COLLEGE & CAREER

AGRICULTURE, FOOD AND NATURAL RESOURCES

Teacher Guide

Managing the Agriscience Laboratory

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1. The Value of Laboratory Experiments in Agricultural Education

The way a student's eyes light up when they make an interesting observation or the joy a student feels when they discover something previously unseen or unknown to their peers — these are the moments when teachers see the value of laboratory experiments in agricultural education. Student ownership and engagement in learning is what drives the professional educator, and this is essential in agricultural education.

Agricultural education allows students to explore skills, knowledge, and careers related to the industries of agriculture, food, and natural resources. These subjects expose students to a wide variety of science-related skills that are best taught through observation, investigation, and drawing conclusions from hands-on laboratory experiments. Agricultural education is often represented in the school curriculum as an elective, career and technical education course, but many school districts around the state offer agricultural science courses as equivalents to meeting high school science graduation requirements. The overlapping content and integrated standard alignment between agricultural education courses and non-agriculture courses like biology, chemistry, and physical science allow for many activities, labs, and teaching strategies to be shared among agriculture and general science teachers.

Laboratory experiments, therefore, allow students to directly engage with the learning objectives and literally see what they are learning with their own eyes. From things as simple as observing the incubation and hatching of baby chicks to the complexity of crossing commercial corn hybrids over multiple growing seasons, students receive tremendous, undeniable value when they are empowered to explore and discover the science behind agriculture. Laboratory experiments clarify and illustrate concepts taught in the classroom. Understandings are deepened through application and reflection. These experiences develop skills while boosting motivation, and they promote safe working habits while demonstrating industry-aligned practices and a controlled working environment.

2. The Essential Components of the Modern Learning Laboratory

In 2021, 24% of Illinois high school and middle school AFNR programs reported their facilities included a stand-alone agriscience laboratory space; however, many programs conduct experiments in existing facilities, such as a mechanics laboratory, general classroom, or greenhouse. Each laboratory should have adequate working space for the locally determined occupancy of each section or course assigned to use that laboratory. Work with your department chair, administration, and teacher colleagues to determine the ideal number of students for the space because this number will inform how the lab is designed, managed, and maintained throughout the school year. State laws and regulations governing class size are based on occupancy standards established by the Building Officials and Code Administrators International Inc. and the National Fire Protection Association Inc. Both sets of standards call for 50 square feet of space per person in school

laboratories or workshops. The National Science Teachers Association (NSTA) calls for a minimum of 45 square feet per student for a stand-alone laboratory and 60 square feet per student for a combination laboratory-classroom. This translates into at least 1,250 square feet for a laboratory and 1,440 square feet for a combined laboratory classroom. The NSTA recommends a maximum class size of 24 students in high school laboratory science classes.

There are several aspects, other than adequate working space, to consider about your agriscience lab.

1. Safety and proximity must be considered regarding gas, electrical outlets, water access, material retrieval and return, hazardous material disposal, regular foot traffic, and safe ease of access and exit from the laboratory in the case of fire, tornado, or other mass movement of students.
2. Working surfaces must be resistant to caustic or corrosive materials. The surfaces must be easy to clean and spacious enough to allow for safe and convenient material layout and usage.
3. Ventilation for all laboratories should conform to local building code requirements, and these specially designed working areas (fume hoods) should be visible and accessible to all laboratory participants. All fume hood controls should be accessible outside of the ventilation area.
4. The laboratory should be designed in accordance with the Americans with Disabilities Act in such a manner to create equal access to all students of differentiated abilities. Portable, adjustable lab stations should be considered, as needed, for current or future students.
5. Storage space should be provided to ensure that all equipment, chemicals, and other teaching and learning supplies can be secured against unauthorized use. In-room storage should be installed in a manner as not to hamper student movement to workstations or exits.
6. Specialized storage space should be designated to contain any poisonous, corrosive, caustic, or explosive materials and should be outfitted with a secure locking system.
7. Flammable storage space should be clearly labeled and vented to the outside of the building.
8. Safety equipment should be provided to reduce the potential for accidental injury.
    a. Portable fire extinguishers (ABC-rated) should be acquired, installed, and maintained.
    b. Eyewash stations are required for all laboratories.
    c. Secure master controls should be provided for gas, water, and electricity.
    d. In the event of fire, electrical shock, flooding, or explosion, the teacher should be able to shut down the services and initiate the appropriate emergency procedures.
    e. Provide safety shower(s) where strong caustics, corrosives, or skin-absorbable poisons are utilized.
    f. Read and follow all labeled instructions and safety materials obtained and utilized in the laboratory.
    g. Personal protective equipment (PPE), such as protective aprons, gloves, and splash-resistant goggles, must be provided and readily available in the laboratory.
    h. Safety charts, fire blankets, and first-aid kits must be furnished in all science laboratories.
    i. All chemicals must be labeled with the name, purchase date, and expiration date of the chemical on the container and separated by incompatible types. Each school building must maintain an annual inventory of the laboratory chemicals, along with the Safety Data Sheets.
    j. Each laboratory should have an outside-line phone readily accessible in case of emergency.
9. The classroom and laboratory should be furnished with desks; a teacher desk; and student lab workstations with gas, water, and electric connections. They also should have student tables; a teacher demonstration table; sinks; instructional white or erasable boards; TV monitor; computer or equivalent working stations, as needed; safety goggle/glasses cabinet; and display/storage cabinets. At least one sink should be deep and large with a high swivel spout faucet. This sink should be capable of holding a small bucket.
10. Plastic laminate table tops wear exceptionally well under normal use. They have superior resistance to scratching with limited resistance to high temperatures, organics, and concentrated acids and bases.

