must be made accessible for students. Work with your special education department and building and facilities manager to determine appropriate access to your existing laboratory facilities. If you are in a position to design new facilities, be sure the architect with whom you are working accounts for accessibility in the design. Resources related to making agricultural equipment more accessible for people with physical disabilities can be found from the National AgrAbility Project (2021) at www.agrability.org.

INVENTORYING EQUIPMENT AND SUPPLIES

An ***inventory*** is a complete list (by kind and number) of equipment, tools, and supplies. An inventory should be taken as soon as possible upon initial employment and yearly thereafter. The results should be communicated to administrators. A sample inventory form is shown in Figure 9.8. The teacher can use this form when walking around viewing the items. Then, the information can be entered into a computer database created in a software program such as Microsoft Excel or Google Sheets. Note that in addition to counting the number of items, documenting their condition and usefulness is also necessary. Items that are in less than desirable condition should be repaired or replaced. Consideration should be given to getting rid of items that were not used the previous year and are not anticipated to be used the next year. Not only do these take up space that could be used for other purposes, but they contribute to an environment of clutter and disorganization.

SAFETY IN INSTRUCTIONAL ENVIRONMENTS

All agricultural facilities require safety be practiced. ***Safety*** is the reduction of risk and of the likelihood of personal injury. Many items used in the agricultural education curriculum can cause injury if misused or if safety is not practiced. Chemicals, power tools, heavy objects, pinch points, electricity, motorized vehicles, hot objects, and animals all have the potential to cause injury or harm to students.

Safety is a vital concern for the agriculture teacher. Instructional time must be devoted to safety instruction so students both know and practice safe habits. Safety equipment must be provided in working condition and its use strictly enforced. Finally, the agriculture teacher must be a role model in the use of safe practices.

Agriculture teachers may be held liable for actions they may or may not take within the classroom and laboratory (Lee, 2000). An agriculture teacher is expected to do what a reasonable, prudent person would do. The teacher should provide instruction and practice in the

INVENTORY FORM

School year _____ – _____

Agriculture program _____

Person completing form _____

Item Name and Brand	Number of Items	Model No./ Serial No.	Condition	Used Last Year or Will Be Used Next Year?

FIGURE 9.8 An inventory form for equipment, tools, and supplies.

safe use of equipment, tools, and supplies. It is advisable that prior to any students entering a laboratory facility, they have received instruction in safety and have passed a safety knowledge test. Documentation must be kept that shows students have passed a safety knowledge test and have demonstrated safe operation and practices. Safety guards and equipment must be installed, and students must understand their use. Tools and equipment must be properly maintained or taken out of use until repaired. Finally, tools and equipment should be used for designed purposes. Other uses may place students at risk of harm or injury.

Teachers are responsible for the safety of their students. Many teacher actions and practices contribute to a safe instructional environment. Lee (2000) summarized these into 10 essential safety practices for teachers (see Table 9.1).

Power Equipment Safety

Power equipment presents safety considerations for the eyes, hearing, and the extremities. Whether using power hand tools or larger stationary power equipment, students must follow safe practices. Eye protection is not only important for the person operating a tool but also for those in the immediate area. A good practice is to require the use of eye protection at all times within the laboratory space. This eliminates students' forgetting to put their eye protection on and the need to define the dividing line for when eye protection must be worn.

Hearing protection is important for the student operating a power tool or power equipment. It may also be required for those within the immediate area. Teenagers may not realize the extent to which exposure to loud noises can cause damage, so it is critical that the agriculture teacher be a role model and enforce use of hearing protection.

Often overlooked is the need to keep long hair from contacting moving surfaces. Long hair should be pulled back or put under a hat so that it is not loose.

TABLE 9.1

Safety Practices in Agricultural Education

Practice	Explanation
Plan and practice.	Teachers should plan learning activities and try out what students will be doing.
Instruct students.	Teachers should instruct students in potential dangers to avoid and safe practices to follow. Documentation is critical.
Supervise the learning environment.	Teachers should always be present with their students and be attentive to what is happening in the learning environment.
Keep up the facilities.	Teachers should keep laboratory facilities clean, in good repair, and free of potential hazards. Broken equipment, dangerous chemicals, and safety devices should always be dealt with properly.
Be a good example.	Teachers should set a good example by dressing and grooming properly and wearing proper protection. They should never violate safety procedures.
Use safety cleanup materials.	Teachers should have the appropriate cleanup materials readily available in case of an accident.
Know and follow school policies.	Teachers should know and follow school policies. The hazardous waste officer should be asked to review the laboratory and teaching content.
Obtain professional educator liability insurance.	All educators need to have insurance coverage that protects them while they are conducting their professional duties. However, insurance does not provide protection if the teacher is negligent.
Be a good housekeeper.	Keeping the classroom and the laboratory in good condition helps avoid some hazards.
Post emergency numbers.	Teachers should post emergency telephone numbers near all telephones.

Other safety considerations around power equipment include proper clothing and footwear and removal of jewelry. Sweatshirts with long hood strings, long necklaces, and various rings or piercings can cause safety concerns when working with tools or animals. When welding, it is important that in addition to wearing appropriate welding coats or coveralls, students wear cotton or wool-based fabrics, as man-made fabric blends tend to be highly flammable. Students should also be aware that slick-bottomed shoes and open-toed shoes are not appropriate for the laboratory. There may be instances when athletic footwear is also not appropriate. The agriculture teacher should conduct a safety inventory to identify potential dangers and hazards before using laboratory instruction.

Chemical Storage

Chemicals are used throughout the curriculum in agricultural education. The agriculture teacher should be trained in the proper storage, handling, and use of all chemicals used in the program. A system should be established for filing ***Safety Data Sheets (SDS)*** and for ensuring that out-of-date chemicals are removed and properly disposed of. Previously known as Material Safety Data Sheets (MSDS), the SDS include information about hazardous materials in a consistent, easily understood format. For more on what information can be found on an SDS, please visit https://www.osha.gov/sites/default/files/publications/OSHA3514.pdf (Occupational Safety and Health Administration, 2012).

Often, facilities and maintenance departments in your school district will request a copy of the SDS be sent to them, and a binder of SDS be kept in the location where the chemicals are stored so that in event of a spill or exposure, the SDS are readily accessible. Lee (2000, p. 77) gave the following suggestions for properly storing chemicals:

FIGURE 9.9 Chemicals such as pesticides should have their own locking storage cabinet that is designed to store them properly.

- An appropriate storage area should be provided. Often known as the stockroom, this area should be locked and kept off-limits to students and other school personnel.
- Only compatible chemicals should be stored together. Some chemicals are incompatible and will react violently if they come together when accidentally spilled.
- Chemical containers should always be labeled appropriately. Chemicals that are unlabeled invite trouble.
- Chemicals that are corrosive and flammable should be stored in approved fireproof cabinets.
- All containers should be properly covered. Tops should be appropriate for the materials being stored.

Safety Equipment

It is important that students have access to and use proper safety equipment. Lee (2000, pp. 79–80) gave the following recommended safety equipment list:

Emergency eyewash equipment—A handheld wash bottle that can be disposed of after one use is likely best; several are needed in each laboratory area.

A fountain, permanently mounted, may work well (minimum of one per laboratory, with additional fountains in larger laboratories). An alternative is a unit that requires no plumbing and uses a special eyewash solution. Either should be capable of flushing both eyes at the same time.

Caution: Keep eyewash facilities clean. Microorganisms that cause infection can build up in facilities that are not properly maintained.

Drench shower—freestanding or mounted (minimum of one per laboratory).

Fire blanket—fiberglass; 43 × 39 inches (one per laboratory).

First-aid kit—metal cabinet complete with standard first-aid supplies (one per laboratory).

Tethered buoy ring (needed for aquaculture involving ponds, large tanks, and streams)—rope 30 feet or longer attached to sturdy post (one per worksite or tank).

Sanitizing goggle cabinet with goggles—wall-mounted, with ultraviolet lamp; 20-goggle minimum capacity (one or more per laboratory).
Goggles—clear; scratch-resistant (one pair for each student).
Fire extinguisher—Halon or dry chemical charge (one or more per laboratory).
Particle masks—bulk quantity.
Safety storage cabinet—approved double-wall construction; 18-gauge welded steel; must conform to OSHA regulations (one per laboratory).
Sand bucket—metal; five-gallon size, with sand (one per laboratory).
Smoke or heat detector—standard detector (one per laboratory).
Aprons—vinyl, rubberized, or leather, depending upon the requirements of the laboratory (one per student or 20 per laboratory, depending on the number of students).
Safety gloves—disposable latex gloves (quantity supply for laboratory); leather gloves as appropriate (one pair per student or 20 pairs per laboratory, depending on the number of students).
Trash containers—metal- or plastic-lined; 10-gallon size (one per workstation).
Broom with dustpan—for cleaning nonhazardous spills (one set per workstation).
Mitts—nonslip; used for handling hot materials (one pair for each workstation).
Safety charts—wall-mounted signs or charts appropriate for laboratory area (one set per laboratory).
Cleanup kits—approved kits for caustic, solvent, and acid spills (one of each for each laboratory).
Other safety equipment—as needed for laboratory activities.

Vandalism and Violence

Classroom management techniques are discussed in Chapter 14. There are additional considerations regarding student management in the laboratory. In all cases, the agriculture teacher must follow local procedures regarding violence, vandalism, and student behavioral problems. Some students may be prone to threaten or cause harm to other students or the teacher. These students may be denied access to the laboratory. Vandalism can render some equipment inoperable and, depending on budgets, not repairable. Vandalism also disrupts the aesthetics of the laboratory and if left untreated can lead to further vandalism. Theft, besides being illegal, creates a need for expensive replacement of items stolen and disrupts learning, as students may not be able to work until items are replaced.

The agriculture teacher can take some actions to alleviate potential vandalism and violence problems. First, tools and other materials should be kept in locked storage rooms or cabinets. See Chapter 21 for suggestions on end-of-class cleanup procedures. Second, the laboratory should be arranged so the teacher can see all students as they work. And finally, the teacher should never leave the laboratory or classroom unsupervised. If the teacher must be out for a time, another licensed agriculture teacher should be in the room to supervise.

REVIEWING SUMMARY

Facilities are important for instruction in agricultural education. The facilities must match the type and size of program the school and the community need. The agricultural education program plan should guide the facility planning, maintenance, and updating processes, using the National Quality Program Standards as an evaluation and planning tool. Building agricultural education facilities involves input from the community, school administrators, the agriculture teacher(s), architects, and others.

Four types of facilities are typically found in an agricultural education program. One or more dedicated classrooms assist in the instructional program. Laboratory facilities are a must and need to match the instructional program. The agricultural education program requires storage facilities for the various equipment, tools, and supplies needed for the instructional program. Finally, an office and workspace facilitate the agriculture teacher doing their job.

Organization of agricultural education facilities aids the instructional process and gives them an attractive and professional appearance. Careful thought must be put into whether the facilities will be designed for a one-teacher or multiple-teacher agricultural education program. If possible, the design should allow for future additions or modifications as the program focus expands or changes.

The agriculture teacher is responsible for selecting and ordering equipment, tools, and supplies. Using local suppliers is good for positive public relations and community support but may not always be possible or allowed. The teacher is also responsible for the maintenance and inventorying of these items. Regular maintenance greatly extends the life and usefulness of equipment and tools.

Safety is critical when using agricultural education facilities. Teachers may be held liable for student injuries because of actions they did or did not take. Teachers must be familiar with safety rules and practices themselves and must instill these in their students. Most important, agriculture teachers must model safe practices and must not violate safety procedures.

QUESTIONS FOR REVIEW AND DISCUSSION

1. What are the questions to be asked when designing agricultural education facilities?
2. What are the four categories of agricultural education facilities? Why are these needed?
3. Why are tables and movable chairs preferable for an agricultural education classroom?
4. What are the areas of agricultural education for which laboratories are needed?
5. What are special storage needs in agricultural education?
6. Why does an agriculture teacher need an outside telephone line and an Internet-connected computer?
7. What questions should be answered when purchasing equipment, tools, and supplies?
8. Why is maintenance of equipment and tools important in agricultural education?
9. Why is a beginning inventory upon initial employment important? Why is an annual inventory important?
10. Why is safety so important in agricultural education?

ACTIVITIES

1. Investigate the guidelines and requirements for agricultural education facilities in your state. Begin with the website of the state department supervising CTE education in agriculture. Contact the individual in charge of school facilities at the state level and request information, including copies of relevant state laws.
2. Debate the necessity for agriculture teachers to have equipment and facilities that may not be available to other teachers. Examples include a private office, an outside telephone line, additional storage space, a workroom or conference room, vehicles, and specialized equipment or rooms.
3. Using the *Journal of Agricultural Education*, *The Agricultural Education Magazine*, and the proceedings of the National Conference of the American Association for Agricultural

Education, write a report on research about safety within agricultural education. Current and past issues of these journals can be found in the university library. Past and current issues can be found online at www.aaaeonline.org or www.naae.org.

4. Consider an ideal facility for the area of agricultural education you want to teach. Sketch the layout of the classroom and laboratory areas. Be sure to include storage and office areas. Be sure to include doors, windows, bench arrangements, and other details. Make your sketch on poster paper for display and discussion.
5. Using the National Quality Program Standards quality indicators, assess the program facilities and equipment at a program of your choice. Identify examples of evidence and develop an action plan for how to improve the quality of facilities and equipment available at the program. The NQPS can be accessed at https://thecouncil.ffa.org/program-standards-tool/.
6. Interview a variety of agriculture teachers to develop a list of equipment and consumables that would be needed to stock a laboratory facility of your choice. While developing this list, identify sources where you could purchase this equipment, and the estimated cost. As part of your interview with your selected teachers, describe the source of funds used to support the cost of maintaining their facilities.

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10

Instructional Resources

Have you ever attempted to do a job without adequate tools or materials? Hard to do, right? Think of the situation you were in as related to that of a teacher without needed instructional resources.

Achieving goals in education requires resources just as much as making achievements in other areas of our lives and society. A student needs "tools" in order to learn; a teacher needs "tools" in order to promote learning. Teachers need resources to efficiently develop skilled and knowledgeable students just as veterinarians need instruments and equipment to promote animal health and floral designers need flowers and supplies to construct an arrangement. Without the needed "learning tools," the teaching–learning process will be inefficient and fail to reach its potential in promoting goal achievement.

Some schools provide an abundance of resources for teaching and learning; other schools may not. Teachers are in the important position of using resources to promote student learning in an attempt to gain the desired outcomes of education. Further, teachers have the responsibility of obtaining the needed resources to the fullest extent possible. This will often require extra initiative to make needs known to school administrators and promote the allocation of school resources so that students have the "tools" they need in order to learn.

TERMS

academic software
activity manual
ancillary instructional resource
basal instructional resource
Chromebook
cloud storage
computer-based module
consumable
desktop computer
display panel
document camera
e-book reader
e-learning
electronic-based material
equipment
facility
instructional materials
instructional materials adoption
instructional resource guide
instructional resources
instrument
interactive whiteboard
laptop
lesson plan library
netbook
paper-based material
reference
school management software
smartphone
student-use material
supply
tablet computer
teacher's manual
teacher-use material
textbook
tool
webcam

OBJECTIVES

This chapter addresses the National Quality Program Standards for Agriculture, Food, and Natural Resources Education (National Council for Agricultural Education, 2016), specifically Standard 1C: Program Design and Instruction—Facilities and Equipment. It has the following objectives:

1. Describe the roles of instructional resources in accountability.
2. Identify kinds and sources of instructional resources.
3. Discuss e-learning media in agricultural education.
4. Apply selection criteria in obtaining instructional resources.
5. Explain the management of instructional resources.

FIGURE 10.1 Agriculture teachers use a range of instructional resources to help students learn agricultural knowledge and skills.

ROLES OF INSTRUCTIONAL RESOURCES IN ACCOUNTABILITY

A resource-rich learning environment in the classroom and laboratory promotes teaching and learning. An agricultural education teacher has the responsibility of requesting and obtaining appropriate instructional resources. A wise teacher always maintains a list of needed materials just in case funds become available. A teacher also has the responsibility of preparing precise requests for instructional materials (similar to bid specifications) and justifying their importance and usefulness.

Instructional resources are the materials used in the teaching process. They are among the "tools" teachers use in providing instruction and students use in learning. In a broad sense, instructional resources include many kinds of materials, ranging from those that are published on paper or as computer-based materials to plants, animals, lab instruments, supplies, and safety equipment.

Some materials and teaching approaches are much more effective than others. Good assessment of materials is needed before obtaining and using them in a teaching–learning environment. Just because certain materials are available does not mean they will make a strong contribution to student achievement. Teachers should be prudent in making resource choices. Careful investigation of materials is needed before obtaining and using them with students. Determine the experiences of other teachers, the approaches used in the development of the material to assure authenticity, correlation to content standards, and contribution to high assessment scores of students.

Defining Instructional Materials

Some instructional resources are known as ***instructional materials***. Instructional materials are materials that have the content or skill information being taught. They include textbooks, activity/lab manuals, transparencies, electronic presentations, brochures, magazines, reference manuals in either print or electronic format, and many others, but not laboratory facilities, equipment, tools, and supplies. Students primarily learn through their interactions with teachers and instructional materials. Selection of these instructional materials varies by subject and school district.

A teaching and learning environment rich in relevant, up-to-date instructional materials promotes increased achievement. As tools in the teaching and learning process, instructional materials are sometimes compared to the tools carpenters use in construction, such as hammers, levels, and squares. Without these tools, construction cannot progress; carpenters cannot achieve their goals. Likewise, without instructional materials, learning cannot progress; teachers and students cannot achieve their educational goals.

Students in an environment that is deficient in instructional materials will not likely perform well on accountability testing. Low scores by students may result in the teacher not being viewed as accountable in promoting student achievement. The school administrators may also not appear accountable as instructional leaders. The bottom line: A resource-rich learning environment promotes student educational achievement and provides motivation for future success.

Indicators of High-Quality Instructional Materials

Instructional materials have a direct impact on student learning and achievement. In some cases, the quality of instructional materials has been shown to have at least as much if not more impact on student learning as the quality of the teacher using those materials. It is imperative the teacher access and utilize high-quality instructional materials to support students' learning and skill development.

Identifying what makes instructional materials high quality varies from state to state, with the state department of education often providing a definition. Typically, instructional materials are deemed to be of high quality when they are

- Aligned with educational standards
- Implemented through rigorous instructional experiences that provide students opportunities to learn through meaningful and authentic activities
- Developed based on research on the science of teaching and learning
- Implemented by teachers who are engaged in ongoing professional learning on how to best implement the materials

(Bucolo, 2020)

Recent research during the COVID-19 pandemic suggested additional indicators of high-quality instructional materials:

- Technology enabled throughout to allow learning to occur across modalities
- Culturally relevant and responsive to the needs of students and families
- Designed to help families assist in student learning

(Chu et al., 2021)

When deciding what instructional materials will be used to implement your agriculture curriculum, it is essential to evaluate your potential materials for evidence of the above characteristics.

Agricultural Education Instructional Materials

Many kinds of instruments, tools, equipment, and supplies are instructional resources that may be used in agricultural education. These vary with the nature of the instructional program. The curriculum outline and courses are established first. Appropriate instructional resources are then obtained to implement the curriculum. A particular course should not be offered just because a school has the facilities for doing so. Courses are offered to fill educational needs.

