

Agricultural Education

Agricultural education encompasses a wide range of activities and facilities. Students and teachers make use of various tools, machinery, equipment, and vehicles to perform tasks. Careful attention must be given to adhering to safety standards.

Facilities

Greenhouses

All general safety guidelines should be followed in agriculture labs. In addition, the following should be observed to ensure safety in greenhouse areas:

- Do not work alone in the greenhouse.
- Know the locations of fire alarms and fire extinguishers.
- Wear closed-toe footwear in the greenhouse and safety glasses when working with chemicals, machinery, and while pruning.
- Do not drink water from any hoses or faucets in the greenhouses.
- Always wash hands after working and before eating or drinking.
- In the event of lightning, hail, or high winds, immediately leave the greenhouse for a more secure structure.
- In the event of a fire, immediately evacuate the greenhouse, set off the fire alarm, and notify the authorities. Polycarbonate/acrylic greenhouse coverings are extremely flammable, and the fumes are hazardous.
- Stay on rubber mats when possible. The greenhouse floors can become slippery when wet. Algae on floors is slippery. Floors may need to be treated to reduce algae growth.
- Take care when using rolling benches to avoid pinching fingers and damaging plant material. Exercise care around greenhouse benches because they are very sharp on the corners.
- Use greenhouse tools with care, because many are sharp.
- Make sure that electricity in the greenhouse is well-grounded and that extension cords are adequate to carry the current. Avoid using electrical equipment when floors are wet or near moisture pads.
- Ensure that fans are properly guarded.
- When cleaning greenhouse glass:
 - avoid working at height (e.g., use a mechanical washing system if possible); wear fall protection if working at height;
 - ensure no one is under a roof that is being cleaned from above;
 - wear snug-fitting clothing and slip-resistant footwear; and
 - take only essential tools and equipment onto the greenhouse roof.

Agricultural Labs

Studies by safety engineers have pointed out a definite relationship between the number of accidents in any particular lab and the housekeeping conditions of the lab. It is important to establish and maintain cleanliness and orderliness, eliminate hazards, and develop proper attitudes and orderly work habits in students. The following are recommended housekeeping practices considered essential for the lab:

- Arrange all equipment to permit safe and efficient work practices.
- Store materials and supplies safely and prohibit the storage of materials and debris on benches in the work areas.
- Provide the appropriate type and quantity of waste containers and dispose of combustible waste materials using proper methods.
- Ensure floors are cleaned regularly.
- Conduct regular inspections to maintain clean and orderly conditions.
- Clean splash guards and collecting pans of all machines that use oil and coolants.
- Maintain a supply of brooms, bench brushes, towels, and other cleaning equipment and use housekeeping tools, equipment, and supplies properly.

- Remind students of their responsibility to keep the lab clean and orderly and organize a housekeeping routine which involves all students.

Further, consider the following:

- Neatness—It is important to have definite places for tools to be kept when not in use. Clean up oily rags, waste paper, scrap materials, and other flammable materials daily and place them in suitable metal or other nonflammable containers.
- Storage of materials—Store or stack materials securely and in such a way as to make them accessible yet secure. This calls for a careful study of suitable storage space options. Provide for the adequate storage of the variety of materials used in the lab. Consider accessibility, lighting, and ventilation in storerooms.
- Maintenance of aisle space—Maintain adequate aisles in all facilities and storage rooms. This aisle space or travel zone can be maintained more readily if the area needed is clearly marked on the floor with white or yellow lines. This practice has been found satisfactory in industry and school laboratories. A general rule is that main aisles must be parallel to the flow of materials in process. Aisles must be kept clear of materials and equipment at all times. Tool rooms and emergency equipment must be located off main aisles.

Posting of Eye Hazardous Areas

The entrance to all labs or other areas that require industrial-quality eye protection must be posted with a sign indicating these requirements. In addition, machines, equipment, or process areas and laboratories requiring operators to wear specific eye and face protection must be posted with warning signs. Visitors must also wear any protective devices required in the area they are visiting. Extra devices must be available at all times to lend to visitors. Devices called *visitors' specs* do not meet ANSI standards.

Clothing

Follow these guidelines with regard to clothing in the lab:

- Do not wear clothing or jewelry that can get caught in any machinery or otherwise cause an accident.
- Do not wear loose clothing, baggy shirts, shorts, dragging pants, or any clothing that has cuffs or frayed edges; do not wear flannel clothing.
- Some tasks, such as welding, require long sleeves along with coveralls or a leather jacket.
- Do not weld if clothing or shoes have oil on them.
- Wear closed-toed shoes (boots or heavy leather shoes are best); do not wear flip-flops or other sandals.

Respiratory Protection

If there is ever a danger of an inhalation hazard, wear a respirator. The four general types are as follows:

- Self-contained breathing apparatus (SCBA)—carries its own air supply in a compressed air tank; is used where there is not enough oxygen or where there are dangerous fumes in the air.
- Supplied air mask—uses a remote compressor or air tank to provide oxygen and is used under the same conditions as the SCBAs.
- Full-facepiece mask with a chemical canister (gas mask)—used to protect against brief exposure to a dangerous gas or fume.
- Half mask or mouthpiece with a mechanical filter—used where dust or other solid particles can be inhaled.

Refer to the Washington State Department of Labor and Industry's safety videos for more information (<http://lni.wa.gov/Safety/TrainTools/Videos/Online/default.asp>).

PPE Guidelines

- Eye protection (safety glasses) must be worn at all times in the lab. Eye protection must meet a minimum standard of ANSI Z87.1. Eye protection must provide front and side protection.
- Face shields, welding helmets, and handheld shields must be worn over primary eye protection (safety glasses).

