

Safe Use of Pesticides

Pesticides restricted by the state or federal government require application by a licensed applicator. These regulations apply to farm, landscape, and greenhouse applications. Even if you do not apply restricted chemicals, it is recommended that you take the training associated with the licensing to become familiar with the safety application of and regulations associated with restricted chemicals.

Emergency Plan

An emergency plan outlining steps to be taken in the event of a spill or leak should be posted near the entrance of every facility in which agricultural chemicals are stored. Each emergency plan should include information about the location of emergency and first aid equipment, emergency phone numbers, and clean-up instructions. Confer with your school to see what plan might be in place.

Spills

Many regulations exist covering the handling of hazardous material spills. Consult with local authorities to determine how spills of the hazardous materials you store need to be handled. By determining whom to call ahead of time, you will be better prepared if a spill occurs.

Storage of Medication

All drugs for livestock use must be stored in accordance with labeling instructions to maintain its efficacy. Specific instructions on temperature and exposure to light will be noted on all labels. Organized storage will help to prevent the inadvertent use of a product.

Storage of Petroleum Products

Appropriate guidelines must be followed when setting up fuel storage facilities to ensure that environmental and fire safety concerns are met. Labeling regulations vary and depend on the sizes of fuel tanks and whether storage is above ground or underground. Disposal of used oil products and the recycling of used petroleum is subject to regulation.

Fertilizer Storage

Liquid fertilizer storage tanks should be located within a properly sized walled or bermed leak-proof secondary containment structure. Large dry-bulk fertilizer storages should be sited on elevated ground with all rain, snow melt, or flood water diverted away. Fertilizers must be kept dry in well-constructed facilities to prevent caking and consolidation. Extra care must be practiced when impregnating fertilizers with pesticides.

Hazardous Wastes

Hazardous waste includes such materials as batteries, paint, and unused chemicals. Many regulations exist covering the handling of hazardous waste. Consult with local authorities (often counties have disposal programs) to determine how the hazardous waste you generate can be disposed of properly. Use recycling programs whenever possible.

Hazardous Chemical Storage Guidelines

Chemical storage is regulated by the Environmental Protection Agency (EPA), The Uniform Fire Code (UFC), The National Fire Protection Association (NFPA), and the Occupational Health and Safety Administration (OSHA). There are two major categories of stored materials: toxic materials and materials not classified as toxic. Within each of these categories, materials are segregated into seven other groups: acids and bases, flammable/combustible materials, oxidizers, organic peroxides, water reactive materials, explosives/unstable materials, and other.

Chemicals should be stored in cabinets. In school lab settings, common chemicals that fall under these regulations are fuels, paints, and solvents. **Note:** The SDS always identifies the type of chemical and its properties.

Cabinet Requirements

Cabinets should meet the following requirements:

- Each cabinet should be labeled with the contents of the cabinet.
- Each cabinet should be clearly labeled as to the hazard class of the materials stored within the cabinet (e.g., acids, flammables, etc.).
- Each cabinet must be rated for use with the hazard class of the most hazardous content stored.
- No paper products, office equipment, food, or any other non-hazardous material should be stored in any hazardous material storage cabinet.
- The cabinet must be listed with an approved testing laboratory (i.e., UL, FM) for the intended use.
- Cabinet capacities must be according to the requirements and limitations of the Virginia Statewide Fire Prevention Code, Part V.

Welding Gases

Compressed gases such as oxygen, carbon dioxide, argon, and acetylene are commonly found in labs. Cylinders in use must be restrained by nonflammable restraints (e.g., chain) at the base and upper third of the cylinder. Gas must be stored in ventilated areas.

The following excerpts from the *Safe Handling of Compressed Gases*, published by the Compressed Gas Association Inc., are good guidelines for proper compressed gas handling and storage. Please also refer to *Compressed Gas Safety*, the fact sheet created by Oregon OSHA (<https://osha.oregon.gov/OSHAPubs/factsheets/fs09.pdf>).

Safe Handling Rules for Cylinders of Compressed Gases

The rules of this section apply generally to the handling of all cylinders containing compressed gases.

Where the user is responsible for the handling of the cylinder and connecting it for use, such cylinders must carry a legible label or stencil identifying the content. See American Standard Method of Marking Portable Compressed Gas Containers to Identify the Material Contains, Z48.1(3), and CGA Pamphlet C-7, "A Guide to the Preparation of Labels for Compressed Gas Containers."

Never drop cylinders nor permit them to strike against each other or against other surfaces violently.

Avoid dragging or sliding cylinders. It is safer to move cylinders even short distances by using a suitable truck.

Use a suitable hand truck, fork truck, roll platform or similar device with cylinder firmly secured for transporting and unloading.

Protect cylinders from any object that will produce a cut or other abrasion in the surface of the metal. Do not store cylinders near elevators or gangways, or in locations where heavy moving objects may strike or fall on them.

Cylinders must be protected against tampering by unauthorized individuals.

Before using cylinder, be sure it is properly supported to prevent it from being knocked over.

Do not store reserve stocks of cylinders containing flammable gases with cylinders containing oxygen. They must be segregated. Inside buildings, stored oxygen and fuel gas cylinders must be separated by a minimum

of 20 feet, or there must be a fire-resistive partition between the oxygen and fuel gas cylinders. This is in accordance with NFPA Standard No. 51, "Gas Systems for Welding and Cutting."

Storage of Inflexible Three-Dimensional Materials

Examples of this category of materials include: angle iron, square tubing, bar stock, lumber, conduit, and plastic bar stocks. The storage configuration may be either in the horizontal or vertical position. In the horizontal position, the weight of the material needs to be considered. The heavier materials must be stored on lower levels and the lighter materials stored at higher levels. Vertical storage of materials must lean toward the wall, with the height limited to eight to 10 feet, allowing a person to grasp the material above the midpoint.

Storage of Flexible and Sheet Stock Materials

This category of materials includes materials that are generally rolled onto coiled spools. If possible, a spooling rack must be devised to dispense these materials. Materials such as sheet metal, which need to remain flat, are best stored horizontally on wide shelving or vertically between full-width dividers.

Chest problems

The main causes of chest problems are dust or chemicals you use, or which you may be in contact with, at work. These can cause unpleasant irritation or inflammation in the nose, throat, or lungs. Some may cause more serious allergy and ill health, such as asthma and bronchitis. Chest problems may result from breathing in:

- Dust from harvesting or handling grain, mixing animal feedstuff, feeding animals, handling moldy hay or bedding in closed buildings used for intensive animal rearing (especially pigs and poultry), and waste products from animals or poultry;
- Vapors (including fumes, gases, and aerosols) from slurry, silage, welding fumes, some veterinary medicines, and disinfectants such as phenols and glutaraldehyde.