3. Developing Expectations and Training Students

Consistency is key when training students how to learn in a safe, efficient agriscience laboratory. The two greatest challenges teachers face when managing agriscience labs are safety and time. Establishing a commonly known and followed routine is the best way to train students. Modeling these expectations from the first day in an agriscience laboratory and consistently repeating and reaffirming appropriate behavior will pay dividends throughout the school year. The only question is — how?

Key information should be presented to students in multiple ways. Safety rules, common procedures, material storage and collection information, and even emergency procedures should be posted throughout the room in clearly visible, obvious, and appropriate locations. Lab-specific information can be distributed via a printed handout or digital file or displayed on a classroom TV or monitor each day.

Before conducting the first science lab, explain the general lab procedures and distribute a handout (hard copy or digital) of the common procedures. Things like obtaining the required materials; preparing lab reports with data tables, notes, and sketches; and cleaning after experiments will all have generally consistent procedures regardless of the specific experiment. These procedures, which should be consistent and based on the working space and age and experience of the students, should be reviewed and modeled before any hazardous or complex lab work is done. Consider explaining these procedures and demonstrating proper steps. Then have students model these steps in an easy, low-risk lab activity like working with modeling clay, creating an origami structure, or even planting seeds for a classroom garden. This will help to build expectations and train students before any hazardous materials or complicated labs are performed. Model all necessary procedures, from wearing and using PPE to cleaning the laboratory and turning in completed work.

4. Safety in the Agriscience Laboratory

Inform students of the safety hazards and safety requirements of your lab and subject. Consider the different safety practices needed for the various agricultural education learning spaces (e.g., general classrooms, agriscience laboratories, industrial shops, greenhouses, gardens, and even field and farm visits). On Day 1, clearly explain the rules regarding PPE. Many programs utilize a unit of instruction explicitly addressing safety practices, procedures, and common hazards specific to the space and subject for that course. This unit is often concluded with a comprehensive safety assessment that can be used as a prerequisite to full participation in laboratory experiments in the agriscience classroom.

Consider requiring both students and guardians to sign a safety contract, which you should then keep on file. Explain that safety is a zero-tolerance component of the agricultural education program, and that safety takes precedence over all other components, including the learning objectives of the day and any personal or social concerns at school and home. Completing the laboratory experiment safely and without harm to themselves or others is the priority of every student and teacher.

Repeating safety concerns specific to each laboratory experiment is also important. Utilize the Safety Data Sheets for each laboratory experiment as a teaching tool. Students will gain valuable skills in reading and understanding safety precautions while preparing for the lab that day.

5. Collaborative Working Groups

There is no set rule for forming lab groups but doing so in an intentional and strategic way can be key to success or failure in the laboratory. Differing dynamics from class to class make standardizing lab group selection nearly impossible. Here are some suggestions on how to form working groups:

1. *Station Size* — Most lab tables accommodate four students, so you may find it beneficial to form groups accordingly. You may need some built in flexibility for labs or activities that are better suited for pairs or other configurations. Adjust group size, as needed.
2. *Alphabetically* — While this may seem like an unintentional way of forming groups, using the alphabetical order of first or last names can be a great way to form groups when you have not yet learned the dynamics of a new class of students. Try being creative with this method as well. For example, pair the first two students with the last two students. Once you've learned different working dynamics for specific students, you can make small adjustments as needed.
3. *Randomly* — When trying to be fair and equitable in establishing working groups, it may be best simply to draw names from a hat. This can be made to be a special occasion of sorts. However, make sure to inform your students that you still maintain the right to make changes, as needed. Consider having students write any notes or concerns they have for working groups before publishing a finalized list of groups. You will want to consider if a student has special needs or preferences before finalizing groups.
4. *Pairing Students by Strengths* — Consider pairing students who you know have special skills or abilities that can contribute to the overall success of a group. For example, an ideal group would have a balance of students who are proficient writers, investigators, timekeepers, leaders, and workers (students who are great about getting right to work at the start of class). A well-balanced group can

learn to utilize different strengths and abilities throughout the year. You may also have students adopt these official "roles" within their group.