- A lab coat or coveralls are recommended to be worn at all times in the lab. Never wear loose-fitting clothing or frayed or rolled edges of garments, which could be caught in machinery or catch sparks. Ensure that no flannel or oily garments are worn in the lab.
- Complete coverage of the foot with nonflammable footwear (no nylon) is required in the lab setting.
- Wear leather gloves and coveralls for protection against burns.

Selection of Appropriate Equipment

The list below details what type of PPE to select for particular parts of the body and particular hazards:

- Eyes and face
 - Protection from flying particles or dust—safety glasses with side shields, goggles, face shields, sand-blasting helmets
 - Protection from molten metal—splash goggles, face shields
 - Protection from liquid chemicals—gas-tight goggles, face shields
 - Protection from ultraviolet or infrared light—laser-safety lens with appropriate filter
- Head
 - Protection from falling or overhead objects—hard hat, helmet
 - Protection from electrical conductors—class B hard hat, helmet
 - Protection from power-driven machinery—head covering or caps that completely cover the hair
 - Protection from molten metals—heat-resistant hood and neck covering
- Feet and legs
 - Protection from falling or crushing objects—steel-toed shoes/boots, metatarsals
 - Protection from puncture hazards—puncture-resistant soles
 - Protection from electrical conductors—electrical-hazard shoes
 - Protection from hot substances—leggings or leg or foot guards
 - Protection from chemicals—chemical-resistant footwear
- Hands
 - Protection from hazards such as chemicals, cuts and lacerations, punctures, and extreme temperatures must be selected according to vendor glove charts, standard industry practices, process knowledge, and considerations of dexterity requirements and fit.

Small Outdoor Machinery

Edger

Read and understand the operator's manual.

- Do not remove safety equipment/shields from the unit.
- Wear shoes (not sandals) and required goggles, earplugs, etc.
- Keep hands and feet away from moving parts.
- Do not make operating adjustments while the machine is running.
- Do not operate the equipment in an unsafe manner.
- Do not operate the equipment when there is a danger to bystanders.
- Check oil/fuel levels before operating.
- Check belts for excessive wear (contact technician).
- Clean dirt, grass, etc., from the machine before storing it.
- A technician will make height adjustments, if necessary.
- Report any broken or unsafe equipment to a technician.
- Do not operate equipment deemed unsafe.

Power Mower (Riding)

Read and understand the operator's manual.

- Do not remove safety equipment/shields from the mower.
- Wear shoes (not sandals) and required goggles, earplugs, etc.
- Keep hands and feet away from moving parts.
- Do not make operating adjustments while the machine is running.
- Do not operate the equipment in an unsafe manner.
- Do not operate the equipment when there is a danger to bystanders.
- Check oil/fuel levels before operating.
- Check belts for excessive wear (contact a technician).
- Clean dirt, grass, etc., from the mower before storing.
- A technician will make height adjustments, if necessary.
- Report any broken or unsafe equipment to a technician.
- Do not operate equipment deemed unsafe.
- Remain seated during operation of machine.

Power Mower (Walk)

Read and understand the operator's manual.

- Do not remove safety equipment/shields from the unit.
- Wear shoes (not sandals) and required goggles, earplugs, etc.
- Keep hands and feet away from moving parts.
- Do not make operating adjustments while machine is running.
- Do not operate equipment in an unsafe manner.
- Do not operate equipment when there is a danger to bystanders.
- Check oil/fuel levels before operating.
- Check belts for excessive wear (contact a technician).
- Clean dirt, grass, etc., from the machine before storing.
- A technician will make height adjustments, if necessary.
- Report any broken or unsafe equipment to a technician.
- Do not operate equipment deemed unsafe.

Rototiller

Read and understand the operator's manual.

- Do not remove safety equipment/shields from the unit.
- Wear shoes (not sandals) and required goggles, earplugs, etc.
- Keep hands and feet away from moving parts.
- Do not make operating adjustments while the machine is running.
- Do not operate equipment in an unsafe manner.
- Do not operate equipment when there is a danger to bystanders.
- Check oil/fuel levels before operating.
- Check belts for excessive wear (contact a technician).
- Clean dirt, grass, etc., from the machine before storing.
- A technician will make height adjustments, if necessary.
- Report any broken or unsafe equipment to a technician.
- Do not operate equipment deemed unsafe.

Chain Saw

Read and understand the operator's manual.

- Personal safety
 - Use safety footwear, snug-fitting clothing, and eye, hearing, and head protection.
 - Wear nonslip gloves to improve your grip. Do not wear scarves, jewelry, or neckties, which could be drawn into the engine or catch on the chain or underbrush.