Warning signs include irritation/watering of the eyes and nose, blocking stuffy nose, sore throat, cough with or without phlegm, aching muscles or fever after work with moldy hay, breathlessness, tightness of the chest during work, after work, or while doing exercise you could normally cope with, and wheezing.

These symptoms can be short-lived at the time of a job, or they may get worse and last longer until they are almost always present. They can be set off by even minuscule exposures to any substance to which you have become allergic or sensitized. If you smoke and are also exposed to these substances, you are more likely to develop more serious chest problems.

It is important to protect yourself and students, and for most products that you buy, advice will be available on the manufacturer's label or data sheet. Take the following precautions.

Avoid breathing in the harmful substances by:

- Using alternative substances where possible;
- Changing to low-dust materials (e.g., granules, pellets);
- Enclosing sources of dust or spray;
- Vacuuming spillages instead of sweeping up, using a high efficiency filter.

Reduce the amount you breathe in by:

- Using local exhaust ventilation (e.g., when welding);
- Using effective filters in tractor/vehicle cabs;
- Maintaining filters to manufacturer's requirements;
- Improving ventilation in the building;
- Wearing effective respiratory protective equipment. Make sure you use the appropriate mask or respirator for dusts, vapors, or aerosols.

If you need to wear masks or respirators, always adjust the straps so they fit properly. Store them in a clean dry place. Do not hang them from hooks or nails in dirty, dusty areas.

Processes

Plumbing Safety

The materials used in plumbing may expose the plumber to health hazards.

- Glues and solvents used with plastic pipe are of special concern. Use in well-ventilated areas and avoid ignition sources. See SDS for more information.
- Pipe-sealing compounds may also pose hazards (see SDS).

Special precautions should be taken with working on existing sewer pipe. Sewers contain biological health hazards and possibly toxic chemicals. Personal protective equipment should be used and skin thoroughly washed after exposure.

Safety glasses should always be worn to protect the eyes from flying debris, chemicals, and biological hazards. Gloves, boots, and coveralls may also be appropriate under some conditions.

- Electrical tools should be used with extreme caution in wet areas. Follow safety instructions for the tool.
- Always check for existing wiring and other pipes before boring holes for new pipes.
- Torches used for soldering are hot, and freshly soldered joints are also hot, posing a burn hazard.
- Care must be taken not to burn the surrounding building when soldering pipe in place. Have fire extinguishers on hand, and always check charred surfaces for heat.
- Spent fuel bottles should be disposed of properly.
- Lead solder is not to be used for potable-water plumbing.
- Threading machines create sharp shavings, heat, and hot pipe. Use threading machines according to the manufacturer's directions.

Painting Safety

Safety data sheets for materials should be consulted before using any paint materials because different materials have different safety concerns.

- Wear dust masks when sanding.
- Wear eye protection at all times.
- Never sand materials containing lead (old paint).
- Use dust-collection systems when possible.
- Never grind in an area where painting is in progress (spark hazard).

When using stains, paints, and other finishes:

- Wear approved eye protection.
- Wear a respirator when spraying finishing materials.
- Avoid breathing fumes from toxic materials.
- Wear rubber or vinyl gloves to minimize the risk of skin irritations when using a cloth or a pad to apply solvents, bleaches, stains, and finishes and when cleaning brushes.
- Wash your hands after using any finishing materials.

Finishing Room Safety

- Do all finishing in a separate, well-ventilated area specifically designed for finishing.
- Make sure the proper types of fire extinguishers are available in the room.
- For spraying, use a properly installed spray booth. Keep the spray booth clean and well-maintained.
- Keep the entire area clean and free from spills.
- Never leave opened finishing materials unattended.

- Never use tools or machines that can cause sparks or start a fire in the finishing area.

Using and Storing Paint and Solvents

- Solvents emit dangerous fumes. Use only in a well-ventilated area.
- Many solvents are extremely flammable. Keep all solvents away from sources of heat, sparks, and fires.
- Store paint and solvents in their original containers. If, for some reason, this is not possible, be sure the new container is clearly labeled.
- Be sure to read and obey the labels on each type of solvent (refer to SDS for complete list of hazards and precautions).

In industry, the most popular method of applying paint is to spray it on, using compressed air, a high-velocity airless sprayer, or an electrostatic applicator. Paint can also be applied with brushes. The material itself is the primary hazard when painting. Painting may expose you to potentially dangerous chemicals that may damage your health. This guide outlines some of the hazards associated with painting and provides information on how to work safely while painting.

Choose paint materials with safety in mind. Never use materials which are unlabeled or their contents cannot be determined. Always follow the safety recommendations for the material being used.

Overexposure to a substance means too much has been breathed in, swallowed, or absorbed through the skin. The possible effects of overexposure to paint and the chemicals it contains vary according to the type of paint. Some health problems caused by overexposure to paint material are:

- drowsiness;
- dizziness/light headedness;
- disorientation;
- nausea/vomiting;
- eye and throat irritation;
- dermatitis;
- general allergic response such as hives;
- asthma-like wheezing with tightness in the chest;
- heavy metal poisoning (lead, chromium, nickel and cadmium); or
- nerve, kidney or liver damage.

A wide variety of ingredients are used in paints and thinners. These chemicals are not found in all paints, but you have probably come into contact with some of them at one time or another. The following is a list of common ingredients of paints and thinners:

Pigments

- white lead
- red/brown iron oxide
- chromium oxide
- iron blue
- cadmium yellow
- lead powder

Solvents – thinners

- toluene
- xylene
- carbon tetrachloride
- perchloroethylene
- isopropyl alcohol
- cyclohexanol
- n-amyl acetate
- methyl ethyl ketone
- cyclohexanone

- methylene chloride

Resins

- isocyanates (contained in urethane resins)
- epichlorohydrin (contained in epoxy resins)

You may already be familiar with the paints you use regularly, but do you know their possible harmful effects? Ask for the SDS (see below) for each paint. These are available from the manufacturer or paint supplier. The SDS will describe the possible hazards and what precautions are needed. All of the above-listed ingredients have standards for worker exposure.

Spray Painting Safety

Spray painting is a common and effective way to protect and beautify parts, products, vehicles, and buildings. Spray painting allows coverage of large areas with even coats of primer, paint, sealers, and other coatings. However, workers in spray painting operations need to recognize and guard against the hazard associated with spray painting processes.

Hazardous chemicals in coatings and solvents can enter the body several ways. Workers can inhale chemical vapors from spraying, absorb the chemical by skin contact or inject the chemical with high-pressure spray-painting equipment.

Because proper ventilation is important when working with paint coatings, a spray booth is an excellent way to remove spray paint vapors and debris from a worker's breathing zone. Many coatings contain flammable substances that are aerosolized when sprayed through powered equipment and without proper ventilation, such as in a spray booth, these vapors can build up and create an explosion and fire danger. But to provide maximum protection, the spray booth must be properly maintained, including regular cleaning of filters and overspray. And to prevent sparking a flammable substance, smoking and other sources of flame near spray painting operations should be prohibited and tools should be properly rated and grounded for work in a spray-painting area.

