

Lesson C2–1

Practicing Safety in the Lab

Unit C. Basic Principles of Agricultural/Horticultural Science

Problem Area 2. Identifying and Using Agriscience Tools and Equipment

Lesson 1. Practicing Safety in the Lab

New Mexico Content Standard:

Pathway Strand: Natural Resources and Environmental Systems

Standard: VIII: Understand environmental service systems.

Benchmark: VIII-B: Apply hazardous materials management principles to assure a safe facility.

Performance Standard: 1. Describe risks related to hazardous materials. 2. Describe health and safety practices to reduce risks from hazardous materials. 3. Describe use appropriate use of Personal Protective Equipment.

Student Learning Objectives. Instruction in this lesson should result in students achieving the following objectives:

1. Explain the meaning of safety
2. List hazards found in agriscience laboratories
3. Identify and properly use personal protection equipment
4. Describe safety practices with machinery and tools
5. Describe safety in agriscience laboratories

List of Resources. The following resources may be useful in teaching this lesson:

Recommended Resources. One of the following resources should be selected to accompany the lesson:

Morgan, Elizabeth M., et al. *AgriScience Explorations*, Second Edition. Danville, Illinois: Interstate Publishers, Inc., 2000. (Chapter 6)

Lee, Jasper S. and Diana L. Turner. Activity Manual — *AgriScience*, Third Edition. Danville, Illinois: Interstate Publishers, Inc., 2003. (Agriscience laboratory and safety skills section, pages 1–6)

Other Resources. The following resources will be useful to students and teachers:

Dosman, James A. and Cockcroft, Donald W. *Principles of Health and Safety in Agriculture*. Boca Raton, Florida: CRC Press, Inc., 1989.

Lee, Jasper S. *Program Planning Guide for AgriScience and Technology Education*, Second Edition. Danville, Illinois: Interstate Publishers, Inc., 2000. (Note: Teachers should refer to Chapter 7 in this publication.)

Wood, Clair G. *Safety in School Science Labs*. Portland, Maine: J. Weston Walch, Publisher 1991.

List of Equipment, Tools, Supplies, and Facilities

Writing surface

Overhead projector

Transparencies from attached masters

Copies of student lab sheets

The following personal protection equipment: goggles or safety glasses, rubber gloves, ear plugs or muffs, and particle mask.

One sheet of poster board/paper

Water-based markers

One sheet clear transparency film

Eye dropper

Terms. The following terms are presented in this lesson (shown in bold italics):

Accident

Carelessness

Ear muffs

Ear plugs

Goggles

Hazard

Materials Safety Data Sheets (MSDS)

Personal protective equipment (PPE)

Risk

Safety

Safety glasses

Interest Approach. Use an interest approach that will prepare the students for the lesson. Teachers often develop approaches for their unique class and student situations. A possible approach is included here:

Approach One: *Draw the outline of a human face on a sheet of poster paper. Use water-based markers so that the lines will “run” when water gets on them. Draw reasonably prominent ears, eyes, nose, and mouth on the face. Particularly make the eyes blue or brown. Place the poster on a bulletin board or stand it in the molding at the bottom of a writing surface. Lightly tape a clear piece of plastic or transparency film over one eye and leave the other eye uncovered. Use an eye dropper and squirt a tiny amount (one or two drops) of water into one eye. Have students observe how the marker “runs” or blurs as a symbol of eye injury. Next, squirt a couple of drops at the covered eye and note what happens. Ask students to explain the benefit of eye protection.*

Summary of Content and Teaching Strategies

Objective 1: Explain the meaning of safety

Anticipated Problem: What is safety?