Facilities are essential in carrying out the instruction of a course of study. A ***facility*** is the school building (including classrooms and laboratories), grounds around the building, and any structures on a permanent foundation. Greenhouses and other useful structures are sometimes defined as facilities and other times as equipment. As a facility, a greenhouse, livestock barn, or other structure would need to be situated on a permanent foundation. Facilities should provide a modern and safe educational environment for students and teachers. Some states have facility plans for agricultural education facilities. In constructing facilities, local school boards engage the services of an architect. Agriculture teachers and advisory groups should provide input to the architect in the design of facilities for agricultural education.

More information on agricultural education laboratory and classroom facilities can be found in Chapter 9.

Equipment includes instructional resources that are larger, often stationary, and frequently operated with motors or engines. Equipment with motors or engines may be known as power equipment. In an agricultural mechanics lab, equipment may include welding machines, radial arm saws, and air compressors. Equipment in horticulture may include trimmers, mowers, soil mixers, and components of irrigation systems. With care, equipment is long lasting and can be used repeatedly. Equipment often poses hazards to students and teachers. Proper instruction in safety and safe usage is essential. In addition, instructional equipment includes items used in the classroom or laboratory to provide information and reinforce learning.

FIGURE 10.2
Instructional resources should support the intended outcomes of teaching and learning, such as those used in extracting DNA from strawberries. (COURTESY OF EDUCATION IMAGES.)

Instruments, tools, and equipment are used repeatedly in teaching and learning. An ***instrument*** is a device used for a particular purpose. An example is a caliper used to make precise measurements. Instruments are often small and require careful storage to maintain them and protect them from damage. Some instruments are fairly expensive; others are inexpensive.

A ***tool*** is a handheld device that aids in doing a task. An example is a claw hammer. A claw hammer is designed to drive and pull nails. Without a hammer, nail driving is difficult. Proper hammers, for example, are needed so students can be taught selection, use, and care of them. Tools used in agricultural mechanics classes vary from those used in horticulture, veterinary science, or forestry, though a few may be the same.

Schools that fail to allocate funds for instructional resources are planning to fail in student achievement. Quality instructional resources allow students to learn on their own and help develop self-motivation toward learning. Relevant instructional resources designed for student use empower students as learners to continue learning on their own without the continuous intervention of a teacher.

The instruments, tools, and equipment needed vary with the course and curriculum outline. A general agriscience class will have instructional resources that support achieving the educational objectives of the course. These may include microscopes, slides, soil test kits, and numerous other items.

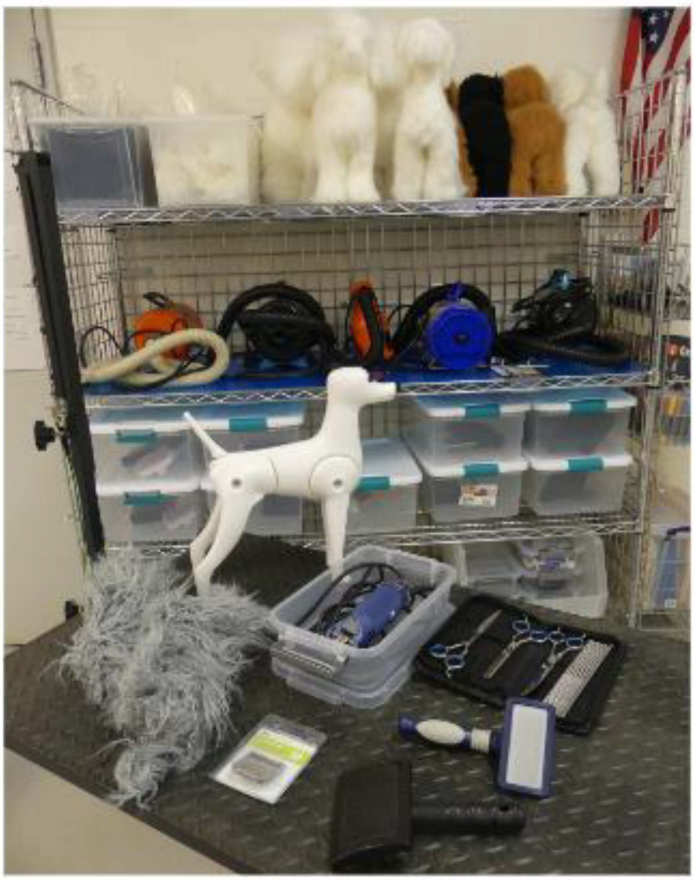

FIGURE 10.3 Equipment and supplies should be appropriate to the area of instruction, such as animal science.

Supplies are needed to use most instruments, tools, and equipment. A ***supply*** is a consumable material used to carry out instructional activities and/or work. ***Consumables*** are teaching supplies that are used up each year during instruction. Supplies vary with the nature of the instruction. Horticultural supplies may include potting soil, seeds, fertilizer, herbicide, insecticide, and other materials used to grow plants in the greenhouse or land lab. In agricultural mechanics, supply needs vary with the areas taught. For example, welding requires rods or wire, metal, and/or other supplies; construction requires lumber, plywood, nails, and other supplies; and machinery maintenance requires oil, filters, and other supplies.

A list of instruments, tools, equipment, and supplies for a particular course is often included with the curriculum map for a course. Otherwise, a teacher would get input from local advisory council members, other experienced teachers, and state supervisory personnel. Teachers gaining employment with existing programs will often go to schools that have some resources remaining from previous years. A new teacher should inventory what is on hand and in workable condition and then request resources needed to implement the curriculum. In all cases, teachers should follow school procedures in making requests. More information about ordering consumables for laboratory-based instruction can be found in Chapters 9 and 21.

KINDS OF INSTRUCTIONAL MATERIALS

Instructional materials can be classified in a number of ways, such as by intended user and by medium of presentation. Teachers choose materials that provide the best fit in their schools and with their students. (*Note:* This section of the chapter refers to materials used in communicating subject matter and achieving subject-matter objectives. It does not include instruments, tools, and equipment used in laboratory skill development. See Chapters 9 and 21 for more information about these items.)

Commonly used materials include textbooks and the ancillaries that accompany them. An ***ancillary instructional resource*** is a secondary or supplementary material that accompanies another material, most often a textbook. The material an ancillary accompanies is known as basal. A ***basal instructional resource*** is a material that provides the base or foundation for the organization of a subject. All else revolves around the basal resource. Textbooks are often considered basal instructional resources.

In selecting an ancillary, ask the following questions:

- How well does the material correlate with the basal textbook/material?
- Does the material promote systematic learning?
- Does the material reinforce important concepts in the basal textbook?
- Are the activities appealing to learners?
- Has the material been field tested?
- Is the material current?
- Is a companion instructor's guide available? (This may include online support for the ancillary.)

User Classification

Instructional resources can be classified by who uses them. Some materials are designed for use by students as important resources in learning. Other materials are designed for use by teachers in efficiently directing the learning of students often focused on using student materials. Either may be published on paper or available electronically.

Student-Use Material

Student-use material is an instructional resource prepared for use by students. Usually, a great deal of care has been taken to make the material appealing to students. The writing level is within the range of readability of the students. Numerous photographs and line drawings are used to depict important concepts. Textbooks are the most common student-use materials, though activity manuals, lab exercise manuals, and self-paced CD materials are also used.

Textbooks A ***textbook*** is a book designed for use by students that deals with a specific subject. Textbooks have usually been prepared following a systematic format, carefully reviewed to assure technical accuracy, and correlated to appropriate course objectives or standards. Textbooks are usually organized into parts or units. Each part or unit is composed of several chapters. The chapters are further divided with headings and subheadings. Motivational approaches to gain student attention and interest are used. End-of-chapter evaluations and hands-on activities are presented.

A textbook is usually prepared for students at a particular grade level or range of grades, such as grade 10 or grades 9 through 11. Hard copy textbooks are typically printed in color and bound with hard covers. Textbooks are increasingly available in digital formats. At times these digital textbooks, sometimes called eTextbooks, are available in PDF form, while at others they are more interactive in nature, allowing students to highlight, flag, and take notes on the text. eTextbooks are often accessed through an app or website login.

Typical subjects of textbooks used in agricultural education classes include agriscience, horticulture, biotechnology, landscaping, veterinary science, and plant and soil science. Teachers who choose to use hard copy textbooks might purchase enough copies for an entire class to check out for the year, or they may purchase classroom quantities of books that remain in the agriculture classroom for use during class time only.

With care, paperback and hardbound textbooks are not destroyed after one use and can be used repeatedly with several classes. Students should be encouraged to take good care of books so the books have long, useful lives. Paper books can be used in locations where internet service and computer equipment are not available, but eTextbooks are increasingly becoming available to use in off-line settings.

Activity manuals An ***activity manual*** is an ancillary resource that has activities organized around a basal resource, such as a textbook. The activities often focus on several goals and approaches in learning. Overall, the activities reinforce the achievement of objectives in the textbook, review terms, and provide hands-on experiments or other investigations. Students carry out the investigations and record their observations or experiences in space provided in the manual. Some of the investigations may involve using precise laboratory instruments. Other activities may involve collecting data from crops, animals, streams, forests, and other phenomena. Activity manuals often have instructor's guides to aid the teacher in directing student learning. Each student needs their own activity manual. Most activity manuals are consumable; they can be used only once because students answer questions and record information in them. Some activity manuals may be available as online materials. Some teachers have students create interactive notebooks using cloud-based storage systems like Google Classroom, which replace hard copies of activity manuals.

Computer-based modules A ***computer-based module*** is instructional material that involves the use of units or modules guided by a computer program. The computer program directs students from one activity to another and through the activities. Textbooks, video

clips, and hands-on activities may be part of the instruction. Some observations show students with this type of instruction lose interest after a few weeks.

Record books Supervised experience and FFA participation accomplishments should be recorded. This may be with paper-printed record books or computer-based record systems. Records are essential for students to apply for advancements in FFA. States and/or local school districts may have record books or systems developed specifically for their use. National FFA award applications for proficiency awards, American Degrees, and SAE grants all require use of the Agricultural Experience Tracker (AET) software to upload records of SAE and FFA involvement.

Online reinforcement and assessment Online approaches for reinforcing rote learning, providing student tutorials, and assessing student learning are available. Most widely used is the online assessment of student learning. Some are offered through state education agencies; others are from commercial assessment sources.

Teacher-Use Material

Teacher-use material is an instructional resource designed for use by a teacher. Its purpose is to aid the teacher in planning, delivering, and evaluating instruction. Some teacher-use materials stand alone, such as program planning materials. Other teacher-use materials are companions to student-use materials.

Following are a few examples of teacher-use materials.

Teachers' manuals A ***teacher's manual*** is a teacher-use material prepared to accompany a student-use material, such as a textbook. A teacher's manual or teacher's edition provides useful information for the teacher to use in delivering instruction using a student edition textbook. A teacher's manual will typically summarize content, offer teaching suggestions, include additional recommended resources, and provide answers to questions in the student edition. Teachers' manuals may be provided free of charge by publishers to teachers who adopt and purchase classroom sets of student edition textbooks. Teachers' manuals may be printed on paper or available in electronic form as a CD/DVD or for downloading from the provider's internet site. (In some cases, editions of textbooks are published that incorporate the teacher's manual in the same binding as the student edition. These may be known as teachers' editions.)

Instructional resource guides An ***instructional resource guide*** is a collection of material that helps a teacher plan and deliver instruction. Instructional resource guides often contain detailed lesson plans, sample tests, transparencies or electronic-presentation images, lab sheets, and other material for use in delivering instruction. The guides may be prepared as loose-leaf notebooks, available to access through an online portal, on CD-ROMs, or a combination of formats. Increasingly, such materials may be available on the internet by using access codes. Such materials are usually sold, though they are occasionally offered free of charge if teachers adopt and use specific student materials.

Lesson plan libraries A ***lesson plan library*** is a collection of teaching plans focused on a fairly broad area, such as landscaping or wildlife management. The lesson plans are complete with a summary of content, suggested instructional strategies, sample tests, lab sheets, and transparencies or electronic-presentation images. Lesson plan libraries are often correlated to state standards or course blueprints. They may also be closely correlated to end-of-course

or other forms of competency tests. These lesson plans may be available on a CD or by subscription to an online site. Some state teacher organizations and education agencies provide lesson plan libraries; others are available through commercial sources. Most commercial sources have rigorous review processes to assure that materials have been field-tested and are technically accurate and educationally sound.

Reference materials ***Reference*** materials are needed for use by the teacher in preparing lesson plans and answering questions. A reference is material that is more advanced than students would normally use. References may be in a variety of formats, including books, manuals, brochures, notebooks, websites, CDs, and videos. They are sometimes publications from the Extension Service. References on science, agriculture, horticulture, veterinary medicine, and other areas are often needed, depending on the technical areas included in the instructional program and the nature of the agricultural industry in the local community. References on FFA are needed in all programs. Websites can often be used as sources of information. An example is the publication of the National Agriculture, Food, and Natural Resources Career Cluster Content Standards, which is available at https://thecouncil.ffa.org/afnr/.

Medium Classification

Medium classification refers to the form in which instructional resources are used by students and teachers. Some instructional resources are printed on paper; others may be in electronic form on CD or available through the internet.

Paper-based material is instructional and learning material that is printed on paper. This medium of material has long been used and has yielded good educational results. The material may be printed in color or in black and white. Almost all are bound in some way—for example, as loose-leaf notebooks, hardback textbooks, or softback activity manuals.

Electronic-based material is instructional and learning material that is used in conjunction with a computer or computer network system. While once primarily depending on material available through CDs or DVDs, most electronic materials are now accessible through the internet. Each student needs access to a computer that has a strong connection to the internet. Students may work alone or work together in pairs. Some schools establish instructional technology labs, where groups of 20 or so students work at the same time.

Electronic materials available through the internet typically involve the teacher having an access code to a website. The availability of an access code may require payment of an annual fee to the website provider. Computer hardware is needed for students to use these instructional resources. (The next section of this chapter, "Materials for E-Learning," provides more information about electronic-based materials.)

MATERIALS FOR E-LEARNING

E-learning is electronically based teaching and learning that usually involves some application of computer technology. It may be used by a teacher to supplement classroom instruction or as a stand-alone source of instruction. In most cases, e-learning approaches are integrated as supplements or enhancements in the traditional agricultural education classroom and laboratory. In agricultural education, they typically do not replace the instruction of the teacher. As Roblyer and Dowering (2010) indicated, "simply having students use technology does not raise achievement." They further indicated the impact of technology depends on the ways it is used.

Essentially, e-learning involves an internet-enabled computer or smart device (such as an iPad) to transfer knowledge and skills. E-learning approaches are also used in the evaluation or assessment of student performance. Interaction may involve a mainframe computer thousands of miles away from the school, home, or wherever it is being used. The fundamental principles of how people learn apply to e-learning just as they do to other forms of instruction.

E-learning, and all that it embraces, has received considerable attention in recent years. Schools have made major financial investments to obtain and install e-learning materials and train teachers in the use of e-learning approaches. During the COVID-19 pandemic, e-learning became the primary mode of instruction for millions of schools around the world.

Agriculture teachers often find computer-based and online materials and approaches excellent supplements to face-to-face methods. Visual materials are increasingly computer-based and have mostly replaced older materials such as transparencies, 35 mm slides, and videotapes. Online information can be accessed that is up-to-date and relevant to instructional needs.

With e-learning, the quality of the content and the engagement of learners in actively mastering the information are very important. The teacher must be quite involved in delivering instruction and using e-learning approaches to enrich, enhance, review, and assess student learning, not to be the major source of instruction. Technology is not to be used in teaching just for the sake of having technology. This chapter focuses on basic categories of instructional resources and not on the approaches in their use. Chapter 13 highlights approaches to implementing e-learning or digital learning in agricultural education.

Presentation Media

Classroom approaches may involve computer-based presentation materials. Two major ways are available for presentation enrichment of classroom learning using computer-based materials: interactive whiteboards and electronic display panels or monitors.

An ***interactive whiteboard*** is a presentation medium that uses a computer connected to a projector to display materials on a white surface that acts as a touch screen. (*Note:* An interactive whiteboard is sometimes referred to as a Smart Board, which is a registered trademark of Smart Technologies.) The components are connected wirelessly or with USB or HDMI cables. A laptop or PC at the teacher's workstation often serves as the source of information. The information may be from a CD/DVD, online sources, or entered by the teacher. A projector displays a computer's video output on the interactive whiteboard. It becomes interactive when special pens or other devices are used to write or draw on the presentation. (See Figure 10.4.)

Projectors for interactive boards are typically mounted to the ceiling. They are positioned to assure the best possible projection without distortion. They are typically connected to the computer with a cable, though some operations may involve wireless technology. It is important to follow the manufacturer's recommended maintenance and care of the projector, particularly in regularly cleaning an air filter, as neglecting this can lead to the untimely demise of the very expensive projector light bulb.

A ***display panel*** is an electronic presentation device connected to a computer, camera, or other equipment for the presentation of visual information. Large tube-type devices have been replaced with liquid crystal display (LCD) flat panel displays. The images may be prepared by the teacher or obtained from a commercial source on a CD/DVD, from an online source, by way of satellite or broadcast television, or from other sources. In some cases, display panels may have audio capabilities. For classroom use, the area of display should be large enough for the most distant students to readily view what is being shown. In larger

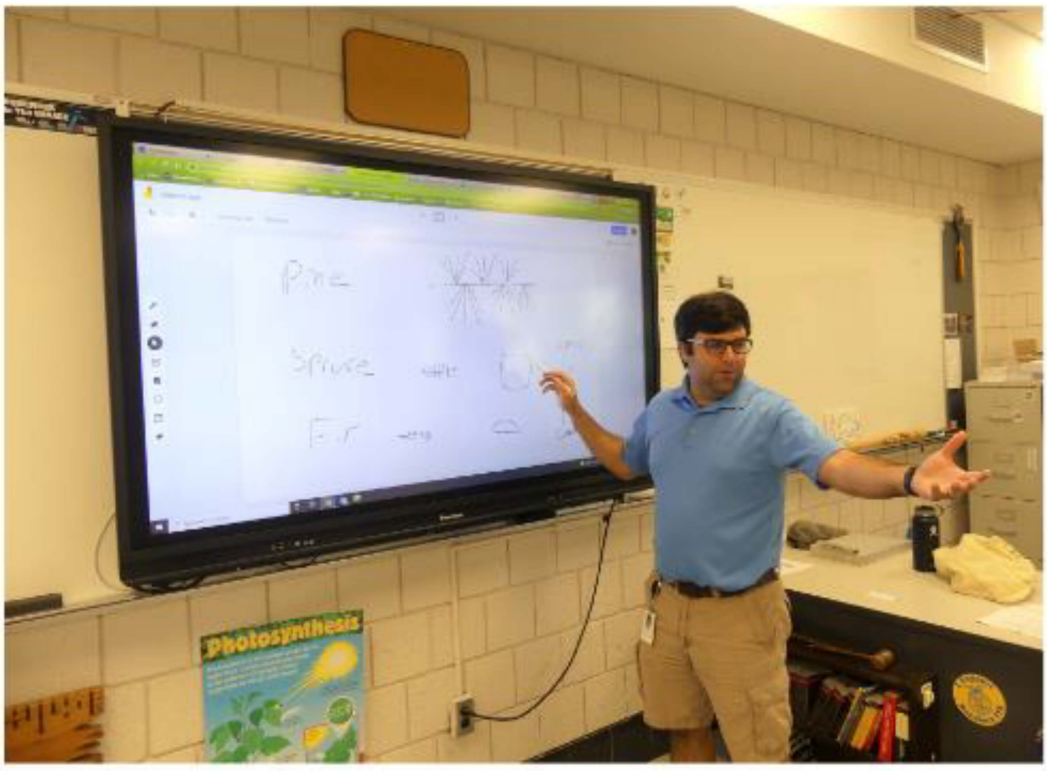

FIGURE 10.4 This interactive whiteboard allows the teacher to draw on the screen as if it were a whiteboard, but it also operates as a large touchscreen that controls the computer to which it is connected.

rooms, display panels may be positioned around the room from the ceiling or wall. Most are rather permanently attached to the wall or ceiling, though some are on carts that make them transportable. With individual or small group use, smaller versions such as personal computer or laptop screens may be adequate.