Because much of the equipment used for spray painting and surface preparation uses compressed air, workers should be aware that noise can be a risk, so should wear hearing protection when working with air-powered tools.

Following a few sensible rules can help to reduce exposure to chemical hazards.

Whenever possible, painting or priming operations should be done in a spray booth or room. These areas have been designed to reduce exposure to paint vapors and additives; use them correctly. You should make sure that the ventilation in the spray booth or room is adequately maintained and working properly.

Before using the spray booth or room: turn on the ventilation system, check the spray booth filters and change if necessary, and turn on the make-up air unit.

When painting in an enclosed space (a room): provide outside ventilation air with fans or open windows, turn off ignition sources like wall heaters.

When painting follow the equipment manufacturer's instructions, avoid using plastic drop cloths on the floor (slip hazard), never point a spray gun at yourself or anyone else, position yourself so the piece you are spraying is between you and the exhaust fan, do not over spray, and use appropriate personal protection.

One positive step you can take to ensure continuing good health is to use personal protective equipment. Here is a brief description of some of the protective equipment available.

Respirators

Two types of respirators, the air-purifying and the atmosphere supplying, are commonly used in spray painting.

You *must* use the correct type of respirator for the job being done and the chemicals being used. The air-purifying type of respirator should be used only during exposure to those specific chemicals, or groups of chemicals, described on the respirator cartridge. These cartridges are good only for a limited time and must be replaced with new ones when:

- you can smell vapors in the mask,
- they become difficult to breathe through, or
- they have been used for their specific lifetime.

The atmosphere-supplying type of respirator must be used in some paint spraying operations, particularly with urethane paints or when painting in a confined space e.g. inside a tank.

Remember: Whichever respirator is used, it must fit properly to ensure adequate protection (check the manufacturer's instructions). Respirator maintenance and cleaning is important. No one wants to use a dirty, leaky respirator which has been worn previously by someone else. Keep your respirator in good condition by cleaning and sanitizing it regularly. Store it in a clean place. Check it for pliability and signs of deterioration before you wear it. If the respirator needs repair, use only the manufacturer's recommended replacement parts. With a little thought, and a small amount of effort, your respirator will protect you for a long time.

Eye and Hearing Protection

Without good eyesight you cannot do your job properly, so why risk eye damage or loss of eyesight from solvent spray or splashing? Wear your safety goggles to protect your eyes from paint materials as well as the particulates created during sanding and grinding.

Some painting equipment, such as grinders and compressors, creates loud noise. Hearing protection is required when noise levels exceed 85 db.

Protective Clothing

Some of the chemicals you work with can injure skin or cause dermatitis. Coveralls and gloves prevent these chemicals from coming into contact with your skin, reducing the risk of damage. Wear your coveralls and gloves whenever working with chemicals. Clean your gloves and wash your coveralls regularly to prevent chemicals from accumulating, especially around the cuffs, where they can easily come into contact with your skin. As an additional protective measure, use barrier creams on your hands, face, and neck. Check to make sure you have the correct barrier cream for the chemicals being used.

Fire and Explosion Hazards

Because of the danger of fire and explosion where paints which contain flammable solvents are being used, care should be taken to remove all potential sources of ignition before starting work. This means open flames, cutting and welding torches, gas-fired heaters and materials which may give off sparks, whether electrical, mechanical, friction, or static, and there must be no smoking. Make sure the correct types of fire extinguishers are available at the work site.

Remember: Different fires require different extinguishers.

Important: Flammable materials are required to be stored in flammable materials storage cabinets. Many paints and solvents are flammable materials.

Dust and Preparation

Many painting projects require preparation of the materials to be painted. Preparation often involves sanding of the surface, which creates a health hazard if dust masks are not worn. Ideally, dust-collection systems should be used to prevent large amounts of small particulates from entering the air.

Sanding and scraping of old paint may hold additional hazards if the old paint contains lead.

Things to do and not to do before painting

- Do post “No Smoking” and “No Welding” signs.
- Do remove portable lamps and heaters from the area.
- Do make sure painting is done away from open flames, sparks, non-explosion-proof motors or any other source of ignition.
- Do check the ventilation system to make sure it is on and working correctly.
- Do electrically ground all spraying equipment.
- Do make sure approved respirators, eye goggles and any other protective equipment required for the job are worn.
- Don’t smoke.
- Don’t take more paint out of the store room than you can use in one day.

Solvents

Solvents are so common in many workplaces that workers forget how dangerous they are. A solvent can be generally described as a substance, usually a liquid, that is used to dissolve another substance. Although solvents can be used safely, health problems can result from skin contact with solvents or from inhalation of their vapors. In addition to the health hazards, many solvent vapors are flammable and explosive.

One of the most common health hazards associated with exposure to solvents is dermatitis. Contact dermatitis can develop from a single exposure or from multiple exposures. It can leave the skin susceptible to a short-term infection or to a chronic condition. Exposure can also result in sensitization to the solvent, which is a delayed allergic reaction that often becomes more severe with subsequent exposures.

One big danger with solvents is that they can cause trouble before you realize what has happened. Depending on the type and concentration of the solvent, exposure effects can range from mild respiratory irritation to severe damage to body organs and systems. In extreme cases, overexposure to solvent vapors can cause respiratory failure and death.

When working with solvents, it is important to know what solvents are being used and what steps should be taken to protect against harmful or dangerous exposures. To optimize safety follow these suggestions:

- Know what solvents you are working with.
- Read the labels and the safety data sheets of the solvents. They list the hazards, health effects, and safe-handling procedures.
- Make sure the workspace is properly ventilated.
- Use recommended gloves, eye and face protection, boots, other protective clothing, or barrier creams as required.
- If respiratory equipment is used, make sure it gives appropriate protection for the exposure.
- Take care when pouring solvents from one container to another, because fire or explosions can occur from static electricity buildup.
- Clean up solvent spills promptly.
- Never wash your hands with solvents.
- Prohibit welding, cutting, soldering, and other sources of ignition in areas where solvents are used.
- Store flammable solvents in well-ventilated areas constructed of fire-resistant materials.
- Ground and bond all tanks and equipment for storage.
- Install readily accessible fire extinguishers in storage and work areas.

As with other toxic substances in the workplace, the preferred methods of hazard control are substitution of a less toxic substance in an operation, local exhaust ventilation, and enclosure.

