Basic Shop Safety

Safe-ty (sayf'-tee:) n. the condition of being safe from risk or danger.

Introduction

Safe at All Levels:

Many students like to work with their hands, and they enjoy developing skills which can be used to build things. Working and learning in the agricultural mechanics laboratory can be fun and rewarding, but students must realize the lab can also be a dangerous place. Workplace safety is well regulated by government standards, but sometimes student safety can be neglected in the teaching atmosphere of a school or trade school. Teachers should realize the shop is often the first place students are exposed to proper safety training.

Setting a Standard:

Safety procedures that become a habit in class will usually be carried over into the workplace. Teachers must become well aware of the hazards inherent in the laboratory setting and use methods to lessen those dangers. Students must recognize hazardous situations and learn how to protect themselves from injury. Such attention to safety concerns will raise the safety awareness standards of the agricultural mechanical industry as a whole.

An Accident Waiting to Happen?

Accidents and health problems associated with agricultural/mechanical sciences are shocking. Results from a recent study of agricultural science programs in Texas showed that in 239 randomly selected schools, 1,449 accidents occurred in one year. This means about four accidents occurred in those agricultural laboratories everyday.

Accidents are the leading cause of death or injury for persons age one to 37. Agriculture continues to be one of the most hazardous industries, with a disproportionate share of the nation's occupational-related fatalities. For these reasons, safety in the agricultural mechanics lab is vital. This study guide complements the presentation *Basic Shop Safety* by expanding on the information and by presenting activities that help students learn and understand the safety concepts being taught. Using of both presentation and study guide will help students retain the information and incorporate it into their daily shop activities.

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Section I: Personal Protective Equipment

When firefighters respond to a call, they wear equipment to protect themselves against dangers inherent in their job—fire, heat, chemical spills and vapors. Because an agricultural mechanic laboratory also has potential dangers, when you are working in the lab you should wear protective equipment. Different laboratory situations call for various combinations of personal protective equipment to take care of your eyes, ears (hearing), body, lungs and head.

Eye Protection

Anytime you are in the workshop take special care to protect your eyesight because eyes are particularly vulnerable to injury. The majority of eye accidents occur in situations identical to those found in the typical vocational shop setting, so do not think the steps and protection you must take in class are something for school only. Most eye injuries can be avoided with a little time and attention. Studies show that *no* eye protection was worn in over 60 percent of daily eye accidents, and more than half of those who did have eye protection were wearing *the wrong devices for the jobs they were doing*.

Safety glasses and clear face shields provide good eye protection for most lab work. Other eye and face protection devices should also be available in the lab: dust goggles, chemical goggles and chipping goggles. Welding requires special filtered lenses for eye protection.

Safety Glasses:

Most eye injuries happen when material flies upward from a piece of machinery such as a saw or grinder. Other eye injuries happen when a person is hit by material (like a board being thrown from a saw) or by a tool. The best eye protection against flying material and eye impacts is provided by industrial quality safety spectacles with side shields. If the safety spectacle is industrial quality, it will have “Z87” stamped on the frame and the manufacturers trademark will be on the lens. If these designations are not there, they are not industrial quality.

Ordinary prescription glasses are not adequate protection. People who wear glasses to correct vision should wear safety goggles over their glasses or have prescription safety goggles made.

Face Shields:

Clear face shields are recommended where there is a danger of fragments being thrown at the worker’s face. However, while clear face shields provide excellent face protection, they do not give adequate eye protection. Safety goggles or safety glasses must be worn under the face shield to provide protection against penetrating material.

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Welding Eye Protection:
While welding, you have to protect yourself from extreme heat, infrared radiation and molten melt splashes. *Welding helmets* and w*elding goggles* have filtering lenses to reduce the amount of radiant energy which reaches the interior of the eye. It is a good idea to wear a set of industrial quality safety spectacles underneath a welding mask to add protection against flying slag and metal chips. Similarly, if you are wearing welding goggles, also put on a clear plastic face shield to add protection against flying material.

All eye protection equipment should be inspected on a regular basis for defects such as cracks, improper fit and general wear and tear. Defective eye protection devices should be discarded. Obtain safety equipment in good condition before proceeding with your work. People have many excuses for not wearing the proper eye protection:

They're uncomfortable.
I can't work in them.
This job will only take a minute.
I'll look weird.
No excuse is worth losing your eyesight. Wear appropriate EYE PROTECTION.