- Always hold the chain saw with both hands when the engine is running. Use a firm grip with thumbs and fingers encircling the chain saw handle.
- Guard against kickback
 - Hold the chain saw firmly with both hands. Do not overreach. You cannot maintain good control of the saw if you cut above shoulder height.
 - Do not let the nose of the guide bar contact a log, branch, the ground, or any other obstruction. Keep the anti-kickback device properly mounted on the guide bar.
 - Throttle up before letting the chain contact the wood. Do all cutting at full throttle.
 - Keep the chain sharp. Do not operate with a loose chain. Maintain the correct tension of the chain as prescribed in the owner's manual.
- Guard against the effects of a long or continuous exposure to noise.
- Never operate a chain saw when you are fatigued.
- Keep all parts of your body away from the saw chain when the engine is running.
- Precautions with chain saws
 - Always carry the chain saw with the engine stopped, the guide bar and saw chain to the rear, and the muffler away from your body. When transporting your chain saw, use the appropriate guide bar scabbard.
 - Always use caution when handling fuel. Move the chain saw at least 10 feet (3 meters) from the fueling point before starting the engine.
 - Keep the handles dry, clean, and free of oil or fuel mixture.
 - Before you start the engine, make sure the saw chain is not contacting anything.
 - Shut off the engine before setting down the saw. Do not leave the engine running unattended.
 - Operate the chain saw only in well-ventilated areas.
 - Never operate a chain saw that is damaged, improperly adjusted, or is not completely and securely assembled. Be sure that the saw chain stops moving when the throttle control trigger is released.
- Precautions about maintenance
 - Competent chain saw service personnel should perform all chain saw service. If improper tools are used to remove the flywheel or clutch, or if an improper tool is used to hold the flywheel in order to remove the clutch, structural damage to the flywheel could occur, which could subsequently cause the flywheel to burst.
- Precautions in cutting/work area
 - Do not operate a chain saw in a tree unless you have been specifically trained to do so.
 - Keep bystanders and animals out of the work area.
 - Never start cutting until you have a clear work area, secure footing, and a planned retreat path from the falling tree.
 - Use extreme caution when cutting small-size brush and saplings, because slender material may catch the saw chain and be whipped toward you or pull you off balance.
 - When cutting a limb that is under tension, be alert for spring back so that you will not be struck when the tension in the wood fibers is released.

Vehicle and Equipment Maintenance and Fueling

Injuries can occur during vehicle or equipment maintenance. If equipment starts up unexpectedly during repairs or maintenance, injury or death may result. Reduce the risk of electrical shocks, burns, or electrocution by de-energizing and locking out electrical equipment. When vehicles are being fueled, there is a risk of fire, explosion, or exposure to hazardous materials.

Locking Out Equipment

The following safety guidelines apply to locking out equipment:

- Identify the machinery or equipment that needs to be locked out.
- Shut off the machinery or equipment. Make sure that all moving parts have come to a complete stop.
- Identify and deactivate the main energy-isolating device for each energy source.

- Apply a personal lock to each energy-isolating device for each energy source. Ensure that all parts and attachments are secured against inadvertent movement.
- Make sure that all workers are in the clear and that no hazard will be created if the lockout is not effective, then test the lockout. After testing the Start button, remember to hit the Stop button again, or reset the equipment to Off.

Fueling Vehicles

The following safety guidelines apply to fueling vehicles:

- Store fuel in a safe, secure location with the appropriate warning signs in place.
- Use only approved fuel containers. Protect them from damage.
- Make sure there is a fire extinguisher nearby that is rated for gasoline fires.
- To avoid carbon monoxide poisoning, do not run an engine inside an enclosed area.
- Turn off the vehicle and let it cool before fueling.
- Use gloves while fueling. If gasoline comes into contact with skin, wash immediately with soap and water.

Tractors

Read and understand the operator's manual.

- Safety is the responsibility of the operator.
- Use the steps and handholds provided in getting up and down from a tractor. Keep steps, pedals and footwear clean of mud and oil to avoid slips. Do not jump from a tractor or climb up and down from the rear.
- Tractors have a high center of gravity; therefore they are easy to overturn. To avoid tipping over, reduce speed when:
 - Making turns, especially on rough and muddy surfaces.
 - Going across a slope.
 - Pulling heavy or unstable loads.
- Go up steeper slopes in reverse. Avoid slopes too steep for safe operation.
- Avoid driving near ditches, holes, levees, trees, and electrical poles.
- Operate the tractor smoothly, without sudden turns, stops or starts.
- Before getting down for whatever reason, but especially for making adjustments on implements:
 - Come to a standstill.
 - Put the Power Takeoff in neutral.
 - Lower the implement to the ground.
 - Set the brakes.
 - Turn off the motor.
 - Put the key in your pocket.
- Hitch implements only to the traction bar, using the recommended hitch points. Use the proper hitch pin, along with its safety pin. Attach the safety chain.
- Sit down before starting the motor. Remain seated while driving.
- Use the safety belt if the tractor has a Rollover Protective Structure (ROPS), so the tractor or its ROPS will not crush you if the tractor overturns.
- Do not allow anyone to ride on the tractor, drawbar, or implements.
- Let the engine cool before checking the radiator or refueling, to avoid burns to the hands or face. Do not smoke while refueling.
- Always keep the Power Take Off (PTO) shields in place.
- Do not wear loose clothes, rings, or long hair, because they can get caught on the tractor, in the PTO, or the implements.
- Use personal protective equipment when necessary: goggles, hearing protection protectors, dust masks or respirators (for chemicals).
- Drive only when you are physically able to do it so safely.

Read and understand the operator's manual.