- I. **Safety** is preventing injury and loss.
 - A. Injury and loss may be inflicted on people or their property.
 1. People can suffer cuts and other wounds, injury to eyes and hearing, loss of appendages, and death as a result of accidents.
 2. Animals, crops, machinery, and other property can be injured or destroyed by accidents.
 3. Safety should also consider protecting the environment from spills of toxic materials, release of smoke, and other activities that may result in environmental damage.
 - B. Precautions can be taken to make an environment safer.
 1. An **accident** is an event that occurs unintentionally. People do not know that an accident is going to happen. If they did, they would avoid them. Accidents occur at home, work, school, and all other places. Some places have greater hazards than others.
 2. A **hazard** is a danger where risk is present. Some situations are more hazardous than others, such as operating a motor vehicle is more hazardous than using a computer. We can practice safety if we know the hazards associated with a particular activity.

3. **Risk** is the chance that an accident will occur. Risk can be reduced by taking the proper precautions.
 4. **Carelessness** is failing to pay attention to hazards and taking unnecessary risk. Many people know what is safe but fail to go about their work and activities in a careful manner.
- C. Safety is important for a number of reasons. Protecting people is important. Protecting property is also important. Following safety practices prevents violating laws and avoids costs of medical bills and repairing or replacing damaged property.

Use background information as well as real-life examples in covering this objective. Have students read the appropriate sections in the textbook. Use the writing surface or TM:C2–1A to present definitions of the key terms. Ask students to name examples of unsafe situations that have resulted in accidents. (Their examples may range from driving an automobile in an unsafe manner to carelessness in using tools.) Emphasize the importance of behavior that respects risks and takes steps to reduce the hazards that may be present. Use the writing surface or TM: C2–1B to list the reasons safety is important, with stress on people and property.

Objective 2: List hazards found in agriscience laboratories.

Anticipated Problem: What hazards are found in agriscience laboratories?

- II. Agriculture/horticulture laboratories involve a number of areas where safety hazards are found.
 - A. Begin by assessing the conditions in a laboratory that pose safety hazards.
 1. Identify the equipment, materials, and activities that occur.
 2. Assess the equipment, materials, and activities in terms of risk and identify practices that can be followed to reduce risk.
 - B. Areas involving hazards in agriculture/horticulture laboratories are fairly easy to identify. Visual inspection will allow most hazards to be identified.
 1. Hazards are associated with using power tools and equipment.
 2. Hazards are associated with using living organisms, including plants, animals, and microbes.
 3. Hazards are associated with chemicals, fertilizers, and other substances.
 4. Hazards are involved with many work activities, such as constructing projects, carrying out experiments, and handling animals.
 5. Hazards are involved in using electricity and electrical power tools.
 6. Hazards are found in many places such as water, falling, and exposure to sun and temperatures.

This objective should be taught as related to the agriculture/horticulture laboratory and the activities of students in the lab as well as in supervised experience. Have students read the appropriate sections in the textbook. A list of possible hazards is presented in the recommended textbook. Have students name exam-

ples of activities that occur in a laboratory that could result in injury. Develop a list on the writing surface or use TM: C2–1C. Relate examples of accidents you are aware of that occurred in laboratories.

Objective 3: Identify and properly use personal protection equipment (PPE).

Anticipated Problem: What is personal protection equipment and how is it used?