Hearing Protection
An agricultural mechanics laboratory can often be a loud place in which to work. Hearing protection devices should be worn when noise is excessive or prolonged.

Noise Research:
Noise is measured in units called decibels (dB). Decibels measure the relative loudness of sounds, with one decibel being the faintest audible sound and 130 decibels being the upper limit of the unit scale. The effects of excessive noise has been widely studied. The results show:

- at levels below 80 dB, no permanent hearing loss is demonstrated.
- at around 95 dB, about 50 percent of the people will experience permanent hearing loss.
- most people regularly exposed to eight hours per day of noise greater than 105 dB will experience permanent hearing loss.
- if there is going to be a partial recovery of temporary hearing loss, the recovery will occur over a period of two weeks.
- regular exposure to moderate levels of noise does not toughen up the ear and make it resistant to hearing loss.

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Workplace Noise:
Some shop equipment in the agricultural mechanics laboratory can produce noise over 120 decibels, well beyond the safe level for ears without protection. While loud noises at brief intervals does little damage, loud noises for longer amounts of time may cause hearing loss.

Established Levels:
Acceptable noise levels within the workplace have been established by the Occupational Safety and Health Association (OSHA). Hearing loss may occur if noise exposure exceeds 90 dB for eight hours or 115 dB for 15 minutes during an eight-hour workday. When noise remains below these levels, repeated exposure will not impair the ability to hear normal speech.

Hearing Protection:
Wear earplugs when the laboratory is expected to be especially noisy (90 dB or above) or noisy for extended periods of time. Muff-style hearing protection devices may be worn when using a specific tool for short periods.

Body Protection
Protection from bodily harm means wearing appropriate clothing. In general, wear shirts with long sleeves that are buttoned at the cuff, slacks without cuffs and closed-toe shoes or boots without laces. Welding often requires specialized body protection.

Clothing:
Loose-fitting or flowing clothing can get caught in machinery. For instance, an unbuttoned shirt sleeve, a tie or the dangling end of a belt could get caught in moving parts and pull the worker into the machinery. Other clothing which can be potentially dangerous in the agricultural mechanics laboratory includes: coats and jackets, scarves, sash-type belts and gloves.

Work Gloves:
These help protect the worker against electrical shock and burns. However, gloves should *not* be worn around moving machinery such as a band saw or metal bender. Instead of protecting the wearer, gloves can get caught in moving parts and drag the student into the equipment.

Welding Attire:
should be flame resistant. Apparel made from natural fibers such as wool or cotton provides better protection than synthetic fibers like polyester and rayon. If you are wearing welding goggles, protect your hair by wearing a cotton cap. Wear clothing that does not provide places to catch sparks: pockets should have flaps and pants should not have cuffs.

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Hair:
Students with long hair should wear it pulled back and fastened so it will not get caught in the machinery or obscure the students' vision. It is a good idea to fasten hair back even if wearing a cap because if the cap is knocked off the head, hair could get in the way.

Jewelry:
All types of jewelry, including bracelets, rings, chains and dangling earrings, should be removed and secured in a safe location before working in an agricultural mechanics laboratory. Loose jewelry can get caught in machinery, and rings can conduct electricity causing an electrical shock or burn.

Respiratory Protection
Vapors created by machinery and chemicals, and dust produced by running equipment in the agricultural mechanics laboratory can irritate or harm the lungs. The main defenses against respiratory problems are dusk masks and ventilation.

Ventilation:
Agricultural mechanics laboratories should have adequate ventilation to keep fresh air circulating and to take out and reduce the concentration of harmful vapors in the air. Gasoline, solvents, cleaners and other chemicals can emit flammable gases which need to be removed from the work area. Welding produces metal oxide fumes that can irritate and damage the lungs. Running combustion engines (forklifts, portable pumps and portable air compressors) produce large quantities of carbon monoxide. All vapors should be vented from the work area, so always be sure the ventilation system is operating. The shop should have a whole-shop ventilator capable of rapidly pulling out harmful vapors, and ventilators should be placed near vapor or dust causing equipment such as grinders and saws.