Ladder Safety

- Ladders are commonly used for painting. Ladder safety begins with selecting the right ladder for the job and includes inspection, setup, proper climbing or standing, proper use, care, and storage. This combination of safe equipment and its safe use can eliminate most ladder accidents.
- Always check a ladder before using it. Inspect wood ladders for cracks or splits. Inspect metal and fiberglass ladders for bends and breaks. Never use a damaged ladder. Tag it “Defective” and report it to your supervisor/teacher.
- When setting up a ladder, make sure it is straight and sitting firmly on the ground or floor. If one foot sits lower, build up the surface with firm material; do not set it on boxes, bricks, or other unstable bases. Lean the ladder against something solid but not against a glass surface. Make sure the ladder is placed at a safe angle, with the base away from the wall or edge of the upper level about one foot for every four feet of vertical height. Keep ladders away from doorways or walkways, unless barriers can protect them.
- Keep the steps and rungs of the ladder free of grease, paint, mud, or other slippery material. And remember to clean debris off your shoes before climbing. Always face the ladder when climbing up or down, using both hands to keep a good grip on the rails or rungs. Never carry heavy or bulky loads up a ladder. Climb up yourself first, and then pull up the material with a rope or bucket.
- Many ladder accidents occur because of slipping or skidding. You can prevent these accidents by equipping the ladder with nonslip safety feet, blocking its base, or tying it to a sound, permanent structure.
- Overreaching is probably the most common cause of falls from ladders. A good rule is to always keep your belt buckle inside the rails of a ladder. Do not try to move a ladder while you are on it by rocking, jogging, or pushing it away from the supporting wall.
- When you have finished the job, properly store the ladder so it will not be exposed to excessive heat or dampness and will be in good condition for the next time.

Livestock

General

One in three injuries on the farm/ranch involves handling or contact with large animals. Animal movements are generally unpredictable, so learn to recognize signs of fear, pain, and stress in farm/ranch animals. The following safety guidelines apply to working around or handling livestock:

- Practice good housekeeping.
 - Keep the work area clean and free of debris.
 - Check for and eliminate any sharp corners or protrusions in walkways.
 - Clean concrete ramps and floors regularly to prevent slips and trips. Keep pitchforks and other sharp tools stored away from walkways.
 - Keep facilities in good repair. Chutes, stalls, fences ramps, levers, and latches must be maintained regularly.
- Provide well-kept facilities to allow safe, humane, and efficient movement of animals.
- Provide personnel with training to handle each stage of production with zero tolerance for mistreatment of animals in their care.
- Provide access to high-quality water and nutritionally balanced diets appropriate for each type of animal.
- Observe animals to make sure basic needs for food and water are being met and to detect illness or injury.
- Develop herd health programs with veterinary advice and provide prompt veterinary medical care when required.
- Use humane methods to euthanize sick or injured animals when deemed appropriate.
- Maintain biosecurity to protect the health of all animals and personnel.
- Provide transportation that avoids undue stress caused by overcrowding, excess time in transit, or improper handling during loading and unloading.
- Monitor entry into the facility; sales and service personnel could bring diseases from other farms. Liquid manure holding facilities must be secured against entry. Outdoor lagoons and ponds must be fenced.
- Keep children away from animals, particularly in livestock-handling areas.

- Maintain even lighting. Shadows mixed with light spots inside handling facilities will increase animals' fear and tension. Maintain evenly dispersed lighting in these areas.
- Approach animals safely. The safest approach is to announce your approach through a touch to the front or side of the animal. Most large animals will kick in an arc beginning toward the front and moving toward the back. Avoid this kicking region when approaching the animal.
- Leave a way to get out of a facility, if necessary. Avoid entering an enclosed area with a large animal unless it is equipped with an easily accessible mangate.
- Be careful around injured or sick animals. Protect against any animal-borne diseases (e.g., undulant fever, tetanus, rabies).
- Wear appropriate PPE and practice good hygiene by washing hands and face after handling animals.
- Remain alert to possible danger by watching animals for signs of aggressiveness or fear. Bear in mind the following:
 - Warning signs may include raised or pinned ears, raised tail or hair on the back, bared teeth, pawing the ground, or snorting.
 - Respect all animals. Their size and bulk make them potentially dangerous.
 - Most animals tend to be aggressive when protecting their young; be extra careful around newborn animals.
 - Stay clear of animals that are frightened or spooked. Be extra careful around new or strange animals.
 - Most male animals are dangerous. Use special facilities for these animals and practice extreme caution when handling them.
 - Anyone who works with livestock knows each animal has its own personality. Animals sense their surroundings differently than humans. Their vision is in black and white, not in color. They also have difficulty judging distances. Differences exist between the vision of cattle, swine, and horses.
 - Animals have extremely sensitive hearing and can detect sounds that human ears cannot hear. Loud noises frighten animals, and research proves that high-frequency sounds actually hurt their ears. These factors explain why animals are often skittish and balky, particularly in unfamiliar surroundings.
- Although handling methods may vary greatly for different types of livestock, there are some generally accepted rules for working with any animal:
 - Most animals will respond to routine; be calm and deliberate.
 - Avoid quick movements or loud noises.
 - Be patient; never prod an animal when it has nowhere to go.
 - Respect livestock — do not fear it!
 - Move slowly and deliberately around livestock; gently touch animals rather than shoving or bumping them.
 - Always have an escape route when working with an animal in close quarters.

Cattle Safety

To safely handle cattle, it is important to understand their behavior patterns. Understand the behavioral principles of the flight zone and the point of balance. When cattle are being herded, back up and retreat from inside the flight zone. When they slow down or stop moving, re-enter the flight zone to get them moving again. This is the principle of pressure and release. The flight zone is the animal's safety zone, and its size varies depending on three factors:

- Genetic traits (excitable versus calm)
- Amount of contact with people (see them every day or only twice a year)
- Quality of the contact with people (negative versus positive)

The following safety guidelines apply to the handling of cattle:

- Separate cattle safely. Because one large cow can weigh up to 1,500 pounds, it is not a good idea to manually separate cows using gates or boards. A frightened cow or horse can easily trample a person. It is safer to use handling facilities made specially for separating large animals.
- Work safely with dairy cattle. Dairy cattle are generally more nervous than other animals, so it's important to approach these animals gently to avoid startling them. Once dairy cattle have been moved into milking stalls, give them a moment to adapt to the new environment before beginning the milking procedure.

- Handle cattle calmly. Do not make loud noises.
- Beware of the lone animal. Animals separated from the herd are a major cause of accidents involving gates.
- Keep equipment well-maintained. Worn-out latches on squeeze chutes have caused serious accidents when they have suddenly come loose. Gates must swing freely and have well-maintained latches that are easy to latch and unlatch.
- Cattle-handling facilities must have nonslip flooring in high-traffic areas such as squeeze chutes, scales, crowd pens, and loading ramps. Animals panic when they slip.
- Only fill the crowd pen leading to the single-file chute halfway. Cattle will move more easily and safely when they are not overcrowded.
- Wait until the single-file chute is almost empty before putting more cattle into the crowd pen. The cattle will move into the lead-up chute that leads to the squeeze more easily if they can pass through the crowd pen and are not forced to wait.
- Remove distractions from corrals and chutes that make cattle balk or turn back. Get down in the chute to see what cattle are seeing.