Arrangements may be established so that teachers have access to smaller screens at their desk or station. Portable devices with wireless connectivity are sometimes used. Information may be recorded or saved for future use.

A teacher station may also include a document camera to present visual information to the group. A ***document camera*** can be positioned to capture live video of the teacher writing on a piece of paper, demonstrating how to perform a skill, or showing where to find information in a textbook. Document cameras can be used for face-to-face instruction to more easily show a large room of students how to perform a skill such as making a corsage and in e-learning environments when teaching online during live or on-demand instruction.

Many laptop computers come equipped with a built-in webcam. A ***webcam*** is a camera that can capture live video and transmit it to the internet in live time. Webcams can also be added externally to perch atop a desktop screen, or they can be stand-alone cameras that sit on a desk. Webcams allow teachers to record videos that show their faces or to participate in online virtual meetings. Imperative to the success of using a webcam are microphones, which capture the sounds of the person speaking on the webcam. These microphones might

FIGURE 10.5 This teacher is demonstrating how to perform CPR on a canine CPR dummy to students learning at a distance through online learning. A document camera positioned to the right of the laptop makes this type of demonstration possible.

be internal to the computer, or can be plugged in externally. Microphones are also sometimes found built into earbuds or headphone devices. It is important to ensure that appropriate software is installed on your computer to ensure the webcam and microphone are properly working.

Various remote devices are available to operate and prepare interactive materials. Some of these are used by the teacher; others are used by students. Wireless pens may be used on whiteboard surfaces or other devices. A common wireless device used in educational settings is an Apple iPad tablet, which can be used to control the image on the projection screen from a distance.

The "heart" of an interactive system is the computer software. The software may be designed for teachers and/or students to prepare and present information. It may be used to prepare visuals and save presentations for future use. This software is typically stored in the computer located in the classroom near the equipment. The software selected must be compatible with the interactive surfaces and other devices that are used. One presentation software program that is often used in education is PowerPoint, a product of Microsoft. This software allows teachers and students to prepare presentations using bulleted summaries of the content and includes various illustrations such as line art and photographic images. Increasingly, many schools are utilizing educational resources from Google, which are freely accessible through cloud-based programs such as the Google Suite. The Google Suite includes Google Docs, Sheets, and Slides, which are analogous to the Microsoft Office Suite programs of Microsoft Word, Excel, and PowerPoint.

Software programs may also make virtualization possible. These often use virtual materials prepared by commercial or government sources. The processes or items depicted are not real but are realistic. Mostly, it is modeling through the use of a computer, such as the virtual tail docking of a pig or construction of a flower arrangement.

Networking of all school rooms may be used to share useful information with all students and teachers. In a school district, all school sites may be networked so multiple schools are involved. School districts often employ IT specialists to establish and operate networks and

FIGURE 10.6 A teacher's workstation in a classroom can often have a variety of electronic presentation media. How many different digital devices can you identify at this teacher's desk?

assist teachers with individual classroom needs. In some cases, a school program in radio or television may allow students to prepare and present information by way of the network.

Learner-Focused Media

Several electronic devices are available for individual e-learning and/or ready access to information. Individuals may purchase these devices or schools may purchase them in bulk and check them out to individual students. Changes frequently occur with these devices as new applications are developed. Several examples are included here.

Desktop computer A ***desktop computer*** is a personal computer with limited portability that is essentially for use in a single location. Schools typically place networked desktops in agricultural education classrooms, though some are stand-alone. They may be connected to a modem for internet access and to a printer for producing copies on paper. Programs may be loaded into each individual computer. In some cases, a central server might be used for several keyboards and screens. Students would be provided access codes for networked desktop computers. Use by students would occur at school and during times made available for computer use. The uses might be for internet research, instructional program use, preparation of presentations, and entering record information. Schools often restrict access on a computer to certain websites and other information.

Laptop A ***laptop*** is a personal computer that is easily transported for mobile use and has the capabilities of a typical desktop computer. A rechargeable battery system is located inside a laptop. Such computers can also be operated by plugging into a 110-volt receptacle, provided an adapter is used. Laptops may be issued to students for use at school or to take home for use. Schools would typically obtain a quantity of laptops so each student has one for their use. An IT specialist would typically be in charge of school-issued laptops. Students can generally view the same information and perform the same operations on a laptop as on a desktop. Internet access may be wireless or by cable depending on how the laptop is configured. School websites and FFA chapter websites may have educational information or present links for accessing educational sites. Laptops can be used in vehicles using battery power or 110-volt plug-in as found in some vehicles. Vehicles with "hot spots" may also allow mobile access to the internet, and most smartphones can be turned into a wireless hot spot as well.

The ***netbook*** is a category of small and inexpensive laptop computer that has found some favor for educational purposes. Netbooks are often purchased by schools and issued to students. A popular device increasingly used by schools is a ***Chromebook***. These devices operate much like a netbook but do not have the ability to install Microsoft Office products, as the Chromebook utilizes Google's Chrome operating system. Since Chromebooks rely on the Google Suite of programs for browsing the internet, word processing tasks, and preparing presentations, they depend on a strong connection to the internet for maximum functionality.

Smartphone A ***smartphone*** is a mobile telephone with a computing platform that allows features such as internet and email capability far beyond telephone conversations. Smartphones allow the downloading of apps (software for specific purposes) that make it possible to access agricultural or other information that is not otherwise available on a mobile basis. Agriculture apps allow individuals on farms—in pastures and fields—to access information for a specific use. For example, the USDA has the app known as SoilWeb, which is a GPS-based program that provides soil survey information. Another app is the PictureThis plant identifier, which aids in the identification of plants as well as diagnosis and treatment of plant diseases. A QR (quick response) code reader app may be installed on a device for scanning QR codes to gain near-instant connectivity to a site or source of information. Many smartphones now have QR reader capabilities built into their camera and do not need to download an additional app. Smartphones are often the only source of internet for students in rural and urban areas who do not have access to high-speed internet.

Tablet computer Best known as the iPad by Apple, Inc., tablet computers have made major advances in use and popularity. A ***tablet computer*** is a device that has features of a small computer and of a smartphone. The operation platform is similar to that of a smartphone. Apps can be added to achieve specific goals. Some schools are issuing iPads to students for access to online information, including textbooks and other e-learning materials. The devices are small, lightweight, resilient, and yet have an adequate-sized screen. Email and web work can be done with an iPad in a location with wireless internet access. Mini iPads are also used with connectivity to Wi-Fi or cellular sources for sharing information.

E-book reader Also referred to as an e-reader, an ***e-book reader*** is a mobile electronic device designed for reading digital e-books and periodicals. E-book readers are similar to tablet computers. The Amazon Kindle is the most popular e-book reader. Others include the Nook by Barnes and Noble and the Kobo Clara HD.

School Software

The two kinds of software, according to Lever-Duffy and McDonald (2011), most widely found in schools are administrative software and academic software. Administrative software may be referred to as school management software.

School management software is a computer-based program used in schools to achieve a wide range of functions related to delivering education, recording data, and reporting information. Such software is typically networked throughout a school system, with limited access by authorized individuals. Access is granted to various sites in the system to teachers, students, parents, and others using access codes and passwords restricting what can be seen and done. The system may include administrative functions of the school, student enrollment and class scheduling, posting announcements and homework, and recording and reporting the performance of students. For example, teachers may report student attendance, grades, and other information via online software management. Some systems have built-in parental notifications if students are absent, fail to achieve a minimum performance level on a test, or do not turn in homework.

An example is PowerSchool, which has web-based school management software programs. In addition to school and education management, PowerSchool also has reporting features for parents and students. Alerts can be quickly communicated to all school personnel, parents, and students through posting and calling systems. Access codes restrict use to authorized individuals. A feature gaining attention is that of an app for mobile devices such as iPhones, iPads, and similar devices. In addition to PowerSchool, examples of other systems are RenWeb, Rediker Software, and QuickSchools.

School management software is used in one way or another in almost all school districts. Links within school systems may direct students to e-learning sites, and in some cases, the electronic gradebook is embedded within a learning management system. Some school systems are linked to regional and state education agencies. FFA record systems are typically separate from school management.

Academic software is software that is useful to teachers and learners in the teaching and learning processes. This software is used to enrich the education environment. Examples of uses of academic software, according to Lever-Duffy and McDonald (2011), include desktop publishing, graphics, reference, tutorials and drill-and-practice, educational games, and simulations. Agricultural educators have some software applications with unique roles for agricultural education, such as supervised experience record keeping and curriculum planning.

In the use of online e-learning materials, all educators should be aware of the provisions of the Children's Online Privacy Protection Act of 1998 (COPPA). In short, this act is administered through the Federal Trade Commission (FTC) and prohibits the online gathering of information of children under the age of 13 unless parental consent has been provided. This would particularly apply to some middle school agricultural education programs. Many school systems have local policies and procedures that also apply.

SELECTING AND OBTAINING INSTRUCTIONAL RESOURCES

Choosing the instructional materials to use in teaching is an important decision. Recent agricultural education research revealed teachers do not rely on a single source of instructional materials and instead tend to select resources that meet their specific program needs (Easterly & Simpson, 2020). The content of materials should be closely correlated to the state or local curriculum requirements. These should carefully follow end-of-course or other testing programs

used in local schools and may be mandated by the state education agency. It would be unwise to use materials that do not cover content in the tests that are administered. The materials must be appropriate for the levels of the learners and up-to-date in content. Teaching out-of-date information is a serious compromise of student time and other resources.

Instructional materials adoption is the process used by school districts and state education agencies in selecting materials and allocating resources. Local school boards or school administrators often establish procedures to be followed. Some states (particularly those that provide funds for purchasing textbooks) have statewide adoptions carried out under the direction of their state boards of education. A key part of the process at all levels is to obtain the input of laypeople. The laypeople are stakeholders in the schools and may be parents, business leaders, and others who are not educators. A selection committee or advisory group is often involved. Public hearings may be held for community members to provide input.

Selection Criteria

Teachers make thousands of decisions each day during in-the-moment instruction, and during their instructional planning time. There are a myriad of factors that influence these instructional decisions. Bugler et al. (2017) interviewed teachers to identify how they obtained, evaluated, and selected instructional materials to be used in their classrooms. Figure 10.7 illustrates their findings.

Selecting instructional materials is an important decision. School funds are limited, and teachers want to get the best possible materials. The same criteria are typically applied in the

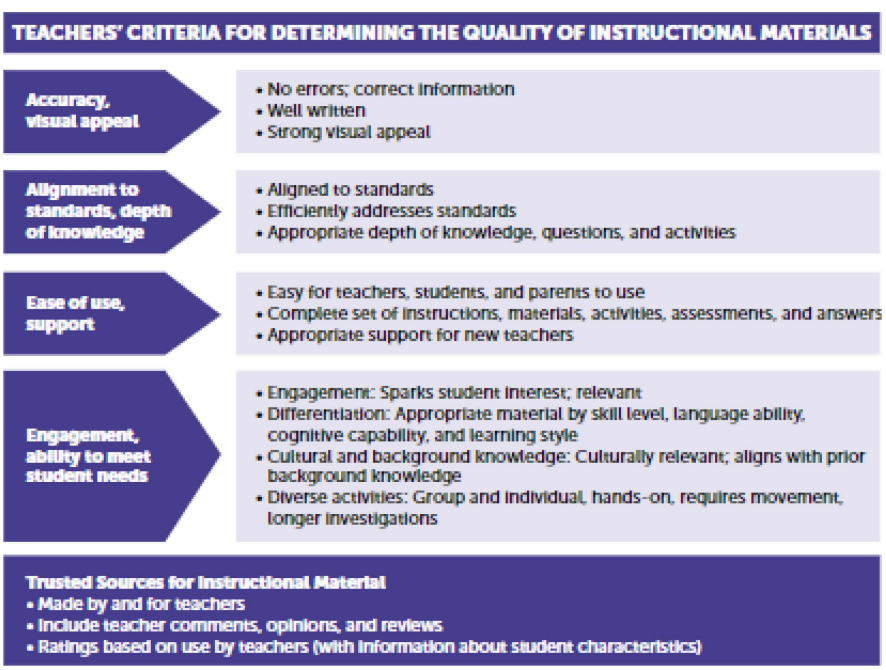

FIGURE 10.7 Teachers' criteria for determining the quality of instructional materials. (FROM *HOW TEACHERS JUDGE THE QUALITY OF INSTRUCTIONAL MATERIALS* BY DAN BUGLER, STACY MARPLE, ELIZABETH BURR, MIN CHEN-GADDINI, AND NEAL FINKELSTEIN. REPRODUCED WITH PERMISSION FROM WESTED. RETRIEVED FROM HTTPS://WWW.WESTED.ORG/RESOURCES/SELECTING-INSTRUCTIONAL-MATERIALS-BRIEF-1-QUALITY.)

selection of computer-based and e-learning materials as to those that are printed on paper. Here are some questions to ask in the selection process:

- Is the material correlated with the objectives and end-of-course test for a course? (In other words, does the material contribute to the achievement of state-specified objectives and good performance by students on end-of-course tests?)
- Is the content coverage in sufficient detail?
- Is the content technically accurate?
- Is the content current (up-to-date)?
- Is the content sequenced properly?
- Is the content written on an appropriate level?
- Is the material appealing to students?
- Is the material appropriately illustrated with photographic images and line art?
- Is the material durably constructed/prepared?
- Has the material been field tested and reviewed as part of development?
- Are ancillaries available to support use of the material?
- Is the material priced within range for the funds available?
- Is the material appropriate to the values of community citizens?

Specific criteria may be used in evaluating textbooks, activity manuals, and other materials. (See Figure 10.8 for a sample textbook evaluation form.) It is important to be aware of local school district and state procedures on materials acquisition.

Types of Instructional Resources

Several different types of instructional resources are available to teachers including paid and free access. No matter what type of material teachers decide to use when planning instruction, they should be sure it helps students accomplish the learning objectives. Be sure to reflect upon the indicators of high-quality instructional materials outlined earlier in this chapter. Ideally, teachers should select materials that help them conduct a student-centered activity-based lesson that engages students' curiosity and motivation.

Information-Based Resources

Information-based resources are materials that communicate content knowledge such as a textbook, Extension document, or peer-reviewed journal articles. Teachers can curate intentional selection of information-based resources to provide students as part of their exploration on a subject instead of providing lecture notes, or these resources could be used to create accurate class notes. Teachers should be sure to curate information-based materials from reliable sources so that content is up-to-date and accurate.

File-Sharing Resources

Teachers frequently share materials that they created through various platforms. Platforms that provide a space for teachers to share educational materials are file-sharing resources. Examples of file-sharing resources include NAAE Communities of Practice and a popular Facebook group called Ag Education Discussion Lab. While file-sharing resources can be a great source of mentoring and quick information, not all content shared on these platforms is automatically high quality. Teachers should use their judgment when determining if the materials obtained from file-sharing sites are accurate and appropriate for use in their classrooms to meet the needs of their diverse students.

Agricultural Education
TEXTBOOK EVALUATION FORM

Title of book: _____ Edition: _____

Date published: _____ Class quantity cost (per copy): _____

Name and address of publisher/source: _____

_____

Instructions: Rate the following items as acceptable (YES) or unacceptable (NO) as they relate to the textbook. Place an x in the column that represents your evaluation.

The textbook	YES	NO
1. Is written at the appropriate level	_____	_____
2. Has a durable binding	_____	_____
3. Is technically accurate	_____	_____
4. Is technically up to date	_____	_____
5. Has modern photographs	_____	_____
6. Has helpful and good-quality line drawings	_____	_____
7. Has a companion teacher's manual	_____	_____
8. Has a student-friendly layout	_____	_____
9. Facilitates systematic instruction	_____	_____
10. Has useful questions at the end of each chapter	_____	_____
11. Suggests activities to apply the content	_____	_____
12. Equitably treats all individuals	_____	_____
13. Emphasizes safety and ethics	_____	_____
Overall, the book would be useful in my program	_____	_____

Comments: _____

_____

_____

Signature of reviewer: _____ Date: _____

FIGURE 10.8 Sample form to use in evaluating textbooks.

Lesson Plans Provided by Organizations

Many nonprofit organizations feature education and outreach as a component of their mission. Consequently, some organizations may provide free educational materials for teachers as long as they register to have an account with their page. At times, some materials will be made available for free, while other components are available for purchase. Examples of organizations that provide lesson plans include the National FFA Organization, National

4-H, Agriculture in the Classroom, and the National Good Agricultural Practices Program at Cornell University. Depending on the source, teachers may have to evaluate whether the materials are appropriate for their students and their needs.

Fee-Based Instructional Materials

Some companies or organizations seek to generate income from the development and sale of instructional materials. Fee-based instructional materials may be available for a one-time fee or a subscription-based program in which the teacher is either charged by the number of students utilizing a program, or a time frame of use. Common fee-based instructional material services that provide agricultural education curriculum materials include CASE, MyCAERT, One Less Thing, iCEV, and AgEdNet. While these resources are usually of high quality and often integrate easily into online learning platforms, they can be expensive.

Web-Based Inquiry Resources

Finally, teachers might choose to use web-based inquiry resources that serve as tools to virtually simulate various natural phenomena. Many web-based inquiry resources are primarily focused on science concepts and skills instead of production agriculture. Examples of web-based inquiry resources include Labster, the National Science Digital Library, and ExploreLearning Gizmos.

Obtaining Materials

Always follow the procedures of a local school in obtaining materials. The school principal, director, or department chair can provide information on how the process works. Some schools may have textbook coordinators that stay current with the situation on adoptions and bidding processes.

School systems vary, but many solicit instructional materials in the spring for use the following year. The requests are obtained from all teachers and compiled into a master list. Administrators and others review the list and set priorities on what is to be obtained. Once purchasing decisions have been made, the recommendations may be taken to the local school board for approval before a purchase order is issued. Depending on the budgetary year, purchases are often made in early July with funds budgeted for the next school year.

In some states, state funding is available for instructional materials in local schools only if materials on state-adopted lists are selected. Such lists may include textbooks, CD-based materials, web-based materials, and other kinds of instructional materials. A state list may have two or more alternatives for a particular course or subject. State adoptions often occur on a cycle of five years or so. Local school districts appoint local adoption committees. Local districts that buy materials not on the state-adopted list must usually use local school funds for these purchases.