Dust Masks:
Ventilation effectively reduces vapors and fumes, but does <u>not</u> effectively reduce dust particles. Many dust-producing machines now come with vacuums attached to reduce the amount of particles allowed into the air. However, these types of "ventilators" are not always effective, and they may need cleaning and filter replacement.

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If working with material that creates a dust cloud, protect yourself with a dust mask, which is a covering for the mouth and nose that effectively removes large particles from the air you are breathing. Some dust masks are durable items with replaceable filters; others are paper masks you can mold to fit your face. Whichever type you use, remember the filter is intended for one-time use. If the dust mask is durable, replace the filter each time you use it; if you are using a paper filter mask, throw the whole dust mask away after you are finished using the machine.

Head Protection
Students sometimes say that if they wear a safety hat, they will not be able to hear and see hazards as well. Many workers set bad examples by not wearing hard hats when they should. Neither excuse holds in the face of head injuries which could have been avoided with a layer of protection between the head and the object. Like wearing any other personal protective device, wearing a safety hat can soon become a habit if it is worn every time it is needed.

Hard Hat:
When working in an area where equipment, tools and materials are extended above you, wear a hard hat to protect your head. Hard hats are made of resilient materials such as plastic and fiberglass and are suspended on the head with an adjustable headband to provide further cushioning capability. A chinstrap will keep your hard hat from accidentally falling off while you are looking up or bending over.

Personal Protective Equipment -- Conclusion
Occasionally, students will neglect to protect their bodies because they are in a hurry or do not want to be burdened with what they see as cumbersome items to wear. And, unfortunately, some teachers are lax in insisting on or modeling safety first. Most accidents are caused when someone is in a hurry or does not use the proper tool for the job. Wearing the proper personal protection equipment does not guarantee you never will be involved with an accident, but wearing it *will* prevent many injuries and surely will lessen the effect of a bad accident.

Use common sense and identify your personal protection equipment needs before beginning a task. If you are unsure of what you need, ask your instructor. Do not make a serious mistake that could cost you your sight, hearing or a limb.

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Section II: Safe Work Habits

When we were little, we were told to look both ways before crossing the street. We learned why this was good advice, and soon incorporated the safety habit into our lifestyles. Even now, we habitually glance left, right, then left again before we step into a road. In much the same way, looking out for hazards and developing good safety habits as you work in the agricultural mechanical laboratory will lessen your chances of being injured.

Before you begin your work in the laboratory…

1. Check the workplace for hazards and determine what can be done to correct any problems.
2. Wear the proper personal protection equipment for the job.
3. Make sure the right tools and equipment are present to do the job properly. If another tool will do the job better, use that tool.
4. Make sure the equipment is in proper working condition. Do not make adjustments to equipment while it is operating. Stop the equipment and disconnect it from its power source; then make the adjustment.
5. When you carry sharp or pointed tools, keep the sharp edge pointed away from your body in case you fall. If possible, carry sharp or pointed tools in a scabbard or cover.
6. Never try to catch a sharp tool that is falling. Let it fall to the ground; then pick it up.
7. After using a tool, wipe it clean and store it for later use.
8. Do not lay tools on top of ladders or other areas where they could fall on someone below.
9. Never throw or pitch tools to people. Walk over and hand it to them.
10. When handing someone a tool, make sure he or she has a firm grip on the tool before you release it.

Let your best safety precautions become so automatic they become habits you use every day.

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Section III: Common Hazards

Mechanical Hazards

Most tools in an agricultural mechanics laboratory have sharp cutting edges or pinch points which create potential hazards to those working on the tool or near it. Many power tools have guards that should be in place every time the tool is operated.

Use Tool Guards:

Table Saws must be guarded. Guards on table saws serve two purposes:

- to shield fingers from contact with cutting edges
- to provide anti-kickback protection

Grinders should be guarded, and the guard should be properly adjusted. The tool rest must be no more than one-eight of an inch from the grinding wheel. If the tool rest is farther away, fingers or material could get lodged between the tool rest and the grinding wheel.

Wear Proper Equipment:

Wear eye protection when operating mechanical equipment, including a face shield when flying fragments are a possibility. Do not wear gloves when operating moving machinery, because the gloves can get caught and pull your hands into the machinery.