- Ensure any attached equipment or accessories are correctly installed, are approved for use with the tractor, do not overload the tractor, and are operated and maintained in accordance with the instructions issued by the equipment or accessory manufacturer.
- Use an approved ROPS or safety cab and seat belt for safe operation. Overturning a tractor without a ROPS or safety cab can result in death or injury.
- Always use the seat belt with the ROPS or safety cab.
- Use the handholds and step plates when getting on and off the tractor to prevent falls. Keep steps and platform clear of mud and debris.
- Do not permit anyone but the operator to ride on the tractor. There is no safe place for extra riders.
- Remember that your tractor, if abused or incorrectly used, can be dangerous and become a hazard to the operator and to bystanders. Do not overload or operate with attached equipment, which is unsafe, not designed for the particular task or is poorly maintained.
- Replace all missing, illegible, or damaged safety decals.
- Keep safety decals clean of dirt and grime.
- Follow these guidelines when operating the unit:
 - Position the transmission in neutral and apply the parking brake before starting the tractor.
 - Do not start the engine or operate controls while standing beside the tractor. Always sit in the tractor seat when starting the engine or operating the controls.
 - Do not bypass the safety start switch. Use booster cables only in the recommended manner. Improper use can result in a tractor runaway.
 - Avoid accidental contact with the gearshift lever or power-reversing lever while the engine is running. Unexpected tractor movement can result from such contact.
 - Do not get off the tractor while it is in motion.
 - Never attach chains, ropes or cables to the loader, ROPS, or backhoe for pulling purposes.
 - Never leave the tractor without first lowering the backhoe and loader buckets to the ground.
 - Stop the engine, apply the parking brake, and put the gearshift lever and power-reversing lever into neutral before dismounting.
 - Do not engage the parking brake while the tractor is in motion.
 - Never leave the tractor when it is parked on an incline. Always park the tractor on level ground where possible. If the tractor is to be parked on an incline, always lower the buckets so that the cutting tips contact the ground, apply the parking brake, and securely block the wheels.
 - Always keep a lookout for bystanders.
 - Always check overhead clearance, particularly when transporting the tractor.
 - If the engine or power steering ceases operating, stop the tractor immediately.
 - Do not run the engine in a closed building without adequate ventilation, because exhaust fumes can suffocate you.
 - Always carry out the recommended checks before commencing work each day.
 - Always place the torque converter shuttle lever in neutral before operating the backhoe.
 - Do not enter the platform from the rear.
 - Always check the location of gas and electrical lines before you start to dig.
 - Watch out for overhead and underground high-voltage electrical lines when operating the loader or backhoe.
 - To prevent upsets, avoid full reach and swinging the bucket to the downhill side when operating on a slope.
 - Never operate the controls when standing on the ground.
 - Always deposit the spoil on the uphill side when operating on a slope.
 - Always travel slowly over uneven ground.
 - Take special care when excavating with a high-capacity bucket.
 - Always use the recommended amount of counterweights to ensure good stability.
 - Do not transport anyone in the loader bucket.

- Always carry the loader bucket low for maximum stability and visibility, whether the bucket is loaded or empty.
- Be careful when handling round objects such as oil drums, pipes, or poles. Lifting too high or rolling back too far could result in these objects rolling rearward down the loader arms and onto the operator.
- Follow these guidelines when driving the unit:
 - Always drive with care and at speeds compatible with safety, especially when operating over rough ground, crossing ditches or slopes, or when turning.
 - Never allow the tractor to over-run when going downhill. Do not coast or freewheel down hills.
 - Always use the transport lock when transporting the tractor.
 - Lock the foot-brake pedals together when traveling on the highway to provide two-wheel braking.
 - Do not engage the differential lock when turning the tractor. When engaged, the lock will prevent the tractor turning.
 - Always sit in the driver's seat and wear your seat belt when driving the tractor.
 - Ensure the tractor lights are adjusted to avoid blinding an oncoming driver.
 - Use the flasher/turn signal lights and slow-moving vehicle signs when traveling on public roads, both day and night.
 - Avoid accidental contact with the gearshift lever or power reversing lever while the engine is running. Unexpected tractor movement can result.
 - Any towed vehicle whose total weight exceeds that of the towing tractor must be equipped with brakes, for safe operation.
 - When the tractor is stuck, back out to prevent upset.

Rotary Mower

Read and understand the operator's manual.

- Make sure that lock pins are installed into the upper and lower link pins on the hitch.
- Add front-end weights as required to maintain enough weight on the front wheels for safe steering.
- Slow down on curves and in rough places to maintain a safe steering weight on the front wheels.
- Never start or accelerate suddenly so that safe steering can be maintained.
- Use caution when lifting implements while going up steep slopes.
- These implements use a PTO-driven driveline, so keep hands, feet, hair, and clothing away from PTO shaft.
- Disengage the tractor PTO and set the brakes, then turn engine the off before dismounting. Always dismount from side, never over the drive line.
- The implement should not be operated unless the tractor master shields and all gear box input and output shields are in place.
- Check the proper placement of the PTO shaft shield.
- Driveline shields should turn freely by hand without the PTO being engaged.
- Ensure that u-joint yokes are locked properly onto the tractor and implement shafts.
- Look and listen for evidence of rotation.
- Keep everyone clear when the implement is being raised or lowered. Raise or lower slowly and cautiously.
- Keep yourself and other persons clear of this machine while in operation, because objects can be thrown out at a high velocity.
- Wear goggles or safety glasses, hearing, and dust protection while operating.
- Check blades and blade bolts for wear and looseness daily.
- Do not clean, lubricate, or make repairs or adjustments to this machine until the PTO is disengaged, the tractor is shut off, and the blade carrier has stopped rotating.
- Transport information: Before operating or moving on highways, clean off reflectors, make certain the slow-moving vehicle sign is clearly visible, and install a safety chain, if required. Also make sure the mower is raised as high as possible.

Flail Mower

Read and understand the operator's manual.

- Observe all safety rules for tractor operation.
- Carefully hook up the tractor's three-point hitch to the mower. Do not allow anyone to stand between the tractor and the mower.
- Hook up the PTO and check that it is properly engaged. Make sure the PTO guard is in place.
- Grease all fittings.
- When driving down road, watch the right side carefully because it extends far to right.
- When in the area to be mowed, carefully adjust the mower to cut as low as possible without hitting dirt.
- Keep everyone well away from the machine when it is operating because of flying objects coming from under the machine.
- Wear personal protective equipment.