III. *Personal protective equipment* (PPE) are devices worn or used to protect from injury.

- A. Individuals should take the initiative to properly use the appropriate PPE in a laboratory.
 - 1. PPE must be available and clean.
 - 2. Incorrectly using PPE does not provide the needed protection.
 - 3. PPE may be owned by an individual or by the school and stored in a facility that keeps it sanitary. Some PPE cannot be shared, such as ear plugs and masks. Goggles and safety glasses may be shared if properly cleaned between uses.
- B. PPE are often needed in four major areas in an agriculture/horticulture laboratory: eyes, hearing, skin and body, and respiratory.
 - 1. Eye protection is needed in areas where eyes may be injured. The protection afforded should be appropriate for the hazard. Some activities, such as welding, need to protect the eyes from bright light. Other activities, need to protect the eyes from splashing liquids, such as with chemicals, or flying particles, as with cutting wood, metal, or plastic. The most widely used PPE includes goggles, safety glasses, and face shields. Eye PPE should fit properly and not have broken or cracked lens. Lens should be clean. **Goggles** are eye PPE with lens and rims that prevent solid objects, liquids and other materials from getting into the eyes. They should be held snugly against the face by a strap. **Safety glasses** are specially designed spectacles that prevent flying objects from getting into the eyes. They should fit tightly and have brow bars and side panels that afford protection. It is best to use goggles in situations where liquids are involved because of the tight seal around the forehead and cheeks that prevent liquids from running into the eyes. In some cases, face shields are used alone or in combination with safety glasses. Tinted lens should be used as appropriate.
 - 2. Hearing protection is needed in areas where noise occurs on a sustained basis and with sufficient volume to damage hearing. Environments with loud bangs or engines require hearing protection. Ear plugs and muffs are most commonly used. **Ear plugs** are small foam rubber devices that fit into the ear canal to reduce the passage of sound waves into the ear. Ear plugs may be single plugs or corded pairs. **Ear muffs** are sound absorptive devices that cover the entire outer ear and prevent the passage of sound waves into the ear.
 - 3. Skin and body protection is needed to prevent injury to the skin, bones, and other body tissues and organs. Gloves are worn on the hands to protect from solutions, cuts, and abrasions. Many kinds of gloves are available, ranging from the leather welding gloves with gauntlets to rubber gloves used in handling biological tissues. Special types of gloves to resist cutting by sharp knives are worn in meats laborato-

ries. Boots and special shoes may be needed, depending on the hazards in the laboratory. Hats are used to protect from falling objects and other hazards and reduce contamination of food products with hair. The kind of hat to use depends on the situation. Aprons and special clothing are needed in some situations, such as a chemical laboratory.

4. Respiratory protection is needed in places where dust, liquid droplets, gases, and other materials may be in the air. Particle masks and respirators are most widely used. Special types of respirators are needed in some particularly hazardous situations that should be avoided in school labs. Particle masks should be clean and fit properly over the nose and mouth. The strap or elastic band should hold the particle mask securely in place so that no air can enter around the edges of the mask. Respirator equipment should be selected for the particular situation in which it will be used. Air circulation and removal is needed in areas where smokes, fumes, and other air-borne materials are being released.
- C. Reliance only on PPE is not sufficient. Steps must be taken to make a laboratory environment as safe as possible otherwise.

Have students read the section in the textbook on personal protection equipment. This may be as homework or in supervised study. In some cases, students may read orally to the class as part of enhancing reading skill development. Bring specimens of PPE used in the school lab into the classroom. Outline the major areas on the writing surface or use TM: C2–1D. Demonstrate the proper use of PPE. Have each student try on PPE and adjust it for maximum protection. Explain the policy of the school on PPE and how PPE is kept clean and in good condition. Outline when eye PPE is used on the writing surface or use TM: C2–1E. Outline the use of hearing PPE or use TM: C2–1F. Outline the use of skin and body PPE on the writing the surface or use TM: C2–1G.

Objective 4: Describe safety practices with machinery and tools.

Anticipated Problem: What safety practices should be followed with machinery and tools?

- IV. Many kinds of power machines and tools pose hazards to users and those who are observing their use.
 - A. Power equipment, engines, and motors are especially hazardous.
 1. Always know how to properly operate equipment before attempting to use it.
 2. Study the operator’s manual.
 3. Get an experienced operator to “check-out” a person before attempting to use equipment or tools.
 4. Know the sources of hazards. Several potential hazards are with fuels, batteries, electricity, PTO and pulleys, cooling systems, and moving parts.
 5. Tractors and equipment and power tools have special hazards. All safety practices should be conscientiously observed in using them.
 6. Dress properly and wear PPE for the kind of equipment that is being used.