5. *Students' Choice* — This method may work in classes with existing relationships, common interests, and shared working styles. However, careful monitoring is essential to prevent lab time from turning into solely "fun" time with friends.
6. *Flexibility* — Lab group membership doesn't necessarily need to be set in stone for the length of the course. Regrouping students periodically so they have a chance to work with multiple lab partners can allow students to build new relationships and may keep things exciting and new. Obviously, consistent groups can become more efficient and uniform in their communications and assigned roles; however, learning to work with different people in changing environments is a great skill for students to learn.

6. Material Distribution and Collection

This aspect of agriscience laboratories is often the greatest challenge in terms of effectively managing the time available. Consistency is also important here as well. If working materials (beakers, sensors, monitors) are housed in the same place for each lab, students can be trained and trusted to obtain these materials independently. If multiple materials are needed, it can be helpful to gather those materials into a single "kit" for students to retrieve in one trip. Any specialized materials (like chemicals, organic materials, soil, etc.) should be placed in an easily accessible and clearly marked location. Before the start of each lab, briefly review each of the required materials and remind students of their location in the laboratory.

You may also want to consider these other items relating to material distribution and collection:

1. Discuss the activity before students begin. Point out and, if needed, discuss common errors and safety precautions. If not already conducted in a pre-lab, demonstrate those procedures or portions that present the greatest difficulty for students.
2. Train students to obtain materials. They should know where to locate basic equipment and how to properly clean and store that equipment once the activity is completed.
3. Throughout the activity, periodically remind students of the amount of working time remaining so that they can monitor their own progress and timeliness. Specifically address students who are noticeably behind and encourage them to catch up, if possible.
4. Have a consistent procedure for general laboratory cleanup. Assign roles to specific groups and maintain your ability to monitor this process. Try not to become actively engaged in cleaning, as your watchful eyes will be essential in the controlled chaos of cleaning up the agriscience lab. Ensure students are not taking unnecessary risks, like hurrying or rushing with hazardous materials, improperly cleaning and storing equipment, or improperly disposing of or returning hazardous materials.

7. Best Practices for Managing Agriscience Labs

Agriscience labs can be an extremely fun and rewarding way of gaining new knowledge and skills; however, they do present a highly complex management system for teachers. Some ideas to consider as best practices have been listed below. Review and implement these ideas in your own program for continued success!

1. Perform the lab yourself before doing it in class with students. Preferably, enlist the help of a non-science colleague who will be able to model the perceptions of students not already familiar with the concepts, equipment, and procedures of science. This will help you be prepared on lab day.
2. Do not leave large bottles of chemicals accessible to students. Labeled dropper bottles are safer for students to use and make it easier for you to inventory chemicals after use.
3. Count before the bell rings. Science materials can easily and unintentionally "walk" away with students as they rush to make it to their next class period. Lock up expensive items, such as balances and microscopes. You may also find it helpful to number such items so that you can easily identify which item has not yet been returned. For more expensive items, consider having students "sign out" specific items and use this as a checklist when the equipment is turned in.
4. Take advantage of other programs at your school to help manage your agriscience laboratory. If your school has teacher assistants, they may prove helpful in organizing and maintaining laboratory equipment and working stations. You may also find that other courses or departments have similar needs, and that a shared working space or aligning lab days may be helpful.
5. Coordinate with colleagues. If you share a room or lab space, make sure all teachers using the room have similar expectations. This is incredibly helpful when students are returning to a known classroom or space and can model expectations they have already learned.

8. Additional Resources

Consider exploring these additional resources for more information on managing an agriscience laboratory.

- Angelo. “Classroom Management: It's Not Just Tips and Tricks.” *Science Teaching*, (link).
- Gonser, Sarah. Berger, Tom. “5 Smart Ways to Run Science Labs When You’re Teaching Remotely.” *Edutopia.* October 29, 2020. (link).
- Tammy. “Managing Your Science Labs.” *The Owl Teacher*. Retrieved August 25, 2021. (link).