Spray Rig–Ground Sprayer

Read and understand the operator's manual.

- Observe all safety rules for tractor operation.
- Grease fittings.
- Back the tractor up to the spray rigs and carefully hook up to the three-point hitch. Do not allow anyone to stand between the tractor and the sprayer.
- Connect the PTO shaft and check that it is properly engaged with cover in place.
- Raise the tank from the ground before driving forward. The equipment will be damaged if it is not raised.
- Avoid overfilling to eliminate spills.
- Wear proper spray clothing before mixing or applying spray material.
- Triple-rinse any empty containers into the spray tank.
- Close the lid to the container and fasten properly after filling to eliminate spills.
- When using a handgun for spraying, be sure it is not leaking.
- When using booms, do not allow you or others to be exposed to the spray when making adjustments.
- When finished spraying, clean the spray rig thoroughly using approved methods.

Posthole Digger

Read and understand the operator's manual.

- To prevent possible personal injury during assembly, installation, operation, adjustment, or removal of the implement, it is recommended that gloves and safety glasses or face shields be worn.
- Do not operate equipment unless guards and safety shields are in place.
- Do not wear loose clothing or have long hair worn in a down position while operating or working around the digger.
- Do not attempt to work around the digger with the PTO shaft is revolving.
- Shut off the tractor engine, set brakes and lower the implement to the ground before leaving the tractor seat.
- At no time will the auger be operated without the tractor operator on the tractor and in position to disengage the PTO immediately.
- Keep all spectators clear of auger when it is in operation.
- Do not oil or attempt to make any adjustments while the implement is in operation.
- Do not exceed 540 rpm while operating this PTO-powered implement.
- Do not attempt to operate the implement on steep hillsides.
- Reduce your speed while transporting the implement over rough ground.
- Keep all bolts and nuts tight. Replace any damaged or worn parts immediately.
- When the use of hand tools is required to perform any part of assembly, installation, removal, or adjustment of the implement, be sure the tools used are designed and recommended by the tool manufacturer for the specific task they will be used for.

Front End Loader

Read and understand the operator's manual.

- Always use seat belts when the tractor is equipped with a ROPS. Never use the seat belt when the tractor is not equipped with a ROPS.
- Do not lift or carry anybody on the loader or in the bucket or attachment.
- Never allow anyone to get under the loader bucket or reach through the lift arms when the bucket is raised.
- Do not walk or work under the raised loader, bucket, or attachment unless it is securely blocked or held in position.
- Improper use of a loader can cause serious injury or death.
- Operate the loader from the operator's seat only.
- Add recommended wheel ballast or rear weight to provide good stability.
- Move the wheels to the tractor manufacturer's widest recommended settings to increase stability.
- Move and turn the tractor at low speeds.
- Carry the loader arms at a low position during transport.
- Exercise caution when operating the loader with a raised, loaded bucket or fork.
- Avoid loose fill, rocks, and holes. They can be dangerous for loader operation or movement.
- Be extra careful when working on inclines.
- Avoid overhead wires and obstacles when the loader is raised. Making contact with electric lines can cause electrocution.
- Allow for the loader length when making turns.
- Stop the loader arms gradually when lowering or lifting.
- Use caution when handling loose or shiftable loads.
- Lower all loader hydraulic arms, stop the engine and lock the brakes before leaving the tractor seat.
- Make sure all parked loaders on stands are on a hard, level surface. Engage all safety devices.
- Operate the loader controls only when properly seated at the controls.
- Visually check for hydraulic leaks and broken, missing, or malfunctioning parts. Make necessary repairs. Inform your repair facility.
- Escaping hydraulic oil under pressure can have sufficient force to penetrate the skin, causing serious personal injury. If injured by escaping fluid, notify your instructor/supervisor and obtain medical treatment immediately.
- Before disconnecting hydraulic lines, relieve all hydraulic pressure.
- Do not tamper with the relief valve setting. The relief valve is preset at the factory. Changing the setting can cause overloading the loader and tractor, and serious operator injury may result.
- Using front-end loaders for handling large, heavy objects, such as large round or rectangular bales, logs, and oil drums, is not recommended.
- Handling large heavy objects can be extremely dangerous due to:
 - Danger of rolling the tractor over.
 - Danger of upending the tractor.
 - Danger of the object rolling or sliding down the loader arms onto the operator.
- If you must handle heavy loads, protect yourself by:
 - Never lifting the load higher than necessary to clear the ground when moving.
 - Ballast the tractor rear to compensate for the load.
 - Never lifting a large object with equipment that does not have an anti-roll device.
 - Moving slowly and carefully, avoiding rough terrain.

Fork Lift – Lift Truck

Before operating a lift truck, the operator must be trained and certified to operate the lift being used.