Horse Safety

Horses detect danger through their vision, sense of smell, and keen sense of hearing.

They have wide-angle vision, but they also have blind spots directly behind and in front of themselves. Always work with calm but deliberate movements around horses. Nervous handlers can make horses nervous, creating unsafe situations.

Approaching the Horse

The following safety guidelines apply to approaching the horse:

- When catching a horse, approach from its left shoulder. Move slowly but confidently, speaking to the horse during the approach. Read the horse's intention by watching its body language.
- When approaching a horse in a stall, speak to the horse to get its attention and wait until it turns toward the sound before entering and make sure the horse moves over before walking in beside it. Be careful when approaching a horse that is preoccupied, such as when its head is in a hay manger.
- When approaching from the rear, advance at an angle while speaking to the horse, making sure to have its attention. Touch it gently while passing by its hindquarters.
- Speak to the horse and keep hands on it when moving around it. Even if a horse is aware of a person's presence, it can be startled by quick movements.

Leading the Horse

The following safety guidelines apply to leading the horse:

- Hold the lead line with the right hand, 8 to 10 inches away from the horse's head, while holding the end (or bight) of the line with the left hand. Always use a lead line to maintain this safety zone and to prevent getting a hand caught in the halter.
- Teach the horse to walk; walk at its left shoulder, with the right elbow near the horse's shoulder to anticipate its actions.
- Do not let the horse take charge during a walk. Do not allow it to fall behind either, because it could jump if spooked.
- To lead a horse through a doorway, step through first, then quickly step to the side out of the horse's way. Keep an eye on the horse, because some try to rush through narrow spaces.
- Never wrap any piece of equipment attached to a horse around the hand, even with small loops, because it could wrap tightly around the hand and cause serious injury.
- After removing the halter, make the horse stand quietly for several seconds before letting it go completely. This will help prevent the horse from developing a habit of bolting away and kicking in the process.

- Some horses can become sour and begin nipping if they anticipate discomfort during grooming. Do not hurry the grooming procedure, especially with a young or nervous horse. Stay near the horse and keep a hand on it at all times to anticipate its movements.
- Do not climb over or under the lead line of a tied horse. The horse may pull back, lunge forward, paw, or try to bite. This could cause tripping or entrapment. Never walk under the belly of any horse.

Sheep Safety

Sheep react to their surroundings, including the working environment and facilities; the following sheep facts and suggestions for working with them will help make the experience positive:

- Be patient when introducing something new, because sheep like routine and fear new visual objects.
- Sheep are predictable, so use knowledge of their prior reactions.
- Sheep react negatively to loud noises; they will bunch up in corners to protect themselves.
- When moving, gathering, or sorting sheep, the more efficient the operation, the better; wool grabbing and rough handling will cause bruising.
- Sheep have a flight zone, so determine what this is for the flock. Sheep tend to move in the opposite direction of the handler and toward other sheep.
- Sheep move best when not afraid, so work slowly and calmly.
- Sheep do not like to move into the darkness; place a chute facing a well-lit area (sheep have no depth perception; shadows, dark surfaces, and water can be problematic).
- Sheep will move to a partially full pen.
- Sheep will move better through long, narrow pens and chutes rather than square pens and wide chute systems. Sheep prefer moving on a flat surface or uphill. Sheep resist moving from one type of surface to another.

To perform hoof trimming, crutching, teeth inspections, wool-quality tests, and ear-tag checking, the sheep will have to be caught and restrained. *Catch and throw* is a good method of restraining an individual animal.

It is best to start in a small, clean yard with the individual animals to be restrained. Take care not to pull the wool throughout the procedure because this can bruise the sheep and damage the wool. Rams must only be handled by an experienced person, because they are larger and may be aggressive, especially during the breeding season.

Catch and Restrain

The following safety guidelines apply to catching and restraining sheep:

- Catch the sheep with one hand on the rump and the other under the muzzle.
- Straddle the sheep if necessary to restrain it.
- Turn the sheep's head around as far as possible away from the body.
- Pivot backward around with the sheep following. The sheep will go down on its rump.
- Lean the sheep against the knees and apply pressure with both knees to secure the sheep in a grip.
- To release the sheep, let it drop onto its front legs. It will quickly regain a standing position.

The area at the back of the sheep's head is a blind spot when their head is raised. If a sheep is approached from the rear, a handler can remain undetected visually and have a better chance at catching the animal. With its head down in a grazing position, the sheep can see in all directions, a good defensive adaptation whereby the sheep can see predators from all sides.

Swine Safety

The following information about swine and safety guidelines may assist when working near or handling swine:

- Swine have a range of vision of more than 300 degrees. Although this allows them to see behind themselves without turning their heads, it also causes them to be sensitive to sharp contrasts in light and dark. Swine may

balk and be reluctant to move if they encounter shadows, puddles, bright spots, a change in flooring type or texture, drains, metal grates, or flapping objects.

- Swine are not normally aggressive; however, they can become dangerous if threatened, especially sows protecting their young.
- Move swine by guiding them and using gates and/or panels. Other useable tools for moving swine include large flags or plastic paddle sticks. Swine will stop when a solid barrier is placed in front of them.
- Announce your approach to swine as with other animals. Do not walk up to them quietly and surprise them.
- Provide facilities to protect and shelter swine from weather extremes while protecting air and water quality in the natural environment.
- Do not prod swine in sensitive areas such as the eyes, nose, anus, or testicles; if the pig appears distressed during handling, allow it to rest and recover without prodding.
- Do not use funnel-shaped pens to load swine because they will often continue to press forward.

Livestock Medicine

The following safety guidelines apply to working around and administering medicine to livestock:

- Develop a herd health plan to minimize disease problems.
- Obtain the advice of a veterinarian on the product most suited to the animal's needs.
- Read the label carefully before treating the animal, comply with the manufacturer's dosage guide, and note the manufacturer's recommendations, precautions, contraindications, and warnings; do not use any medicine if the label or container has evidence of tampering.
- Consult a veterinarian on the most appropriate intramammary antibiotics for mastitis control/treatment in the herd. Have a planned mastitis control program targeting all factors likely to influence herd mastitis levels.
- Use only approved products licensed for use with the particular species.
- Purchase only from suppliers authorized to sell the particular remedy; never borrow prescription medicines (e.g., antibiotics) from other producers.

Equipment and Facilities for the Administration of Livestock Medicines

The following safety guidelines apply to the provision of suitable equipment and facilities related to the administration of medicine to livestock:

- Suitable handling and restraining facilities are essential to minimize the risk of physical injury during administration of livestock medicines.
- Store medicines in a secure place. All drugs for livestock use must be stored in accordance with labeling instructions to maintain their efficacy. Specific instructions on temperature and exposure to light will be noted on all labels. Organize storage to prevent the inadvertent use of a wrong product.
- Check that dosing or injection guns are properly calibrated to deliver the correct dosage.
- Damaged or worn equipment (e.g., dosing guns) can inflict unnecessary stress and injury on stock and constitute an animal welfare hazard.
- Make sure animals are at the recommended age or weight if using boluses or bullets. Use the correct applicator gun.
- Follow the manufacturer's recommendations or veterinary instructions in relation to needle size (gauge) required for specific situations.
- Dispose of unused medicines and used needles in a safe manner.