In any school, developing a strong justification for instructional materials is often needed. It is a teacher's responsibility to provide a rationale for obtaining new materials. Developing support from advisory committee members is usually helpful. As mentioned earlier, it is always wise to have a list of needed instructional materials available just in case you are informed at the last minute that some funds are available. It is the teacher's responsibility to be aggressive in obtaining quality, up-to-date instructional materials for agricultural education.

While it is the teacher's responsibility to procure quality instructional materials for their students, they should avoid making a habit of purchasing these supplies using their personal funds. The school budget should support the acquisition of supplies and not rely on individual teachers to regularly purchase expensive supplies.

MANAGING INSTRUCTIONAL RESOURCES

Instructional materials need to be managed so that they are readily available and are protected from unnecessary wear and tear. The appearance of an agricultural education office, classroom, or laboratory can be greatly influenced by how materials are filed. Piles of worn books, stacks of out-of-date brochures, broken computer equipment, damaged CDs and DVDs, and dilapidated racks of magazines detract from appearance and lower the overall perception of agricultural education facilities by students and others. Keep facilities neat, clean, and well organized!

Books

If a textbook is used as the basis of the planned curriculum, greatest learning efficiency occurs when there is a textbook for every student and every student has a textbook checked out. The textbook may be taken home or to a study area as well as used in the classroom. Having students use textbooks as an integral part of learning has a major upward impact on student achievement scores. In the case of online textbooks, students may be provided access codes for use at home.

When not in use or checked out to students, textbooks and other books used by students can be organized on bookshelves in the classroom or storage room. Stored books should be arranged by title, and all turned the same way. The place where books are stored should be dry and away from direct sunlight.

Reference books used by students may be kept on bookshelves in the classroom area. Students should be instructed to return each book to its proper location after use. Reference books used by the teacher may be kept in the agricultural education office or on the teacher's desk at the front of the classroom.

Brochures and Magazines

Brochures and magazines related to the instruction should be displayed in the classroom. Extension Service bulletins, as well as handbooks on agricultural chemicals, plant and/or animal diseases, and related topics, may also be included. These are often in racks or on shelves that allow students to easily see titles or subjects and return the items after use. Brochures and magazines for teacher reference can be kept in the agricultural education office.

Brochures and magazines should be periodically checked for damage and age. Tattered materials should be discarded, and new ones obtained. Out-of-date materials should also be discarded. Older materials may promote the use of practices that are no longer permissible, such as the common use of methyl bromide as a soil fumigant. Magazines older than one year should be discarded unless there is a very special reason to retain them. Out-of-date magazines might be saved for future learning activities such as making a collage, or for use as reference material.

School libraries or media centers can often support the agricultural education program by obtaining brochures and magazines. Libraries and media centers have facilities for organizing such materials and making them available to students. The agriculture teacher can work with the librarian or media center director to see that appropriate materials are obtained and made available.

Electronic Media

While much of media storage is being moved to the cloud and other digital repositories, some programs still use CDs, DVDs, and in some cases, videotapes. ***Cloud storage*** is a network of online storage where data is stored in virtualized pools by third parties. It can be helpful to have copies of CDs, DVDs, and videotapes to use when the school internet may not be working.

All electronic materials used in an agricultural education program should be carefully and securely stored to provide protection, prevent loss, and facilitate locating them when needed.

Organizer cabinets or shelves can be obtained for CDs and DVDs. Videotapes, though not widely used any more, can be stored on regular shelving. Turn all materials so the titles are easily seen. Materials may be organized by subject in alphabetical sequence or by the class in which they are used. To assure security, such materials are often kept in the agricultural education office or stored in an instructional materials room. Conditions of storage should protect the materials from damage. Such materials may be in locked storage cabinets or rooms to assure protection from theft and vandalism.

Records

An agricultural educator has several roles related to records. In some cases, records are kept in the central office of the school, and the teacher must provide the information that is to be recorded. In other cases, the teacher enters the information in a networked computer information system. Some information is recorded on a daily basis, such as class attendance. Other information is recorded on a weekly, semester, or annual basis.

Records of FFA participation and supervised experience activities are often kept in the agricultural education office or classroom. Students may have access to their records and regularly record information to keep them up-to-date. Good records are essential for the teacher in preparing state reports on the program. They are important for individual students in working toward FFA advancements. Students may save SAE records on a USB flash drive (thumb drive) for transportability and reduce information on the hard drive of a computer. (It is wise to keep backup files in case a USB flash drive is misplaced.)

Increasingly, schools are using online forms of electronic record keeping for SAE and FFA engagement. The Agricultural Experience Tracker (AET) is an example of an online record keeping system that allows students to access their records anywhere that they have an internet connection, including through an app on their smartphone. Some states have state-specific record keeping software for SAEs. Be sure to check with your state affiliate of the National Association of Agricultural Educators to find out what type of record keeping system is the expectation in your state.

Some records should be retained indefinitely in an agricultural education department. Records of FFA membership may need to be retained for at least 10 years but may be kept longer depending on school procedures. In all cases, records must be accurate and protected from tampering. Inaccurate records result in later problems and in decision making based on false information.

Agriculture teachers need to be aware of FERPA guidelines in dealing with student records. FERPA is an abbreviation of the Family Educational Rights and Privacy Act, or Buckley Amendment. The federal act protects the privacy of student education records. FERPA gives parents certain rights until the student reaches the age of 18 or attends a school beyond the high school level. The law provides that parents may inspect records, ask that errors be corrected, and sign a written release for any information to be disclosed. In some instances, uses of student records are exempt from FERPA regulations, such as when a student transfers to another school or the school prepares a directory. FERPA applies to all schools that receive funds through the U.S. Department of Education.

Laboratory Materials

Laboratory materials must be managed properly to assure safety and security and to prevent unauthorized use and damage. How materials are stored and organized varies with the kinds of tools, instruments, equipment, or supplies. (*Note:* Chapters 9 and 21 provide additional information related to tools and equipment in laboratory settings.)

Tools and instruments are typically stored in a locking cabinet or tool room that is opened and made available to students as needed. Each item should have a specific place in a cabinet or on a wall panel or shelf. The name of the item or a drawing may be used to identify the location.

Equipment is managed to assure a long, useful life. Covers may be put on some types of equipment, such as microscopes, when they are not in use. Other equipment may be locked in cabinets, with voltage meters and DO (dissolved oxygen) meters being examples. Larger equipment, such as welding machines and table saws, may be stationary on a counter or lab facility floor. Management also includes being sure that the equipment is cleaned after use, protected from damage, and kept in a safe operating condition. All safety guards, goggles, and other personal protective equipment (PPE) must be in good condition and accessible before some laboratory learning activities.

Supplies are stored based on the nature of the material. Gasoline, for example, must be stored in approved containers and in locations away from open flames or sources of ignition. Chemicals may be kept locked in cabinets or closets to prevent unauthorized access. Other materials may need only to be protected from the weather, such as some potting media that should be protected from rain. Living forms, such as seeds, should be stored to assure viability.

REVIEWING SUMMARY

Many kinds of instructional resources (materials used in teaching) are used in agricultural education. Student achievement is promoted by having a resource-rich learning environment. It is the teacher's responsibility to have appropriate materials available for efficient teaching and learning. Further, these materials should support the achievement of learning standards established for the agricultural education program and promote student performance on assessments.

Instructional resources include both published and nonpublished materials. Each type is obtained to promote the achievement of the goals of the instructional program. Some materials are designed for student use; other materials are for teacher use.

Instructional materials are published kinds of instructional resources. These include textbooks, activity manuals, teachers' manuals, references, and similar materials in paper or electronic formats. Materials that provide the base or foundation are known as basal materials. A textbook is an example. Materials that accompany and enrich basal materials are known as ancillary materials. An activity manual is an example.

Nonpublished instructional resources are used to add hands-on learning opportunities for students. A wide range of instruments, tools, equipment, and supplies are needed. Instruments, tools, and equipment are lasting and can be used over and over. Supplies tend to be consumable and include such things as seeds, flowers, animal feed, paint, lumber, nails, and welding rods. These are obtained to implement instruction as specified in the curriculum guide provided by the state or local school district.

E-learning is the use of computer technology to promote teaching and learning. In most cases, it should supplement and enhance instruction provided by the teacher—not replace the teacher. Presentation media include the interactive whiteboard with associated computer and projector or a display panel or set of panels, depending on room size. Individual learner-focused media may be used with desktops, laptops, smartphones, and tablet computers.

Materials are selected after the courses and the curriculum have been identified. The materials should help implement the curriculum and help achieve the instructional objectives. All materials should have appropriate content and be up-to-date, technically accurate, sequenced properly, written at the appropriate level, and appealing to students. Illustrations,

durable construction, evidence of field testing, and availability of ancillaries are also factors in selection.

Once materials are obtained, the teacher is responsible for managing them. This includes organizing and storing them, protecting them from damage or loss, and issuing them to students. It also includes obtaining, organizing, maintaining, and promoting use by students of the appropriate personal protective equipment (PPE).

QUESTIONS FOR REVIEW AND DISCUSSION

1. What are instructional resources?
2. Distinguish between consumable and nonconsumable instructional materials.
3. Discuss the responsibility of a teacher in obtaining instructional resources.
4. What is instructional material? Give three examples.
5. Distinguish between instruments, tools, and equipment used in agricultural education.
6. What is a supply? How do supplies vary with the instructional program?
7. What is student-use material? Name and briefly explain four examples.
8. What is teacher-use material? Name and briefly explain four examples.
9. Distinguish between paper-based and electronic-based instructional material.
10. What is e-learning? How is it used in agricultural education classes?
11. What presentation media may be used in e-learning?
12. What questions should be answered in selecting instructional materials?
13. What practices may be used in obtaining instructional materials?
14. Discuss the educational benefits of issuing textbooks to students.
15. What practices should be followed in managing instructional materials?

ACTIVITIES

1. Investigate the instructional materials selection and purchasing procedures in a local school. Interview an administrator, the chair of the materials adoption committee, or a teacher. Determine the practices in adopting materials, the use of citizen input, the schedule followed, and other details relating to agricultural education. Prepare a written report on your findings.
2. Assess the sources of instructional materials for agricultural education. Visit the websites of at least three sources and determine the kinds of materials available, the costs, and other details. Following are a few sample websites:

   AgEdNet—https://www.agednet.com/
   Ag Educational Solutions—https://ageducationalsolutions.com/
   Curriculum, Content and Assessments for CTE—www.mycaert.com
   CEV Educational Multimedia—https://www.icevonline.com/
   ITCS Instructional Materials—www.aces.uiuc.edu/IM
   Lab Aids Lab Kits—https://lab-aids.com/
   NASCO Education Supplies—https://www.enasco.com/c/Education-Supplies
   NASCO Farm and Ranch—https://www.enasco.com/c/Farm-Ranch
   National FFA Organization—www.ffa.org
   Pearson (career and technical–agriscience)—www.pearson.com
   Cengage Learning—https://www.cengage.com/
   Curriculum for Agricultural Science Education—www.case4learning.org
   One Less Thing—https://www.onelessthing.net/

3. Select a secondary agriculture textbook (basal material) of your choosing. Any title or subject will be fine. Assess the book. Apply criteria stated in this chapter. Write a one- or two-paragraph assessment of the merits of the book for use in a high school class on a subject in line with that of the book.
4. Assume you have just taken an agriculture teaching position at a school that has not previously had an agriculture program. Your administrator has indicated funds are available to purchase materials. What would you request? Choose a typical class (such as introduction to agriscience, livestock, or horticulture) and develop a specific list for a class of 20 students. Prepare details such as a list of bid specifications. Include estimated total cost, not to exceed $3,000.
5. Investigate the possible impact of the Children's Online Privacy Protection Act of 1998 on students in agricultural education. Prepare a brief report on your findings. The act can be accessed at www.ftc.gov/ogc/coppa1.htm
6. Develop a list of instructional materials needed to teach a unit of your choice. Identify the vendor, price per unit, estimated quantity needed, estimated shipping, and estimated total cost.

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11

The Psychology of Learning

Mr. Franklin Kowalski teaches Agriculture to students in 7th through 12th grades. He has noticed students in the same grade are at different maturity and cognitive levels and wonders why. He wonders why he can teach the same the lesson he did last year, the same way, but where last year's group fully understood the material and wanted to go deeper into the subject, this year's class struggles with the basics.

Mr. Kowalski remembers the learning theories he studied in college. Fortunately, he can recall the important areas that will help him improve on student learning. In recalling the learning theories, he asked himself three questions:

1. How do students learn?
2. Do students have different ways of learning?
3. Why are some students "naturally" motivated to learn?

He is looking back in his college notes and books to brush up his answers. He is beginning with his *Foundations of Agricultural Education* book.

TERMS

affective
behavioral learning theory
brain-based learning theory
cognitive
cognitive learning theory
constructivism
hierarchy of human needs
learning
learning style
mindset
motivation
operant conditioning
Premack principle
psychomotor
schema
self-efficacy
theory of multiple intelligences

OBJECTIVES

This chapter addresses the National Quality Program Standards for Agriculture, Food, and Natural Resources Education (National Council for Agricultural Education, 2016), specifically Standard 6: Certified Agriculture Teachers and Professional Growth. It has the following objectives:

1. Explain the meaning of learning.
2. List and describe appropriate learning theories.
3. Relate the role of learning theories to instruction in agricultural education.
4. Identify student learning styles.
5. Discuss student motivation and strategies for motivating students to learn.

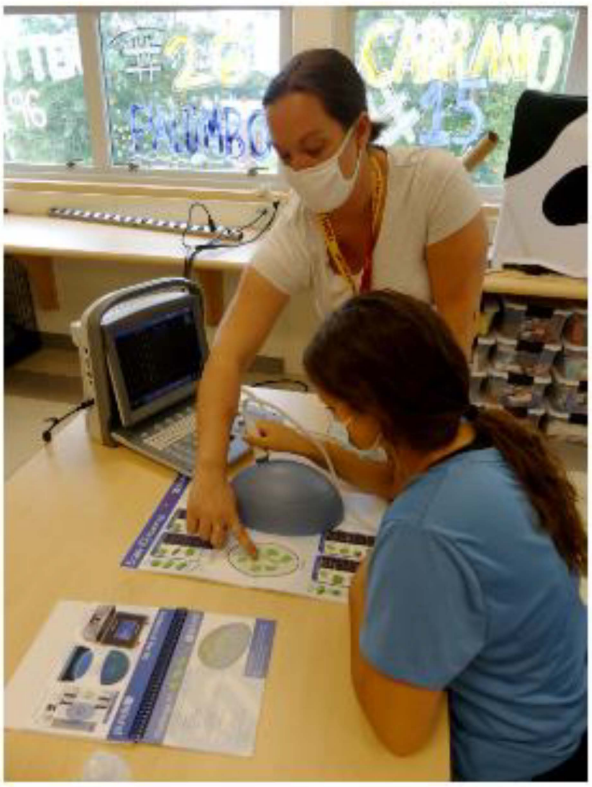

FIGURE 11.1 Understanding how people learn helps teachers be more effective.

WHAT IS LEARNING?

Learning is a permanent change in behavior as the result of an experience. The change can be in thinking, actions, and problem-solving. Learning results in people viewing situations differently in the future. They adapt their behavior based on what they have learned and the demands of their new environment (Martin & Torok-Gerard, 2019).

Behavior is more than a physical, outward activity. It is broadly defined and includes the ***cognitive*** (knowledge or "stored" information), ***affective*** (attitude), and ***psychomotor*** (manipulative skill) domains. Learning must also be the result of experience. So, although students change as they age, such as growing in height and weight, this is not learning.

Learning is not limited to school-based experiences. Students learn from their environment, parents, peers, and numerous other sources. Agricultural education, through supervised agricultural experience and FFA, is designed to expand school-based learning beyond the classroom and laboratory. Through this structure, agricultural education places learning within real-world social settings.

MAJOR LEARNING THEORIES

In the 20th century, two dominant types of theories were held of how people learn: behavioral learning theories and cognitive learning theories. These theories continue to impact education in the 21st century.

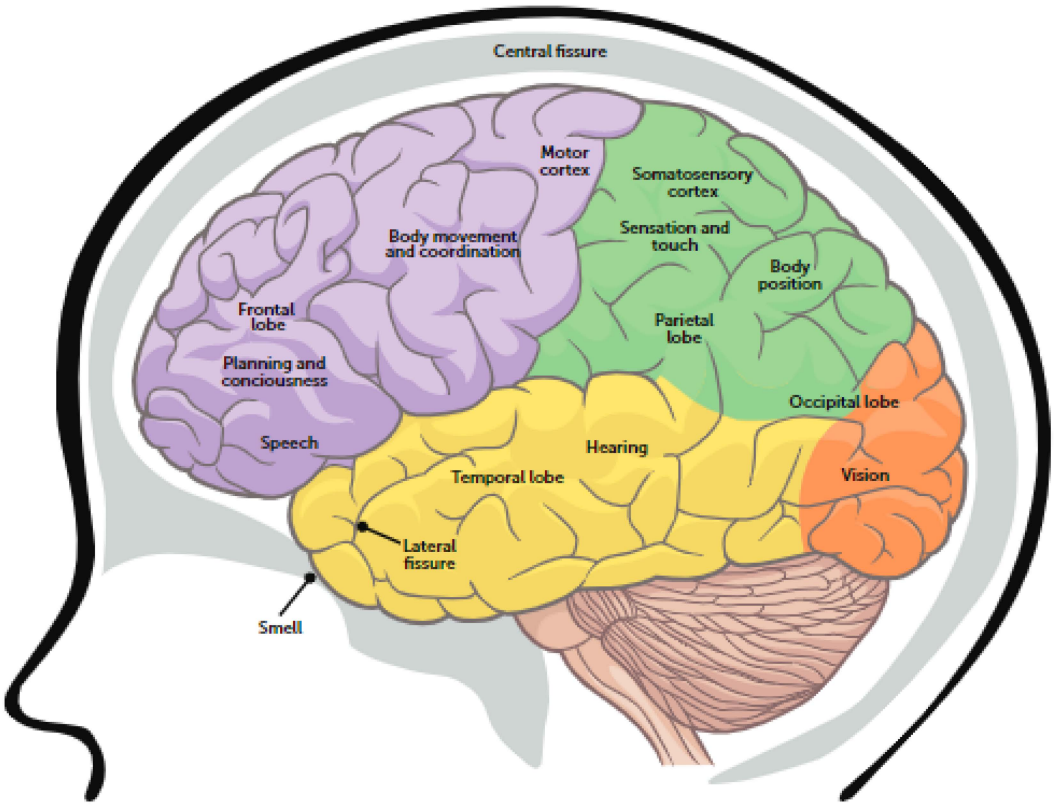

FIGURE 11.2 The brain is the most important learning tool.

A ***behavioral learning theory*** is a theory of learning that focuses on observable changes in outward behavior and on the impact of external stimuli to effect change. From this type of theory, we get student learning objectives, as discussed in Chapter 12.

A ***cognitive learning theory*** is a theory of learning that focuses on the internal mental processes, how they change, and how they affect external behavior changes.