- Before you use the equipment, give your lift truck a thorough operational check. Check the oil, coolant, and battery levels. Give the truck a general inspection, looking for cracked hoses or fittings.
- Always wear a seat belt to protect yourself in case of a rollover.
- Immediately report faulty performance or damage.
- Make sure you know the load capacity of your truck and do not exceed it.
- Always lift with the load placed squarely on the forks, with the mast vertical or tilted slightly back.
- Tilt the elevated load forward only when directly over the unloading point, and always travel with the load as low as possible.
- When traveling with a load, carry the load as close to the floor as possible with mast tilted slightly back.
- Never lift or lower loads while traveling.
- Slow down at cross aisles, sharp curves, ramps, dips, and blind corners or on wet, slippery, or rough surfaces.
- Check your loads. Do not move a questionable or unsafe load. If a load looks poorly balanced, loose, or too heavy, check it out.
- Always position your loads evenly on the forks for proper balance.
- Ramps require another special technique. Always drive in reverse when you are carrying a load down a ramp or incline and look in the direction of travel.
- Always keep the load well back against the backrest and the mast tilted backward.
- When lifting, lowering, or carrying loads, keep the mast vertical or tilted back, never forward.
- Start and stop your lift truck gradually to protect against load damage and shifting.
- Observe speed limits and keep lift truck travel speeds slow when encountering uneven or rough surfaces.
- Keep a safe distance between your lift truck and other lift trucks, industrial vehicles, or pedestrians working in the area.
- Do not use your lift truck to haul riders or a load for which it was not intended.
- Keep arms, legs, and other parts of the body within the lift truck and overhead guard area.
- When parking the lift truck, make sure the forks are completely lowered and tilted forward slightly to keep the ends against the floor.
- Park the truck in neutral, shut off the engine, set the parking brake, and remove the ignition key.
- Protect against accidents and damage by making sure that the load weight does not exceed floor limits, and that a raised mast or overhead guard clear all overhead obstacles, water and steam pipes, eaves of the building, etc.
- Make sure your counterweight swings clear of merchandise, racks and equipment, and pedestrians when rounding corners or maneuvering.
- Do not allow the fork tips to strike any object, and when working in areas with blind corners or aisles, travel in reverse if necessary.
- Always watch for loose or poorly stacked loads, overhead obstacles and hazards, and falling objects.
- Where applicable, wear a hard hat.
- Do not allow riders on the lift truck.
- Pay special attention to load swing when turning or load shifts, which may upset your truck's balance.
- Careless operation around a loading dock can mean serious injury or damage to your equipment and merchandise.
- Elevated loads are supported by powerful hydraulics, but play it safe. Do not walk or stand under elevated forks or an elevated load.
- Lift truck refueling or battery changes should take place only in a safe, designated area.
- Always apply the rules of common sense, courtesy, and safety when operating lift trucks or working in the lift truck area.

Skid Steer Loader

Read and understand the operator's manual.

- Conduct a pre-operation safety check before entering to verify the integrity of safety devices, tires, structural components, and engine (e.g., no leaks, adequate fuel, etc.).
- Enter the equipment only when the bucket or other attachments are on the ground or are locked in place with lift arm supports.
- Face the seat and keep a three-point contact with the hand holds and steps.
- Do not use the operating controls as handholds or steps.
- Always wear the seatbelt when operating the equipment.
- Follow these guidelines when operating the unit:
 - Immediately after starting the engine, verify the working nature of the controls, brakes, horn, and alarms.
 - Operate the loader from the operator compartment, never from the outside.
 - Never exceed the manufacturer's specified load limit. Take care to evenly distribute the load. In some cases, it may be necessary to secure the load to prevent falling or shifting.
 - Never work around the equipment when the bucket or fork attachment is raised unless it is supported, the brakes are set, and the key is removed from the ignition. Use lift arm supports when they are present on the equipment. If no supports are present, contact the equipment dealer or manufacturer for help in determining proper support procedures.
 - Never allow a person to position themselves under or near the bucket or frame while the skid steer loader is in operation.
- Follow these guidelines when driving the unit:
 - Keep arms, legs, and head inside the cab when operating the loader.
 - Avoid excessive speeds.
 - Operate the equipment on stable surfaces. When possible, load, unload, and turn the equipment around on level ground.
 - For maximum stability, travel and turn equipment when the bucket is in the lowest position possible.
 - Avoid traveling across slopes and hills; if absolutely necessary, travel straight up or down with the heavy end of the machine pointed uphill.
 - Always look in the direction of travel.
 - Never allow passengers in the operator compartment or bucket of the skid steer loader.
 - Before leaving the operator's seat, set the bucket on the ground, set the parking brake, and turn off the engine.

All-terrain Vehicle (ATV)

Read and understand the operator's manual.

- Be at least 16 years old.
- Always obey Utah's ATV laws.
- Ensure the ATV is the correct size for the rider's age and weight.
- Always wear a DOT-approved helmet, gloves, eye protection, long sleeves, and long pants.
- The engine, exhaust, and muffler become hot and can cause burns.
- Attaching a whip or flags will increase visibility.
- Keep hands and feet away from all moving parts.
- Follow these guidelines for inspections:
 - Inspect tires and wheels before operation.
 - Inspect controls and cables.
 - Inspect lights and ensure they work properly.
 - Check oil and fuel levels before riding.
 - If there is a chain, check that it is properly lubricated.
 - If there is a drive shaft, ensure that there are no leaks.
- Follow these guidelines when riding the ATV:
 - Never carry passengers.
 - Never ride on the road.

- Do not carry or tow loads.
- Properly shift your weight when making a turn.
- Apply the brakes evenly and gently.
- Avoid steep slopes.
- When riding up a steep slope, shift your weight forward while leaving your feet firmly planted on the floorboards.
- If the ATV slides backward on a steep incline, gently apply the brakes.
- Keep feet on floorboards at all times.