Administration of Medicine

- Competent individuals should administer livestock medicines (i.e., someone who can adequately assess or check live animal weight to determine the dose rates and follow the manufacturer's instructions).
- Always complete the specified treatment program if using antibiotics or an antimicrobial.
- Do not mix medicines or wormers with other medicines or mineral vitamin supplements.
- Check the expiration date on the product. Do not use any medicine past its expiration date. Observe any in-use expiration dates.

- Injectable medicines are normally given as subcutaneous (under the skin) or intramuscular injections. Follow the manufacturer's recommendations.
- Do not inject cattle in the valuable meat areas. There is always a risk of an abscess forming or damage/blemishes occurring. The most valuable cuts are in the loin area and the hindquarter area. Forequarter cuts (shoulders/neck) are generally less valuable.
- Replace needles if they are damaged. In the rare event that a needle breaks during an injection the needle must be removed promptly. Veterinary assistance may be necessary to remove broken needles in a safe, hygienic manner. A broken needle can lead to significant hazards further along the food chain. It also compromises basic animal welfare requirements.

Hygiene Practices when Administering Medicine

- Ensure the injection site is clean and use a sterile needle for each injection. Used needles can cause tissue damage and inflict pain on the animal.
- Use disposable needles and syringes if treating potentially infectious or transmissible diseases.
- Sterilize needles and syringes in boiling water for 20 minutes (or use alcohol or a suitable sterilizing agent). Alcohol or disinfectants are not recommended to sterilize needles or syringes if using certain vaccines. Check the manufacturer's recommendations.
- Automatic reloading injection guns are widely used for overall herd or flock treatments (e.g., flock vaccination). Follow all manufacturer instructions carefully.
- Personnel must not eat food or smoke while handling and administering livestock medicines.
- Wear appropriate PPE. Cover or protect any open wounds or sores likely to come in contact with the animal. Practice good hygiene; always wash hands after handling animals and before eating.

Procedures Following the Administration of Medicine

- Record the details of the medicine use in the animal records.
- Check and note the withdrawal period for the livestock remedy.
- Segregate the animal identity cards of treated cattle for the duration of the remedy withdrawal period. This will prevent the accidental or inadvertent sale of animals within the withdrawal period.
- Use a marking stick or spray to identify treated livestock that are not normally tagged or individually identified.
- Do not sell or supply milk or livestock until all withdrawal periods have elapsed. Ensure that residue-contaminated milk does not enter the milk bulk tank or food supply chain. Do not feed this milk to any livestock.
- Make sure that someone on the farm is personally responsible for ensuring that withdrawal periods are observed.

Zoonoses

Diseases passed to humans from animals are known as zoonoses. Microorganisms such as bacteria, viruses, parasites, and fungi can cause illness by infecting the body when they penetrate the skin (through small cuts, for example).

- Decide what you need to do to prevent or control exposure;
- Minimize the risk of infection by keeping stock healthy. Vaccinate where appropriate (e.g., against enzootic abortion of ewes);
- Avoid, or if this is not possible, reduce contact with animals where practicable;
- Ensure good personal hygiene. Wash before eating or drinking;
- Wear suitable protective clothing such as overalls when handling animals, especially if they are sick, and gloves and a waterproof apron if handling possibly infected material such as products of birth or muck and sewage;
- Wash and cover immediately all cuts and grazes.

Consult your veterinarian on likely zoonoses from your animal, but note that common ones include:

- Orf from sheep or goats: produces painful pustules on the hands, arms, and face;
- Leptospirosis from rats (Weil's disease) and cattle urine: causes a feverish illness with headache and can result in meningitis. Early treatment is vital;

- Ringworm: a fungal disease from many types of livestock;
- Enzootic abortion (*Chlamydia psittaci*) from sheep: pregnant women should not associate or work with ewes during lambing, nor be exposed to contaminated clothing or other sources of infection, because severe illness and miscarriage may result;
- Cryptosporidiosis: from a parasite picked up by touching livestock, animal housing, or feed, which can cause diarrhea in humans, and can be particularly severe in young children;
- Ornithosis (another form of *Chlamydia psittaci*) from birds: can cause flu-like symptoms in humans followed by pneumonia.

Illness following infection by the *Escherichia coli* 0157 bacterium may be severe and even fatal. Any ruminant (i.e., cattle, sheep, goats, and deer) may carry the organism, which can survive for many weeks in feces or soil. Good personal hygiene is essential.

Veterinary Medicines

All medicines should be stored securely, where students cannot get at them. Make sure syringes and needles are stored securely. If veterinary medicines are misused, they can cause ill health, so when you or your veterinarian have decided that you must treat the animal, consider:

- Less-hazardous products (e.g., a water-based vaccine instead of an oil-based one or a non-organophosphorus [OP] product rather than an OP). Remember to consider the environment as well as human health and safety;
- Using a safer application system (e.g., a pour-on or injectable rather than a dip);
- Engineering controls (e.g., splash screens around the dip bath, shrouded needles);
- What training is needed to safely use the product? Special rules apply to sheep dips;
- How you plan to dispose of the product (e.g., sheep dips that contain OP compounds are potentially more hazardous to humans than non-OP alternatives. However, non-OP dips pose a greater hazard to aquatic life, so dispose of any dip properly, not into watercourses or soak ways).

Always:

- Wash off splashes from the skin and clothing immediately, and wash before eating, drinking, or smoking. Do not work among freshly treated animals if you could be contaminated;
- Follow any emergency measures recommended by the manufacturer (e.g., with oil-based vaccines);
- Report all suspected cases of poisoning, so they can be thoroughly investigated.
- Follow the label instructions.

Diseases passed to humans from animals are known as zoonoses. Microorganisms such as bacteria, viruses, parasites, and fungi can cause illness by infecting the body when they penetrate the skin (e.g., through small cuts). The following safety guidelines apply to the prevention or control of exposure:

- Minimize the risk of infection by keeping stock healthy. Vaccinate where appropriate (e.g., against enzootic abortion of ewes).
- Avoid or reduce contact with animals where practical.
- Ensure good personal hygiene. Wash before eating or drinking.
- Wear appropriate PPE.
- Wash and immediately cover all cuts and grazes.