Chemical Hazards

Chemical substances-gasoline, solvents, thinners, paints and similar liquids present problems because they can affect safety in more than one way. For example, solvents can burn skin and present fire hazard and ventilation problems. Always wear the proper personal protection equipment while working with chemicals and know where the particular chemical's MSDS is located in case you have to refer to it. Let's discuss MSDSs and the particular dangers (fire, skin and eyes, ventilation) related to chemical hazards.

MSDS:

A Material Safety Data Sheet (MSDS) is similar to the label found on the chemical container. MSDSs list cautions, hazards, protection equipment to wear, first aid procedures and steps to take if the chemical spills on you or is inhaled. Ideally, a MSDS should be posted anywhere a chemical is stored or used, and MSDSs should also be available in bound form (laminated to keep clean and useable) at the shop office or first aid station in the ship area. If a worker is involved in a chemical accident, take the MSDS along and give it to the emergency physician.

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Fire Hazards:
Gasoline and solvents should be stored only in containers approved for that substance. All chemical containers should be clearly labeled, and safety cans should be stored in cabinets especially designed for flammable material.

Welding involves combining two potentially dangerous gases, oxygen and acetylene. Acetylene, a flammable substance, ignites easily. Oxygen, an oxidizer, can serve as a catalyst to fires. Be sure the oxygen-acetylene cylinders are shut off when you are finished, stored properly (upright and secured with a chain), and the welding regulators, hoses and torches are in good operating condition.

Skin and Eye Hazards:
Some chemicals can irritate or burn your skin and eyes. One such chemical is Carburetor cleaner, a solvent often used while you work on small gas engines. Carburetor cleaner is a particularly caustic chemical which can cause chemical burns to the skin and eyes. When working with this and other chemicals, wear chemical goggles, keep sleeves rolled down and know where you can quickly reach water if the chemical should spill on your body.

Ventilation Hazards:
Nearly all chemicals used in the agricultural mechanics laboratory can irritate or harm your lungs if you breathe the vapors. The vapors can also sting or harm your eyes. Make sure you have adequate ventilation when chemicals are being used in the lab. Never work alone with chemicals in case you are overcome with the fumes and help is not available.

Packaging and Labels:
All chemicals come packaged and labeled. Labels should never be removed or defaced. They are there to remind you of the potential hazards of that particular chemical. Labels are a condensed version of an MSDS. A label will tell you

1. The manufacturer's name, telephone number and address
2. Handling and storage procedures
3. Proper personal protective equipment to use
4. Health hazards
5. Physical hazards

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Know the hazards unique to the chemicals you are going to be using. Ask yourself the following questions:

1. What personal protective equipment should I wear to work safely with this material?
2. What are the ventilation requirements?
3. Is there danger of fire or explosion?
4. How should spills or releases be handled?
5. What should be done if the chemical comes in contact with the skin, eyes or other material?
6. What should be done if the material is swallowed?
7. What are the proper disposal procedures?
8. Whom do I call if an accident occurs and assistance is required?

Electrical Hazards

Electricity is an efficient source of energy for power tools and welding, and it is the most common source of energy in laboratories. When used properly, electricity is safe. When used improperly, it can be deadly.

Cords:

Do not use tools with frayed cords, even if the cord has been mended with electrical tape. Replace the cord with a new one.

Grounding Plugs:

Most electrical tools have a three-prong plug. The rounded grounding prong protects the operator from short circuits by directing stray electricity to the ground. If the grounding prong has been removed so the tool can be plugged into a two-prong outlet, you should not use the tool. The danger in using a tool with an altered plug is that if there is a short in the tool or an electrical surge in the wiring system, the electricity will take the path of least resistance to the ground, most likely through whoever is operating the tool.

Wet Conditions:

Never operate electrical equipment outdoors or in wet conditions unless the circuit is protected by a ground fault circuit interrupter. These interrupters “sense” short circuits and immediately interrupt the flow of electricity, thus preventing electric shock. The National Electrical Code now requires all outdoor outlets and outlets in wet areas, such as kitchens and bathrooms, be protected by a ground fault circuit interrupter. If you are not sure the outlet is grounded or the tool it is plugged into is protected by a circuit interrupter, stop working immediately if you are outdoors and it begins to rain or if your work is
in a wet area.

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Fire Hazards
Agricultural mechanical laboratories that are cluttered with paper, lumber, scraps, sawdust and oily rags are dangerous fire hazards. Keep your workspace clear of items which can create or fuel a fire. Hold a fire drill the first week of school to show that “Safety First” is a priority.