Behavioral Learning Theories

An influential behavioral theory explaining how students learn is operant conditioning, based on the work of Edward Thorndike and B. F. Skinner (Parsons et al., 2019). This theory expands on two earlier behavioral principles: contiguity and classical conditioning.

Contiguity states that if two things, a stimulus and a response, are paired together often enough, the learner will make an association between them. This occurs in the classroom with drill-and-practice activities. A student who pairs a picture of a steer "red with white face and no horns" with the beef breed "polled Hereford" is following the principle of contiguity.

Classical conditioning is best known by the work of Pavlov and his experiments with dogs salivating. Dogs naturally salivate when food is placed in front of them. However, Pavlov found dogs could associate other things, such as a sound, with getting food. Eventually, the dogs would salivate upon hearing the sound although no food was present. Classical conditioning occurs regularly in the classroom. A student who becomes nervous or anxious when a test is given is an example. Teachers who have open, inviting classrooms are using classical

FIGURE 11.3 Classical conditioning explains how external stimuli can trigger involuntary responses.

conditioning by making students feel safe and accepted and associating that with learning. In classical conditioning, the behavior is involuntary and typically emotional or physiological. The stimulus is first, followed by the behavior.

In ***operant conditioning***, the student has control of the behavior. The stimulus is a consequence of the behavior. In the classroom, a teacher who praises correct student answers to questions is using operant conditioning. The consequence (praise) follows the behavior (correct response), leading to greater classroom participation. Teachers use reinforcement to increase or strengthen behaviors and punishment to decrease or weaken behaviors.

An important principle regarding reinforcement is called the ***Premack principle***. This states that a preferred activity can be used as a reinforcer for a less preferred activity (Santrock, 2008). The Premack principle works by placing the less preferred activity before the preferred activity. Agricultural education examples abound. Mr. Jones's animal science class dislikes calculating feed rations and mixtures for the aquaculture tanks but enjoys testing and analyzing the water and recording the results. Mr. Jones is using the Premack principle when he says to the class, "Let's do a good job of accurately calculating feed mixtures during the first part of the class period, then we'll conduct water-quality tests in the aquaculture laboratory."

Cognitive Learning Theories

Cognitive learning theories look at how people process information, organize information, and construct knowledge. In the cognitive view, students are active learners who seek information and are constantly reorganizing new and old information. Associated with cognitive learning theories is the information processing model, which focuses on how people gather, code, and store information in their memory and subsequently retrieve it (Martin & Torok-Gerard, 2019). The information processing model compares human information processing to the computer and how it works. Teachers use cognitive learning theories when they direct student attention, enhance student perception, and provide students with rehearsal

tools. Teachers who use frequent examples, clear objectives and directions, and varied interest approaches are assisting students in cognitive learning. Organizational tools such as notes and learning webs are other examples of this theory in practice.

Bandura's social cognitive theory (1986) added social factors to learning theories. Bandura's theory recognizes behavior, person/cognitive, and environment factors all play a reciprocal part in learning (Santrock, 2008). Teaching through Career Development Events (CDE) can use social cognitive theory. The agriculture teacher establishes an environment of modeling, guided practice, and peer teaching. Students develop cognitive strategies allowing them to problem solve the CDE, which improves performance. Mock events develop behavior that is culminated at the CDE competition. The person/cognitive factor most recently emphasized is self-efficacy. ***Self-efficacy*** is the belief that one can accomplish something and have a positive outcome (Bandura, 1997). Self-efficacy influences behavior, so increasing student self-efficacy should lead to positive behavior and more effective learning.

Constructivism is a set of learning theories that emphasize how students actively make sense of the information they receive (Parsons et al., 2019; Woolfolk, 1998). One view of constructivism is concerned with how students use internal schemas to represent accurately the outside world. A ***schema*** is an abstract guide used to organize an experience or concept. A second view of constructivism focuses less on the accurate representation of the outside world and more on how old knowledge and new knowledge are transformed to be useful to the individual. A third view of constructivism states knowledge reflects the outside world but is filtered and influenced by culture, language, teachers, and other factors.

Agriculture teachers use constructivism when they follow a "learning by doing" approach. They are encouraging their students to make sense of the outside world through actively engaging in their environment. An example is the agriculture teacher who teaches parliamentary procedure by organizing the class as a mini-FFA chapter with activities and with decisions to be made. Some students may construct the parliamentary procedure knowledge around a schema of "This is how my youth group could operate." Other students may construct a schema of "This is what it means to be an FFA member or officer."

Brain-Based Learning

The ***brain-based learning theory***, developed by Caine and Caine (n.d., 1991, 1994, 1997), resulted from a synthesis of theories and literature regarding the brain from multiple disciplines, including biology and psychology. From this synthesis, Caine and Caine developed 12 principles of brain/mind learning. These are listed in Box 11.1, and a brief description of each follows.

Principle 1 states the brain and body both are involved in learning. Teachers using this principle will engage students in activities that require them to use their senses and bodies. Principle 2 states that learning has social aspects and is influenced by social interactions. FFA, with its student, chapter, and community activities, provides multiple opportunities to combine learning with social interactions and relationships. Principles 3, 4, and 5 are concerned with how learners acquire and store information. Learners need to make sense of their environment and experiences (Principle 3). They do this by organizing information into unique mental schemas (Principle 4). Emotions and mindsets are a part of learning and are critical in establishing mental patterns or linkages (Principle 5).

Principle 6 states our brains perceive information both in parts and in its wholeness at the same time. In addition to facts and information, agriculture teachers should organize instruction so real-world examples and stories are also included. Principle 7 states although the brain perceives what it is focused upon, it also perceives information that is outside of

BOX 11.1 ***The 12 Mind/Brain Learning Principles***

1. Learning engages the physiology.
2. The brain/mind is social.
3. The search for meaning is innate.
4. The search for meaning occurs through patterning.
5. Emotions are critical to patterning.
6. The mind/brain processes parts and wholes simultaneously.
7. Learning involves both focused attention and peripheral perception.
8. Learning always involves conscious and unconscious processes.
9. We have at least two ways or organizing memory: a spatial memory system and a set of systems for rote learning.
10. Learning is developmental.
11. Complex learning is enhanced by challenge and inhibited by threat.
12. Each brain is uniquely organized.

Adapted from Caine & Caine (n.d.).

this focus. Teachers use this principle when they place posters and pictures on the classroom walls. Principle 8 states although learning involves conscious activity, much learning occurs afterward in unconscious processes. Therefore, learning is facilitated when time is provided for reflection. Kolb's experiential learning theory (1984), used in 4-H and agricultural education, emphasizes the need for reflection within the learning process. Principle 9 states we organize in two different categories of memories. One, rote memorization, is most useful for isolated information. The other, dynamic, is engaged best through experiences and infotainment.

Principle 10 states the brain develops in a predetermined way during childhood yet never loses its capacity for learning. Educators who espouse a lifelong learning approach are following this principle. Principle 11 states the best learning environment is one that appropriately challenges learners. Caine and Caine used the term "downshifting" to describe what happens to students who are threatened in the learning environment. Students who downshift feel helpless and fatigued and then give up. Principle 12 states every student is unique. In structuring the learning environment, the teacher must recognize different learning styles, multiple intelligences, and student diversity in its broadest definition. Chapter 12 explains the teaching processes involved in meeting the unique needs of all students.

ROLE OF LEARNING THEORIES IN AGRICULTURAL EDUCATION

Agricultural educators use learning theories to organize and structure subject matter, to motivate students, and to determine what teaching methods to use. The ultimate goal is to provide the optimal learning environment for students of agricultural education. Learning theories help explain why supervised experience and FFA are critical components of the total agricultural education program.

As discussed in Chapters 2 and 3, agricultural education over the years has fluctuated between a vocational focus and a science/business focus. Another way of characterizing this is between instructing students in agriculture for future careers and instructing students about

agriculture for agricultural literacy. It is important to consider the focus of the agricultural instruction in our view of student learning.

To have the optimal impact on educational practice and student learning, learning theories must be translated into language that is relevant and applicable to teachers. Newcomb et al. (2004) described 16 principles of teaching and learning to guide teachers in the instructional process. These are summarized in Box 11.2.

WAYS OF VIEWING STUDENT INTELLIGENCE

Howard Gardner (1983, 2008), in his ***theory of multiple intelligences***, proposed there are eight dimensions of intelligence. These are bodily-kinesthetic (skillful use of the body and handling of objects), interpersonal (ability to sense emotions, needs, and motivations in others), intrapersonal (ability to use self-awareness to guide decisions and behavior), linguistic (skillful use of words and language), logical-mathematical (skillful use of numbers, logic,

BOX 11.2 *Principles of Teaching and Learning*

1. When the subject matter to be learned possesses meaning, organization, and structure that are clear to students, learning proceeds more rapidly and is retained longer.
2. Readiness is a prerequisite for learning. Subject matter and learning experiences must be provided that begin where the learner is.
3. Students must be motivated to learn. Learning activities should be provided that take into account the wants, needs, interests, and aspirations of students.
4. Students are motivated through their involvement in setting goals and planning learning activities.
5. Success is a strong motivating force.
6. Students are motivated when they attempt tasks that fall in a range of challenge such that success is perceived to be possible but not certain.
7. When students have knowledge of their learning progress, performance will be superior to what it would have been without such knowledge.
8. Behaviors that are reinforced (rewarded) are more likely to be learned.
9. To be most effective, reward (reinforcement) must follow as immediately as possible the desired behavior and be clearly connected with that behavior by the student.
10. Directed learning is more effective than undirected learning.
11. To maximize learning, students should "inquire into" rather than "be instructed in" the subject matter. Inquiry-oriented approaches to teaching improve learning.
12. Students learn what they practice.
13. Supervised practice that is most effective occurs in a functional educational experience.
14. Learning is most likely to be used (transferred) if it occurs in a situation as much like that in which it is to be used and immediately preceding the time when it is needed.
15. Learning is most likely to take place when what is to be transferred is a generalization, a general rule, or a formula.
16. Students can learn to transfer what they have learned; teachers must teach students how to transfer learning to laboratory and real-life situations.

Adapted from Newcomb et al. (2004).

reasoning, and patterning), musical (ability to sense sound, tone, pitch, and rhythm), spatial (ability to perceive the visual world and recreate based on one's own perceptions), and naturalistic (ability to identify and distinguish elements of the natural world). Gardner believed everyone possesses intelligence in all eight dimensions; however, most people excel in only a few. Students are more successful when engaged in learning using the intelligence they excel at than when there is a mismatch. Because of this, teachers must provide learning opportunities that engage students' multiple intelligences.

Carol Dweck (2006) proposed two mindsets that can be applied to learning. A ***mindset*** is what a person believes about the underlying nature of their abilities. A person with a fixed mindset equates success in learning with their innate characteristics. Therefore, their abilities are fixed and learning is validation of their abilities. A fixed mindset can lead to someone not reaching their full potential. Individuals with a growth mindset challenge themselves and see failure as an opportunity to enhance learning and their abilities. Having a growth mindset can lead to someone seeking to learn and achieve more. Teachers who want to build students' growth mindset should praise students for effort rather than innate ability, challenge students to try more difficult tasks, and encourage students to persevere.

Learning styles are often included in how we view teaching. A ***learning style*** is a description of how a person prefers to learn and under what environment he or she prefers to learn. Some students are intrinsically motivated and approach education as a "learn for the sake of learning" situation. These are the students who easily take notes, ask questions on their own initiative, and delve deeper into subjects than required by assignments. These students appreciate teachers who provide time for class discussions and who give assignments with flexible requirements. Other students are more extrinsically motivated and approach learning from a "what is required" perspective. These students are motivated by grades, rewards, and structure. Extrinsically motivated students appreciate teachers who use a businesslike approach and who give assignments with specific requirements.

Another way to characterize learning styles is as auditory, visual, or kinesthetic. Auditory learners prefer to be in an educational setting where there is talking, speaking, and auditory clues regarding the content. Visual learners like to read, see notes, and observe. Kinesthetic learners like to touch, manipulate, and do in order to learn. Regardless of their primary learning style, students learn best when instruction is varied and includes all three learning styles.

STUDENT MOTIVATION

Motivation is the energy and direction given to behavior. Some students appear to be highly motivated; others appear to lack motivation. Of course, this interpretation of motivation is in terms of learning a particular subject or skill.

There are two sources of motivation for students in the classroom: those things internal to them (intrinsic motivation) and those things external to them (extrinsic motivation). Although a teacher has the most control over extrinsic motivational factors, understanding intrinsic motivational factors is also important.

Intrinsic Motivation

Maslow (1970) developed a ***hierarchy of human needs***, which is depicted in Figure 11.4. The most basic needs (physiological) are those of shelter, food, sleep, water, and survival. Transferring this to the school setting, the classroom should be in good repair, have adequate furniture, and provide light, heating, and cooling. Students who come to school hungry or sleep-deprived are less motivated to learn until these needs are met.

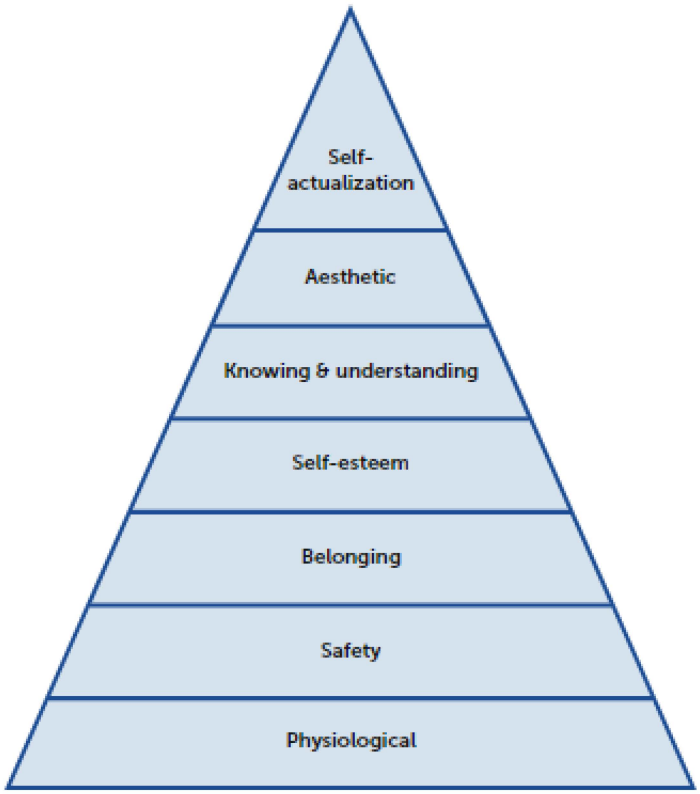

FIGURE 11.4 Maslow's hierarchy of needs. (ADAPTED FROM MASLOW, 1970.)

Next in the hierarchy are safety needs. Personal safety concerns related to gangs, bullies, or crime may detract from student learning. It is important that all students feel safe in the classroom.

Belonging is the third step in the hierarchy. Students need to feel they belong in the classroom, are accepted by their peers, and have something of worth to contribute. The teacher's attitude, words, and actions contribute to or detract from students' sense of belonging.

The next step is self-esteem. Students need opportunities to build their self-confidence, obtain approval, and be recognized. Teachers must proactively provide opportunities for all students to develop their self-esteem.

The top three steps in the hierarchy are called growth needs. When these needs are met, the person is motivated to seek even more. For example, when knowing and understanding needs are met, the student has an even greater motivation to know and understand more in that area.

Extrinsic Motivation

Crunkilton and Krebs (1982) described practices teachers can use to affect student motivation. These are outlined in Box 11.3 as primary, or universal, principles and as secondary principles. These principles can be used to gain student attention and motivation at the beginning of the class period. However, teachers should use these principles throughout their instruction.

Agricultural education is well suited for teachers to use all the principles of interest but especially the natural impulses. Anything living, plants and animals, or other real objects from nature touch on the love of nature within students. Hands-on learning taps into students'

BOX 11.3 *Principles of Interest*

Primary

1. Much of the interest a person exhibits comes from natural impulses within the person:

Love of nature	Competition
Altruism	Sociability
Curiosity	Ownership
Self-advancement	Desire for approval
Creativeness	Activity

2. Something is interesting if it affects us, others about us, or humanity at large.
3. Interest increases with an increase in related knowledge of any subject, provided such knowledge is well understood.
4. Interest increases with the acquisition of any given ability or skill.
5. Interest flows, or spreads, from any interesting thing into any uninteresting thing whenever the two are clearly connected in thought.

Secondary

1. Thinking is essentially interesting; memorization, uninteresting.
2. Interest is contagious in the sense that when one or more persons show interest in something, others will tend to "catch" that interest.
3. Interest is strengthened by a sense of progress.
4. Interest is created and sustained by a state of suspense.
5. An idea, when fully accepted, becomes a new interest center, from which interest will spread to any other thing that is seen to be connected with it.
6. The novel and unexpected are interesting.
7. Humor creates interest.

Adapted from Crunkilton & Krebs (1982).

FIGURE 11.5 A variety of realia (real things or likenesses of real things) stimulates interest and helps motivate student learning. (COURTESY OF EDUCATION IMAGES.)

creativeness, activity, and self-advancement. When structured appropriately, hands-on learning can also involve ownership, competition, and approval. Community service activities are one example of altruism. Group projects allow students to be sociable but also involve activity, creativity, and ownership.

REVIEWING SUMMARY

To be effective, agriculture teachers need to know how students learn. The goal of instruction is to engage all students actively.

Educational practice in agricultural education has been influenced by both behavioral and cognitive learning theories. Brain-based learning theory gives an explanation of why some agricultural education tenets work and an impetus to change those teaching practices that do not work.

Students are intelligent in multiple ways. Agriculture teachers need to structure instruction so students of differing intelligences can all succeed. The best teachers are cognizant of student mindsets and learning styles and tailor instruction to meet student needs.

Motivation is a key factor in the learning environment. Without motivation, there will be no learning. The goal is to achieve intrinsic motivation.

QUESTIONS FOR REVIEW AND DISCUSSION

1. What is learning?
2. Where does learning occur?
3. Describe how an agricultural education class is conducted by a teacher who is a behavioral learning theory adherent.
4. Describe how an agricultural education class is conducted by a teacher who is a cognitive learning theory adherent.
5. What is the Premack principle?
6. What is downshifting?
7. Explain Gardner's theory of multiple intelligences.
8. Explain Dweck's growth mindset theory.
9. Explain the impact of Maslow's hierarchy of needs on agricultural education classrooms.
10. How are the primary and secondary principles of interest used in agricultural education classrooms?
11. What is motivation? Differentiate between the two types.
12. How does classical conditioning occur in the classroom? Explain.

ACTIVITIES

1. Investigate mindset theory. Chose an agricultural topic and develop a lesson incorporating activities and challenges that encourage students to enhance their growth mindset.
2. Investigate Gardner's theory of multiple intelligences. Report on the eight dimensions using a different FFA Career Development Event to highlight each dimension.
3. Using the *Journal of Agricultural Education*, *The Agricultural Education Magazine*, and the proceedings of the National Conference of the American Association for Agricultural

Education, report on learning theory and learning styles research in agricultural education. Current and past issues of these journals can be found in the university library. Selected past issues can be found online at www.aaaeonline.org or www.naae.org.