Additional Resources for Agricultural Education Safety Information

General Lab Safety

- CDC: Animals in Schools and Daycare Settings (<https://www.cdc.gov/features/animalsinschools/index.html>)
- Texas A&M Agrilife Extension: Agricultural Safety and Health Educational Material (<https://agsafety.tamu.edu/educational-material/>)

Small Animal Care Safety Guidelines

- OSHA: Working with Small Animals (<https://www.osha.gov/Publications/laboratory/OSHAquickfacts-lab-safety-working-with-small-animals.pdf>)
- American Veterinary Medical Association: Companion Animal Care Guidelines (<https://www.avma.org/KB/Policies/Pages/Companion-Animal-Care-Guidelines.aspx>)

National Safe Tractor and Machinery Operation Program (NSTMOP)

- Penn State Extension: SAY National Clearinghouse (<https://extension.psu.edu/business-and-operations/farm-safety/say-project>)

Landscaping and Horticulture

- OSHA: publications related to crystalline silica (<https://www.osha.gov/pls/publications/publication.athruz?pType=Industry&pID=118>)
- Interfaith Worker Justice: *Health and Safety in the Workplace—Landscaping Industry Curriculum Instructional Guide* (http://files.www.iwj.org/resources/trainings/HS_training_modules/LANDSCAPING_WORKERS_TRAINING-2011.pdf)

Sample Safety Tests

For sample safety tests, refer to pages 132 to 172 of the *California Agricultural Teachers' Essential Guide to Safety* (<http://www.agedweb.org/TeacherResources/Safety%20Guide.pdf>).

Welding

GMAW (MIG)

- Check all welding cables to be sure that they are in good repair and properly connected. Be sure the equipment is properly grounded.
- Never pull a portable MIG welder by its leads.
- A welder is to say, “cover,” before the start of weld to let others know to turn away or to protect their eyes.
- When the electrical switch is on, never touch electrical connections or the welding wire.
- Never weld in wet locations or with wet hands, feet, or clothing.
- Be sure there are no matches or other flammable materials in pockets because the materials could ignite.
- Handle hot metal with pliers or tongs.
- Weld only in well-ventilated places.
- Use needle-nose pliers to clean the tip; never pound the tip on the bench or floor.
- If a small ball of metal has formed on the end of the wire, cut it off with the wire cutters so about one-sixteenth inch sticks out of the tip. This must be done often so the electricity can connect from the metal wire to the piece of metal more easily.
- Before rethreading wire through the welding cable, make sure to cut the wire with side cutters. The cutters provide a clean cut so the wire feeds through the cable.
- Tack the end of metal pieces together to hold them in place before making a welding bead.
- Use a steady motion when welding. The rate of travel and angle of the welding tip will depend on the weld being done.
- If the metal wire melts to the tip, tell the teacher so a new tip can be put in its place.
- Cool the metal after each weld so that the metal does not get too hot, especially with thinner metal pieces.
- Change the wire speed when the machine is on. Adjust the wire speed when welding to get a desired speed.

Oxygen Acetylene

- Keep the cylinder valves closed when not in use.
- Keep the cylinders away from electrical service, and avoid contacting the cylinders with flame.
- Never use oxygen or acetylene from a cylinder without first attaching a regulator to control the pressure.
- Avoid the unnecessary release of free acetylene into the air because it is combustible.
- Never use oil of any kind on any part of the oxy-acetylene equipment. Oil and straight oxygen is a very explosive mixture.
- Never move cylinders, empty or full, without protective caps in place.
- Use CO₂ or dry chemical fire extinguishers.
- Do not hang the torch on the regulator valves.
- Do not attempt to use or repair a damaged regulator. Turn it in to the teacher immediately.
- Never weld near combustible or flammable materials or gases.
- Weld in a well-ventilated area because clothing and other combustible materials will readily ignite and burn in an oxygen-saturated atmosphere.
- Never lay down a lit blowpipe.
- Never use oxygen under pressure for dusting clothes, blowing out pipes, paint spraying, or other similar activities.
- Use proper hoses and fittings: red hoses and left-handed threads for acetylene, green hoses and right-handed fittings for oxygen.
- Connections must always be tight. Check for leaks periodically, using a soapy water solution.
- Protect hoses from hot iron, sparks, and traffic. Replace all worn hoses.
- Always keep the welding or cutting tip pointed away from all personnel to prevent saturating clothes with gases before lighting.
- Know the gas welding system.
- Keep the flame away from bottles, regulators, and hoses.
- Keep oil, grease, and other flammable liquids away from all welding equipment.
- Always screw the cap into place over the bottle valve before moving a bottle.
- Never open both valves on the blowpipe at the same time without the torch being lit.
- Keep the torch tips clean at all times.
- When lighting the oxygen-acetylene torch, follow these steps:
 - Check all valves on the blowpipe. Valves must be closed.
 - The regulator adjustment screws must be loose.
 - Open the cylinder or bottle valves slowly, standing to one side of the regulator.
 - Open the acetylene bottle valve no more than one turn.
 - Open the oxygen bottle valve all the way.
 - Tighten each regulator adjustment screw to bring the low pressure up to the amount needed.
 - Acetylene pressure is never more than 15 pounds per square inch.
 - Let some oxygen escape from the blowpipe by opening and closing the oxygen blowpipe valve.
- When lighting the torch, follow these steps:
 - Open the acetylene blowpipe valve and light the tip with a striker.
 - Open the acetylene valve until the flame stops smoking.
 - Open the oxygen blowpipe valve until a neutral flame is burning at the tip.
- When finished using the gas welder, be careful to follow these steps in order:
 - Close the acetylene valve on the blowpipe.
 - Close the oxygen valve on the blowpipe.
 - Close both bottle valves.
 - Open the acetylene blowpipe valve to bleed the line.
 - When all of the pressure is out of the system, close the acetylene blowpipe valve.
 - Open the oxygen blowpipe valve to bleed the line.
 - When the pressure is off both gauges, close the oxygen blowpipe valve.
 - Coil the hoses, replace the equipment and tools, and clean the area.

- If unsure about something, ask the teacher for help.