- B. Hand tools can cause severe injuries if not used properly.
 - 1. Hand tools should always be in proper working condition.
 - 2. Hand tools should be used properly and only as intended.
 - 3. Wear eye and hearing protection as appropriate.
 - 4. Properly store tools when not in use.
 - 5. Never throw or drop a tool.
- C. Electricity safety poses special problems in many laboratories.
 - 1. Electrical circuits may pose special safety risks particularly around water.
 - 2. All electrical devices should be installed according to the proper electrical code.
 - 3. All circuits should be protected with ground fault circuit interrupters (GFCI).
 - 4. Use only UL (Underwriters Laboratory) approved materials.
 - 5. Turn switches off except when electrical power is needed.
 - 6. Avoid using extension cords, especially long cords with small gauge wire.

Have students read as home work or during supervised study the sections in the textbook that relate to power and hand tool safety. Some of the safety practices may be demonstrated at this time. Other safety practices may be incorporated into instruction on the use of the equipment or tools. Use student input to outline the major content on the writing surface. If time permits, tour the school lab and discuss areas where safety is a particular problem. Use the writing surface or TM: C2-1H to outline safety practices around electricity. Show students how to identify a GFCI-protected circuit.

Objective 5: Describe safety in agriscience laboratories.

Anticipated Problem: What safety practices should be followed in science-based agricultural/horticultural laboratories?

- V. Chemicals, living organisms, and devices that can cause injury are found in science-based agricultural/horticultural laboratories.
 - A. Use chemicals safely.
 - 1. **Material Safety Data Sheets** (MSDS) are sheets sent with all shipments of chemicals and are available from chemical suppliers or via the Internet. Refer to them for information on particular chemicals. MSDS provide information on the safe use of the particular chemical. Always understand the chemical that is being used.
 - 2. Follow basic rules: know the material, never touch or taste the substance, avoid inhaling fumes, conduct experiments in ventilated areas, and store and label chemicals properly.
 - B. Avoid hazards with laboratory equipment.
 - 1. Laboratory equipment can cause cuts and other injuries. Use the equipment to minimize risk.
 - 2. With glass, never use broken or cracked glass ware. Do not drop or force glass. Avoid heating and rapidly cooling glass. Carefully clean up broken glass to avoid injury.

- C. Handle organisms carefully. Know the nature of the organism and how to handle it. Plants, animals, and microbes can all cause injury.
- D. Use fire and heat properly to avoid accidents and assure a safe laboratory.
- E. Know the laboratory and the procedures to follow. Know where safety equipment is located, such as fire extinguishers and emergency eye wash equipment. Follow the policy of the school in reporting accidents.

Have students read the sections in the textbook that relate to safety in science-based agriscience laboratories. Have students review a sample MSDS for chemicals used in the school lab. Outline the content on the writing surface as related to your facilities. Provide students with copies of the safety policies of the school. Go over these policies. Tour the laboratory and identify safety equipment and features. Have students use the Lab Sheet on Safety Hazard Identification (LS: C4–1A) in studying the laboratory to identify safety features.

Review/Summary. Summarize the content of the lesson by asking students to explain each objective. Reteach areas where students appear deficient. Use the writing surface or TM: C2–1I to summarize important safety rules. It may be a good idea to provide each student with a paper copy of this transparency. You may also wish to use a lab safety test based on the local school situation.

Application. Application will occur as students perform learning activities in the school laboratory or as they work in their supervised experience programs. A lab sheet on laboratory safety may also be used.

Lab Safety Hazard Identification—LS:C2–1A

Students can use the Internet to explore MSDS for various chemical products. A web site with 90,000 MSDS is maintained by the Sigma-Aldrich, Inc., as follows:

<http://www.sigma-aldrich.com/>

Note: It is important for teachers to cover those safety areas unique to the laboratories in their schools. Safety areas related to the instructional content should be covered thoroughly. Students should never be involved in any learning activity without first being properly instructed in areas of safety. It is a good idea to prepare, administer, and keep on file a safety test that documents the achievement of each student in this regard.

Evaluation. Evaluation should focus on the extent to which the students achieve the objectives for the lesson. This will include how they practice safety in the laboratory, use PPE, and otherwise demonstrate their understanding of laboratory safety. A written test may be used. A sample written test is attached.