Welding
is a particularly hazardous activity. Before welding, remove any combustible materials. Remember that sparks can ignite combustible materials several feet away.

Cleaning Materials
such as solvent-soaked oily rags, are a fire hazard. They should always be thrown away, or stored for later cleaning in a container with a tight fitting lid.

Fire Protection Equipment:
Be sure to keep the proper fire protection equipment in the laboratory. Common protection equipment includes fire extinguishers (labeled as to what type of fires it will smother), sand, fire blankets and smoke detectors. Know where all fire protection equipment is located, and know how to use it properly. An escape route should also be marked for the shop in case of fire, and the sheet should be hung where everyone in the shop can see it.

Vehicle Hazards
Vehicles are commonly used in laboratories for moving and unloading material and equipment.

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Trailers:
Trailers can pose hazards, especially while they are in reverse. Here are a few safety rules to follow while operating a trailer.

- Always use the proper size hitch.
- Check the brake lights, turn signals and hazard lights to ensure they are functioning properly.
- Load the trailer with most of the weight above the axles to keep the hitch level.
- Use safety chains which attach the trailer to the vehicle, so if the trailer does pop off the hitch, the trailer will not drop onto the road or careen into another lane and cause an accident.
- Do not overload a trailer. If the item you are hauling is too big for the trailer, find a trailer that can handle the load.
- Items such as lumber and pipe that extend more than three feet past the end of the trailer should have a red or orange safety flag tied to the end of the material. The flag will alert motorists of the extended load so they will allow more stopping distance.
- When driving long trailers, you may need to turn wide to make corners. Allow space to make these turns, and be aware of other vehicles around you.
- When you back a trailer, have a spotter behind you to give you directions and tell you when to stop. Make sure you and the spotter agree on the hand signals that will be used.
- When unhitching the trailer, make sure the wheels are choked in front and back so the trailer does not start rolling.

Forklifts:
Forklifts are used to move heavy materials and equipment. These vehicles are quite useful in a laboratory atmosphere, but they can be a hazard if they are not used properly.

- Pay attention to the forklift's backup signal, and never disconnect the backup signal.
- Do not transport more than one person in the cab; never transport people on the forks.
- Forklifts have a small turning radius; be careful you do not tip the machine over.
- Observe safe speeds while operating a forklift.
- Forklifts are not toys, do not play with them.

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Section IV: First Response Procedures
This section gives steps to follow if an accident occurs in the shop or lab. The procedures cover the most common accidents, but use your common sense if someone gets hurt and you do not know what to do first. Most important is to restore breathing, then stop bleeding. If an artery has been cut (the blood will spurt, not just run), then breathing and bleeding problems are both of equal importance.

If there is an accident in your area:
First:
Check the accident scene to make sure it is secure and nobody else will be injured.

Second:
Get help immediately. Shout out to others, get the instructor or call 911.

Third:
Provide basic First Aid care to the injured person until help can arrive.

Fourth:
Even if the injured person feels fine, he or she should not go alone to receive medical attention, especially if the person has to drive himself or herself to a medical care center. An injury can cause a delayed shock reaction, which may cause the person to faint or become unconscious, or the person may have other injuries that were not apparent at the time.

Abrasions and Lacerations
Stop the Bleeding by applying and maintaining direct pressure on the wound.
Elevate the wound if possible, and keep applying direct pressure.
Call 911 if the bleeding does not stop. If the bleeding is brought under control, have the victim taken to receive medical attention.

Thermal Burns
Stop the burning process by extinguishing the fire with a thermal blanket or by making the victim drop and roll on the ground. Do not attempt to put out a fire on another person with a fire extinguisher because many extinguishers contain materials (carbon dioxide and dry chemicals) which can cause further harm to the victim.
Attend to the victim after the fire is put out. Cover the victim with a dry, clean cloth. Do not apply any type of ointment on the burn.
Seek medical attention for the victim.