Materials, Combustibles, and Substances Safety

Topic	Information
Combustibles and Toxic Substances	Many industrial supplies are flammable, explosive or subject to spontaneous combustion. Store combustible supplies and waste in fire-safe containers.
Chemicals/Hazardous Substances	Follow procedures for safe handling, use, storage, and disposal of chemicals/hazardous substances, including emergency procedures and spill cleanup. Label containers if you transfer the product from the original container. Know where to find safety data sheets (SDS) and be able to answer the following questions for each product used: <ul style="list-style-type: none"> ● What are the hazards of the product you are using? ● How do you protect yourself from the hazards of the product? ● What would you do if an emergency occurred? ● Where can you find out more information about the product you are using?
Corrosives	Acids and caustics can burn the skin and eyes, causing permanent damage; they can also corrode metal, so wear goggles, gloves, and protective clothing.
Flammables and Combustibles	Many industrial supplies are flammable, explosive or subject to spontaneous combustion, so store combustible supplies and waste in fire-safe, closed containers and keep them away from ignition sources.
Hazardous Waste	Follow procedures for handling and disposing of hazardous waste. Many counties provide for disposal of hazardous waste.
Poisons	Follow procedures for the safe use of poisons, and label the containers if you transfer the product from the original container.
Substances Under Pressure (e.g. compressed gas cylinders)	Cylinders can explode if dropped or heated, so keep them away from ignition sources. Always follow procedures for safe use.
Wood Dust	Some wood dusts cause allergies (e.g., oak, mahogany, western red cedar, redwood).

Chemical Safety

Safety Data Sheet (SDS)

When working with any type of chemical, the safety data sheet (SDS) should be posted in a conspicuous place in the work area. SDS binders are available for this purpose. Teachers should review the SDS for all materials used in the shop or farm and be familiar with any hazards that may be associated with use of the materials. If a material does pose a health hazard, teachers should observe appropriate precautions when they or their students handle the material.

As of June 1, 2015, the Hazard Communication Standard (HCS) requires chemical manufacturers, distributors, or importers to provide SDSs to communicate the hazards of hazardous chemical products.

Standardized SDS Sections:

- Identification
- Hazard(s) Identification
- Composition/Information on Ingredients
- First-Aid Measures
- Fire-fighting Measure
- Accidental Release Measures
- Handling and Storage
- Exposure Controls/Personal Protection
- Physical and Chemical Properties
- Stability and Reactivity
- Toxicology Information
- Ecological Information
- Disposal Considerations
- Transport Information
- Regulatory Information
- Other Information

Common materials that require SDS are:

- Gasoline and other fuels
- Welding rod
- Welding gases
- Paint
- Solvents
- Fertilizer
- Pesticides
- Cleaners
- Other petroleum products
- Adhesives (e.g., PVC cement)
- Portland cement
- Lead acid and rechargeable power tool

SDS are available from product manufacturers (see their websites) and also can be found at <https://www.msds-online.com/resources/ghs-answer-center/ghs-101-safety-data-sheets-sds>. For additional information regarding SDS requirements, visit <https://www.osha.gov/Publications/OSHA3514.html>

Pesticides restricted by the state or federal government require application by a licensed applicator. These regulations apply to farm, landscape, and greenhouse applications. It is recommended that farm personnel take the training associated with the licensing to become familiar with the safety application of and regulations associated with restricted chemicals, even if they are not applying restricted chemicals.

Pesticides can get into the body through many different ways (i.e., through the skin, mouth, nose, or eyes) and can have acute and chronic effects on health. The following resources may prove helpful:

- Utah Pesticide Safety (<https://ag.utah.gov/farmers/plants-industry/pesticides/>;
<https://extension.usu.edu/vegetableguide/pesticide/safety-regulation-storage>)

- Safe Herbicide Use from the Penn State Extension Service (<http://extension.psu.edu/pests/weeds/control/introduction-to-weeds-and-herbicides/safe-herbicide-use>).

In addition, the following safety precautions must be followed:

- Follow all safety precautions on the label. Know and observe the general rules for safe chemical (e.g., pesticide) use, and record the date, time, location, and amount of each substance used.
- Ensure familiarity with current federal and state laws and regulations related to chemical use in agriculture.
- Always wear PPE.
 - Protecting the eyes:
 - Always wear eye protection when mixing, loading, and applying chemicals; cleaning or repairing equipment; or flagging for an aerial application.
 - Types of eye protection can be safety glasses (with temple and brow protection), goggles, a face shield, or a full-face mask. Pilots can use a visor for eye protection. Regular eyeglasses and sunglasses do not provide enough protection.
 - Protecting the hands:
 - Keeping chemicals off hands is often the hardest part of working safely with chemicals. Once a chemical gets on the hands, it can get into the eyes or mouth through contact with the hands. Always wash hands before eating, drinking, or using the restroom.
 - Always wear gloves when mixing, loading, and applying pesticides; cleaning or repairing pesticide-application equipment; during all hand applications of pesticides; and anytime it is recommended on the manufacturer's label. If the label does not indicate the type of glove needed, use gloves made of chemical-resistant material like rubber or neoprene. Never wear fabric-lined or leather gloves unless the label specifically says to do so. If the label indicates that gloves must not be worn, do not wear gloves. Always follow manufacturer's recommendations.
 - Protecting the lungs:
 - Always wear a respirator while using chemicals that are harmful if inhaled (this can include fumigants, powders, dusts, and some liquids), any time the label requires its use, or when mixing, loading, and applying chemicals.
 - Protecting the body:
 - Always wear clean coveralls (or a long-sleeved shirt and long pants) whenever working with chemicals with the word *danger* or *warning* on the label.
 - If the label recommends wearing chemical-resistant clothing and equipment, always do so while mixing, loading, and applying chemicals.
- Be cautious of concentrated chemicals before they are mixed with water.
- Avoid the drift of spray or dust that may endanger other crops or animals. Cover feed pans, troughs, and watering tanks in livestock areas; protect beehives.
- Never eat or drink while applying chemicals.
- Avoid spilling spray materials on your skin or clothing. If such an accident occurs, wash immediately with soap and water.
- Always wash hands with soap and water after chemical use.
- Bathe after applying pesticides and change into freshly laundered clothing. Wash clothing worn during application, keeping in mind that, until laundered, such clothing must be handled according to the same precautions as the chemical itself. Wash contaminated clothing apart from other laundry, and take care in disposing of the wash water.
- If poisoning is suspected, contact the nearest Poison Control Center, hospital emergency room, or physician. Take the chemical label and, if possible, the SDS to give to the attending physician.