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12

The Teaching Process

Juanita Rivera is an excited beginning agriculture teacher. It's the week before school begins, and her facilities are clean and organized. Her classroom has tables and chairs for 30 students and is equipped with an interactive whiteboard and internet-connected computer. Countertops with base storage cabinets and strategically placed sinks are along two of the walls. Against another wall are five internet-connected computer stations.

A walk through her office and into the laboratory reveals two aquaculture tanks with a hydroponics station and grow lights. Spaced throughout the remainder of the laboratory are workbenches and tool/equipment storage cabinets for various agricultural mechanization experiments and projects.

Juanita is continually thinking about one overriding question: "How will I teach my students to best help them learn?" Now, that is a good question. It is time she started planning!

OBJECTIVES

This chapter addresses the National Quality Program Standards for Agriculture, Food, and Natural Resources Education (National Council for Agricultural Education, 2016), specifically
Standard 1B: Program Design and Instruction—Instruction
Standard 1D: Program Design and Instruction—Assessment
It has the following objectives:

1. Discuss the principles that guide learning in the 21st century.
2. Explain teaching methods.
3. Identify considerations in selecting a method.
4. Describe Bloom's taxonomy and relate its use to teaching.
5. Compare and contrast student-centered and teacher-centered instructional methods.
6. Discuss examples of teacher-centered instructional methods.
7. Discuss examples of social interaction instructional methods.
8. Discuss examples of student-centered instructional methods.
9. Describe the process of developing and/or adapting appropriate lesson plans in teaching.
10. Discuss the use of instructional technologies in teaching.

TERMS

Bloom's taxonomy
case study
cooperative learning
culturally responsive teaching
demonstration
discussion
experiment
field trip
independent study
inquiry-based instruction
learning module
learning objective
lecture
lesson plan
project-based learning (PBL)
project
resource people
role-playing
scenario
simulation
supervised study
teaching method

FIGURE 12.1 The teacher facilitates classroom learning activities and empowers students to take responsibility for their learning.

TEACHING AND LEARNING IN THE 21ST CENTURY

Before selecting a teaching method, it is important to consider foundational principles of designing learning experiences to help students be prepared for the demands of the modern workforce. Darling-Hammond et al. (2008) identified the following ideas that should guide teaching and learning in the 21st century:

Students possess diverse experiences and knowledge they bring with them to classroom learning. Teachers should be sure to activate and build upon this prior knowledge to maximize learning.

To cultivate deep understanding and application of learning, students must have a foundation of factual and conceptual knowledge they know how to draw upon in practical applications in the real world.

Learning is more effective for students when they are aware of their own learning processes and learn how to identify and reflect on their own metacognition.

Remember that no matter what content you are teaching or what method you use to engage students in learning about the content, you are first teaching *students*. Building positive relationships with them; learning about their communities, values, and beliefs; and grounding your teaching within these contexts is absolutely critical for student success. The diverse array of learners in your classroom need a teacher who can create a positive and welcoming learning environment that embraces their identities. Utilizing a ***culturally responsive*** approach to teaching, teachers can build upon the cultural knowledge, experiences, and frames of reference of culturally diverse students to create more relevant and meaningful learning experiences that are validating, empowering, and transformative.

CHOOSING THE TEACHING METHOD

Several teaching methods or strategies are available to agriculture teachers. A ***teaching method*** is the overall means a teacher uses to best facilitate student learning. Most methods comprise a number of techniques or details for delivering the instruction.

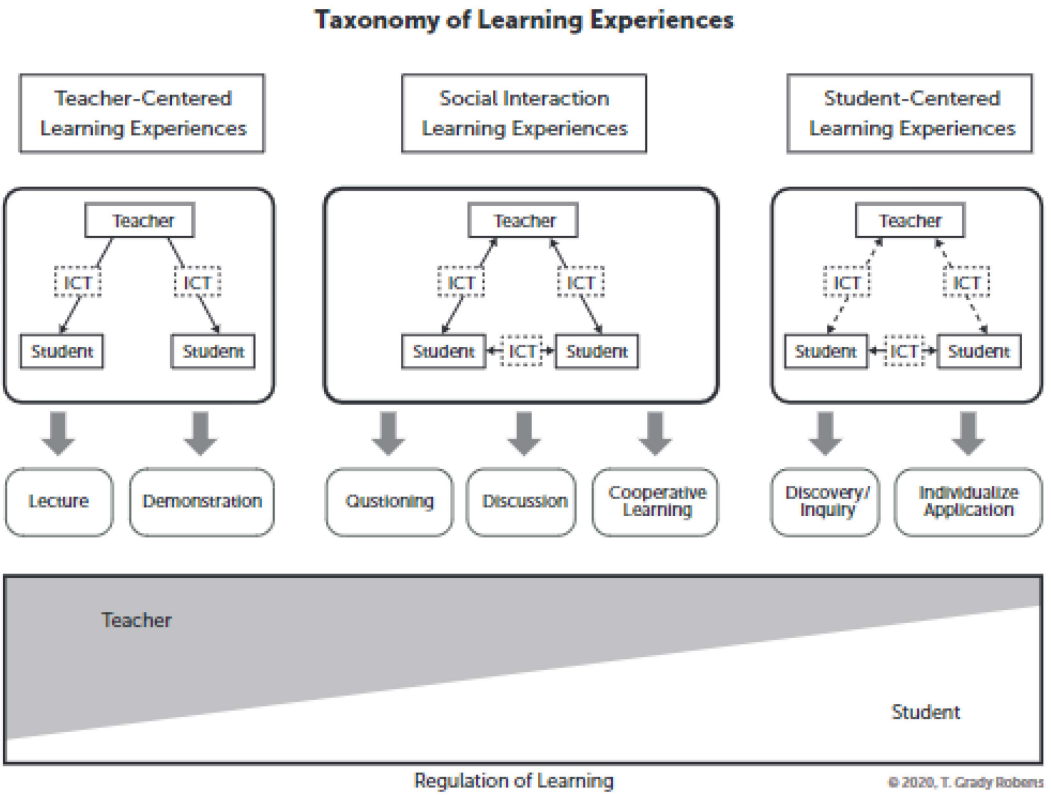

FIGURE 12.2 Teaching methods can be broadly categorized into teacher-centered, social interaction, and student-centered learning experiences. In the diagram, "ICT" refers to "information communication technologies." (COURTESY OF T. GRADY ROBERTS.)

Major Methods

Teaching methods can be broadly categorized based on who is the focus of the learning activities: teacher-centered, social interaction, or student-centered. Roberts et al. (2010) outlined major learning methods, as shown in Figure 12.2.

Factors Affecting Selection of Teaching Method

Selection of appropriate teaching methods should be guided by the established learning objectives for the lesson, but are also influenced by the overall goals of the course and program, resources available and educational context, and the experience of the instructor as well as the instructor's philosophical beliefs about teaching and learning.

Learning Objectives

Learning objectives outline what students should know, do, or be able to understand by the end of a lesson. Learning objectives should be aligned with your state or national educational standards frameworks to ensure daily instruction addresses the major concepts and skills deemed important by your state educational agency. To provide students with learning experiences that help them move toward the established learning objectives, agriculture teachers need to select an appropriate teaching method. For example, a learning objective that states, "Students will be able to independently create a boutonniere using the

supplied materials" would suggest students should be able to physically assemble a boutonniere. Planning a lesson that consists primarily of the teacher lecturing would not be an appropriate teaching method in this setting, as students would likely not have the opportunity to work with the materials necessary to craft the boutonniere. More information on how to write learning objectives is found later in this chapter.

Course and Program Goals

As you learned in Chapter 5, it is essential to identify program goals as part of your program vision and mission statement. Chapter 7 discussed the process of curriculum development and identification of transfer goals, or those things that students should be able to do beyond the scope of your course and/or program. For example, if an agriculture program has identified that students graduating from the program should be able to advocate for agriculture drawing upon up-to-date industry practices, then the program instructor(s) should plan learning experiences that provide students with opportunities to deepen their understanding of current agricultural practices and hone their ability to advocate on behalf of agriculture as part of their coursework. Likewise, if the agriculture program provides valuable training opportunities for students going directly into the agriculture industry upon graduation, then the coursework should offer multiple learning experiences that help students develop the psychomotor skills, affective skills, and agricultural knowledge needed to be successful in their employment.

Resources Available and Instructional Context

Although facilities, equipment, and supplies are a factor in determining the method of instruction, these are less of a limiting factor than some might believe. An agriculture teacher who lacks microscopes to conduct an experiment may be able to borrow some from the science teacher. The problem of outdated equipment might be solved through field trips, computer simulations, or supervised experience at businesses with up-to-date equipment.

The abilities to improvise, borrow, and create are extremely valuable ones for an agriculture teacher to possess. Chapter 6 discussed utilizing advisory and citizen groups. These are helpful in getting needed resources for effective teaching. Chapter 9 discussed in further detail the role facilities play in teaching, and Chapter 21 discusses laboratories. Chapter 24 explains the importance of community resources for an effective agricultural education program.

Finally, considerations such as class size, time available to devote to a topic, and class structure influence the decision on what method of instruction to choose. As detailed below, some methods are best suited for individual or small-group instruction. Other methods are designed to cover a large amount of information as efficiently as possible. Class structural factors include time of day, time of year, proximity to holidays or vacations, and type of schedule system. Class periods under a block system, which can range from 85 to 100 minutes in length, require great variety in both instructional methods and learning tasks.

Experience and Philosophical Beliefs of the Instructor

Finally, the teaching philosophy and experience of the teacher influence what instructional approaches might be used so as to best reach the diverse array of students whom they teach. Teachers should be always striving to build their repertoires of teaching methods. Beginning teachers tend to utilize those methods they are most comfortable with and feel are the strongest. However, these teachers are cautioned not to overuse a particular method.

Chapter 11 outlined the theories that undergird the science of teaching and learning. Two broad categories of educational theories fall into behaviorist approaches and constructivist approaches. Teaching methods and instructional design that rely primarily on acquisition of

discrete and compartmentalized skills and knowledge, and position the teacher as in control of the learning, draw from behaviorist principles. In this approach, the focus of teaching is on transmission of content. A teacher drawing from constructivist principles would focus more on helping students make connections to the content across different settings, and tends to craft lessons that utilize instructional methods that encourage students to have varying degrees of control over the learning experience.

Teaching methods that draw from behaviorist principles are typically teacher-centered approaches, while those that draw from constructivist principles are student-centered or social interaction approaches. While there are numerous teaching methods, this chapter will focus on the major approaches utilized by school-based agriculture teachers within each of these categories.

Choosing the appropriate method is not merely using a formula but involves numerous considerations. What principles of learning should be applied to the lesson? At what developmental level are the students? What are their learning styles and dimensions of multiple intelligences? Are there physical, mental, or emotional considerations? What resources are available to use in implementing a teaching method? What should students know and be able to do at the end of the lesson? At what level of learning are students expected to demonstrate knowledge, skills, or dispositions?

BLOOM'S TAXONOMY

The question of level of learning expected of students is important. In 1956, Benjamin S. Bloom classified educational objectives into what is commonly referred to as ***Bloom's taxonomy***. He first stated there were three domains of learning. The cognitive domain is those things involving mental activity. The affective domain is those things involving attitudes, emotions, and values. The psychomotor domain is those things involving body movements, mechanical skills, and manual skills. Figure 12.3 illustrates the three domains of Bloom's taxonomy.

Categories of Cognitive Skills

Within Bloom's taxonomy for the cognitive domain are six categories. Although Bloom did not present these as a hierarchy, the term "higher-order thinking skills" is sometimes applied to the last three of the six. The categories of the original taxonomy (from lowest to highest) are Knowledge, Comprehension, Application, Analysis, Synthesis, and Evaluation. Krathwohl (2002) presented a revised taxonomy. The three lower levels were renamed as Remember,

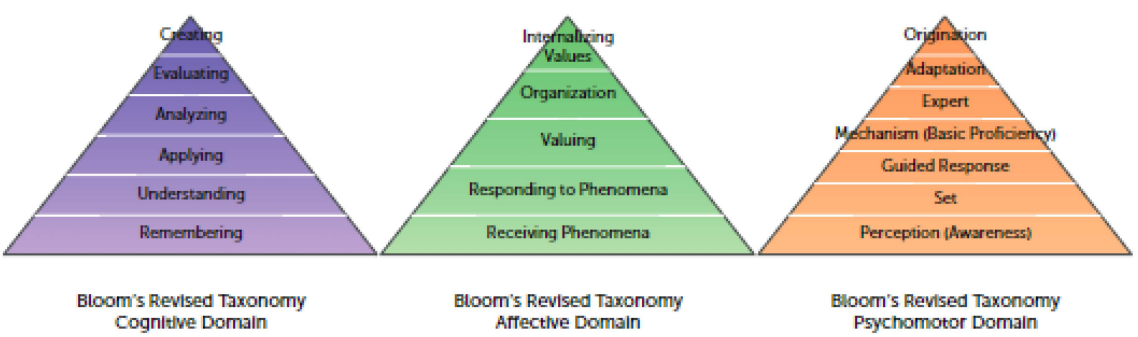

FIGURE 12.3 The cognitive, affective, and psychomotor domains of Bloom's revised taxonomy.

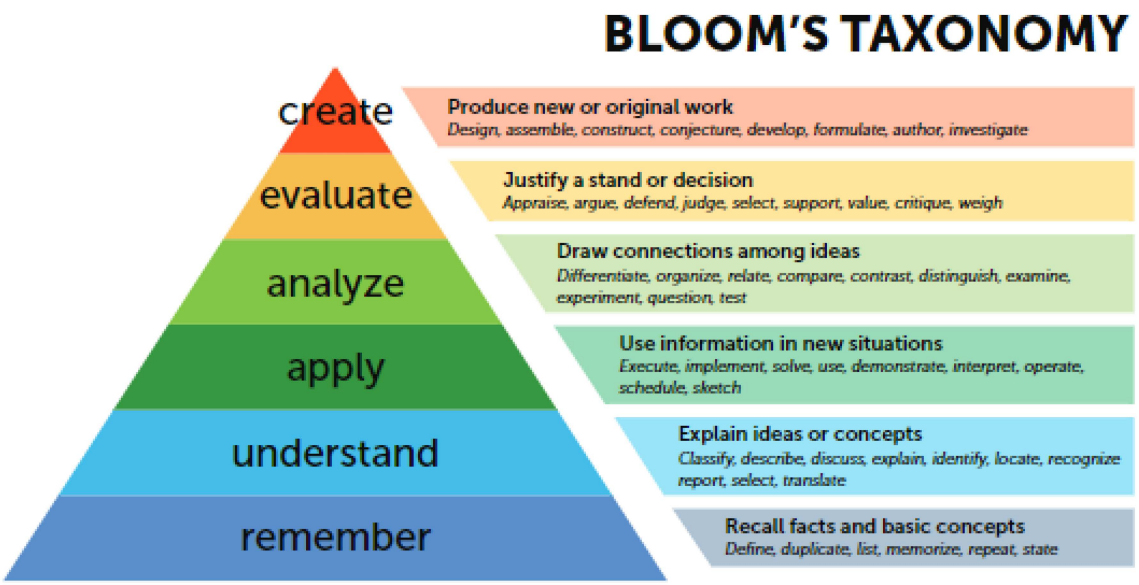

FIGURE 12.4 Bloom's revised taxonomy for teaching, learning, and assessment.
(COURTESY OF VANDERBILT UNIVERSITY CENTER FOR TEACHING.)

Understand, and Apply. The three higher-level categories were renamed as Analyze, Evaluate, and Create, with the top two category places switched. Figure 12.4 illustrates Bloom's revised taxonomy for teaching, learning, and assessment.

Boxes 12.1, 12.2, and 12.3 give examples of verbs associated with each of the domains.

Writing Objectives

Teachers use Bloom's taxonomy to write learning objectives (cognitive, affective, and psychomotor) to guide instruction, inform students, ensure coverage of subject matter, and guide evaluation. A ***learning objective*** is a carefully written statement of the intended outcomes of a learning activity. Several variations are used, including behavioral objectives. Teaching proceeds best if the learning objectives have been carefully specified.

BOX 12.1 *Verbs Associated With Bloom's Cognitive Domain*

Remember	Understand	Apply	Analyze	Evaluate	Create
Define	Classify	Execute	Differentiate	Appraise	Design
Duplicate	Describe	Implement	Organize	Argue	Assemble
List	Discuss	Solve	Relate	Defend	Construct
Memorize	Explain	Use	Compare	Judge	Conjecture
Repeat	Identify	Demonstrate	Contrast	Select	Formulate
State	Locate	Interpret	Distinguish	Support	Author
	Recognize	Operate	Examine	Value	Investigate
	Report	Schedule	Experiment	Critique	
	Select	Sketch	Question	Weigh	
	Translate		Test		

BOX 12.2 ***Verbs Associated With Bloom's Affective Domain***

Receiving Phenomena	Responding to Phenomena	Valuing	Organization	Internalizing Values (Characterization)
Asks	Answers	Completes	Adheres	Acts
Chooses	Assists	Demonstrates	Alters	Discriminates
Describes	Aids	Differentiates	Arranges	Displays
Erects	Complies	Explains	Combines	Influences
Follows	Conforms	Follows	Compares	Listens
Gives	Discusses	Forms	Completes	Modifies
Holds	Greets	Initiates	Defends	Performs
Identifies	Helps	Invites	Explains	Practices
Locates	Labels	Joins	Formulates	Proposes
Names	Performs	Justifies	Generalizes	Qualifies
Points to	Practices	Proposes	Identifies	Questions
Replies	Presents	Reads	Integrates	Revises
Selects	Reads	Reports	Modifies	Serves
Sits	Recites	Selects	Orders	Solves
Uses	Reports	Shares	Organizes	Verifies
	Selects	Studies	Prepares	
	Tells	Works	Relates	
	Writes		Synthesizes	

BOX 12.3 ***Verbs Associated With Bloom's Psychomotor Domain***

Perception (Awareness)	Set (Mindsets)	Guided Response	Mechanism (Basic Proficiency)	Complex Overt Response (Expert)*	Adaptation	Origination
Chooses	Begins	Copies	Assembles	Assembles	Adapts	Arranges
Describes	Displays	Traces	Calibrates	Calibrates	Alters	Builds
Detects	Explains	Follows	Constructs	Constructs	Changes	Combines
Differentiates	Moves	Reacts	Dismantles	Dismantles	Rearranges	Composes
Distinguishes	Proceeds	Reproduces	Displays	Displays	Reorganizes	Constructs
Identifies	Reacts	Responds	Fastens	Fastens	Revises	Creates
Isolates	Shows		Fixes	Fixes	Varies	Designs
Relates	States		Grinds	Grinds		Initiate
Selects	Volunteers		Heats	Heats		Makes
			Manipulates	Manipulates		Originate
			Measures	Measures		
			Mends	Mends		
			Mixes	Mixes		
			Organizes	Organizes		
			Sketches	Sketches		

*Key verbs are same as Mechanism, but are performed at a quicker or higher quality level.

Learning objectives are always written in terms of what the student will be able to do at the conclusion of the instruction. Some school districts may expect teachers to format their learning objectives as "I can . . ." statements so that the objectives are written in student-friendly language. Writing objectives using Bloom's taxonomy is as simple as ABCD.

Consider this example: "Students will be able to quote the FFA Creed from memory with 80% word accuracy."