Plasma Arc Cutter

- Make sure that work area is well-ventilated when using the plasma arc cutter (PAC). The PAC process generates fumes and therefore must be well-ventilated.
- The operator must position himself/herself so there will be minimum exposure of fumes during the cutting process.
- Use a cutting table, which has a down draft to capture fumes. A cutting table with water filtration is also recommended for plasma arc cutting.
- Never use the PAC in areas where combustible or explosive gases or materials are located.
- Chlorinated solvents and cleaner vapors in the presence of PAC generates toxic phosgene gas. Avoid plasma arc cutting use in areas which house chlorinated solvents and cleaners.
- Never touch any parts on the PAC that are electrically connected. The PAC uses high amperage and produces high voltage that can cause severe or fatal electrical shock.
- Disconnect the electrical power before performing any service or repair on the PAC.
- Do not use the PAC to cut on containers that have held combustible materials.
- Hydrogen gas may be formed and trapped when cutting aluminum in the presence of water. Trapped hydrogen gas in the presence of an arc will ignite and explode; make sure fumes are well-ventilated when cutting aluminum.
- Make sure that others in the work area are protected from the PAC arc rays and fumes.
- Use pliers or tongs to handle hot metals cut by the PAC. Cool and store hot metal before leaving the work area.
- To activate the PAC, make sure the air pressure is sufficiently around 70 psi (for most PAC units) and the ground clamp is attached to the work piece.
- Turn the PAC on and adjust the amperage to the manufacturer's specifications for the thickness of metal to be cut.
- Position the shielding cup over the metal, press the igniter button and allow the arc to become established.
- Next, move the arc over the cut line and make the cut.
- The thicker the metal, the slower the travel speed must be to get a good cut. The quality of the cut usually decreases as the metal thickness increases and the travel speed decreases.
- A guide bar may be used to help achieve straight cuts.
- The shielding cup and constricting nozzle must be held approximately one-eighth inch to one-quarter inch from the metal being cut. The operator must avoid dragging the constricting nozzle and shielding cup on the metal when making the cut, unless they are specifically designed to touch the base metal while cutting.
- Always make cuts on the waste side of the cut line.
- Avoid cutting with the PAC in damp or wet locations, where the hazards of electrical shock are greatly increased.
- If plasma arc cutting over an open barrel with a grate, be aware that the fume plume will be directed back toward the operator. Avoid this condition if at all possible; otherwise, limit the exposure to fumes to short durations.
- Cuts with the PAC may be made by moving forward, backward, or sideways. Determine which direction is easiest and use that procedure as often as possible.
- Always move the PAC as fast as possible when making a cut. This increases time efficiency, improves the cut quality, and reduces the buildup of dross.
- Compressed air used in PAC must be dry or the cutter will not yield a quality cut or it may not cut at all. An auxiliary air filter may be placed in the compressed air line to condition the air for a PAC.
- Always turn the PAC off before laying the torch down and leaving the work area.
- If the quality of the cut deteriorates to an unacceptable level, either the constricting nozzle, the electrode, or both may need to be changed. The electrode on most PAC will have a life of about twice that of the constriction

nozzle. Keep a supply of constricting nozzles and electrodes on hand, because they deteriorate quickly during continuous use. Turn the PAC off to put on replacement parts.

- Keep the PAC torch leads and ground lead stored so they will not be cut or damaged when not in use.

SMAW (Arc)

- Keep the welding area clean and free of tools, scrap metal, and water.
- Make sure the work area is free of flammable, volatile, or explosive materials. (e.g., propane, gasoline, grease, and coal dust).
- Propane - one 2.5 LBS container can be stored indoors - all else must be stored outside
- Do not carry matches, butane or propane lighters, or other flammables in pockets while welding.
- Shield others from the light rays produced by arc welding. Keep the welding curtain in place at all times.
- Never weld while standing in water or on damp ground. Do not weld in damp areas; keep hands and clothing dry at all times. Dampness on the body increases the chance of electrical shock when welding.
- Guard against the use of damp or wet clothing when welding. The use of such clothing increases the possibility of electrical shock.
- Never breathe fumes when welding lead, cadmium, chromium, steel, manganese, brass, bronze, beryllium, zinc, or galvanized steel. These fumes are toxic and may cause sickness or death. A good exhaust system is essential when welding within a confined lab.
- Protect welding cables from sparks, hot metal, open flames, sharp edges, oil, and grease.
- Never lay the electrode holder on the welding table or a grounded metal surface. Place it on an insulated hanger. An electrode holder must never touch a compressed gas cylinder.
- Place electrode stubs in a suitable container. Do not allow stubs to get on the floor in the welding area.
- Use tongs or pliers to handle hot metal after it has been welded. Completely submerge metal in water when cooling; this prevents burns from steam.
- Never weld with the cables coiled over the shoulders.
- Disconnect the power to a welding machine before making any repairs.
- Report accidents to the teacher immediately; treat any cuts or burns promptly.
- Cool and store any hot metal before leaving the work area.
- Do not use cables that are frayed, cracked, or that have bare spots in the insulation.
- Use a fire blanket to smother clothing fires. Use a dry-chemical type C extinguisher to put out an electrical fire.
- Check to make sure the welding machine is properly grounded. The welding equipment must be installed according to the provision of the NEC and the manufacturer's recommendations.
- A power disconnect switch must be conveniently located near each welding machine.
- Turn the welder off and store the cables before leaving the welding area.
- The operator must keep all cable connections tight.
- Inspect electrode holders for defective jaws and poor insulation.
- Make adjustments in polarity and amperage only when the machine is not under load. Switching the current while the machine is under load will cause an arc to form between the contact surfaces.
- Wear a welding helmet with a correct-shade filter lens. A number 10 to 12 filter lens is usually satisfactory for general-purpose welding. Most welding helmets provide a flip-up device to allow chipping or grinding to be done without removing the helmet.
- Keep welding screens in place to protect on-lookers from arc flash.
- Turn on the fumes removal system before starting to weld.
- Do not weld in areas that store compressed-gas cylinders.
- Be sure that all gas cylinders are chained in an upright position before starting to weld.
- Clear all combustible materials from the welding area before welding.
- When using water-cooled equipment, check for water leakage often.
- Use an audible signal, such as "cover," to indicate to others that you plan to strike an arc.
- If an electrode sticks, try to twist it free. If twisting fails to free the electrode, release the electrode from the electrode holder. Turn off the switch on the welder and use pliers to break the electrode free.

- Avoid welding directly on concrete floors. Residual moisture in the concrete may be turned to steam, resulting in the concrete exploding.

TIG

- Check all welding cables to be sure they are in good repair and properly connected. Be sure the equipment is properly grounded.
- Make sure the ceramic cup is in good condition before operation.
- Check that the tungsten rod is in proper condition. Mild steel welding needs a point and aluminum welding needs a ball at end of the tungsten rod. Do not touch the tungsten rod with your bare hand when the welder is on.
- Make sure the gas is on during operation and turn the gas off after the welding job is complete.
- Unprotected skin is quickly sunburned by the arc rays.
- Do not touch the live electrode or electrical parts.
- Repair or replace a worn, damaged, or cracked torch or cable insulation.
- Turn off the welding power source before changing the tungsten electrode or torch parts.
- Keep all covers and the handle securely in place.
- Allow the torch to cool before touching and do not touch hot metal; protect hot metal from contact by others.
- To reduce the risk of electric shock, follow these procedures:
 - Keep cables close together by twisting or taping them, or using a cable cover.
 - Do not place the operator's body between welding cables. Arrange the cables to one side and away from the operator. Do not coil or drape the cables around the body.
 - Keep the head and trunk as far away from the equipment in the welding circuit as possible.
 - Connect a work clamp to a workpiece as close to the weld as possible.
 - Do not work next to, sit on, or lean on the welding power source.
 - Do not weld while carrying the welding power source or wire feeder.