Answers to Sample Test:

Part One: Matching

1=i, 2=j, 3=h, 4=a, 5=c, 6=f, 7=g, 8=e, 9=d, and 10=b

Part Two: Completion

1=particle, 2=Gloves, 3=Ear muffs, 4=head, and 5=people and property

Part Three: Short Answer

1. Any rules listed on TM: C2-1I or on a locally prepared safety sheet will be satisfactory.

Test

Lesson C2–1: Practicing Safety in the Lab

Part One: Matching

Instructions. Match the term with the correct response. Write the letter of the term by the definition.

- | | | |
|------------|-------------------|---------------------------------|
| a. safety | e. safety glasses | i. ear plugs |
| b. hazard | f. risk | j. Materials Safety Data Sheets |
| c. PPE | g. carelessness | |
| d. goggles | h. accident | |

- _____ 1. Small devices that fit into the ear canal to reduce the passage of sound waves into the ear.
- _____ 2. Information on the safe use of chemical materials.
- _____ 3. An event that occurs unintentionally.
- _____ 4. Preventing injury or loss.
- _____ 5. Equipment that is worn to protect the human body from injury.
- _____ 6. The chance that an accident will occur.
- _____ 7. Failing to pay attention to hazards and taking unnecessary risk.
- _____ 8. Spectacles specially designed to keep flying objects from getting into the eyes.
- _____ 9. Eye PPE held in place by a strap to assure a snug fit around the eyes.
- _____ 10. A danger where risk is present.

Part Two: Completion

Instructions. Provide the word or words to complete the following statements.

1. A _____ mask is an example of respiratory PPE.
2. _____ are PPE worn on the hands to protect from injury.
3. _____ PPE worn over the ears to protect from damaging noise.
4. Hats are used to protect the _____ from injury.
5. Injury and loss from accidents may be to _____.

Part Three: Short Answer

Instructions. Provide information to answer the following questions.

1. List five important safety rules in an agriscience laboratory.

SAFETY DEFINITIONS

Safety—preventing loss or injury.

Hazard—danger in an environment where risk could result in human injury.

Risk—chance of an accident or injury occurring.

Carelessness—failing to pay attention to hazards and taking unnecessary risks.

IMPORTANCE OF SAFETY

Safety is important because:

- **People are protected.**
- **Fish and other organisms are protected.**
- **Equipment is protected.**
- **Buildings last longer.**
- **Medical expenses are avoided.**
- **Laws are not violated.**

HAZARDS ARE ASSOCIATED WITH MANY ACTIVITIES

- **Using power tools and equipment**
- **Using living organisms**
- **Using chemicals, fertilizer, and other materials**
- **Constructing projects, carrying out experiments, and handling animals**
- **Using electricity**
- **Using water**
- **Exposure to the sun**

PPE

Personal Protective Equipment (PPE)—devices worn or used to protect from injury.

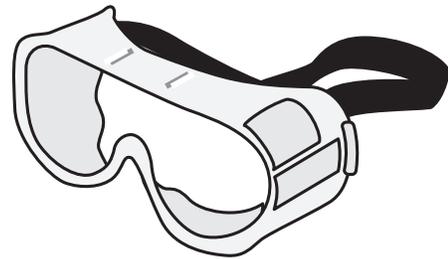
- **Eye protection**
 - Goggles
 - Safety glasses
 - Face shields
- **Hearing protection**
 - Ear plugs
 - Ear muffs
- **Skin and body**
 - Gloves
 - Boots/shoes
 - Hats
 - Aprons and special clothing
- **Respiratory**
 - Particle masks
 - Respirators

EYE PPE

Needed when:

- using liquids that may splash into the eyes
- doing work where small particles of wood, plastic, metal, concrete, etc., may fly into the eyes