- "A" stands for audience and is almost always students.
- "B" stands for behavior, or what is expected of the students. In this example, the students are to quote the FFA Creed. (This is sometimes known as the "terminal behavior.")
- "C" stands for the condition under which the behavior is to be done. In this example, students are to quote from memory.
- "D" stands for the degree or level to which students are to perform to succeed. In this example, students must be 80% accurate, or can misspeak only 20% of the creed.

TEACHER-CENTERED METHODS

Different methods of instruction assist students in accomplishing the learning objectives. Teacher-centered instructional methods center the focus of the learner's attention primarily on the instructor. The teacher is almost exclusively responsible for structuring the learning environment and serves as the primary conveyor of information. These methods tend to be utilized for whole group direct instruction. Lecture, demonstrations, and teacher-led experiments are commonly used teacher-centered methods in school-based agricultural education.

Lecture

Very few agriculture teachers lecture in the formal definition of the methodology. An accomplished lecturer should be an expert in the subject, be skilled in oratory, and have experience and presence that earn respect from the audience.

However, the use of lecture in its many forms is a frequently used instructional method. As commonly defined, ***lecture*** is an oral presentation by the teacher or other individual. It may include a wide range of techniques. Lecture involves these five qualities:

1. More teacher talk than student talk.
2. Greater degree of flow of communication from teacher to students than from students to teacher or from student to student.
3. Linear flow of information, with the structure determined by the teacher.
4. Use of illustrative materials to supplement what is being spoken. These include PowerPoint presentations, chalkboard/whiteboard notes and illustrations, overhead transparencies, slides, real objects, audio and video presentations, and pictures.
5. Use in combination with discussion to create lecture-discussion. This is typified by periods of lecture with note-taking followed by class discussion, analysis, or application of the preceding content.

When does a teacher choose lecture as a preferred instructional method? Lecture is best suited to large groups as is often seen in college classrooms. Lecture is also best when the content is such that all students need to have the same information on the same level. Within

BOX 12.4 *Characteristics of a Good Lecturer*

1. Thoroughly prepares for the lecture
2. Sees that the room is properly arranged for the lecture
3. Has knowledge of the audience the helps in relating to their interests
4. Is enthusiastic, promoting student interest
5. Speaks clearly and fluently; varies rate and intensity of speech
6. Avoids distracting mannerisms
7. Emphasizes major points and uses appropriate realia (real things) to promote learning
8. Chunks learning into appropriately sized segments
9. Properly introduces and summarizes the subject

Bloom's taxonomy, knowledge and comprehension objectives are well suited for the lecture methodology. When time is a concern, lecture allows for disseminating a large amount of information in the least amount of time.

A good lecture requires organization. Unprepared teachers who believe they can just "throw together" a lecture at the last minute are fooling themselves and stealing instructional time from their students. Class needs to begin with a well-thought-out introduction. What are the students expected to know and be able to do after the instruction; in other words, what are the objectives? Why should students want to learn the content? What do students already know in this area, or what have they studied in previous lessons related to this area? The introduction should transition into a structured presentation of new content. If the topic is new, the lecture should first present the whole picture, then break it into its components, then present the whole again.

High school students should be provided an organizational outline to guide their note-taking from the lecture. This outline could be done on the chalkboard/whiteboard, as a PowerPoint presentation, or in the form of a note-taking guide. When lecturing to high school students, the teacher needs to check for understanding through questions, exercises, and frequent reviews.

Box 12.4 lists the characteristics of a good lecturer. Teachers should evaluate themselves on each of these characteristics and work to improve those in which they have a deficiency.

Demonstration

The agricultural education curriculum has many topics that are well suited for demonstrations. There are skills in each agricultural area—mechanics, horticulture and landscaping, plant and soil science, natural resources, agricultural business, animal science, and food science—in which demonstrations are appropriate. A ***demonstration*** is a teaching process that involves showing students how to do something before they do it for themselves or that involves showing them what would happen as the result of a particular action. Practice by students of the skill demonstrated is essential in order to assure their skill development.

As in other group teaching methods, planning is essential to the success of a demonstration. All materials need to be gathered ahead of time, the teacher needs to have practiced the demonstration, and care must be taken to ensure all students can see the demonstration. The teacher may want to have parts of the demonstration completed in advance, especially if time is a consideration. For example, demonstrating proper painting techniques may require letting the primer dry for 24 hours before putting on the coat of paint. Instead of taking multiple days to do the demonstration, the teacher may demonstrate applying primer,

then pull out a previously primed wall section that has dried and use it to demonstrate applying the coat of paint.

When planning a demonstration, it is important for the agriculture teacher to consider the layout of the room or space in which they will be demonstrating a skill so they can ensure all students will be able to see the skill demonstrated. The demonstration may be aided by the use of a document camera that projects a live video feed to a larger screen so students can view the small details of what the teacher is demonstrating, such as when demonstrating how to make a bow or corsage. Demonstrations can also be helpful when the teacher has limited resources for all students to engage with the materials directly, such as when conducting a dissection of a ruminant digestive system. These systems, which are quite substantial in size, are not easily obtained in large quantities, nor would many agriculture classrooms be suited to large quantities of these tracts laid out around the room. Through a demonstration with an overhead document camera, an agriculture teacher can show students the fine details of the various parts of the digestive system in an efficient manner.

Teacher-Led Experiments

Because agriculture is an applied science, it is especially important experiments be a part of instruction. All areas of agricultural education lend themselves to experiments. An ***experiment*** is a trial using a definite and planned procedure. The outcome of the trial is predicted as part of the scientific method. Experiments can be carried out using very formal procedures or less formal ones. Teacher-led or teacher-directed experiments are those experiments in which the teacher determines what research question will be explored and what procedures will be followed. Often these experiments follow a step-by-step format that students follow to achieve the teacher-planned outcomes, leading to this approach sometimes being referred to as a "cookbook" method of experimentation. Often, this approach is used when a teacher wants to have students see a scientific principle in practice, or help students familiarize themselves with following laboratory procedures, using laboratory equipment, and engaging in the scientific method.

What is the value of experiments? Experiments are intertwined with the scientific method, which is the basis for the problem-solving teaching approach. Experiments teach observation skills, measurement, analysis, and reasoning. Experiments utilize a "learning by doing" approach that actively engages the students physically as well as mentally. While teacher-directed or cookbook experiments have been criticized for not actively engaging student thinking in the laboratory setting, recent research suggests teacher-directed experiments can positively influence student learning about the nature of science and positively influence student enjoyment of science. When blended with inquiry-based instruction opportunities (discussed in the student-centered methods section), teacher-directed laboratory instruction may benefit student learning in science even more than when used alone (Areepattamannil et al., 2020).

Teacher planning and preparation are keys to the success of using experiments as a teaching method. An experiment needs to be planned thoroughly. The teacher must have done the experiment beforehand in order to anticipate student questions and frustration areas. The teacher must decide whether supplies and equipment will be needed for each student or whether students will work together in groups. In addition, the students need to be prepared for the experiment. What are the procedures to follow? What are students to observe? How are students to record and analyze data? Students also need to know experiments do not always yield perfect data. Sometimes experiments that yield outlier data are the most interesting. It is not enough to simply do the experiment; the students need to understand why the experiment yielded the results.

BOX 12.5 ***Steps in Conducting an Experiment***

1. Interest is developed. The appeal may flow from a student's SAE, an FFA CDE, or personal interests. The teacher may also create interest through techniques discussed in Chapter 11.
2. The problem is defined. What do the students want to discover?
3. Information is gathered. Students find out what is already known about this problem. This is also known as a literature review.
4. Hypotheses are formed. What possible explanations are there for the observed phenomena?
5. The experiment is planned. Supplies and equipment are gathered. Procedures are determined. A timeline for data collection is developed.
6. The experiment is conducted. Data are collected through observations and measurements.
7. Data are analyzed, and conclusions are drawn.
8. A lab report is written.

Box 12.5 shows the typical steps in conducting an experiment. Experiments in agriculture may last for multiple days or even weeks, so several data collection sheets may be necessary.

SOCIAL INTERACTION METHODS

Social interaction methods of learning are those that involve interaction not only between students, but between the teacher and the students, so all parties are interacting with another throughout the learning experience. The teacher may not be the focus of the learning activity, but has assuredly spent much time up front scaffolding the learning experiences to allow for more interaction among students and the instructor. Social interaction methods include questioning and discussion, cooperative learning, project-based learning, role-plays, field trips, and guest speakers.

Discussion and Questioning

Discussions are commonly used in agricultural education. A ***discussion*** is a teaching process that involves student sharing of information. Typically, discussion might involve the agriculture teacher posing questions to the students, which they answer directly, offer their opinions about, or debate. Discussion may be combined with lecture, as described in the previous section, or be the sole instructional method used.

A well-conducted discussion requires extensive planning by the teacher. The teacher needs to determine the objectives of the discussion ahead of time and structure the discussion to accomplish the objectives within the time frame selected. Nothing is more frustrating than an endless discussion with no conclusion or resolution of the topic discussed. A good discussion involves student-to-student interaction in addition to student-to-teacher and teacher-to-student.

Box 12.6 presents qualities of a good discussion. All participants—the students as well as the teacher—need to be ready for the discussion. The teacher should have a lesson plan for the discussion, just as he or she would for any other lesson using another instructional method.

A properly organized discussion will flow from point to point logically yet allow for student insights and questions. Students need to possess the necessary background information to make informed comments. This may require students to have read materials for homework

BOX 12.6 *Qualities of a Good Discussion*

1. An appropriate situation exists for discussion.
2. Students possess the background knowledge necessary to give informed answers or opinions.
3. The classroom climate is such that students feel safe in voicing opinions and answering questions; they do not fear ridicule or embarrassment.
4. The teachers asks appropriate-level questions, asks probing questions when students give one-word answers, and provides answer prompts when necessary.
5. Incorrect information is corrected while the dignity of the student who gave the wrong information is maintained.
6. All students are actively engaged in the discussion.
7. Students have ample opportunities to contribute to the discussion, with no one monopolizing the time.
8. The teacher actively listens, provides feedback, and clarifies when necessary.
9. Key points are highlighted during the discussion and are summarized at the end.
10. The discussion is brought to a conclusion.

or during previous class instruction. During the discussion, the teacher serves as a facilitator, prompter, and conversation referee. Depending on the class size, the teacher may need some system for making sure all students participate in the discussion. Before the allotted time expires, the teacher needs to bring the discussion to closure, highlight key points, and assist the students in formulating conclusions.

The types of questions asked in a discussion are critical to the types of answers students will give and the level of their learning. There are five basic types of questions: closed, open, probing, higher-order, and divergent. Closed questions are used to regulate answers or obtain specific answers. For example, "Lecture is best used in what situations?" Open questions are useful for starting a discussion and seek a variety of answers. Such questions many times allow students to describe their own experiences or express opinions, so there are no wrong answers. Probing questions are used when students give one-word answers, more information is needed, or there is a desire to bring other students into the discussion. Sometimes probing questions mirror what a student has said. For example, "Are you saying you think lecture is overused?" Higher-order questions require students to think rather than recite memorizations. Higher-order questions are designed to make students discover rules and principles as they express their ideas. These questions use verbs from the upper three levels of Bloom's taxonomy, such as analyze, generalize, and critique. Divergent questions have no "right" answers. These require students to use their imaginations and think beyond set borders or parameters. Divergent questions lead to creativity and new ideas and are sometimes referred to as open-ended-answer questions.

Cooperative Learning

In ***cooperative learning***, students work together in a group small enough to allow all members to collectively contribute to a central, clearly defined task without necessarily needing the direct supervision of the teacher. Learning in a group setting can help students learn how to work with others, practice communication skills, and promote problem-solving. A recent survey of agricultural employers indicated being dependable, ability to think critically, engage in strategic planning, clear communication, active listening, and problem-solving skills

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as being the most desirable workforce competencies of agriculture and natural resources college graduates (Easterly et al., 2017). Planning opportunities for students to work toward development of these competencies at the high school level through cooperative learning experiences can help your students be much more prepared for the demands of the workforce.

When planning to have students work cooperatively in groups, it is very important to establish structured expectations of how the groups should function. The teacher may assign specific students to roles that promote on-task and collaborative behavior, or provide students a method through which to assign students to various roles. For example, one student might serve as the discussant who facilitates the conversation of the group, another might be the note taker, and another might be assigned to intentionally bring up opposing views to drive discussion and analysis. When determining the arrangement of students into such groups it is wise to consider the social dynamics that exist between students, demographic differences that may result in inequitable group behaviors, and specific learning needs of students who may have an IEP or 504 Plan.

Project-Based Learning

Though not always occurring in a group setting, ***project-based learning*** is an approach to learning and student engagement that can be used to guide a particular unit or course, or even as a framework for how an entire school may facilitate learning. Project-based learning or PBL provides opportunities for students to investigate an authentic and complex question, problem, or real-world challenge in a personally meaningful way.

While many teachers may use projects in their classes, "doing a project" is not the same thing as project-based learning. In PBL, the project *is* the unit; it is the main focus of the unit and requires students to engage in critical thinking, problem-solving, and various forms of communication to answer a driving question that guides the path of the project. Conversely, "doing a project" in a class differs in that the project is often completed at the conclusion of a unit, after the content has been taught by the teacher.

For example, an agriculture teacher might teach a welding fabrication unit in which students craft a welded project determined by the teacher, such as a hay rack, creep feeder, gate, or truck bed liner. Students would typically create these projects after having participated in lengthy instructional experiences led by the teacher on how to construct the selected project. If this same unit were to be redesigned to utilize a project-based approach, the teacher might present students with a problem that can be solved through welding fabrication, such as a local horse farm seeking to redesign their hay racks after experiencing challenges with the currently existing design. Students might visit the farm, or examine sample hay racks from the farm to troubleshoot the source of their problem, and then work together to design new racks that provide a better solution. Once all hay racks have been designed and fabricated, the class might install the hay racks for the barn owner and communicate how their new designs will address the problem identified.

Role-Play

Role-playing is the act of an individual assuming the real or imagined role of another individual. It is a useful instructional methodology for the agricultural education classroom when teaching concepts related to human relations, developing leadership skills, or teaching students other basic agricultural skills. Role-playing allows students to practice these skills in a safe and simulated environment so they are better prepared when encountering similar situations outside the classroom.

Newcomb et al. (2004) identified the following steps to planning and implementing role-play in the agriculture classroom:

1. Select appropriate subject matter for role-play (do *not* use culturally sensitive topics that demean, diminish, or dehumanize the experiences of others, particularly those of historically oppressed groups).
2. Determine the learning objectives for the lesson.
3. Design student roles to be played so they are aligned with the learning objectives.
4. Determine how many students will actively participate (will it be all students in the class, or a select few "on stage" in front of the class?).
5. Prepare the students who are participating in their roles for what they should be prepared to demonstrate.
6. Plan how you will help students reflect upon their experience and observations, and identify the key takeaways.

The FFA component of agricultural education provides many opportunities for student role-playing. When studying parliamentary procedure, students are better able to comprehend officer roles and FFA ceremonies by role-playing officers and members and conducting FFA business. Role-playing is also a useful tool in the classroom when discussing sensitive topics. A debate on the place animal rights have in the animal production industry could quickly become heated and unruly. If, instead, students are assigned to role-play various characters, such as animal rights activist, rancher, feedlot owner, and consumer, then the situation becomes less personal and more objective.

Field Trips

Field trips are a useful instructional method for making the "real world" part of the planned learning experiences. A ***field trip*** is a learning experience that involves traveling away from the agriculture classroom. An example is a field trip to an agricultural experiment station to observe research projects that are underway.

Field trips can be used for one of three purposes. At the beginning of an instructional unit, field trips are beneficial as an interest approach and to help the students to see the whole of a topic. Field trips during the middle of a unit can serve as fact-finding missions for problem solving or provide opportunities to test hypotheses. At the end of an instructional unit, field trips are useful for demonstrating theory into practice and bringing the parts back into a whole picture.

Field trips that involve travel must be planned and approved well in advance. School systems sometimes restrict when field trips can be taken and how many can be taken within the school year. School administrators may insist trip planning and approval forms be submitted at the beginning of the school year for any field trips taken that year. This requires the teacher to be organized and to prioritize which trips are crucial to student learning. Another consideration is transportation. Details such as cost, a bus driver, parental permission, and notification of other teachers must all be planned.

Field trips do not have to involve taking buses to faraway sites. Mini-trips can be taken right on the school grounds. For schools on block scheduling, the longer class periods allow mini-trips to and from sites close to the school within the agriculture class period. Virtual field trips may not involve the sensory experiences real field trips provide, but they can be an acceptable substitute. Videos, the internet, and student presentations can all provide some sense of "being there."

Guest Speakers

Agricultural education can be a difficult curriculum to teach. Very few agriculture teachers, if any, feel comfortable in their knowledge of every agricultural subject area. ***Resource***

people, who are experts in their area, can provide the knowledge and insights the agriculture teacher may not have as a guest speaker. Resource people can also lend credibility to information or instruction students doubt or about which they have heard conflicting opinions. In addition, by utilizing resource persons in the classroom, the agriculture teacher is introducing their students to key community contacts and potential employers.

Resource people may be used in several ways. An individual resource person may be invited to present to the class in a lecture, discussion, or demonstration format. Another common procedure is to invite three to five resource persons to conduct a panel discussion. Given the flexibility virtual video conferencing platforms offer, the teacher might also be able to include guest speakers over a virtual format, opening up the possibility to feature experts and perspectives not just from the local community, but across the country and the world! No matter the approach, the agriculture teacher should contact each resource person several weeks in advance of the presentation date. This should be followed by an email, letter, or phone call describing the class, the objectives of the class period, and suggested topics of discussion. A day or two before the presentation, the agriculture teacher should contact each resource person to confirm date, time, and location and answer any last-minute questions. If the speaker will be coming to school, it will also be important to review any procedures such as checking in at the main office, parking, and bell schedules.

STUDENT-CENTERED METHODS

Methods that engage students as the primary agent of learning are student-centered. Development of interpersonal relationships between the teacher and the student are essential to the success of student-centered methods. Students may be involved in developing the learning goals in collaboration with the teacher, with the teacher serving as a guide and resource. While teacher-centered methods are sometimes described as "sage on the stage" approaches, student-centered methods require the teacher to be a "guide on the side" to allow students to take leadership in their own learning. Common student-centered methods used in agricultural education include inquiry-based instruction, case studies, scenarios, simulations, games, supervised individual study, independent studies, learning modules, and projects.

Inquiry-Based Instruction

A common practice in science classrooms, ***inquiry-based instruction*** is a teaching method that meshes the natural curiosity of students along with the scientific method to cultivate critical thinking skills and scientific knowledge. Inquiry-based approaches to learning attempt to replicate the natural problem-solving processes we engage in when observing new phenomena or asking questions about the natural world.

There are varying levels of student inquiry that rely on instructional scaffolding to support student learning. The most teacher-supported type of inquiry is structured inquiry. A structured inquiry is a teacher-led or teacher-directed experiment, in which the entire class engages in exploration of the same research question. In controlled inquiry, the teacher selects the topics to be explored and identifies resources that students will use to answer the selected question; in this manner the teacher can intentionally curate the learning experience of students. In guided inquiry, the teacher might pose a question to students and then allow students to design a product or solution using their choice of resources. Finally, the most loosely structured form of inquiry is free inquiry or open inquiry. In this approach, students decide what to research and how they will conduct their research. Integrating the National FFA Agriscience Fair into your instruction is one way students can easily engage

in inquiry. The degree to which students have freedom to make decisions is determined by how much scaffolded support is provided by the teacher.