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Chemical Exposure (Eye)
Immediately flush the eye (the first 10 seconds are crucial) with lots of gently running water while holding the eyelids apart. If the victim is wearing contact lenses, remove them. Flush eyes using an eyewash fountain or eyewash bottle; if not available, hold head under faucet and allow a gentle stream of water to flood the eye. Do not use an eyecup, as this will allow contaminated water to flow back over the injured eye.
Check the MSDS for how long to flush the eyes (at least 15 minutes, but sometimes longer) and for additional eye care information for this chemical. Do not attempt to neutralize any chemical in the eye with another chemical agent. Do not bandage the eye or apply salves or ointments.
Seek medical attention for *any* chemical exposure to the eyes, even if they look all right. Only a doctor can tell if any parts of the eyes have been damaged.

Chemical Exposure (Skin)
Stop the burning process by removing contaminated clothing so the chemical is not being pressed against the skin. If the chemical is in a dry, solid form, then try to remove as much of it as possible by brushing it from the clothing. If the chemical is not reactive to water (check the MSDS), flush the area for at least 15 minutes. Do not attempt to neutralize any chemical on the skin with another chemical agent.
Seek medical attention if burns are evident on the skin. Wash any clothes exposed to chemicals (alone) before reuse or discard. Do not mix with other clothing.

Chemical Exposure (Ingestion)
Refer to the MSDS for recommended treatment. With some chemicals, you should induce vomiting; with other chemicals, making the victim vomit the poison up can cause *more* damage.
Dilute the chemical by having the victim drink water or milk, if this is recommended on the MSDS.

Chemical Exposure (Inhalation)
Move the victim to fresh air and keep him or her calm.
Start artificial respiration if the victim has ceased to breathe.
Seek medical attention immediately, even if the victim feels fine after recovery. Several inhaled chemicals take several hours for symptoms to develop.

Electrical Shock
Stop the electrical current from causing any further damage. Shut off the source of power or carefully remove the electrical problem, if possible. Use an insulated object or make sure whatever you are using does not conduct electricity (wood, plastic-handled tools); never touch a power source or line with your hands or a metal object.

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Start CPR procedures if the victim has ceased to breathe and/or his or her heart has stopped.
Treat any burns. Most electrical accidents involve burns; refer to the section on thermal burns for treatment instructions.

Eye Trauma
Penetrating Trauma: Tell the victim to close his or her eyes to keep them from moving and causing any further damage. Or, loosely bandage the uninjured eye to keep both eyes from moving. Do not try to wash the object out and do not try to remove it (doing so can tear the eye and cause worse damage). Call for emergency help.

Impact Trauma: Blows to the eye can cause internal injury. Apply cold compresses immediately and for 15 minutes, then as needed to reduce pain and swelling. Seek medical attention, even if the victim says they are fine. Internal swelling can cause eye damage even later, and a doctor can use specialized equipment to see all the parts of an eye to check for damage.

Specks in the Eye: Lift upper eyelid outward and down over the lower lid to encourage tears to flush out the particle. Gently wash or use eye drops to flush the eye. If the speck will not wash out, keep the eye closed (cover or bandage lightly) and seek medical treatment. Never second-guess eye injuries.

Broken Bones
Keep the broken bone still by keeping the victim calm to minimize his or her movement.
Call the paramedics who will immobilize the injury for further treatment.

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Additional Information

First-aid kits should be placed in strategic locations throughout agricultural mechanics laboratories, and they should be easy to see and get to. These kits should be adequately supplied and inventoried on a regular basis.

Knowing how to handle an emergency is critical for students and instructors. You do not have to be an expert to know how to react when an accident occurs.

- Know and practice emergency steps for the most common accidents.
- Know where emergency supplies and equipment are kept: first aid kits, fire extinguishers, blankets, sand, MSDSs, phones and so on.
- Learn first aid skills, including CPR.
- If an injury was caused by a chemical agent, be sure to take the MSDS with you to the doctor. Many MSDSs have notes to physicians which can help them administer treatment and have phone numbers the physician can call for further information.
- Be aware of hazards for the particular area in which you are working.
- Wear protective gear to prevent or minimize accidents.

Review

- Wear personal protective equipment in a laboratory or a shop.
- Learn to recognize potential laboratory hazards.
- Observe the area to identify hazards before beginning work.
- Use the proper tools and equipment for the job.
- Be sure the equipment is in good working condition.
- Try to prevent mechanical, chemical electrical fire and vehicle hazards in the workplace.
- Know how to react if an accident occurs.
  - Check the accident scene to be sure no one else will get hurt.
  - Get help immediately.
  - Give the victim first aid until emergency help arrives.

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