Goggles—prevent tiny objects, liquids and other materials from entering the eyes



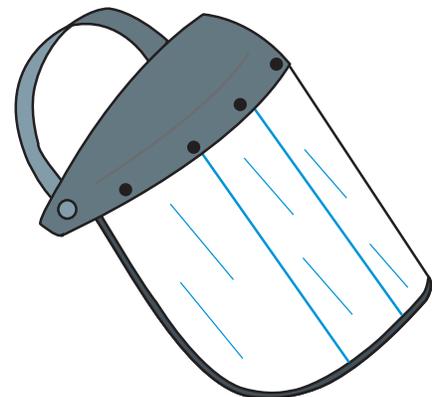
Splash-Impact Goggles

Safety glasses—spectacles designed to prevent tiny objects from flying into the eyes



Safety Glasses
with side shields and brow guard

Face shield—break-resistant see-through plastic material that covers the entire face



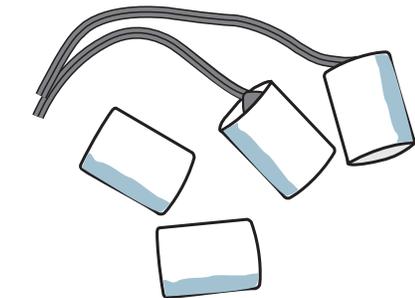
Face Shield

HEARING PPE

Needed when:

- Sustained noise occurs that can damage hearing
- Loud noise occurs occasionally that will potentially damage hearing

Ear plugs—small foam devices that fit into the ear and reduce the movement of sound waves to delicate areas that can be damaged



Corded and Uncorded Ear Plugs

Ear muffs—sound-absorptive devices that cover the entire outer part of the ear to prevent or reduce the passage of sound waves



Ear (hearing) Muffs

SKIN AND BODY PPE

Needed when:

- **Activities may result in cuts or other injuries**
- **Harmful solutions may get on the skin**
- **Falling objects or other accidents result in blows to the body**

Gloves—devices worn to protect the hands; kind varies with nature of the work; rubber or plastic gloves are used to protect skin from liquids; fabric/steel combination used to protect from cuts

Boots—worn on feet in place of shoes or over regular shoes to protect from liquids or falling objects; often made of rubber or plastic though some may be of leather with reinforced steel toes and other parts

Other skin and body ppe—hats, aprons, waders, etc., should be used as needed

ELECTRICITY SAFETY

Electricity is the flow of electrons; shock or electrocution can occur if an individual serves as the conduit for the flow of electrons; moisture increases the rate of flow

Safety:

- **Use ground fault circuit interrupters (GFCI) on circuits**
- **Install all wiring and devices properly**
- **Use UL approved materials**
- **Avoid water when using electricity**
- **Be sure switches are off when installing electrical devices**
- **Avoid extension cords**

SAFETY RULES IN THE AGRISCIENCE LAB

- **Learn how to be safe**
- **Think safety; anticipate and avoid dangers**
- **Wash hands after working in the lab**
- **Properly wear PPE**
- **Read and follow instructions**
- **Keep equipment and facilities in good condition**
- **Keep facilities clean and free of debris**
- **Use GFCI**
- **Use life vests and throwable tethered buoys**
- **Never take unnecessary risk**
- **No horseplay in the lab**
- **No eating or drinking in the lab**
- **Alert other people to safety**
- **Have a telephone and post emergency numbers**

Lab Sheet

Lab Safety Hazard Identification

Instructions: Read the following statements that help identify potential hazards in an agriscience laboratory. Make a tour of the school's lab facilities and determine the safety hazards that are present. Place a check by the hazard that you see. Add to the list of hazards.

Potential Hazard	Present
1. Chemicals stored in the lab	_____
2. Fuel stored in the lab	_____
3. Living organisms in the lab facilities	_____
4. Steps or stairs are needed to get to materials and supplies	_____
5. No fire extinguisher	_____
6. Power grinder used in the lab	_____
7. Power saws used in the lab	_____
8. Welding and cutting equipment used in the lab	_____
9. GFCI devices NOT installed on electrical circuits	_____
10. Pipes and boards on the floor (may cause falls)	_____
11. Water on the floor	_____
12. Other potential safety hazards (list) _____	

Overall, how do you feel about the safety in this laboratory? _____

On the back of this sheet write a description of how to go about working safely in the laboratory.