When utilizing inquiry-based approaches it is important to consider how you will support student learning. Knowledge of student learning preferences, self-efficacy, and experience with more autonomy in the classroom can help the teacher determine to what degree they should structure a learning experience using inquiry. Facilitating inquiry-based instruction can be challenging for teachers accustomed to teacher-centered classrooms. Several professional development resources exist for teachers looking to expand their ability to facilitate inquiry-based learning, such as NAAE's National Agriscience Teacher Ambassador Program and Curriculum for Agricultural Sciences Education (CASE) institutes.

Case Studies

Case studies are stories with an educational message. They put students in the position of the problem solver situated in the story, but do not provide answers, generating an action-oriented teaching environment. According to Herreid (1998), a good case:

- Tells a story, focusing on an interest-arousing issue
- Is set in the past five years and is relevant to the reader
- Creates empathy with the central characters
- Includes quotations
- Has pedagogical use
- Is conflict-provoking, forcing the reader to make a decision
- Is general enough that it can apply to a myriad of situations
- Is short enough to hold the reader's attention but long enough to introduce the facts and complexity of the case

Case studies can be used to explore a topic or kick off a unit. For example, an agriculture teacher teaching a natural resources class might craft a case study about an invasive species affecting the local area or state to introduce a unit on management of invasive species. To guide student learning, they might chunk the case into several pieces and selectively distribute it at key moments across the unit to propel student decision-making and drive instruction.

Scenarios

Similar to case studies, ***scenarios*** are short stories focused on a particular group of individuals that describe the nature of the individuals involved, the context, and the goals they want to achieve. Scenarios are generally shorter than case studies, ranging from a few sentences to a paragraph long. They may be used to activate prior knowledge, provide opportunities for students to apply their learning, or be used to assess learning. There are five types of scenarios: skill-based, problem-based, issue-based, speculative, and gaming. For more information on these five types of scenarios, see Chapter 13.

Simulations

Simulations are learning activities that are used to replace and amplify real experiences with guided ones in a controlled setting. They are often immersive in nature and are closely aligned with role-plays, but can also be used when the teacher has students act out various abstract concepts in a concrete, tangible way. For example, in an animal reproduction unit, the agriculture teacher might have students represent different structures and hormones within the bovine reproductive tract to kinesthetically illustrate the estrous cycle.

Simulations can also occur in virtual settings. For example, students might practice welding using welding simulation software, or they might conduct dissections using a fetal pig dissection website. Other virtual simulations allow students to remove or add various variables to illustrate the outcomes through a computer-generated animation. Simulations such as these can be very helpful tools to replace actual immersive experiences or enhance students' learning.

Games

Learning games can have several practical uses within an agriculture classroom, as described in Chapter 13. They involve students in competition against themselves, a computer, or other students, and highlight problem solving and decision making. Games can be used to introduce or reinforce content and can occur in a face-to-face setting or virtual setting.

Supervised Study and Individualized Application

Supervised study is a method in which students are directly responsible for their own learning while under the direction of the teacher. When used effectively, supervised study enhances student interest and develops students' problem-solving abilities. To guide the students, most supervised study involves the use of worksheets or of questions to be answered.

Although supervised study is typically thought of as students reading textbooks, students' use of references can take many forms. Videos, pictures, extension publications, commercial brochures, journals and magazines, internet resources, and resource people are all examples of valid references.

Care should be taken when the internet is used as a resource. Students should understand that on the internet:

- Not all websites are appropriate.
- Not all information is accurate.
- Not all information is unbiased.

The agriculture teacher should work with the school media specialist in determining appropriate resources and teaching students information-searching procedures.

The supervised part of supervised study is critical. The agriculture teacher is responsible for directing the supervised study. The teacher should be in a location where they can see all the students and should not be using supervisory time for tasks such as making telephone calls or grading assignments. Occasionally the teacher should circulate around the room and monitor student progress. This does not mean interrupting students with chitchat or needlessly giving answers. Instead, the teacher can provide encouragement, assist with misunderstandings, and assess individual comprehension of the topic.

Although supervised study is categorized as individualized instruction, there may be times when students can work together—for example, on group projects or presentations and during peer-assisted instruction. Grouping students is also appropriate when reference materials are limited.

Guided practice is a special form of supervised study. Whereas supervised study is typically associated with cognitive and affective learning objectives, guided practice is used for psychomotor objectives. In guided practice, the agriculture teacher demonstrates a skill or activity and then provides opportunity for students to practice the skill while under the watchful eye of the teacher. The teacher can quickly correct bad habits or safety problems individually or bring the students together for group instruction if appropriate.

Independent Study

There are occasions when it is appropriate to teach an agriculture course or topic as an independent study. An ***independent study*** is a learning activity that is not part of an organized class learning experience. Maybe a student wants to take an advanced level of an agriculture course and the number enrolled is not enough to justify a class period for the course. In such a case, the student would take on more responsibility for their instruction.

To be successful, independent study must have clear objectives, guidelines, and timelines in place at the beginning. Although the student assumes greater responsibility for finding resource materials and studying those materials, the agriculture teacher is still responsible for evaluation and overall direction.

Increasingly, independent study opportunities are available through distance education. Instruction may be delivered via packets of printed material, videos, the internet, or combinations of these. Students may be eligible to receive high school or college credit or both.

Learning Modules

A ***learning module*** is a self-contained activity that a student can complete independently in a face-to-face or online setting. Learning modules are most often used for cognitive and psychomotor objectives. Learning modules may be purchased or may be developed by the agriculture teacher. Modules placed around the room can be combined into stations that students rotate through as they complete the activities. An advantage of learning modules is that students can proceed at their own pace and instruction can be modified to meet students' individual learning needs. Learning modules are also useful in meeting FFA membership requirements for nonenrolled students.

Projects

Agricultural laboratories are ideal for individual student projects. A ***project*** is a significant, practical activity of educational value with one or more definite goals. An advantage of projects is they can maximize student interest because the student has flexibility in choosing a project to complete. The project can also be geared to the ability of the student. Thus, instruction is available at the appropriate level for all students.

As with other methods discussed, projects require planning and active participation by the agriculture teacher. The teacher must instruct students on wise use of time; responsibility for safety, cleanliness, and productivity; and the importance of doing a quality job. The agriculture teacher must answer several questions before using individual projects as an instructional method. What is the learning purpose behind a project? What are the minimum requirements for an acceptable project? What is the maximum time allowed for project completion? What are the procedures for using tools/equipment, cleaning up the laboratory, and obtaining materials/supplies? What safety and behavior rules need to be emphasized?

DEVELOPING A LESSON PLAN

A ***lesson plan*** is the road map an agriculture teacher uses to ensure effective, efficient, and empowering instruction. It is much like the plans used in building a house or the script used in making a movie or television program. Doctors performing surgery devise plans of action, sometimes even placing dotted lines where incisions should be made. Football coaches develop plays, playbooks, and game plans. Teachers also need direction and vision! It should

be made clear, however, that teachers are not movie actors and lesson plans are not scripts. A well-developed lesson plan allows the teacher to be flexible and creative and to take advantage of the "teachable moment."

There are many styles and formats of lesson plans, yet they all have some common components. Following are the essential components of a lesson plan.

Preparatory block The first essential component is the preparatory block. This contains organizational information useful for filing and indexing, documentation, and quick referencing. The block also includes unit and lesson titles, the length of the class period for which the lesson plan is designed, as well as the intended grade level of the lesson.

Desired results block Beginning your instructional planning by identifying your educational goals and objectives is important. Here, the educational standards, key ideas/questions explored by the lesson, and key vocabulary terms are listed. As part of this block are the assessments of learning aligned with the learning objectives. The teacher might also detail in this section how they plan to differentiate their lesson to meet the needs of specific learners in their class. For more information on differentiated instruction, see Chapter 7.

Materials and resources block This block contains a list of what materials are needed to deliver the lesson, including worksheets, handouts, printouts of PowerPoint presentations, and note-taking guides.

Lesson initiation block The next component is the lesson initiation, or beginning of the lesson, block. This part of a plan contains the interest approach, review of previous material, pretests, and other activities that occur at the beginning of a lesson.

Content and teaching–learning activities block The content and teaching–learning activities block is next. The two sections of this block may be set up one on top of the other or side by side. Depending on the lesson plan style, the sections of this block may be very detailed or serve as outlines. At a minimum, the content section contains an outline of the subject matter with key information highlighted. There is no need to repeat word for word information that is already found in a textbook or on a worksheet.

The teaching–learning activities section describes the strategies used to teach the content. These include instructions to the teacher on methods, questions to be asked of students, student activities, and procedural instructions, such as when or how to do a task. This section should include checks for understanding and scaffolding techniques. When designing the learning activities for a lesson, it is important to consider the three primary elements of the Universal Design for Learning (UDL) framework: (1) How will the teacher plan to provide students multiple means of engagement with the content? (2) How will the teacher plan to provide multiple means of content representation? (3) How will the teacher provide students with multiple means of action and expression of their learning?

Lesson closure block The lesson closure block provides details on how the lesson will be summarized and what conclusions can be drawn from the lesson. This block may also contain details on how this lesson links back to previous lessons and forward to the next lesson. It is important to include suggestions on how students can apply the lesson content. The evaluation section contains a description of how the students will be assessed, and copies of the evaluation instrument(s) and answer key(s) are attached to the plan.

In general, a lesson plan will cover one to five instructional periods. A lesson plan that takes less than one instructional period to cover means the topic is probably too narrow for a complete lesson. A lesson plan that takes more than five instructional periods to cover may mean the topic is a unit of instruction that needs to be divided into two or more lessons. Also, the teacher may develop daily plans to guide the introduction, teaching–learning, checks for understanding, and evaluation for each class session. These are broad guidelines and do not apply to all situations. A sample lesson plan template can be seen in Figure 12.5.

Preparatory block

Lesson topic: _____ **Grade level:** _____

Unit & course: _____ **Length of class period:** _____ minutes

Prepared by: _____

Desired results block

Desired Results
Educational standards addressed by this lesson: • •
What key problem(s) or concepts are students investigating during this lesson?
Key vocabulary terms used in this lesson:

Student Learning Objectives and Associated Assessments		
Objective Students will be able to:	Formative Assessment(s)	Summative Assessment(s)
Note: Attach all formative assessments and student handouts to this lesson plan. Include an answer key.		

Differentiation
How will you differentiate the content of your lesson?
How will you differentiate the learning process of your lesson?
How will you differentiate the expected learning products of your lesson?
How will you differentiate the learning environment during your lesson?

Materials & resources block

Materials and Resources Needed		
Source	Material	Quantity

FIGURE 12.5 Sample format of a lesson plan showing relationships of plan parts to the major blocks.

	Content block	Teaching–learning activities block		
Lesson segment	**Agriculture terms/ concepts/skills content outline**	**Activity to engage learners in the content**	**Anticipated management strategies**	
	(What ag knowledge/skills are students learning in this segment of the lesson?)	*(What are the students doing?)*	*(What is the teacher doing?)*	
Lesson initiation (est. time)		Students will be... • •	The teacher will... • •	**Lesson initiation block**
Transition (est. time)	*What will you say to cue desired behavior and link the initiation to the next segment?*			
Activity 1 (est. time)	Students will learn and know... • • • •	Students will be... • •	The teacher will... • •	
Transition (est. time)	*What will you say to cue desired behavior and link this activity to the next segment?*			
Activity 2 (est. time)	Students will learn and know... • • • •	Students will be... • •	The teacher will... • •	
Transition (est. time)	*What will you say to cue desired behavior and link this activity to the next segment?*			
Activity 3 (est. time)	Students will learn and know... • • • •	Students will be... • •	The teacher will... • •	
Transition (est. time)	*What will you say to cue desired behavior and link the learning from today to the closing activity?*			**Lesson closure block**
Lesson closure (est. time)		Students will be... • •	The teacher will... • •	

FIGURE 12.5 *Continued.*

In a traditional schedule, the agriculture teacher instructs students for 180 days and has five to six class periods a day. If the average lesson plan lasts for three days, then this typical agriculture teacher will need to develop 60 lesson plans for each class, or up to 360 separate lesson plans. Of course, time frames and lesson plan needs vary somewhat with semester-long classes and alternative scheduling. Why should an agriculture teacher develop their own lesson plans if these can be purchased? How should an agriculture teacher use commercially developed lesson plans?

Many states, either through curriculum centers or private companies, provide lesson plans for state-approved curriculums to their agriculture teachers. These lesson plans are typically professionally done and include illustrations, PowerPoint presentations, premade tests with answer keys, and suggested teaching–learning activities. These lesson plans can be a great help to both beginning and experienced teachers. Beginning teachers are saved the time of creating lesson plans from scratch. Experienced teachers may gain new ideas for teaching certain content.

These purchased lesson plans do not relieve the teacher of the responsibility of planning instruction. Commercial lesson plans may be generic in nature, requiring the agriculture teacher to make the content locally applicable. Often the plans consist of activities that center around a PowerPoint slide deck, with various rote memorization activities. A teacher wanting to provide more meaningful, student-centered experiences will need to modify those plans to meet the needs of their students. The plans may be written at the level of a typical student, requiring the agriculture teacher to modify them to differentiate instruction to reach all students in the classroom. In addition, each agriculture teacher has a style of teaching they develop over time. The commercial lesson plans are not written for a particular teacher's style, so modifications will need to be made in this area. Finally, commercial lesson plans, just like teacher-developed lesson plans, should be updated yearly with new content and teaching modifications.

USING INSTRUCTIONAL TECHNOLOGIES AND THE INTERNET

We live in a technological, information-rich society. Technologies seem to rise and become obsolete within a decade. The rate of information production continues to increase so rapidly that the time it takes for the volume of information to double is measured in years and months. Education is adopting instructional technologies at an ever-increasing rate. However, there are principles that apply, whether one is using a chalkboard/whiteboard, a PowerPoint presentation, or some other audiovisual aid.

The principles of interest discussed in Chapter 11 apply to using instructional technologies. Instructional technologies can be used to bring nature, humor, creativity, human interest, and the unusual into the classroom. When used effectively, instructional technologies can spread interest from interesting things to uninteresting ones. A caution is that the technology used should not be the focus but instead should enhance interest in the topic being studied.

Visuals

Well-designed visuals are important regardless of the instructional technology used. Visuals need to be visible and comprehensible to all students regardless of their location in the classroom. Instructional technologies need not be new to be valuable. The chalkboard/whiteboard is a useful tool in almost every agricultural education classroom. Because of its large size, ease of use, and ease of correction, this instructional tool is extremely functional.

Some instructional technologies do become obsolete. Filmstrips and 16 mm films gave way to first videotape and laserdiscs, then DVDs, and now to MP4 files that can be streamed from the internet. Reel-to-reel audiotapes were replaced by audiocassettes, which were then replaced by audio compact discs. Some of the instructional technologies discussed in this section will probably become obsolete within the near future.

Computers in the Classroom

The computer, in all of its forms and sizes, continues to be a valuable instructional tool in the classroom. Its uses cut across all areas of instruction. PowerPoint presentations are used to deliver notes, present procedures, and provide pictures to supplement lectures. Word processing, spreadsheet, and database programs are used in all aspects of teaching. Specialized computer programs are available to assist with agronomic, agribusiness, and management applications. The use of GPS and GIS has allowed agriculture teachers to teach about site-specific farming and other applications.

Some commercial curriculum services, such as iCEV Multimedia, have adapted their curricular materials to be accessible primarily through online classrooms such as Google Classroom. Students move through various learning modules and earn digital badges to illustrate their learning, which may result in industry-recognized certifications. More information on using computers and other digital technology in the agriculture classroom is described in Chapter 13.

REVIEWING SUMMARY

Today's learners bring unique experiences to the classroom and live in an information-rich world. Teachers need to design instruction that builds upon the assets students bring, while attending to their unique learning needs. Instruction that helps students develop deep understanding of agricultural concepts, provides opportunities for application, and weaves in a focus on metacognition of learning strategies is most effective for student learning. Teachers who organize their instruction using lesson plans, who carefully select teaching methods, and who appropriately utilize instructional technology have a positive impact on student learning. Teachers should strive to build continually upon their instructional repertoire and experiment with new techniques and technologies.

Bloom's taxonomy has guided teachers for more than 50 years in writing appropriate learning objectives. Although more recent research has shown students learn through their whole experience, Bloom's three domains of learning are still important for planning, assessment, and accountability purposes.

Teaching methods can be categorized as teacher-centered, social interaction, or student-centered. Effective teachers learn which methods work best in what situations, with what students, and for what purposes. Effective teachers also have a clear understanding of their teaching philosophy and how it impacts their instructional decision-making.

Lesson plans are critical for teachers to be effective and efficient. Although numerous styles of lesson plans exist, they all have certain similar components. Commercially or professionally developed lesson plans hold advantages for both beginning and experienced teachers; however, the local teacher must still personalize the plans.

Instructional technologies enhance the classroom environment. Through the use of these technologies, students are exposed to content and resources they would not have access to otherwise. Teachers need to take care that the subject matter, not the instructional technologies, is the focus of student attention. Computers, although extremely useful in the classroom, are merely another tool the teacher uses to enhance the student learning experience.

QUESTIONS FOR REVIEW AND DISCUSSION

1. Recall the principles that guide learning in the 21st century outlined by Darling-Hammond et al. (2008). How do agriculture teachers integrate these principles into their instruction?
2. What factors influence selection of a teaching method? Are there any other factors you can identify that would influence your selection of an appropriate teaching method?
3. How is Bloom's taxonomy used in the agricultural education classroom?
4. How are learning objectives written using the ABCD approach?
5. How do student-centered and teacher-centered instructional methods differ?
6. Discuss when it may be appropriate to utilize teacher-centered approaches such as lecture.

7. What is a lesson plan?
8. Why is it important for all agriculture teachers to use lesson plans?
9. What are the common components of all lesson plan styles?
10. What are the advantages and disadvantages of using commercially or professionally prepared lesson plans?
11. How do the principles of interest discussed in Chapter 11 relate to instructional technologies?

ACTIVITIES

1. Investigate the affective and psychomotor domains of learning. Why have these not been developed as fully or emphasized as much in education as the cognitive domain? How is this different or the same for agricultural education?
2. Investigate agricultural education resources on the internet. Develop and organize a sharable document (such as a Google Sheet) or create a Wakelet that serves as a collection of the resources you find.
3. Using the *Journal of Agricultural Education*, *The Agricultural Education Magazine*, and the proceedings of the National Conference of the American Association for Agricultural Education, write a report on block scheduling research in agricultural education. Current and past issues of these journals can be found in the university library. Selected past issues can be found online at www.aaaeonline.org or www.naae.org.
4. Explore the differences between behaviorist and constructivist teaching approaches. Which of these systems do you align more with? Revisit your teaching philosophy statement and consider how your teaching philosophy guides your instructional decision-making.
5. Explore culturally responsive teaching, culturally relevant pedagogy, and trauma-informed teaching. How do each of these approaches to instruction help students learn and grow?

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