Warning Labels

Most labels have a word in all-capital letters on the front of the label to indicate health hazards. Commonly used words are the following:

- **DANGER:** this pesticide is extremely harmful.
- **WARNING:** this pesticide is moderately harmful.

- *CAUTION*: this pesticide is slightly harmful but still can cause illness.

If the label does not have one of these words, it means that the chemical (e.g., pesticide) is less likely to cause harm. However, always handle every chemical with care.

Chemical Storage, Spills, and Disposal

Commercial fertilizers, petroleum products, pesticides, and other products and chemicals may be stored in labs or on school farms. Potentially poisonous, corrosive, volatile, flammable, or dangerous materials or liquids must be stored in structurally sound facilities to prevent leaks and spills. Storage of these materials must consider physical security as well as the hazard posed in the event of a fire, earthquake, or other natural disaster.

Hazardous Wastes

Hazardous waste includes such materials as batteries, paint, and unused chemicals. Many regulations exist covering the handling of hazardous waste. Maintain an understanding of federal, state, and local regulations regarding the handling of hazardous waste.

Consult with local authorities to determine how spills of hazardous materials need to be handled. Determine whom to call ahead of time to be prepared if a spill occurs. Additionally, consult with local authorities (often, localities have disposal programs) to determine how to properly dispose of hazardous waste. Use recycling programs whenever possible.

Be sure to properly dispose of herbicide containers according to state regulations.

Agricultural Chemical Storage

All agricultural chemicals must be stored in a dedicated facility. Storage structures must meet the following minimum standards:

- Be ventilated naturally or mechanically to the outdoors to prevent the accumulation of toxic or flammable vapors
- Be accessible from outdoors and secured from unauthorized entry
- Have an impervious floor, typically concrete, without a floor drain and curbed to contain a volume at least equal to the largest container stored within
- Be separated from all food, feed, and water supplies
- Be separated from all other occupancies either by an open space or by a fire separation wall having a fire rating resistance of at least one hour
- Be clearly identified with a sign saying *Danger—chemical storage* or *Authorized persons only* permanently attached to the outside of each entrance
- Contain shelving that separates oxidizing chemicals from combustible chemicals
- Have an insulated and heated cabinet for chemicals requiring protection from freezing

If a storage structure is incorporated with a sprayer-filling station, it must be located well away from and sloped away from any surface-water sources or groundwater-supply sources. It must be situated on land that is naturally impermeable or has been covered with an artificial impermeable base.

Avoid cross-contamination. Do not store herbicides with pesticides. A storage facility must be dedicated to the storage of full and partially full containers only. If temporary storage is required, the site selected must be one that is used infrequently and is fenced or enclosed.

Applicable regulations and 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.

Liquid fertilizer storage tanks must be located within a properly sized walled or bermed, leak-proof, secondary-containment structure. Large dry-bulk fertilizer storages must 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.

Agricultural Chemical Disposal

Empty containers must be triple-rinsed or cleaned to the point where they pose no threat to people, animals, or the environment. Check local regulations for container disposal requirements. To minimize the number of containers that must be disposed of, personnel are encouraged to calculate chemical needs carefully. If chemicals are already mixed and contained in a sprayer, they may be further diluted and sprayed on an already sprayed crop. This eliminates the need to drain the sprayer and store used or diluted chemicals.

Chemicals that are not likely to be needed in the future or whose efficacy is likely to decline before they will be used again must be disposed of in an environmentally responsible manner. Unopened pesticides can be returned to the vendor. Partially full containers must be disposed of properly. Excess pesticide, whether diluted or not, must never be disposed of in an inconspicuous farm location or drained into the sewer system. Under no circumstances should expired chemicals or incompletely washed containers be stored in an area not dedicated to pesticide storage.

Hazardous Material Storage

Commercial fertilizers, petroleum products, and pesticides and other products may be stored in labs or on school farms. Potentially poisonous, corrosive, volatile, flammable, or dangerous materials or liquids must be stored in structurally sound facilities to prevent leaks and spills. Storage of these materials could consider physical security as well as the hazard they might pose in the event of a fire or earthquake.

Storage and Disposal of Used Containers

A storage facility should be dedicated to the storage of full and partially full containers only. Empty containers should be triple-rinsed or cleaned to the point where they pose no threat to people, animals, or the environment. If temporary storage is required, the site selected should be one that is used infrequently and is fenced or enclosed. Check local regulations for container disposal requirements.

Disposal of Diluted Chemicals

To minimize the number of containers that must be disposed of, farmers are encouraged to calculate their chemical needs carefully. If chemicals are already mixed and contained in a sprayer, they may be further diluted and sprayed on an already sprayed crop. This eliminates the need to drain the sprayer and store used or diluted chemicals.

Recycling of Unused or Expired Chemicals

Chemicals that are not likely to be needed in the future or whose efficacy is likely to decline before they will be used again should be disposed of in an environmentally responsible manner. Unopened pesticides can be returned to the vendor. Partially full containers should be disposed of properly.

Excess pesticide, whether diluted or not, should never be disposed of in an inconspicuous farm location or drained into a sewer system. Under no circumstances should expired chemicals or incompletely washed containers be stored in an area not dedicated to pesticide storage.

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.